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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	616137.100360	8112

21874 7590 07/01/2025

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EXAMINER	
MAUST, TIMOTHY LEWIS	

ART UNIT	PAPER NUMBER
3753	

NOTIFICATION DATE	DELIVERY MODE
07/01/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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patentdocket@troutman.com

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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/882,703	01-Jul-2025	12347711

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	07/01/2025	12347711	616137.100360	8112

21874 7590 06/18/2025

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 281 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Ming-Chien Chiu, NEW TAIPEI, TAIWAN;
CHIA-HO CHUANG, NEW TAIPEI, TAIWAN;
Kuo-Hua Lee, NEW TAIPEI, TAIWAN;
Shu-Hung Lin, NEW TAIPEI, TAIWAN;
Hao-Kang HSIA, NEW TAIPEI, TAIWAN;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

GUDENG PRECISION INDUSTRIAL CO., LTD., New Taipei, TAIWAN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/882,703	**06/05/2025 10:29:54 AM Z ET**	**616137.100360**

Title of Invention

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8112	FILED BY	Danielle Olive
PATENT CENTER #	70742269	FILING DATE	08/08/2022
CUSTOMER #	21874	FIRST NAMED INVENTOR	Ming-Chien Chiu
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Tim Xia

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
0114970255US2IFTrans.pdf	1	Issue Fee Payment (PTO-85B)	231 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0114970255US2IFTrans.pdf	1DDEF0DC145E1461A2CE6AE7D074E5DDC88697A3EB026C4 9C598F519E78129A7C570BC669534E961C785A62DA3E605927 2EC9A86E02B00645918CFC9CEB73619

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21874 7590 03/24/2025

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

TITLE OF INVENTION: GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1290	$0.00	$0.00	$1290	06/24/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
MAUST, TIMOTHY LEWIS	3753	141-236000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 troutman pepper locke
2 Tim Tingkang Xia, Esq.
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: GUDENG PRECISION INDUSTRIAL CO., LTD.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): NEW TAIPEI, TAIWAN

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 201507

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Tim Tingkang Xia/ Date June 5, 2025

Typed or printed name Tim Tingkang Xia Registration No. 45242

Entegris, EX1002, p. 7

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/882,703	**06/05/2025 10:29:54 AM Z ET**	**616137.100360**

Title of Invention

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8112	FILED BY	Danielle Olive
PATENT CENTER #	70742269	AUTHORIZED BY	Tim Xia
CUSTOMER #	21874	FILING DATE	08/08/2022
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Ming-Chien Chiu

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 201507	**E202565A30486894**	**Danielle Olive**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
201507	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1290.00	1	1290.00
			TOTAL AMOUNT:	**$1,290.00**

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New Applications Under 35 U.S.C. 111

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Receipt will establish the filing date of the application

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

21874 7590 03/31/2025

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EXAMINER	
MAUST, TIMOTHY LEWIS	

ART UNIT	PAPER NUMBER
3753	

NOTIFICATION DATE	DELIVERY MODE
03/31/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@troutman.com

CORRECTED ***Notice of Allowability***	**Application No.** 17/882,703	**Applicant(s)** Chiu et al.	
	Examiner TIMOTHY L MAUST	**Art Unit** 3753	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to papers filed on 1/14/25.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 8-38 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TIMOTHY L MAUST/
Primary Examiner, Art Unit 3753

Doc Code: IDS.3P
Description: Third Party Submission Under 37 CFR 1.290

PTO/SB/429
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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THIRD-PARTY SUBMISSION UNDER 37 CFR 1.290

APPLICATION #
17882703

U.S. Patents

Cite #	Patent #	Kind Code[1]	Issue Date (YYYY/MM/DD)	First Named Inventor

U.S. patent application publications

Cite #	Publication #	Kind Code[1]	Publication Date (YYYY/MM/DD)	First Named Inventor
1	US 2023-0128154	A1	2023/04/27	Mark Smith

Foreign patents and published foreign patent applications

Cite #	Foreign Document #[3]	Country Code[2]	Kind Code[1]	Publication Date (YYYY/MM/DD)	Applicant, patentee or first named inventor	T[5]

Non-patent publications

Cite #	Author (if any), title of the publication, page(s) being submitted, publication date, publisher (where available), place of publication (where available).	T[5]	E[6]

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Statements

The party making the submission is not an individual who has a duty to disclose information with respect to the above-identified application under 37 CFR 1.56.

This submission complies with the requirements of 35 U.S.C. 122(e) and 37 CFR 1.290.

Resubmission: This resubmission is being made responsive to a notification of non-compliance issued for an earlier filed third-party submission. The corrections in this resubmission are limited to addressing the non-compliance.
1. Fee previously paid: The party making this resubmission requests that the Office apply the previously-paid fee set forth in 37 CFR 1.290(f).
2. Fee exemption applies: The party making this resubmission states that no fee is required to accompany this resubmission as the undersigned is again making the fee exemption statement set forth in 37 CFR 1.290(g).

Signature	Name	Registration #
/Julie Bardon/	Julie Bardon	–

Examiner Signature	Date considered
/TIMOTHY L MAUST/	03/26/2025

*EXAMINER: Signature indicates all documents listed above have been considered,except for citations through which a line is drawn. Draw line through citation if not considered. Include a copy of this form with next communication to applicant. 1. If known, enter kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16. See MPEP 901.04(a). 2. Enter the country or patent office that issued the document, by two-letter code under WIPO standard ST.3. See MPEP 1851. 3. For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. 4. If known, enter the kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 . See MPEP 901.04(a). 5. Check mark indicates translation attached. 6. Check mark indicates evidence of publication attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(**Not for submission under 37 CFR 1.99)**

Application Number	17882703
Filing Date	2022-08-08
First Named Inventor	Ming-Chien Chiu
Art Unit	OPAP
Examiner Name	DOCKET CENTRAL
Attorney Docket Number	0114970.255US2

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6368411	B2	2002-04-09	Roberson, Jr. et al.	
	2	6899145	B2	2005-05-31	Aggarwal	
	3	9305817	B2	2016-04-05	Kaise et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20160276190	A1	2016-09-22	Smith et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Nu	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2002170876	JP	A	2002-06-14	EBARA CORP		☒

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	OPAP
	Examiner Name	DOCKET CENTRAL
	Attorney Docket Number	0114970.255US2

	2	3960787	JP	B2	2007-08-15	SHIN ETSU POLYMER CO LTD		☒
	3	5241607	JP	B2	2013-07-17	SHIN ETSU POLYMER CO LTD		☒
	4	2020150245	JP	A	2020-09-17	UNIV NAT TAIPEI TECH		☒
	5	1343202	EP	A1	2003-09-10	EBARA CORP		☒
	6	1555689	EP	B1	2010-05-19	SHINETSU POLYMER CO		☒
	7	2272088	EP	B1	2016-12-07	ENTEGRIS INC		☒
	8	2009114798	WO	A2	2009-09-17	ENTEGRIS INC et al.		☒
	9	2011072260	WO	A2	2011-06-16	ENTEGRIS INC et al.		☒
	10	2017040913	WO	A1	2017-03-09	ENTEGRIS INC		☒
	11	2018179964	WO	A1	2018-10-04	SHINETSU POLYMER CO		☒
	12	2020046867	WO	A1	2020-03-05	ENTEGRIS INC		☒

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	OPAP
	Examiner Name	DOCKET CENTRAL
	Attorney Docket Number	0114970.255US2

	13	2022269718	WO	A1	2022-12-29	MIRAIAL CO LTD		☒

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/TIMOTHY L MAUST/	Date Considered	05/13/2024

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	OPAP
	Examiner Name	DOCKET CENTRAL
	Attorney Docket Number	0114970.255US2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Tim Tingkang Xia/	Date (YYYY-MM-DD)	2023-09-08
Name/Print	Tim Tingkang Xia	Registration Number	45242

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

/TIMOTHY L MAUST/ 03/26/2025

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

21874 7590 03/24/2025

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EXAMINER
MAUST, TIMOTHY LEWIS

ART UNIT	PAPER NUMBER
3753	

DATE MAILED: 03/24/2025

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

TITLE OF INVENTION: GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1290	$0.00	$0.00	$1290	06/24/2025

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21874 7590 03/24/2025
Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

TITLE OF INVENTION: GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1290	$0.00	$0.00	$1290	06/24/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
MAUST, TIMOTHY LEWIS	3753	141-236000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Entegris, EX1002, p. 20

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

21874 7590 03/24/2025

Troutman Pepper Locke LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EXAMINER	
MAUST, TIMOTHY LEWIS	
ART UNIT	**PAPER NUMBER**
3753	

DATE MAILED: 03/24/2025

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 17/882,703	Applicant(s) Chiu et al.	
	Examiner TIMOTHY L MAUST	Art Unit 3753	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to papers filed on 1/14/25.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 8-38 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TIMOTHY L MAUST/
Primary Examiner, Art Unit 3753

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Arguments

Applicant's arguments, see papers, filed 1/14/25, with respect to claims 8-38 have been fully considered and are persuasive. The Non-Final rejection of 10/15/24 has been withdrawn.

Allowable Subject Matter

Claims 8-38 are allowed.

Reasons for Allowance

The following is an examiner's statement of reasons for allowance: None of the prior art of record, alone or in combination, teach:

A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

A buffering gas chamber, configured at a bottom portion of the wafer container, the bottom portion provided with at least one coupling structure, the coupling structure defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another…the

buffering gas chamber providing a gas to pass through the porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial, as defined within the context of claim 8 along with all other claim limitations.

A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

A gas cartridge, configured at a bottom portion of the wafer container to define a buffering gas chamber, the bottom portion provided with at least two coupling structures, each of the coupling structures defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another… the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the at least two porous tubes and enter the accommodating space, as defined within the context of claim 20 along with all other claim limitations.

A wafer container, comprising: a buffering gas chamber, formed below the bottom portion, the buffering gas chamber having a plurality of gas intake channels, the gas intake channels communicating with the corresponding through channels… a plurality of porous tubes, each of the porous tubes having an open end, the open end

correspondingly sleeved connecting with the coupling structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel, allowing a gas to pass through the porous tubes and enter an accommodating space of the shell, as defined within the context of claim 30 along with all other claim limitations.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TIMOTHY LEWIS MAUST whose telephone number is (571)272-4891. The examiner can normally be reached Monday - Thursday, 7am - 5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Craig Schneider can be reached on 571-272-3607. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is

available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TIMOTHY L MAUST/
Primary Examiner, Art Unit 3753

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	**Art Unit**
	TIMOTHY L MAUST	3753

CPC							
Symbol						**Type**	**Version**
H01L	/	21	/	67389		F	2013-01-01

CPC Combination Sets								
Symbol						**Type**	**Set**	**Ranking**	**Version**
	/		/						

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	31	
/TIMOTHY L MAUST/ Primary Examiner, Art Unit 3753	10 March 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20250310

Entegris, EX1002, p. 28

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	**Art Unit**
	TIMOTHY L MAUST	3753

INTERNATIONAL CLASSIFICATION					
CLAIMED					
H01L21/673	/	21	/	673	
NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	31	
/TIMOTHY L MAUST/ Primary Examiner, Art Unit 3753	10 March 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20250310

Entegris, EX1002, p. 29

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	**Art Unit**
	TIMOTHY L MAUST	3753

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	31	
/TIMOTHY L MAUST/ Primary Examiner, Art Unit 3753	10 March 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office Part of Paper No.: 20250310

Entegris, EX1002, p. 30

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	Art Unit
	TIMOTHY L MAUST	3753

CPC - Searched*		
Symbol	Date	Examiner
H01L 21/67389, 21/67393	10/09/2024	tlm

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
141	text	10/09/2024	tlm

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Assignee search	10/09/2024	tlm
Inventor name search	10/09/2024	tlm
CPC and text search in SEARCH	10/09/2024	tlm
MLTD search of pertinent prior art	10/09/2024	tlm
3rd party submission reviewed	10/09/2024	tlm
Updated search	03/10/2025	tlm

/TIMOTHY L MAUST/ Primary Examiner, Art Unit 3753	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	Art Unit
	TIMOTHY L MAUST	3753

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
Interference search in SEARCH	see CPC search history	03/10/2025	tlm

/TIMOTHY L MAUST/ Primary Examiner, Art Unit 3753	

PE2E SEARCH - Search History (Prior Art)

There are no Prior Art searches to show.

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	592	h01l21/67393	(US-PGPUB)	OR	ON	ON	2025/03/10 08:30 AM
N2	436	h01l21/67389	(US-PGPUB)	OR	ON	ON	2025/03/10 08:30 AM
N3	402	1 AND (smif foup)	(US-PGPUB)	OR	ON	ON	2025/03/10 08:30 AM
N4	325	2 AND (smif foup)	(US-PGPUB)	OR	ON	ON	2025/03/10 08:31 AM
N5	76	3 AND buffer$3	(US-PGPUB)	OR	ON	ON	2025/03/10 08:31 AM
N6	79	4 AND buffer$3	(US-PGPUB)	OR	ON	ON	2025/03/10 08:31 AM

Bibliographic Data

Application No: 17/882,703

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /TIMOTHY L MAUST/ (Examiner's Signature) | (Initials)

Title: GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
08/08/2022	141	3753	
RULE			

APPLICANTS

GUDENG PRECISION INDUSTRIAL CO., LTD., New Taipei, TAIWAN

INVENTORS

Ming-Chien Chiu, NEW TAIPEI, TAIWAN

CHIA-HO CHUANG, NEW TAIPEI, TAIWAN

Kuo-Hua Lee, NEW TAIPEI, TAIWAN

Shu-Hung Lin, NEW TAIPEI, TAIWAN

Hao-Kang HSIA, NEW TAIPEI, TAIWAN

CONTINUING DATA

This application has PRO of 63316391 03/03/2022

This application has PRO of 63284105 11/30/2021

This application has PRO of 63233878 08/17/2021

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

08/18/2022

STATE OR COUNTRY

TAIWAN

ADDRESS

FILING FEE RECEIVED

$1,970

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7235138	B2	2007-06-26	Zheng et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20150357218	A1	2015-12-10	Lin et al.	
	2	20160118282	A1	2016-04-28	Maraschin et al.	
	3	20170213752	A1	2017-07-27	Ogawa et al.	
	4	20180261483	A1	2018-09-13	WOO et al.	
	5	20180374731	A1	2018-12-27	WOO et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

	6	20190393063	A1	2019-12-26	Matsutori	
	7	20210013075	A1	2021-01-14	Chiu et al.	
	8	20210280446	A1	2021-09-09	Fuller et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Nu	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	20140055699	KR	A	2014-05-09	WOO BUM JE		☒
	2	20210055483	KR	A	2021-05-17	WONIK IPS CO LTD		☒
	3	20060100992	KR	A	2006-09-22	SAMSUNG ELECTRONICS CO LTD		☒
	4	101366135	KR	B1	2014-02-25	L S TEC CO LTD		☒
	5	I773536	TW	B	2022-08-01	GUDENG PREC IND CO LTD		☒

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.L.M/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/TIMOTHY L MAUST/	Date Considered	02/10/2025

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Tim Tingkang Xia/	Date (YYYY-MM-DD)	2025-01-14
Name/Print	Tim Tingkang Xia	Registration Number	45242

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/882,703	**01/14/2025 09:35:45 AM Z ET**	**0114970.255US2**

Title of Invention

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8112	FILED BY	Debby Yew
PATENT CENTER #	68723969	FILING DATE	08/08/2022
CUSTOMER #	21874	FIRST NAMED INVENTOR	Ming-Chien Chiu
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Tim Xia

Documents

TOTAL DOCUMENTS: 7

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
0114970255US2ResponseOA.pdf	15	Amendment/Request for Reconsideration-After Non-Final Rejection	1634 KB
0114970255US2IDS.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	46 KB
Warning: This is not a USPTO supplied IDS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.			
KR101366135B1.pdf	25	Foreign Reference	1019 KB
KR20060100992A.pdf	10	Foreign Reference	434 KB
KR20140055699A.pdf	13	Foreign Reference	1147 KB
KR20210055483A.pdf	22	Foreign Reference	995 KB

TWI773536B.pdf	42	Foreign Reference	13927 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0114970255US2ResponseOA.pdf	679EFF8095725FDBA2C044F78476C025430B1DF73DE616160E21D86E83F4AFDEB3FF826C6A2FD97666CA3F3D66877C7C316652EA5563F70CA0EFC12251B2055D
0114970255US2IDS.pdf	7870DF796BA5FAA8B766D50D0522499F54896D408B5CC8AC48C78CD464486A666550456ED49C458C9CB5F81C76259776D01F4C93257772E9921A22002A83BCFC
KR101366135B1.pdf	214AF3386C35CAE33232FC5C3A051D501D49796AF112D3A20892650AB9173C83689ACDF0260E5BD38DF6C4FBD0D0D827263FB4BCDBB1C712631CC10C9420E7D5
KR20060100992A.pdf	53C93A471C911422688B0D172196EA9A716D61193729DD80AFB86DA0A29E06DFC1628BE7219C2F9C0F3CEB8D11F0EC5ABFB76BB1956CC4FEF494FFCF97E11C85
KR20140055699A.pdf	9A7050E2C37C9C2AE0B6D7172A930EFFFC86D814ADD2EBD086D9D3B63EB18C93C28CC4AF4D2FB0AC59E0660C17D6FE0DBB7ACDC15D81E4F82F7CC6186784D754
KR20210055483A.pdf	3C91F6B1B7EAC34223345E9BAA25D80B85AB842DB37018841266770E844329AFD1B1A04073EEE5E0DCB47AD39DE3D9093DBB6012820E2343D25CDAF818A3FAB5
TWI773536B.pdf	56E7D63C867626AA4749C78E25FE72B3B53E5DE8157831978840A84934D040A5DECFBCBB310E5E848811D4EC06AAC3612466F0642BF26D44F717D251DFFCB0BE

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Espacenet

Bibliographic data: KR20060100992 (A) — 2006-09-22

WAFER CLEANING BOAT AND STORAGE HAVING THE SAME

Inventor(s): KIM YONG DAE [KR] ± (KIM, YONG DAE)

Applicant(s): SAMSUNG ELECTRONICS CO LTD [KR] ± (SAMSUNG ELECTRONICS CO., LTD)

Classification: **- international:** ***H01L21/304; H01L21/68***
- cooperative: **H01L21/67028 (KR); H01L21/67303 (KR)**

Application number: KR20050021995 20050316 Global Dossier

Priority number(s): KR20050021995 20050316

Also published as: KR100678475 (B1)

Abstract not available for KR20060100992 (A)

(19)대한민국특허청(KR)
(12) 공개특허공보(A)

(51) 。Int. Cl.
H01L 21/304 (2006.01)
H01L 21/68 (2006.01)

(11) 공개번호 10-2006-0100992
(43) 공개일자 2006년09월22일

(21) 출원번호 10-2005-0021995
(22) 출원일자 2005년03월16일

(71) 출원인 삼성전자주식회사
경기도 수원시 영통구 매탄동 416

(72) 발명자 김용대
경기 수원시 영통구 망포동 벽산아파트 108동 1705호

(74) 대리인 박상수

심사청구 : 있음

(54) 웨이퍼 세정용 보트 및 이를 갖는 스토리지

요약

본 발명은 웨이퍼 세정용 보트에 관한 것으로서, 복수매의 웨이퍼가 적재되도록 다수의 안착판이 형성된 복수개의 로드와, 로드들 내부에 형성된 가스공급유로와, 가스공급유로와 연통되고, 웨이퍼 상에 필터링된 세정가스를 분사할 수 있도록 안착판 선단부에 형성된 가스분사구와, 가스공급유로와 연결되어 세정가스를 공급하는 가스공급부를 포함함으로써, 복수매의 웨이퍼를 보트에 적재시킨 상태에서 잔류가스로 인해 이물질이 웨이퍼 표면에 응착되는 것을 보트 자체 내에서 세정시킴으로써 제품 수율을 향상시키고, 후속공정 진행시 정상적인 공정이 이루어질 수 있도록 할 수 있다.

대표도

도 2

명세서

도면의 간단한 설명

도 1은 본 발명의 웨이퍼 세정용 보트 및 이를 갖는 스토리지를 보여주는 부분절개사시도이다.

도 2는 도 1에 도시된 선 I-I'를 따르는 단면도이다.

도 3은 도 2에 도시된 표시부호 A의 확대도이다.

도 4는 도 3에 도시된 안착판의 선단부에 대한 다른 실시예를 보여주는 부분단면도이다.

도 5는 도 4에 도시된 가스분사구의 다른 실시예를 보여주는 부분단면도이다.

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도 6은 도 2에 도시된 슬릿에 가스분사구가 더 형성된 것을 보여주는 단면도이다.

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 웨이퍼 세정용 보트 및 이를 갖는 스토리지(storage)에 관한 것으로서, 보다 상세하게는 공정을 마친 웨이퍼 상에 형성된 이물질을 세정할 수 있도록 웨이퍼 상으로 세정가스를 분사하는 웨이퍼 세정용 보트 및 이를 갖는 스토리지에 관한 것이다.

일반적으로 반도체 소자제조에 사용되는 에칭설비는 감광막 현상공정이 끝난 후 감광막 밑에 성장 또는 증착시킨 박막 들, 예를 들어 Si 막, 폴리실리콘(Poly Si) 막, SiO_2막 등 을 공정목적에 따라 선택적으로 제거하는 장비로서, 에칭방식에 따 라 화학약품에 의한 습식(Wet)과 가스를 이용하는 건식(Dry)방식으로 나뉠 수 있다.

여기서 건식방식의 경우를 설명하면 다음과 같다.

예를 들어 웨이퍼 상에 형성된 폴리실리콘(Poly Si) 막질 을 에칭할 때에는 주로 $C1_2$, HBr 등의 반응가스를 사용하는데, 이들 가스는 대기상태에 노출되면 웨이퍼 상에서 응축(Condensation)되는 성향이 매우 강하다.

그리고 상기와 같은 성질을 갖는 반응가스를 사용하여 에칭공정을 수행한 후에는 반응하고 남은 잔류가스가 남게 되는데 이를 강제 배기하기 위하여 에칭설비에는 스토리지가 마련된다.

스토리지는 복수매의 웨이퍼가 안착된 상태에서 내부 공간에 잔존하는 잔류가스를 강제펌핑하여 퍼지(purge)시키게 한다.

그러나 에칭이 완료된 웨이퍼를 후속공정으로 안내하기 위하여 스토리지로부터 이송할 경우 대기 중에 노출되어 웨이퍼 표면에 반응가스의 일부가 응축, 액화되어 잔류하게 된다. 왜냐하면, 상기와 같이 강제펌핑을 통해 잔류가스가 완전히 퍼지 되지 않기 때문이다.

여기서 상기와 같은 문제점을 해소하기 위해서는 잔류가스가 완전히 배기될 때까지 강제펌핑하면서 웨이퍼를 장시간 대기하여야 하는데 이는 공정시간을 길게 하고 그로 인해 공정효율을 떨어뜨리게 된다.

따라서 상기와 같이 스토리지 내에서 잔류가스가 완전히 퍼지 되지 않으면, 웨이퍼표면에 반응가스들로 인해 응축현상이 발생되고, 그로 인해 공정불량의 원인 이 되는 문제점이 있다.

발명이 이루고자 하는 기술적 과제

따라서 본 발명은 상기와 같은 문제점을 해결하기 위하여 안출된 것으로서, 본 발명의 제 1목적은 웨이퍼 상의 이물질을 제거할 수 있도록 세정가스를 웨이퍼 상에 분사시키는 웨이퍼 세정용 보트를 제공함에 있다.

또한, 본 발명의 제 2목적은 상기와 같은 웨이퍼 세정용 보트를 스토리지내 장착하여 에칭후 잔존하는 잔류가스가 복수매의 웨이퍼 상에 응축되지 않도록 함과 아울러 잔류가스를 강제퍼지시키는 웨이퍼 세정용 보트를 갖는 스토리지를 제공함에 있다.

발명의 구성 및 작용

전술한 문제점을 해결하기 위한 본 발명의 웨이퍼 세정용 보트는 복수매의 웨이퍼가 적재되도록 다수의 안착판이 형성된 복수개의 로드와; 상기 로드들 내부에 형성된 가스공급유로와; 상기 가스공급유로와 연통되고, 상기 웨이퍼 상에 세정가스를 분사할 수 있도록 상기 안착판 선단부에 형성된 가스분사구; 및 상기 가스공급유로로 상기 세정가스를 공급하는 가스공급부를 포함한다.

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여기서 상기 안착판 선단부는 상기 웨이퍼 상부를 향해 경사진 것이 바람직하다. 또한 웨이퍼 상부를 향해 직각일 수도 있다.

그리고 상기 가스분사구는 상기 안착판들 사이에 상기 가스공급유로와 연통되도록 더 형성된 것이 바람직하다.

또한 상기 가스분사구의 내경은 상기 세정가스가 분사되는 방향의 출구부측으로 점차적으로 넓어지도록 형성된 것이 바람직하다.

나아가, 상기 가스공급유로와 상기 가스공급부 사이에는 먼지 등의 이물질을 거를 수 있는 필터가 더 개재되는 것이 바람직하다.

한편, 본 발명에 따른 웨이퍼 세정용 보트를 갖는 스토리지는 본체와; 상기 본체 내부에 장착되어 복수매의 웨이퍼가 적재되고, 상기 웨이퍼 상에 세정가스를 분사하여 세정하는 웨이퍼 세정부; 및 상기 본체에 장착되어 상기 본체 내부의 잔류가스를 외부로 강제 배기하는 강제배기부를 포함한다.

여기서 상기 웨이퍼 세정부는 상기 웨이퍼들이 적재되는 다수의 안착판이 형성되는 복수개의 로드와, 상기 로드들 내부에 상기 세정가스가 공급되도록 형성된 가스공급유로와; 상기 가스공급유로와 연통되고, 상기 안착판의 선단부에 형성되어 상기 세정가스를 상기 웨이퍼 상으로 분사하는 가스분사구; 및 상기 가스공급유로로 상기 세정가스를 공급하는 가스공급부를 포함한다.

그리고 상기 안착판의 선단부는 상기 웨이퍼 상부를 향해 경사진 것이 바람직하고, 상기 웨이퍼 상부를 향해 직각으로 형성될 수도 있다.

또한 상기 가스분사구는 상기 안착판들 사이에 상기 가스공급유로와 연통되도록 더 형성된 것이 바람직하다.

그리고 상기 가스분사구의 내경은 상기 세정가스가 분사되는 방향의 출구부측으로 점차적으로 넓어지도록 형성된 것이 바람직하다.

나아가, 상기 가스공급유로와 상기 가스공급부 사이에는 먼지 등의 이물질을 거를 수 있는 필터가 더 개재되는 것이 바람직하다.

이하, 첨부된 도면을 참조로 하여, 본 발명의 웨이퍼 세정용 보트 및 이를 갖는 스토리지에 대한 바람직한 실시예를 설명하도록 한다.

먼저, 본 발명의 웨이퍼 세정용 보트에 대한 바람직한 실시예를 설명하도록 한다.

도 1 및 도 2를 참조로 하면, 본 발명의 웨이퍼 세정용 보트(120)는 다수의 웨이퍼(W)가 적재되도록 다수개의 안착판(122)이 형성된 복수개의 로드(121)가 마련되고, 바람직하게는 3개의 로드(121)가 마련되고, 각 로드(121)에 형성된 안착판(122) 상부에 세정될 웨이퍼(W)가 적재된다. 그리고 안착판(122)의 선단부(124)는 적재되는 웨이퍼(W) 상부를 향하여 소정 각도(α°)로 경사지도록 형성된다. 여기서, 소정각도는 안착판(122) 상면의 수평기준으로 하방으로의 90°이내의 각도인 것이 좋다. 또한, 안착판(122)의 선단부(124)가 웨이퍼(W) 표면을 향하도록 하는 각도인 것이 좋다.

여기서, 각 로드(121) 내부에는 질소(N_2)등의 세정가스가 유동되는 가스공급유로(123)가 형성된다. 또한 3개의 로드(121)에 형성된 가스공급유로(123) 하부에는 가스공급유로(123)로 세정가스를 공급하는 가스공급부(130)가 연결되어 설치된다.

가스공급부(130)는 가스공급유로(123)와 연결되는 가스공급튜브(131)와, 가스공급튜브(131)로 세정가스를 세정가스용기(미도시)로부터 공급하는 공급펌프(132)로 구성되는 것이 바람직하다.

도 2를 참조 하면, 안착판(122) 선단부(124)에는 각각 홀(hole) 형상의 가스분사구(122a)가 형성되어 로드(121) 내부의 가스공급유로(123)와 연통되도록 되어 공급되는 세정가스를 웨이퍼(W) 상부로 분사되도록 형성된다.

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안착판(122) 선단부(124)가 웨이퍼(W) 상부를 향하여 소정각도(α°)로 경사져 있기 때문에 가스공급유로(123)로 공급된 세정가스는 웨이퍼(W) 상부로 분사되어 웨이퍼(W) 표면을 세정하도록 된다. 여기서 소정각도는 안착판 수평 위치를 기준으로 하방으로 90°이내인 것이 좋다.

또한 웨이퍼(W) 상부로 향하도록 경사진 안착판(122) 선단부(124)는 직각(β°)으로 경사질 수도 있다(도 4참조.). 따라서 분사된 세정가스는 웨이퍼(W) 상부로 공급되어 퍼지면서 웨이퍼(W) 표면을 세정한다.

도 3을 참조로 하면, 상기와 같은 가스분사구(122a)의 내경을 웨이퍼 상부로 분사되는 출구부측으로 갈수록 점차적으로 커지도록 하여, 가스공급유로(123)로 공급된 세정가스가 웨이퍼(W) 상부로 넓게 퍼지면서 분사되도록 유도할 수도 있다. 즉, 가스분사구(122a) 출구부의 내경(ℓ')을 가스분사구(122a) 출구부 내측의 내경(ℓ)보다 더 넓어지도록 형성한다.

따라서 적은 양의 세정가스로도, 또는 적은 압력의 가스공급압으로도 웨이퍼(W) 표면을 용이하게 세정할 수 있다.

도 6을 참조로 하면, 상기와 같이 안착판(122) 선단부(124)에 가스분사구(122a)를 각각 형성시키는 것이 바람직하나, 이와 더불어 각 안착판(122) 사이에 형성된 슬릿(125)에 별도의 가스분사구(122c)를 형성하여, 웨이퍼(W) 상부로 세정가스를 분사시, 안착판(122) 선단부(124) 및 슬릿(125) 위치에서 동시에 분사되도록 하여 웨이퍼(W) 표면에 더 많은 세정가스를 단시간에 공급할 수 있도록 한다.

따라서 적은 시간에 다량의 세정가스를 공급함에 따라 웨이퍼(W) 표면은 단시간에 용이하게 세정 될 수 있다.

한편, 상기와 같이 안착부(122)의 선단부(124)에 형성된 가스분사구(122a) 및 슬릿(125)에 추가로 형성된 가스분사구(122c)도 상기와 마찬가지로 출구부로 갈수록 내경이 넓어지도록 형성할 수 있다.

또한, 세정가스용기로부터 공급되어 웨이퍼(W) 표면으로 분사되는 세정가스에 이물질이 섞이지 않도록 가스공급유로(123)와 가스공급튜브(131) 사이에 먼지 등의 미물질을 거를 수 있는 필터(200)를 개재한다(도 2참조.).

여기서 필터(200)는 먼지 등을 비롯한 염분까지도 필터링 할 수 있는 고어텍스재질이 특수필터인 것이 좋다.

다음은 본 발명의 웨이퍼 세정용 보트를 갖는 스토리지에 대한 바람직한 실시예를 설명하도록 한다.

도 1 및 도 2를 참조로 하면, 본 발명의 웨이퍼 세정용 보트(120)를 갖는 스토리지(100)는 에칭설비(미도시) 일측에 본체(110)가 마련되고, 본체(110) 내부에 웨이퍼(W)를 세정하는 웨이퍼 세정부가 장착된다. 그리고 에칭설비에서 에칭이 진행되면서 발생된 잔류가스를 본체(110) 외부로 강제펌핑 할 수 있도록 본체(110)에는 강제배기부(140)가 장착된다.

강제배기부(140)는 본체(110)에 연결된 가스배기튜브(141)와, 가스배기유로(141)와 연결되어 가스를 강제펌핑하는 펌프(142)로 구성됨이 바람직하다.

웨이퍼 세정부는 에칭을 마친 복수매의 웨이퍼(W)가 적재되도록 다수의 안착판(122)이 형성된 복수개의 로드(121)와, 로드(121)들을 통해 웨이퍼(W)로 분사되는 질소 등의 세정가스를 공급하는 가스공급부(130)로 구성된다.

여기서, 각 로드(121) 내부에는 가스공급부(130)로부터 공급되는 세정가스가 유동되도록 가스공급유로(123)가 형성된다.

그리고 도 2를 참조하면, 각 로드(121)에 형성된 안착판(122) 선단부(124)는 안착판(122)에 적재되는 웨이퍼(W)를 향해 상기와 같이 소정 각도(α°) 경사지거나, 웨이퍼(W) 상부로 직각(β°)이 되도록 되며, 안착판(122) 선단부(124)에는 로드(121) 내에 형성된 가스공급유로(123)와 연통되어 공급되는 세정가스가 분사되도록 홀 형상의 가스분사구(122a)가 형성된다.

여기서, 가스공급부(130)는 상기 본체(110)에 장착된 각 로드(121)에 형성된 가스공급유로(123)와 연결되는 가스공급튜브(131)와, 가스공급튜브(131)로 세정가스를 세정가스공급원(미도시)으로부터 강제 공급하도록 하는 공급펌프(132)로 구성됨이 바람직하다.

도 3을 참조하면, 상기와 같은 가스분사구(122a)의 내경을 웨이퍼(W) 상부로 향하는 출구부측으로 갈수록 넓어지도록 형성하여 공급되는 세정가스가 웨이퍼(W) 표면으로 퍼지도록 분사하도록 할 수 있다.

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또한, 도 6을 참조하면, 상기와 같이 다수의 안착판(122) 선단부(124)에 가스분사구(122a)를 형성하여 웨이퍼(W) 표면으로 세정가스를 공급하게 함이 바람직하나, 안착판(122)들 사이에 형성되는 슬릿(125)에 추가로 가스분사구(122c)를 더 형성하여 안착판(122) 선단부(124)에 형성된 가스분사구(122a)와 동시에 세정가스를 웨이퍼(W) 표면으로 분사시킴으로서 단시간에 웨이퍼(W) 표면을 세정할 수 있다.

따라서 적은 시간에 다량의 세정가스가 웨이퍼(W) 상으로 분사됨으로 세정효율을 크게 향상시킬 수 있다.

또한, 상기와 같이 안착판(122) 선단부(124)에 형성된 가스분사구(122a)와 슬릿(125)에 형성된 가스분사구(122c)는 각각 웨이퍼(W) 표면을 향하여 경사지도록 형성된 것이 바람직하며, 각 가스분사구(122a, 122c)는 출구부측으로 갈수록 내경이 넓어지도록 형성되는 것이 좋다.

또한, 세정가스공급원으로부터 공급되어 웨이퍼(W) 표면으로 분사되는 세정가스에 이물질이 섞이지 않도록 가스공급유로(123)와 가스공급튜브(131) 사이에 먼지 등의 미물질을 거를수 있는 필터(200)를 개재한다(도 2참조.).

여기서 필터(200)는 먼지 등을 비롯한 염분까지도 필터링 할 수 있는 고어텍스재질이 특수필터인 것이 좋다.

따라서 도 1을 참조하면, 에칭을 마친 복수매의 웨이퍼(W)가 로드(121)의 안착판(122) 상에 적재된 상태에서 상기와 같은 본체(110) 내의 잔류가스를 강제배기부(140)를 통해 외부로 배출하고, 그 후 상기와 같이 가스분사구(122a, 122c)를 통해 웨이퍼(W) 표면으로 세정가스를 분사시킴으로써, 에칭 후 잔류가스 및 이물질이 웨이퍼(W) 표면 상에 응축되는 것을 방지할 수 있다. 또한, 세정가스공급원으로부터 공급되는 세정가스가 필터(200)를 통과하여 이물질이 필터링된 상태에서 웨이퍼(W) 상부로 분사되므로 세정가스 불량으로 인한 웨이퍼(W) 오염을 추가로 방지할 수 있다(도 2참조.).

발명의 효과

따라서 본 발명에 의하면, 에칭 공정진행 후, 복수매의 웨이퍼를 보트에 적재시킨 상태에서 잔류가스로 인해 이물질이 웨이퍼 표면에 응착되는 것을 보트 자체 내에서 세정시킴으로써 제품 수율을 향상시키고, 후속공정 진행시 정상적인 공정이 이루어질 수 있도록 공정효율을 향상시킬 수 있다.

또한, 후속공정 진행전 상기와 같이 보트 자체 내에서 웨이퍼를 세정함으로써 별도의 세정장치를 구비할 필요가 없음으로 제조설비비용의 절감을 가져오는 효과가 있다.

(57) 청구의 범위

청구항 1.

복수매의 웨이퍼가 적재되도록 다수의 안착판이 형성된 복수개의 로드;

상기 로드들 내부에 형성된 가스공급유로;

상기 가스공급유로와 연통되고, 상기 웨이퍼 상에 세정가스를 분사할 수 있도록 상기 안착판 선단부에 형성된 가스분사구; 및

상기 가스공급유로와 연결되어 상기 세정가스를 공급하는 가스공급부를 포함하는 것을 특징으로 하는 웨이퍼 세정용 보트.

청구항 2.

제 1항에 있어서, 상기 안착판 선단부는 상기 웨이퍼 상부를 향해 경사진 것을 특징으로 하는 웨이퍼 세정용 보트.

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청구항 3.

제 1항에 있어서, 상기 가스분사구는 상기 안착판들 사이에 상기 가스공급유로와 연통되도록 더 형성된 것을 특징으로 하는 웨이퍼 세정용 보트.

청구항 4.

제 1항에 있어서, 상기 가스분사구의 내경은 상기 세정가스가 분사되는 방향의 출구부측으로 점차적으로 넓어지도록 형성된 것을 특징으로 하는 웨이퍼 세정용 보트.

청구항 5.

제 1항에 있어서, 상기 가스공급유로와 상기 가스공급부 사이에는 필터가 더 개재되는 것을 특징으로 하는 웨이퍼 세정용 보트.

청구항 6.

본체;

상기 본체 내부에 장착되어 복수매의 웨이퍼가 적재되고, 상기 웨이퍼 상에 세정가스를 분사하여 세정하는 웨이퍼 세정부; 및

상기 본체에 장착되어 상기 본체 내부의 잔류가스를 외부로 강제 배기하는 강제배기부를 포함하는 것을 특징으로 하는 웨이퍼 세정용 보트를 갖는 스토리지.

청구항 7.

제 6항에 있어서, 상기 웨이퍼 세정부는 상기 웨이퍼들이 적재되는 다수의 안착판이 형성되는 복수개의 로드와, 상기 로드들 내부에 상기 세정가스가 공급되도록 형성된 가스공급유로와, 상기 가스공급유로와 연통되고, 상기 안착판의 선단부에 형성되어 상기 세정가스를 상기 웨이퍼 상으로 분사하는 가스분사구 및 상기 가스공급유로와 연결되어 상기 세정가스를 공급하는 가스공급부를 포함하는 것을 특징으로 하는 웨이퍼 세정용 보트를 갖는 스토리지.

청구항 8.

제 7항에 있어서, 상기 안착판의 선단부는 상기 웨이퍼 상부를 향해 경사진 것을 특징으로 하는 웨이퍼 세정용 보트를 갖는 스토리지.

청구항 9.

제 7항에 있어서, 상기 가스분사구는 상기 안착판들 사이에 상기 가스공급유로와 연통되도록 더 형성된 것을 특징으로 하는 웨이퍼 세정용 보트를 갖는 스토리지.

청구항 10.

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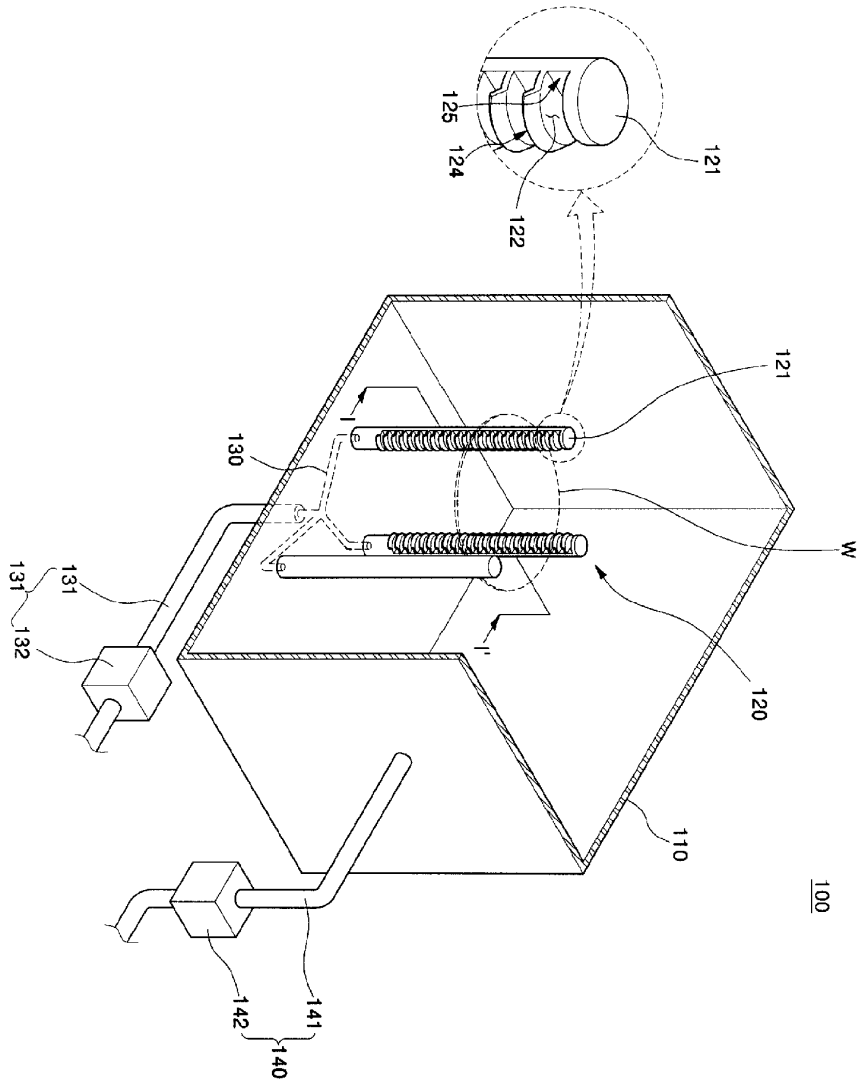
제 7항에 있어서, 상기 가스분사구의 내경은 상기 세정가스가 분사되는 방향의 출구부측으로 점차적으로 넓어지도록 형성된 것을 특징으로 하는 웨이퍼 세정용 보트를 갖는 스토리지.

청구항 11.

제 7항에 있어서, 상기 가스공급유로와 상기 가스공급부 사이에는 필터가 더 개재되는 것을 특징으로 하는 웨이퍼 세정용 보트를 갖는 스토리지.

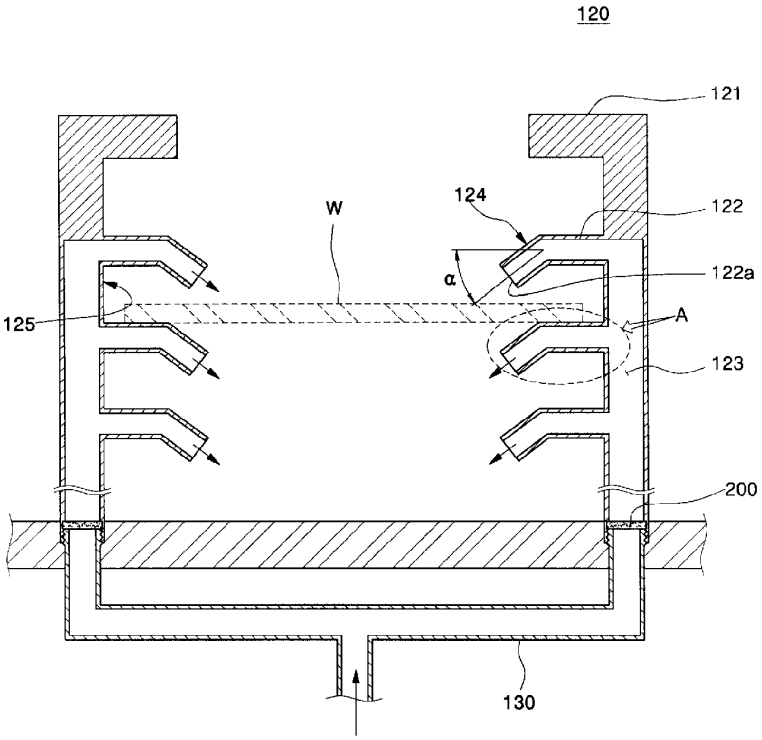
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도면1

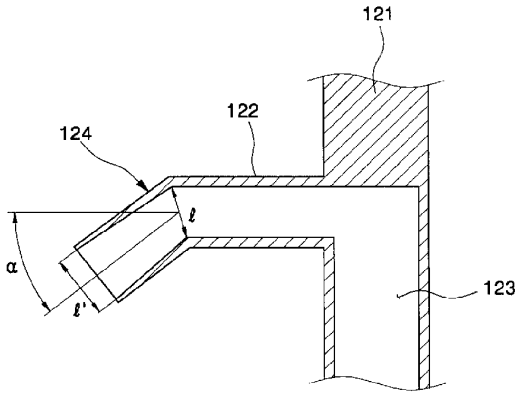


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도면2

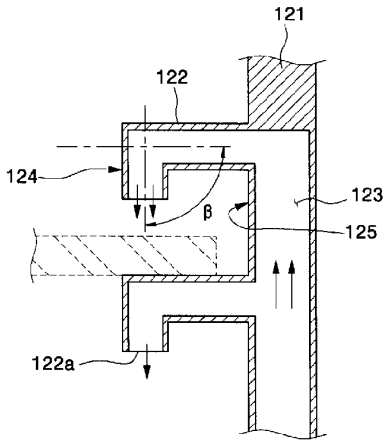


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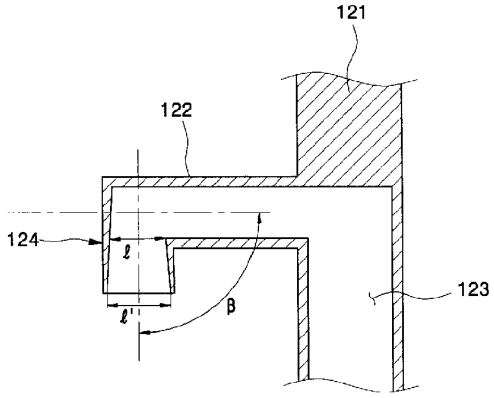


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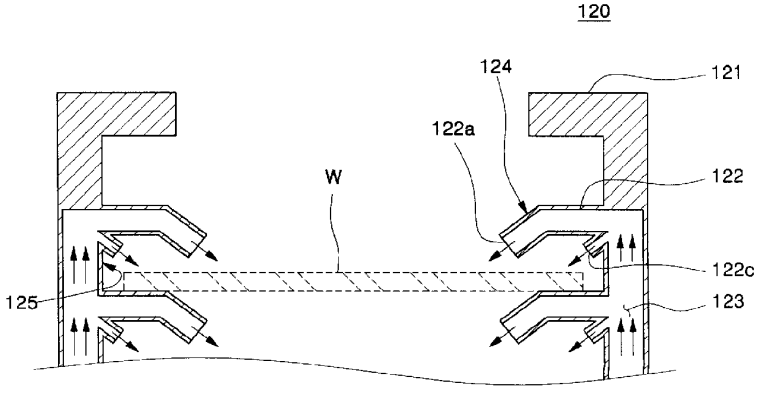
도면4



도면5



도면6



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PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(**Not for submission under 37 CFR 1.99)**

Application Number	17882703
Filing Date	2022-08-08
First Named Inventor	Ming-Chien Chiu
Art Unit	3753
Examiner Name	TIMOTHY LEWIS MAUST
Attorney Docket Number	0114970.255US2

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7235138	B2	2007-06-26	Zheng et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20150357218	A1	2015-12-10	Lin et al.	
	2	20160118282	A1	2016-04-28	Maraschin et al.	
	3	20170213752	A1	2017-07-27	Ogawa et al.	
	4	20180261483	A1	2018-09-13	WOO et al.	
	5	20180374731	A1	2018-12-27	WOO et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

	6	20190393063	A1	2019-12-26	Matsutori	
	7	20210013075	A1	2021-01-14	Chiu et al.	
	8	20210280446	A1	2021-09-09	Fuller et al.	

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Nu	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	20140055699	KR	A	2014-05-09	WOO BUM JE		☒
	2	20210055483	KR	A	2021-05-17	WONIK IPS CO LTD		☒
	3	20060100992	KR	A	2006-09-22	SAMSUNG ELECTRONICS CO LTD		☒
	4	101366135	KR	B1	2014-02-25	L S TEC CO LTD		☒
	5	I773536	TW	B	2022-08-01	GUDENG PREC IND CO LTD		☒

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NON-PATENT LITERATURE DOCUMENTS

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	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Tim Tingkang Xia/	Date (YYYY-MM-DD)	2025-01-14
Name/Print	Tim Tingkang Xia	Registration Number	45242

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Espacenet

Bibliographic data: KR101366135 (B1) — 2014-02-25

POST PURGE SYSTEM

Inventor(s): KIM BONG HO [KR] ± (KIM, BONG HO)

Applicant(s): L S TEC CO LTD [KR] ± (L.S TEC CO ., LTD)

Classification: **- international:** ***B08B5/02; H01L21/302***
- cooperative: **H01L21/67167 (KR)**

Application number: KR20130120656 20131010 Global Dossier

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Abstract of KR101366135 (B1)

The present invention relates to a post purge device having an inner space for accommodating at least one wafer and comprising a wafer accommodating part having one side opened to accommodate or discharge the wafer; a Fume removing part having multiple spraying nozzles at a regular interval at one side among the inner surfaces of the wafer accommodating part forming the inner space and controlling first gas to be sprayed at the spraying nozzle for the Fume and foreign materials formed at the surface of the accommodated wafer, which is accommodated at the wafer accommodating part, to be separated; and a Fume exhausting part mounted at the inner surface of the wafer accommodating part facing the opened one side for exhausting the sprayed first gas and the Fume and foreign materials separated from the surface of the wafer.

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(73) 특허권자
주식회사 엘에스테크
경기도 성남시 분당구 황새울로200번길 28 , 509호(수내동, 오너스타워)
(72) 발명자
김봉호
경기 성남시 분당구 분당로 212, 201동 902호 (분당동, 샛별마을동성아파트)
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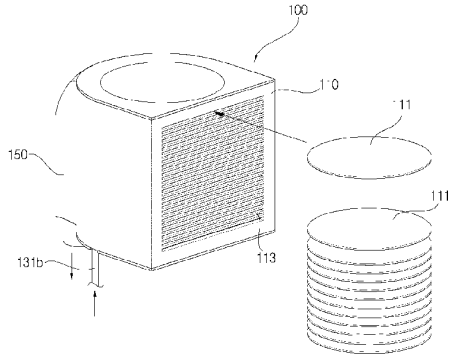
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(54) 발명의 명칭 **포스트 퍼지 장치**

(57) 요 약

본 발명의 일실시 예에 따른 포스트 퍼지 장치는 적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부, 내부공간을 형성하는 웨이퍼 수납부의 내부면 중 일면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 웨이퍼 수납부에 수납된 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 분사노즐에서 제1 기체가 분사하는 Fume 제거부 및 개구된 일면과 마주보는 웨이퍼 수납부의 내부면에 배치되어 분사된 제1 기체와 웨이퍼의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시키는 Fume 배기부를 포함한다.

대 표 도 - 도1



Entegris, EX1002, p. 58

특허청구의 범위

청구항 1

적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 상기 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부;

상기 내부공간을 형성하는 상기 웨이퍼 수납부의 내부면 중 일면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 상기 웨이퍼 수납부에 수납된 상기 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 상기 분사노즐에서 제1 기체가 분사하는 Fume 제거부; 및

개구된 상기 일면과 마주보는 상기 웨이퍼 수납부의 내부면에 배치되어 분사된 상기 제1 기체와 상기 웨이퍼의 표면으로부터 이탈된 상기 퓸(Fume)과 상기 이물질을 배기시키는 Fume 배기부;를 포함하고,

상기 Fume 제거부는 상기 분사노즐이 형성되는 분사배관이 세로길이 방향으로 적어도 하나 이상이 배치되고, 상기 하나의 분사노즐은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되고,

상기 분사노즐은 상기 분사배관에 하향 경사지게 설치되면서 수납되어 적층되는 상기 웨이퍼들 사이마다 위치되고, 상기 분사노즐보다 낮은 위치에 적층되는 상기 웨이퍼의 상면을 향해 경사지게 상기 제1 기체를 분사하고,

상기 분사배관은 상기 분사노즐을 통해 분사되는 상기 제1 기체의 맥동현상을 제어하는 바이패스를 포함하는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 2

적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 상기 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부;

상기 내부공간을 형성하는 상기 웨이퍼 수납부의 내부면 중 일면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 상기 웨이퍼 수납부에 수납된 상기 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 상기 분사노즐에서 제1 기체가 분사하는 Fume 제거부; 및

상기 Fume 제거부와 마주보는 상기 웨이퍼 수납부의 내부면 중 타면에 배치되어 분사된 상기 제1 기체와 상기 웨이퍼의 표면으로부터 이탈된 상기 퓸(Fume)과 상기 이물질을 배기시키는 Fume 배기부;를 포함하고,

상기 Fume 제거부는 상기 분사노즐이 형성되는 분사배관이 세로길이 방향으로 적어도 하나 이상이 배치되고, 상기 하나의 분사노즐은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되고,

상기 분사노즐은 상기 분사배관에 하향 경사지게 설치되면서 수납되어 적층되는 상기 웨이퍼들 사이마다 위치되고, 상기 분사노즐보다 낮은 위치에 적층되는 상기 웨이퍼의 상면을 향해 경사지게 상기 제1 기체를 분사하고,

상기 분사배관은 상기 분사노즐을 통해 분사되는 상기 제1 기체의 맥동현상을 제어하는 바이패스를 포함하는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 3

삭제

청구항 4

삭제

청구항 5

삭제

Entegris, EX1002, p. 59

청구항 6

청구항 1 또는 청구항 2에 있어서,

상기 분사노즐은 상기 제1 기체를 분사하는 지름이 상기 일면의 위치에 따라 다르게 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 7

적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 상기 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부;

상기 내부공간을 형성하는 상기 웨이퍼 수납부의 내부면 중 양측면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 상기 웨이퍼 수납부에 수납된 상기 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 상기 분사노즐에서 제1 기체가 분사하는 Fume 제거부; 및

개구된 상기 일면과 마주보는 상기 웨이퍼 수납부의 내부면에 배치되어 분사된 상기 제1 기체와 상기 웨이퍼의 표면으로부터 이탈된 상기 퓸(Fume)과 상기 이물질을 배기시키는 Fume 배기부;를 포함하고,

상기 Fume 제거부는 상기 분사노즐이 형성되는 제1 분사배관과 상기 분사노즐이 형성되는 제2 분사배관이 세로길이 방향으로 적어도 하나 이상이 배치되고, 상기 하나의 분사노즐은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되고,

상기 분사노즐은 상기 제1 분사배관 및 상기 제2 분사배관에 하향 경사지게 설치되면서 수납되어 적층되는 웨이퍼들 사이마다 위치되고, 상기 분사노즐보다 낮은 위치에 적층되는 웨이퍼의 상면을 향해 경사지게 상기 제1 기체를 분사하고,

상기 제1 분사배관과 상기 제2 분사배관은 상기 분사노즐을 통해 분사되는 상기 제1 기체의 맥동현상을 제어하는 바이패스를 포함하는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 8

삭제

청구항 9

삭제

청구항 10

삭제

청구항 11

청구항 7에 있어서,

상기 분사노즐은 상기 제1 기체를 분사하는 지름이 상기 일면의 위치에 따라 다르게 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 12

청구항 7에 있어서,

상기 제1 분사배관은 상기 웨이퍼 수납부의 양측면 중 일면에 배치되고, 상기 제2 분사배관은 상기 웨이퍼 수납부의 양측면 중 타측면에 배치되며, 상기 제1 분사배관과 상기 제2 분사배관은 서로 대응되면서 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

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청구항 13

청구항 7에 있어서,

상기 제1 분사배관은 상기 웨이퍼 수납부의 양측면 중 일면에 배치되고, 상기 제2 분사배관은 상기 웨이퍼 수납부의 양측면 중 타측면에 배치되며, 상기 제1 분사배관과 상기 제2 분사배관은 서로 대응되지 않도록 엇갈리면서 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 14

청구항 12 또는 청구항 13에 있어서,

상기 제1 분사배관에 형성되는 상기 분사노즐의 위치는 상기 제2 분사배관에 형성되는 상기 분사노즐의 위치와 서로 대응되면서 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 15

청구항 12 또는 청구항 13에 있어서,

상기 제1 분사배관에 형성되는 상기 분사노즐의 위치는 상기 제2 분사배관에 형성되는 상기 분사노즐의 위치와 서로 대응되지 않도록 엇갈리면서 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 16

청구항 1, 청구항 2, 청구항 7 중 어느 한 항에 있어서,

상기 Fume 배기부는 상기 제1 기체, 상기 퓸(Fume)과 상기 이물질을 배기시키는 배기구가 소정의 폭과 너비를 가지면서 적어도 하나 이상이 일정한 간격으로 배치되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 17

청구항 16에 있어서,

상기 배기구는 상기 웨이퍼 수납부의 상단에서 하단으로 진행할수록 상기 배기구의 형상 또는 상기 배기구의 면적이 서로 다르게 형성되는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 18

청구항 16에 있어서,

상기 배기구의 소정의 폭은 상기 웨이퍼 수납부의 상단에서 하단으로 진행할수록 작아지는 것을 특징으로 하는 포스트 퍼지 장치.

청구항 19

청구항 16에 있어서,

상기 배기구의 소정의 너비는 상기 웨이퍼 수납부의 상단에서 하단으로 진행할수록 작아지는 것을 특징으로 하는 포스트 퍼지 장치.

명 세 서

Entegris, EX1002, p. 61

기 술 분 야

[0001] 본 발명은 포스트 퍼지 장치에 관한 것으로, 웨이퍼 수납부에 반입되거나 반출되는 웨이퍼의 표면상에 흡착되는 이물질을 효율적으로 제기할 수 있는 포스트 퍼지 장치에 관한 것이다.

배 경 기 술

[0002] 일반적으로 반도체 소자는 웨이퍼 상에 증착 공정, 연마 공정, 포토리소그래피 공정, 식각 공정, 이온주입 공정, 세정 공정, 검사 공정, 열처리 공정 등이 선택적이면서도 반복적으로 수행되어 제조되며, 이렇게 반도체 소자로 형성되기 위하여 웨이퍼는 각 공정에서 요구되는 특정 위치로 운반되어 진다.

[0003] 반도체 제조 공정 시에, 가공되는 웨이퍼는 고정밀도의 물품으로 보관 및 운반 시 외부의 오염 물질과 충격으로부터 오염되거나 손상되지 않도록 개구 통합형 포드(Front Opening Unified Pod;FOUP)과 같은 웨이퍼 수납 용기에 수납되어 이송하였다.

[0004] 여기서 식각 공정 후 FOUP 내에서 식각 공정진 웨이퍼와 식각 공정 후 웨이퍼의 혼재오염 (Cross Contamination)을 막기 위하여 EFEM (Equipment Front End Module) 옆면에 Side Storage (혹은 Buffer Station)를 배치하여 식각 공정 후 웨이퍼를 FOUP 내의 식각 공정 진 웨이퍼 분리한 후 식각 공정이 마무리 되면 전체 웨이퍼를 FOUP 내로 수납하여 이후 공정으로 이송한다.

[0005] 사이드 스토리지가 혼재오염을 방지하였으나, 여전히 웨이퍼 표면에는 이물질과 Fume등이 잔류하여 수율과 제품특성에 문제점이 발생되었고, 집적도가 점점 높아짐에 따라 더욱 더 심각한 문제가 발생하였다.

[0006] 또한 LOT 내의 특정 진행 순서 웨이퍼의 수율과 제품특성에 문제가 발견되었다 .

발명의 내용

해결하려는 과제

[0007] 본 발명은 상술한 바와 같은 종래기술의 문제점들을 해결하기 위하여 안출된 것으로서, 포스트 퍼지 장치에 안착된 웨이퍼 수납부에 반입되기나 반출되는 웨이퍼의 표면상에 흡착되는 이물질 및 Fume 등을 효율적으로 제기할 수 있는 포스터 퍼지 장치를 제공하는 것이다.

과제의 해결 수단

[0008] 본 발명의 일실시 예에 따른 포스트 퍼지 장치는 적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부, 내부공간을 형성하는 웨이퍼 수납부의 내부면 중 일면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 웨이퍼 수납부에 수납된 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 분사노즐에서 제1 기체가 분사하는 Fume 제거부 및 개구된 일면과 마주보는 웨이퍼 수납부의 내부면에 배치되어 분사된 제1 기체와 웨이퍼의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시키는 Fume 배기부를 포함한다.

[0009] 또한, 본 발명의 다른 실시 예에 따른 포스트 퍼지 장치는 적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부, 내부공간을 형성하는 웨이퍼 수납부의 내부면 중 일면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 웨이퍼 수납부에 수납된 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 분사노즐에서 제1 기체가 분사하는 Fume 제거부 및 Fume 제거부와 마주보는 웨이퍼 수납부의 내부면 중 타면에 배치되어 분사된 제1 기체와 웨이퍼의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시키는 Fume 배기부를 포함한다.

[0010] 또한, Fume 제거부는 분사노즐이 형성되는 분사배관이 세로길이 방향으로 적어도 하나 이상이 배치되고, 하나의 분사노즐은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되는 것을 포함할 수 있다.

[0011] 또한, 분사노즐은 분사배관에 하향 경사지게 설치되면서 수납되어 적층되는 웨이퍼들 사이마다 위치되고, 분사

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노즐보다 낮은 위치에 적층되는 웨이퍼의 상면을 향해 경사지게 제1 기체를 분사하는 것을 포함할 수 있다.

[0012] 또한, 제1 분사배관과 제2 분사배관은 분사노즐을 통해 분사되는 제1 기체의 맥동현상을 제어하는 바이패스를 포함할 수 있다.

[0013] 또한, 분사노즐은 제1 기체를 분사하는 지름이 일면의 위치에 따라 다르게 형성되는 것을 포함할 수 있다.

[0014] 또한, 본 발명의 또 다른 실시 예에 따른 포스트 퍼지 장치는 적어도 하나 이상의 웨이퍼를 수납하도록 소정의 내부 공간이 형성되고, 웨이퍼를 수납하거나 배출하도록 일면이 개구되어 형성되는 웨이퍼 수납부, 내부공간을 형성하는 웨이퍼 수납부의 내부면 중 양측면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 웨이퍼 수납부에 수납된 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 분사노즐에서 제1 기체가 분사하는 Fume 제거부 및 개구된 일면과 마주보는 웨이퍼 수납부의 내부면에 배치되어 분사된 제1 기체와 웨이퍼의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시키는 Fume 배기부를 포함한다.

[0015] 또한, Fume 제거부는 분사노즐이 형성되는 제1 분사배관과 분사노즐이 형성되는 제2 분사배관이 세로길이 방향으로 적어도 하나 이상이 배치되고, 하나의 분사노즐은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되는 것을 포함할 수 있다.

[0016] 또한, 분사노즐은 제1 분사배관 및 제2 분사배관에 하향 경사지게 설치되면서 수납되어 적층되는 웨이퍼들 사이마다 위치되고, 분사노즐보다 낮은 위치에 적층되는 웨이퍼의 상면을 향해 경사지게 제1 기체를 분사하는 것을 포함할 수 있다.

[0017] 또한, 제1 분사배관과 제2 분사배관은 분사노즐을 통해 분사되는 제1 기체의 맥동현상을 제어하는 바이패스를 포함할 수 있다.

[0018] 또한, 분사노즐은 제1 기체를 분사하는 지름이 일면의 위치에 따라 다르게 형성되는 것을 포함할 수 있다.

[0019] 또한, 제1 분사배관은 웨이퍼 수납부의 양측면 중 일면에 배치되고, 제2 분사배관은 웨이퍼 수납부의 양측면 중 타측면에 배치되며, 제1 분사배관과 제2 분사배관은 서로 대응되면서 형성되는 것을 포함할 수 있다.

[0020] 또한, 제1 분사배관은 웨이퍼 수납부의 양측면 중 일면에 배치되고, 제2 분사배관은 웨이퍼 수납부의 양측면 중 타측면에 배치되며, 제1 분사배관과 제2 분사배관은 서로 대응되지 않도록 엇갈리면서 형성되는 것을 포함할 수 있다.

[0021] 또한, 제1 분사배관에 형성되는 분사노즐의 위치는 제2 분사배관에 형성되는 분사노즐의 위치와 서로 대응되면서 형성되는 것을 포함할 수 있다.

[0022] 또한, 제1 분사배관에 형성되는 분사노즐의 위치는 제2 분사배관에 형성되는 분사노즐의 위치와 서로 대응되지 않도록 엇갈리면서 형성되는 것을 포함할 수 있다.

[0023] 또한, Fume 배기부는 제1 기체, 퓸(Fume)과 이물질을 배기시키는 배기구가 소정의 폭과 너비를 가지면서 적어도 하나 이상이 일정한 간격으로 배치되는 것을 포함할 수 있다.

[0024] 또한, 배기구는 웨이퍼 수납부의 상단에서 하단으로 진행할수록 배기구의 형상 또는 배기구의 면적이 서로 다르게 형성되는 것을 포함할 수 있다.

[0025] 또한, 배기구의 소정의 폭은 웨이퍼 수납부의 상단에서 하단으로 진행할수록 작아지는 것을 포함할 수 있다.

[0026] 또한, 배기구의 소정의 너비는 웨이퍼 수납부의 상단에서 하단으로 진행할수록 작아지는 것을 포함할 수 있다.

발명의 효과

[0027] 본 발명의 실시 예에 따른 포스트 퍼지 장치는 포스트 퍼지 장치 내의 웨이퍼 수납부에 식각 후 웨이퍼를 반입하여 식각 후 또는 식각 전.후 웨이퍼의 혼재오염을 방지하면서 웨이퍼 표면에 흡착되는 이물질 및 퓸(Fume) 등을 효과적으로 제거할 수 있을 뿐만 아니라 식각시 특정 순서에 진행된 웨이퍼에 대한 효율적 대응을 통하여 수율 및 제품특성을 향상할 수 있는 효과가 있다.

[0028] 또한, 본 발명의 실시 예에 따른 포스트 퍼지 장치는 에어커튼부와 에어샤워부를 배치함으로써 웨이퍼 내 손상방지와 끊어짐이 없는 지속적 커튼 기능을 유지할 수 있는 효과가 있다.

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도면의 간단한 설명

[0029] 도 1은 본 발명의 일실시 예에 따른 포스트 퍼지 장치의 사시도.

도 2는 본 발명의 일실시 예에 따른 포스트 퍼지 장치의 내부가 보이도록 도시한 사시도.

도 3은 본 발명의 일실시 예에 따른 포스트 퍼지 장치의 내부가 보이도록 도시한 정면도.

도 4는 본 발명의 일실시 예에 따른 포스트 퍼지 장치의 단면도.

도 5는 본 발명의 일실시 예에 따른 분사배관에 배치되는 분사노즐을 설명하기 위한 정면도.

도 6은 본 발명의 일실시 예에 따른 분사배관에 배치되는 분사노즐의 위치를 설명하기 위한 측면도.

도 7은 본 발명의 일실시 예에 따른 분사배관에 배치되는 분사노즐의 위치를 설명하기 위한 확대도.

도 8은 본 발명의 일실시 예에 따른 포스트 퍼지 장치 중 분사배관의 다양한 실시 예이다.

도 9a 내지 도 9e은 본 발명의 일실시 예에 따른 포스트 퍼지 장치 중 배기구의 다양한 실시 예를 도시한 정면도.

도 10은 본 발명의 다른 실시 예에 따른 포스트 퍼지 장치의 사시도.

도 11은 본 발명의 다른 실시 예에 따른 포스트 퍼지 장치의 내부가 보이도록 도시한 정면도.

도 12는 본 발명의 다른 실시 예에 따른 분사배관에 배치되는 분사노즐의 위치를 설명하기 위한 측면도.

도 13은 본 발명의 또 다른 실시 예에 따른 포스트 퍼지 장치의 사시도.

도 14는 본 발명의 또 다른 실시 예에 따른 포스트 퍼지 장치의 내부가 보이도록 도시한 사시도.

도 15는 본 발명의 또 다른 실시 예에 따른 포스트 퍼지 장치의 내부가 보이도록 도시한 정면도.

도 16은 본 발명의 다양한 실시 예에 따른 포스트 퍼지 장치 중 일면의 일측에 에어커튼부가 장착된 사시도.

도 17은 본 발명의 다양한 실시 예에 따른 포스트 퍼지 장치 중 상단에 에어샤워부가 장착된 사시도.

도 18은 본 발명의 다양한 실시 예에 따른 포스트 퍼지 장치 중 일면의 양측에 에어커튼부가 장착된 사시도.

도 19은 본 발명의 다양한 실시 예에 따른 포스트 퍼지 장치 중 일면의 양측에 장착된 에어커튼부가 동작하는 동작도.

도 20은 본 발명의 다양한 실시 예에 따른 포스트 퍼지 장치 중 상단에 에어샤워부가 장착되고, 일면의 양측에 에어커튼부가 장착된 사시도.

발명을 실시하기 위한 구체적인 내용

[0030] 이하, 본 발명에 따른 바람직한 실시 예를 첨부된 도면을 참조하여 상세히 설명하되, 본 발명에 따른 동작 및 작용을 이해하는데 필요한 부분을 중심으로 설명한다.

[0031] 도 1 내지 도 9e를 살펴보면, 본 발명의 일실시 예에 따른 포스트 퍼지 장치(100)는 웨이퍼 수납부(110), Fume 제거부(130) 및 Fume 배기부(150)를 포함하여 구성된다.

[0032] 웨이퍼 수납부(110)는 적어도 하나 이상의 웨이퍼(111)를 수납하도록 소정의 내부 공간이 형성되고, 웨이퍼(111)를 수납하거나 배출하도록 일면이 개구되어 형성된다.

[0033] Fume 제거부(130)는 내부공간을 형성하는 웨이퍼 수납부(110)의 내부면 중 일면에 일정한 간격으로 분사노즐(132)이 복수 개가 배치되고, 웨이퍼 수납부(110)에 수납된 웨이퍼(111)의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 분사노즐(132)에서 제1 기체가 분사한다. 이러한 Fume 제거부(130)는 분사노즐(132)이 형성되는 분사배관(131a)이 세로길이 방향으로 적어도 하나 이상이 배치된다. 여기서 Fume 제거부(130)는 분사배관(131a)에 체결되면서 분사배관(131a)과 교차하는 방향으로 체결되어 분사배관(131a)을 지지하는 동시에 분사배관(131a)에 제1 기체를 제공할 수 있는 공급배관(131b)을 포함할 수 있다.

[0034] 또한, 분사배관(131a)은 사각기둥으로 도시하였으나 이에 한정되는 것은 아니며, 분사노즐(132)을 배치할 수 있

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다면 다각형기둥 또는 원기둥으로 형성될 수 있다.

[0035] 또한, Fume 제거부(130)는 3개의 분사배관(131a)이 배치되는 것을 도시하였으나 이에 한정되는 것은 아니며, 웨이퍼 수납부(110)의 내부공간의 크기 또는 주변환경에 따라, 분사배관(131a)을 1개부터 n(n=1이상의 자연수)까지 배치할 수 있다.

[0036] Fume 배기부(150)는 개구된 일면(113)과 마주보는 웨이퍼 수납부(110)의 내부면에 배치되어 분사된 제1 기체와 웨이퍼(111)의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시킨다. 이러한 Fume 배기부(150)는 소정의 폭과 너비를 가지면서 제1 기체, 퓸(Fume)과 이물질을 배기시키는 배기구(151)가 적어도 하나 이상으로 형성될 수 있다. Fume 배기부(150)에 대한 자세한 설명은 후술하기로 한다.

[0037] 도 5 내지 도 7에 도시된 바와 같이, Fume 제거부(130)는 분사노즐(132)이 형성되는 분사배관(131a)이 세로길이 방향으로 적어도 하나 이상이 배치되고, 하나의 분사노즐(132)은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치될 수 있다.

[0038] 여기서, 분사배관(131a)이 웨이퍼 수납부(110)의 내부에 3개가 배치되면, 도 5의 (a)와 같이, 분사노즐(132)은 가로길이 방향으로 분사구멍이 세 개가 배치될 수 있고, 분사배관(131a)이 웨이퍼 수납부(110)의 내부에 2개가 배치되면, 도 5의 (b)와 같이, 분사노즐(132)은 가로길이 방향으로 분사구멍이 두 개가 배치될 수 있다.

[0039] 이와 같이, 분사노즐(132)은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되어 제1 기체를 분사함으로써, 웨이퍼 수납부(110)의 구석구석까지 골고루 분사할 수 있다. 이에 따라, 데드존(Dead Zone)이 발생되지 않는다.

[0040] 즉, 웨이퍼 수납부(110)의 구석구석까지 골고루 분사할 수 있도록 분사노즐(132)이 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치됨으로써, 웨이퍼 수납부(110)에 적층되는 웨이퍼(111)의 표면에 데드존(Dead Zone)이 발생되지 않아 퓸(Fume)과 이물질을 깨끗하게 제거할 수 있다.

[0041] 또한, 도 6 및 도 7에 도시된 바와 같이, 분사노즐(132)은 분사배관(131a)에 하향 경사지게 설치되면서 수납되어 적층되는 웨이퍼(111)들 사이마다 위치되고, 분사노즐(132)보다 낮은 위치에 적층되는 웨이퍼(111)의 상면을 향해 경사지게 제1 기체를 분사한다.

[0042] 여기서 분사노즐(132)의 위치는 분사노즐(132)보다 낮은 위치에 적층되는 웨이퍼(111)의 바로 위에 적층되는 웨이퍼(111)의 위치와 실질적으로 동일한 위치까지 최대한으로 설치될 수 있으며, 바람직하게는 수납되어 적층되는 웨이퍼(111)들 사이마다 위치될 수 있다.

[0043] 이와 같이, 분사노즐(132)이 분사노즐(132)보다 낮은 위치에 적층되는 웨이퍼(111)의 상면을 향해 경사지게 제1 기체를 분사함으로써, 적층되는 웨이퍼(111)가 떨리는 현상을 미연에 방지할 수 있다. 즉, 웨이퍼 수납부(110)에 적층되는 웨이퍼(111)는 고정되어 있지 않기 때문에 분사노즐(132)이 분사될 경우 약간의 흔들림이 발생할 수 있으나 본 발명의 분사노즐(132)과 같이, 하향 경사지게 설치되어 웨이퍼(111)의 상면을 향해 경사지게 제1 기체를 분사함으로써, 분사되는 동안 적층되는 웨이퍼(111)를 위에서 아래로 소정이 압력을 가할 수 있다. 이에 따라 적층되는 웨이퍼(111)가 떨림현상이 제거되는 동시에 패턴의 무너짐을 방지할 수 있다.

[0044] 또한, 도 7에 도시된 바와 같이, 분사배관(131a)은 분사노즐(132)을 통해 분사되는 제1 기체의 맥동현상을 제어하는 바이패스(133)를 포함한다. 이와 같이, 분사배관(131a)의 내부에 바이패스(133)를 배치하여 분사노즐(132)을 제어함으로써, 분사노즐(132)을 통해 분사되는 제1 기체가 실질적으로 동일한 압력으로 분사될 수 있다. 게다가 바이패스(133)를 통해 제1 기체의 맥동현상을 제어하여 갑작스런 제1 기체 분사로 인한 웨이퍼상의 패턴이 무너지는 것을 방지하기 할 수 있다.

[0045] 이에 따라, 제1 기체의 맥동현상을 제어하면서 동일한 압력으로 제1 기체가 균일하게 적층되는 웨이퍼(111)들에 분사됨으로써, 웨이퍼상의 패턴이 무너지는 것을 방지하면서 웨이퍼(111)의 표면에 형성되는 퓸(Fume)과 이물질을 효율적으로 이탈시킬 수 있을 뿐만 아니라 제품특성도 개선될 수 있다.

[0046] 도 8을 살펴보면, 웨이퍼 수납부(110)에 형성되어 제1 기체를 분사하는 분사노즐을 설명하기 위한 것이다.

[0047] 분사노즐(132)은 제1 기체를 분사하는 지름이 일면의 위치에 따라 다르게 형성될 수 있다.

[0048] 즉, 도 8의 (a)에 도시된 바와 같이, 제1 기체를 분사하는 분사노즐(132)의 지름은 웨이퍼 수납부(110)를 1/2로 나누어 상부와 하부로 나눌 경우 상부에 배치되는 분사노즐(132)의 지름이 하부에 배치되는 분사노즐(132)의 지름보다 작게 형성될 수 있다.

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[0049] 또는, 도 8의 (b)에 도시된 바와 같이, 제1 기체를 분사하는 분사노즐(132)의 지름은 웨이퍼 수납부(110)를 1/3로 나누어 상부, 중부, 하부로 나눌 경우 상부에 배치되는 분사노즐(132)의 지름이 중부에 배치되는 분사노즐(132)의 지름보다 작게 형성될 수 있고, 중부에 배치되는 분사노즐(132)의 지름이 하부에 배치되는 분사노즐(132)의 지름보다 작게 형성될 수 있다.

[0050] 또는, 도 8의 (c)에 도시된 바와 같이, 제1 기체를 분사하는 분사노즐(132)의 지름이 상부에서 하부로 진행할수록 분사노즐(132)의 지름이 점진적으로 커질 수 있다.

[0051] 지금까지 설명한 바와 같이, 분사노즐(132)이 일면의 위치에 따라 지름을 달리하도록 형성함으로써, 분사노즐(132)에서 분사되는 제1 기체의 압력을 실질적으로 동일하게 할 수 있다. 즉, 웨이퍼 수납부(110)의 하부에서 상부로 갈수록 제1 기체가 분사되는 압력이 낮아지기 때문에 분사노즐(132)의 지름을 축소함으로써, 분사되는 제1 기체의 압력을 높일 수 있다.

[0052] 이에 따라, 분사노즐(132)은 실질적으로 동일한 압력을 가지는 제1 기체를 웨이퍼 수납부(110)의 내부로 분사하여 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질을 균일하게 이탈시킬 수 있다.

[0053] 도 9a 내지 도 9e을 살펴보면, 웨이퍼 수납부(110)에 형성되는 배기구(151)의 다양한 형상을 설명하기 위한 것이다.

[0054] 먼저 도 11a에 도시된 바와 같이, Fume 배기부(150)는 제1 기체, 퓸(Fume)과 이물질을 배기시키는 배기구(151a)가 소정의 폭과 너비를 가지면서 적어도 하나 이상이 일정한 간격으로 배치될 수 있다. 이때, 배기구(151a)는 웨이퍼 수납부(110)를 1/2로 나누어 상단과 하단으로 나눌 경우 상단에 배치되는 배기구(151a)의 폭(d1)이 하단에 배치되는 배기구(151a)의 폭(d2)보다 크게 형성될 수 있다. 여기서 상단에 배치되는 배기구(151)의 너비와 하단에 배치되는 배기구(151)의 너비는 실질적으로 동일하게 형성될 수 있다.

[0055] 또한, 도 9b에 도시된 바와 같이, 배기구(151b)의 소정의 폭(d3,d4)은 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 작아질 수 있다. 여기서 배기구(151)의 너비는 실질적으로 동일하게 형성될 수 있다.

[0056] 이에 따라, 배기구(151b)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 배기구(151)의 형상 또는 배기구(151b)의 면적이 서로 다르게 형성될 수 있다.

[0057] 또한, 도 9c에 도시된 바와 같이, 배기구(151c)의 소정의 너비(11,12)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 작아지면서 배기구(151c)의 소정의 폭(d5,d6)은 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 길어질 수 있다.

[0058] 이에 따라, 배기구(151c)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 배기구(151)의 형상은 달라질 수 있으나 배기구(151c)의 면적은 실질적으로 동일하게 형성될 수 있다.

[0059] 또한, 도 9d에 도시된 바와 같이, 배기구(151d)의 소정의 너비(13,14)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 작아질 수 있다. 여기서 배기구(151d)의 폭(d7)은 실질적으로 동일하게 형성될 수 있다. 이에 따라, 배기구(151d)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 배기구(151d)의 형상 또는 배기구(151)의 면적이 서로 다르게 형성될 수 있다.

[0060] 또한, 도 9e에 도시된 바와 같이, 배기구(151e)의 소정의 폭(d8,d9)은 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 작아지고, 배기구(151e)의 소정의 너비(15,16)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 작아질 수 있다. 이에 따라, 배기구(151e)는 웨이퍼 수납부(110)의 상단에서 하단으로 진행할수록 배기구(151e)의 형상 또는 배기구(151)의 면적이 작아지도록 형성될 수 있다.

[0061] 지금까지 설명한 도 9a 내지 도 9e에 도시된 바와 같이, 배기구(151a 내지 151e)는 다양한 형상으로 웨이퍼 수납부(110)에 형성되어 배치될 수 있으며, 이에 한정되는 것은 아니며, 웨이퍼에서 이탈되는 퓸(Fume)과 이물질을 용이하게 배기할 수 있다면, 어떠한 형상으로 형성되더라도 무관할 수 있다.

[0062] 도 10 내지 도 12를 살펴보면, 본 발명의 다른 실시 예에 따른 포스트 퍼지 장치(300)는 웨이퍼 수납부(310), Fume 제거부(330) 및 Fume 배기부(350)를 포함하여 구성된다.

[0063] 이러한, 본 발명의 다른 실시 예에 따른 포스트 퍼지 장치(300)에 해당하는 각각의 구성요소들에 대한 기능 및 그것들 간의 유기적인 관계는 일실시 예에 따른 포스트 퍼지 장치(100)에 해당하는 각각의 구성요소들에 대한

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기능 및 그것들 간의 유기적인 관계와 동일하므로, 이것에 대한 각각의 부연설명들은 이하 생략하기로 한다.

[0064] Fume 제거부(330)는 내부공간을 형성하는 웨이퍼 수납부(310)의 내부면 중 일면에 일정한 간격으로 분사노즐(332)이 복수 개가 배치되고, 웨이퍼 수납부(310)에 수납된 웨이퍼(111)의 표면에 형성되는 퓸(Fume)과 이물질이 이탈되도록 분사노즐(332)에서 제1 기체가 분사한다. 이러한 Fume 제거부(130)는 분사노즐(332)이 형성되는 분사배관(331a)이 세로길이 방향으로 적어도 하나 이상이 배치된다. 여기서 Fume 제거부(330)는 분사배관(331a)에 체결되면서 분사배관(331a)과 수직 방향으로 체결되어 분사배관(331a)을 지지하는 동시에 분사배관(331a)에 제1 기체를 제공할 수 있는 공급배관(331b)을 포함할 수 있다.

[0065] 또한, Fume 제거부(330)는 분사노즐(332)이 형성되는 분사배관(131a)이 세로길이 방향으로 적어도 하나 이상이 배치되고, 하나의 분사노즐(332)은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치될 수 있다. 이때 분사배관(331a)이 웨이퍼 수납부(310)의 내부에 3개가 배치되면, 분사노즐(332)은 가로길이 방향으로 분사구멍이 세 개가 배치될 수 있고, 분사배관(331a)이 웨이퍼 수납부(310)의 내부에 2개가 배치되면, 분사노즐(332)은 가로길이 방향으로 분사구멍이 두 개가 배치될 수 있다.

[0066] 이와 같이, 분사노즐(332)은 가로길이 방향으로 분사구멍이 하나 이상 셋 이하로 배치되어 제1 기체를 분사함으로써, 웨이퍼 수납부(110)의 구석구석까지 골고루 분사할 수 있기 때문에 데드존(Dead Zone)이 발생되지 않는다. 이에 따라, 퓸(Fume)과 이물질을 깨끗하게 제거할 수 있다.

[0067] Fume 배기부(350)는 Fume 제거부(330)와 마주보는 웨이퍼 수납부(310)의 내부면 중 타면에 배치되어 분사된 제1 기체와 웨이퍼(111)의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시킨다. 이러한 Fume 배기부(350)는 소정의 폭과 너비를 가지면서 제1 기체, 퓸(Fume)과 이물질을 배기시키는 배기구(151)가 적어도 하나 이상으로 형성될 수 있다.

[0068] 또한, 도 11 및 도 12에 도시된 바와 같이, 분사노즐(332)은 분사배관(331a)에 하향 경사지게 설치되면서 수납되어 적층되는 웨이퍼(111)들 사이마다 위치되고, 분사노즐(332)보다 낮은 위치에 적층되는 웨이퍼(111)의 상면을 향해 경사지게 제1 기체를 분사할 수 있다. 이와 같이, 분사된 제1 기체와 웨이퍼(111)의 표면으로부터 이탈된 퓸(Fume)과 이물질은 Fume 제거부(330)와 마주보는 웨이퍼 수납부(310)의 내부면 중 다면에 배치되는 Fume 배기부(350)를 통해 효율적으로 배기될 수 있다.

[0069] 이와 같이, 분사노즐(332)이 분사노즐(132)보다 낮은 위치에 적층되는 웨이퍼(111)의 상면을 향해 경사지게 제1 기체를 분사함으로써, 적층되는 웨이퍼(111)가 떨리는 현상을 미연에 방지할 수 있다. 즉, 웨이퍼 수납부(310)에 적층되는 웨이퍼(111)는 고정되어 있지 않기 때문에 분사노즐(332)이 분사될 경우 약간의 흔들림이 발생할 수 있으나 본 발명의 분사노즐(332)과 같이, 하향 경사지게 설치되어 웨이퍼(111)의 상면을 향해 경사지게 제1 기체를 분사함으로써, 분사되는 동안 적층되는 웨이퍼(111)를 위에서 아래로 소정이 압력을 가할 수 있다. 이에 따라 적층되는 웨이퍼(111)가 떨림현상이 제거되면서 패턴의 무너짐을 미연에 방지할 수 있어, 웨이퍼(111)의 표면에 형성되는 퓸(Fume)과 이물질을 균일하게 이탈시키면서 Fume 제거부(330)와 마주보며 배치되는 Fume 배기부(350)를 통해 빠르게 배기시킬 수 있다.

[0070] 또한, 분사배관(331a)은 분사노즐(332)을 통해 분사되는 제1 기체의 맥동현상을 제어하는 바이패스(미도시)를 포함할 수 있으나 이에 대한 자세한 설명은 도 7에서 자세하게 설명한 바이패스(133)의 기능과 효과가 실질적으로 동일함으로 이에 대한 자세한 설명은 생략하기로 한다.

[0071] 도 13 내지 도 15를 살펴보면, 본 발명의 또 다른 실시 예에 따른 포스트 퍼지 장치는 웨이퍼 수납부(510), Fume 제거부(530,540) 및 Fume 배기부(550)를 포함하여 구성된다.

[0072] 이러한, 본 발명의 또 다른 실시 예에 따른 포스트 퍼지 장치(500)에 해당하는 각각의 구성요소들에 대한 기능 및 그것들 간의 유기적인 관계는 일실시 또는 다른 실시 예에 따른 포스트 퍼지 장치(100, 300)에 해당하는 각각의 구성요소들에 대한 기능 및 그것들 간의 유기적인 관계와 동일하므로, 이것에 대한 각각의 부연설명들은 이하 생략하기로 한다.

[0073] 웨이퍼 수납부(510)는 적어도 하나 이상의 웨이퍼(111)를 수납하도록 소정의 내부 공간이 형성되고, 웨이퍼(111)를 수납하거나 배출하도록 일면이 개구되어 형성된다.

[0074] Fume 제거부(530,540)는 내부공간을 형성하는 웨이퍼 수납부(510)의 내부면 중 양측면에 일정한 간격으로 분사노즐이 복수 개가 배치되고, 웨이퍼 수납부(510)에 수납된 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 이탈

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되도록 분사노즐에서 제1 기체가 분사한다.

[0075] 또한, Fume 제거부(530,540)는 분사노즐이 형성되는 제1 분사배관(531a)과 분사노즐이 형성되는 제2 분사배관(541a)이 세로길이 방향으로 적어도 하나 이상이 배치된다. 이때, 제1 분사배관(531a)이 웨이퍼 수납부(510)의 양측면 중 일면에 배치되면, 제2 분사배관(541a)은 웨이퍼 수납부(310)의 양측면 중 타측면에 배치된다. 이러한 제1 분사배관(531a)과 제2 분사배관(541a)은 서로 대응되면서 형성될 수 있다.

[0076] 또한, 제1 분사배관(531a)에 형성되는 분사노즐의 위치는 제2 분사배관(541a)에 형성되는 분사노즐의 위치와 서로 대응되어 형성될 수 있다.

[0077] 또한, 제1 분사배관(531a)에 형성되는 분사노즐의 위치는 제2 분사배관(541a)에 형성되는 분사노즐의 위치와 서로 대응되어 형성될 수도 있으나 제1 분사배관(531a)에 형성되는 분사노즐의 위치와 제2 분사배관(541a)에 형성되는 분사노즐의 위치는 서로 대응되지 않도록 엇갈리면서 형성될 수 있다.

[0078] Fume 배기부(550)는 개구된 일면(533)과 마주보는 웨이퍼 수납부(510)의 내부면에 배치되어 분사된 제1 기체와 웨이퍼의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기시킨다.

[0079] 도 16 내지 도 20을 살펴보면, 본 발명의 다양한 다른 실시 예에 따른 포스트 퍼지 장치(700,800,900,1000)는 웨이퍼 수납부(710,810,910,1010), Fume 제거부(730,830,930,1030) 및 Fume 배기부(750,850,950,1050)를 포함하여 구성된다.

[0080] 이러한, 본 발명의 다양한 실시 예에 따른 포스트 퍼지 장치(700,800,900,1000)에 해당하는 각각의 구성요소들에 대한 기능 및 그것들 간의 유기적인 관계는 일실시 내지 또 다른 실시 예에 따른 포스트 퍼지 장치(100,300,500)에 해당하는 각각의 구성요소들에 대한 기능 및 그것들 간의 유기적인 관계와 동일하므로, 이것에 대한 각각의 부연설명들은 이하 생략하기로 한다.

[0081] 도 16에 도시된 바와 같이, 웨이퍼 수납부(710)의 개구된 일면(713)의 일단에는 적어도 하나 이상의 제1 에어분사노즐(771a)이 일정한 간격으로 배치되고, 웨이퍼 수납부(710)에 수납되는 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 웨이퍼 수납부(710)를 벗어나 EFEM 공간으로 이탈되는 것을 방지하도록 제1 에어분사노즐(771a)에서 제2 기체를 분사하는 에어커튼부(770a)를 포함할 수 있다. 이러한 제1 에어분사노즐(771a)은 제2 기체를 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사할 수 있다.

[0082] 즉, 에어커튼부(770a)는 웨이퍼 수납부(710)의 개구된 일면(713)의 일단에 배치되어 웨이퍼가 수납되는 방향과 교차되는 방향으로 제2 기체를 분사함으로써, 제1 기체에 의해 웨이퍼에서 이탈된 퓸(Fume)과 이물질이 웨이퍼 수납부(710)를 벗어나 EFEM 공간으로 벗어나는 것을 미연에 방지할 수 있다.

[0083] 또한, 도 17에 도시된 바와 같이, 웨이퍼 수납부(810)의 개구된 상단에는 적어도 하나 이상의 제2 에어분사노즐(891)이 일정한 간격으로 배치되고, 웨이퍼의 표면에서 이탈된 퓸(Fume)과 이물질이 웨이퍼 수납부(810)에서 벗어나지 않도록 제2 에어분사노즐(891)이 웨이퍼 수납부(810)의 상단에서 하단으로 제3 기체를 분사하는 에어샤워부(890)를 포함할 수 있다.

[0084] 이러한 제2 에어분사노즐(891)은 제3 기체를 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사하되, 웨이퍼 수납부(810)의 상단에서 하단으로 분사할 수 있다.

[0085] 즉, 에어샤워부(890)는 웨이퍼 수납부(810)의 개구된 상면에 배치되어 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사하되, 웨이퍼 수납부(810)의 상단에서 하단으로 제3 기체를 분사함으로써, 제1 기체에 의해 웨이퍼에서 이탈된 퓸(Fume)과 이물질이 웨이퍼 수납부(810)를 벗어나 EFEM 공간으로 벗어나는 것을 미연에 방지할 수 있다.

[0086] 또한, 도 18에 도시된 바와 같이, 웨이퍼 수납부(910)의 개구된 일면(913)의 양단에는 적어도 하나 이상의 제1 에어분사노즐(971a,971b)이 일정한 간격으로 배치되고, 웨이퍼 수납부(910)에 수납되는 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질이 웨이퍼 수납부(910)를 벗어나 EFEM 공간으로 이탈되는 것을 방지하도록 제1 에어분사노즐(971a,971b)에서 제2 기체를 분사하는 에어커튼부(970a,970b)를 포함할 수 있다. 이러한 제1 에어분사노즐(971a,971b)은 제2 기체를 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사할 수 있다.

[0087] 즉, 에어커튼부(970a,970b)는 웨이퍼 수납부(910)의 개구된 일면(913)의 양단에 배치되어 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사하되, 3시에서 9시 방향 또는 9시에서 3시 방향으로 제2 기체를 분사함으로써, 제1

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기체에 의해 웨이퍼에서 이탈된 퓸(Fume)과 이물질이 웨이퍼 수납부(910)를 벗어나 EFEM 공간으로 벗어나는 것을 미연에 방지할 수 있다.

[0088] 이때, 에어커튼부(970a,970b)는 도 19에 도시된 바와 같이, 일단에 배치되는 제1 에어분사노즐(971a)의 위치와 타단에 배치되는 제1 에어분사노즐(971b)의 위치가 서로 대응되지 않도록 엇갈리게 배치되면서 제2 기체를 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사할 수 있다. 이와 같이, 일단에 배치되는 제1 에어분사노즐(971a)과 타단에 배치되는 제1 에어분사노즐(971b)이 엇갈리게 배치되어 제2 기체의 와류현상이 발생되지 않기 때문에 웨이퍼에서 이탈된 퓸(Fume)과 이물질이 웨이퍼 수납부(910)에서 벗어나 EFEM 공간으로 벗어나는 것을 효율적으로 방지할 수 있다.

[0089] 또한, 도시되지 않았지만, 에어커튼부(970a,970b)는 일단에 배치되는 제1 에어분사노즐(971a)은 제2 기체를 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사하고, 타단에 배치되는 제1 에어분사노즐(971b)은 웨이퍼 수납부(910)의 내부를 향해 분사할 수 있다. 즉, 에어커튼부(970a,970b)의 일단에 배치되는 제1 에어분사노즐(971a)은 제2 기체를 웨이퍼가 수납되는 방향과 교차되는 방향으로 분사하여 제1 기체에 의해 웨이퍼에서 이탈된 퓸(Fume)과 이물질이 웨이퍼 수납부(910)를 벗어나 EFEM 공간으로 벗어나는 것을 방지하고, 에어커튼부(970b)의 타단에 배치되는 제1 에어분사노즐(971b)은 웨이퍼 수납부(110)의 내부를 향해 분사하여 웨이퍼의 표면에 형성되는 퓸(Fume)과 이물질을 이탈시키는 동시에 웨이퍼의 표면으로부터 이탈된 퓸(Fume)과 이물질을 배기구(151)로 유도할 수도 있다.

[0090] 또한, 도 20을 살펴보면, 웨이퍼 수납부(1010)의 개구된 일면(1013)의 양단에는 적어도 하나 이상의 제1 에어분사노즐(1071a)이 일정한 간격으로 배치되면서, 제2 기체를 분사하는 에어커튼부(1070a)와 웨이퍼 수납부(1010)의 개구된 상면에는 적어도 하나 이상의 제2 에어분사노즐(1091)이 일정한 간격으로 배치되면서, 제3 기체를 분사하는 에어샤워부(1090)를 포함할 수 있다.

[0091] 또한, 도시되지 않았지만, 웨이퍼 수납부(1010)의 개구된 일면(1013)의 일단에는 적어도 하나 이상의 제1 에어분사노즐(1071a)이 일정한 간격으로 배치되면서 제2 기체를 분사하는 에어커튼부(1070a)와 웨이퍼 수납부(1010)의 개구된 상면에는 적어도 하나 이상의 제2 에어분사노즐(1091)이 일정한 간격으로 배치되면서 제3 기체를 분사하는 에어샤워부(1090)를 포함할 수 있다. 이에 대한 자세한 설명은 도 16 내지 도 19에서 이미 설명한 에어커튼부(770a,870a,970a)와 에어샤워부(790,890,990)의 기능과 효과가 실질적으로 동일함으로 이에 대한 자세한 설명은 생략하기로 한다.

[0092] 한편 본 발명의 상세한 설명에서는 구체적인 실시 예에 관해 설명하였으나, 본 발명의 범위에서 벗어나지 않는 한도 내에서 여러 가지 변형이 가능함은 물론이다. 그러므로 본 발명의 범위는 설명된 실시 예에 국한되어 정해져서는 안되며 후술하는 특허청구의 범위뿐만 아니라 이 특허청구의 범위와 균등한 것들에 의해 정해져야 한다.

부호의 설명

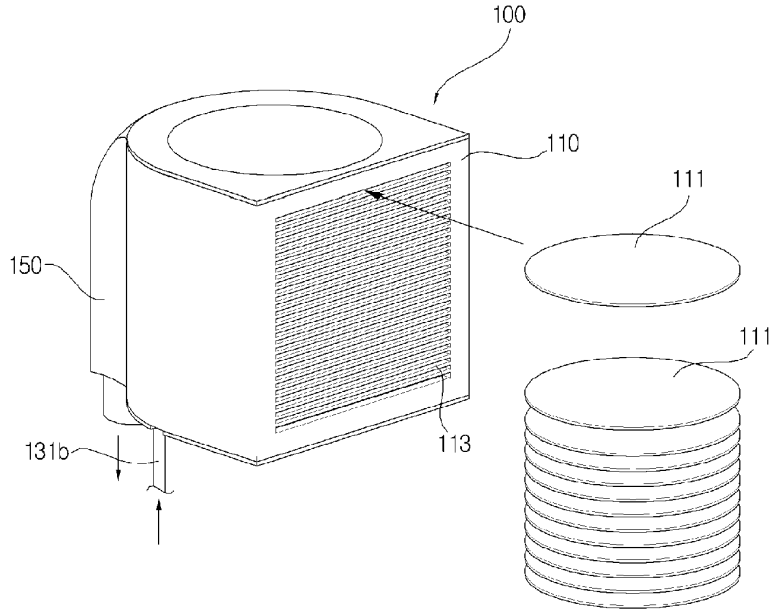
[0093] 110: 웨이퍼 수납부 111: 웨이퍼

130: Fume 제거부 150: Fume 배기부

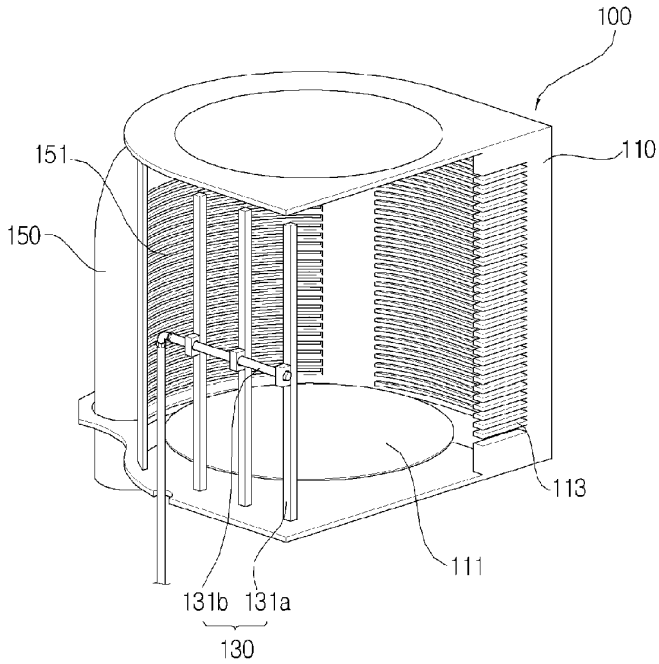
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도면

도면1

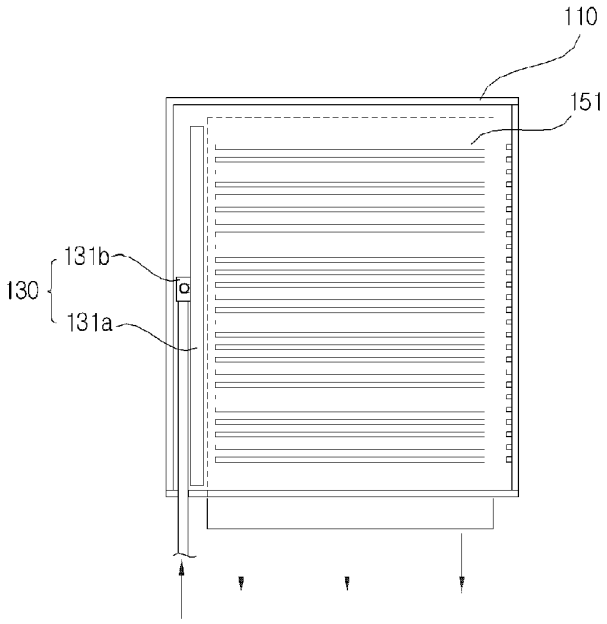


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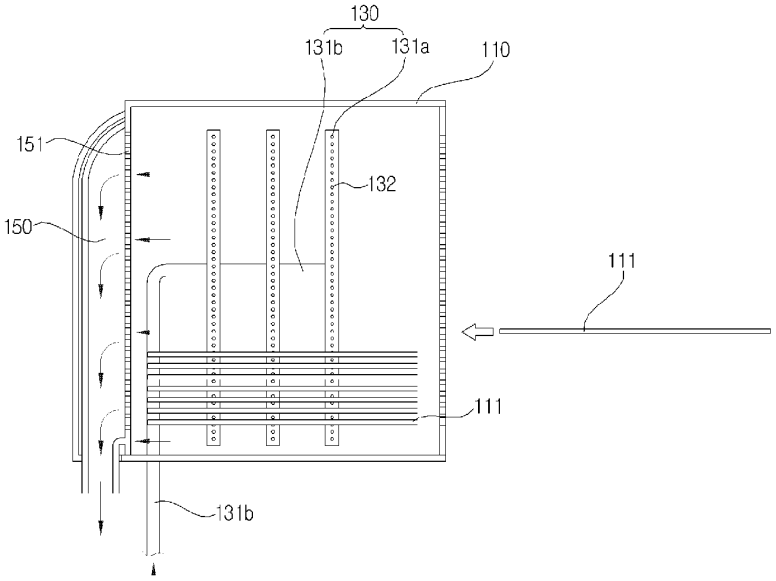


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도면3

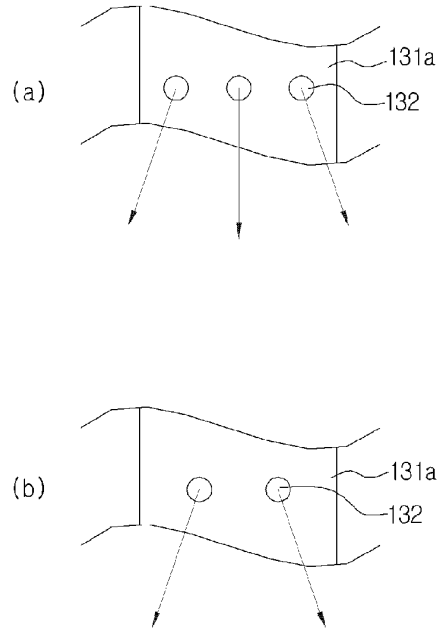


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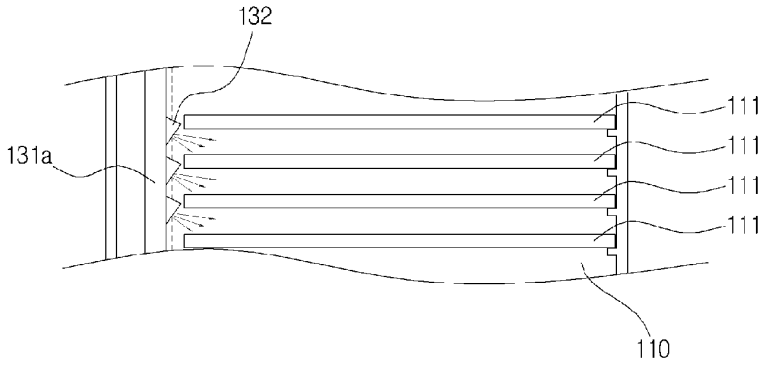


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도면5

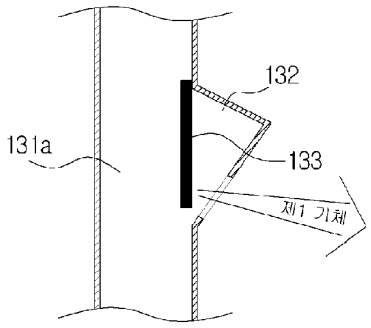


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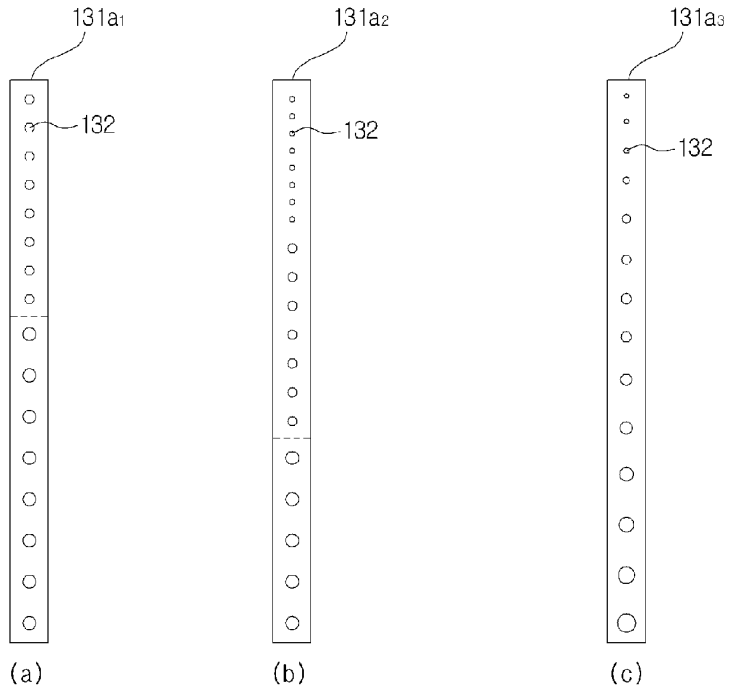


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도면7

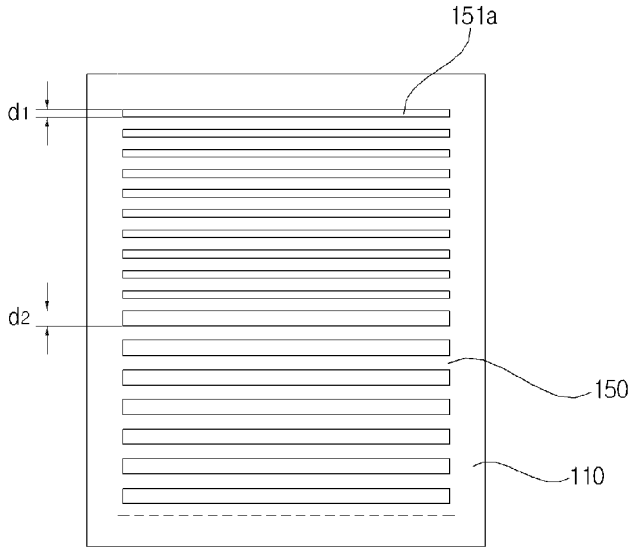


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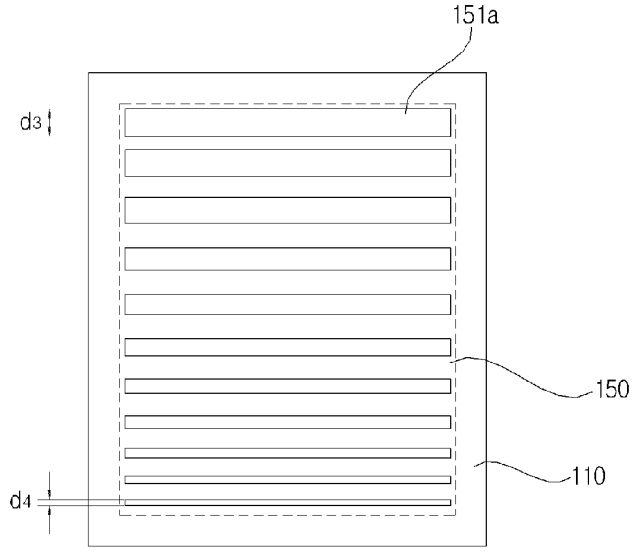


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도면9a

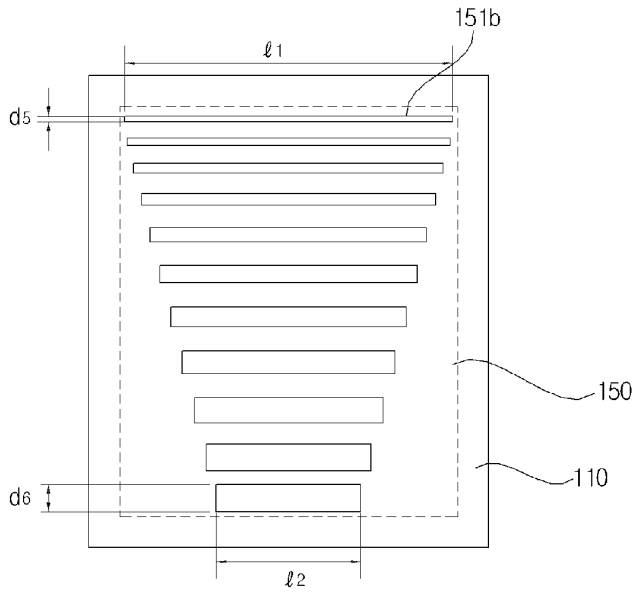


도면9b

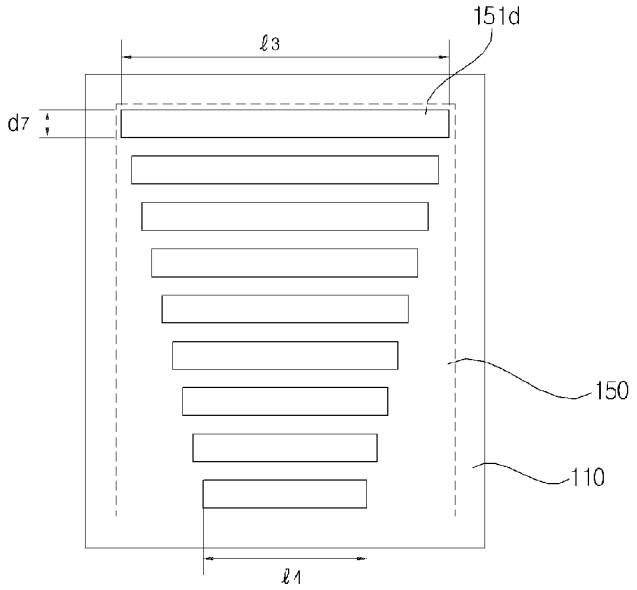


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도면9c

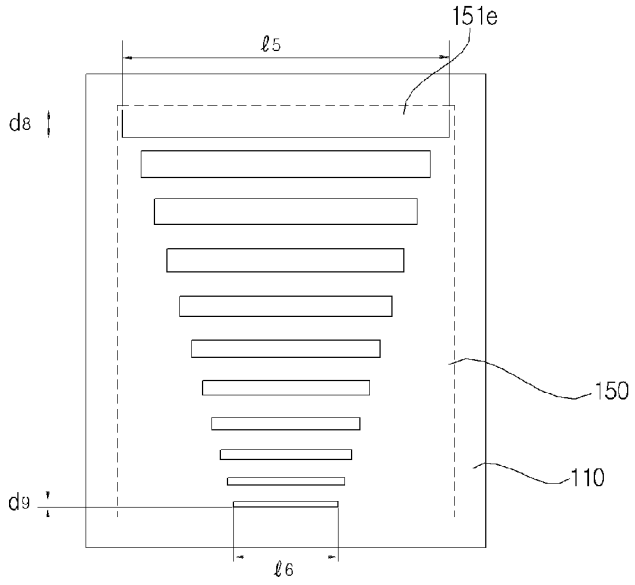


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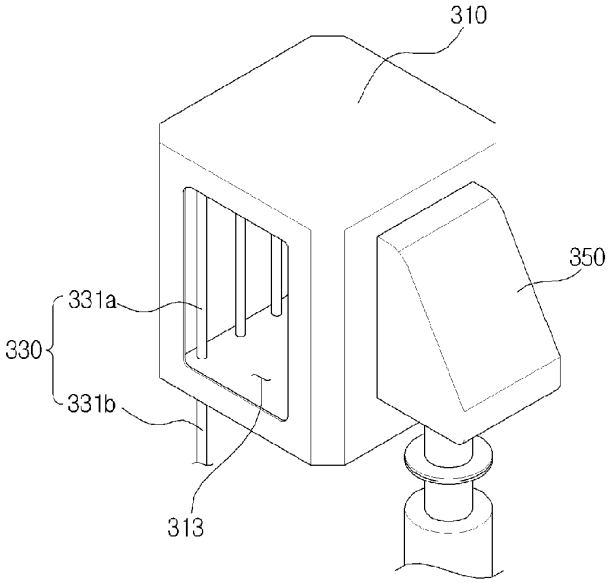


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도면9

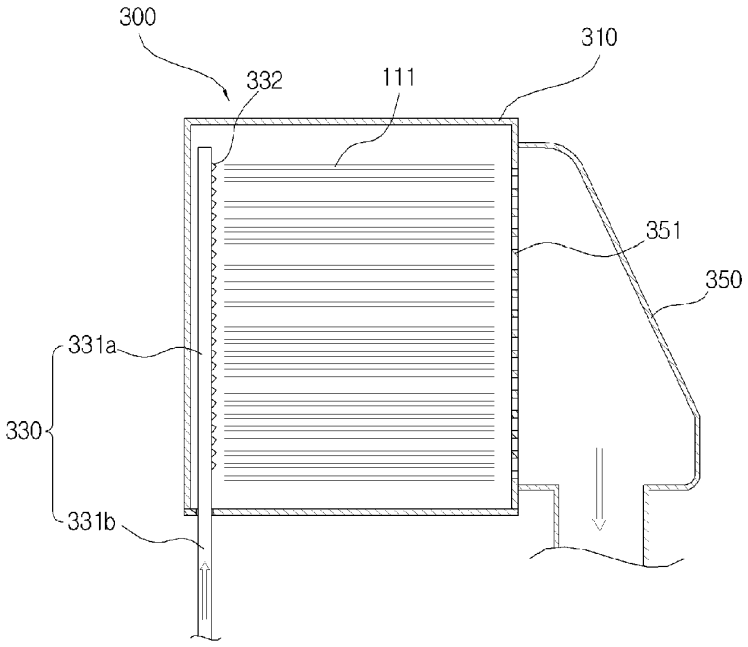


도면10

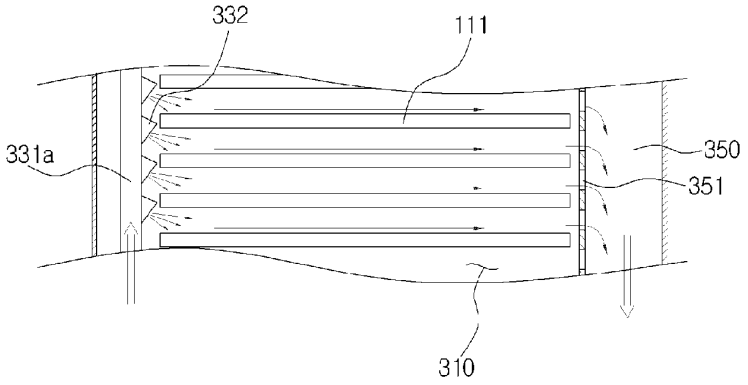


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도면11

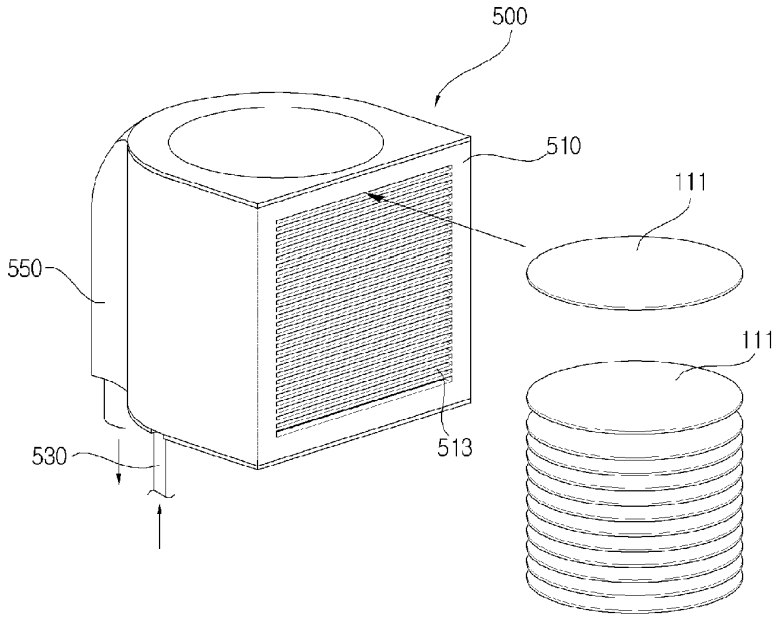


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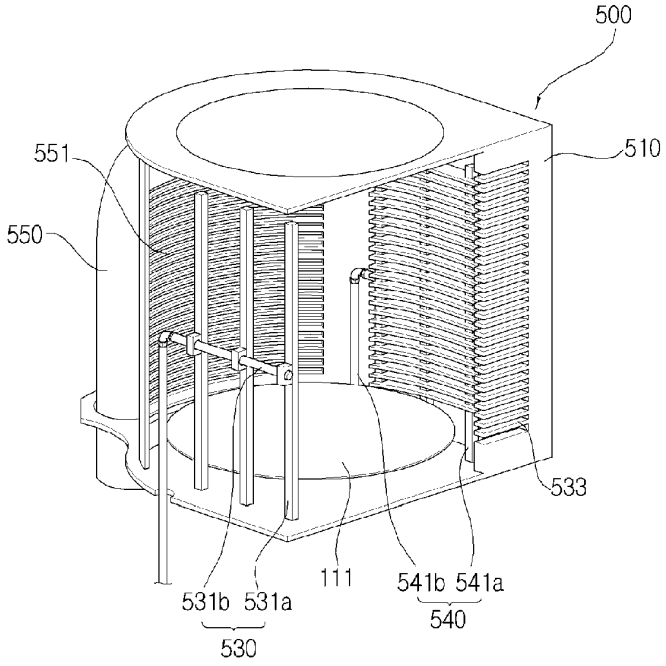


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도면13

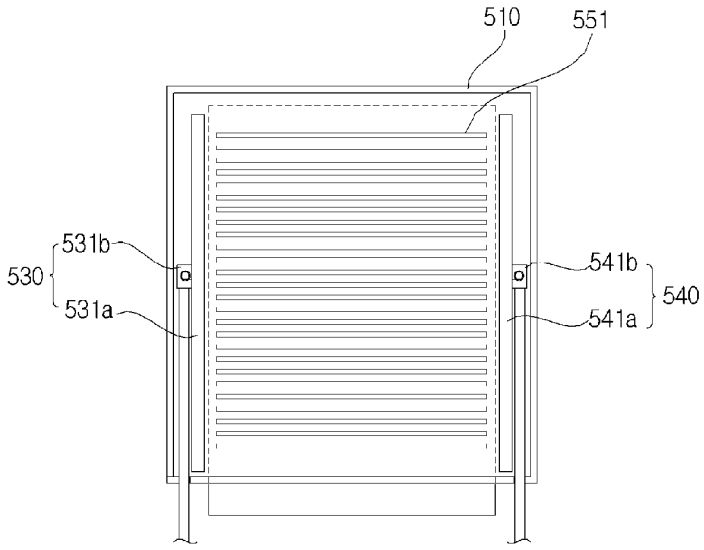


도면14

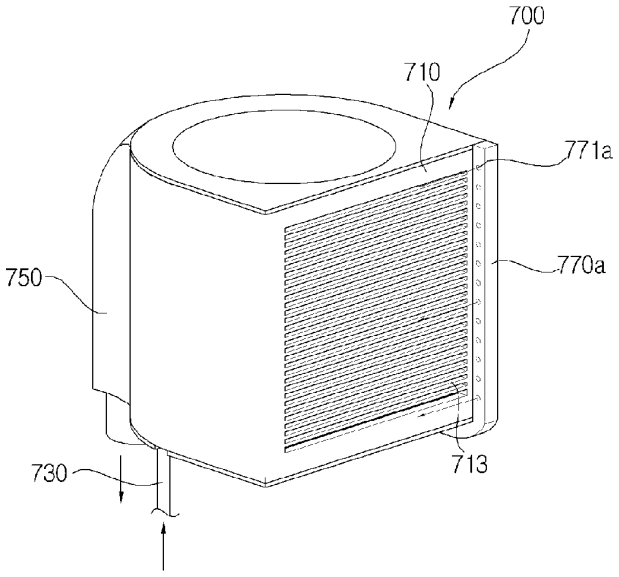


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도면15

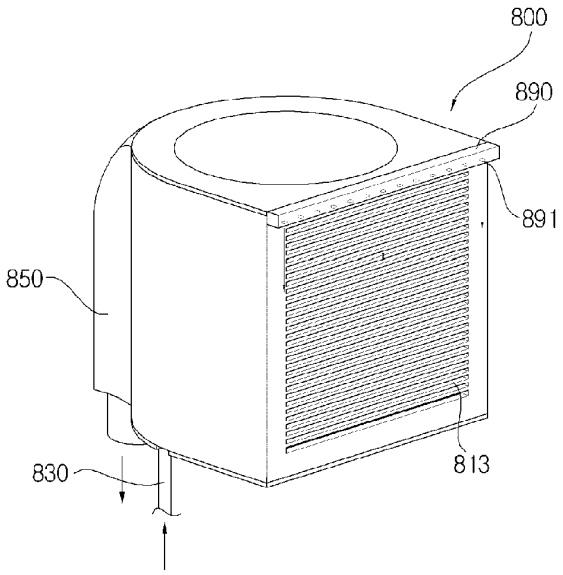


도면16

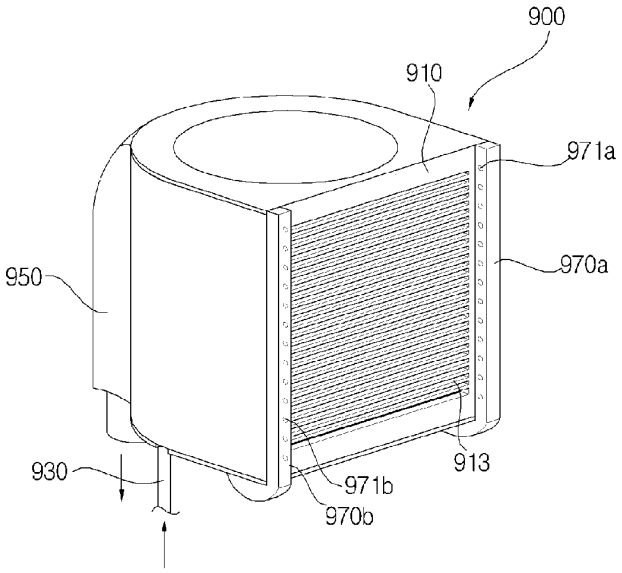


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도면17

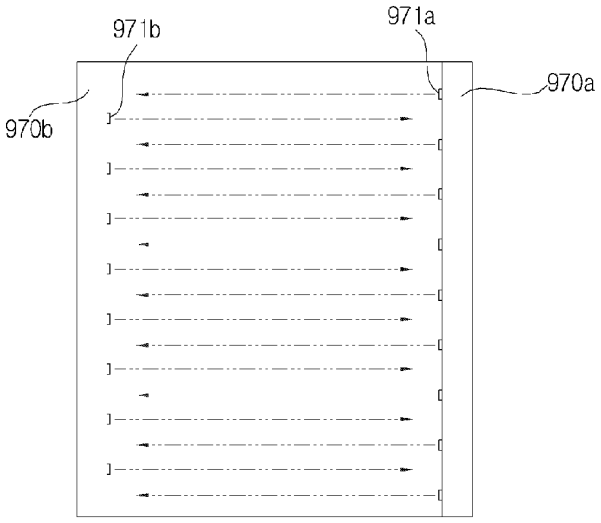


도면18

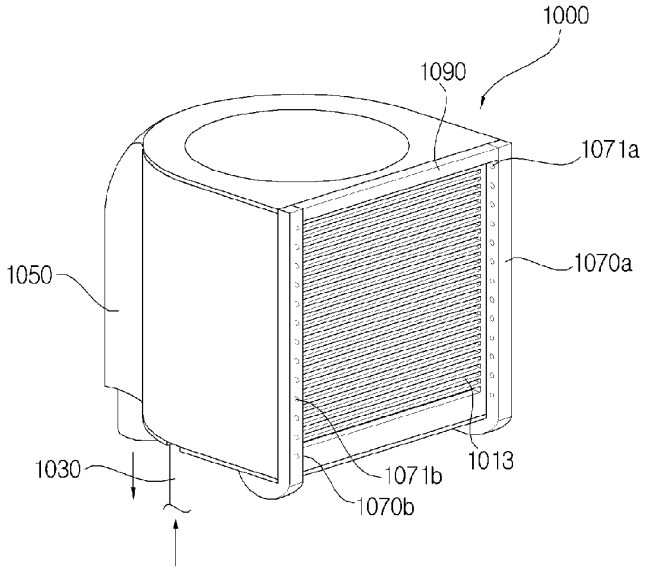


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도면19



도면20



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Espacenet

Bibliographic data: KR20140055699 (A) — 2014-05-09

A PURGE GAS PIPE OF THE WAFER PURGING CASSETTE

Inventor(s): WOO BUM JE [KR] ± (WOO, BUM JE)

Applicant(s): WOO BUM JE [KR] ± (WOO, BUM JE)

Classification: **- international:** ***B65D85/38; B65D85/86; H01L21/673***
- cooperative: H01L21/67017 (KR); H01L21/6732 (KR); B65D85/30 (KR)

Application number: KR20120122908 20121101 Global Dossier

Priority number(s): KR20120122908 20121101

Also published as: KR101458626 (B1)

Abstract of KR20140055699 (A)

The present invention relates to a purge gas pipe for a wafer purging cassette. The purpose of the present invention is to maximize the efficiency in processing process gas on a wafer and remaining harmful gas such as fume which is a by-product of the process. In the purge gas pipe for a wafer purging cassette, a gas blowing hole adjacent to a piping line has a large caliber while gas blowing holes at a distance from the piping line have a small caliber gradually depending on the distance, in order to make the flow rate of purge gas supplied from the piping line consistent. Therefore, the purge gas pipe for a wafer purging cassette can maximize the efficiency in removing process gas and contaminants such as fume by injecting the purge gas supplied from the piping line to the surface of the wafer at a consistent flow rate.

(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(11) 공개번호 10-2014-0055699
(43) 공개일자 2014년05월09일

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B65D 85/86 (2006.01)
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(22) 출원일자 2012년11월01일
심사청구일자 2012년11월01일

(71) 출원인
우범제
경기도 용인시 수지구 성복1로 91, 109동 1901호 (성복동, 버들치마을 성복힐스테이트1차)
(72) 발명자
우범제
경기도 용인시 수지구 성복1로 91, 109동 1901호 (성복동, 버들치마을 성복힐스테이트1차)
(74) 대리인
김희곤, 김인한

전체 청구항 수 : 총 4 항

(54) 발명의 명칭 **웨이퍼 퍼징 카세트**

(57) 요 약

본 발명은 웨이퍼 퍼징 카세트의 퍼지가스관에 관한 것으로, 그 목적은 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 유해가스 잔존물의 처리효율을 극대화하는 것이다.

이러한 목적으로 이루어진 본 발명은;

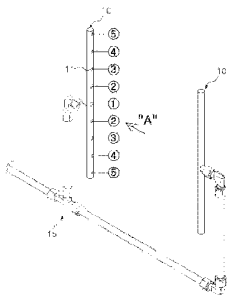
웨이퍼 퍼징 카세트에 관한 것으로,

상기 웨이퍼 퍼징 카세트의 퍼지가스관은;

배관라인으로 부터 공급되는 퍼지가스의 유량이 균일해지도록 상기 배관라인과 인접한 위치에 구비된 가스분출공은 큰 구경으로 형성하고, 상기 배관라인과 멀어지는 가스분출공은 점진적으로 작은 구경으로 형성한다.

이에 따라, 배관라인으로 부터 공급되는 퍼지가스를 균일한 유량으로 웨이퍼 표면에 분사하여 공정 가스 및 퓸 등의 오염 물질의 제거효율을 극대화하는 이점이 있다.

대 표 도 - 도2



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특허청구의 범위

청구항 1

웨이퍼 처리장치의 이송용기에 구비된 웨이퍼를 이송로봇에 의해 각 공정별로 이송하는 이송장치와, 상기 이송장치 일측에 구비되어 다수의 웨이퍼를 격납한 후 이동하여, 웨이퍼 상부표면에 여러가지 기능을 갖출 수 있도록 박막 증착공정, 식각공정 및 웨이퍼 상부에 층간 절연막등을 증착한 후에 일괄적으로 웨이퍼 표면을 연마하여 단차를 제거하는 평탄화공정등을 순차적으로 수행하고 난 뒤 잔존하는 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 잔존물을 제거하도록 배관라인으로 공급된 퍼지가스를 길이방향 등간격으로 다수 구비된 가스분출공을 통해 분사하는 퍼지가스관을 갖춘 웨이퍼 퍼징 카세트에 있어서,

상기 웨이퍼 퍼징 카세트의 퍼지가스관은;

상기 배관라인으로 부터 공급되는 퍼지가스의 유량이 균일해지도록 상기 배관라인과 인접한 위치에 구비된 가스분출공은 큰 구경으로 형성하고, 상기 배관라인과 멀어지는 가스분출공은 점진적으로 작은 구경으로 형성하는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

청구항 2

제 1항에 있어서,

상기 가스분출공은, 균일한 유량으로 분사되는 퍼지가스가 웨이퍼 표면에 확산되도록 단면상 내측에서 외측으로 갈 수록 확경되도록 테이퍼가 형성되는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

청구항 3

제 1항에 있어서,

상기 가스분출공은, 상기 퍼지가스관의 너비방향 직사각형 또는 장공중 어느 하나로 형성되며, 길이방향 등간격으로 다수 형성되는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

청구항 4

제 3항에 있어서,

상기 장공 또는 직사각형중 어느 하나로 형성된 가스분출공은, 배관라인과 인접한 위치에서 상기 배관라인과 멀어지는 위치로 갈 수록 점진적으로 짧은 길이로 형성하는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

명 세 서

기 술 분 야

[0001] 본 발명은 웨이퍼 처리장치에 관한 것으로서, 더욱 상세하게는 웨이퍼 처리장치상에서 웨이퍼에 대한 각종 공정 수행 후, 수직방향으로 적층된 각각의 웨이퍼 상에 잔존하는 공정 가스를 균일한 유량으로 분사하는 웨이퍼 퍼징 카세트의 퍼지가스관에 관한 것이다.

배 경 기 술

[0002] 일반적으로, 반도체의 핵심 소재인 웨이퍼 상부 표면에 여러 가지 기능을 수행할 수 있도록 박막을 증착하고, 이를 패터닝하여 다양한 회로구조를 형성하는 웨이퍼 처리장치에 대해서는 여러가지가 알려져 오고 있다.

[0003] 예를 들면, 도 1a에 도시한 웨이퍼 처리장치(TE)(이하, "처리장치"라 칭한다)가 그 대표적인 것으로 그 내용은 다음과 같다.

[0004] 도시한 바와 같이, 종래 처리장치(TE)는 이송장치(CE)와 카세트(CA)와 반도체 제조공정모듈(SM)(이하, "공정모듈" 이라 칭한다)로 대별된다.

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[0005] 이송장치(CE)는 내부에 이송로봇(MR)이 적어도 하나 이상 구비되며, 도시한 방향 기준하여 하측에 적어도 하나 이상의 이송용기(MB)를 갖추고 있다.

[0006] 다시 말해서, 이송장치(CE)는 내부에 구비된 이송로봇(MR)을 이용하여 이송용기(MB)에 구비된 웨이퍼(WF)를 각 공정에 공급한다.

[0007] 카세트(CA)는 도 1b에 도시한 바와 같이, 다수의 웨이퍼(WF)를 적층할 수 있도록 상, 하 방향으로 다수의 리브(LV)가 구비된다.

[0008] 이 카세트(CA)에 공급된 웨이퍼(WF)는 후술하는 공정모듈(SM)에서 다수의 공정들을 수행하기 전에 보관된다.

[0009] 이와 같이, 카세트(CA)에 구비된 웨이퍼(WF)는 공정모듈(SM)에서 웨이퍼(WF) 상부표면에 여러가지 기능을 갖출 수 있도록 3B족 또는 5B족의 불순물 이온을 주입하는 불순물 이온 주입공정과 반도체 기판상에 물질막을 형성하는 박막 증착공정, 상기 물질막을 소정의 패턴으로 형성하는 식각공정 및 웨이퍼 상부에 층간 절연막등을 증착한 후에 일괄적으로 웨이퍼 표면을 연마하여 단차를 제거하는 평탄화 공정(Chemical Mechanical Polishing : CMP)등을 순차적으로 수행한다.

[0010] 한편, 상술한 소정의 공정이 완료된 웨이퍼(WF)는 개별 단위로 이동하지 않고, 상기한 카세트(CA)에 20개 ~ 25개 단위 묶음으로 격납되어 이동하는데, 이 이동하는 웨이퍼(WF)는 상술한 각 공정상에서 사용되는 공정 가스 및 공정상의 부산물인 퓸(Fume) 등(이하, "잔존물"이라 칭한다)이 제거되지 않고 웨이퍼의 표면에 잔존한 상태로 구비된다.

[0011] 이러한 잔존물은 도시한 방향기준하여 길이방향 등간격으로 다수 구비된 퍼지가스 분사관(PB)의 수직방향 등간격으로 다수형성된 가스분출공(GH)을 통해 분출되는 퍼지가스에 의해 제거된다.

[0012] 그러나, 상기한 퍼지가스 분사관(PB)에 다수 형성된 가스분출공(GH)은 배관라인(PS)으로 부터 공급되는 퍼지가스를 상, 하 방향으로 균일하게 분사하지 못하므로 잔존물의 처리효율이 떨어지는 문제가 있었다.

발명의 내용

해결하려는 과제

[0013] 본 발명은 상술한 바와 같은 종래의 문제점을 해결하기 위해 안출된 것으로서, 본 발명의 목적은, 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 잔존물의 처리효율을 높이는데 있다.

과제의 해결 수단

[0014] 이러한 목적으로 이루어진 본 발명은;

[0015] 웨이퍼 처리장치의 이송용기에 구비된 웨이퍼를 이송로봇에 의해 각 공정별로 이송하는 이송장치와, 상기 이송장치 일측에 구비되어 다수의 웨이퍼를 격납한 후 이동하여, 웨이퍼 상부표면에 여러가지 기능을 갖출 수 있도록 박막 증착공정, 식각공정 및 웨이퍼 상부에 층간 절연막등을 증착한 후에, 일괄적으로 웨이퍼 표면을 연마하여 단차를 제거하는 평탄화공정등을 순차적으로 수행하고 난 뒤, 잔존하는 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 잔존물을 제거하도록 배관라인으로 공급된 퍼지가스를 길이방향 등간격으로 다수 구비된 가스분출공을 통해 분사하는 퍼지가스관을 갖춘 웨이퍼 퍼징 카세트에 관한 것으로,

[0016] 상기 웨이퍼 퍼징 카세트의 퍼지가스관은;

[0017] 배관라인으로 부터 공급되는 퍼지가스의 압력이 균일해지도록, 상기 배관라인과 인접한 위치에 구비된 가스분출공은 큰 구경으로 형성하고, 상기 배관라인과 멀어지는 가스분출공은 점진적으로 작은 구경으로 형성한다.

[0018] 또한, 상기 가스분출공은;

[0019] 균일한 유량으로 분사되는 퍼지가스가 웨이퍼 표면에 확산되도록 단면상 내측에서 외측으로 갈 수록 확경되는 테이퍼가 형성된 것을 특징으로 한다.

[0020] 또한, 상기 가스분출공은;

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[0021] 상기 퍼지가스관의 너비방향으로 직사각형 또는 장공으로 형성된 것을 특징으로 한다.

[0022] 또한, 상기 장공 또는 직사각형중 어느 하나로 형성된 가스분출공은, 배관라인과 인접한 위치에서 상기 배관라인과 멀어지는 위치로 갈 수록 점진적으로 짧은 길이로 형성한다.

발명의 효과

[0023] 상술한 바와 같이, 본 발명에 의하며, 배관라인으로 부터 공급되는 퍼지가스를 균일한 유량으로 웨이퍼 표면에 분사하여 공정 가스 및 퓸 등의 오염 물질의 제거효율을 극대화한 효과가 있다.

도면의 간단한 설명

[0024] 도 1a는 종래 카세트가 구비된 웨이퍼 처리장치를 평면에서 바라본 도면이고,

도 1b는 종래 카세트에 구비된 퍼지가스관을 보인 사시도이고,

도 2는 본 발명의 퍼지가스관과 배관라인만 발췌하여 보인사시도이고,

도 3은 도 2 "A"방향에서 바라본 퍼지가스관의 일측년도이고,

도 4는 본 발명의 퍼지가스관이 구비된 카세트를 보인 사시도이고,

도 5는 본 발명에 따른 퍼지가스관에 마련된 가스분출공의 다른 실시예를 보인 사시도이고,

도 6의 가)와 나)는 본 발명에 따른 퍼지가스관에 마련된 가스분출공의 또 다른 실시예를 보인 도면이다.

발명을 실시하기 위한 구체적인 내용

[0025] 도 2 내지 도 4를 참조하면, 본 발명에 따른 웨이퍼 퍼징 카세트(1)의 퍼지가스관(10)(이하, "가스관"라 칭한다)은 길이방향 등간격으로 다수 형성된 가스분출공(11)을 포함한다.

[0026] 도시한 바와 같이, 가스분출공(11)은 배관라인(15)으로 부터 공급되는 퍼지가스의 유량이 균일해지도록, 상기 배관라인(15)과 인접한 위치에 구비된 가스분출공(11)은 큰 구경으로 형성하고, 상기 배관라인과 멀어질 수록 점진적으로 작은 구경으로 형성한다.(이하, 설명 편의상 가스분출공(11)에 번호를 붙여 설명한다)

[0027] 예를 들면, 배관라인(15)이 구비된 위치에 구비된 가장 큰 구경의 1번 가스분출공(11)이 φ10의 크기로 형성된 경우, 일측에 인접한 가스분출공(11)과 점점 멀어지는 위치에 구비된 가스분출공(11)의 구경은 점진적으로 작아진다. 예를 들면, "입력은 면적에 반비례"한다는 이론에 근거하여 2, 3, 4, 5,번 가스분출공(11)의 구경은φ9, φ8, φ7, φ6로 작아지지만, 상대적으로 압력은 높게 형성되어 웨이퍼상에 분출되는 퍼지가스의 압력은 균일하다.

[0028] 따라서, 도 4에 도시한 바와 같은 카세트(1)에 각기 다른 구경으로 가스분출공(11)이 형성된 가스관(10)을 구비하여 중간부분에 퍼지가스를 공급하는 배관라인(15)의 상, 하 방향으로는 점진적으로 작은 구경으로 가스분출공(11)을 형성하여 전체적으로 분출되는 퍼지가스의 압력과 유량은 균일함으로서, 웨이퍼(5)의 잔존물 처리효율이 극대화되었다.

[0029] 도시한 것은 중간부분에 연결된 배관라인(15)에 의해 중간부분의 가스분출공(11)이 큰 구경으로 형성된 것을 설명하였으나, 그것은 일실시예일 뿐, 배관라인(15)을 가스관(10)의 끝단에 배치하고, 그 배관라인(15)이 연결된 끝단에 구비된 가스분출공(11)을 큰 구경으로 형성한 후, 점진적으로 작은 구경으로 가스분출공(11)을 형성하여도 본 발명 소기의 목적을 달성할 수 있음은 물론이다.

[0030] 도 5에 도시한 것은, 본 발명에 따른 가스관(10)에 형성된 가스분출공(11)의 다른 실시예를 보인 것으로, 상술한 바와 같이, 각기 다른 구경에 의해 균일한 유량으로 분사되는 퍼지가스가 웨이퍼 표년에 확산되도록 단면상 내측에서 외측으로 갈 수록 확경되는 테이퍼(11a)가 형성된다.

[0031] 이 테이퍼(11a)를 형성하는 방법은 해당 가스분출공(11) 보다 큰 규격의 드릴을 이용해서 형성할수 있다.

[0032] 예를 들면, 가스분출공(11)의 구경이 φ10이라면, 그 가스분출공(11)에 φ20정도 규격의 드릴을 관통시키지 않고, 도시한 바와 같이, 해당 드릴의 끝부분을 이용해서 홈파기를 하면 도시한 바와 같은 테이퍼가 형성된다.

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[0033] 도 6의 가)와 나)는 본 발명의 또 다른 실시예를 보인 것으로, 가스관(10)의 가스분출공(11)을 도시하지 않은 웨이퍼의 평면에 대해 수평방향이 되도록 직사각형(11b) 또는 장공(11c)으로 형성한다.

[0034] 이 가스분출공(11)도 상술한 일실시예와 마찬가지로 수평방향으로의 길이를 조절함으로서, 균일한 압력의 퍼지가스를 분출할 수 있다.

[0035] 다시 말해서, 배관라인(15)이 배치된 부분의 가스분출공(11)의 길이가 20㎜라면, 점진적으로 2~3㎜씩 짧게 형성하면 상술한 일실시예의 동일한 효과를 얻을 수 있다.

[0036] 이와 같이, 가스분출공(11)을 직사각형 또는 장공으로 형성하면, 도시하지 않은 웨이퍼의 수평상으로 분출되는 퍼지가스를 균일한 압력으로 확산시킬 수 있으므로, 공정가스 및 퓸(Fuem)등의 오염물질 제거 효율을 높일 수 있다.

[0037] 본 발명은 상술한 특정 바람직한 실시 예에 한정되지 아니하고, 청구범위에서 청구하는 본 발명의 요지를 벗어남이 없이 당해 발명이 속하는 기술분야에서 통상의 지식을 가진자 라면 누구든지 다양한 변형실시가 가능한 것은 물론이고, 그와 같은 변형실시는 본 발명의 청구범위 기재 범위 내에 있게 된다.

부호의 설명

[0038]

1 : 웨이퍼 퍼징 카세트

10 : 퍼지가스관

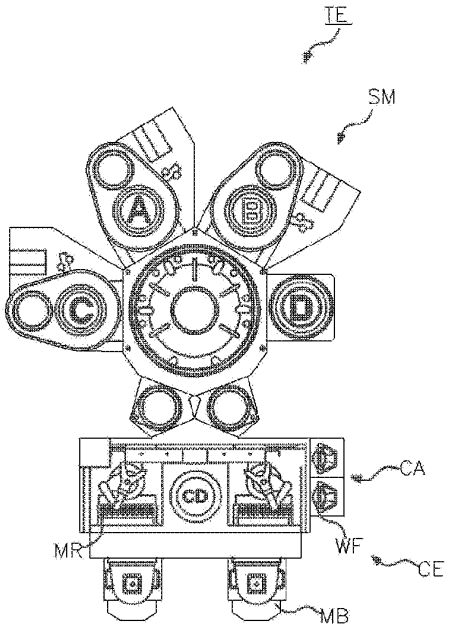
11 : 가스분출공

15 : 배관라인

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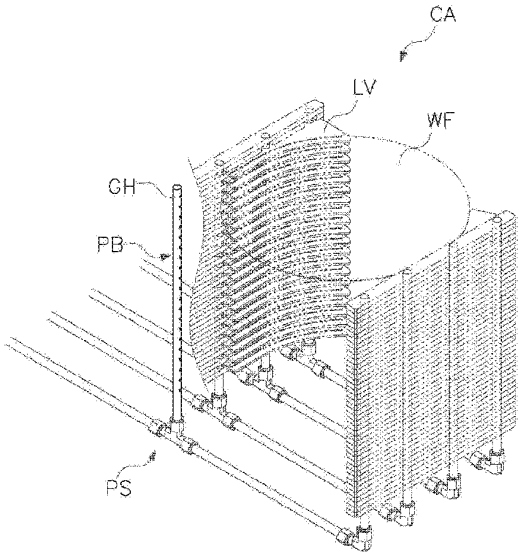
도면

도면1a



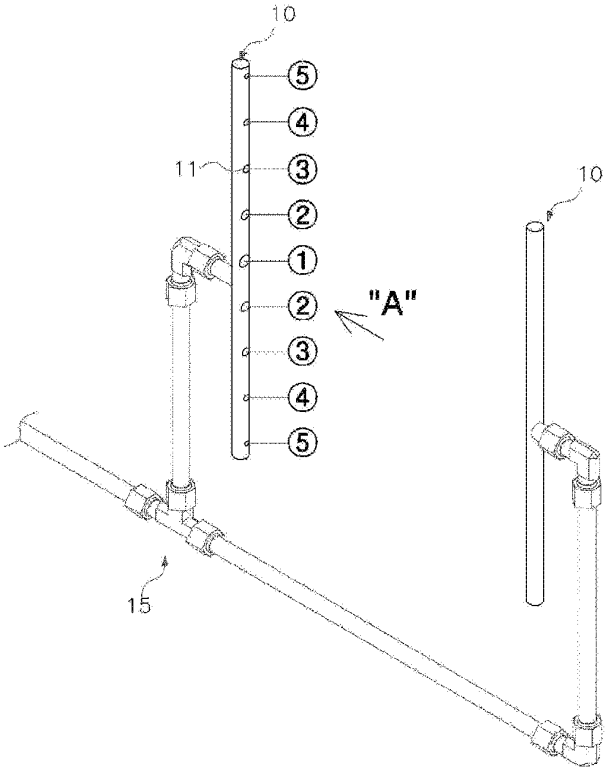
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도면1b

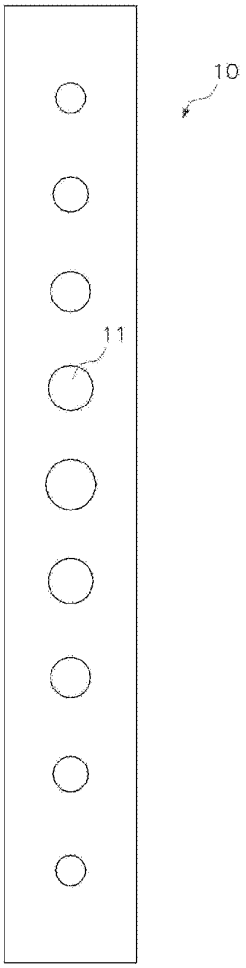


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도면2

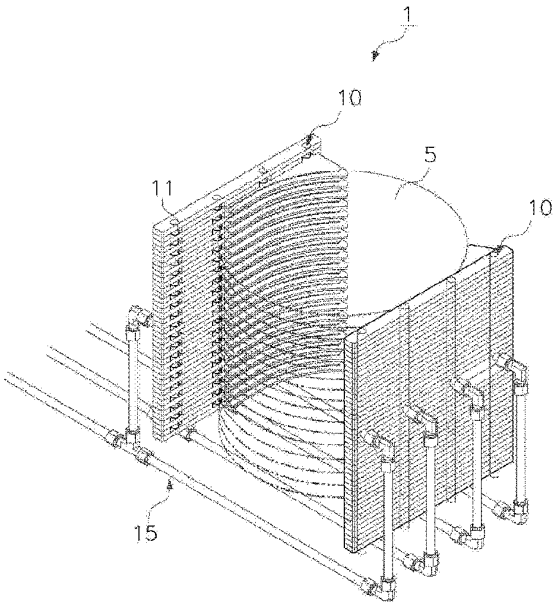


도면3



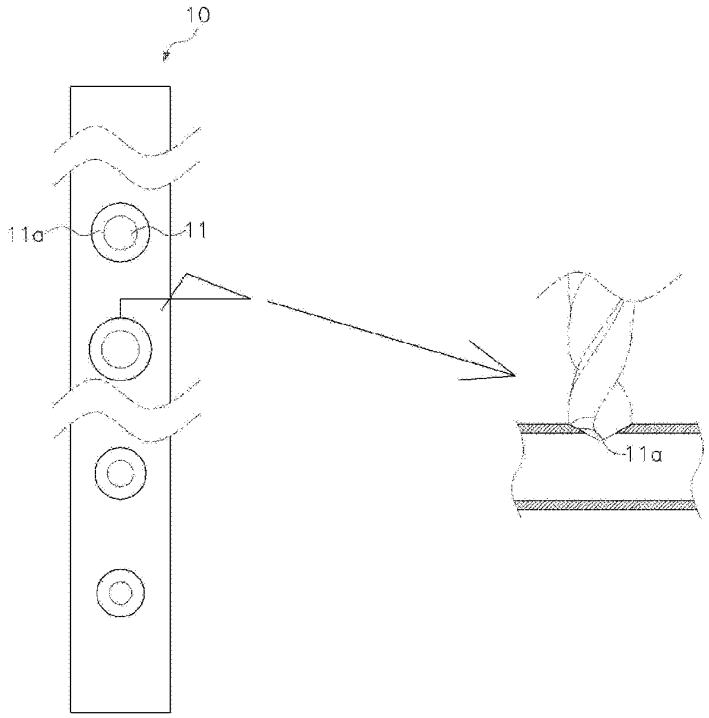
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도면4



Entegris, EX1002, p. 92

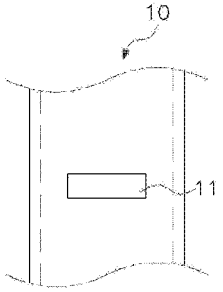
도면5



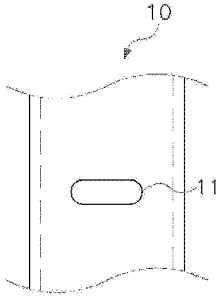
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도면6

가)



나)



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APPARATUS FOR PROCESSING WAFER

Inventor(s): CHOI WOO YONG; KIM GUN HO; PARK DAE SEON; PARK KYOUNG WAN; LEE HAK MUN ± (최우용, ; 김건호, ; 박대선, ; 박경완, ; 이학문)

Applicant(s): WONIK IPS CO LTD [KR] ± (주식회사 원익아이피에스)

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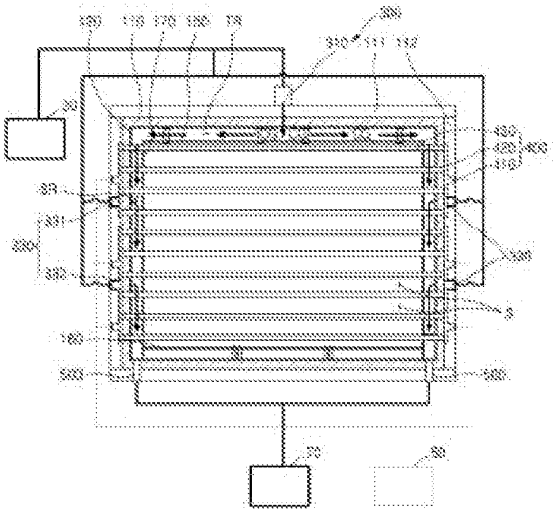
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Abstract of KR20210055483 (A)

Disclosed is a substrate processing device. The substrate processing device according to the present invention can improve a temperature uniformity between upper and lower slots by controlling a gas flow from an upper to a lower direction during a substrate processing process. The substrate processing device includes: a main body; a septum; a substrate support unit; a heater unit; an airflow gas supply unit; and a gas outlet unit.



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심사청구일자 없음

(71) 출원인
주식회사 원익아이피에스
경기도 평택시 진위면 진위산단로 75 ()
(72) 발명자
최우용
경기도 평택시 평택5로 271, 102동 1203호
김건호
경기도 오산시 가수행복로 55-5, 1202동 605호
(뒷면에 계속)
(74) 대리인
김한

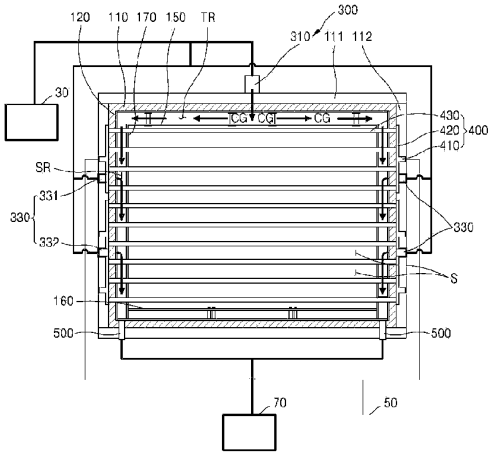
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(54) 발명의 명칭 **기판 처리 장치**

(57) 요 약

기판 처리 장치가 개시된다. 본 발명에 따른 기판 처리 장치는, 기판 처리 공정시 상부에서 하부 방향으로 가스 흐름을 제어하여 상하부 슬롯 간의 온도 균일도를 향상시킬 수 있다.

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(72) 발명자
박대선
경기도 안산시 상록구 각골동로 54, 201호
박경완
경기도 화성시 동탄문화센터로 38, 418동 801호

이학문
충청북도 음성군 맹동면 이수로 31, 106동 306호

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청 구 범 위

청구범위

청구항 1

내부 공간을 제공하는 본체;

상기 내부 공간에 본체의 상부벽과 측벽으로부터 소정 거리 이격되게 배치되어 복수의 기판이 처리되는 처리 공간을 형성하는 격벽;

상기 처리 공간에 상기 기판이 수직방향을 따라 상호 이격되이 배치되도록 지지하는 기판 지지부;

수직 방향을 따라 이격되이 배치되는 복수의 히터 유닛을 포함하고, 상기 기판 지지부에 지지된 상기 기판을 가열하기 위한 히터부;

상기 본체의 상부에 연결되고, 상기 본체의 상부벽과 상기 격벽 사이의 제1 기류 공간에 기류 가스를 분사하는 기류 가스 공급부; 및

상기 본체의 측벽과 상기 격벽 사이의 제2 기류 공간에 연결되고, 상기 본체 내의 가스를 배출하는 가스 배출부

를 포함하는, 기판 처리 장치.

청구항 2

제1항에 있어서,

상기 격벽은,

상기 본체의 상부벽에 소정 거리 이격되어 배치되는 상부 격벽;

상기 본체의 좌측벽, 우측벽, 후측벽에 소정 거리 이격되어 배치되는 측부 격벽

을 포함하고,

상기 제1 기류 공간과 상기 제2 기류 공간이 연결된, 기판 처리 장치.

청구항 3

제1항에 있어서,

상기 기류 가스 공급부에 대응되는 상기 본체의 상부벽 내측면에는 복수의 분산홀이 형성된 기류 확산판이 배치되는, 기판 처리 장치.

청구항 4

제1항에 있어서,

상기 본체의 측부에 연결되고, 상기 본체의 측벽과 상기 격벽 사이의 제2 기류 공간에 기류 가스를 분사하는 측부 기류 가스 공급부를 더 포함하는, 기판 처리 장치.

청구항 5

제1항에 있어서,

상기 측부 기류 가스 공급부에 대응되는 상기 본체의 측벽 내측면에는 복수의 분산홀이 형성된 측부 기류 확산판이 배치되는, 기판 처리 장치.

청구항 6

제4항에 있어서,

상기 측부 기류 가스 공급부는,

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외부의 기류 가스 공급 수단으로부터 기류 가스를 공급받고 수직 방향으로 연장 형성되는 기류 가스 유입관;

상기 기류 가스 유입관에 연통되어 기류 가스를 전달 받고 수평 방향으로 연장 형성되는 적어도 하나의 기류 가스 측부 분배관; 및

각각의 상기 기류 가스 측부 분배관에서 상기 본체의 측부에 연결되는 적어도 하나의 기류 가스 측부 공급관;

을 포함하는, 기판 처리 장치.

청구항 7

제6항에 있어서,

각각의 기류 가스 측부 분배관에 밸브가 설치되고, 각 밸브의 제어에 따라 제2 기류 공간의 높이 방향에 따라 기류 가스의 공급양을 제어할 수 있는, 기판 처리 장치.

청구항 8

제6항에 있어서,

각각의 기류 가스 측부 공급관에 밸브가 설치되고, 각 밸브의 제어에 따라 제2 기류 공간의 수평 방향에 따라 기류 가스의 공급양을 제어할 수 있는, 기판 처리 장치.

청구항 9

제1항에 있어서,

상기 가스 배출부는 제2 기류 공간의 상기 본체 하측벽 또는 측벽의 하부에 연결되는, 기판 처리 장치.

청구항 10

제1항에 있어서,

상기 격벽과 대향하는 상기 본체의 내벽면에 단열판이 밀착되게 설치되는, 기판 처리 장치.

청구항 11

제1항에 있어서,

상기 본체의 측벽 및 상기 격벽을 관통하여 적어도 일부가 상기 처리 공간 내에 배치되고, 상기 처리 공간에 공정 가스를 분사하는 공정 가스 공급부를 더 포함하는, 기판처리 장치.

청구항 12

제11항에 있어서,

상기 공정 가스 공급부는,

외부로부터 공정 가스를 공급받는 공정 가스 연결관;

상기 본체 및 상기 격벽을 관통하고 소정 간격을 이루어 배치되는 복수의 공정 가스 공급관;

상기 공정 가스 인결관에 일측이 인통되고 타측은 상기 복수의 공정 가스 공급관에 인결되는 공정 가스 분배관을 포함하는, 기판 처리 장치.

청구항 13

제1항에 있어서,

상기 본체의 측벽 및 상기 격벽을 관통하도록 복수의 지지바가 설치되고,

상기 처리 공간의 전면 및 후면에 각각 대향하는 한 쌍의 지지바 상에 하나 또는 복수의 상기 기판 지지부가 지지되는, 기판 처리 장치.

청구항 14

Entegris, EX1002, p. 99

제13항에 있어서,

상기 본체의 측벽 및 상기 격벽을 관통하도록 설치되는 상기 히터 유닛 중 일부가 상기 지지바로 사용되고,

상기 처리 공간의 전면 및 후면에 각각 대향하는 한 쌍의 히터 유닛 상에 하나 또는 복수의 상기 기판 지지부가 지지되는, 기판 처리 장치.

청구항 15

제13항에 있어서,

상기 지지바는 내부가 빈 형상이고, 상기 지지바 내부에 상기 히터 유닛이 삽입되는, 기판 처리 장치.

발명의 설명

기 술 분 야

[0001] 본 발명은 기판 처리 장치에 관한 것이다. 보다 상세하게는, 기판처리 공정시 가스 흐름을 제어하여 상하부 슬롯 간의 온도 균일도를 향상시킬 수 있는 기판 처리 장치에 관한 것이다.

배 경 기 술

[0002] 표시 장치 또는 반도체 소자 제조시 사용되는 기판 처리 장치에서 기판이 처리되는 처리 공간 내부에는 많은 양의 가스가 공급 및 배출될 수 있다. 이러한 가스는 기판 상에 박막을 형성하거나, 기판 상의 박막에 패턴을 형성하거나, 처리공간 내부의 분위기를 환기시키는 등의 목적으로 처리 공간의 내부에 공급될 수 있다. 기판 처리 공정을 완료한 후, 처리 공간 내부의 가스는 외부로 배출될 수 있다.

[0003] 열처리 공정에서 양질의 제품을 얻기 위해서는 기판의 면내 온도 편차를 최소화하도록 온도를 제어해야 할 필요가 있다. 하지만, 기존의 설비는 본체 내부 공간, 다시 말해 기판이 처리되는 처리 공간 내에서 슬롯 별로 좌측에서 우측으로 기류의 흐름을 형성하는 것이 일반적이다. 이른바, 층류(laminar flow)를 형성하기 위해, 처리 공간의 대향하는 양측에서 가스의 공급과 배출을 수행하게 된다. 하지만, 열 이동에 의해서 좌측과 우측의 온도가 차이가 나는 문제점이 있었다.

[0004] 또한, 상기 기존의 설비는 처리 공간을 냉각시키는 과정에서도 위해서도 좌측에서 우측으로 기류의 흐름을 형성하여, 우측으로 가스가 배출되면서 냉각을 진행하게 되는데, 이 경우 냉각 가스가 하부로 이동하려는 경향이 있어 처리 공간의 상부가 하부보다 상대적으로 늦게 냉각되는 문제점이 있었다.

[0005] 따라서, 처리 공간의 좌측과 우측, 상부와 하부의 온도 편차를 해결할 수 있는 기판 처리 장치가 필요한 실정이다.

발명의 내용

해결하려는 과제

[0006] 본 발명은 냉각시 상부에서 하부 방향으로 기류를 형성하여 열을 이동시킴에 따라 상하부 슬롯 간의 온도 편차를 개선할 수 있는 기판 처리 장치를 제공하는 것을 목적으로 한다.

[0007] 또한, 본 발명은 상기와 같은 종래 기술의 제반 문제점을 해결하기 위해 안출된 것으로서, 처리 공간의 온도 편차를 개선할 수 있는 기판 처리 장치를 제공하는 것을 목적으로 한다.

과제의 해결 수단

[0008] 상기의 목적을 달성하기 위하여, 본 발명의 일 실시예에 따른 기판 처리 장치는, 내부 공간을 제공하는 본체; 상기 내부 공간에 본체의 상부벽과 측벽으로부터 소정 거리 이격되게 배치되어 복수의 기판이 처리되는 처리 공간을 형성하는 격벽; 상기 처리 공간에 상기 기판이 수직방향을 따라 상호 이격되어 배치되도록 지지하는 기판 지지부; 수직 방향을 따라 이격되어 배치되는 복수의 히터 유닛을 포함하고, 상기 기판 지지부에 지지된 상기 기판을 가열하기 위한 히터부; 상기 본체의 상부에 연결되고, 상기 본체의 상부벽과 상기 격벽 사이의 제1 기류 공간에 기류 가스를 분사하는 기류 가스 공급부; 및 상기 본체의 측벽과 상기 격벽 사이의 제2 기류 공간에 연결되고, 상기 본체 내의 가스를 배출하는 가스 배출부를 포함하는 것을 특징으로 한다.

Entegris, EX1002, p. 100

[0009] 상기 격벽은, 상기 본체의 상부벽에 소정 거리 이격되어 배치되는 상부 격벽; 상기 본체의 좌측벽, 우측벽, 후측벽에 소정 거리 이격되어 배치되는 측부 격벽을 포함하고, 상기 제1 기류 공간과 상기 제2 기류 공간이 연결될 수 있다.

[0010] 상기 기류 가스 공급부에 대응되는 상기 본체의 상부벽 내측면에는 복수의 분산홀이 형성된 기류 확산판이 배치될 수 있다.

[0011] 상기 본체의 측부에 연결되고, 상기 본체의 측벽과 상기 격벽 사이의 제2 기류 공간에 기류 가스를 분사하는 측부 기류 가스 공급부를 더 포함할 수 있다.

[0012] 상기 측부 기류 가스 공급부에 대응되는 상기 본체의 측벽 내측면에는 복수의 분산홀이 형성된 측부 기류 확산판이 배치될 수 있다.

[0013] 상기 측부 기류 가스 공급부는, 외부의 기류 가스 공급 수단으로부터 기류 가스를 공급받고 수직 방향으로 연장 형성되는 기류 가스 유입관; 상기 기류 가스 유입관에 연통되어 기류 가스를 전달 받고 수평 방향으로 연장 형성되는 적어도 하나의 기류 가스 측부 분배관; 및 각각의 상기 기류 가스 측부 분배관에서 상기 본체의 측부에 연결되는 적어도 하나의 기류 가스 측부 공급관;을 포함할 수 있다.

[0014] 각각의 기류 가스 측부 분배관에 밸브가 설치되고, 각 밸브의 제어에 따라 제2 기류 공간의 높이 방향에 따라 기류 가스의 공급양을 제어할 수 있다.

[0015] 각각의 기류 가스 측부 공급관에 밸브가 설치되고, 각 밸브의 제어에 따라 제2 기류 공간의 수평 방향에 따라 기류 가스의 공급양을 제어할 수 있다.

[0016]

[0017] 상기 가스 배출부는 제2 기류 공간의 상기 본체 하측벽 또는 측벽의 하부에 연결될 수 있다.

[0018] 상기 격벽과 대향하는 상기 본체의 내벽면에 단열관이 밀착되게 설치될 수 있다.

[0019] 상기 본체의 측벽 및 상기 격벽을 관통하여 적어도 일부가 상기 처리 공간 내에 배치되고, 상기 처리 공간에 공정 가스를 분사하는 공정 가스 공급부를 더 포함할 수 있다.

[0020] 상기 공정 가스 공급부는, 외부로부터 공정 가스를 공급받는 공정 가스 연결관; 상기 본체 및 상기 격벽을 관통하고 소정 간격을 이루어 배치되는 복수의 공정 가스 공급관; 상기 공정 가스 연결관에 일측이 연통되고 타측은 상기 복수의 공정 가스 공급관에 연결되는 공정 가스 분배관을 포함할 수 있다.

[0021] 상기 본체의 측벽 및 상기 격벽을 관통하도록 복수의 지지바가 설치되고, 상기 처리 공간의 전면 및 후면에 각각 대향하는 한 쌍의 지지바 상에 하나 또는 복수의 상기 기판 지지부가 지지될 수 있다.

[0022] 상기 본체의 측벽 및 상기 격벽을 관통하도록 설치되는 상기 히터 유닛 중 일부가 상기 지지바로 사용되고, 상기 처리 공간의 전면 및 후면에 각각 대향하는 한 쌍의 히터 유닛 상에 하나 또는 복수의 상기 기판 지지부가 지지될 수 있다.

[0023] 상기 지지바는 내부가 빈 형상이고, 상기 지지바 내부에 상기 히터 유닛이 삽입될 수 있다.

발명의 효과

[0024] 상기와 같이 구성된 본 발명에 따르면, 처리 공간의 온도 편차를 개선할 수 있는 효과가 있다.

[0025] 또한, 본 발명은 냉각시 상부에서 하부 방향으로 기류를 형성하여 열을 이동시킴에 따라 상하부 슬롯 간의 온도 편차를 개선할 수 있는 효과가 있다.

도면의 간단한 설명

[0026] 도 1은 본 발명의 일 실시예에 따른 기판 처리 장치의 전체적인 구성을 나타내는 개략 사시도이다.

도 2는 본 발명의 일 실시예에 따른 기판 처리 장치의 정단면 및 냉각 공정에서의 기류 가스 흐름을 나타내는 개략 정단면도이다.

도 3은 본 발명의 일 실시예에 따른 기판 처리 장치의 측면을 나타내는 개략 측면도이다.

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도 4는 본 발명의 일 실시예에 따른 기판 처리 장치의 상부를 확대한 개략 사시도이다.

도 5는 본 발명의 일 실시예에 따른 기판 처리 장치의 하부를 확대한 개략 사시도이다.

도 6은 본 발명의 일 실시예에 따른 기판을 지지하는 형태를 나타내는 개략도이다.

도 7은 본 발명의 일 실시예에 따른 기류 확산판이 설치된 형태 및 기류 확산판을 나타내는 개략도이다.

도 8 은 본 발명의 일 실시예에 따른 공정 가스 공급부(제2 가스 공급부) 부분을 확대한 개략 사시도 및 정단면도이다.

도 9는 본 발명의 일 실시예에 따른 열처리 공정에서의 공정 가스 흐름을 나타내는 개략도이다.

발명을 실시하기 위한 구체적인 내용

[0027] 후술하는 본 발명에 대한 상세한 설명은, 본 발명이 실시될 수 있는 특정 실시예를 예시로서 도시하는 첨부 도면을 참조한다. 이들 실시예는 당업자가 본 발명을 실시할 수 있기에 충분하도록 상세히 설명된다. 본 발명의 다양한 실시예는 서로 다르지만 상호 배타적일 필요는 없음이 이해되어야 한다. 예를 들어, 여기에 기재되어 있는 특정 형상, 구조 및 특성은 일 실시예에 관련하여 본 발명의 정신 및 범위를 벗어나지 않으면서 다른 실시예로 구현될 수 있다. 또한, 각각의 개시된 실시예 내의 개별 구성요소의 위치 또는 배치는 본 발명의 정신 및 범위를 벗어나지 않으면서 변경될 수 있음이 이해되어야 한다. 따라서, 후술하는 상세한 설명은 한정적인 의미로서 취하려는 것이 아니며, 본 발명의 범위는, 적절하게 설명된다면, 그 청구항들이 주장하는 것과 균등한 모든 범위와 더불어 첨부된 청구항에 의해서만 한정된다. 도면에서 유사한 참조부호는 여러 측면에 걸쳐서 동일하거나 유사한 기능을 지칭하며, 길이 및 면적, 두께 등과 그 형태는 편의를 위하여 과장되어 표현될 수도 있다.

[0028] 본 명세서에 있어서, 기판은 LED, LCD 등의 표시장치에 사용하는 기판, 반도체 기판, 태양전지 기판 등의 모든 기판을 포함하는 의미로 이해될 수 있으며, 본 명세서에서는 플렉서블(Flexible) 표시장치에 사용되는 플렉서블 기판을 주로 예를 들어 설명한다.

[0029] 또한, 본 명세서에 있어서, 기판 처리 공정이란 증착 공정, 열처리 공정 등을 포함하는 의미로 이해될 수 있으며, 본 명세서에서는 논플렉서블(Non-Flexible) 기판 상에 플렉서블 기판 형성, 플렉서블 기판 상에 패턴 형성, 플렉서블 기판 분리 등의 일련의 공정, 더 바람직하게는 플렉서블 기판을 열처리하여 건조하는 공정을 주로 예를 들어 설명한다.

[0030] 이하, 첨부된 도면을 참조하여 본 발명의 실시예에 따른 기판 처리 장치를 상세히 설명한다.

[0031] 도 1은 본 발명의 일 실시예에 따른 기판 처리 장치(100)의 전체적인 구성을 나타내는 개략도이다. 도 2는 본 발명의 일 실시예에 따른 기판 처리 장치(100)의 정단면 및 냉각 공정에서의 기류 가스 흐름을 나타내는 개략 정면도이다. 도 3은 본 발명의 일 실시예에 따른 기판 처리 장치(100)의 측면을 나타내는 개략 측면도이다. 도 4는 본 발명의 일 실시예에 따른 기판 처리 장치(100)의 상부를 확대한 개략 사시도이다. 도 5는 본 발명의 일 실시예에 따른 기판 처리 장치(100)의 하부를 확대한 개략 사시도이다.

[0032] 도 1 내지 도 5를 참조하면, 본 실시예에 따른 기판 처리 장치는 본체(110), 히터부(200), 가스 공급부(300, 400), 가스 배출부(500)를 포함할 수 있다.

[0033] 본체(110)는 내부 공간을 제공하며, 내부 공간에서도 기판(10)이 로딩되어 처리되는 공간인 처리 공간(101)을 제공한다. 본 명세서에 있어서, 본체(110) 내에서 실질적으로 기판 처리가 수행되는 공간은 본체(110)의 내부 공간에서도 격벽(150, 170) 내측면에 의해 형성되는 공간일 수 있다. 다시 말해, 격벽(150, 170) 외측면과 본체(110) 내측면 사이에 형성되는 '기류 공간'[제1 기류 공간(TR) 및 제2 기류 공간(SR)]은 기판 처리가 수행되는 '처리 공간'(101)과는 별개의 공간으로 이해될 수 있다.

[0034] 본체(110)는 대략 육면체 형상을 가지며, 본체(110)의 재질은 석영(Quartz), 스테인리스 스틸(SUS), 알루미늄(Aluminium), 그라파이트(Graphite), 실리콘 카바이드(Silicon carbide) 또는 산화 알루미늄(Aluminium oxide) 중 적어도 어느 하나일 수 있다.

[0035] 처리 공간(101)에는 복수개의 기판(10)이 배치될 수 있다. 복수개의 기판(10)은 각각 일정간격을 가지면서 배치되며, 배치되며, 레더(ladder), 기판 홀더, 보트(boat) 등의 기판 지지부(190)[도 6 참조]에 지지, 안착되어 처리 공간(101) 내부에 배치될 수 있다. 도 1 및 도 2에서는 설명의 편의상 일부의 기판(10)만을 도시한다.

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각각의 기판(10)은 각각 하나의 슬롯(S) 공간을 점유하며 열처리 될 수 있으나, 이에 제한되는 것은 아니며, 두 개 이상의 기판(10)이 하나의 슬롯(S) 공간을 점유하도록 적층 배치할 수도 있다.

[0036] 본체(110)의 일면[일 예로, 전면]에는 기판(10)이 로딩/언로딩 되는 통로인 출입구(105)가 형성될 수 있다. 출입구(105)는 본체(110)의 일면[일 예로, 전면]에만 형성될 수 있고, 반대면[일 예로, 후면]에도 형성될 수 있다.

[0037] 도어(미도시)는 본체(110)의 일면[즉, 출입구(105)가 형성된 면]에 설치될 수 있다. 도어는 전후방향, 좌우방향 또는 상하방향으로 슬라이딩 가능하게 설치될 수 있다. 도어는 출입구(105)를 개폐할 수 있고, 출입구(105)의 개폐 여부에 따라서 처리 공간(101)도 물론 개폐될 수 있다. 또한, 도어에 의하여 출입구(105)가 완전하게 실링되도록 도어와 본체(110)의 출입구(105)가 형성된 면 사이에는 오링(O-ring) 등의 실링부재(미도시)가 개재될 수 있다.

[0038] 한편, 본체(110)의 외측면 상에는 보강리브(111, 112)를 결합할 수 있다. 본체(110)는 공정 중에 내부에서 강한 압력 또는 고온의 영향을 받아 파손되거나 변형이 발생할 수 있다. 따라서, 보강리브(111, 112)를 본체(110)의 외측면 상에 결합하여 본체(110)의 내구성을 향상시킬 수 있다. 필요에 따라서, 특정 외측면 또는 외측면 상의 일부에만 보강리브(111, 112)를 결합할 수도 있다.

[0039] 본체(110)의 벽에는 복수의 관통홀(115)[도 4 참조]이 형성될 수 있다. 제1 가스 공급부(300) 및 제2 가스 공급부(400)의 각 구성이 본체(110) 외벽에서 처리 공간(101)으로 연통될 수 있도록, 본체(110) 벽의 해당하는 부분에 관통홀(115)이 형성될 수 있다. 관통홀(115) 주변에는 기판처리 가스의 누설을 막기 위한 실링 수단(미도시)을 더 개재할 수 있다.

[0040] 본체(110)의 내벽에는 단열판(120)이 설치될 수 있다. 단열판(120)은 처리 공간(101)의 열이 손실되는 것을 방지하는 본연의 단열 역할뿐만 아니라, 본체(110)의 내벽의 온도를 유지하는 역할을 할 수 있다. 이를 위해, 단열판(120)은 본체(110) 내벽과의 사이에 공간을 두지 않고 밀착되어 설치되는 것이 바람직하다. 게다가 단열판(120)과 본체(110) 사이에 공간이 있으면 해당 공간 내에서 가스의 와류가 발생하여 온도 불균일이 발생할 수 있는데, 단열판(120)과 본체(110) 내벽이 밀착되면 와류의 문제가 해결될 수 있다. 단열판(120)은 공지의 단열재를 제한없이 사용할 수 있으나, 열에 대해서 변형이 적은 재질을 사용하는 것이 바람직하다.

[0041] 단열판(120)에는 후술할 본체(110) 외벽에서 처리 공간(101)으로 연통되는 히터부(200), 제1 가스 공급부(300) 및 제2 가스 공급부(400)의 구성이 통과할 수 있도록, 단열체(120)의 해당하는 부분에 홀(121)이 형성될 수 있다. 홀(121)은 관통홀(115)과 대응하는 위치에 형성될 수 있다.

[0042] 단열판(120)이 본체(110)의 내벽에 밀착되어 실질적으로 본체(110)의 내벽을 구성하고, 단열판(120)이 그 자체로 열을 포함하고 있을 수 있다. 다시 말해, 열처리 공정에서 처리 공간(101)에 히터부(200)가 인가하는 열을 외부로 쉽게 방출하지 않고, 단열판(120)이 열을 포함하고 있을 수 있다. 이 열은 본체(110)의 내벽의 온도를 유지할 뿐 아니라, 기판(10)이 유기용매 등의 휘발성 물질을 포함할 경우에는 휘발성 물질이 본체(110)의 내벽에 응축되지 않고 기체 상태로 존재하도록 할 수 있다. 기체 상태의 휘발성 물질은 제1 기류 공간(TR) 및 제2 기류 공간(SR)의 기류의 흐름에 따라 가스 배출부(500)로 배출될 수 있게 된다.

[0043] 격벽(150, 160, 170)은 본체(110)의 내측벽에 소정 거리 이격되도록 배치될 수 있다. 일 예로, 상부 격벽(150)은 본체(110)의 상측벽에 소정 거리 이격되도록 배치되고, 측부 격벽(170)은 본체(110)의 좌측벽, 우측벽, 후측벽에 소정 거리 이격되도록 배치될 수 있다. 각각의 격벽(150, 170)은 상호 연결될 수 있다. 본체(110)의 하측벽에 소정 거리 이격되도록 하부 격벽(160)이 더 배치되고, 상부, 측부 격벽(150, 170)과 상호 연결될 수 있다.

[0044] 격벽(150, 170)에 의해 형성되는 내부 공간은 실질적으로 기판 처리가 수행될 수 있고, 격벽(150, 170)과 본체(110) 내측벽 사이에 형성되는 기류 공간[제1 기류 공간(TR) 및 제2 기류 공간(SR)]은 기류 가스(CG)가 지나는 경로로 사용될 수 있다.

[0045] 측부 격벽(170)에는 후술할 본체(110) 외벽에서 처리 공간(101)으로 연통되는 제2 가스 공급부(400)의 구성이 통과할 수 있도록, 측부 격벽(170)의 해당하는 부분에 홀(171)이 형성될 수 있다. 또한, 본체(110) 외벽에서 처리 공간(101)으로 연통되는 히터부(200)가 통과할 수 있도록, 측부 격벽(170)의 해당하는 부분에 홀(172)이 형성될 수 있다.

[0046] 도 6은 본 발명의 일 실시예에 따른 기판을 지지하는 형태를 나타내는 개략도이다.

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[0047] 도 6의 (a) 및 (b)를 참조하면, 기판(10)은 레더(ladder) 등의 기판 지지부(190) 상에 로딩될 수 있다. 기판 지지부(190)의 모서리 부분에는 복수의 반원 형상의 걸림편(191)이 형성되어 지지바(195)의 외주에 삽입 결합될 수 있다. 그리하여 기판 지지부(190)는 지지바(195) 위에서 안정적으로 거치되고, 기판 지지부(190)를 위로 들어올리는 것만으로 지지바(195)와 분리가능하게 될 수 있다. 복수의 기판 지지부(190) 상에는 복수의 지지핀(192)이 형성되어 기판(10)의 하부를 점촉 지지할 수 있다. 기판 지지부(190)의 구체적인 사항은 본 출원인의 한국특허출원 제10-2011-0030216호, 제10-2011-0034246호, 제10-2012-0006023호, 제10-2012-0006024호 등의 내용이 전체로서 편입된 것으로 간주될 수 있다.

[0048] 지지바(195)는 본체(110)의 벽에 형성된 복수의 관통홀(115) 및 측부 격벽(170)의 홀(172)을 통과하여 설치될 수 있다. 지지바(195) 양단의 고정부(196)는 본체(110)의 외벽에 결합되어 지지바(195)를 고정할 수 있다.

[0049] 다른 실시예에 따르면, 후술할 히터 유닛(210)이 지지바(195) 역할을 수행할 수 있다. 히터 유닛(210) 상에 하나 또는 복수의 기판 지지부(190)가 지지되고, 기판 지지부(190) 상에 기판(10)을 로딩할 수 있다.

[0050] 또 다른 실시예에 따르면, 지지바(195)의 내부가 빈 형상[또는, 중공(中孔) 관 형상]이고, 지지바(195) 내부에 히터 유닛(210)이 삽입될 수 있다. 지지바(195) 상에 하나 또는 복수의 기판 지지부(190)가 지지됨과 동시에 지지바(195) 내부의 히터 유닛(210)에 의해 기판(10)의 가열이 수행될 수 있다.

[0051] 도 6의 (b)를 참조하면, 후술할 히터 유닛(210), 제2 가스 공급관(430) 등은 동일한 수평면 상을 점유하고, 소정 간격을 따라 번갈아 배치될 수 있다. 또한, 특정 수평면과 이에 이웃하는 다른 수평면의 사이에 기판(10)[및 기판 지지부(190)]가 배치될 수 있다. 위와 같이, 동일한 수평면 상에 히터 유닛(210), 제2 가스 공급관(430) 등이 점유하게 하여 슬롯(S)간 피치(pitch)를 최소화함으로써 생산성을 향상시킬 수 있는 이점이 있다.

[0052] 히터부(200)는 처리 공간(101)을 가열하여 기판 처리 분위기를 조성하며 기판(10)을 가열할 수 있다. 복수의 히터 유닛(210)이 본체(110)에 형성된 히터 관통구(201)를 통과하여 처리 공간(101)에 배치될 수 있다. 관통구(201)는 측부 격벽(170)의 홀(172)에 대응하는 위치에 형성될 수 있다. 일 예로, 복수의 히터 유닛(210)은 기판(10)의 로딩/언로딩 방향과 수직한 방향으로 일정한 간격을 가지면서 배치될 수 있고, 기판(10)의 적층 방향을 따라 수직으로 일정한 간격을 가지면서 배치될 수 있다.

[0053] 도 1 내지 도 3에서는 다른 구성의 설명의 편의상 일부의 히터 유닛(210)만을 도시하나, 모든 히터 관통구(201)에 히터 유닛(210)이 삽입되어 히터부(200)를 구성할 수 있다. 따라서, 기판(10)은 상부 및 하부에 배치된 히터부(200)에 의해서 전면적이 균일하게 가열될 수 있으므로, 기판 처리 공정의 신뢰성이 향상되는 이점이 있다.

[0054] 이에 더하여, 서브 히터 유닛(미도시)이 기판(10)의 로딩/언로딩 방향과 평행한 방향으로 챔버(101) 내벽[또는, 본체(110) 내벽]에 기판(10)의 적층 방향을 따라 수직으로 일정한 간격을 가지면서 배치될 수도 있다.

[0055] 히터 유닛(210)은 본체(110)의 일측면에서 타측면까지 연통되는 바(bar) 형상을 가지며, 석영관 내부에 발열체가 삽입된 형태일 수 있다. 일 예로, 히터 유닛(210)은 본체(110)의 좌측면에서 우측면까지 연통될 수 있고, 서브 히터 유닛(미도시)은 출입구(105) 부분을 제외한 본체(110)의 전면에서 후면까지 연통될 수 있다. 단자는 외부의 전원(미도시)으로부터 전력을 공급받아 발열체에서 열을 발생시킬 수 있도록 한다. 히터 유닛(210)/서브 히터 유닛의 개수는 본체(110)의 크기, 기판(10)의 크기 및 개수에 따라서 다양하게 변경될 수 있다.

[0056] 한편, 히터부(200)는 상술한 형태에 제한되지 않고, 격벽(150, 160, 170), 본체 내벽 등에 매립된 형태로 기판(10)을 가열할 수도 있다.

[0057] 가스 공급부(300, 400)는 본체(110) 상부 및 본체(110) 측부에 연결될 수 있다. 가스 공급부(300, 400)는 제1 가스 공급부(300) 및 제2 가스 공급부(400)을 포함할 수 있다.

[0058] 제1 가스 공급부(300)는 본체(110) 상부에 연결되어 제1 가스를 공급할 수 있다. 제1 가스 공급부(300)에서 공급하는 제1 가스는, 대부분 기판(10)의 직접적인 처리 공정에 관여하지 않고, 처리 공간(101)의 상부와 측부, 즉, 제1 기류 공간(TR) 및 제2 기류 공간(SR)에서의 기류(flow)의 형성에 기여할 수 있다. 이하에서는, 제1 가스 공급부(300)에서 공급하는 제1 가스를 '기류 가스'(CG)[도 2 참조]라고 지칭한다. 또한, 제1 가스 공급부(300)는 '기류 가스 공급부'(300)로 명칭을 혼용하여 사용한다.

[0059] 제1 가스 공급부(300)[기류 가스 공급부(300)]의 제1 가스 상부 공급관(310)[기류 가스 상부 공급관(310)]은 외부의 기류 가스 공급 수단(30)으로부터 기류 가스(CG)를 전달받아 제1 기류 공간(TR)으로 공급할 수 있다. 제1 가스 상부 공급관(310)은 본체(110) 상부를 관통하여 제1 기류 공간(TR)으로 연통될 수 있다. 제1 가스 상부

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공급관(310)으로부터 제1 기류 공간(TR)에 기류 가스(CG)를 공급할 수 있다.

[0060] 제1 기류 공간(TR)에 공급된 기류 가스(CG)는 상부 격벽(150)에 막혀 기판(10)의 상부로 직접적인 분사가 제한된다. 기류 가스(CG)는 상부 측부 격벽(150)에 의해 구획된 제1 기류 공간(TR)에 퍼진 후, 측부 격벽(170)에 의해 구획된 제2 기류 공간(SR)으로 이동할 수 있다. 즉, 측부 격벽(170)은 상부 격벽(150)과 모서리 부분에서 연결되어 제1 기류 공간(TR)과 제2 기류 공간(SR)이 연결되도록 구성될 수 있다.

[0061] 제1 가스 공급부(300)는 본체(110) 측부에 디 연결될 수 있다. 본체(110) 측부에 제1 가스 유입관(320)[기류 가스 유입관(320)], 제1 가스 측부 분배관(330)[기류 가스 측부 분배관(330)] 및 제1 가스 측부 공급관(340)[기류 가스 측부 공급관(340)]이 디 연결될 수 있다. 제1 가스 유입관(320), 제1 가스 측부 분배관(330) 및 제1 가스 측부 공급관(340)을 합하여 '측부 기류 가스 공급부'라고 지칭한다.

[0062] 제1 가스 유입관(320)은 외부의 기류 가스 공급 수단(30)으로부터 기류 가스를 공급받아 적어도 하나의 제1 가스 측부 분배관(330: 331, 332)에 기류 가스를 분산하여 전달할 수 있다. 제1 가스 유입관(320)은 본체(110)의 좌측 외벽, 우측 외벽을 따라 수직하게 연장되고, 제1 가스 측부 분배관(330)은 본체(110)의 좌측 외벽, 우측 외벽을 따라 수평하게 연장될 수 있다.

[0063] 제1 가스 측부 분배관(330: 331, 332)은 제1 가스 유입관(320)에 연통되어 기류 가스를 전달 받을 수 있다. 본 명세서에서 제1 가스 측부 분배관(330: 331, 332)이 2개인 것이 예시되나, 기판의 개수/크기, 기판 처리 장치의 크기 등을 고려하여 개수는 증감 가능하다. 각각의 제1 가스 측부 분배관(330: 331, 332)에서 기류 가스(CG)는 다양한 제1 가스 측부 공급관(340: 341, 342, 343)으로 분산되고, 각각의 제1 가스 측부 공급관(340: 341, 342, 343)는 본체(110) 측부를 관통하여 처리 공간(101)으로 연통될 수 있다. 그리하여 제1 가스 측부 분배관(330)으로부터 제2 기류 공간(SR)에 기류 가스(CG)를 더 공급할 수 있다.

[0064] 각각의 제1 가스 측부 분배관(330: 331, 332)과 제1 가스 유입관(320) 사이에는 밸브(V)가 설치될 수 있다. 밸브(V)의 제어에 따라 제2 기류 공간(SR)의 높이 방향에 따라 공급되는 기류 가스(CG)의 양을 제어할 수 있다. 일 예로, 제1 가스 상부 공급관(310)에서 제1 기류 공간(TR)으로 공급하는 기류 가스(CG)의 양으로도 충분하다면, 제2 기류 공간(SR)에 기류 가스(CG)를 공급할 필요 없이 모든 밸브(V)를 잠글 수 있다. 다른 예로, 처리 공간(101) 하부쪽이 대해서 냉각을 더 수행하여 처리 공간(101)의 상하부의 온도 편차를 줄일 필요가 있으면, 제1 가스 측부 분배관(330) 중 가장 하부에 의치한 공급관(332)의 밸브(V)를 최대로 열어 기류 가스(CG)의 공급량을 늘릴 수 있다.

[0065] 또한, 각각의 제1 가스 측부 분배관(330: 331, 332)과 각각의 제1 가스 측부 공급관(340: 341, 342, 343) 사이에는 밸브(V)가 설치될 수 있다. 밸브(V)의 제어에 따라 제2 기류 공간(SR)의 수평 방향에 따라 공급되는 기류 가스(CG)의 양을 제어할 수 있다. 밸브(V)의 개폐 여부, 개폐 정도는 제어 시스템(미도시)에 의해 자동으로 수행될 수 있다.

[0066] 도 7은 본 발명의 일 실시예에 따른 기류 확산판이 설치된 형태 및 기류 확산판을 나타내는 개략도이다.

[0067] 한편, 기류 가스 공급부(300)에서 제1 기류 공간(TR) 및/또는 제2 기류 공간(SR)에 기류 가스(CG)를 공급하지만, 제1 가스 상부 공급관(310)이 본체(110) 상부에 연통되는 면적, 복수의 제1 가스 측부 분배관(330: 331, 332)이 본체(110) 측부에 연통되는 면적에 대해서만 기류 가스(CG)를 공급하므로, 특정 부분에 기류 가스(CG)가 집중될 수 있다.

[0068] 이를 해소하기 위해, 기류 확산판(350)을 개재하여 기류 가스(CG)가 넓은 면적에 분산되며 공급되도록 할 수 있다. 도 7을 참조하면, 기류 확산판(350)에는 소정거리 이격되도록 복수의 분산홀(351)들이 형성될 수 있다. 그리고, 기류 확산판(350)을 본체(110) 상부 내측벽 및/또는 측부 내측벽에 배치할 수 있다. 도 7에는 기류 확산판(350)이 본체(110) 측부 내측벽에 배치되고, 제1 가스 측부 공급관(340: 341)에 대응되도록 연결되는 형태를 예시하나, 본체(110) 상부 내측벽에 배치되고 제1 가스 상부 공급관(310)에 대응되도록 연결되는 것도 동일하게 적용될 수 있다.

[0069] 기류 확산판(350)이 배치되는 본체(110) 내측벽에는 음각 홈이 형성되어 분산 공간(BS)을 제공할 수 있다. 다시 말해, 기류 확산판(350)의 일면과 본체(110) 내측벽의 음각 홈으로 구획되는 공간이 분산 공간(BS)이 될 수 있다. 제1 가스 상부 공급관(310)은 본체(110) 상부 내측벽의 분산 공간(BS)에 연통되고, 제1 가스 측부 분배관(330)은 본체(110) 측부 내측벽의 분산 공간(BS)에 연통될 수 있다. 제1 가스 상부 공급관(310)/제1 가스 측부 분배관(330)으로부터 공급된 기류 가스(CG)는 곧바로 제2 기류 공간(SR)에 분사되지 않고, 분산 공간(BS)을 채울 수 있다. 그리고, 분산 공간(BS)을 채운 기류 가스(CG)들은 복수의 분산홀(351)들을 통과하여 제2 기류

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공간(SR)에 분사될 수 있다. 이처럼 기류 확산판(350)의 면적에 대응하는 범위에 기류 가스(CG)들을 분산시켜 분사할 수 있으므로, 처리 공간(101)의 온도 편차를 보다 균일하고, 미세하게 개선할 수 있는 이점이 있다.

[0070] 기류 가스(CG)는 본체(110)의 상측벽과 상부 격벽(150)의 외측면 사이의 공간[제1 기류 공간(TR)], 및 본체(110)의 좌측벽, 우측벽, 후측벽과 측부 격벽(170)의 외측면 사이의 공간[제2 기류 공간(SR)]을 따라 하부방향으로 이동하여, 배기구(501)를 통해 가스 배출부(500)로 배출될 수 있다.

[0071] 도 8은 본 발명의 일 실시예에 따른 공정 가스 공급부(400)[제2 가스 공급부(400)] 부분을 확대한 개략 사시도 및 정단면도이다.

[0072] 제2 가스 공급부(400)는 본체(110) 측부에 연결되고 본체(110)의 측면 및 격벽(170)을 관통하여 적어도 일부가 처리 공간(101) 내에 배치됨에 따라, 처리 공간(101)에 제2 가스를 공급할 수 있다. 한 쌍의 제2 가스 공급부(400)가 본체(110)의 대향하는 외측벽에 설치될 수 있다.

[0073] 제2 가스 공급부(400)에서 공급하는 제2 가스는, 기판(10)의 직접적인 처리 공정에 관여할 수 있다. 이하에서는, 제2 가스 공급부(400)에서 공급하는 제2 가스를 '공정 가스'(PG)[도 9 참조]라고 지칭한다. 또한, 제2 가스 공급부(400)는 '공정 가스 공급부'(400)로 명칭을 혼용하여 사용한다. 공정 가스는 N_2 등의 불활성 가스를 사용하고, 기판(10)의 열 치리에 기여할 수 있다.

[0074] 제2 가스 공급부(400)[공정 가스 공급부(400)]의 제2 가스 연결관(410)[공정 가스 연결관(410)]의 일단은 외부의 공정 가스 공급 수단(50)에 연결되어 공정 가스를 공급받고, 타단은 제2 가스 분배관(420)[공정 가스 분배관(420)]에 연결되어 공정 가스(PG)를 전달할 수 있다.

[0075] 제2 가스 분배관(420)은 수직 방향으로 형성되고 내측과 본체(110) 외벽 사이에 공정 가스(PG)가 채워질 수 있는 공간을 제공할 수 있다. 제2 가스 분배관(420)의 내측은 복수의 제2 가스 공급관(430)[공정 가스 공급관(430)]이 수직 방향으로 간격을 이루며 연결될 수 있다. 제2 가스 분배관(420)과 본체(110) 외벽 사이에 채워진 공정 가스(PG)는 각각의 제2 가스 공급관(430)으로 분산될 수 있다. 대향하는 한 쌍의 제2 가스 분배관(420)은 각각 제2 가스 공급관(430)의 일단 및 타단에 연결되어 제2 가스 공급관(430)의 양단에 공정 가스(PG)를 공급할 수 있다.

[0076] 또한, 다른 실시예로, 제2 가스 분배관(420)은 수평 방향으로 형성되고 내측과 본체(110) 외벽 사이에 공정 가스(PG)가 채워질 수 있는 공간을 제공할 수 있다. 제2 가스 분배관(420)의 내측은 복수의 제2 가스 공급관(430)[공정 가스 공급관(430)]이 수평 방향으로 간격을 이루며 연결될 수 있다. 또한, 다른 실시예로, 제2 가스 분배관(420)은 수직 및 수평 방향으로 형성되고, 제2 가스 분배관(420)의 내측은 복수의 제2 가스 공급관(430)[공정 가스 공급관(430)]이 수직 및 수평 방향으로 간격을 이루며 연결될 수도 있다.

[0077] 제2 가스 공급관(430)은 본체(110) 측벽 및 격벽(170)을 관통하는 형태로 배치되어 처리 공간(101) 내부로 공정 가스(PG)를 분사할 수 있다. 특히, 제2 가스 공급관(430)이 처리 공간(101)의 내부로 공정 가스(PG)를 분사함에 따라, 처리 공간(101)은 외부보다 압력이 높게 형성될 수 있다. 다시 말해, 기판 처리 공정 중에 격벽(150, 160, 170)으로 구획된 처리 공간(101)이, 격벽(150, 170)과 본체(110) 내측벽 사이에 형성되는 공간[상부 기류 공간(TR) 및 측부 기류 공간(SR)] 또는 본체(110)의 외부보다 압력이 높게 형성되는 양압 상태를 유지하므로, 처리 공간(101)의 내부로 파티클이 유입되는 것을 방지할 수 있는 효과가 있다.

[0078] 제2 가스 공급관(430)이 처리 공간(101)를 관통하기 때문에, 측부 격벽(170)에는 홀(171)이 형성될 수 있는데, 홀(171)의 직경은 제2 가스 공급관(430)의 직경과 동일하거나 크게 형성될 수 있다. 특히, 홀(171)의 직경이 제2 가스 공급관(430)의 직경보다 크게 형성될 때, 홀(171)과 제2 가스 공급관(430)의 외주 사이에 틈(GP)이 생길 수 있다. 이러한 틈(GP)은 공정 가스(PG)가 측부 격벽(170)과 본체(110) 내측벽 사이의 공간[제2 기류 공간(SR)]으로 빠져나갈 수 있는 통로로서 작용할 수 있다. 물론, 모든 홀(171)의 직경이 제2 가스 공급관(430)의 직경보다 클 필요는 없고, 일부의 홀(171)에만 틈(GP)을 구비할 수 있다. 한편, 측부 격벽(170)에는 공정 가스(PG)가 제2 기류 공간(SR)으로 빠져나갈 수 있는 별도의 홀(미도시)을 더 구비할 수 있다.

[0079] 각각의 제2 가스 공급관(430)은 슬롯(S) 공간의 상, 하부에 수평 방향으로 소정 간격을 가지며 배치되는 것이 바람직하다. 그리하여, 슬롯(S) 공간에 배치된 기판(10)의 상, 하부에서 공정 가스를 분사하여 처리 공간(101) 내의 모든 기판(10)에 균일하게 공정 가스를 공급할 수 있다.

[0080] 제2 가스 공급관(430)의 외주에는 복수의 토출공(미도시)이 형성될 수 있다. 토출공은 처리 공간(101) 내에 위치하는 제2 가스 공급관(430)의 외주에 형성될 수 있다. 일 예로, 기판(10) 면 상에 직접적인 분사를 피하기

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위해, 제2 가스 공급관(430)의 외주 좌/우측 방향, 즉, 수평면 방향으로 복수의 토출공이 형성될 수도 있다. 그리하면, 기판(10)과 평행한 방향으로 공정 가스(PG)를 공급할 수 있게 된다. 또는, 다른 예로, 복수의 토출공은 제2 가스 공급관(430)의 상부, 하부 중 어느 한 부분에 형성되어 기판(10)의 상부 방향, 하부 방향 중 적어도 어느 한 방향을 통해 공정 가스(PG)를 공급할 수도 있다. 이에 따라, 기판(10)과 이에 이웃하는 기판(10) 사이의 공간, 또는, 슬롯(S)들 사이의 공간에 공정 가스(PG)를 공급할 수 있고, 슬롯(S)에 배치되는 기판(10)의 양면에 공정 가스(PG)를 균일하게 공급할 수 있다.

[0081] 다시 도 5를 참조하면, 가스 배출부(500)가 본체(110) 하부에 연결되어 처리 공간(101)의 기류 가스(CG), 공정 가스(PG)를 외부의 펌프 등과 같은 공정 가스 배출 수단(70)으로 배출할 수 있다. 본체(110)의 일측벽(예를 들어, 하측벽)에는 배기구(501)가 형성될 수 있다. 가스 배출부(500)는 배기구(501)에 연결될 수 있다. 배기구(501)는 본체(110)의 측벽과 격벽(150, 170) 사이 공간의 본체(110)의 적어도 일부에 연통되도록 형성될 수 있다. 일 예로, 배기구(501)는 본체(110)의 하부 측벽과 측부 격벽(170) 사이 공간의 본체(110)의 하부에 형성될 수 있다. 즉, 배기구(501)는 제2 기류 공간(SR)의 하부에 형성될 수 있다. 또한, 본체(110)의 좌측벽, 우측벽 등의 측벽의 하부 부근에 배기구(501)가 형성될 수도 있다. 이때 배기구(501)는 적어도 공정 가스 공급부(400)보다는 낮은 위치에 형성되는 것이 바람직하다. 본체(110) 하부의 배기구(501)를 매개하여 가스 배출부(500)가 본체(110)와 연통될 수 있다. 배기구(501) 및 가스 배출부(500)의 개수, 위치 등은 본체(110)의 크기, 기판(10)의 크기 및 개수에 따라서 다양하게 변경될 수 있다.

[0082] 가스 배출부(500)는 본체(110)의 내부 공간, 즉, 제1 기류 공간(TR) 및 제2 기류 공간(SR) 내에 강한 흡압을 인가할 필요가 있다. 이에 따라, 제1 가스 공급부(300)에서 공급한 기류 가스가 제1 기류 공간(TR) 및 제2 기류 공간(SR)에서 강한 기류의 흐름을 형성할 수 있다. 제1 기류 공간(TR) 및 제2 기류 공간(SR)에서 강한 기류의 흐름은 격벽(150, 170) 내측면, 즉, 기판(10) 주변의 가스들까지 끌어당겨 신속한 배기를 가능하게 할 수 있다. 기판(10)이 휘발성 물질을 포함한 경우라면, 휘발성 물질까지 기류의 흐름에 따라 제2 기류 공간(SR)을 통해 가스 배출부(500)으로 배출될 수 있다. 또한, 상부 기류 공간(TR) 및 측부 기류 공간(SR)이 처리 공간(101)보다 음압에 해당하므로, 상부 기류 공간(TR) 및 측부 기류 공간(SR)의 파티클이 처리 공간(101)의 내부로 유입되는 것을 방지할 수 있다.

[0083] 기판(10), 특히 대면적의 기판(10)에 열처리를 수행할 때, 기판(10)의 면내 온도 편차를 최소화하도록 온도를 제어해야 한다. 기존의 설비는 기판이 처리되는 공간의 대향하는 양측에서 가스의 공급과 배출을 수행하여 슬롯 별로 좌측에서 우측으로 기류의 흐름을 형성하는 것이 일반적이다. 하지만, 열 이동에 의해서 좌측과 우측의 온도가 차이가 나거나, 냉각시 챔버 상부가 하부보다 상대적으로 늦게 냉각되어 온도 편차를 발생하는 문제점이 있었다.

[0084] 도 2에는 냉각 시에 기류 가스(CG)의 흐름을 화살표로 도시하였다. 도 2 를 참조하면, 본 발명은 제1 가스 공급부(300)[기류 가스 공급부(300)]에서 제1 기류 공간(TR) 및 제2 기류 공간(SR)을 따라 상부 방향에서 하부 방향으로 강한 기류의 흐름을 형성할 수 있다. 이에 따라, 상대적으로 온도가 높은 처리 공간(101) 상부의 열을 하부로 이동시켜, 처리 공간(101) 상부와 하부의 온도 편차를 최소화 할 수 있다. 또한, 냉각 시에 기판(10)에 직접적으로 가스를 분사하지 않고, 제1 기류 공간(TR) 및 제2 기류 공간(SR)으로 기류 가스(CG)가 흐르게 함에 따라 기판(10)의 충격을 최소화 할 수 있다. 또한, 제1 기류 공간(TR) 및 제2 기류 공간(SR)에서의 강한 기류의 흐름이 처리 공간(101)의 공정 가스(PG)들을 끌어당겨 배기시킴에 따라서, 신속한 냉각과 배기를 가능하게 하는 이점이 있다.

[0085] 도 9는 본 발명의 일 실시예에 따른 열처리 공정에서의 가스 흐름을 나타내는 개략도이다.

[0086] 도 9에는 기판 처리 공정 시에 공정 가스(PG)의 흐름을 화살표로 도시하였다. 도 9를 참조하면, 본 발명은 제2 가스 공급관(430)[공정 가스 공급관(430)]이 처리 공간(101)에 배치되며, 제2 가스 공급관(430)에 형성된 복수의 토출공로부터 공정 가스(PG)가 공급되므로, 기판(10)의 전면적에 균일하게 공정 가스(PG)가 공급될 수 있다. 그리고, 공정 가스(PG)는 각 슬롯(S) 내에서 중심으로부터 좌/우측으로 퍼져나갈 수 있으므로, 대면적 기판(10)에서도 면내 온도 편차를 최소화 할 수 있다. 또한, 제2 기류 공간(SR)에서 가스 배출부(500)를 향한 하부 방향으로 강한 기류의 흐름은, 처리 공간(101) 내의 공정 가스(PG)가 빠르게 사이드 부분[제2 기류 공간(SR)]으로 배기될 수 있도록 할 수 있다.

[0087] 본 발명은 상술한 바와 같이 바람직한 실시예를 들어 도시하고 설명하였으나, 상기 실시예에 한정되지 아니하며 본 발명의 정신을 벗어나지 않는 범위 내에서 당해 발명이 속하는 기술분야에서 통상의 지식을 가진 자에 의해 다양한 변형과 변경이 가능하다. 그러한 변형예 및 변경예는 본 발명과 첨부된 특허청구범위의 범위 내에 속하

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는 것으로 보아야 한다.

부호의 설명

[0088] 10: 기판

100: 기판 처리 장치

101: 처리 공간

110: 본체

120: 단열판

150, 160, 170: 격벽

200: 히터

210: 히터 유닛

300: 제1 가스 공급부

400: 제2 가스 공급부

500: 가스 배출부

501: 배기구

CG: 제1 가스

PG: 제2 가스

S: 슬롯(slot)

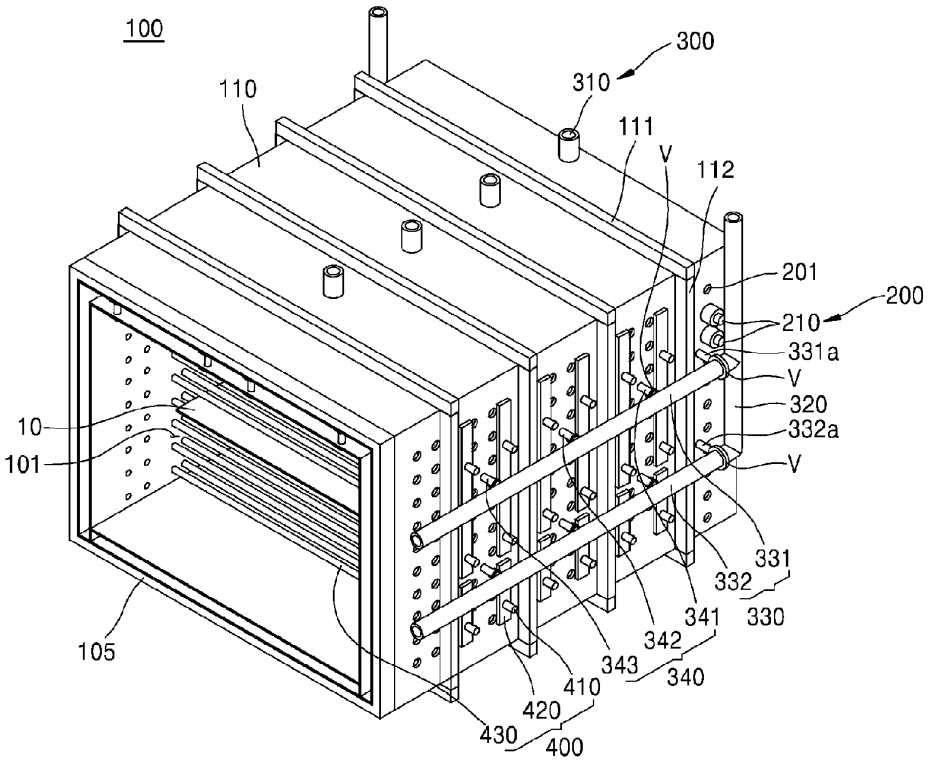
SR: 제2 기류 공간

TR: 제1 기류 공간

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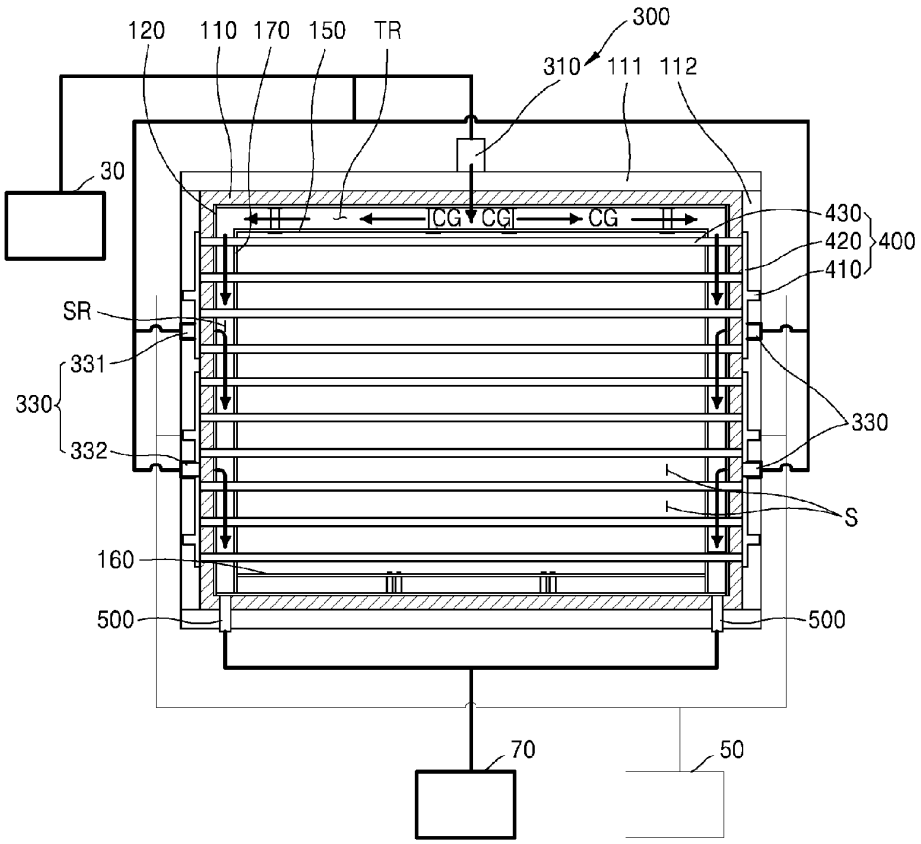
도면

도면1



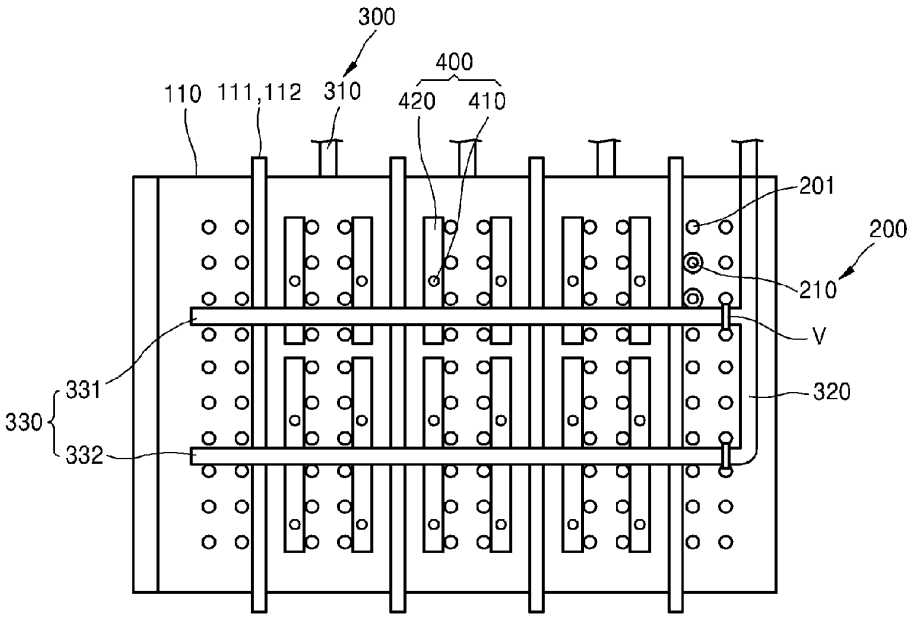
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도면2

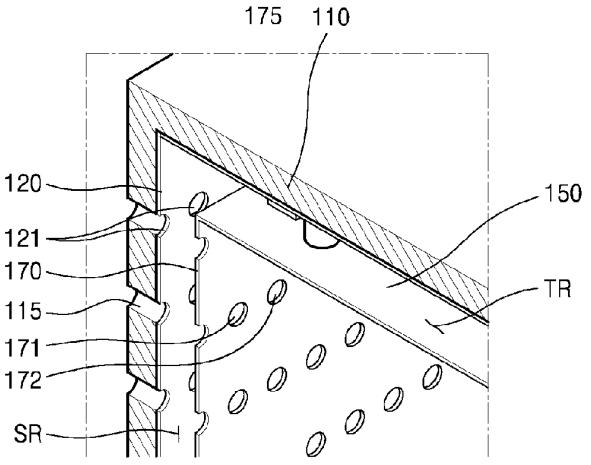


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도3

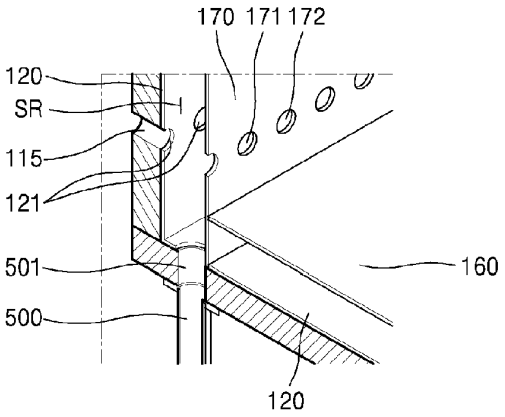


도4



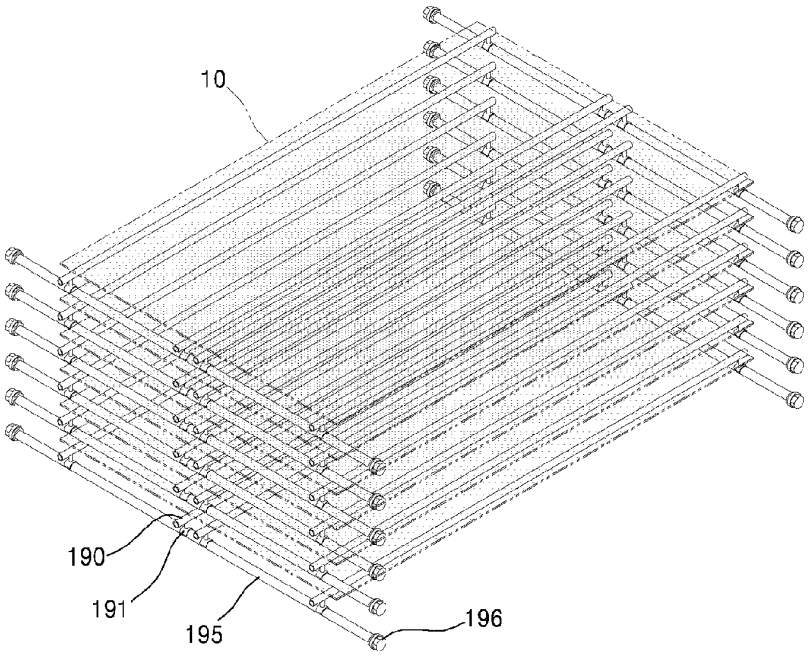
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도면5

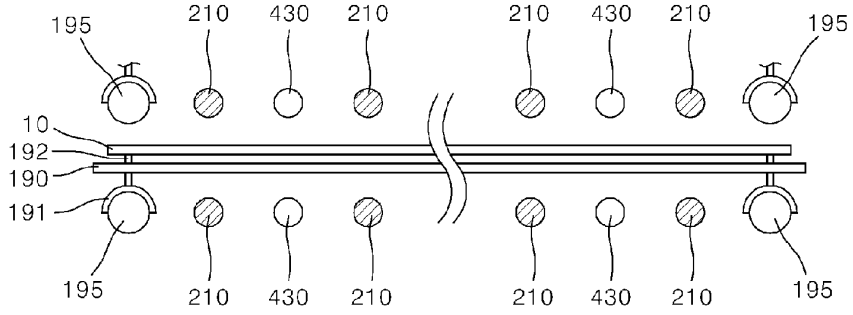


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도면6



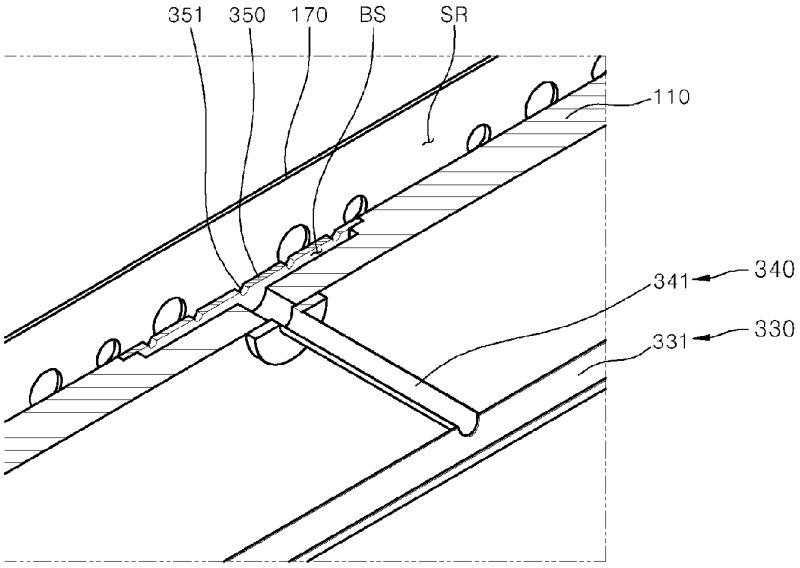
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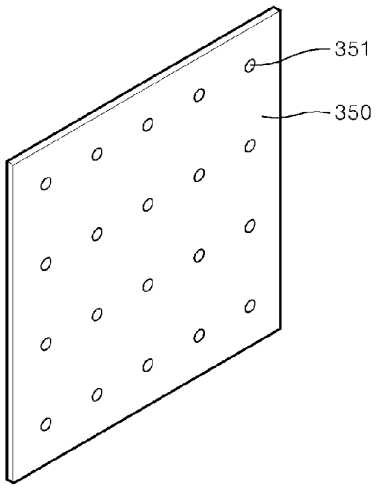
(b)

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도면7



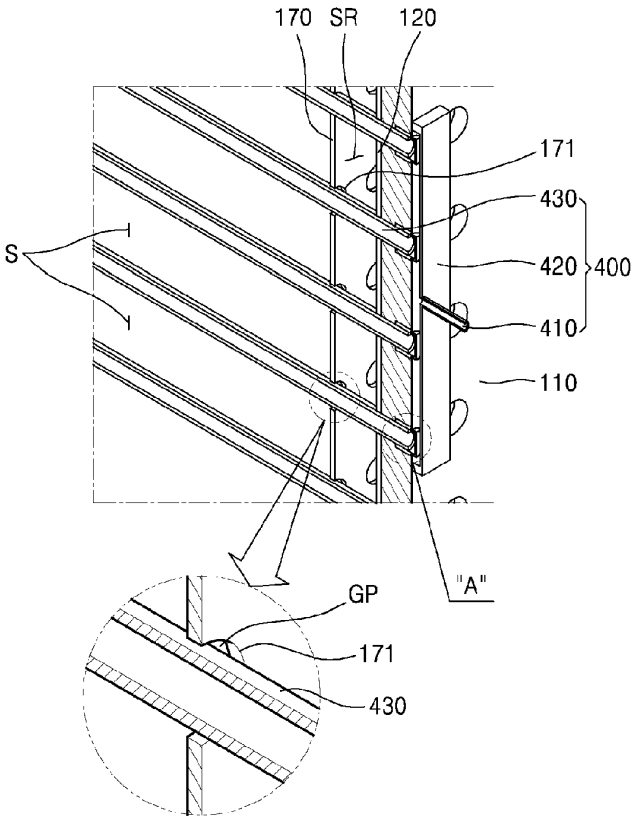
(a)



(b)

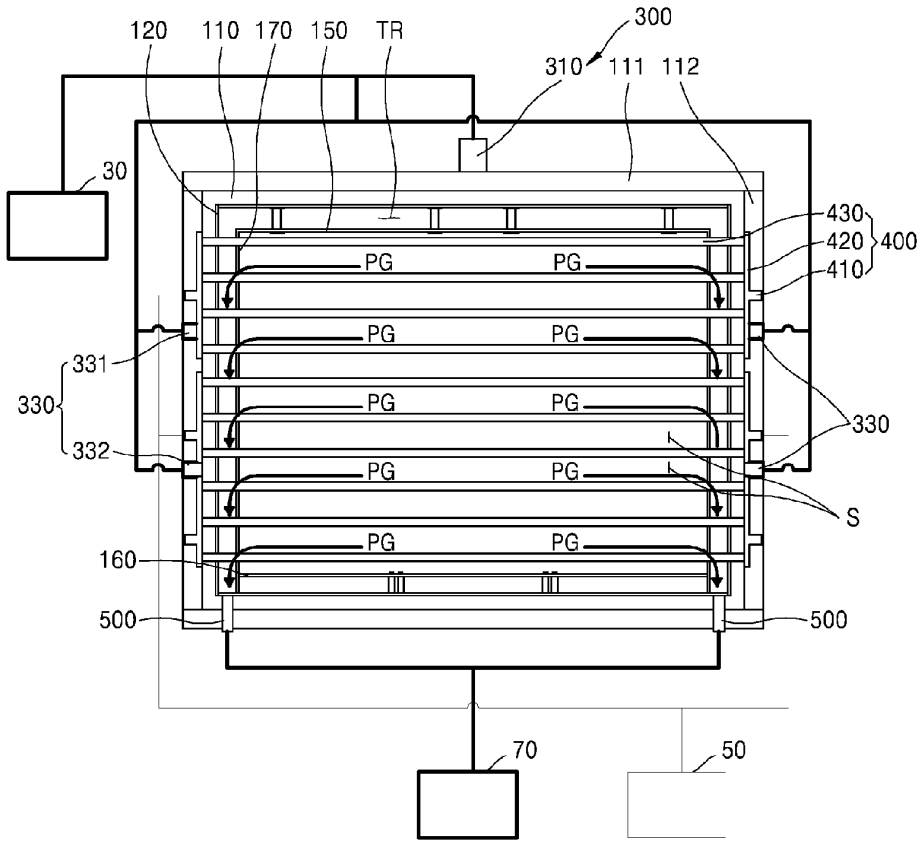
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도6



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도9



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Espacenet

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Substrate container system

Inventor(s): CHIU MING-CHIEN [TW]; CHUANG CHIA-HO [TW]; LEE KUO-HUA [TW]; LIN SHU-HUNG [TW]; HSIA HAO-KANG [TW] ± (CHIU, MING-CHIEN, ; CHUANG, CHIA-HO, ; LEE, KUO-HUA, ; LIN, SHU-HUNG, ; HSIA, HAO-KANG)

Applicant(s): GUDENG PREC IND CO LTD [TW] ± (GUDENG PRECISION INDUSTRIAL CO., LTD)

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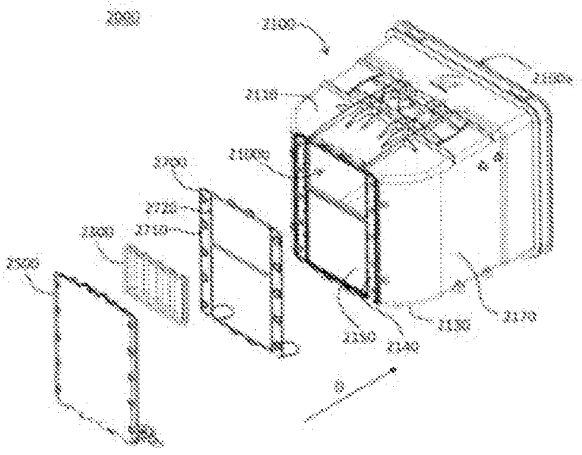
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Abstract of TW202302425 (A)

A substrate container including a container body, a filter member, a back cover is provided. The container body having a top face, a bottom face opposing the top face, a back plate of a first height connecting the top face and the bottom face, a front opening located between the top face and the bottom face, and a back opening opposing the front opening. The front opening enables passage of a substrate and the back opening is located on the back plate and has a smaller second height. The filter member covers the back opening. The back cover establishes sealing engagement with the container body. A gas guiding channel



extending in a direction of the first height is formed between the back cover and the container body. The back cover and the filter member define a buffering compartment, and the gas guiding channel has an outlet connecting the buffering compartment.

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(71)申請人：家登精密工業股份有限公司 (中華民國) GUDENG PRECISION INDUSTRIAL CO., LTD (TW)
新北市土城區中央路 4 段 2 號 9 樓

(72)發明人：邱銘乾 CHIU, MING-CHIEN (TW) ；莊家和 CHUANG, CHIA-HO (TW) ；李國華 LEE, KUO-HUA (TW) ；林書弘 LIN, SHU-HUNG (TW) ；夏浩剛 HSIA, HAO-KANG (TW)

(74)代理人：陳慧玲

(56)參考文獻：

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US	2020/0020549A1	US	2021/0111048A1

審查人員：林世崇

申請專利範圍項數：14 項 圖式數：25 共 38 頁

(54)名稱

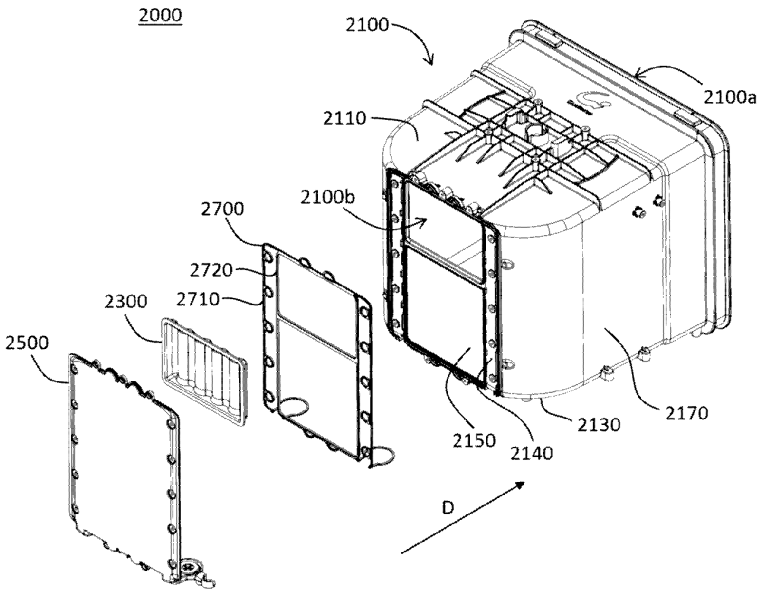
基板容器系統

(57)摘要

一種基板容器系統，包括一容器主體、一過濾組件以及一後蓋，容器主體包括一頂面、與頂面相對之一底面以及連接頂面與底面之一背板，容器主體具有一前開口及一後開口，前開口位於頂面與底面之間，用以供一基板通過，後開口位於背板，與前開口相對，其中，背板具有一第一高度，後開口具有小於第一高度之一第二高度。過濾組件覆蓋於後開口。後蓋用以與容器主體建立密封地接合，後蓋與容器主體間形成一導氣通道，沿第一高度的方向延伸，後蓋與過濾組件共同定義了一緩衝室，導氣通道具有一出口，連接於緩衝室。

A substrate container including a container body, a filter member, a back cover is provided. The container body having a top face, a bottom face opposing the top face, a back plate of a first height connecting the top face and the bottom face, a front opening located between the top face and the bottom face, and a back opening opposing the front opening. The front opening enables passage of a substrate and the back opening is located on the back plate and has a smaller second height. The filter member covers the back opening. The back cover establishes sealing engagement with the container body. A gas guiding channel extending in a direction of the first height is formed between the back cover and the container body. The back cover and the filter member define a buffering compartment, and the gas guiding channel has an outlet connecting the buffering compartment.

指定代表圖：



【圖1】

符號簡單說明：

2000:基板容器系統

2100:容器主體

2100a:前開口

2100b:後開口

2110:頂面

2130:底面

2140:導氣通道

2150:背板

2170:側壁

2300:過濾組件

2500:後蓋

2700:密封構件

2710:第一密封環部

2720:第二密封環部

D:延伸方向

I773536

【發明摘要】

公告本

【中文發明名稱】 基板容器系統

【英文發明名稱】 SUBSTRATE CONTAINER SYSTEM

【中文】

一種基板容器系統，包括一容器主體、一過濾組件以及一後蓋，容器主體包括一頂面、與頂面相對之一底面以及連接頂面與底面之一背板，容器主體具有一前開口及一後開口，前開口位於頂面與底面之間，用以供一基板通過，後開口位於背板，與前開口相對，其中，背板具有一第一高度，後開口具有小於第一高度之一第二高度。過濾組件覆蓋於後開口。後蓋用以與容器主體建立密封地接合，後蓋與容器主體間形成一導氣通道，沿第一高度的方向延伸，後蓋與過濾組件共同定義了一緩衝室，導氣通道具有一出口，連接於緩衝室。

【英文】

A substrate container including a container body, a filter member, a back cover is provided. The container body having a top face, a bottom face opposing the top face, a back plate of a first height connecting the top face and the bottom face, a front opening located between the top face and the bottom face, and a back opening opposing the front opening. The front opening enables passage of a substrate and the back opening is located on the back plate and has a smaller second height. The filter member covers the back opening. The back cover establishes sealing engagement with the container body. A gas guiding channel extending in a direction of the first height is formed between the back cover and the container body. The back cover and the filter member define a buffering

compartment, and the gas guiding channel has an outlet connecting the buffering compartment.

【指定代表圖】　　圖1

【代表圖之符號簡單說明】

2000：基板容器系統

2100：容器主體

2100a：前開口

2100b：後開口

2110：頂面

2130：底面

2140：導氣通道

2150：背板

2170：側壁

2300：過濾組件

2500：後蓋

2700：密封構件

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2710：第一密封環部

2720：第二密封環部

D：延伸方向

【發明說明書】

【中文發明名稱】　基板容器系統

【英文發明名稱】　SUBSTRATE CONTAINER SYSTEM

【技術領域】

【0001】 本發明是有關於一種防止諸如晶圓(wafer)的易碎物品在儲存、運送和運輸期間受到環境污染的可運輸容器，且特別是有關於一種能夠在容器系統內分配淨化氣體(purging gas)的容器系統。

【先前技術】

【0002】 在現代半導體製程中，精密的工件（例如，晶圓(wafer)，光罩(reticle)/遮罩(mask)）在可以被製成集成電路之前，會在多個製程設備進行多個製程。晶圓通常會從製造晶圓的設施被運輸或輸送到另一地點，以在該地點對所述晶圓進一步處理。此類精密裝置的移動通常以專用的基板容器（例如，前開式基板傳送盒 ，front opening unified pod, FOUP）來完成。

【0003】 FOUP通常在多個製程站之間用於容納300mm或450mm的晶圓。慣例上，FOUP具有一個外殼，該外殼限定了一個開放的內部空間，且該外殼中有多個架子，用於固定多個彼此相間隔的晶圓。而且，外殼限定了前開口，所述前開口可被前門構件覆蓋，該前門構件結合了密封構件和閂鎖機構，以在門和外殼之間建立氣密接合。

【0004】 理想上，在載入或取出基板的期間（例如，當前門被移除並且內部被暴露時），需要控管侵入基板容器的環境污染物（例如，空氣/灰塵/濕

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氣）。即使周圍環境是無塵室，當環境污染物侵入到容器中時也會對設置其中的基板的產能產生不利影響。為此，將淨化設備結合到運載盒系統中，以在所述盒的裝載/卸載期間支援淨化工序(purging process)。

【發明內容】

【0005】 有鑒於此，本發明提出一種基板容器系統，利用在容器主體的背板上形成高度小於背板的後開口，並於後開口處覆蓋過濾組件的方式，讓過濾組件以非整面方式提供淨化氣體。

【0006】 依據本發明之一方面，提供一種基板容器系統，包括一容器主體、一過濾組件以及一後蓋。容器主體包括一頂面、與頂面相對之一底面，以及連接頂面與底面之一背板。容器主體具有一前開口及一後開口，前開口位於頂面與底面之間，用以供一基板通過，後開口位於背板，與前開口相對。其中，背板具有一第一高度，後開口具有小於第一高度之一第二高度。過濾組件覆蓋於後開口。後蓋用以與容器主體建立密封地接合，後蓋與容器主體間形成一導氣通道，沿第一高度的方向延伸。後蓋與過濾組件共同定義了一緩衝室，導氣通道具有一出口，連接於緩衝室。

【0007】 於一實施例中，第二高度為第一高度的約10%至約90%。

【0008】 於一進一步的實施例中，第二高度為第一高度的約10%至約50%，且後開口位於鄰近頂面處。

【0009】 於一實施例中，過濾組件具有一氣體釋放面，其面積大於後開口之面積，氣體釋放面具有平行於背板的一平面。

【0010】 於再一實施例中，過濾組件具有一氣體釋放面，其面積大於後開口之面積，氣體釋放面具有與背板夾有一銳角的一平面。

【0011】 於另一實施例中，過濾組件具有一氣體釋放面，其面積大於後開口之面積，氣體釋放面具有一波浪面。

【0012】 於又一實施例中，過濾組件具有一氣體釋放面，其面積大於後開口之面積，氣體釋放面通過後開口朝向容器主體延伸，形成一彎曲輪廓。

【0013】 於再一實施例中，過濾組件具有一氣體釋放面，其面積大於後開口之面積，氣體釋放面通過後開口朝向後蓋延伸，形成一彎曲輪廓。

【0014】 於一實施例中，其中後蓋具有朝容器主體凸出的多個凸肋，用來抵接於過濾組件，凸肋為間隔配置以於其中形成多個凹槽，導氣通道的該出口至少包括凹槽。

【0015】 於一實施例中，後蓋包括一進氣結構，彎曲地延伸在容器主體的底面下方，進氣結構包括與底面相對並且面朝下的一進氣埠，藉以連接於一外部淨化設備。基板容器系統更包括一氣閥組件，用以供一淨化氣體通過。其中，進氣埠具有一連接結構，氣閥組件經由連接結構連接至進氣埠。氣閥組件包括一氣閥主體及一第一彈性材料，第一彈性材料設置於氣閥主體之一側，並且具有一翼片。當氣閥組件組裝在連接結構時，翼片發生形變，藉以與連接結構建立密封地接合。氣閥組件更包括一第二彈性材料，設置於氣閥主體之另一側，第二彈性材料具有一對接面，用以供外部淨化設備對接，藉以形成密封地接合。

【0016】 於一實施例中，基板容器系統更包括一密封構件，具有一第一密封環部及一第二密封環部，第一密封環部佈置在後蓋與容器主體之間，第二密封環佈置在過濾組件與容器主體之間。

【0017】 本發明實施例之基板容器系統中，背板具有第一高度，後開口具有小於第一高度之第二高度，過濾組件設置於後開口，藉以讓過濾組件以非整面方式提供淨化氣體，讓容器主體的內部空間在高度方向上具有不同的淨化氣

體流速，可以在載入或取出基板的期間，避免門外氣體帶著灰塵、微粒或濕氣等污染物進入容器主體內，維持潔淨度以及減緩濕度回升。

【圖式簡單說明】

【0018】 為讓本發明之上述以及其他特徵、優點與實施例能更明顯易懂，所附圖式之說明如下：

圖1繪示依照本發明一實施例的基板容器系統的立體爆炸圖；

圖2繪示圖1的容器主體的立體圖；

圖3繪示圖2的容器主體的示意圖；

圖4繪示容器主體沿圖3的剖面P1的剖面圖；

圖5繪示圖3的容器主體的後視圖；

圖6繪示依照本發明另一實施例的容器主體的後視圖；

圖7繪示依照本發明又一實施例的容器主體的後視圖；

圖8繪示依照本發明再一實施例的容器主體的後視圖；

圖9繪示依照本發明另一實施例的容器主體的後視圖；

圖10繪示圖1的基板容器系統組裝前的示意圖；

圖11繪示圖1的容器主體、密封構件以及過濾組件組裝後的示意圖；

圖12繪示圖1的基板容器系統組裝後的示意圖；

圖13a繪示圖1中過濾組件的立體圖；

圖13b繪示圖1中過濾組件的側視圖；

圖14a繪示另一實施例的過濾組件的立體圖；

圖14b繪示另一實施例的過濾組件的側視圖；

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圖14c繪示圖14b之過濾組件與背板的示意圖；

圖14d繪示圖14c之過濾組件與背板於另一實施方式的示意圖；

圖15a繪示又一實施例的過濾組件的立體圖；

圖15b繪示又一實施例的過濾組件的側視圖；

圖16a繪示再一實施例的過濾組件的立體圖；

圖16b繪示再一實施例的過濾組件的側視圖；

圖17繪示圖1的後蓋、過濾組件及密封構件組裝前的示意圖；

圖18繪示圖1的後蓋、過濾組件及密封構件組裝後的示意圖；

圖19繪示沿圖18中剖面P2的立體剖面圖；

圖20繪示圖1的基板容器系統的示意圖；

圖21繪示圖20中沿剖面P3的剖面圖；

圖22繪示依照本發明一實施例的氣閥組件的立體圖；

圖23繪示氣閥組件沿圖22的剖面P4的剖面圖；

圖24繪示氣閥組件組裝於進氣埠時的示意圖；以及

圖25繪示圖22的氣閥組件的另一視角的立體圖。

【實施方式】

【0019】 本中華民國發明專利申請主張2021年06月30日提出申請之編號為17/363,328名稱「SUBSTRATE CONTAINER SYSTEM」之美國專利申請案的國際優先權，該案係為2020年05月12日提出申請之編號為16/872,392之美國申請案的部分延續案(Continuation-In-Part)，前述案件的內容通過引用併入本文，並且成為說明書的一部分。

【0020】 以下將參考所附圖式輔以描述更為詳盡地描述本發明的公開內容。圖式中所示為本發明的示例性實施例，並非用來限制本發明；事實上，本發明可以依據許多不同的形式來實施，並且不應被解釋為僅限制於此處所闡述的示例性實施例。提供這些示例性實施例是為了使本發明的說明更為公開透徹和完整，並且將本發明的範圍充分地傳達給本領域相關的技術人員。

【0021】 在實施例的詳細說明中，相同的圖式標號表示相同或類似的元件。本說明書中使用的術語僅用於描述特定示例性實施例的目的，而不意圖限制本發明。如本文所使用的單數型式的「一」、「一個」及「所述」，除非上下文另外清楚地指出，否則旨在同時包括複數形式。此外，當在本文中使用時，「包括」、「包含」及「具有」所涵蓋的範圍並不排除存在或添加一個或多個其它特徵、區域、整數、步驟、操作、元件、組件和/或群組。

【0022】 本發明實施例之基板容器系統，容器主體的背板上具有後開口，後開口以非整面方式提供淨化氣體，讓容器主體的內部空間在高度方向上具有不同的淨化氣體流速，可以避免門外氣體帶著灰塵、微粒或濕氣等污染物進入容器主體內，從而維持潔淨度以及減緩濕度回升。以下將輔以圖1至圖25，詳細說明本發明實施例的基板容器系統。本發明實施例的圖式中，示例性的基板容器系統的部分元件或結構並未繪示在圖式中，以清楚顯示本發明之特徵。

【0023】 請同時參照圖1及圖2，圖1繪示依照本發明一實施例的基板容器系統的立體爆炸圖，圖2繪示圖1的容器主體的立體圖。本實施例的基板容器系統2000包括一容器主體2100、一過濾組件2300以及一後蓋2500。基板容器系統2000例如是一前開式基板傳送盒(front opening unified pod, FOUP）。本實施例的容器主體2100包括一頂面2110、與頂面2110相對之一底面2130，以及連接頂面

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2110與底面2130之一背板2150。容器主體2100具有一前開口2100a及一後開口2100b，前開口2100a位於頂面2110與底面2130之間，用以供一基板通過。基板容器系統2000更包括前門（圖式中未繪示），前門包括了閂鎖機構及氣密構件，當前門覆蓋於前開口2100a，並與容器主體2100相鎖固時，前門與容器主體2100形成一個氣密的內部空間，用來承載晶圓、光罩或其他具有高潔淨度要求的基板。

【0024】 本實施例中，容器主體2100係由塑料一體成形，並且更包括兩側壁2170，連接於頂面2110及底面2130之間，且兩側壁2170分別位於背板2150的相對兩側。整體而言，容器主體2100經由頂面2110、底面2130、兩側壁2170以及背板2150形成一個箱體，用來容置基板。前開口2100a由頂面2110、底面2130、兩側壁2170圍繞形成，且其寬度及高度均大於後開口2100b。

【0025】 請同時參照圖3及圖4，圖3繪示圖2的容器主體2100的示意圖，圖4繪示容器主體2100沿圖3的剖面P1的剖面圖。後開口2100b位於背板2150，與前開口2100a相對，其中，背板2150具有一第一高度H1，後開口2100b具有小於第一高度H1之一第二高度H2。頂面2110及底面2130之間距由前開口2100a往後開口2100b的方向逐漸縮小，直至背板2150的位置。背板2150連接於頂面2110及底面2130，背板2150的第一高度H1大致上等於容器主體2100於此處的高度。後開口2100b的第二高度H2小於背板2150的第一高度H1，表示後開口2100b並非佔滿整個背板2150，後開口2100b是以非整面方式形成。

【0026】 根據前述，後開口2100b的第二高度H2小於背板2150的第一高度H1，在一實施例中，第二高度H2為第一高度H1的約10%至約90%；在更進一步

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的實施例中，第二高度H2為第一高度H1的約10%至約50%，且後開口2100b位於鄰近頂面2110處。

【0027】 請參照圖5，其繪示圖3的容器主體的後視圖。在圖5的實施例中，第二高度H2約為第一高度H1的40%，且後開口2100b位於鄰近頂面2110處，亦即後開口2100b在高度上為靠近頂面2110的上方位置。

【0028】 請參照圖6，其繪示依照本發明另一實施例的容器主體的後視圖。在圖6的實施例中，第二高度H2(i)約為第一高度H1(i)的90%，且後開口2100b(i)位於鄰近頂面2110(i)處。

【0029】 請參照圖7，其繪示依照本發明又一實施例的容器主體的後視圖。在圖7的實施例中，第二高度H2(ii)約為第一高度H1(ii)的10%，且後開口2100b(ii)位於鄰近頂面2110(ii)處。

【0030】 請參照圖8，其繪示依照本發明再一實施例的容器主體的後視圖。在圖8的實施例中，第二高度H2(iii)約為第一高度H1(iii)的50%，且後開口2100b(iii)位於鄰近頂面2110(iii)處。

【0031】 請參照圖9，其繪示依照本發明另一實施例的容器主體的後視圖。在圖9的實施例中，第二高度H2(iv)約為第一高度H1(iv)的20%，且後開口2100b(iv)與頂面2110(iv)具有一段距離。

【0032】 前述多種第一高度H1(i)~H1(iv)及第二高度H2(i)~H2(iv)之實施例，並非用以限制本發明，只要是第二高度H2為第一高度H1的約10%至約90%者，均屬於本發明的範圍。另外，後開口2100b較佳地在高度方向位於上方鄰近頂面2110之處，使得提供淨化氣體時，淨化氣體在不同高度具有不同的流速，此點將在後續進行說明。

【0033】 請同時參照圖10至圖12，圖10繪示圖1的基板容器系統組裝前的示意圖，圖11繪示圖1的容器主體、密封構件以及過濾組件組裝後的示意圖，圖12繪示圖1的基板容器系統組裝後的示意圖。本實施例的基板容器系統2000中，過濾組件2300覆蓋於後開口2100b。後蓋2500用以與容器主體2100建立密封地接合，後蓋2500與容器主體2100間形成一導氣通道2140，沿第一高度H1的方向延伸。後蓋2500與過濾組件2300共同定義了一緩衝室2340，導氣通道2140具有一出口2140a，連接於緩衝室2340。

【0034】 基板容器系統2000通以淨化氣體後，淨化氣體由底部進入導氣通道2140，接著沿著第一高度H1的方向朝上擴散移動，並經由出口2140a進入緩衝室2340。過濾組件2300為多孔性材料，例如是由多孔燒結材料一體成形，其材料可以例如包括並不限於陶瓷材料和基於聚合物的材料。當淨化氣體進入緩衝室2340累積達到設計的壓力閥值時（或稱之為飽壓），淨化氣體會經由過濾組件2300均勻透出，並且在淨化操作的期間保持壓力的穩定。

【0035】 過濾組件2300較佳地大致上呈一平板狀結構，其具有面朝容器主體2100內部空間的一氣體釋放面2310。藉由平板狀結構的過濾組件2300設計，相較於其他習知型式的過濾組件（例如柱狀的氣體擴散塔），在相同氣體釋放面積的條件下，平板狀結構的過濾組件2300內部具有較大的通氣空間（相對來說，柱狀的氣體擴散塔其內部的通氣空間較小），且平板狀結構的過濾組件2300其氣體釋放面2310，是全面朝向容器主體2100的內部空間擴散淨化氣體（相對來說，柱狀的氣體擴散塔其氣體釋放面，有部分是朝向容器後方透出淨化氣體），有助於淨化效率的提升。

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【0036】 請同時參照圖1、圖13a及圖13b，圖13a及圖13b分別繪示圖1中過濾組件的立體圖及側視圖。過濾組件2300的氣體釋放面2310面積大於後開口2100b之面積。淨化氣體經由氣體釋放面2310均勻穩定地透出，從而進入容器主體2100的內部空間，以對於基板進行淨化操作。本實施例中，氣體釋放面2310具有一波浪面，及氣體釋放面為凹凸起伏狀態。在組裝時，所述氣體釋放面2310通過後開口2100b延伸進入容器主體2100內部（如沿著圖1及圖10所示的延伸方向D延伸進入容器主體2100內部），可以增加氣體釋放面2310的面積，有助於淨化效率的提升。

【0037】 請同時參照圖14a至圖14c，圖14a及圖14b分別繪示另一實施例的過濾組件的立體圖及側視圖，圖14c繪示圖14b之過濾組件與背板的示意圖。過濾組件2300(i)的氣體釋放面2310(i)面積大於後開口2100b之面積。淨化氣體經由氣體釋放面2310(i)均勻穩定地透出，從而進入容器主體2100的內部空間，以對於基板進行淨化操作。本實施例中，氣體釋放面2310(i)具有平行於背板2150的一平面，有助於淨化氣體透出的均勻度。在組裝時，所述氣體釋放面2310(i)通過後開口2100b延伸進入容器主體2100內部（如沿著圖1及圖10所示的延伸方向D延伸進入容器主體2100內部），有助於淨化效率的提升。

【0038】 請參照圖14d，繪示圖14c之過濾組件與背板於另一實施方式的示意圖。在不同的實施方式中，過濾組件2300(i)’的氣體釋放面2310(i)’具有與背板2150夾有一銳角的一平面。在這樣的實施例中，平面並非與背板2150平行，可以選擇性地朝向容器主體2100的頂面2110或底面2130傾斜，以調整氣體釋放面2310(i)’逸出氣體的角度。此處所述平面與背板2150之角度，可以視產品的需求或規格進行調整設計。

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【0039】 請同時參照圖15a及圖15b，分別繪示又一實施例的過濾組件的立體圖及側視圖。過濾組件2300(ii)的氣體釋放面2310(ii)面積大於後開口2100b之面積。淨化氣體經由氣體釋放面2310(ii)均勻穩定地透出，從而進入容器主體2100的內部空間，以對於基板進行淨化操作。本實施例中，氣體釋放面2310(ii)通過後開口2100b朝向後蓋2500延伸（如沿著圖1及圖10所示的延伸方向D的相反方向），形成一彎曲輪廓，從而形成凹狀態，可以增加氣體釋放面2310(ii)的面積，有助於淨化效率的提升。

【0040】 請同時參照圖16a及圖16b，分別繪示再一實施例的過濾組件的立體圖及側視圖。過濾組件2300(iii)的氣體釋放面2310(iii)面積大於後開口2100b之面積。淨化氣體經由氣體釋放面2310(iii)均勻穩定地透出，從而進入容器主體2100的內部空間，以對於基板進行淨化操作。本實施例中，氣體釋放面2310(iii)通過後開口2100b朝向容器主體2100延伸（如沿著圖1及圖10所示的延伸方向D延伸），形成一彎曲輪廓，從而形成凸狀態，可以增加氣體釋放面2310(iii)的面積，有助於淨化效率的提升。

【0041】 接著請同時參照圖17至圖19，圖17繪示圖1的後蓋、過濾組件及密封構件組裝前的示意圖，圖18繪示圖1的後蓋、過濾組件及密封構件組裝後的示意圖，圖19繪示沿圖18中剖面P2的立體剖面圖。本實施例中，後蓋2500具有朝容器主體2100凸出（如沿著圖1及圖10所示的延伸方向D凸出）的多個凸肋2510，用來抵接於過濾組件2300，多個凸肋2510為間隔配置以於其中形成多個凹槽2510a，導氣通道2140的出口2140a至少包括這些凹槽2150a。

【0042】 請參照圖1、圖10以及圖17至圖19。基板容器系統2000更包括一密封構件2700，具有一第一密封環部2710及一第二密封環部2720，第一密封環

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部2710佈置在後蓋2500與容器主體2100之間，第二密封環部2720佈置在過濾組件2300與容器主體2100之間。後蓋2500經由第一密封環部2710與容器主體2100建立密封地接合，過濾組件2300經由第二密封環部2720與容器主體2100對應後開口2100b之周圍部分建立密封地接合。藉由密封構件2700提供於容器主體2100與後蓋2500之間，讓兩者之間的導氣通道2140可以達成氣密，避免漏氣的情況發生，確保淨化氣體僅會透過過濾組件2300進入容器主體2100的內部空間。

【0043】 接下來對於淨化氣體進入基板容器系統2000的入口端進行說明。請同時參照圖17至圖21，圖20繪示圖1的基板容器系統和剖面P3的示意圖，圖21繪示圖20沿剖面P3的剖面圖。基板容器系統2000的後蓋2500包括一進氣結構2540，彎曲地延伸在容器主體2100的底面2130下方，進氣結構2540包括與底面2130相對並且面朝下的一進氣埠2541，藉以連接於一外部淨化設備（圖式中未顯示此周邊元件）。進氣結構2540連通於導氣通道2140，且本實施例中進氣結構2540與導氣通道2140為成對配置，分別位在後開口2100b的相對兩側邊（如圖1及圖17所示）。

【0044】 基板容器系統2000更包括一氣閥組件2900，用以供淨化氣體通過，其中，進氣埠2541具有一連接結構2542，氣閥組件2900經由連接結構2542連接至進氣埠2541。

【0045】 請繼續參照圖21，淨化氣體經由氣閥組件2900進入進氣結構2540，接著沿著導氣通道2140朝上擴散（如圖中粗黑箭頭所示），接著通過導氣通道的出口2140a（圖21中未標示）進入緩衝室2340。淨化氣體在緩衝室2340中達到飽壓後，經由氣體釋放面2310均勻地朝向容器主體2100的內部空間透出。在容器主體2100的高度上，對應過濾組件2300位置所吹拂的淨化氣體流

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速，會高於其他部分的淨化氣體流速；亦即淨化氣體在不同高度具有不同的流速。以圖21的實施例為例，過濾組件2300位於容器主體2100的上半部分，因此淨化氣體於容器主體2100上半部分的流速高於下半部分的流速，如圖中容器主體2100內所繪示的上下兩個空心箭頭所示。在相同淨化氣體流量的條件下，相較於整面均勻地吹拂，本發明實施例以非整面吹拂使得上半部的流速高於下半部的流速，可以更有利地避免前門打開時，由上而下吹拂的門外氣體帶著灰塵、微粒或濕氣等污染物進入容器主體2100內，從而維持潔淨度以及減緩濕度回升。

【0046】 接下來對於氣閥組件2900進行說明。請同時參照圖22至圖24，圖22繪示依照本發明一實施例的氣閥組件的立體圖，圖23繪示氣閥組件沿圖22的剖面P4的剖面圖，圖24繪示氣閥組件組裝於進氣埠時的示意圖。氣閥組件2900包括一氣閥主體2930及一第一彈性材料2910。第一彈性材料2910設置於氣閥主體2930的一側，並且具有一翼片2911。當氣閥組件2900組裝在進氣埠2541的連接結構2542時，翼片2911發生形變，藉以與連接結構2542建立密封地接合。

【0047】 於一實施例中，連接結構2542是一個套筒，用來供氣閥組件2900套接。翼片2911凸出於第一彈性材料2910外表面，並往外延伸一段距離，當組裝氣閥組件2900於連接結構2542時，翼片2911與連接結構2542發生干涉而彎折（如圖24所示），藉以讓翼片2911可以與連接結構2542建立密封地接合。

【0048】 請參照圖23至圖25，圖25繪示圖22的氣閥組件的另一視角的立體圖。氣閥組件2900更包括一第二彈性材料2920，設置於氣閥主體2930之另一側，具有一對接面2921，用以供外部淨化設備對接，藉以形成密封地接合。本實施例中，第一彈性材料2910及第二彈性材料2920位於氣閥主體2930的相對兩

側，利用第二彈性材料2920讓外部淨化設備與對接面2921密封接合，可以避免漏氣，有助於淨化操作的效率。

【0049】 前述詳細說明所揭露的多個實施例，提供一種基板容器系統，包括：一容器主體，包括一頂面、與頂面相對之一底面，以及連接頂面與底面之一背板，容器主體具有一前開口及一後開口，前開口位於頂面與底面之間，用以供一基板通過，後開口位於背板，與前開口相對，其中，背板具有一第一高度，後開口具有小於第一高度之一第二高度；一過濾組件，覆蓋於後開口；以及，一後蓋，用以與容器主體建立密封地接合，後蓋與容器主體間形成一導氣通道，沿第一高度的方向延伸，後蓋與過濾組件共同定義了一緩衝室，導氣通道具有一出口，連接於緩衝室。容器主體的背板上具有後開口，後開口以非整面方式提供淨化氣體，讓容器主體的內部空間在高度方向上具有不同的淨化氣體流速，可以避免門外氣體帶著灰塵、微粒或濕氣等污染物進入容器主體內，維持潔淨度以及減緩濕度回升。

【0050】 雖然本發明已以多個實施例揭露如上，然其並非用以限定本發明。任何熟習此技藝者，在不脫離本發明之精神和範圍內，當可作各種更動與潤飾，因此本發明之保護範圍當視後附申請專利範圍所界定者為準。

【符號說明】

【0051】

2000：基板容器系統

2100：容器主體

2100a：前開口

2100b：後開口

2100b(i)：後開口

2100b(ii)：後開口

2100b(iii)：後開口

2100b(iv)：後開口

2110：頂面

2110(i)：頂面

2110(ii)：頂面

2110(iii)：頂面

2110(iv)：頂面

2130：底面

2140：導氣通道

2140a：出口

2150：背板

2170：側壁

2300：過濾組件

2300(i)：過濾組件

2300(i)’：過濾組件

2300(ii)：過濾組件

2300(iii)：過濾組件

2310：氣體釋放面

2310(i)：氣體釋放面

2310(i)’：氣體釋放面

2310(ii)：氣體釋放面

2310(iii)：氣體釋放面

2340：緩衝室

2500：後蓋

2510：凸肋

2510a：凹槽

2540：進氣結構

2541：進氣埠

2542：連接結構

2700：密封構件

2710：第一密封環部

2720：第二密封環部

2900：氣閥組件

2910：第一彈性材料

2911：翼片

2920：第二彈性材料

2921：對接面

2930：氣閥主體

D：延伸方向

H1：第一高度

H1(i)：第一高度

H1(ii)：第一高度

H1(iii)：第一高度

H1(iv)：第一高度

H2：第二高度

H2(i)：第二高度

H2(ii)：第二高度

H2(iii)：第二高度

H2(iv)：第二高度

P1：剖面

P2：剖面

P3：剖面

P4：剖面

【發明申請專利範圍】

【請求項1】 一種基板容器系統，包括：

一容器主體，包括一頂面、與該頂面相對之一底面，以及連接該頂面與該底面之一背板，該容器主體具有一前開口及一後開口，該前開口位於該頂面與該底面之間，用以供一基板通過，該後開口位於該背板，與該前開口相對，其中，該背板具有一第一高度，該後開口具有小於該第一高度之一第二高度；

一過濾組件，覆蓋於該後開口；以及

一後蓋，用以與該容器主體建立密封地接合，該後蓋與該容器主體間形成一導氣通道，沿該第一高度的方向延伸，該後蓋與該過濾組件共同定義了一緩衝室，該導氣通道具有一出口，連接於該緩衝室。

【請求項2】 如請求項1所述的基板容器系統，其中該第二高度為該第一高度的約10%至約90%。

【請求項3】 如請求項2所述的基板容器系統，其中該第二高度為該第一高度的約10%至約50%，且該後開口位於鄰近該頂面處。

【請求項4】 如請求項1所述的基板容器系統，其中該過濾組件具有一氣體釋放面，其面積大於該後開口之面積，該氣體釋放面具有平行於該背板的一平面。

【請求項5】 如請求項1所述的基板容器系統，其中該過濾組件具有一氣體釋放面，其面積大於該後開口之面積，該氣體釋放面具有與該背板夾有一銳角的一平面。

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【請求項6】 如請求項1所述的基板容器系統，其中該過濾組件具有一氣體釋放面，其面積大於該後開口之面積，該氣體釋放面具有一波浪面。

【請求項7】 如請求項1所述的基板容器系統，其中該過濾組件具有一氣體釋放面，其面積大於該後開口之面積，該氣體釋放面通過該後開口朝向該容器主體延伸，形成一彎曲輪廓。

【請求項8】 如請求項1所述的基板容器系統，其中該過濾組件具有一氣體釋放面，其面積大於該後開口之面積，該氣體釋放面通過該後開口朝向該後蓋延伸，形成一彎曲輪廓。

【請求項9】 如請求項1所述的基板容器系統，其中該後蓋具有朝該容器主體凸出的複數個凸肋，用來抵接於該過濾組件，該些凸肋為間隔配置以於其中形成複數個凹槽，該導氣通道的該出口至少包括該些凹槽。

【請求項10】 如請求項1所述的基板容器系統，更包括：

一密封構件，具有一第一密封環部及一第二密封環部，該第一密封環部佈置在該後蓋與該容器主體之間，該第二密封環佈置在該過濾組件與該容器主體之間。

【請求項11】 如請求項1所述的基板容器系統，其中該後蓋包括：

一進氣結構，彎曲地延伸在該容器主體的該底面下方，該進氣結構包括與該底面相對並且面朝下的一進氣埠，藉以連接於一外部淨化設備。

【請求項12】 如請求項11所述的基板容器系統，更包括：

一氣閥組件，用以供一淨化氣體通過，其中，該進氣埠具有一連接結構，該氣閥組件經由該連接結構連接至該進氣埠。

【請求項13】 如請求項12所述的基板容器系統，其中該氣閥組件包括：

一氣閥主體；及

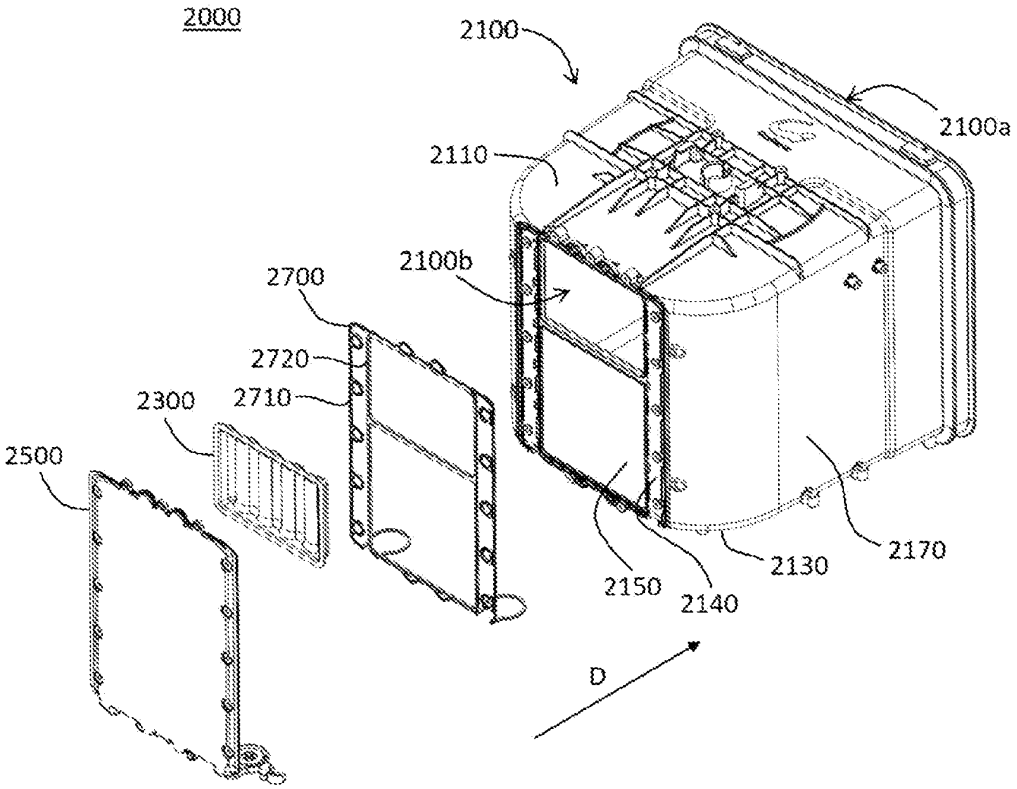
一第一彈性材料，設置於該氣閥主體之一側，並且具有一翼片，當該氣閥組件組裝在該連接結構時，該翼片發生形變，藉以與該連接結構建立密封地接合。

【請求項14】 如請求項13所述的基板容系統，其中該氣閥組件更包括：

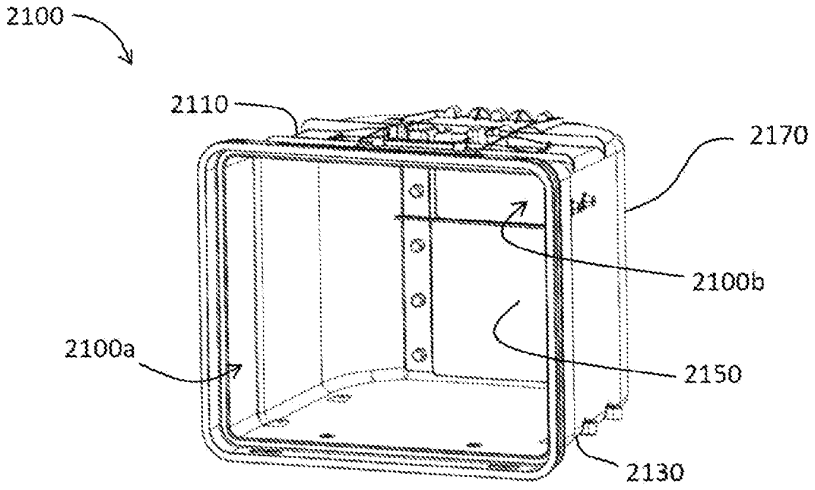
一第二彈性材料，設置於該氣閥主體之另一側，具有一對接面，用以供該外部淨化設備對接，藉以形成密封地接合。

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【發明圖式】

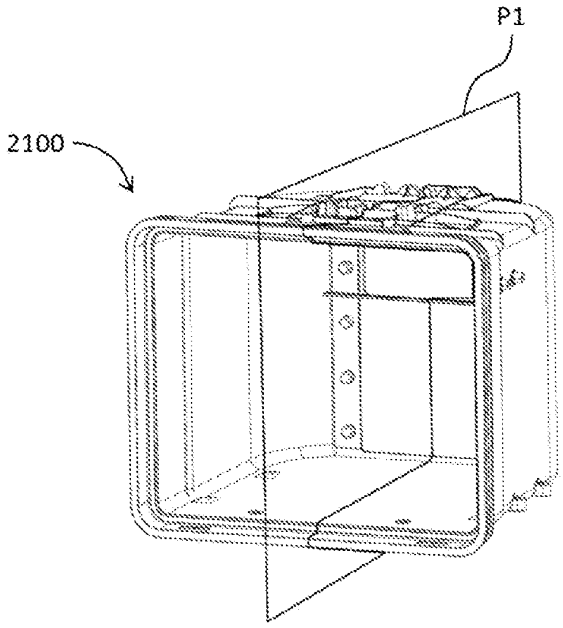


【圖1】

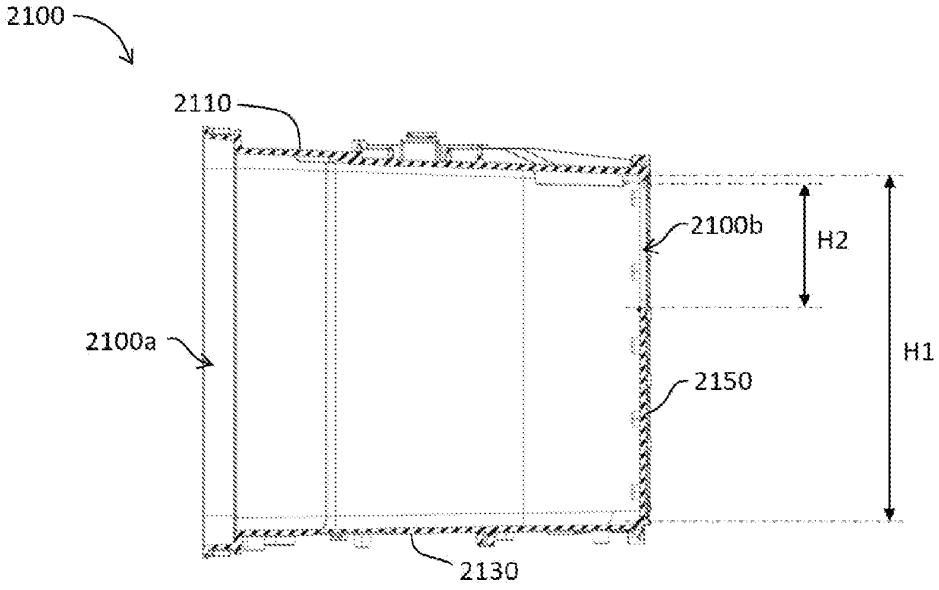


【圖2】

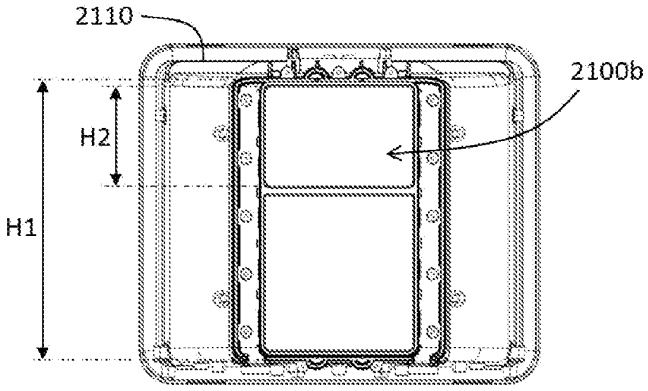
Entegris, EX1002, p. 144



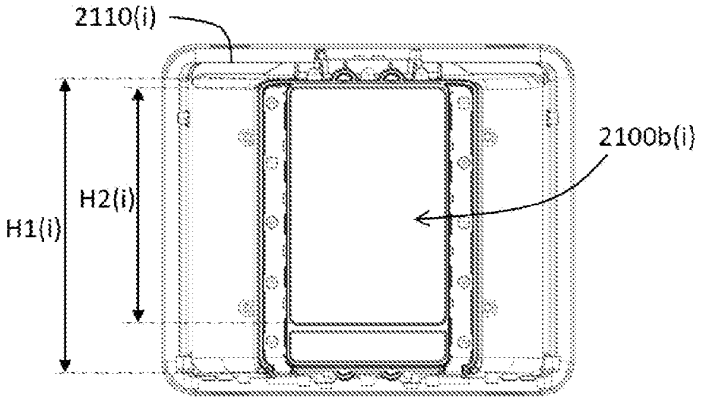
【圖3】



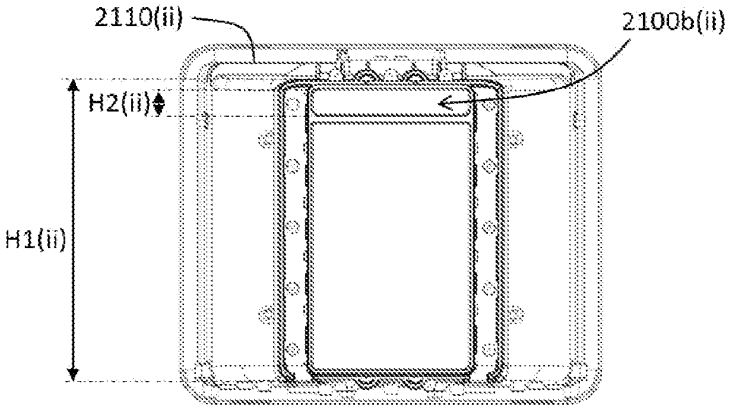
【圖4】


2110
2100b
H2
H1

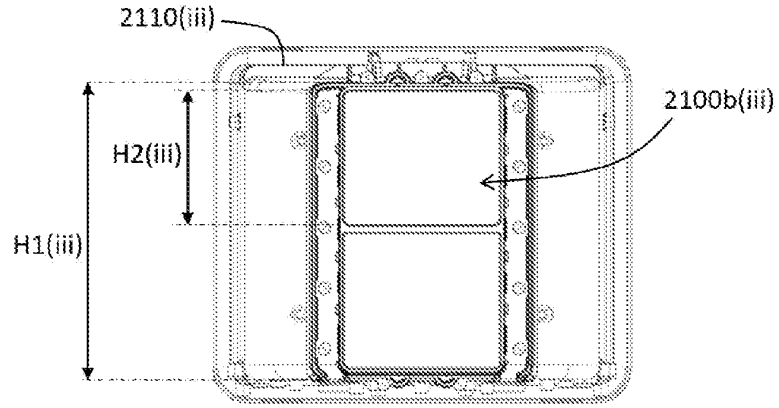
【圖5】


2110(i)
2100b(i)
H2(i)
H1(i)

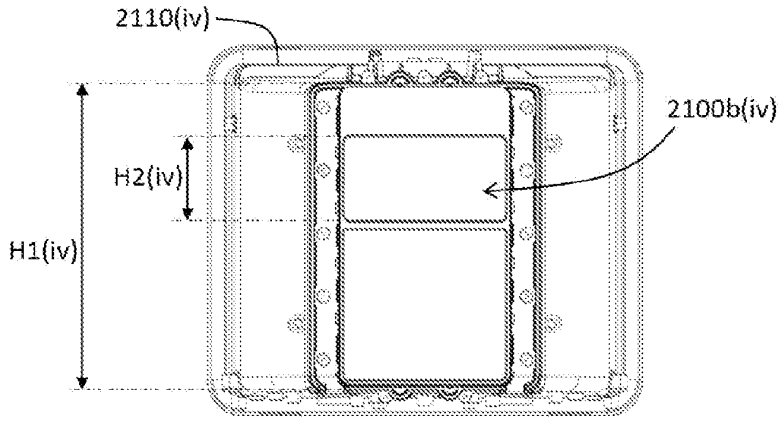
【圖6】


2110(ii)
2100b(ii)
H2(ii)
H1(ii)

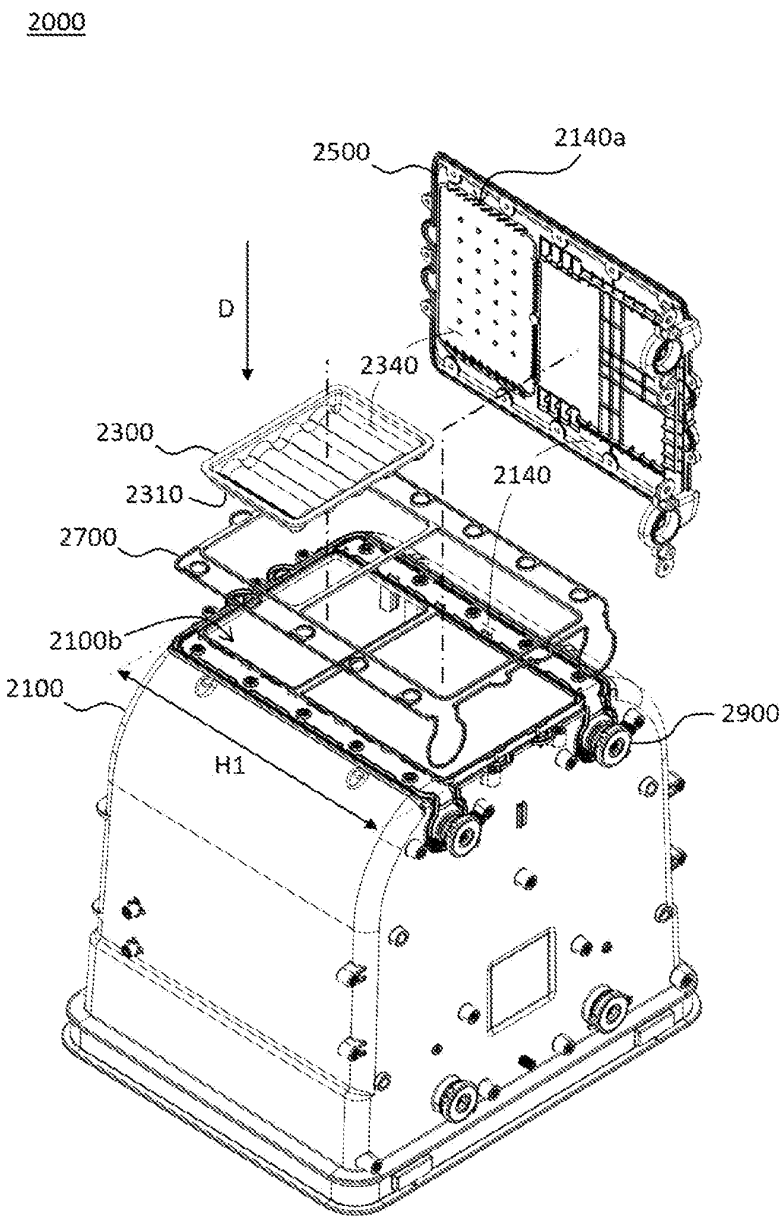
【圖 7】



【圖8】

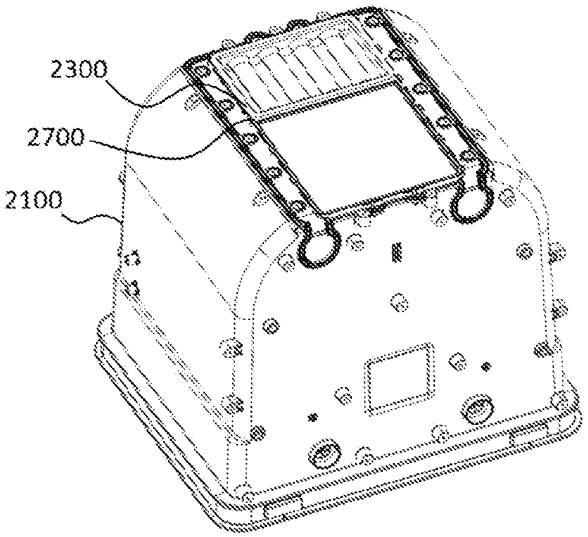


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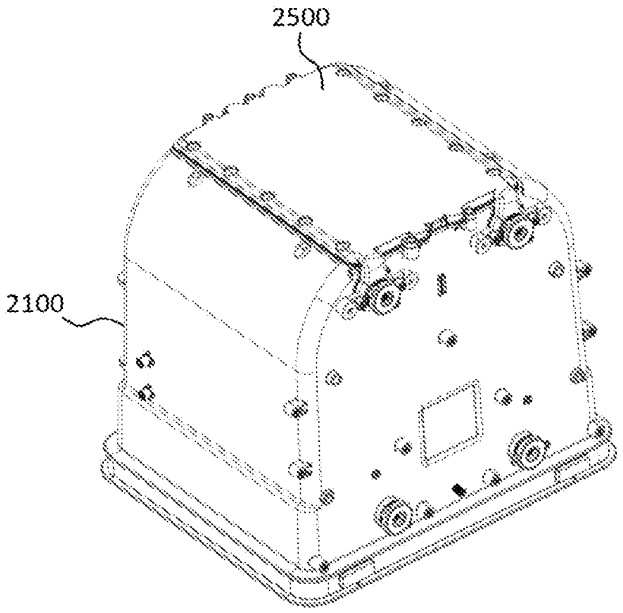


【圖10】

Entegris, EX1002, p. 148

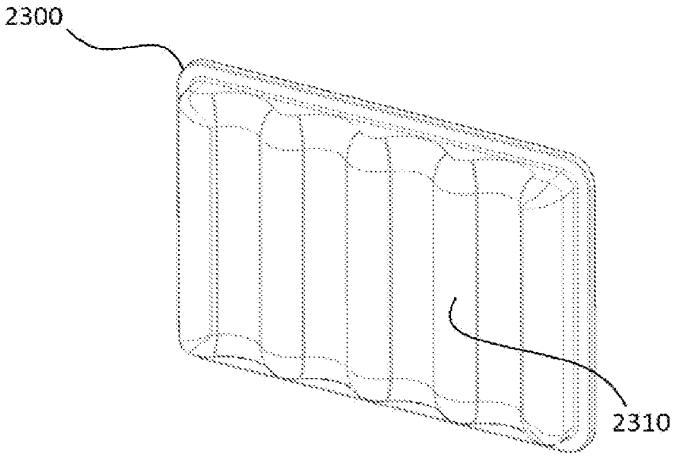


【圖11】

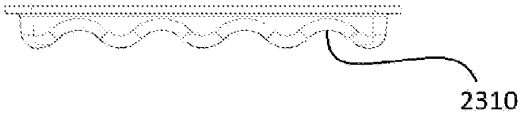


【圖12】

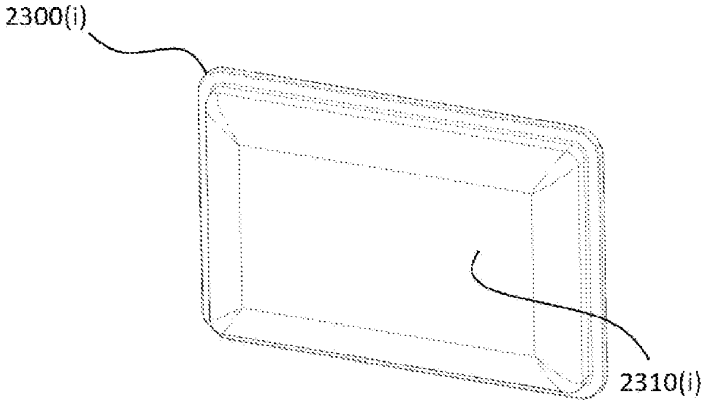
Entegris, EX1002, p. 149



【圖13a】

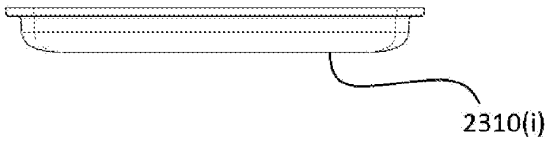


【圖13b】

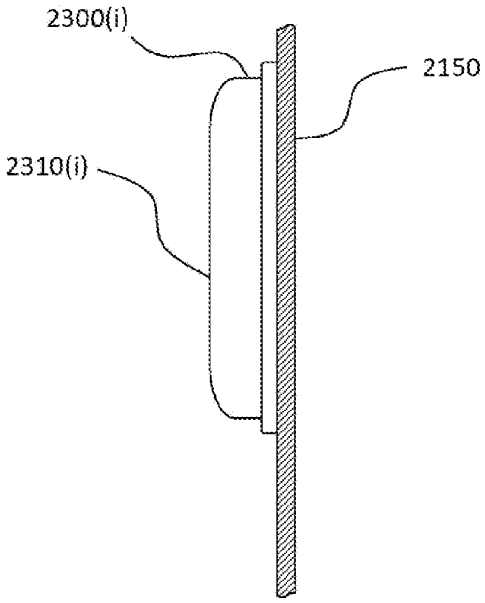


【圖14a】

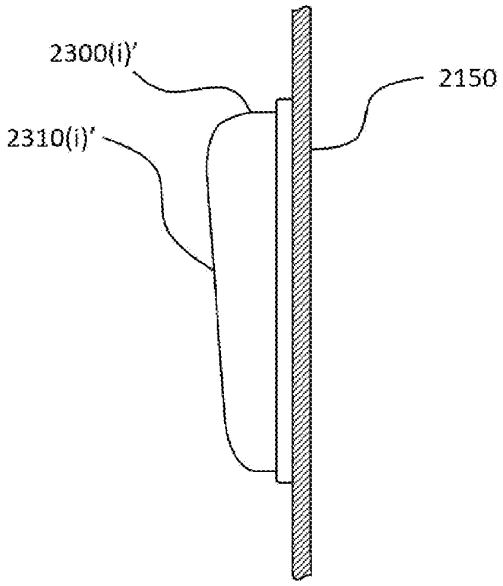
Entegris, EX1002, p. 150



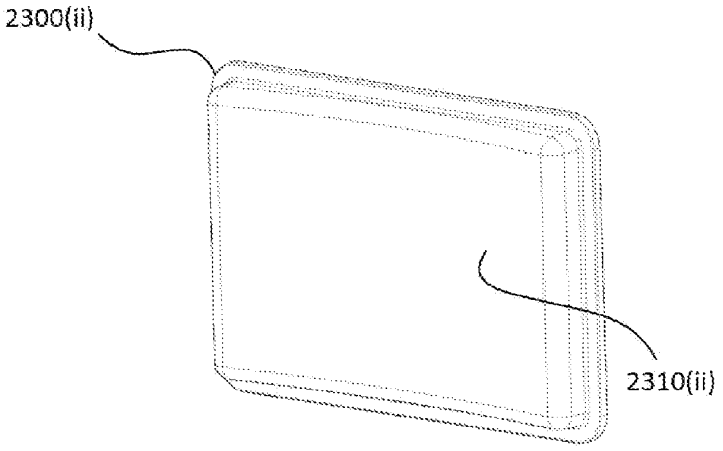
【圖14b】



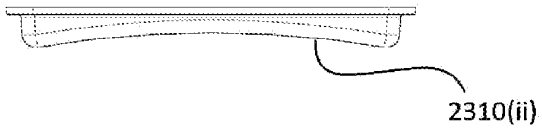
【圖14c】



【圖14d】

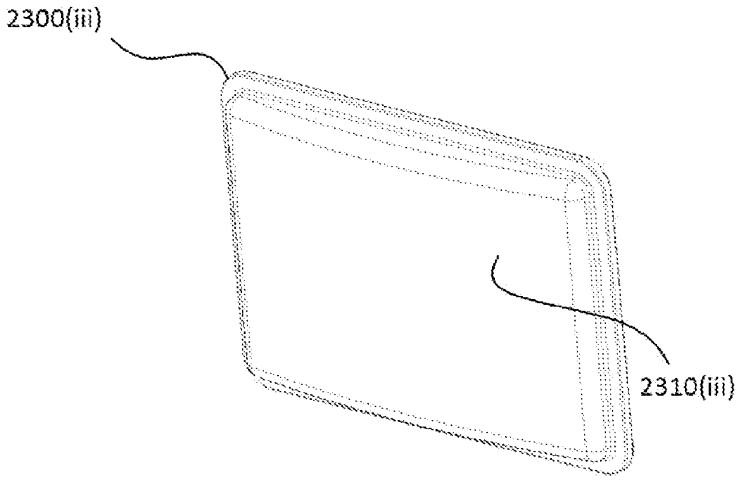


【圖15a】

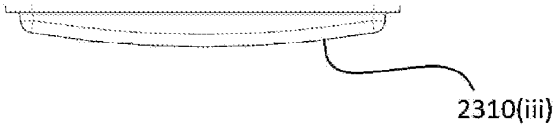


【圖15b】

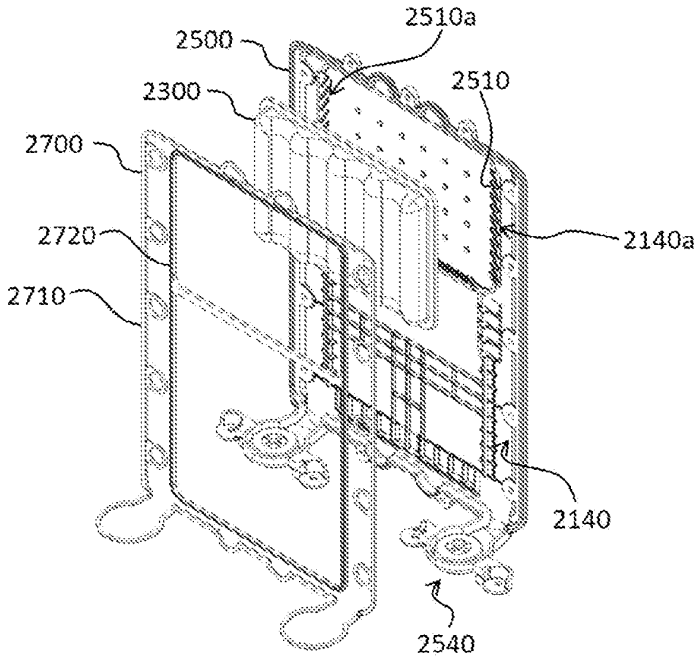
Entegris, EX1002, p. 152



【圖16a】

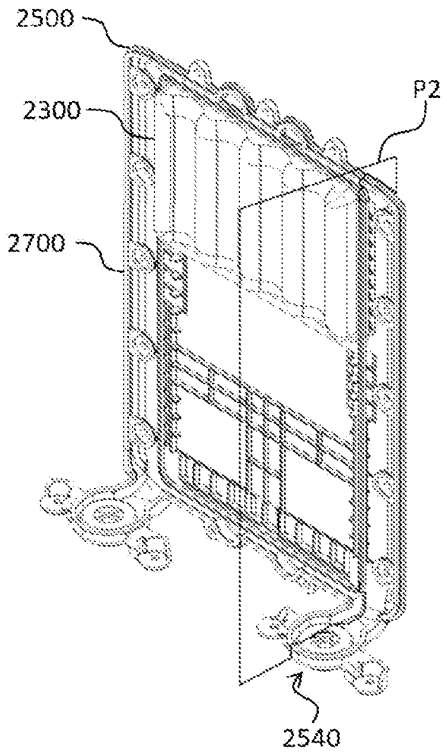


【圖16b】



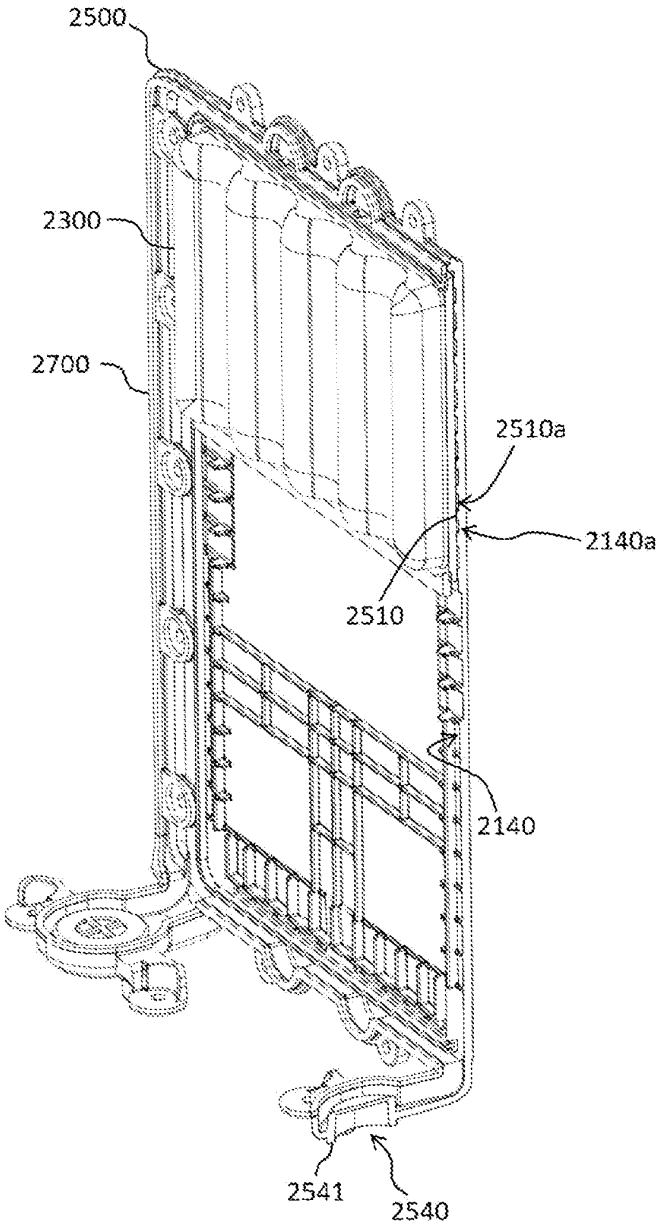
【圖17】

Entegris, EX1002, p. 153

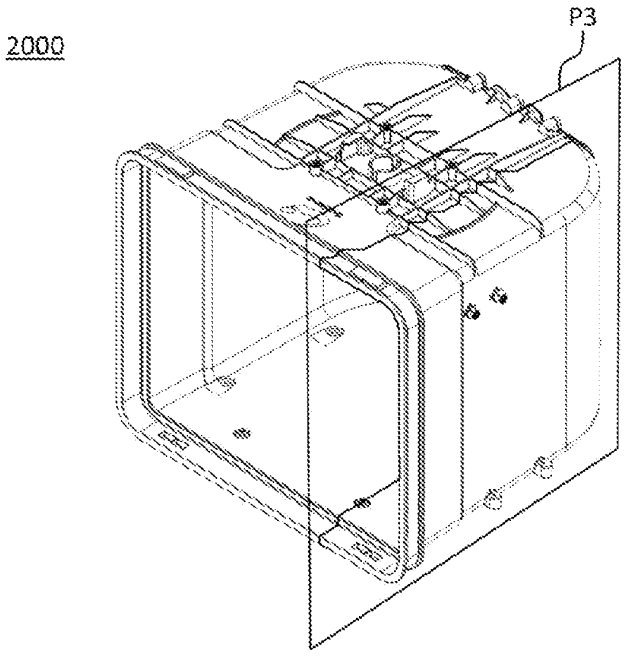


【圖18】

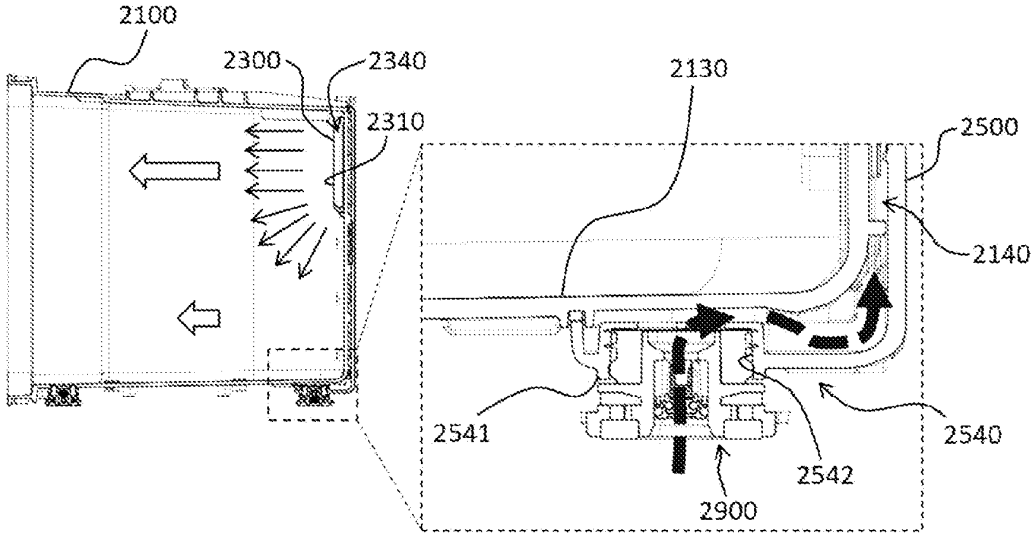
Entegris, EX1002, p. 154



【圖19】

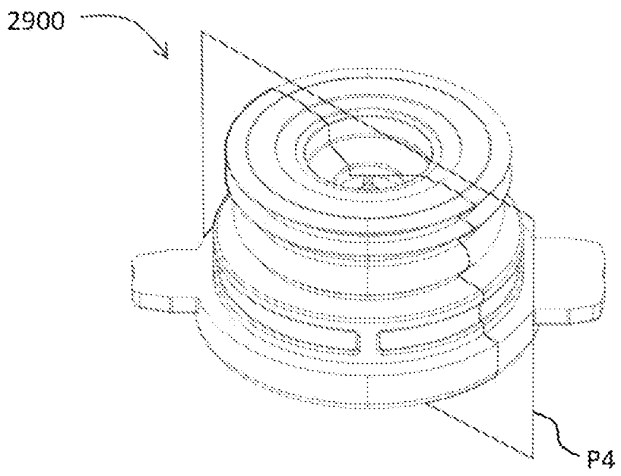


【圖20】

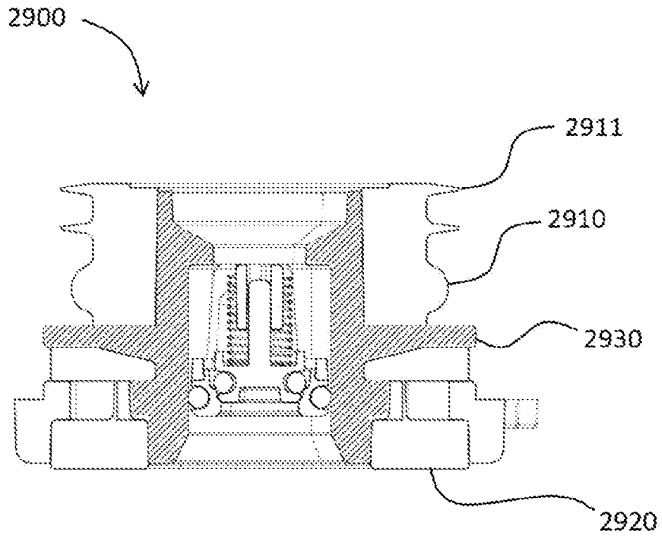


【圖21】

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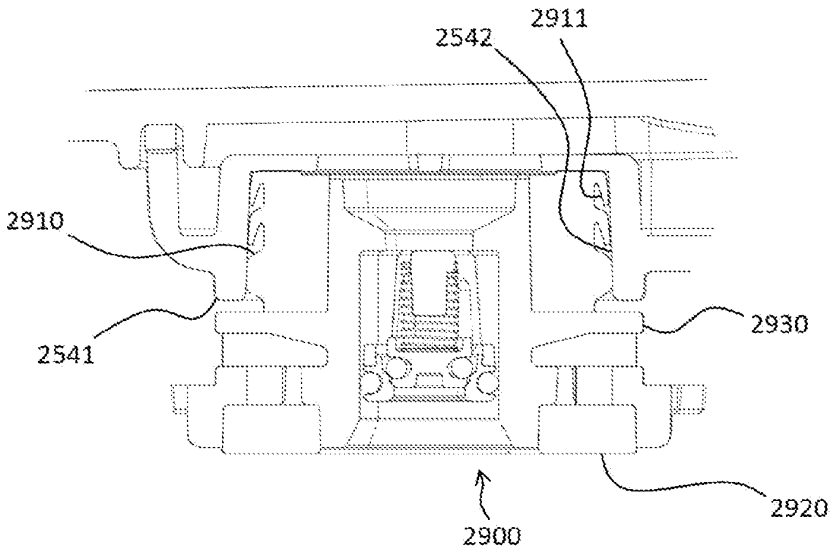


【圖22】

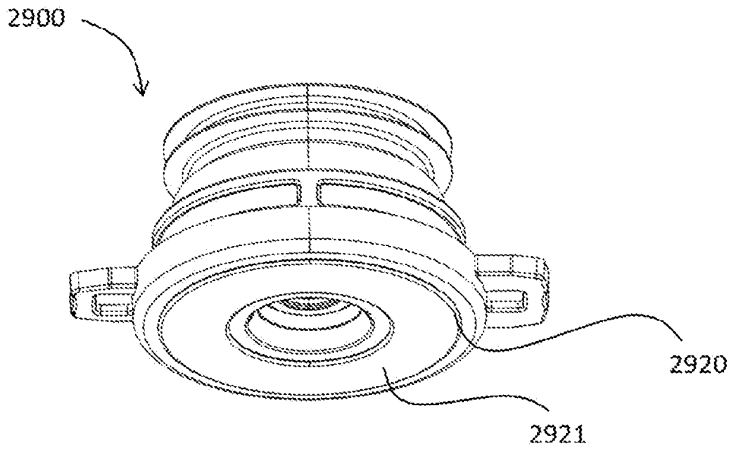


【圖23】

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【圖24】



【圖25】

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Ming-Chien Chiu et al.	Examiner:	Timothy Lewis Maust
Serial No.:	17/882,703	Group Art Unit:	3753
Filed:	August 8, 2022	Docket No.:	616137.100360 (previously 0114970.255US2)
Title:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME		

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

January 14, 2025

CUSTOMER NO. 21874

Dear Sir/Madam:

In response to the Office Action mailed October 15, 2024, please amend the above-identified application as follows and consider the following Remarks/Arguments:

Amendments to the Claims are reflected in the listing of claims that begins on page **2** of this paper.

Remarks/Arguments begin on page **9** of this paper.

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AMENDMENT TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the present application:

Listing of Claims

1-7. (Cancelled)

8. (Original) A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

a buffering gas chamber, configured at a bottom portion of the wafer container, the bottom portion provided with at least one coupling structure, the coupling structure defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and

at least one porous tube, having a longitudinal space, the porous tube installed to the coupling structure of the wafer container, the longitudinal space of the porous tube communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial.

9. (Original) The gas diffusion device according to claim 8, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial.

10. (Original) The gas diffusion device according to claim 8, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the

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porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial; the center axis of the longitudinal space of the porous tube is offset from the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis.

11. (Original) The gas diffusion device according to claim 8, wherein the longitudinal space of the porous tube has a closed end and an open end, and the open end receives the corresponding coupling structure, so that the gas enters the longitudinal space by passing through the buffering gas chamber and the open end.

12. (Original) The gas diffusion device according to claim 8, wherein a shape of a horizontal cross section of the porous tube is an ellipsoid or an elongated narrow shape having a long axis and a short axis, or a circle having a diameter.

13. (Original) The gas diffusion device according to claim 12, further comprising:

a first collar, arranged in the open end, the first collar located between the open end and the coupling structure.

14. (Original) The gas diffusion device according to claim 13, further comprising:

a second collar, located between the first collar and the coupling structure when the second collar is disposed on the coupling structure so as to reinforce airtightness.

15. (Original) The gas diffusion device according to claim 13, wherein a material of the first collar is softer than a material of the porous tube to prevent breaking of the open end.

16. (Currently amended) The gas diffusion device according to claim 14, wherein the second collar and the porous tube are sintered or bonded into an integral structure to prevent breaking of the open end.

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17. (Original) The gas diffusion device according to claim 15, wherein the coupling structure, the porous tube, the first collar and/or the second collar are/is made of a thermal resistant material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

18. (Original) The gas diffusion device according to claim 8, further comprising:

an airflow guiding member, arranged adjacent to one side of the porous tube, the airflow guiding member configured to adjust an airflow direction of the gas entering the accommodating space.

19. (Original) The gas diffusion device according to claim 8, further comprising:

at least one gas intake module, communicatively coupled to the buffering gas chamber, the gas intake module having the gas intake center axis, supplying the gas in one single gas intake direction to pass through the gas intake channel and enter the buffering gas chamber.

20. (Original) A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

a gas cartridge, configured at a bottom portion of the wafer container to define a buffering gas chamber, the bottom portion provided with at least two coupling structures, each of the coupling structures defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and

at least two porous tubes, each of the porous tubes having a longitudinal space, the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass

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through the at least two porous tubes and enter the accommodating space.

21. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, the center axis of the longitudinal space of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial.

22. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial; the center axis of the longitudinal space of each of the porous tubes is offset from the center axis of the through channel, the center axis of the open end of the porous tube and the gas intake center axis.

23. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tube has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, and the center axis of the longitudinal space of each of the porous tubes are coaxial; a position of a gas intake center axis along which the gas passes is offset from the center axis of the through channel , the center axis of the open end and the center axis of the longitudinal space that are coaxial.

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24. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels and the center axis of the open end of each of the porous tubes are coaxial; a gas intake center axis along which the gas passes and the center axis of the longitudinal space are both offset from the center axis of the through channel and the center axis of the open end that are coaxial.

25. (Original) The gas diffusion device according to claim 20, wherein the gas cartridge has a bottom portion and a sidewall extending from the bottom portion, and the gas intake channel is formed at the bottom portion of the gas cartridge.

26. (Currently amended) The gas diffusion device according to claim 20, wherein the gas cartridge is installed at the bottom portion of the wafer container, such that [[the]]a bottom portion and [[the]]a sidewall of the gas cartridge and the bottom portion of the wafer container define the buffering gas chamber.

27. (Original) The gas diffusion device according to claim 20, wherein a plurality of annular sidewalls further extend from a lower surface of the bottom portion of the gas cartridge, each of the annular sidewalls defines an installation space for filling with a gas intake module, and the gas intake module has the gas intake center axis; the installation space, the gas intake channel at the bottom portion of the gas cartridge and the buffering gas chamber communicate with one another, such that the gas in one single air intake direction supplied by the gas intake module passes through the gas intake channel and enters the buffering gas chamber.

28. (Original) The gas diffusion device according to claim 20, wherein the wafer container comprises a base plate installed at the bottom portion of the wafer container, and the

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buffer gas chamber is between the bottom portion and the base plate of the wafer container.

29. (Original) The gas diffusion device according to claim 28, wherein the base plate is made of a material comprising a self-lubricating material.

30. (Currently amended) A wafer container, comprising:

a shell, comprising a bottom portion, the bottom portion configured with a plurality of coupling structures, the coupling structures defining a plurality of through channels;

a buffering gas chamber, formed below the bottom portion, the buffering gas chamber having a plurality of gas intake channels, the gas intake channels communicating with the corresponding through channels; and

a plurality of porous tubes, each of the porous tubes having an open end, the open end correspondingly ~~sleeved~~ connecting with the coupling structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel, allowing a gas to pass through the porous tubes and enter an accommodating space of the shell.

31. (Original) The wafer container according to claim 30, wherein the porous tube has a longitudinal space, the longitudinal space has a closed end and an open end, and the gas in the buffering gas chamber is capable of passing through the open end to enter the longitudinal space.

32. (Original) The wafer container according to claim 30, further comprising:

a collar, arranged between the open end and the coupling structure, a material of the collar being softer than a material of the porous tube to prevent breaking of the open end.

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33. (Original) The wafer container according to claim 30, further comprising:

a gas cartridge, having a bottom portion and a sidewall extending from the bottom portion, the bottom portion of the gas cartridge having the gas intake channels formed thereon.

34. (Original) The wafer container according to claim 33, wherein the gas cartridge is installed at the bottom portion of the shell, such that the gas cartridge and the bottom portion of the shell define the buffering gas chamber.

35. (Original) The wafer container according to claim 33, wherein a plurality of annular sidewalls further extend from the bottom portion of the gas cartridge, and each of the annular sidewalls defines an installation space for filling with a gas intake module.

36. (Original) The wafer container according to claim 30, wherein the wafer container further comprises a door detachably combined with the shell, and a pair of support portions configured on an inner side of the shell, and the wafer container is made of a thermal resistance material, which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

37. (Original) The wafer container according to claim 30, further comprising:

a base plate, connected below the shell to support the shell;

wherein the buffering gas chamber is between the bottom portion and the base plate of the shell.

38. (Original) The wafer container according to claim 37, wherein the base plate is made of a material comprising a self-lubricating material.

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REMARKS/ARGUMENTS

Claims 8-38 were pending in the present application before this amendment as set forth above. By this amendment, claims 16, 26 and 30 are amended. Currently, claims 8-38 remain pending.

In the October 15, 2024 Office Action, Claims 16 and 26 are objected to because of informalities. Claim 8-38 are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Ogawa (US 10,923,373).

Applicant appreciates the Examiner's careful review of the present application and allowability of claim 5.

In response, as set forth above, Applicant has amended Claims 16, 26 and 30. Specifically, Claims 16 and 26 have been amended to correct the informalities. Claims 30 has been amended to remove the word "sleeved". Support for the amendments can be found in the disclosure of the present application, as originally filed. No new matter is introduced.

The following remarks herein are considered to be responsive thereto.

Objections to the Claims

As set forth above, Claims 16 and 26 have been amended to correct the informalities.

Claim Rejections under 35 U.S.C. 102

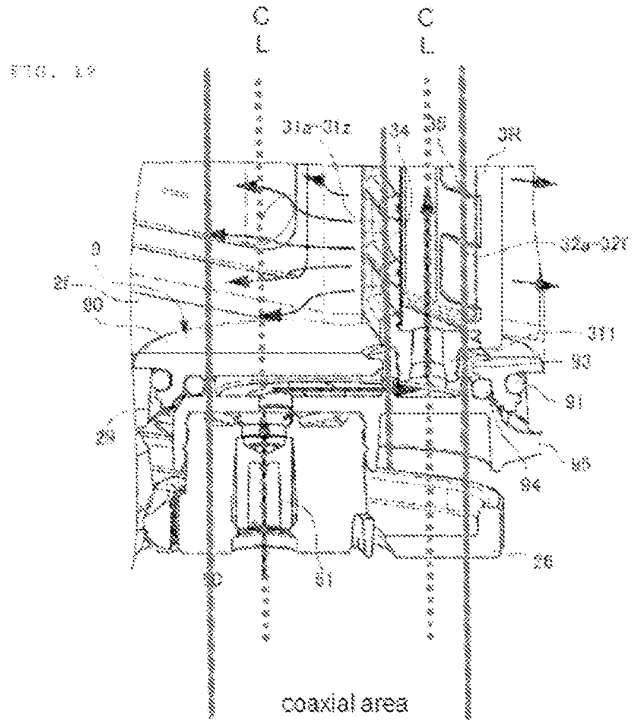
Claim 8-38 are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Ogawa. Applicant respectfully traverses the rejections as follows.

1. Claim 8 is not anticipated by Ogawa.

Claim 8 recites, in combination with other feature, "a gas intake center axis of the gas and a center axis of the coupling structure being **coaxial**." Applicant respectfully submits that Ogawa does not disclose or otherwise teach at least the limitation set forth above, and thus Ogawa cannot anticipate Claim 8.

In the Action, the Examiner deemed that FIG. 12 of Ogawa, as shown below, discloses the element set forth above. Apparently, the gas intake center axis and the center axis of the

coupling structure is **not coaxial**, and the coaxial area should not be construed as the annotated FIG. 12.



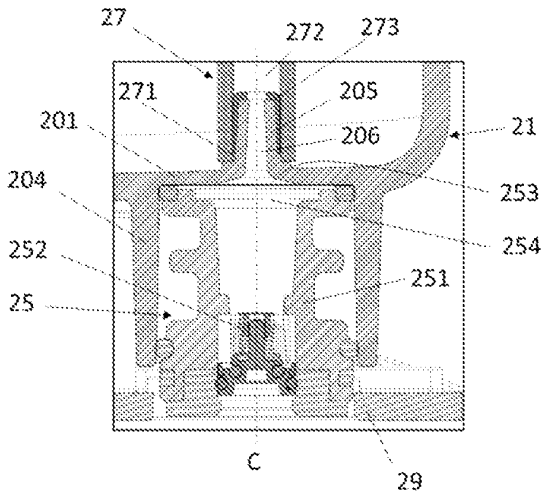
(Ogawa, FIG. 12 annotated by Examiner.)

Specifically, Ogawa describes:

"*Finally, the flow of the gas G will be described. FIG. 12 is a cross-sectional perspective view showing the flow of the gas flowing from the intake valve. The flow of the gas G is indicated by arrows. In FIG. 12, the gas G which is introduced at a high pressure from the intake valve 50 passes through the filter member 51, and* ***flows through the gap between the offset plate presser 90 and the offset plate 95****, and is directed to the connection portion between the offset plate presser 90 at the back B and the connecting member 311 at the lower portion of the gas replacement unit 3R.*"(Ogawa, col. 10, lines 50-59)

As shown in FIG. 12 of Ogawa, the gas replacement unit 3R is offset to the intake valve 50. Therefore, the gas G flows from the intake valve 50 to gas replacement unit 3R through the gap between the offset plate presser 90 and the offset plate 95.

As to the claimed invention, the claimed coaxial feature can be referred to the FIG. 6 of present application, the gas intake center axis of the gas and the canter axis of the coupling structure are coaxial without offset, so the gas enters the porous tube directly, rather than be deflected by an offset portion before entering the porous tube.



(Present claimed invention, FIG. 6.)

In view of the foregoing, Ogawa does not disclose the feature combination of pending Claim 8. At least, Ogawa is silent about "a gas intake center axis of the gas and a center axis of the coupling structure being coaxial." of pending Claim 8. Therefore, the skilled person would not anticipate the claimed combination of features after a fully and fair reading of Ogawa.

For at least the foregoing reasons, Applicant respectfully submits that the subject matters of Claims 8-19 are not anticipated by Ogawa, and are therefore patentable. Withdrawal of the rejections under 35 U.S.C. § 102 is respectfully requested.

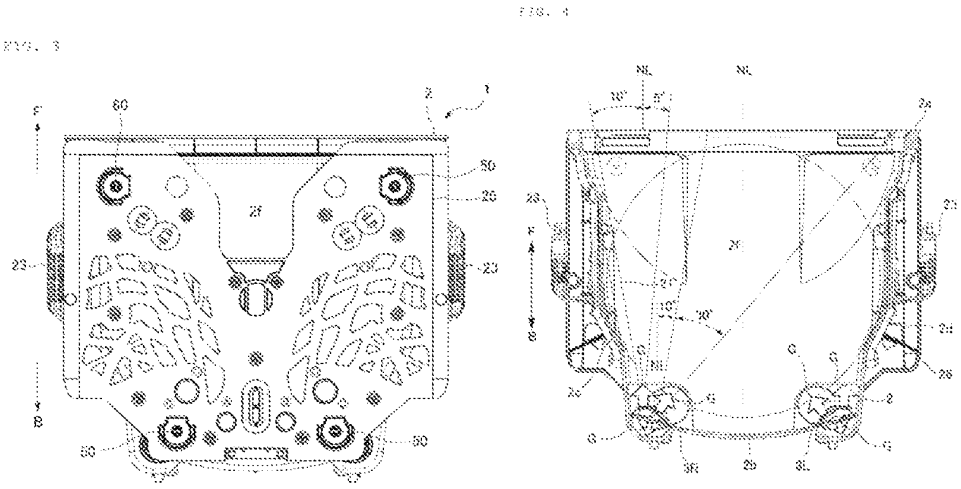
2. Claim 20 is not anticipated by Ogawa.

Claim 20 recites, in combination with other feature, "the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber, the

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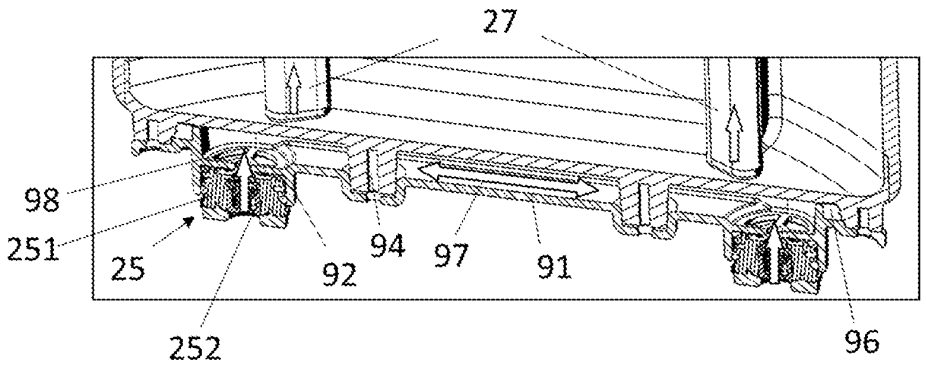
buffering gas chamber providing a gas to pass through the at least two porous tubes and enter the accommodating space." Applicant respectfully submits that Ogawa does not disclose or otherwise teach at least the limitation set forth above, and thus cannot anticipate Claim 20.

Referring to FIGS. 3 and 4 of Ogawa, although Ogawa discloses two gas replacement units (3R, 3L), each gas replacement unit corresponds only an intake valve 50. That is, the gas flows through to one gas replacement from only one intake valve.



(Ogawa, FIGS. 3 and 4.)

As to the claimed invention, as the figure shown below, the two porous tubes 27 communicating with the buffering gas chamber 97. On the other words, the claimed invention recites the multiple porous tubes are communicated with the buffering gas chamber, so as to resolves the problem of an uneven airflow entering the interior of the container or an insufficient total flow caused by a difference in the incoming air of a conventional diffuser. Therefore, Ogawa at least does not disclose or teach the element "a gas cartridge" recited in Claim 20.



(Present claimed invention, FIG. 19.)

In view of the foregoing, Ogawa does not disclose the feature combination of pending Claim 20. At least, Ogawa is silent about "the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, **the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber**, the buffering gas chamber providing a gas to pass through the at least two porous tubes and enter the accommodating space" recited in Claim 20. Therefore, the skilled person would not anticipate the claimed combination of features after a fully and fair reading of Ogawa.

For at least the foregoing reasons, Applicant respectfully submits that the subject matters of Claims 20-29 are not anticipated by Ogawa, and are therefore patentable. Withdrawal of the rejections under 35 U.S.C. § 102 is respectfully requested.

3. Claim 30 is not anticipated by Ogawa

Claim 30 recites, in combination with other feature, "buffering gas chamber having a plurality of gas intake channels, the gas intake channels communicating with the corresponding through channels" and "a plurality of porous tubes, each of the porous tubes having an open end, the open end correspondingly connecting with the coupling structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel." Applicant respectfully submits that Ogawa does not disclose or otherwise teach at least the limitations set forth above, and thus cannot anticipate the feature combination of Claim 30.

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As the similar reasons mentioned in Claim 20 argument. Ogawa discloses the gas flows to one gas replacement unit from only one intake valve.

The claimed invention recites a plurality of gas intake channels communicating with a plurality of porous tubes via the buffering gas chamber which is used to resolves the problem of an uneven airflow entering the interior of the container or an insufficient total flow caused by a difference in the incoming air of a conventional diffuser. Ogawa at least does not disclose or teach the element "buffering gas chamber" recited in Claim 30.

In view of the foregoing, Ogawa does not disclose the combination of pending Claim 30. At least, Ogawa is silent about "**buffering gas chamber having a plurality of gas intake channels, the gas intake channels communicating with the corresponding through channels**" and "a plurality of porous tubes, each of the porous tubes having an open end, the open end correspondingly connecting with the coupling structure at the bottom portion and **communicating with the buffering gas chamber** via the corresponding through channel" recited in Claim 30.

For at least the foregoing reasons, Applicant respectfully submits that the subject matters of Claims 30-38 are not anticipated by Ogawa, and are therefore patentable. Withdrawal of the rejections under 35 U.S.C. § 102 is respectfully requested.

It is now believed that the application is in condition for allowance and such allowance is respectfully requested.

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CONCLUSION

Applicant respectfully submits that the foregoing Response places this application in condition for allowance. If the Examiner believes that there are any issues that can be resolved by a telephone conference, or that there are any informalities that can be corrected by an Examiner's amendment, please call the undersigned at 404-870-4698.

It is believed that no fee is due. However, the Commissioner is hereby authorized to charge any deficiency of fees that may be required, and credit of any overpayments to Deposit Account No. 121781.

Respectfully submitted,

TROUTMAN PEPPER LOCK LLP

January 14, 2025



Tim Tingkang Xia
Attorney for Applicant on the Record
Reg. No. 45,242

Terminus 200, Suite 2000
3333 Piedmont Road NE
Atlanta, Georgia 30305
Phone: 404-870-4698
Customer No. 21874

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/882,703	Filing Date 08/08/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	01/14/2025	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 21	Minus	** 38	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 4	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/DENISE T LILES/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

21874 7590 10/15/2024

Locke Lord LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EXAMINER	
MAUST, TIMOTHY LEWIS	

ART UNIT	PAPER NUMBER
3753	

NOTIFICATION DATE	DELIVERY MODE
10/15/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patent@lockelord.com

Office Action Summary	**Application No.** 17/882,703	**Applicant(s)** Chiu et al.	
	Examiner TIMOTHY L MAUST	**Art Unit** 3753	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 9/16/24.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 8-38 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 8-38 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 8/8/22 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

Applicant's election without traverse of Group II, claims 8 - 38 in the reply filed on 9/16/24 is acknowledged.

Claim Objections

Claim 16 is objected to because of the following informalities: "the second collar and the porous tube are sintered or bonded into an integral" is grammatically incorrect. Appropriate correction is required.

Claim 26 is objected to because of the following informalities: "the sidewall" should be "a sidewall". Appropriate correction is required.

Claim Rejections - 35 USC § 102

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

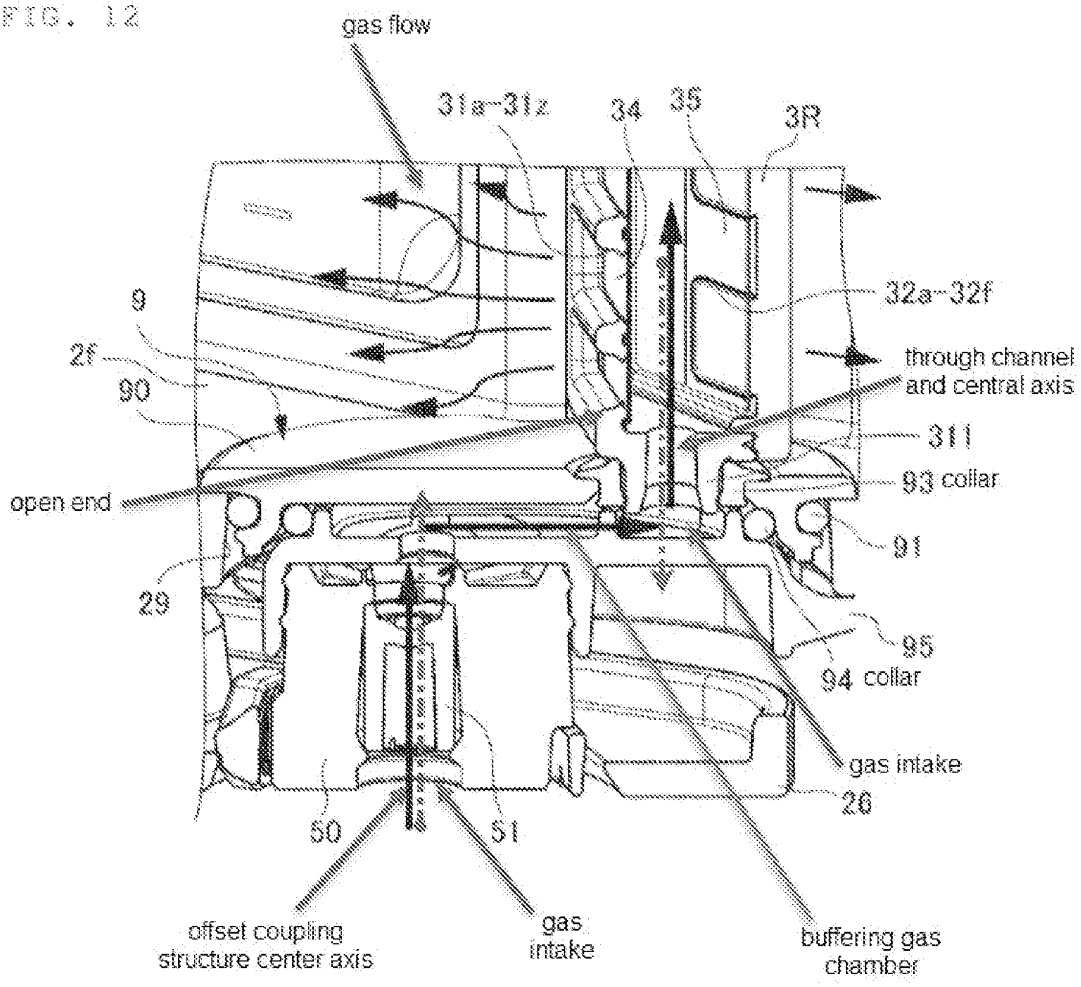
> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention.

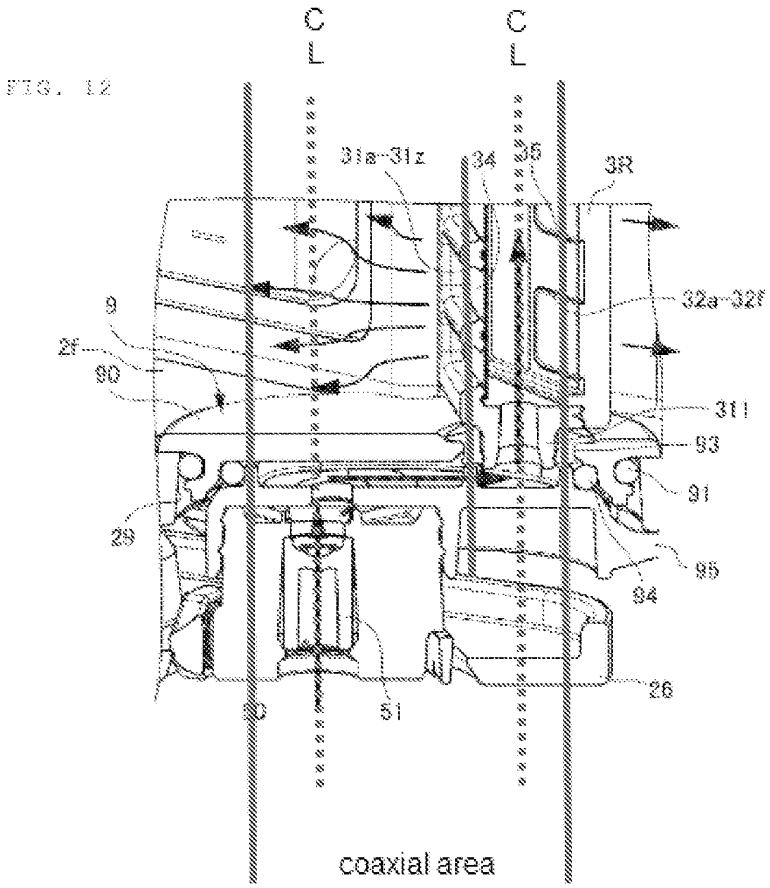
Claim(s) 8 - 38 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Ogawa (10923373).

Regarding claim 8, the Ogawa reference discloses a gas diffusion device (see Fig. 2), installed in a wafer container (1) having an accommodating space, the gas diffusion device comprising:

a buffering gas chamber (see Annotated Figure 12), configured at a bottom portion of the wafer container, the bottom portion provided with at least one coupling structure (90, 95), the coupling structure defining a through channel having a center axis (see Fig. 2A), the buffering gas chamber having at least one gas intake channel (defined at intake valve 50), the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another (see gas flow from 50 to 31a-z); and at least one porous tube (see 3R in Figures 5 - 8), having a longitudinal space, the porous tube installed to the coupling structure of the wafer container (311 is coupled to 93; see Annotated Figure 12), the longitudinal space of the porous tube communicating with the buffering gas chamber, the buffering gas chamber providing a gas (G) to pass through the porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial (see Annotated Figure 12).

FIG. 12


gas flow
31a–31z
34
35
3R
32a–32f
9
2f
90
through channel and central axis
311
93 collar
open end
91
29
95
94 collar
gas intake
26
50
51
offset coupling structure center axis
gas intake
buffering gas chamber



Regarding claim 9, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial. **See Annotated Figure 12**.

Regarding claim 10, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial; the center axis of the longitudinal space of the porous tube is offset from the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis. **See Annotated Figure 12.**

Regarding claim 11, wherein the longitudinal space of the porous tube has a closed end and an open end (Figs. 5 – 8), and the open end receives the corresponding coupling structure (coupled at 311; Fig. 12), so that the gas enters the longitudinal space by passing through the buffering gas chamber and the open end.

Regarding claim 12, wherein a shape of a horizontal cross section of the porous tube is an ellipsoid or an **elongated narrow shape having a long axis and a short axis** (see Figs. 5 – 8), or a circle having a diameter.

Regarding claim 13, further comprising: a first collar (93), arranged in the open end, the first collar located between the open end and the coupling structure (90).

Regarding claim 14, further comprising: a second collar (94), located between the first collar (93) and the coupling structure (90, 95) when the second collar is disposed on the coupling structure so as to reinforce airtightness. **See Figure 12.**

Regarding claim 15, wherein a material of the first collar (93) is softer than a material of the porous tube to prevent breaking of the open end. **First collar (93) is a "packing", which would inherently be made of a softer material than porous tube (32).**

Regarding claim 16, wherein the second collar (94) and the porous tube (32) are sintered or bonded into an integral to prevent breaking of the open end. **As best understood, the Ogawa reference meets the claim limitation**.

Regarding claim 17, wherein the coupling structure, the porous tube, the first collar and/or the second collar are/is made of a thermal resistant material which is **one** or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP. **See column 5, lines 14 – 23**.

Regarding claim 18, further comprising: an airflow guiding member (32a-z), arranged adjacent to one side of the porous tube, the airflow guiding member configured to adjust an airflow direction of the gas entering the accommodating space.

Regarding claim 19, further comprising: at least one gas intake module (50; absent further defined structure), communicatively coupled to the buffering gas chamber, the gas intake module having the gas intake center axis, supplying the gas in

one single gas intake direction to pass through the gas intake channel and enter the buffering gas chamber.

Regarding claim 20, the Ogawa reference discloses a gas diffusion device (see Figure 2), installed in a wafer container (1) having an accommodating space, the gas diffusion device comprising:

a gas cartridge (50), configured at a bottom portion (26) of the wafer container to define a buffering gas chamber, the bottom portion provided with at least two coupling structures (defined at 50, see Figure 3), each of the coupling structures defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber (defined at 50), the through channel and the accommodating space communicating with one another; and at least two porous tubes (3R, 3L), each of the porous tubes having a longitudinal space, the at least two porous tubes respectively installed to corresponding coupling structures (90, 95) of the wafer container, the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the at least two porous tubes and enter the accommodating space. **See Annotated Figure 12**.

Regarding claim 21, wherein the at least two coupling structures (90, 95) are formed as extending from the bottom portion (26) of the wafer container, an open end of the longitudinal space of each of the porous tubes (3R, 3L) has a center axis, and the longitudinal space has a center axis; the center axis of each of the through channels,

the center axis of the open end of each of the porous tubes, the center axis of the longitudinal space of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial. **See Annotated Figure 12.**

Regarding claim 22, wherein the at least two coupling structures (90, 95) are formed as extending from the bottom portion (26) of the wafer container, an open end of each of the porous tubes (3R, 3L) has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial; the center axis of the longitudinal space of each of the porous tubes is offset from the center axis of the through channel, the center axis of the open end of the porous tube and the gas intake center axis. **See Annotated Figure 12.**

Regarding claim 23, wherein the at least two coupling structures (90, 95) are formed as extending from the bottom portion (26) of the wafer container, an open end of the longitudinal space of each of the porous tubes (3R, 3L) has a center axis, and the longitudinal space of each of the porous tube has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, and the center axis of the longitudinal space of each of the porous tubes are coaxial; a position of a gas intake center axis along which the gas passes is offset from the center axis of the through channel , the center axis of the open end and the center axis of the longitudinal space that are coaxial. **See Annotated Figure 12.**

Regarding claim 24, wherein the at least two coupling structures (90, 95) are formed as extending from the bottom portion (26) of the wafer container, an open end of each of the porous tubes (3R, 3L) has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels and the center axis of the open end of each of the porous tubes are coaxial; a gas intake center axis along which the gas passes and the center axis of the longitudinal space are both offset from the center axis of the through channel and the center axis of the open end that are coaxial. **See Annotated Figure 12**.

Regarding claim 25, wherein the gas cartridge has a bottom portion and a sidewall extending from the bottom portion, and the gas intake channel is formed at the bottom portion of the gas cartridge. **"sidewalls" are defined by the openings that contain gas cartridges (50).**

Regarding claim 26, wherein the gas cartridge (50) is installed at the bottom portion (26) of the wafer container (1), such that the bottom portion and the sidewall of the gas cartridge and the bottom portion of the wafer container define the buffering gas chamber. **See Annotated Figure 12**.

Regarding claim 27, wherein a plurality of annular sidewalls further extend from a lower surface of the bottom portion (26) of the gas cartridge, each of the annular sidewalls defines an installation space for filling with a gas intake module, and the gas intake module has the gas intake center axis; the installation space, the gas intake

channel at the bottom portion of the gas cartridge and the buffering gas chamber communicate with one another, such that the gas in one single air intake direction supplied by the gas intake module passes through the gas intake channel and enters the buffering gas chamber. **See Annotated Figure 12.**

Regarding claim 28, wherein the wafer container comprises a base plate (26) installed at the bottom portion of the wafer container, and the buffer gas chamber is between the bottom portion and the base plate of the wafer container. **See Annotated Figure 12.**

Regarding claim 29, wherein the base plate (26) is made of a material comprising a self-lubricating material. **See column 5, lines 14 – 23, where liquid crystal polymer is an example of a self-lubricating material.**

Regarding claim 30, the Ogawa reference discloses a wafer container (1; see Figure 3), comprising: a shell (2), comprising a bottom portion (26), the bottom portion configured with a plurality of coupling structures (defined at 50), the coupling structures defining a plurality of through channels (see Annotated Fig. 12);
a buffering gas chamber (see Annotated Fig. 12), formed below the bottom portion, the buffering gas chamber having a plurality of gas intake channels (via 50), the gas intake channels communicating with the corresponding through channels; and
a plurality of porous tubes (3R, 3L), each of the porous tubes having an open end (see Annotated Fig. 12), the open end correspondingly sleeved connecting with the coupling

structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel, allowing a gas to pass through the porous tubes and enter an accommodating space of the shell. **See Annotated Figure 12.**

Regarding claim 31, wherein the porous tube (3R) has a longitudinal space, the longitudinal space has a closed end and an open end, and the gas in the buffering gas chamber is capable of passing through the open end to enter the longitudinal space. **See Annotated Figure 12.**

Regarding claim 32, further comprising: a collar (93), arranged between the open end and the coupling structure, a material of the collar being softer than a material of the porous tube to prevent breaking of the open end. **First collar (93) is a "packing", which would inherently be made of a softer material than porous tube (32).**

Regarding claim 33, further comprising: a gas cartridge (50), having a bottom portion and a sidewall extending from the bottom portion, the bottom portion of the gas cartridge having the gas intake channels formed thereon. **See Annotated Figure 12.**

Regarding claim 34, wherein the gas cartridge (50) is installed at the bottom portion (26) of the shell, such that the gas cartridge and the bottom portion of the shell define the buffering gas chamber. **See Annotated Figure 12.**

Regarding claim 35, wherein a plurality of annular sidewalls further extend from the bottom portion of the gas cartridge (50), and each of the annular sidewalls defines an installation space for filling with a gas intake module. **"annular sidewalls" are defined by the openings that contain gas cartridges (50).**

Regarding claim 36, wherein the wafer container (1) further comprises a door detachably combined with the shell (2), and a pair of support portions configured on an inner side of the shell, and the wafer container is made of a thermal resistance material, which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP. **See column 5, lines 14 – 23**.

Regarding claim 37, further comprising: a base plate (bottom portion 26 is a base plate), connected below the shell to support the shell; wherein the buffering gas chamber is between the bottom portion and the base plate of the shell. **See Annotated Figure 12**.

Regarding claim 38, wherein the base plate is made of a material comprising a self-lubricating material. **See column 5, lines 14 – 23, where liquid crystal polymer is an example of a self-lubricating material**.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TIMOTHY LEWIS MAUST whose telephone number is (571)272-4891. The examiner can normally be reached Monday - Thursday, 7am - 5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Craig Schneider can be reached on 571-272-3607. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TIMOTHY L MAUST/
Primary Examiner, Art Unit 3753

Notice of References Cited	Application/Control No. 17/882,703	Applicant(s)/Patent Under Reexamination Chiu et al.	
	Examiner TIMOTHY L MAUST	Art Unit 3753	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-10923373-B2	2021-02-16	Ogawa; Osamu	H01L21/67379	1/1
	B					
	C					
	D					
	E					
	F					
	G					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	Art Unit
	TIMOTHY L MAUST	3753

CPC - Searched*		
Symbol	**Date**	**Examiner**
H01L 21/67389, 21/67393	10/09/2024	tlm

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
141	text	10/09/2024	tlm

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Assignee search	10/09/2024	tlm
Inventor name search	10/09/2024	tlm
CPC and text search in SEARCH	10/09/2024	tlm
MLTD search of pertinent prior art	10/09/2024	tlm
3rd party submission reviewed	10/09/2024	tlm

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/TIMOTHY L MAUST/ Primary Examiner, Art Unit 3753	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	Art Unit
	TIMOTHY L MAUST	3753

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/09/2024	10/09/2024							
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	2	÷	-							
	3	÷	-							
	4	÷	-							
	5	÷	-							
	6	÷	-							
	7	÷	-							
	8	÷	✓							
	9	÷	✓							
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	36	÷	✓							
	37	÷	✓							
	38	÷	✓							

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Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(**Not for submission under 37 CFR 1.99)**

Application Number	17882703
Filing Date	2022-08-08
First Named Inventor	Ming-Chien Chiu
Art Unit	3753
Examiner Name	TIMOTHY LEWIS MAUST
Attorney Docket Number	0114970.255US2

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	1	20140055699	KR	A	2014-05-09	WOO BUM JE		☒

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

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Examiner Signature	/TIMOTHY L MAUST/	Date Considered	10/09/2024

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Tim Tingkang Xia/	Date (YYYY-MM-DD)	2024-09-16
Name/Print	Tim Tingkang Xia	Registration Number	45242

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	4	"20230128154"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/05/13 10:06 AM
L2	4	("20160276190" OR "6368411" OR "6899145" OR "9305817").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/05/13 10:08 AM
L3	82	("4616683" | "4705444" | "4724874" | "4728389" | "4745088" | "4804086" | "4863561" | "4957781" | "5032545" | "5169272" | "5252133" | "5255783" | "5277579" | "5320218" | "5354198" | "5373806" | "5433574" | "5469963" | "5482161" | "5536320" | "5575081" | "5611452" | "5735961" | "5740845" | "5810062" | "5879458" | "6042651" | "6221163").pn. OR ("6368411").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/05/13 10:11 AM
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		| "4745088" | "4804086" | "4863561" | "4957781" | "5032545" | "5169272" | "5252133" | "5255783" | "5277579" | "5320218" | "5354198" | "5373806" | "5433574" | "5469963" | "5482161" | "5536320" | "5575081" | "5611452" | "5735961" | "5740845" | "5810062" | "5879458" | "6042651" | "6221163").pn. OR ("6368411").urpn. AND (PGPB | USPT | USOC).dbnm.					
L19	4	("20160276190" OR "6368411" OR "6899145" OR "9305817").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/07/16 10:08 AM
L20	0	"2010059956"	(US-PGPUB; USPAT)	OR	ON	ON	2024/07/16 10:08 AM
L21	1	"20100059956"	(US-PGPUB; USPAT)	OR	ON	ON	2024/07/16 10:08 AM
L22	0	"2010059956"	(US-PGPUB; USPAT)	OR	ON	ON	2024/07/16 10:08 AM
L23	17	"9054144"	(US-PGPUB; USPAT)	OR	ON	ON	2024/07/16 10:08 AM
L24	1	("9054144").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/07/16 10:08 AM
L25	20	("4616683" | "5575081" | "6221163" | "6368411" | "6758876" | "6899145" | "20100022093" | "20110114534").pn. OR ("9054144").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/07/16 10:08 AM
L26	4943	h01l21/67389	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/07/16 10:08 AM
L27	2151	11 AND foup	(US-PGPUB; USPAT;	OR	ON	ON	2024/07/16

			USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				10:08 AM
L28	1999	12 AND gas	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/07/16 10:08 AM
L29	137	13 AND manifold	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/07/16 10:08 AM
L30	2	("11610795").pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO,	OR	ON	ON	2024/07/16 10:08 AM

Entegris, EX1002, p. 201

			NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L31	55	("6368411").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/01 11:20 AM
L32	29	("4745088" | "5346518" | "5960959" | "6042651" | "6368411" | "6758876" | "7900776" | "8318275" | "20020038773" | "20040182472" | "20050077204" | "20050115866" | "20050252827" | "20060207916" | "20060283774" | "20090026109" | "20090206001").pn. OR ("8783463").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 10:46 AM
L33	83	("4616683" | "4705444" | "4724874" | "4728389" | "4745088" | "4804086" | "4863561" | "4957781" | "5032545" | "5169272" | "5252133" | "5255783" | "5277579" | "5320218" | "5354198" | "5373806" | "5433574" | "5469963" | "5482161" | "5536320" | "5575081" | "5611452" | "5735961" | "5740845" | "5810062" | "5879458" | "6042651" | "6221163").pn. OR ("6368411").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 01:31 PM
L34	43380	141/$.ccls.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 02:03 PM
L35	73	34 AND foup	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 02:03 PM
L36	17	("4745088" | "5879458" | "6364922" | "6368411" | "6488775" | "6899145" | "8413814" | "8413815" | "8783463" | "8895356" | "9054144" | "10043696" | "10101047" | "20040182472" |	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 02:11 PM

Entegris, EX1002, p. 202

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L38	73	34 AND smif	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 02:24 PM
L39	6161	h01l21/67393	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/10/08 02:32 PM
L40	41	29 AND diffus$3	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/10/08 02:33 PM
L41	982	39 AND diffus$3	(US-PGPUB; USPAT; USOCR; FIT (AP, AT,	OR	ON	ON	2024/10/08 02:33 PM

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			AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L42	937	41 AND gas	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/10/08 02:33 PM
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L44	13	("5879458" | "6221163" | "RE39241" | "7201276" | "8783463" | "9054144" | "9543177" | "10347517" | "20050115866" | "20160276190").pn. OR ("10672637").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/10/08 02:46 PM

L45	4	"20230128154"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/10/09 09:37 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(**Not for submission under 37 CFR 1.99)**

Application Number	17882703
Filing Date	2022-08-08
First Named Inventor	Ming-Chien Chiu
Art Unit	3753
Examiner Name	TIMOTHY LEWIS MAUST
Attorney Docket Number	0114970.255US2

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Nu	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	20140055699	KR	A	2014-05-09	WOO BUM JE		☒

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	3753
	Examiner Name	TIMOTHY LEWIS MAUST
	Attorney Docket Number	0114970.255US2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Tim Tingkang Xia/	Date (YYYY-MM-DD)	2024-09-16
Name/Print	Tim Tingkang Xia	Registration Number	45242

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/882,703	**09/16/2024 12:35:46 PM Z ET**	**0114970.255US2**

Title of Invention

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	8112	FILED BY	Debby Yew
PATENT CENTER #	67186790	FILING DATE	08/08/2022
CUSTOMER #	21874	FIRST NAMED INVENTOR	Ming-Chien Chiu
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Tim Xia

Documents

TOTAL DOCUMENTS: 3

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
0114970255US2ResponseRR.pdf	10	Response to Election / Restriction Filed	160 KB
0114970255US2IDS.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	40 KB
Warning: This is not a USPTO supplied IDS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.			
KR20140055699A.pdf	13	Foreign Reference	1147 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
0114970255US2ResponseRR.	7AF20274D36A0F0745320A923E1DEFEF2B674CB2F8573C052

pdf	27919D4E285DC017347C9D2A6FBCC2D491135442F037B1D14 FD35D5154E3C87447C793711C48F7D
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KR20140055699A.pdf	9A7050E2C37C9C2AE0B6D7172A930EFFFC86D814ADD2EBD0 86D9D3B63EB18C93C28CC4AF4D2FB0AC59E0660C17D6FE0 DBB7ACDC15D81E4F82F7CC6186784D754

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Espacenet

Bibliographic data: KR20140055699 (A) — 2014-05-09

A PURGE GAS PIPE OF THE WAFER PURGING CASSETTE

Inventor(s): WOO BUM JE [KR] ± (WOO, BUM JE)

Applicant(s): WOO BUM JE [KR] ± (WOO, BUM JE)

Classification: **- international:** ***B65D85/38; B65D85/86; H01L21/673***
- cooperative: H01L21/67017 (KR); H01L21/6732 (KR); B65D85/30 (KR)

Application number: KR20120122908 20121101 Global Dossier

Priority number(s): KR20120122908 20121101

Also published as: KR101458626 (B1)

Abstract of KR20140055699 (A)

The present invention relates to a purge gas pipe for a wafer purging cassette. The purpose of the present invention is to maximize the efficiency in processing process gas on a wafer and remaining harmful gas such as fume which is a by-product of the process. In the purge gas pipe for a wafer purging cassette, a gas blowing hole adjacent to a piping line has a large caliber while gas blowing holes at a distance from the piping line have a small caliber gradually depending on the distance, in order to make the flow rate of purge gas supplied from the piping line consistent. Therefore, the purge gas pipe for a wafer purging cassette can maximize the efficiency in removing process gas and contaminants such as fume by injecting the purge gas supplied from the piping line to the surface of the wafer at a consistent flow rate.

(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(11) 공개번호 10-2014-0055699
(43) 공개일자 2014년05월09일

(51) 국제특허분류(Int. Cl.)
H01L 21/673 (2006.01) *B65D 85/38* (2006.01)
B65D 85/86 (2006.01)
(21) 출원번호 10-2012-0122908
(22) 출원일자 2012년11월01일
심사청구일자 2012년11월01일

(71) 출원인
우범제
경기도 용인시 수지구 성복1로 91, 109동 1901호 (성복동, 버들치마을 성복힐스테이트1차)
(72) 발명자
우범제
경기도 용인시 수지구 성복1로 91, 109동 1901호 (성복동, 버들치마을 성복힐스테이트1차)
(74) 대리인
김희곤, 김인한

전체 청구항 수 : 총 4 항

(54) 발명의 명칭 **웨이퍼 퍼징 카세트**

(57) 요 약

본 발명은 웨이퍼 퍼징 카세트의 퍼지가스관에 관한 것으로, 그 목적은 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 유해가스 잔존물의 처리효율을 극대화하는 것이다.

이러한 목적으로 이루어진 본 발명은;

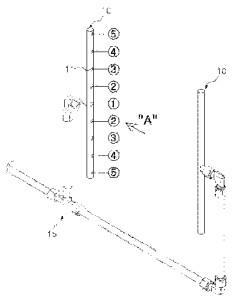
웨이퍼 퍼징 카세트에 관한 것으로,

상기 웨이퍼 퍼징 카세트의 퍼지가스관은;

배관라인으로 부터 공급되는 퍼지가스의 유량이 균일해지도록 상기 배관라인과 인접한 위치에 구비된 가스분출공은 큰 구경으로 형성하고, 상기 배관라인과 멀어지는 가스분출공은 점진적으로 작은 구경으로 형성한다.

이에 따라, 배관라인으로 부터 공급되는 퍼지가스를 균일한 유량으로 웨이퍼 표면에 분사하여 공정 가스 및 퓸 등의 오염 물질의 제거효율을 극대화하는 이점이 있다.

대 표 도 - 도2



Entegris, EX1002, p. 213

특허청구의 범위

청구항 1

웨이퍼 처리장치의 이송용기에 구비된 웨이퍼를 이송로봇에 의해 각 공정별로 이송하는 이송장치와, 상기 이송장치 일측에 구비되어 다수의 웨이퍼를 격납한 후 이동하여, 웨이퍼 상부표면에 여러가지 기능을 갖출 수 있도록 박막 증착공정, 식각공정 및 웨이퍼 상부에 층간 절연막등을 증착한 후에 일괄적으로 웨이퍼 표면을 연마하여 단차를 제거하는 평탄화공정등을 순차적으로 수행하고 난 뒤 잔존하는 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 잔존물을 제거하도록 배관라인으로 공급된 퍼지가스를 길이방향 등간격으로 다수 구비된 가스분출공을 통해 분사하는 퍼지가스관을 갖춘 웨이퍼 퍼징 카세트에 있어서,

상기 웨이퍼 퍼징 카세트의 퍼지가스관은;

상기 배관라인으로 부터 공급되는 퍼지가스의 유량이 균일해지도록 상기 배관라인과 인접한 위치에 구비된 가스분출공은 큰 구경으로 형성하고, 상기 배관라인과 멀어지는 가스분출공은 점진적으로 작은 구경으로 형성하는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

청구항 2

제 1항에 있어서,

상기 가스분출공은, 균일한 유량으로 분사되는 퍼지가스가 웨이퍼 표면에 확산되도록 단면상 내측에서 외측으로 갈 수록 확경되도록 테이퍼가 형성되는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

청구항 3

제 1항에 있어서,

상기 가스분출공은, 상기 퍼지가스관의 너비방향 직사각형 또는 장공중 어느 하나로 형성되며, 길이방향 등간격으로 다수 형성되는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

청구항 4

제 3항에 있어서,

상기 장공 또는 직사각형중 어느 하나로 형성된 가스분출공은, 배관라인과 인접한 위치에서 상기 배관라인과 멀어지는 위치로 갈 수록 점진적으로 짧은 길이로 형성하는 것을 특징으로 하는 웨이퍼 퍼징 카세트의 퍼지가스관.

명 세 서

기 술 분 야

[0001] 본 발명은 웨이퍼 처리장치에 관한 것으로서, 더욱 상세하게는 웨이퍼 처리장치상에서 웨이퍼에 대한 각종 공정 수행 후, 수직방향으로 적층된 각각의 웨이퍼 상에 잔존하는 공정 가스를 균일한 유량으로 분사하는 웨이퍼 퍼징 카세트의 퍼지가스관에 관한 것이다.

배 경 기 술

[0002] 일반적으로, 반도체의 핵심 소재인 웨이퍼 상부 표면에 여러 가지 기능을 수행할 수 있도록 박막을 증착하고, 이를 패터닝하여 다양한 회로구조를 형성하는 웨이퍼 처리장치에 대해서는 여러가지가 알려져 오고 있다.

[0003] 예를 들면, 도 1a에 도시한 웨이퍼 처리장치(TE)(이하, "처리장치"라 칭한다)가 그 대표적인 것으로 그 내용은 다음과 같다.

[0004] 도시한 바와 같이, 종래 처리장치(TE)는 이송장치(CE)와 카세트(CA)와 반도체 제조공정모듈(SM)(이하, "공정모듈" 이라 칭한다)로 대별된다.

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[0005] 이송장치(CE)는 내부에 이송로봇(MR)이 적어도 하나 이상 구비되며, 도시한 방향 기준하여 하측에 적어도 하나 이상의 이송용기(MB)를 갖추고 있다.

[0006] 다시 말해서, 이송장치(CE)는 내부에 구비된 이송로봇(MR)을 이용하여 이송용기(MB)에 구비된 웨이퍼(WF)를 각 공정에 공급한다.

[0007] 카세트(CA)는 도 1b에 도시한 바와 같이, 다수의 웨이퍼(WF)를 적층할 수 있도록 상, 하 방향으로 다수의 리브(LV)가 구비된다.

[0008] 이 카세트(CA)에 공급된 웨이퍼(WF)는 후술하는 공정모듈(SM)에서 다수의 공정들을 수행하기 전에 보관된다.

[0009] 이와 같이, 카세트(CA)에 구비된 웨이퍼(WF)는 공정모듈(SM)에서 웨이퍼(WF) 상부표면에 여러가지 기능을 갖출 수 있도록 3B족 또는 5B족의 불순물 이온을 주입하는 불순물 이온 주입공정과 반도체 기판상에 물질막을 형성하는 박막 증착공정, 상기 물질막을 소정의 패턴으로 형성하는 식각공정 및 웨이퍼 상부에 층간 절연막등을 증착한 후에 일괄적으로 웨이퍼 표면을 연마하여 단차를 제거하는 평탄화 공정(Chemical Mechanical Polishing : CMP)등을 순차적으로 수행한다.

[0010] 한편, 상술한 소정의 공정이 완료된 웨이퍼(WF)는 개별 단위로 이동하지 않고, 상기한 카세트(CA)에 20개 ~ 25개 단위 묶음으로 격납되어 이동하는데, 이 이동하는 웨이퍼(WF)는 상술한 각 공정상에서 사용되는 공정 가스 및 공정상의 부산물인 퓸(Fume) 등(이하, "잔존물"이라 칭한다)이 제거되지 않고 웨이퍼의 표면에 잔존한 상태로 구비된다.

[0011] 이러한 잔존물은 도시한 방향기준하여 길이방향 등간격으로 다수 구비된 퍼지가스 분사관(PB)의 수직방향 등간격으로 다수형성된 가스분출공(GH)을 통해 분출되는 퍼지가스에 의해 제거된다.

[0012] 그러나, 상기한 퍼지가스 분사관(PB)에 다수 형성된 가스분출공(GH)은 배관라인(PS)으로 부터 공급되는 퍼지가스를 상, 하 방향으로 균일하게 분사하지 못하므로 잔존물의 처리효율이 떨어지는 문제가 있었다.

발명의 내용

해결하려는 과제

[0013] 본 발명은 상술한 바와 같은 종래의 문제점을 해결하기 위해 안출된 것으로서, 본 발명의 목적은, 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 잔존물의 처리효율을 높이는데 있다.

과제의 해결 수단

[0014] 이러한 목적으로 이루어진 본 발명은;

[0015] 웨이퍼 처리장치의 이송용기에 구비된 웨이퍼를 이송로봇에 의해 각 공정별로 이송하는 이송장치와, 상기 이송장치 일측에 구비되어 다수의 웨이퍼를 격납한 후 이동하여, 웨이퍼 상부표면에 여러가지 기능을 갖출 수 있도록 박막 증착공정, 식각공정 및 웨이퍼 상부에 층간 절연막등을 증착한 후에, 일괄적으로 웨이퍼 표면을 연마하여 단차를 제거하는 평탄화공정등을 순차적으로 수행하고 난 뒤, 잔존하는 웨이퍼상의 공정 가스 및 공정 부산물인 퓸(Fume) 등의 잔존물을 제거하도록 배관라인으로 공급된 퍼지가스를 길이방향 등간격으로 다수 구비된 가스분출공을 통해 분사하는 퍼지가스관을 갖춘 웨이퍼 퍼징 카세트에 관한 것으로,

[0016] 상기 웨이퍼 퍼징 카세트의 퍼지가스관은;

[0017] 배관라인으로 부터 공급되는 퍼지가스의 압력이 균일해지도록, 상기 배관라인과 인접한 위치에 구비된 가스분출공은 큰 구경으로 형성하고, 상기 배관라인과 멀어지는 가스분출공은 점진적으로 작은 구경으로 형성한다.

[0018] 또한, 상기 가스분출공은;

[0019] 균일한 유량으로 분사되는 퍼지가스가 웨이퍼 표면에 확산되도록 단면상 내측에서 외측으로 갈 수록 확경되는 테이퍼가 형성된 것을 특징으로 한다.

[0020] 또한, 상기 가스분출공은;

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[0021] 상기 퍼지가스관의 너비방향으로 직사각형 또는 장공으로 형성된 것을 특징으로 한다.

[0022] 또한, 상기 장공 또는 직사각형중 어느 하나로 형성된 가스분출공은, 배관라인과 인접한 위치에서 상기 배관라인과 멀어지는 위치로 갈 수록 점진적으로 짧은 길이로 형성한다.

발명의 효과

[0023] 상술한 바와 같이, 본 발명에 의하며, 배관라인으로 부터 공급되는 퍼지가스를 균일한 유량으로 웨이퍼 표면에 분사하여 공정 가스 및 퓸 등의 오염 물질의 제거효율을 극대화한 효과가 있다.

도면의 간단한 설명

[0024] 도 1a는 종래 카세트가 구비된 웨이퍼 처리장치를 평면에서 바라본 도면이고,

도 1b는 종래 카세트에 구비된 퍼지가스관을 보인 사시도이고,

도 2는 본 발명의 퍼지가스관과 배관라인만 발췌하여 보인사시도이고,

도 3은 도 2 "A"방향에서 바라본 퍼지가스관의 일측년도이고,

도 4는 본 발명의 퍼지가스관이 구비된 카세트를 보인 사시도이고,

도 5는 본 발명에 따른 퍼지가스관에 마련된 가스분출공의 다른 실시예를 보인 사시도이고,

도 6의 가)와 나)는 본 발명에 따른 퍼지가스관에 마련된 가스분출공의 또 다른 실시예를 보인 도면이다.

발명을 실시하기 위한 구체적인 내용

[0025] 도 2 내지 도 4를 참조하면, 본 발명에 따른 웨이퍼 퍼징 카세트(1)의 퍼지가스관(10)(이하, "가스관"라 칭한다)은 길이방향 등간격으로 다수 형성된 가스분출공(11)을 포함한다.

[0026] 도시한 바와 같이, 가스분출공(11)은 배관라인(15)으로 부터 공급되는 퍼지가스의 유량이 균일해지도록, 상기 배관라인(15)과 인접한 위치에 구비된 가스분출공(11)은 큰 구경으로 형성하고, 상기 배관라인과 멀어질 수록 점진적으로 작은 구경으로 형성한다.(이하, 설명 편의상 가스분출공(11)에 번호를 붙여 설명한다)

[0027] 예를 들면, 배관라인(15)이 구비된 위치에 구비된 가장 큰 구경의 1번 가스분출공(11)이 φ10의 크기로 형성된 경우, 일측에 인접한 가스분출공(11)과 점점 멀어지는 위치에 구비된 가스분출공(11)의 구경은 점진적으로 작아진다. 예를 들면, "입력은 면적에 반비례"한다는 이론에 근거하여 2, 3, 4, 5,번 가스분출공(11)의 구경은φ9, φ8, φ7, φ6로 작아지지만, 상대적으로 압력은 높게 형성되어 웨이퍼상에 분출되는 퍼지가스의 압력은 균일하다.

[0028] 따라서, 도 4에 도시한 바와 같은 카세트(1)에 각기 다른 구경으로 가스분출공(11)이 형성된 가스관(10)을 구비하여 중간부분에 퍼지가스를 공급하는 배관라인(15)의 상, 하 방향으로는 점진적으로 작은 구경으로 가스분출공(11)을 형성하여 전체적으로 분출되는 퍼지가스의 압력과 유량은 균일함으로서, 웨이퍼(5)의 잔존물 처리효율이 극대화되었다.

[0029] 도시한 것은 중간부분에 연결된 배관라인(15)에 의해 중간부분의 가스분출공(11)이 큰 구경으로 형성된 것을 설명하였으나, 그것은 일실시예일 뿐, 배관라인(15)을 가스관(10)의 끝단에 배치하고, 그 배관라인(15)이 연결된 끝단에 구비된 가스분출공(11)을 큰 구경으로 형성한 후, 점진적으로 작은 구경으로 가스분출공(11)을 형성하여도 본 발명 소기의 목적을 달성할 수 있음은 물론이다.

[0030] 도 5에 도시한 것은, 본 발명에 따른 가스관(10)에 형성된 가스분출공(11)의 다른 실시예를 보인 것으로, 상술한 바와 같이, 각기 다른 구경에 의해 균일한 유량으로 분사되는 퍼지가스가 웨이퍼 표년에 확산되도록 단면상 내측에서 외측으로 갈 수록 확경되는 테이퍼(11a)가 형성된다.

[0031] 이 테이퍼(11a)를 형성하는 방법은 해당 가스분출공(11) 보다 큰 규격의 드릴을 이용해서 형성할수 있다.

[0032] 예를 들면, 가스분출공(11)의 구경이 φ10이라면, 그 가스분출공(11)에 φ20정도 규격의 드릴을 관통시키지 않고, 도시한 바와 같이, 해당 드릴의 끝부분을 이용해서 홈파기를 하면 도시한 바와 같은 테이퍼가 형성된다.

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[0033] 도 6의 가)와 나)는 본 발명의 또 다른 실시예를 보인 것으로, 가스관(10)의 가스분출공(11)을 도시하지 않은 웨이퍼의 평면에 대해 수평방향이 되도록 직사각형(11b) 또는 장공(11c)으로 형성한다.

[0034] 이 가스분출공(11)도 상술한 일실시예와 마찬가지로 수평방향으로의 길이를 조절함으로서, 균일한 압력의 퍼지가스를 분출할 수 있다.

[0035] 다시 말해서, 배관라인(15)이 배치된 부분의 가스분출공(11)의 길이가 20㎜라면, 점진적으로 2~3㎜씩 짧게 형성하면 상술한 일실시예의 동일한 효과를 얻을 수 있다.

[0036] 이와 같이, 가스분출공(11)을 직사각형 또는 장공으로 형성하면, 도시하지 않은 웨이퍼의 수평상으로 분출되는 퍼지가스를 균일한 압력으로 확산시킬 수 있으므로, 공정가스 및 퓸(Fuem)등의 오염물질 제거 효율을 높일 수 있다.

[0037] 본 발명은 상술한 특정 바람직한 실시 예에 한정되지 아니하고, 청구범위에서 청구하는 본 발명의 요지를 벗어남이 없이 당해 발명이 속하는 기술분야에서 통상의 지식을 가진자 라면 누구든지 다양한 변형실시가 가능한 것은 물론이고, 그와 같은 변형실시는 본 발명의 청구범위 기재 범위 내에 있게 된다.

부호의 설명

[0038]

1 : 웨이퍼 퍼징 카세트

10 : 퍼지가스관

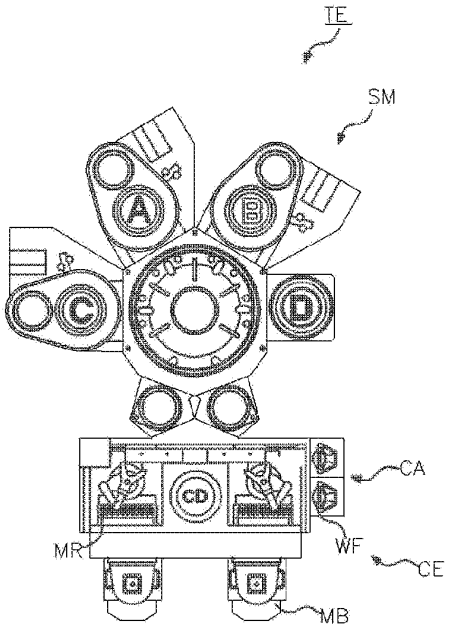
11 : 가스분출공

15 : 배관라인

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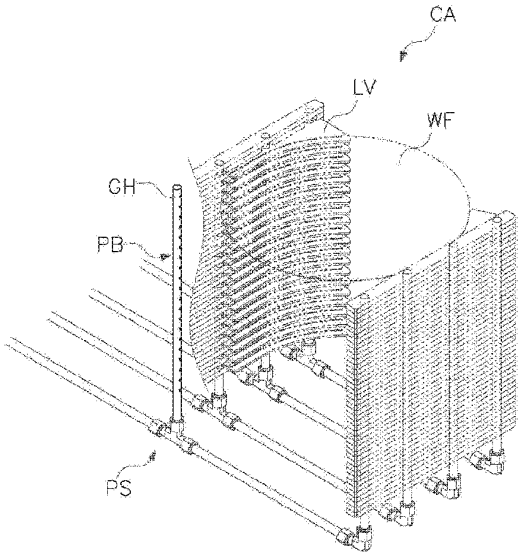
도면

도면1a



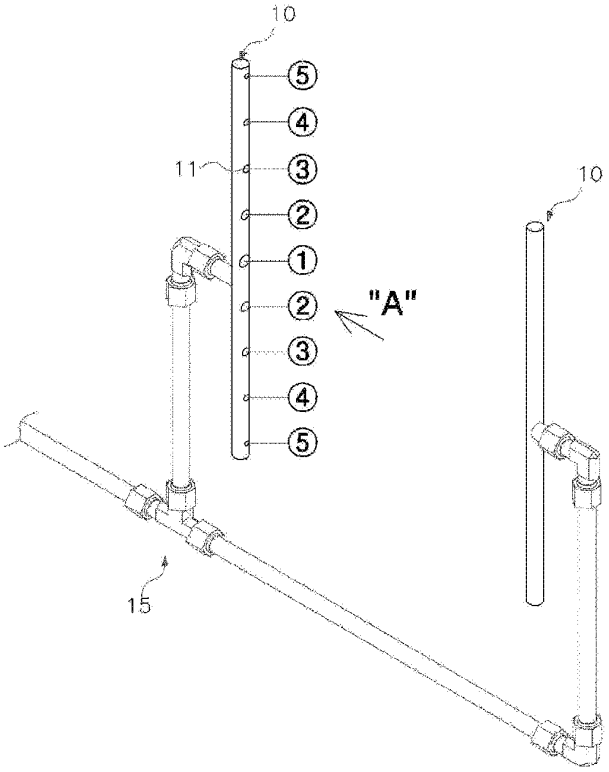
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도면1b

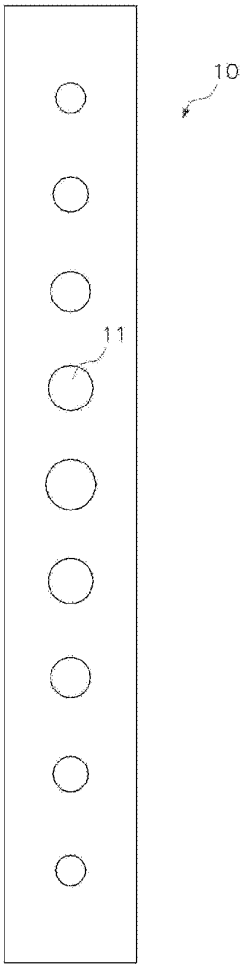


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도면2

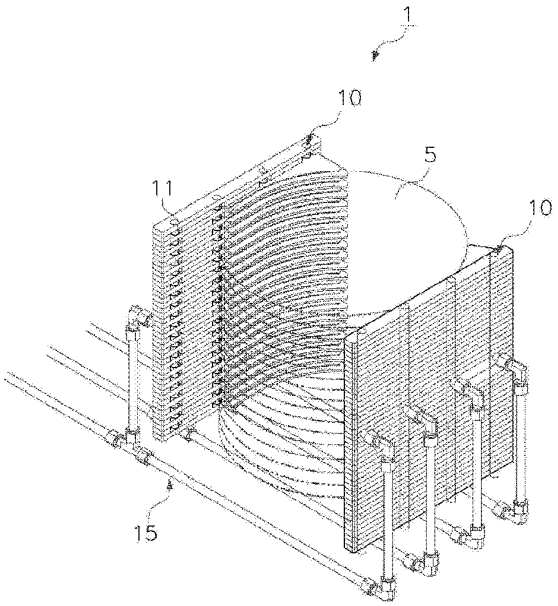


도면3



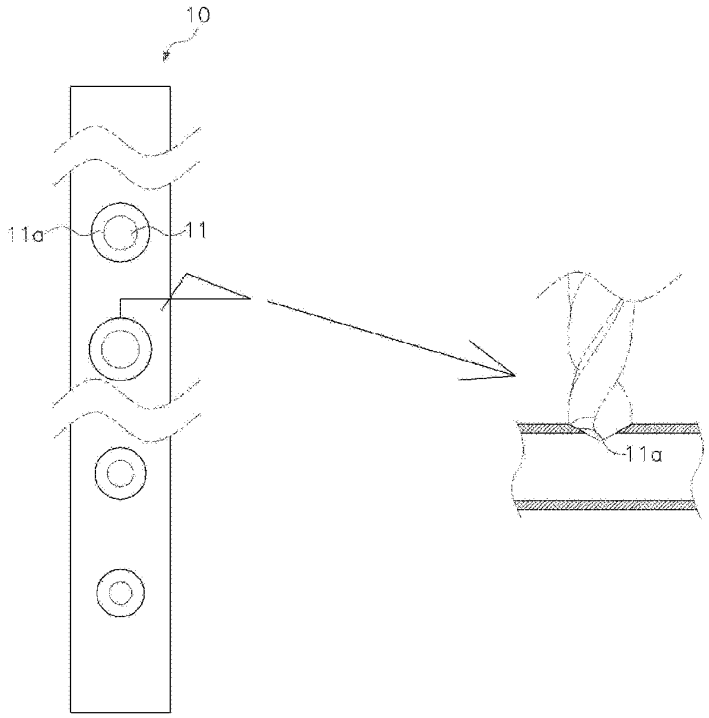
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도면4



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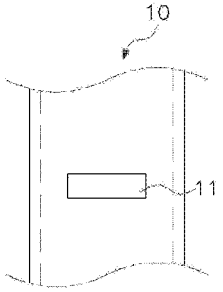
도면5



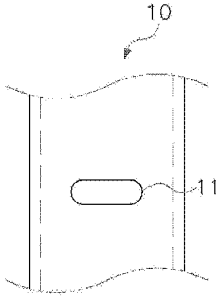
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도면6

가)



나)



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Ming-Chien Chiu et al.	Examiner:	Timothy Lewis Maust
Serial No.:	17/882,703	Group Art Unit:	3753
Filed:	August 8, 2022	Docket No.:	0114970.255US2
Title:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME		

RESPONSE TO RESTRICTION REQUIREMENT

Mail Stop: Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

September 16, 2024

CUSTOMER NO. 21874

Dear Sir/Madam:

Submitted herewith is a response to the Restriction Requirement mailed July 15, 2024. Without acquiescing to the statements made therein, applicant elects, without traverse, **Invention II** and **Species IV to VIII**, *i.e.*, claims 8-38, for the prosecution of the above identified application.

Amendments to the Claims are reflected in the listing of claims that begins on page **2** of this paper.

Remarks begin on page **9** of this paper.

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AMENDMENT TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the present application:

Listing of Claims

1-7. (Cancelled)

8. (Original) A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

a buffering gas chamber, configured at a bottom portion of the wafer container, the bottom portion provided with at least one coupling structure, the coupling structure defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and

at least one porous tube, having a longitudinal space, the porous tube installed to the coupling structure of the wafer container, the longitudinal space of the porous tube communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial.

9. (Original) The gas diffusion device according to claim 8, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial.

10. (Original) The gas diffusion device according to claim 8, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the

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porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial; the center axis of the longitudinal space of the porous tube is offset from the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis.

11. (Original) The gas diffusion device according to claim 8, wherein the longitudinal space of the porous tube has a closed end and an open end, and the open end receives the corresponding coupling structure, so that the gas enters the longitudinal space by passing through the buffering gas chamber and the open end.

12. (Original) The gas diffusion device according to claim 8, wherein a shape of a horizontal cross section of the porous tube is an ellipsoid or an elongated narrow shape having a long axis and a short axis, or a circle having a diameter.

13. (Original) The gas diffusion device according to claim 12, further comprising:

a first collar, arranged in the open end, the first collar located between the open end and the coupling structure.

14. (Original) The gas diffusion device according to claim 13, further comprising:

a second collar, located between the first collar and the coupling structure when the second collar is disposed on the coupling structure so as to reinforce airtightness.

15. (Original) The gas diffusion device according to claim 13, wherein a material of the first collar is softer than a material of the porous tube to prevent breaking of the open end.

16. (Original) The gas diffusion device according to claim 14, wherein the second collar and the porous tube are sintered or bonded into an integral to prevent breaking of the open end.

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17. (Original) The gas diffusion device according to claim 15, wherein the coupling structure, the porous tube, the first collar and/or the second collar are/is made of a thermal resistant material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

18. (Original) The gas diffusion device according to claim 8, further comprising:

an airflow guiding member, arranged adjacent to one side of the porous tube, the airflow guiding member configured to adjust an airflow direction of the gas entering the accommodating space.

19. (Original) The gas diffusion device according to claim 8, further comprising:

at least one gas intake module, communicatively coupled to the buffering gas chamber, the gas intake module having the gas intake center axis, supplying the gas in one single gas intake direction to pass through the gas intake channel and enter the buffering gas chamber.

20. (Original) A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

a gas cartridge, configured at a bottom portion of the wafer container to define a buffering gas chamber, the bottom portion provided with at least two coupling structures, each of the coupling structures defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and

at least two porous tubes, each of the porous tubes having a longitudinal space, the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass

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through the at least two porous tubes and enter the accommodating space.

21. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, the center axis of the longitudinal space of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial.

22. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial; the center axis of the longitudinal space of each of the porous tubes is offset from the center axis of the through channel, the center axis of the open end of the porous tube and the gas intake center axis.

23. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tube has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, and the center axis of the longitudinal space of each of the porous tubes are coaxial; a position of a gas intake center axis along which the gas passes is offset from the center axis of the through channel , the center axis of the open end and the center axis of the longitudinal space that are coaxial.

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24. (Original) The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels and the center axis of the open end of each of the porous tubes are coaxial; a gas intake center axis along which the gas passes and the center axis of the longitudinal space are both offset from the center axis of the through channel and the center axis of the open end that are coaxial.

25. (Original) The gas diffusion device according to claim 20, wherein the gas cartridge has a bottom portion and a sidewall extending from the bottom portion, and the gas intake channel is formed at the bottom portion of the gas cartridge.

26. (Original) The gas diffusion device according to claim 20, wherein the gas cartridge is installed at the bottom portion of the wafer container, such that the bottom portion and the sidewall of the gas cartridge and the bottom portion of the wafer container define the buffering gas chamber.

27. (Original) The gas diffusion device according to claim 20, wherein a plurality of annular sidewalls further extend from a lower surface of the bottom portion of the gas cartridge, each of the annular sidewalls defines an installation space for filling with a gas intake module, and the gas intake module has the gas intake center axis; the installation space, the gas intake channel at the bottom portion of the gas cartridge and the buffering gas chamber communicate with one another, such that the gas in one single air intake direction supplied by the gas intake module passes through the gas intake channel and enters the buffering gas chamber.

28. (Original) The gas diffusion device according to claim 20, wherein the wafer container comprises a base plate installed at the bottom portion of the wafer container, and the

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buffer gas chamber is between the bottom portion and the base plate of the wafer container.

29. (Original) The gas diffusion device according to claim 28, wherein the base plate is made of a material comprising a self-lubricating material.

30. (Original) A wafer container, comprising:

a shell, comprising a bottom portion, the bottom portion configured with a plurality of coupling structures, the coupling structures defining a plurality of through channels;

a buffering gas chamber, formed below the bottom portion, the buffering gas chamber having a plurality of gas intake channels, the gas intake channels communicating with the corresponding through channels; and

a plurality of porous tubes, each of the porous tubes having an open end, the open end correspondingly sleeved connecting with the coupling structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel, allowing a gas to pass through the porous tubes and enter an accommodating space of the shell.

31. (Original) The wafer container according to claim 30, wherein the porous tube has a longitudinal space, the longitudinal space has a closed end and an open end, and the gas in the buffering gas chamber is capable of passing through the open end to enter the longitudinal space.

32. (Original) The wafer container according to claim 30, further comprising:

a collar, arranged between the open end and the coupling structure, a material of the collar being softer than a material of the porous tube to prevent breaking of the open end.

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33. (Original) The wafer container according to claim 30, further comprising:

a gas cartridge, having a bottom portion and a sidewall extending from the bottom portion, the bottom portion of the gas cartridge having the gas intake channels formed thereon.

34. (Original) The wafer container according to claim 33, wherein the gas cartridge is installed at the bottom portion of the shell, such that the gas cartridge and the bottom portion of the shell define the buffering gas chamber.

35. (Original) The wafer container according to claim 33, wherein a plurality of annular sidewalls further extend from the bottom portion of the gas cartridge, and each of the annular sidewalls defines an installation space for filling with a gas intake module.

36. (Original) The wafer container according to claim 30, wherein the wafer container further comprises a door detachably combined with the shell, and a pair of support portions configured on an inner side of the shell, and the wafer container is made of a thermal resistance material, which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

37. (Original) The wafer container according to claim 30, further comprising:

a base plate, connected below the shell to support the shell;

wherein the buffering gas chamber is between the bottom portion and the base plate of the shell.

38. (Original) The wafer container according to claim 37, wherein the base plate is made of a material comprising a self-lubricating material.

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REMARKS

Claims 1-38 were pending in the present application before this amendment as set forth above. By this amendment, claims 1-7 are cancelled. Currently, claims 8-38 remain pending.

In the July 15, 2024 Office Communication, the Examiner indicated that restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claim 1-7, drawn to a gas diffusion device, classified in H01L21/22.

II. Claim 8-38, drawn to a gas diffusion device and wafer container, classified in H01L21/54.

Further, the Examiner indicated that claims 1, 8, 20 and 30 are generic to the following disclosed patentably distinct species, and applicant is required under 35 U.S.C. 121 to elect a single disclosed species or a single grouping of patentably indistinct species:

I – Figure 6;

II – Figure 7;

III – Figures 12A, 12B;

IV – Figure 20;

V – Figure 21A;

VI – Figure 21B;

VII – Figure 21C; and

VIII – Figure 21D.

Applicant appreciates very much the Examiner's careful review of the present application.

In response, as set forth above, without acquiescing to the Examiner's assertion and in order to facilitate the prosecution, applicant hereby elects, without traverse, **Invention II** and **Species IV to VIII**, *i.e.*, claims 8-38, for the prosecution of the above identified application.

Claims 1-7 have been cancelled.

Examination on the merits is therefore respectfully requested and this Application is believed to be in condition for allowance, and such action is earnestly solicited.

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If the Examiner has any questions concerning this Response or the Application in general, the Examiner is requested to contact the undersigned at 404-870-4698.

Respectfully submitted,
LOCKE LORD LLP

September 16, 2024



Tim Tingkang Xia
Attorney for Applicant on the Record
Reg. No. 45,242

Terminus 200, Suite 2000
3333 Piedmont Rd. NE
Atlanta, GA 30305
T: 404-870-4698
Customer No. 21874

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PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/882,703	Filing Date 08/08/2022	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/16/2024	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
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	Independent (37 CFR 1.16(h))	* 3	Minus	*** 4	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JOCELYN M GASKINS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

21874 7590 07/15/2024

Locke Lord LLP
Attn: IP Docketing
P.O. BOX 55874
Boston, MA 02205

EXAMINER	
MAUST, TIMOTHY LEWIS	
ART UNIT	**PAPER NUMBER**
3753	
NOTIFICATION DATE	**DELIVERY MODE**
07/15/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patent@lockelord.com

Office Action Summary	**Application No.** 17/882,703	**Applicant(s)** Chiu et al.	
	Examiner TIMOTHY L MAUST	**Art Unit** 3753	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 8/8/22.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-38 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☑ Claim(s) 1-38 are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-7, drawn to a gas diffusion device, classified in H01L21/22.

II. Claims 8-38, drawn to a gas diffusion device and wafer container, classified in H01L21/54.

The inventions are independent or distinct, each from the other because:

Inventions I and II are related as combination and subcombination. Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because it doesn't require "at least one collar, connected to the open end, configured to buffer a corresponding coupling structure on a bottom portion of a wafer container to which the porous tube is assembled so as to prevent breaking of the open end".

The subcombination has separate utility such as being used in a system that doesn't require the longitudinal space of the porous tube communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the

porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial.

The examiner has required restriction between combination and subcombination inventions. Where applicant elects a subcombination, and claims thereto are subsequently found allowable, any claim(s) depending from or otherwise requiring all the limitations of the allowable subcombination will be examined for patentability in accordance with 37 CFR 1.104. See MPEP § 821.04(a). Applicant is advised that if any claim presented in a divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application.

Restriction for examination purposes as indicated is proper because all the inventions listed in this action are independent or distinct for the reasons given above and there would be a serious search and/or examination burden if restriction were not required because one or more of the following reasons apply:

(a) the inventions have acquired a separate status in the art in view of their different classification; and

(b) the inventions have acquired a separate status in the art due to their recognized divergent subject matter.

Claim(s) 1, 8, 20 and 30 is/are generic to the following disclosed patentably distinct species:

I – Figure 6;

II – Figure 7;

III – Figures 12A, 12B;

IV – Figure 20;

V – Figure 21A;

VI – Figure 21B;

VII – Figure 21C; and

VIII – Figure 21D.

The species are independent or distinct because as disclosed the different species have mutually exclusive characteristics for each identified species. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or a grouping of patentably indistinct species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species** or grouping of patentably indistinct species, including any claims subsequently added. An argument

that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of an invention to be examined even though the requirement

may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected invention**.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other invention.

Applicant is reminded that upon the cancelation of claims to a non-elected invention, the inventorship must be corrected in compliance with 37 CFR 1.48(a) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. A request to correct inventorship under 37 CFR 1.48(a) must be accompanied by an application data sheet in accordance with 37 CFR 1.76 that identifies each inventor by his or her legal name and by the processing fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TIMOTHY LEWIS MAUST whose telephone number is (571)272-4891. The examiner can normally be reached Monday - Thursday, 7am - 5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Craig Schneider can be reached on 571-272-3607. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TIMOTHY L MAUST/
Primary Examiner, Art Unit 3753

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/882,703	Chiu et al.
	Examiner	Art Unit
	TIMOTHY L MAUST	3753

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/09/2024								
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

21874 7590 10/13/2023

LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

EXAMINER	
CENTRAL, DOCKET	

ART UNIT	PAPER NUMBER
OPAP	

NOTIFICATION DATE	DELIVERY MODE
10/13/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patent@lockelord.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

In re Application of	:	
GUDENG PRECISION INDUSTRIAL	:	
CO., LTD.	:	
Application No. 17/882,703	:	DECISION ON PETITION
Filed: 8 Aug 2022	:	
For: GAS DIFFUSION DEVICE, AND	:	
WAFER CONTAINER INCLUDING THE	:	
SAME		

This is a Notice regarding the request for acceptance of a fee deficiency submission under 37 CFR 1.28(c) filed July 20, 2023.

The Office no longer investigates or rejects original or reissue applications under 37 CFR 1.56. 1098 Off. Gaz. Pat. Office 502 (January 3, 1989). Therefore, nothing in this Notice is intended to imply that an investigation was done.

The fee deficiency submission under 37 CFR 1.28(c) is **ACCEPTED**. Accordingly, status as a small entity has been removed and any future fee(s) submitted must be paid at the undiscounted rate.

Since the address in the present request differs from the correspondence address of record, a courtesy copy of this Notice is being mailed to the address given in the request. However, applicant should note that a change in the correspondence address will not affect the fee address. Therefore, if applicant desires to receive future correspondence which **may** be mailed, regarding maintenance fees, for the above-identified patent, a "Fee Address Indication" form and/or a "Request for Customer Number" form(s) should be submitted (See USPTO form numbers PTO/SB/47 and/or PTO/SB/125).

Inquiries related to this communication should be directed to Rachel Rizzo at (571) 272-8991.

/Michelle R. Eason/
Lead Paralegal Specialist, OPET

CC: Terminus 200
3333 Piedmont Rd. NE Ste. 2000
Atlanta, Georgia 30305

Transmittal Communication on Petition	Application/Control No. 17/882,703	Applicant(s)/Patent Under Reexamination Chiu et al.	
	Deciding Official CENTRAL, DOCKET	Office of Petitions OPET	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address. --

(ADDITIONAL PARTY'S CORRESPONDENCE ADDRESS)

Terminus 200
3333 Piedmont Rd. NE Ste. 2000
Atlanta, Georgia 30305

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above-identified Application/Patent.

United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :Suad Mohammed

Sale Accounting Date:10/10/2023

Sale Item Reference Number	Effective Date
17882703	07/20/2023

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I202300859396931	1461	1.28(C) SUBMISSIONS - APPLIC FILE FEE	$2,130.00	Deposit Account

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(**Not for submission under 37 CFR 1.99)**

Application Number	17882703
Filing Date	2022-08-08
First Named Inventor	Ming-Chien Chiu
Art Unit	OPAP
Examiner Name	DOCKET CENTRAL
Attorney Docket Number	0114970.255US2

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6368411	B2	2002-04-09	Roberson, Jr. et al.	
	2	6899145	B2	2005-05-31	Aggarwal	
	3	9305817	B2	2016-04-05	Kaise et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20160276190	A1	2016-09-22	Smith et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Nu	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2002170876	JP	A	2002-06-14	EBARA CORP		☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	OPAP
	Examiner Name	DOCKET CENTRAL
	Attorney Docket Number	0114970.255US2

	2	3960787	JP	B2	2007-08-15	SHIN ETSU POLYMER CO LTD		☒
	3	5241607	JP	B2	2013-07-17	SHIN ETSU POLYMER CO LTD		☒
	4	2020150245	JP	A	2020-09-17	UNIV NAT TAIPEI TECH		☒
	5	1343202	EP	A1	2003-09-10	EBARA CORP		☒
	6	1555689	EP	B1	2010-05-19	SHINETSU POLYMER CO		☒
	7	2272088	EP	B1	2016-12-07	ENTEGRIS INC		☒
	8	2009114798	WO	A2	2009-09-17	ENTEGRIS INC et al.		☒
	9	2011072260	WO	A2	2011-06-16	ENTEGRIS INC et al.		☒
	10	2017040913	WO	A1	2017-03-09	ENTEGRIS INC		☒
	11	2018179964	WO	A1	2018-10-04	SHINETSU POLYMER CO		☒
	12	2020046867	WO	A1	2020-03-05	ENTEGRIS INC		☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	OPAP
	Examiner Name	DOCKET CENTRAL
	Attorney Docket Number	0114970.255US2

	13	2022269718	WO	A1	2022-12-29	MIRAIAL CO LTD		☒

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17882703
	Filing Date	2022-08-08
	First Named Inventor	Ming-Chien Chiu
	Art Unit	OPAP
	Examiner Name	DOCKET CENTRAL
	Attorney Docket Number	0114970.255US2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Tim Tingkang Xia/	Date (YYYY-MM-DD)	2023-09-08
Name/Print	Tim Tingkang Xia	Registration Number	45242

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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(71) Applicant: **Ebara Corporation**
Tokyo 144-8510 (JP)

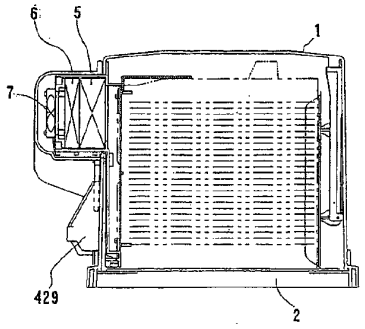
(72) Inventors:
- **SUZUKI, Yoko, Ebara Corporation**
Tokyo 144-8510 (JP)
- **TANAKA, Akira, Ebara Corporation**
Tokyo 144-8510 (JP)
- **KISHI, Takashi, Ebara Corporation**
Tokyo 144-8510 (JP)

(74) Representative: **Wagner, Karl H., Dipl.-Ing.**
Wagner & Geyer,
Patentanwälte,
Gewürzmühlstrasse 5
80538 München (DE)

(54) **DEVICE, CONTAINER, AND METHOD FOR TRANSFERRING SUBSTRATE**

(57) A method of using a substrate transport pod is provided, which is suitable for manufacturing semiconductor devices with copper wiring and low dielectric insulating film having dielectric constants of less than 3. The method is based on loading the substrates into a pod from an atmosphere of a first process, and circulating a gaseous atmosphere through interior of the pod in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, and to expose the substrates to a controlled atmosphere intermittently or continually while the substrates are held in the pod before unloaded from the pod and introduced into a second process. For a pod that is used to house the substrates for the purpose of retaining or transporting, the pod has a pod main body and a door that provides a hermetic sealing, and the pod is made primarily of a materiel that has moisture absorption factor of less than 0.1 %, and the pod can contact the substrates directly or indirectly and has a conductive area so as to enable static charges to be guided out of the pod.

FIG. 71B



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Description

Technical Field

[0001] The present invention relates to the structures, capabilities and methods of operating a substrate transport pod suitable for storing or transporting objects such as semiconductor wafers, photo-masks or hard-disks in a highly clean environment, and relates in particular to a method of managing the operation of the substrate transport pod to be used in semiconductor manufacturing processes.

Background Art

[0002] As semiconductor elements become more minute, it is anticipated that even higher degree of cleanliness would be required in the future. For example, it is anticipated that the target control size of the particles that can cause pattern defects and shorting of wiring would become smaller than 0.1 μm. Further, in addition to particulate contaminants, it becomes necessary to reduce gaseous contaminants. Various hydrocarbon molecules, by adsorbing onto the semiconductor wafers, cause deterioration in voltage resistance of gate oxide film or thickness variations in deposited films. Basic gases react with chemical enhancement type photo-resist to result in loss of resolution, and acidic gases can cause corrosion of wiring.

[0003] In addition, moisture (humidity) has been targeted for reduction in recent years. This is because finer device structure has led to the use of a variety of materials in forming wiring and films, and moisture in the environment can sometimes bind with the above-mentioned materials to cause problems. On the other hand, independent of the trend towards finer device structure, the size of the wafers is increasing and automation is also progressing in the field of processing technologies. Automation of semiconductor manufacturing line is prompted by the fact that it is necessary to segregate humans who acts as a contamination source and the fact that, as the diameter of wafers increases, the weight of the transport pod increases to about 10 kg such that manual handling becomes difficult.

[0004] In the past, with increasing circuit density and speed of semiconductor chips, aluminum has been used as the material for wiring to connect elements within the semiconductor chip. However, when the width of the wires becomes less than 0.13 μm, conventional aluminum wiring causes serious problems of heat generation and signal delay so that, in place of aluminum wiring, there is a trend towards the use of copper wiring.

[0005] Also, SiO_2 has been used as the insulation material for isolation of wiring. However, the dielectric constant of SiO_2 at about 4 is high so that replacement of aluminum wiring with copper wiring only results in about 20 % improvement in signal delay, so that there has been a need to use a substance of lower dielectric constant of less than 3 for the insulation material.

[0006] In readiness for such a development, examination of copper wiring and low dielectric materials for insulation has already identified a potential problem, arising from of the processing of chips with line-width at the level of 0.18 μm. Such low dielectric materials are based on organic materials or porous materials so that problems are encountered such as absorption of moisture from the environment, which leads to increasing dielectric constants, and therefore, these material must be handled differently from conventional insulation films and are presenting an extremely difficult challenge.

[0007] Also, copper used for wiring behaves differently from aluminum that has been used in the past because of its tendency to react with oxygen in the air to produce oxide films. Also, because the copper molecules have higher chemical activity compared with aluminum molecules such that, if particles containing copper or copper vapor itself is discharged into the clean-room, it contaminates the clean-room to lead to severe drop in the yield of semiconductor chips. Also, organic contaminants on silicon substrate surface has been known to cause a drop in reliability of gate oxide film, an increase in incubation time in the low pressure CVD processes and abnormal film growth. Therefore, even if a superior material is found in the future for use in making low dielectric insulation films, it is conceivable that it cannot be adopted because of its susceptibility to contamination from such impurities as organic substances and ions in the environment. Conversely, by controlling the processing environment, an opportunity may emerge of using those materials that have not been able to be used in the past. Also, if ammonia is present, the photo-resist material applied on the semiconductor wafer exhibits a so-called "T-top" phenomenon, which refers to a phenomenon that the top section of the developed photo-resist is wider than the bottom section.

Disclosure of Invention

[0008] The present invention is provided in view of the background information described above, and an object is to provide a substrate transport pod suitable for use in processes for manufacturing semiconductor chips comprised by a combination of copper wiring and low dielectric insulation films having dielectric constant less than 3, and methods for operating the pod. Also, as the line width becomes finer, problems of contamination resulting from minute quantities

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of ammonia and organic substances generated from workers and particle contaminants generated from the work uniform, become more serious. Furthermore, due to diversification of customer demands for semiconductor products, it is anticipated that the proportion of "large variety/small quantity" products such as system LSI (large scale integration) circuits will increase in relation to the proportion of "small variety and large quantity" products such as DRAM (dynamic random access memory) and MPU (micro-processor units). For these reasons, there will be a need for facilities that enable to vary combinations of semiconductor processing easily and quickly. The present invention provides a substrate transport pod suitable for use in an automated semiconductor processing plant for manufacturing semiconductor devices, including large variety and small quantity products, and methods for operating the pod.

[0009] To resolve the problems outlined above, the present invention provides a solution for resolving the problems encountered in semiconductor chip manufacturing processes that utilize copper wiring and insulation films of dielectric constant of less than 3. For example, silicon wafer substrates having low dielectric insulation film, photo-resist film or copper wiring may be housed in a substrate transport pod for transferring or storing the substrates between processes, so that the interior air of the pod is controlled in such a way that the level of at least the moisture is held below a certain value or ammonia concentration is held below a certain value; or if copper film is exposed to the interior air of the pod, the level of at least moisture or oxygen concentration is controlled, so that various problems associated with manufacturing semiconductor chips having copper wiring and insulation films of dielectric constant less than 3 can be resolved. In particular, a structure of the substrate transport pod is provided so as to enable to maintain at least one parameter of the interior air, such as particulate concentration, humidity, organic substance concentration, ionic gas concentration to a level below a specific value. Further, a method of operating a plurality of substrate transport pods in an automated semiconductor manufacturing plant is provided.

Brief Description of Drawings

[0010]

FIGS. 1A, 1B and 1C are diagrams of various air flows in the clean-room;
FIG 2 is a block diagram of the wiring process of semiconductor elements manufacturing suitable for application of the substrate transport pod;
FIG 3 is a cross sectional view of a first embodiment of the substrate transport pod;
FIG. 4 is a cross sectional view of another embodiment of the substrate transport pod;
FIG. 5 is a cross sectional view of another embodiment of the substrate transport pod;
FIG. 6 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 7 is a diagram of an embodiment of powering a substrate transport pod by mounting it on AGV;
FIG 8 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 9 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 10 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 11 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 12 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 13 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 14 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 15 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 16 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 17 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 18 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 19 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 20 is a cross sectional view of another embodiment of the substrate transport pod;
FIGS. 21A to 21F are diagrams of various types of air flow in the substrate transport pod;
FIG 22 is a cross sectional view of another embodiment of the substrate transport pod;
FIGS. 23A and 23B are spring connections of electrical contacts;
FIG 24 is a diagram of an example of non-contact method of powering the substrate transport pod;
FIG 25 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 26 is a cross sectional view of another embodiment of the substrate transport pod;
FIGS. 27A and 27B are cross sectional views of a square- and a round-shaped substrate transport pod, respectively;
FIG 28 shows structures for powering and static charge discharging;
FIGS. 29A to 29F are diagrams of various methods of affixing the door to the pod main body;
FIG. 30 is a diagram of an example of latching mechanism;
FIGS. 31A and 31B are diagrams of wafer supports;

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FIGS. 32A, 32B and 32C are diagrams of connections of the pod main body to a powering apparatus;
FIGS. 33A and 33B are diagrams of seal structures between the pod main body and the lid;
FIGS. 34A and 34B are diagrams of an example of attaching computation unit to the pod;
FIGS. 35A, 35B and 35C are diagrams of filter structures based on folded filtering member;
FIGS. 36A, 36B and 36C are diagrams of filter structures based on wave-shaped separators;
FIG 37 is a diagram of a flat film structure filter;
FIG 38 is a diagram of a unit structure of filter;
FIG 39 is a diagram of a composite type filter unit;
FIGS. 40A, 40B and 40C are diagrams of examples of the structure of chemical filters;
FIG 41 is a diagram of a filter comprised by adsorbing agent held between two sheets of paper;
FIGS. 42A, 42B and 42C are diagrams of examples of the structure of chemical filters;
FIGS. 43A, 43B and 43C are diagrams of another examples of chemical filters;
FIGS. 44A, 44B and 44C are diagrams of still another examples of chemical filters;
FIGS. 45A and 45B are diagrams of still another examples of chemical filters;
FIGS. 46A, 46B and 46C are diagrams of examples of structures used for gaseous contaminants filters: FIG. 46A is a diagram showing direct attachment of the filter to the outer frame; FIG 46B is a diagram showing indirect attachment of the filter to the outer frame; and FIG 46C is a diagram showing attachment of the filter by way of a protrusion; and (A) is a view through A in FIG 46B, and (B) is a view through B in FIG 46B;
FIG. 47 is an illustration of the principle of dehumidification action by solid polymer electrolytic film;
FIG 48 is an exploded diagram of a dehumidifier based on solid polymer electrolytic film;
FIG. 49 is an exploded diagram of another dehumidifier based on solid polymer electrolytic film;
FIG 50 is an exploded diagram of still another dehumidifier based on solid polymer electrolytic film;
FIG. 51 is a cross sectional view of an example of the structure of a fan motor;
FIG 52 is an enlarged cross sectional view of regions near the rotation shaft shown in FIG 51;
FIG 53 is a diagram of air-flow inside the pod caused by thermal convection;
FIG 54 is a diagram of supplying dry gas into the interior of the pod;
FIG 55 is a top view of the substrate transport pod of the present invention;
FIG 56 is a side view of the pod shown in FIG 55;
FIGS. 57A and 57B are, respectively, a top view and a vertical cross sectional view of a substrate transport pod provided with an air cleaning apparatus;
FIGS. 58A and 58B are, respectively, a top view and a vertical cross sectional view of a substrate transport pod;
FIGS. 59A and 59B are, respectively, a top view of a power input apparatus and a bottom view of the substrate transport pod;
FIGS. 60A to 60H are diagrams of various methods of discharging the static electricity from semiconductor wafers disposed inside the substrate transport pod;
FIG 61 is a top view of a substrate transport pod;
FIG 62 is a cross sectional view of the substrate transport pod;
FIG 63 is a bottom view of the substrate transport pod;
FIG 64 is a top view of the substrate transport pod;
FIG 65 is a cross sectional view of a substrate transport pod;
FIG 66 is a bottom view of the substrate transport pod;
FIG 67 is a graph to compare the service life of a dehumidifier;
FIG 68 is a diagram to show the attachment of the substrate transport pod to a processing apparatus;
FIG 69 is a diagram to show transport of substrates from the substrate transport pod mounted on a processing apparatus;
FIGS. 70A and 70B are, receptively, a top view and a vertical cross sectional view of a substrate transport pod;
FIGS. 71A and 71B are, respectively, a top view and a vertical cross sectional view of a substrate transport pod;
FIG 72 is a diagram to show a substrate transport pod mounted on a processing apparatus;
FIG 73 is a diagram to show an example of operation of the pod shown in FIG 72;
FIG 74 is a graph showing dehumidifying performance and fan operations, and ○ refers to fan stopped, ∗ refers to fan operating intermittently, and ♦ refers to fan operating continually;
FIG 75 is a graph showing dehumidifying performance and fan operations, and ∗ refers to operation with two dehumidifying followed by one dehumidifying unit, and ♦ refers to operation with one dehumidifying unit only;
FIG 76 is a flowchart of first stage of semiconductor device production;
FIGS. 77A to 77D are diagrams of a substrate transport pod that allows detaching filter and moisture aversion parts;
FIGS. 78A and 78B are diagrams of a variation of the pod shown in FIG 77;
FIGS. 79A, 79B and 79C are diagrams of the structure of the power input section seen in a front view, a bottom view and a cross-sectional view;

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FIGS. 80A and 80B are diagrams of the structure of a power input apparatus seen in a vertical cross sectional view and a top view;
FIGS. 81A and 81B are diagram of the structure of another power input apparatus seen in a cross sectional view and a top view;
FIG 82 is a diagram of a substrate transport pod seated on a power input apparatus;
FIG 83 is a diagram of a substrate transport pod seated on another power input apparatus;
FIG. 84 is an exploded perspective view of a substrate transport pod;
FIG. 85 is a block diagram of the control section on the substrate transport pod side;
FIG. 86 is a block diagram of the control section on the powering apparatus side;
FIGS. 87A, 87B and 87C are diagrams showing transport state, seated state and door descended state of the substrate transport pod, respectively;
FIGS. 88A, 88B and 88C are diagrams of a variation of the example shown in FIG 87;
FIGS. 89A, 89B and 89C are diagrams of another variation of the example shown in FIG 87;
FIGS. 90A, 90B and 90C are diagrams of still another variation of the example shown in FIG 87;
FIG. 91 is a diagram of a substrate transport pod seated on a power input apparatus;
FIG 92 is a diagram to show a pod transported by OHT, and is being powered;
FIG. 93 is an enlarged view of the ceiling section of the pod shown in FIG. 92;
FIG 94 is a diagram of information management system for substrate transport pods;
FIG 95 is a diagram to explain information holding apparatus attached to the pod-side of the system shown in FIG 94;
FIG 96 is a diagram of a management system in managing washing events and filter exchange events;
FIG 97 is a cross sectional view of a substrate transport pod having a filter near the gas intake opening and the gas discharge opening;
FIG. 98 is a cross sectional view of a substrate transport pod having a cylindrical particle filter (5c) for producing a gaseous stream in the radial direction;
FIG 99 is an enlarged view of the cylindrical particle filter (5c) shown in FIG 98, and a cross sectional view through A-A and an enlarged view of B section;
FIG. 100 is a block diagram for a process of establishing a charging duration; and
FIG. 101 is a conceptual diagram of network management for the substrate transport pods.

Best Mode for Carrying Out the Invention

[0011] Preferred embodiments will be explained in the following with reference to the drawings attached.

[0012] First, the necessity for automation and clean-room will be explained. To prevent human errors by workers and contamination of substrates such as semiconductor wafers by organic substances and minute quantities of ammonia generated from the workers, it is effective to remove the workers from the space used for handling the substrates, and the introduction of process automation is required as a means for achieving such an end. Substrate transport pods for use in such automated facility include SMIF (standard mechanical interface) pod and FOUP (front opening unified pod), which are used in conjunction with door opener that positions the pod at a specific location and opens a door externally, and transport apparatus for automatic transport. SMIF pods and FOUPs are sealed containers that permit lesser degree of cleanliness in the exterior environment of the pod, that is, the cleanliness of the clean-room can be lesser degree. Accordingly, capital cost and operating cost of the clean-room can be reduced.

[0013] Clean-rooms are classified according to air flow pattern as: unidirectional flow clean-room, non-unidirectional flow clean-room and mixed flow type clean-room. FIG 1A shows the air-flow pattern in the unidirectional flow clean-room. In this type of clean-room, clean air that has been filtered through ULPA filter 635 and others is forced out from the ceiling or the front face of one wall and is exited from the floor opposite to the filter or the ceiling 631 to sweep the air from the clean-room through the circulation line 632 and an air blower 633. This method produces a highly clean environment in the entire room and permits reduction in the number of partitions required, but on the other hand, this method is the most expensive. FIG 1B shows the air flow pattern in the non-unidirectional flow clean-room. In this method, clean air that has been filtered through ULPA filter 635 and others is blown out from the ceiling or one portion of one wall and the room air is diluted with the clean air, which is exited from the discharge opening 634. This method is used to generate a degree of cleanliness that is less stringent than the class 6 (corresponds to Federal Standard 209D class 1000) defined by JIS B9920. Although the high degree of cleanliness cannot be produced, the method can reduce the number of partitions as well as capital and operating costs. The method provides advantages such as relative ease in switching the production lines because the number of partitions can be reduced. This method is most suitable for semiconductor plants based on mini-environment type production designed to store substrates primarily in containers. FIG. 1C shows the mixed-flow type clean-room that incorporates the features of both unidirectional flow and non-unidirectional flow clean-rooms described above. This method allows reduction in capital and operating costs

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by producing a high degree of cleanliness only in the production line containing the semiconductor production facilities and passages by the use of the unidirectional flow clean-room, while using the non-unidirectional flow clean-room in service areas and the like that can allow a lesser degree of cleanliness. Because the partition walls 636 are required, it has a disadvantage that regrouping of production line is more difficult. This method is suitable for open cassette type production plant that handles substrates mostly as they are.

[0014] FIG 2 shows an example of wiring formation process of a semiconductor chip based on copper wiring and low dielectric insulation film. As shown in FIG 2, CVD (chemical vapor deposition) apparatus or coater is used to deposit insulation film 62 comprising organic film or porous film, on top of the conductive wiring layer of the semiconductor substrate 61 having device elements fabricated thereon (step A). Next, after forming the plug film and others as necessary, a photo-resist material 63 is applied using a coater, then the coated substrate is dried (step B). Next, after exposing the coated substrate using the stepper (step C), the resist film is developed to form a resist pattern 64 on the insulation film 62 (step D). Next, contact holes and wiring grooves 65 are formed on the insulation film 62 by etching (step E), and after removing the resist film 63, a barrier layer comprising TaN and the like is formed thereon, and on top of this layer, a copper seed layer 66 is formed to serve as the power input layer for electrolytic plating (step F).

[0015] Then, by applying a copper layer 67 on the surface of the semiconductor substrate 61, contact holes and grooves of the device substrate are filled with copper when the copper layer 67 is formed on top of the insulation layer 62 (step G). Then, the device substrate is annealed (step H) and, using chemical and mechanical polishing (CMP), a portion of the copper layer is removed from the top of the insulation layer so as to roughly level the surfaces of the copper layer 67 filling the contact holes and wiring grooves with the surface of the insulation layer (step I). This process is repeated as many times as the number of layers of wiring required to produce a multi-layered wiring structure comprised by 6~8 layers.

[0016] When the low dielectric insulation layer is exposed to the air, it is preferable that the absolute humidity in the air be lower than $4x10^{-3}$ g/g (20 % relative humidity at 25 °C), and more preferably lower than $1x10^{-3}$ g/g (5 % relative humidity at 25 °C).

[0017] When the copper film is exposed to the air, it is preferable that the absolute humidity in the air be lower than $4x10^{-3}$ g/g (20 % relative humidity at 25 °C), or more preferably, lower than $1x10^{-3}$ g/g (5 % relative humidity at 25 °C). Further, the level of organic substances of boiling point higher than 80 °C should be lower than 1 $\mu g/m^3$, or more preferably, lower than 0.5 $\mu g/m^3$. The oxygen concentration should be lower than 10000 ppm, or more preferably lower than 1000 ppm.

[0018] When the resist film is exposed to the air, it is preferable that the basic gases should be lower than 1 $\mu g/m^3$ in concentration, or more preferably lower than 0.5 $\mu g/m^3$.

[0019] Also, when the humidity is low, static electricity is generated easily such that there is a danger of destroying elements such as FET and condensers so that it is preferable that each semiconductor wafer be grounded. The method of grounding include the use of conductive wafer carriers, grounding the wafers through metallic contacts provided on the wafer carrier or using an electrical conductor material to make the wafer carrier itself.

[0020] Next, an embodiment of the substrate transport pod of the present invention will be explained. First, general transport capabilities of the transport pod suitable for automation will be explained. For example, a substrate pod for transporting several semiconductor wafers is comprised at least by the following parts.

① a pod main body having an inverted square cup shape;
② a door that houses an internal mechanism for engaging with the pod main body to operate the door externally;
③ a holding means for holding the wafers separated at a given distance;
④ a retainer for preventing vibration of the wafers;
⑤ a holding means for handling the container.

[0021] The container main body is generally made of a transparent polymeric material or an opaque material having a transparent window so as to enable confirmation of the contents. The door is provided with a positioning hole for externally guiding a latching pin and the like for operating the door, and internally houses a mechanism for locking and unlocking the door that operates in conjunction with the door operating latching pin. This latching mechanism commercially available includes those operated by mechanical drive or by vacuum, compressed air as well as those having magnet-assisted fixation. The holding means is disposed on the ceiling or the side wall section of the pod, and some are shaped so that positioning notches are used to enable a robot to grip the pod or to enable to handle the pod manually. The base requirements of the pod suitable for automation purposes may include any of these methods so long as the required function is achieved.

[0022] FIG 3 shows a substrate transport pod of this embodiment for transporting semiconductor wafers. Further, a memory chip may be provided for the pod so as to track wafer ID, history and status for each wafer batch so as to manage the processing data. The pod is comprised by the box member 1 and a lid member 2, which are affixed by a stopper or latching mechanism and the like, for example, to guard the wafers from contamination by the external

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environment.

[0023] Silicon wafers W are stored in the wafer carrier 4, which is housed inside the substrate transport pod 1. In the interior of the substrate transport pod 1, a gaseous contaminants capture medium 6 and a dehumidifying agent 8 are disposed. The gaseous contaminant capture medium 6 may include non-woven ion exchange cloth, activated carbon fibers or zeolite to remove such gaseous contaminants as hydrocarbons and ammonia that may reside inside the pod. Dehumidifying agent 8 may include silica gel, for example, to remove moisture from the interior of the substrate transport pod. It is preferable that such substances have high surface area so as to increase the gaseous contaminant capture efficiency and dehumidifying effects. The filters may be formed preferably in a wavy shape or a folded shape. It is preferable that the area of the non-woven ion exchange cloth or activated carbon fibers be more than 10 % or more preferably more than 20 % of the surface area of the interior space of the substrate transport pod. It is preferable that the dehumidifying agent be those having a dehumidifying capacity of more than 0.1 g and less than 0.4 g, or more preferably more than 0.5 g and less than 3 g per L (liter) of the volume of the space to be dehumidified.

[0024] FIG 4 shows an example of the variation of the substrate transport pod. Because there is a danger of dust generation from the gaseous contaminant capture medium 6 and dehumidifying agent 8, in order to prevent particle contamination of semiconductor wafers, they are surrounded by a particle filter 5 such as HEPA filter and ULPA filter so as to prevent particulate matters from adhering to the semiconductor wafers W.

[0025] FIG. 5 shows a substrate transport pod 1 which is provided with a motor fan 7a for circulating the interior air by operating a motor 7b so as to force the air through the dehumidifying agent or dehumidifier 8, the gaseous contaminant capture medium 6, and the particle filter 5 to actively remove particulate contaminants. Here, when contamination is not a problem, the particle filer 5 may be omitted.

[0026] Electrical power may be supplied from an external source through a power input terminal 19 provided on the exterior of the substrate transport pod 1 to operate the fan motor and/or dehumidifier. It is preferable that the surface of the terminal be gold-plated to prevent contamination of the clean-room. Here, as shown in FIGS. 98 and 99, the particle filter 5 is a cylindrical filter and may eject air in the radial direction. This example relates to the particle filter but the chemical filter may also be constructed in a similar manner.

[0027] When supplying power externally, it is preferable that the power be turned on after confirming that the substrate transport pod is present and the power is needed to be supplied or that the external power input connector and the power input terminal of the substrate transport pod are connected. This is because the pod is used in a clean-room, and if sparks fly between the electrical terminals, minute metallic particles are generated and contaminate the clean-room.

[0028] Further, as shown in FIG 6, a battery 9 may be mounted on the substrate transport pod 1. Also, the substrate transport pod may be provided with a charging terminal so that the battery may be charged by supplying electrical power from an external source.

[0029] In the case of a container shown in FIG 5 or 6, as shown in FIG. 7, during the period of transport of the substrate transport pod 1 mounted on an unmanned vehicle 10 to travel between the processing apparatuses 11, the air inside the substrate transport pod is circulated by supplying power from the battery mounted on the unmanned vehicle 10 or from an external power source (not indicated) to the fan motor 7 located inside the substrate transport pod 1. Also, when the substrate transport pod 1 is in the standby mode by being placed on the processing apparatus 11, power may be supplied from the processing apparatus 11. For example, a battery provided for the processing apparatus or a part of electrical power supplied from an external source can be used for this purpose. Charging may be carried out in a similar manner.

[0030] Further in FIGS. 8 and 9, if dust generation from the fan motor is a problem when the fan motor 7 is stopped, the particle filter 5 may be placed upstream of the fan motor 7.

[0031] Also, in addition to dust generation from the fan motor 7, if the generation of gaseous contaminant is a problem, a chemical filter 6 may be placed in the upstream side of the fan motor 7. If moisture generation from the fan motor is a problem, dehumidifying agent 8 may be placed in the downstream side of the fan motor 7. These may be placed singly or in combination.

[0032] As shown in FIG 9, the substrate transport pod may be provided with a duct 12 that houses the filters 5, 6. Further, as shown in FIG. 10, there may be provided an air supply opening 21 and a discharge opening 22 for discharging the air from the interior of the substrate transport pod externally. Such a substrate transport pod 1 communicates, as shown in FIG 11, with the interior environment of the processing apparatus or an automatic guided vehicle (AGV). The air supply opening 21 and the discharge opening 22 have a reverse flow prevention device, and they assume a hermetic state excepting when the air is being supplied. The motor fan 7 may be provided on either the processing apparatus 11 or the AGV so that the air inside the substrate transport pod is circulated by flowing through the filter duct 12. The motor fan 7 uses power from the battery 9 provided on the processing apparatus 11 or the AGV 10 or a part of the power supplied from an external source. Further, as shown in FIG. 12, the substrate transport pod 1 may be provided only with the air supply opening 21 and the discharge opening 22, such that the fan motor, filter duct and others are provided on the processing apparatus 11 or the transport apparatus 10 or on a storage facility, as shown in FIG 13, for

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circulating the air.

[0033] Further, as shown in FIGS. 14 and 15, processing apparatus 11 or transport apparatus 10 or storage facility may be used to draw air from the clean-room, and the motor fan 7 is used to circulate the air to the substrate transport pod 1 by opening the discharge opening 22 of the substrate transport pod 1 to discharge the air to the clean-room or the discharge ducts in the processing apparatus. Here, the filters 5, 6 of the motor fan 7 in the upstream side of the motor fan and dehumidifying agent 8 may be omitted.

[0034] Also, as shown in FIGS. 16 and 17, by placing a filter unit on the outside of the substrate transport pod 1, the air inside the substrate transport pod may be circulated through the filters 5, 6 and the dehumidifying agent 8 by way of the air supply opening 21 and the discharge opening 22 communicating with the substrate transport pod 1. Because the filter units 5, 6, 7, 8 are placed outside the substrate transport pod, the interior space can be cleaned easily and filter exchanging can be carried out simply.

[0035] The interior of the substrate transport pod 1 may be provided with a flow regulation plate 23, as shown in FIG 18, so as to prevent the air from bypassing the wafers W by short-cutting from the air supply opening 21 to the discharge opening 22. The degree of opening of the flow regulation plate 23 increases as the air moves away from the air supply opening 21. Accordingly, the flow of air becomes uniform in the wafer stacking direction. In particular, for particles of smaller than 0.1 μm size, the Brownian movement is stronger than the gravitational movement. For example, in the case of 0.1 μm particles, the distance of movement due to Brownian motion is $3x10^{-3}$ cm per one second while the distance of movement due to gravitational settling is $9x10^{-5}$ cm per one second. It is preferable that the average speed of air moving between the wafers be at least 0.3 cm/s and lower than 30 cm/s, or preferably faster than 1 cm/s and lower than 10 cm/s.

[0036] Also, because the particles settle due to gravity, it is preferable to attach the air supply opening 21 to the upper section of the substrate transport pod 1 and attach the discharge opening 22 to the lower section of the substrate transport pod 1, as shown in FIG 19, or the air flow pattern should be formed so as to discharge the air in the lower section of the substrate transport pod 1, as shown in FIG 20.

[0037] FIG. 97 shows an example of disposing the particle filter 5 and the chemical filter 6 in the vicinity of the intake opening of the substrate transport pod 1. In this case, the filters 5, 6 are disposed in the upstream as well as downstream side of the pod 1. Here, the filters 5, 6 may be disposed either the upstream or downstream side.

[0038] FIG. 21A to 21F illustrate various practical situations of gaseous flow when the substrates are placed inside the substrate transport pod. The flow inside the pod 1 is formed by the gas flowing through the chemical filter (gaseous contaminants filter) 6 and the ULPA filter 5 by the action of the fan motor 7, so that the wafers W are swept by the cleanest gas. After flowing among the wafers, it again returns to the fan motor 7 by flowing along the inside wall surface of the pod 1. The interior wall surface of the pod 1 relates to at least one surface of the top/bottom and left/right surfaces of the pod. The opening section of the door may be provided anywhere. In automated transport systems, the opening section for the door is provided in the front or bottom surface of the pod.

[0039] FIG 21A shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and wafers W and returning to the motor fan 7 along the left and right interior walls of the pod 1. FIG 21B shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and wafers W and returning to the motor fan 7 along the top and bottom interior walls of the pod 1. FIG 21C shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and wafers W and returning to the motor fan 7 along all the interior walls of the pod 1. FIG 21D shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 along the left and right interior walls of the pod 1 and then flowing through the wafers W and returning to the motor fan 7. FIG 21E shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 along the top and bottom interior walls of the pod 1 and then flowing through the wafers W and returning to the motor fan 7. FIG 21F shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and returning to the motor fan 7 along the interior walls of the pod 1. In this example, the gas need not flow directly to the wafers W. In all the cases of flow patterns, it is preferable that the gas be circulated at least once or preferably three times during the period between storing of the substrates in the substrate transport pod and removing the wafers again from the pod, such that the number of circulations can be adjusted, depending on the nature of the environment required by the stored substrates and the degree of contamination existing in the environments associated with the processes preceding and succeeding the current process. If there is no restriction on the power consumed by the fan, it is most preferable that the gas be circulated constantly. Here, it should be noted that "the nature of the environment required by the stored substrates" refers to the creation of an environment inside the pod during transit for individual processes so that all or any particular species of contaminants in the pod that may reduce the yield, such as particulate matters, ions, dopants, organic substances, moisture are kept below the target control level.

[0040] The substrate transport pod that performs such environmental control can be used for transporting the substrates within any manufacturing processes, for example, between the steps in a semiconductor manufacturing process, between the floors inside the plant, between plants, or, in addition to transporting them, it may also be used to store substrates.

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[0041] When the substrate transport pod itself has a battery, the fan may be operated intermittently so that the fan will be operating at some intervals. By so doing, the power consumption of the battery can be reduced. It is preferable that the power input terminal 19 be located at the bottom section of the substrate transport pod 1, as shown in FIG 22, so that the electrical resistance at the connection to the apparatus terminal can be kept low because of the weighting effect of the substrate transport pod. It is preferable that the power input terminal 19 be pressed down by a spring member s, as shown in FIG 23A, or by a metal terminal 19 itself providing a spring action as shown in FIG 23B.

[0042] Further, it is preferable that the surfaces of the power input terminals be gold plated, at the receiving end as well as the supply end. The power source may be a direct current source, but alternating current power may also be supplied so that inductive current generated by electromagnetic means, as shown in FIG. 24, can be supplied to the substrate transport pod 1 from AGV 10 or processing apparatus 11. In this case, metal surface is not exposed on the terminal surface so that metal to metal contact is avoided to minimize contamination of the clean-room by generation of metallic dust.

[0043] Also, as shown in FIG 25, it is preferable to provide a shutter or a one-way valve 24 to close the air supply opening 21 and the discharge opening 22, when the connection opening of the AGV 10 or processing apparatus 11 is not connected to the air supply opening 21 and discharge opening 22 of the substrate transport pod 1.

[0044] Also, as shown in FIG 26, it is preferable that, by locating the air supply opening 21 and the discharge opening 22 of the substrate transport pod 1 to face toward the bottom of the substrate transport pod 1, the air supply opening 21a and the discharge opening 22a of AGV 10 or processing apparatus 11 is hermetically connected by means of respective seals 25. The seal 25 may be associated with either the substrate transport pod, AGV or with the processing apparatus.

[0045] The air supply opening and the discharge opening may be provided on the door 2. The cross sectional shape of the substrate transport pod may be square as shown in FIG 27A or circular as shown in FIG 27B, but when it is square shaped, it is preferable that the comer radius R be greater than 10 mm or more preferably greater than 20 mm. Also, it is preferable that the supply opening and discharge opening be provided with a pre-filtering means such as membrane filter to prevent admission of particulate matters.

[0046] For storing semiconductor wafers inside the pod, the most difficult problem is humidity control.

[0047] In the substrate transport pod in this embodiment, the pod main body and the door are made of a polymeric or moisture impervious material having less than 0.1 % water absorption factor. The method of determining the water absorption factor is according to ASTM (American Society for Testing and Materials) D570. Some values of the water absorption factor of general materials used in transporting and storing of semiconductor wafers and the like are: PC (polycarbonate) 0.2 %; PBT (polybutylene terephthalate) 0.08 %; PEEK (polyether etherketone) 0.14 %; PEI (polyetherimide) 0.25 %; and PP (polypropylene) 0.03 %.

[0048] It is preferable that the water absorption factor of the pod 10 be at the most less than 0.3 % or more preferably less than 0.1 %. Polymeric materials of less than 0.1 % water absorption factor include: PE (polyethylene)<0.01 %; PP (polypropylene) 0.03 %; PBT (polybutylene terephthalate) 0.06~0.08 %; PPS (polyphenylene sulfide) 0.02 %; PTFE (polytetrafluoroethylene)<0.01 %; PC (polycarbonate with 20 % added carbon) 0.1 %; and PBT (polybutylene terephthalate with 20 % added carbon) 0.05 %. The material preferable for the pod should have water absorption factor of less than 0.1 %, resistant to chemicals, stable at elevated temperatures, and has a low mold shrinkage of less than 1 % or more preferably less than 0.5 %, and includes such materials as: PPS (polyphenylene sulfide); PPS with added carbon, PBT with added carbon; and PC with added carbon. The material for the pod may include alloy material of different polymers so long as the afore-mentioned characteristics are satisfied.

[0049] Also, it is preferable that at least the wafer support material that contacts the wafers and the door that grounds the wafer support to the pod bottom be made of some electrically conductive material having carbon or other electrical conductor added thereto. The polymeric materials in general are classified as follows: those having surface resistivity $1x10^3$~$1x10^8$ Ω are classified as static-charge conductive materials; those having $1x10^5$~$1x10^{12}$ Ω as static-charge dispersing materials; and those with values higher than $1x10^{12}$ Ω as insulating materials. Also, those material having volume resistivity $1x10^2$~ $1x10^5$ Ω·cm are classified as static-charge conductive material; those having $1x10^4$~ $1x10^{11}$ Ω·cm as static-charge dispersing material; and those with values higher than $1x10^{11}$ Ω·cm as insulating material. In the present invention, it is preferable that the surface resistivity be less than $1x10^{10}$ Ω; and volume resistivity be less than $1x10^9$ Ω·cm, or more preferably surface resistivity be less than $1x10^8$ Ω; and volume resistivity be less than $1x10^7$ Ω·cm. Also, because the non-woven ion exchange cloth and activated charcoal used for gaseous contaminant capture medium contain adsorbed moisture, immediately after their production, so that it is preferable to dry them before use.

[0050] When the atmosphere inside a hermetically sealed pod is replaced with a dry gas, i.e. dried air or an inert gas that does not contain moisture, the internal humidity immediately after replacement drops to the limiting humidity at nearly 0 %. However, if the pod is left in this condition by stopping the supply of dry gas, moisture contained in the polymeric material used in the interior walls diffuses into the pod due to moisture gradient. Therefore, the humidity inside the container that has been filled with dry gas gradually increases with passage of time. As one example, it has been shown that, when commercial PC (polycarbonate) is used for the pod, the relative humidity at 0 % inside the pod

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attained immediately after replacing with a dry gas, rises to a value higher than 30 % after several hours. When PPS (polyphenylene sulfide) that has water absorption factor of 0.02 % is used, the relative humidity at 0 % attained immediately after replacing with the dry gas remains at about 12 % even after more than several hours to demonstrate its superior suppression effect against humidity rise. It is clear from this that it is possible to prevent the rise in the humidity of interior of the pod space during storage/transport of wafers. Also, it is known that the growth of natural oxide film is prevented by storing the wafers in a dark environment. For this reason, it is preferable that the material for constructing the pod should be selected from optically opaque materials rather than from optically transparent materials.

[0051] The pod may be manufactured in one piece by press forming of sheet metal. The optically opaque material should block wavelengths shorter than 1500 nm (near infrared), or more preferably those shorter than 750 nm (visible light) to produce luminance of less than 10 lux or more preferably less than 1 lux. Further, the pod material may be made of a charge-retaining material so as to attract fine particles inside the pod, thereby preventing such fine particles from sticking to the wafers. For example, as shown in FIG 28, the pod may be externally charged or discharged so that the fine particles are adhered to the interior walls during the period of charging the pod and the fine particles adhered to the interior walls are removed during the period of discharging the pod. The pod 1 is charged only when it is placed on the powering/discharging apparatus 30. The pod is provided with a powering/discharging terminals 39 to couple with the powering/discharging apparatus 30.

[0052] Various mechanisms of latching the door 2 to the pod 1 are shown in FIGS. 29A and 29B that show a mechanical arrangement, FIG. 29C shows a magnetic device 30 to hold the door against a sealing surface and FIG 29D shows a vacuum chucking device 40 provided on the interface between the door and a sealing surface. The vacuum chuck is operated by the action of an evacuation means such as vacuum pump 32. Also, the door 2 may be attached to the pod 1 by evacuating the entire vessel to a negative pressure.

[0053] A preferred example of the method of FIG 29D is shown in FIGS. 29E and 29F. The pod 1 has a door 2 that can be opened or closed, and a seal member 54 is provided between the door 2 and the pod to maintain hermetic condition of the interior of the pod. The sealing member is formed in one piece along the external frame of the door. One or a number of sealing members may be provided. Also, the pod has an exhaust duct 53 for closing the door 2 and a port valve 52 for closing/opening one end of the exhaust duct. A groove is formed at the door side end section of the exhaust duct to extend along the flange. An interface 50 is provided on the transport apparatus side and a valve 51 to communicate with the interface is provided.

[0054] Next, the flow pattern in the vacuum chucking method will be explained. As shown in FIGS. 29E and 29F, a method of opening the door from the pod is to place the pod 1 on the interface 50 while the door 2 is closed against the pod 1. Valve 51 is opened to evacuate the interface. Then, valve 51 is closed to maintain the interface section under vacuum and the port valve 52 is opened. Valve 51 is opened to introduce atmosphere inside the interface and the door is opened. A method of closing the door against the pod is to evacuate the interface while holding the door against the pod somehow and opening the port valve 52. The door 2 is then closed tightly against the pod 1. Port valve 52 is closed and the valve 51 is opened to introduce atmospheric pressure inside the interface section, so the pod 1 becomes movable.

[0055] The drive source for the mechanical latching device shown in FIG. 29B may be based on an external mechanical latching device, or it may be based on the method shown in FIG 29B to operate the latch 26 in/out of the door 2 using compressed air through the duct 31. A more preferable method based on FIG 29B is shown in FIG. 30. The latch 26 is provided so as to slide horizontally inside the door so that the latch 26 is always pushed outwards by the pressing means 42 such as coil spring. The pressing means may utilize a metallic coil spring, for example. The latch can be positioned in the first fixed position or the second fixed position. In the first fixed position, the latch 26 is disposed outside of the door 2. This is so that the latch 26 protrudes beyond the door when gas is not evacuated through the duct 31. In the second fixed position, the latch is housed inside the door. This is so that the suction through the duct 31 pulls the latch inside the door. The pod 1 has a groove 45 for receiving the latch. The latch and groove may be provided in plurality. It is preferable that the door 2 be made of an electrically conductive polymeric material, such as carbon-containing polymer, because of protection for static electricity, which will be explained later.

[0056] Next, positioning of the pod will be explained. As shown in FIGS. 32A, 32B and 32C, a locating hole 556 is provided on the pod bottom section 553 so as to correspond with the locating pin 554 provided on the station side. Also, as shown in FIGS. 32A and 32B, the end section 553a of the pod bottom section 553 is beveled so as to facilitate entry into the pod mounting section 555 of the station side. As shown in FIG 32C, the end section 555a of the apparatus mounting section 555 may be machined at a slant angle. In this case, the end section 553a of the pod need not be beveled.

[0057] As shown in FIG. 33, in order to maintain a clean atmosphere inside the pod, sealing member is required between the box and the door. A method is to seal the interface by means of sealing member provided at the interface between the two. In the flange section of the pod main body to contact the sealing member provided on the door 2, guide ribs 559 may be provided inside the flange for mechanical strengthening. Also, a protrusion 560 may be provided on the contact section to the seal member so that hermetic sealing is achieved with a smaller contact pressure. For

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the sealing member 557, it is preferable to use a fluoride-based elastomer, a polyester-based elastomer, a polyurethane-based elastomer or a polyolefin-based elastomer. Further, heat treatment enhances prevention of degassing from the sealing member during processing. Also, it is known that a positive pressure inside the pod prevents entry of contaminants from external sources. Positive pressure environment can be generated constantly or periodically. Further, as shown in FIGS. 34A and 34B, a bar code 558 may be displayed on the outer surface of the pod 1 for content identification.

[0058] Next, the particle filter will be explained.

[0059] In general, air filters are used generally to remove particulate matters. According to the JIS standards, filters are classified into the following four categories according to their particle size and capture efficiently.

① coarse particle filter: an air filter used primarily for particles larger than 5 μm;
② medium performance air filter: an air filter having medium performance primarily for particles smaller than 5 μm;
③ HEPA filter: an air filter having a capture efficiency of greater than 99.97 % for particles of 0.3 μm at a specified wind velocity and generates a pressure drop of less than 245 Pa;
④ ULPA filter: an air filter having a capture efficiency of greater than 99.9995 % for particles of 0.1 μm at a specified wind velocity and generates a pressure drop of less than 245 Pa.

[0060] In the case of creating a clean environment as in the present substrate transport pod, either the HEPA filter or the ULPA filter should be used. The ULPA filter is generally constructed so that folded filter member is provided with spacers to secure flow passages. The pressure loss through the ULPA filter varies depending on the flow resistance of the filtering membrane and the manner of folding the membrane and uniformity of the passages. When the structure is such that the opening area of the filter is small, the length of the flow passage should be increased and it is preferable to use filters having low pressure drop by packing more filtering medium. Filtering media are available commercially in various materials such as glass fibers and fluoride-based resins, and any such filtering medium may be used, but it is preferable to use fluoride-based resins that offer superior chemical resistance, low gas emission and low flow resistance. When the opening area can be made large, it is preferable to decrease the length of flow so as to maximize the utilization of the limited space available.

[0061] A frame made of aluminum or a stainless steel (SUS) or a polymer is filled with folded HEPA or ULPA filter. As shown in FIGS. 35A and 35B, the folded filter member has partitions called ribbons 101 at the apexes. The ribbons serve to maintain a constant separation of the folds to secure passage of air through the filter member. The folded filtering medium 100 is affixed to the outer frame 102 using an adhesive 103. Instead of the ribbons, the filter member may be embossed to secure the flow passages or the ribbon may be eliminated. Also, when the outer frame is made of a polymer, attachment may be made by fusing instead of using adhesive.

[0062] Here, as shown in FIG 36, a filter member may be manufactured by inserting wave-shaped separators 104, instead of the ribbons.

[0063] Also, without folding the filter member, a flat film may be used as a filter member. For example, as shown in FIG 37, a circular filtering medium 100 may be inserted between a circular inner support member 105 and an outer support member 106, and mechanically affixed to produce a flat structured filter. Such a filter has a high flow resistance, and therefore, it is suitable for application to air moving devices such as pumps.

[0064] Filtering media for particle filtering include PTFE, glass fibers, non-woven cloths, recycled products. The structure of the filter may include folded structures (pleats, mini pleats), membranes (sheet type), corrugation and hollow fibers.

[0065] The particle filters are used in an assembled unit by surrounding the filtering medium 100 in an outer frame 102 as shown in FIGS. 38 and 39. To prevent the captured particles from being detached from the filter, it is necessary to seal between the filter members and the outer frame at the sealing sections 107. A general method of sealing is to use an adhesive 103. It is also possible to pressure-bond the filtering medium 100 and the outer frame 102. The adhesive includes urethane-based or epoxy-based resins. Furthermore, when the outer frame is made of a polymeric material, filter members may be fused to the frame. By constructing the particle filter 5 separately from the gaseous contaminants filter 6, as shown in FIG. 39, when the service life is ended, each filter can be replaced independently of the other to increase the respective efficiency of filter utilization. Also, a space S is created between the particle filter 5 and the gaseous contaminants filter 6 by way of the outer frame 102, moisture transmission and the pressure drop of filters themselves can be avoided.

[0066] Next, the chemical filter (gaseous contaminants filter) 6 will be explained.

[0067] Different gaseous contaminant removing means can be chosen depending on the nature of the target substance. Basic gases can be removed effectively by the use of strongly acidic or weakly acidic cation exchange non-woven cloth or fibers, or strongly acidic or weakly acidic cation exchange beads. They can also be removed by the use of activated charcoal or ceramics coated with an acidic chemical. Acidic gases, boron, and phosphorous may be removed effectively by the use of strongly basic or weakly basic anion exchange non-woven cloth or fibers, or strongly

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basic or weakly basic cation exchange beads. They can also be removed by the use of activated charcoal or ceramics coated with a basic chemical. Organic substances can be removed by activated charcoal, activated carbon fibers, zeolite, molecular sieve, silica gel and porous ceramics. Ozone can be removed by the use of a carrier medium made of manganese dioxide in the form of grains or sheet or by attaching them to a carrier, or activated charcoal coated with manganese dioxide. Also, ionized metals in a vapor form, for example, copper sulfide, can be removed by non-woven ion exchange cloth or ion exchange beads. The structure of adsorbing material can be chosen to suit the allowable size of the filter, shape and pressure drop.

[0068] FIG. 40 shows an example of the chemical filter made of a folded sheet type adsorbing material, comprised by an outer frame 102, a sheet shaped adsorbing agent 108, a separator 104 and a seal member 103. The outer frame 102 is made of Al or stainless steel (SUS) or a polymeric material. Sheet type adsorbing material includes: ① non-woven ion exchange cloth; ② activated carbon fibers; ③ non-woven cloth impregnated with activated charcoal in a particulate or powder form; ④ two melt-bonded non-woven cloths 109 laminated and the space filled with adsorbing material 110 comprised by activated charcoal powder or ion exchange resin, as shown in FIG 41; and ⑤ non-woven cloth or fibers for capturing debris falling from activated carbon fibers and others. The adsorbing material may be affixed to the outer frame by means of urethane adhesive or by pressing to a sponge type gasket member.

[0069] As shown in FIGS. 41 and 42, the chemical filter is comprised by an outer frame 102, an adsorbing material 108 or 110 and a support member 111. The structure is such that activated charcoal particles or zeolite or ceramic particles or single crystal particles or ion exchange resin 110, singly or in combination, is wrapped by non-woven ion exchange cloth or fibers or non-woven cloth or fibers108 having no adsorbing capability, and the structure is reinforced with a support member 111 so as not to expand the activated charcoal particles. Another method is shown in FIG 43, in which the spaces in a honeycomb structure 112 or corrugated core 113 are filled with activated charcoal particles or zeolite or ceramic particles or single crystal particles or ion exchange resin 110, singly or in combination, and the filled carrier is wrapped in a non-woven cloth 109 with a support member 111. The material for the honeycomb structure or corrugated core may or may not have adsorbing capability.

[0070] Another filter structure is shown in FIG 44, in which a unified adsorbing member 114 is wrapped with a non-woven ion exchange cloth or fibers 108 or with a non-woven cloth or fibers 109 having no adsorbing capability. Adsorbing agent may be made by bonding activated charcoal or activated charcoal coated with acidic or alkaline substance or ion exchange resin or zeolite to a three-dimensional web structure of foamed urethane, for example, or by making a unified structure by cementing activated charcoal particles using an adhesive and drying.

[0071] Another filter structure is shown in FIG. 45, in which the outer frame holds activated charcoal in fiber/paper form or a ceramic material made into a corrugated form 113 or in a lattice form 115, or activated charcoal powder formed into a honeycomb structure 112, which are wrapped with a non-woven ion exchange cloth or fibers, or with non-woven cloth or fibers having no adsorbing capability. It is also permissible to use the honeycomb structure 112 mentioned in ④ above.

[0072] The material for chemical filter (gaseous contaminants filter) includes: activated charcoal, activated carbon fibers, zeolite, silica gel, ceramic material, a non-woven ion exchange cloth or fibers, ion exchange resins, activated charcoal coated with acid or alkaline substance, activated charcoal on a manganese dioxide carrier, metallic catalyst and photo-sensitive catalyst.

[0073] The filter structure can be made of a single material or a plurality of materials. When a plurality of materials is to be used, activated charcoal particles and non-woven ion exchange cloth may be used, for example. In such a case, non-woven ion exchange cloth is used to contain the particles or powder of activated charcoal. Non-woven ion exchange cloth may be made into a sheet form or a folded form. They may be applied on a carrier body made of urethane, foam body, plastic, polymeric or metallic material. For example, activated charcoal particles on a urethane carrier and ion exchange resin on a urethane carrier; or activated charcoal particles on a urethane carrier and a urethane carrier impregnated with activated charcoal particles.

[0074] The shape of the chemical filter may include a plate type, rolled core type, w-type, cylindrical type, plate-fin type, bypass type, and a three-dimensional skeletal type.

[0075] As shown in FIGS. 46A, 46B and 46C, the structure of the gaseous contaminants filter is unitized by attaching the filter member 108 to an outer frame 102. The outer frame 102 may be made of metals such as stainless steel or aluminum, or plastic. FIG 46A illustrates a direct method and FIG. 46B illustrates an indirect method for attaching the filter 108 to the outer frame. In the direct method, the elastic force of the filter itself is used to press against the outer frame. For example, the filter 108 is folded, and the elastic force in the lamination direction presses the filter against the outer frame 102 (refer to FIG. 46A, see-through view A). Indirect mounting utilizes an elastic member 116a between the filter and the outer frame. For example, an elastic member 116b such as gasket (Teflon) and the like may be used (refer to FIG 46B, see-through view B). Also, as shown in FIG 46C, on the inside surface of the outer frame, a protrusion 117 is provided so as to act as a seal when the filter is pressed against the outer frame.

[0076] Also, a particle filter and a chemical filter may be mounted on one frame to produce a composite filter unit. Or, a particle filter and a sheet type chemical filter may be folded together to produce a unified filtering device.

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[0077] Next, dehumidifying agent and dehumidifier will be explained. To remove moisture contained in air, methods based on a dehumidifying agent containing primarily either silica gel, zeolite (including synthetic zeolite), calcium carbonate, calcium chloride or magnesium chloride is available. When using the dehumidifying agent, it is preferable to use an agent such as silica gel, which can be reused after regenerative heating and available in a cartridge form for easy replacement that can be carried out automatically. Another method that may be considered is to cool the pod or insert a cooled rod inside the pod for a given duration to collect the frozen moisture for removal. Also possible is a dehumidifier based on solid polymer electrolytic film. FIG 47 shows a mechanism of dehumidification. In this method, water molecules on the dehumidifier-side space 120 is decomposed into hydrogen and oxygen using a catalyst, and hydrogen is removed through a solid polymer electrolytic film 121 impressed with a voltage towards the outer side of the dehumidifier space 120, that is, hydrogen is discharged towards the moisture discharge side space 122.

[0078] An example of a minimum number of components required for dehumidifier based on a solid polymer electrolytic film will be explained with reference to FIG 48. The essential components are: a positive electrode 123, a negative electrode 124, a solid polymer electrolytic film 121 and a catalytic layer 125. Also, a feature of assembling the components is that the positive electrode 123 and negative electrode 124 have a catalytic layer 125 and a porous substrate base. The solid polymer electrolytic film 121, porous electrode 129 (123, 124) and the catalyst 125 are assembled into a single unit by having the substrate base coupled into the solid polymer electrolytic film 121 and forming the catalytic layer in the coupling space. It is possible to use ROSAHL made by Ryosai Technica Co. Ltd., for example (refer to FIG 49).

[0079] FIG 50 shows another example of the structure of a dehumidifier based on the solid polymer electrolytic film. This example relates to a unified structure produced by molding a fixation flange section 127 with the pod 1. The effective area of the dehumidifier may be made into a square, rectangular, circular, oval or polygonal shape and others, but it is preferable that the effective area (opening area that contacts the gas to be processed) relative to the electrode area be as large as possible, and specifically, the ratio of the opening area that contacts the gas to be processed to the electrode area be higher than 50 % and less than 99 %, or more preferably higher than 60 % and less than 90 %. If the ratios of the opening area that contacts the gas to be processed to the electrode area are the same, an oval shape is preferable than a circular shape and a rectangular shape is preferable than a square shape, and specifically, it is preferable to design so that the short axis and the long axis, or the short perimeter and the long perimeter are related in a range of not less than 10 % and not more than 99 %. The solid polymer electrolytic film should preferably transmit protons, but it may be served by Nafion (registered trade mark) -117 made by DuPont Co, which has a nominal film thickness of 170 μm. It is also possible to use Nafion-115, or XUS-13.204.10 made by Dow Chemical Co., for example. It is preferable to use platinum or platinum black as the catalyst because of its capability and durability, but platinum on carbon carrier or other platinum group metallic catalyst may be used. It is preferable to use aluminum or stainless steel for the current terminal 128 necessary for application of uniform voltage on the porous electrode 129. For packing material, PTFE is preferable because of its low emission of organic substance. Because the fixation flange contacts the process gas directly so that it is preferable to avoid using metals that are susceptible to corrosion by the process gas, so that resin materials such as polycarbonate is preferable, but if there is no danger of corrosion, stainless steel may be used. Also, it is preferable to provide a guard on the fixation flange and the pod main body so as to avoid contacting the electrode section directly from outside.

[0080] In any of these methods, the use of the fan to circulate air inside the pod can hasten the process of dehumidification. In practicing the present invention, it is acceptable to use any type of dehumidifier so long as the method chosen allows all machines to be arranged suitably. Also, by providing ports on the pod main body for introducing and discharging high purity nitrogen or inert gas into the interior of the pod so that replacement of the interior atmosphere is carried out along with dehumidification, it is possible to further reduce the time required for attaining low humidity in the interior of the pod.

[0081] Also, it is preferable to mount both the dehumidifier and moisture absorbing material (activated charcoal, ion exchange agent, silica gel and the like) to act as a dehumidifying unit for the purpose of removing moisture. This is to maintain the moisture absorbing material in the active initial stage, which exhibits fastest absorption speed, at all times by keeping the absorbing material in the dry state at all times using the dehumidifier. Further, the use of a pod having a means for forcing gas circulation achieves low humidity in the shortest possible time. Whether the means for creating a gas flow is a fan or gas purging, it is preferable to circulate the gas at least once or more, or more preferably more than three times during the duration between wafer storing and wafer removal, such that the number of circulation can be adjusted according to the degree of contamination existing in the outer environments before and after the current process in relation to the degree of cleanliness required by the stored wafers. If there is no restriction on the power consumed by the fan, it is most preferable that the gas be circulated constantly. Here, it should be noted that "the nature of the environment required by the stored substrates" refers to the creation of an environment within the pod during transit between the processes so that all or any particular species of contaminants in the pod that may reduce the yield, such as particulate matters, ions, dopants, organic substances, moisture are kept below the target control level. The substrate transport pod that performs such environmental control can be used for transporting the substrates

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within the any semiconductor manufacturing processes, for example, between the steps, between the floors inside the plant, between plants, or, in addition to transporting them, it may also be used to store substrates.

[0082] Here, when the object is to maintain low humidity, it is better to use a material that has low moisture absorption factor for the pod. This is because, in a typical environment of 25 °C and 50 % relative humidity (RH) generally adopted for clean-rooms, if the interior of the pod space only is reduced in humidity, ① moisture contained in the polymeric materials that comprise the pod migrates towards the low temperature side due to the temperature gradient, ② the moisture contained in the environment external to the pod migrates towards the interior of the pod due to humidity gradient between the interior of the pod and the external environment, and ③ air in the external environment leaks into the interior of the pod through the pod joints. These three reasons cause the moisture to migrate towards the interior of the pod which is maintained at a lower temperature. When the pod is highly hermetic, of the three reasons cited above, the factor that most affects the rise in humidity in the interior of the pod is the above-noted ① moisture contained in the polymeric materials that comprise the pod migrates towards the low temperature side.

[0083] The water absorption factor of polymeric materials is specified in ASTM (American Society for Testing and Materials) D570, and is reproduced in literature or polymer makers catalogue and the like. Polycarbonate (PC) is used often for making substrate transport pod, but the water absorption factor of PC is 0.2~0.3 % so that the pod main body and the door weighing 3 kg would contain 6~9 g of moisture. By using a material having water absorption factor of at least less than 0.1 %, it is possible to reduce the amount of moisture that can be migrated inside the pod, and contributes to improving the performance of the dehumidifier. Polymeric materials of less than 0.1 % water absorption factor include: PE (polyethylene)<0.01 %; PP (polypropylene) 0.03 %; PBT (polybutylene terephthalate) 0.06~0.08%; PPS (polyphenylene sulfide) 0.02 %; PTFE (polytetrafluoroethylene)<0.01 %; PC/carbon (polycarbonate with 20 % added carbon) 0.1 %; and PBT/carbon (polybutylene terephthalate with 20 % added carbon) 0.05 %. Of these substances, for constructing the substrate transport pod, it is preferable to use PPS (polyphenylene sulfide) or PBT (polybutylene terephthalate) or the above-mentioned materials with carbon addition that show characteristics of chemical resistance, superior high temperature properties and low mold shrinkage.

[0084] For the gas circulation apparatus, an axial flow fan, scirocco fan, and scroll fan may be used. A general construction of an axial flow fan is shown in FIG 51. A brushless fan motor is generally comprised by a casing 611, impeller 612, rotation shaft 613, magnet 614, winding 615, control board 616, and a bearing 617. Of the foregoing components, primary contamination sources are magnet 614, winding 615, control board 616, bearing 617 and adhesives used in various joints. First, if rubber is used in the magnet member or ferrite-based magnets bound with an adhesive, rubber and adhesives act as contamination sources, and emit base gases and organic substances. The winding 615 emits organic substances from lubricants used in manufacturing to promote copper wire drawing and insulation materials. The control board 616 emits organic substances from flux and solder resist that are applied for corrosion protection of copper foil. The bearing 617 emits organic substances from the mineral oil based grease used as sliding lubricant, and particulate contaminants are produced by rubbing of the rotor or retainer against the inner or outer ring.

[0085] For example, magnet 614, control board 616, and winding 615 can be coated by the use of the Parylene coating technology, which involves deposition of a polyparaxylene resin by chemical vapor deposition. In the Parylene coating technology, diparaxylene is heated and sublimed under low pressure, and when it is heated to about 600 °C, thermal decomposition takes place and some paraxylene radical gas is generated. By directing the vapor to the target object, a polyparaxylene coating of a molecular weight of about 500,000 can be produced. Parylene coating offers features such as ① processing temperature is about 35 °C and almost no thermal load is applied to the target object; ② because the process is CVD, it is possible to apply uniform coating on complex shapes and composite materials made of metal and plastic; ③ gas permeation is extremely low; ④ cost can be lowered by coating a large quantity of products at one time; and ⑤ there is no need to change the design because the coating can be applied directly to commercially available fan components. Therefore, this method appears to be suitable for reducing chemical contaminants. Coating thickness of more than 0.1 μm and less than 0.5 μm is suitable.

[0086] The bearing 617 is comprised by an outer ring, an inner ring, a rotor, and a retainer. In general, the outer ring, inner ring and rotor are made of high carbon chrome steel or stainless steel or ceramic, and the retainer is made of stainless steel or polyamide resin. Over the years, special-purpose bearings have been developed for vacuum use, low dust generation use, anti-corrosion use and non-magnetic uses, and commercial products have been available since about 1986. Impurities that can be produced from the bearing include particulate contaminants first. According to literature, it is known that particle contaminants from the bearing are often produced by the rotor contacting inner or outer ring. On the other hand, bearings using mineral oil based grease produce the highest amount of chemical contaminants, and contamination decreases in the order of fluoride-based grease and fluoride-based solid polymer lubricants. Particulate contaminants and chemical contaminants are reduced by combining a solid lubricant which emits least amount of gases and a retainer made from a polyamide-based resin or a fluoride-based resin that have self-lubricating properties.

[0087] Further, a method of preventing emission of contaminants from general-purpose bearings using grease that

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does not consider above problems is to use a magnetic fluid seal. Magnetic fluid is made by dispersing ultra-fine particles of magnetic powder in an oil base along with a surfactant agent, for example. Base oil may include paraffin, synthetic isoparaffin, alkyl naphthalene and para-fluoroether and the like. Magnetic particles may include iron, nickel, cobalt, ferrite and the like.

[0088] FIG. 52 shows an enlarged cross sectional view of the vicinity of a rotation shaft 613 of an axial flow brushless fan motor having a magnetic fluid seal. The parts that are required for the magnetic fluid seal are permanent magnet 619, a permanent magnet retainer 620 made of a magnetic material and a magnetic liquid 624, for example. Other necessary parts include a sleeve 622 and a spacer 623 and the like for separating the bearing from the permanent magnet retainer. In the magnetic fluid 624, a magnetic field is formed by the magnetic force generated by the permanent magnet 619 in the direction of permanent magnet ⇒ permanent magnet retainer ⇒ magnetic fluid ⇒ rotation shaft ⇒ permanent magnet retainer ⇒ permanent magnet to prevent segregation in the magnetic fluid due to rotational motion. The particulate and molecular contaminants generated from the bearing 617 are sealed by the magnetic fluid 624 and are prevented from being emitted. Additionally, other special items of note include: rotation shaft to be magnetic; permanent magnet retainer is to be a magnetic body or to be covered with a magnetic body; the housing that holds the permanent magnet retainer is to be a non-magnetic body or to be covered with a non-magnetic body; and another magnetic body is not to be placed near the magnetic fluid. If there is a magnetic body nearby, it is necessary to provide means for shielding the magnetic force field. In the example shown in FIG. 52, both ends of the two bearings are provided with a magnetic fluid seal, but depending on the necessity, it is permissible to have a seal on one end only.

[0089] A method of reducing the contaminants generated by the magnet 614 is to use a plastic magnet. Plastic magnet is used originally to prevent cracking that occurs in sintered ferrite magnets, to reduce the number of components required by unitizing the magnet and the impeller, for example, to reduce the number of steps in assembling the fan motor; or to improve the dimensional precision. In addition to the advantages of the present invention described above, reduction in chemical contamination is achieved by noting that magnetic body can be unified by means of thermoplastic resins. There are ferrite group materials and samarium-cobalt group materials and the like that can serve as the magnetic body, but the choice is made according to the necessary magnetic flux density.

[0090] FIG 53 shows a gas circulation method for circulating air inside the pod main body, other than those based on the gas circulation apparatus. Heat is generated from a heating source 530 external to the pod main body 1 and is absorbed by a heat absorbing section 531 provided on the pod main body. For example, by using thermal radiation such as infrared radiation, the gas inside the pod main body in the vicinity of the heat absorbing section is warmed and consequently, convective current is generated inside the pod main body 1. The gas flow generated inside the pod main body 1 comes into contact with the filters (particle filter 5, gaseous contaminants filter 6) and is cleaned. Further, a dehumidifying unit may be provided inside the pod main body. Further, a flow controller board 521 for forming a uniform pattern of gas flow in the wafer stacking direction may be provided.

[0091] FIG. 54 shows an apparatus for supplying a dry gas inside the pod 1. Air or nitrogen may be used as dry gas. A gas cylinder 38 filled with a dry gas is provided within the apparatus. Dry gas is introduced into the pod main body 1 through a pipe path having a pressure gauge 37 for detecting the pressure inside the interior of the pod, and, according to its reading, a mass flow controller 36 is operated to control the flow rate of the dry gas. Gas discharging is performed more effectively by evacuation. Mobility is increased if the AGV 10 has a gas cylinder 38. Also, if the gas supply source is provided by the nitrogen line from the plant, the processing apparatus 11 can also be served.

[0092] Also, wafer is susceptible to static charging at low humidity, it is preferable that an electrical conductor with added carbon be used to construct at least the wafer support section that contacts the wafers and the door that grounds to the pod bottom section through the wafer support section. Further, non-woven ion exchange cloth or activated charcoal used for gaseous contaminant capture medium contain adsorbed moisture immediately after their manufacture, it is preferable that they be used after being subjected to water removing treatment.

[0093] Next, a method of manufacturing a semiconductor device will be explained.

[0094] Semiconductor device manufacturing process is divided into a first stage in which the device elements such as transistors and condensers are formed within the chip area and the elements are interconnected with copper wiring, and a second stage in which each chip is cut away from the wafer and wiring connections are made to external terminals.

[0095] FIG 2 shows a flowchart of an example of the first state processing. In the first stage processing, after the elements are formed on the wafer, wiring steps are repeated as many times as the number of wiring layers in the multilayered structure. Silicon wafers having FET (field-effect-transistors) and condensers formed thereon are transported to a processing apparatus such as a coater or a CVD apparatus to form insulation layer above the surface. At this time, a low dielectric insulation film having a dielectric constant of less than 3 is formed.

[0096] The low dielectric insulation film may be made using an inorganic material such as SiO_x-based substances made in a porous or honeycomb shape, or PAE (poly arylene ether)-based or MSQ (methyl silses quioxane)-based organic material, and other organic substances in a porous form are useable.

[0097] Such low dielectric insulation films are susceptible to moisture absorption resulting that film is degraded by moisture absorption, or the dielectric constant of the insulation film is raised by the moisture absorbed. Further, it can

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be anticipated that the physical properties of the insulation film are altered by the effects of impurities such as organic matters, ions and metals contained in the environment. Because stable film growth may not be achieved under changing environment, it is essential to provide a stable, clean environment.

[0098] Therefore, at this stage, the wafers having low dielectric insulation film formed on the surface are stored in the substrate transport pod explained earlier, and are transported between the insulation forming apparatus such as coater or CVD apparatus and a photo-resist coating apparatus. The substrate transport pod in this case may be any one of the pods described above, but it is preferable that the interior of the pod is provided with a dehumidifier to provide dry air. Also, it is preferable that the air inside the substrate transport pod is circulated through a dehumidifier to dry the air. It is preferable that the air inside the substrate transport pod be less than 25 % humidity, or more preferably less than 10 % or even more preferably less than 5 %.

[0099] When there is a danger of damaging the elements due to static electricity generated by low humidity, it is preferable to discharge the wafer charges by using electrical conductor for constructing the wafer support member and removing the charges through such members. Electrically conductive materials that can be used include polymeric material with added carbon, surfactant agent or metals. For example, for a pod having a door at the bottom, the box door supports the wafer support member so that the box door is constructed of an electrical conductor. The box grounds the pod through the box door when the box is placed on the processing apparatus or station. It is permissible that the box door is entirely or only the surface layer is constructed of an electrical conductor, so that it can be grounded through a conductive object to the bottom section of the box. Or, only the portion that supports the wafers may be constructed of an electrically conductive polymer or a metallic material, for example.

[0100] Further, if chemical contamination is a problem, a chemical filter should be provided inside the substrate transport pod. It is preferable that the chemical filter be capable of removing non methane-based organic substances, and further, it may be combined with an ionic filter. If particular contamination is also a problem, particle filters such as HEPA and ULPA may be incorporated.

[0101] FIGS. 55 and 56 show an example of loading a substrate cassette 4 for storing substrates W having exposed copper surface, hermetically sealing the pod, and transporting the pod together with the cassette 4 in the hermetically sealed condition. In this case, the substrate transport pod 1 is constructed as a general SMIF pod. Here, degradation of the insulation film can be prevented by providing a dehumidifier inside the substrate transport pod 1 for 8-inch wafers to control the humidity in the interior of the substrate transport pod 1. It is preferable to control the inside humidity to less than 10 % or more preferably to less than 5 %. When the humidity is low, and there is a danger of damaging the insulation film due to generation of static charges, it is preferable to store/transport substrates while the copper surfaces on the wafers are grounded to discharge the static electrical charges.

[0102] By installing a particle filter and a fan motor in the interior of the substrate transport pod 1 so as to clean the inside air by circulating the internal atmosphere, it is possible to prevent cross contamination of the substrates. Also, by installing both a chemical filter and particle filter in the interior of the substrate transport pod 1, both particles and ions can be removed. It is obvious that only particle filter may be used or only an ion filter as the chemical filter may be used. Also, when the fan motor is provided inside the substrate transport pod 1, the fan may be operated without installing a battery inside the pod 1 so that the fan motor may be operated through a power outlet provided on a receiving platform member by placing the substrate transport pod 1 on the platform.

[0103] Also, although the interior space of the substrate transport pod 1 is normally filled with air, but by using an inert gas having limited concentration of oxygen, oxidation of copper can be prevented. The amount of oxygen should be lower than 10,000 ppm, or more preferably lower than 1,000 ppm.

[0104] FIGS. 57, 58 and 59 show another example of the substrate transport pod 1. This pod 1 is used for transport and storage of substrates by accommodating a plurality of 300 mm substrates W on a substrate support member 504 that is affixed to the inside of the pod main body 501. This substrate transport pod 1 is comprised by a pod main body 501; a substrate transport door 502 provided on the side surface of the pod main body 501 of a square tube shape whose opening section can be operated mechanically by being linked to an automatic substrate transport door controller; a lid member 503 disposed opposite to the opening section for covering an opening provided for changing filter and fan motor and the like; a substrate support member 504 for holding substrate wafers W, a ULPA filter 505, a chemical filter 506; and a fan motor 507.

[0105] The substrate transport door 502 is operated by a mechanical device, and on the bottom section of the pod main body 501, there is provided a V-groove 509 for coupling with a kinematic coupling pin 508 for positioning transport door accurately on the precision automatic door device. The substrate transport door 502 is provided with a positioning pin receiving section 510 and a latch receiving section 511 for inserting the latch key for door operation so as to enable to automatically open or close the door from the automatic door device side. Also, a robot holding means 512 is provided so as to enable to transport the pod using such transport apparatus as OHT (overhead hoist transport) or AGV (automatic guided vehicle). The material of construction may be PC, PEEK and PEI and the like. The designs for V-groove 509, positioning pin receiving section 510, latch receiving section 511 for inserting the latch key for door operation, robot holding means 512 and other items regarding automation interfaces are carried out according to SEMI standard

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E1.9, E47.1, E57, E62.

[0106] The interior of the pod main body 501 is divided into a center chamber 513a in the center and a pair of side chambers 513b by a partition plate 530 unified with a pair of spaced left/right substrate support member 504 between the substrate transport door 502 and the lid member 503. On the substrate transport door 502 side of the partition plate 530, a substrate support member 504 is integrally provided, which has a taper section that widens towards the door side so as to couple with the door. The movable wafer vibration prevention mechanism 515 presses the wafer in the vertical direction and holds the wafers in their fixed positions inside the pod and so as to prevent vibration of the wafers. The movable wafer vibration prevention mechanism 515 is provided on the inner side of the substrate loading/unloading door 502, for example.

[0107] On the lid 503 side of the center chamber 513a, a ULPA filter 505 that serves as the particle filter and a chemical filter 506 that serves as the gaseous contaminants filter are disposed so as to permit the air to flow from the lid 503 side to the substrate transport door 502 side. While, on the upstream side of the filter 506, a fan motor 507 is disposed so as to circulate the air towards the substrate transport door 502.

[0108] Both ends of the substrate transport door 502 are shaped so as to curve smoothly towards the interior, and in the center section, a triangular flow regulation plate 514 is provided, but this flow regulation plate 514 may be omitted. Also, the substrate transport door 502 is provided with a fixation jig 515 for substrate shifting prevention. Similarly, the internal surface of the lid member 503 is also curved towards the interior, and in the center, a triangular flow regulation plate 516 is provided. Also, flow regulation plates 517 are provided in two locations adjacent to the inside opening for outflow of clean air, for the purpose of supplying clean air uniformly to a plurality of substrates W. Further, a flow regulation plate 521 may be provided at the back of the filter section. The flow regulation plate 521 can be made of a porous plate or mesh. Because the porous plate or mesh or fixed flange contact the process gas directly so that it is preferable to avoid using metals that are susceptible to corrosion by the process gas, so that resin materials such as polybutylene terephthalate and polycarbonate are preferable, but if there is no danger of corrosion, stainless steel may be used.

[0109] Here, when twenty five substrates W are stored in the substrate transport pod 1, the separation distance between the interior surface of the substrate transport pod 1 and the No. 1 substrate and that between the same and No. 25 substrate are set wider than the separation distance between other substrates W. In this case, No. 1 substrate refers to the substrate near to the pod bottom side. The space associated with No. 1 substrate relates to the distance between No. 1 substrate and the inside surface of the pot bottom section, and the space associated with No. 25 substrate relates to the distance between No. 25 substrate and the inside surface of pod top section. It is preferable that the distances associated with No.1 and No. 25 substrates be more than 2 mm and less than 10 mm. By adopting such a wide separation distance, although uniform flow of air through the substrates W is adversely affected, a flow regulation plate 517 provided at the outflow opening of clean air is designed to carry out effective cleaning by creating a uniform flow of air at the clean air entry section between the substrate carrier main body and No. 1 and No. 25 substrates. Also, a porous plate or mesh member may be placed on the downstream side of the ULPA filter 505 for the purpose of equalizing the wind velocity and protecting the ULPA filter.

[0110] In the bottom section of the lid member 503 is disposed a power unit 518 having a secondary battery, which has a contact point to connect to the terminal 519 of the fan motor 507. Inside the power unit 518 is housed an operation control board for the fan motor 507, and the fan motor 507 is operated according to a control program prescribed in the board to control its operation start/stop timing and rotational speed. Also, at the bottom section of the power unit 518 is provided a charging terminal 520 so as to enable to charge a secondary battery automatically when it is mounted on the on the charging station or on the substrate transport door controller by connecting to the terminal on the apparatus side.

[0111] As described above, when various filters and secondary battery are installed on the substrate transport pod, the center of gravity of the pod shifts to the filter side. If it is attempted to transport the pod in the OHT or so on by grasping the robot holding means 512, for example, while its center of gravity is displaced towards one side, there is a danger of damaging the hoist and others on the OHT system. To avoid such a problem, it is desirable to reduce the weight of filter and secondary battery. Further, it is preferable to place a counter weight near the substrate transport door 502 and/or near the opening section of the pod main body 501 so that the center of gravity of a fully-loaded pod is within ± 100 mm, or more preferably within ± 60 mm of the substrate facial reference line. The substrate facial reference line refers to a plane that dissects the substrate in two parts and is parallel to the front surface of the substrate carrier through which the substrates are loaded/unloaded. Another method is to shift the center of gravity by making the latching mechanism housed inside the substrate transport door 502 with a metallic material, for example, to increase the weight of the substrate transport door 502. That is, it is preferable to adjust the center of gravity so that the center of gravity of the substrate transport pod in the horizontal direction is contained within a circle having a radius dimension that is 90 % of the substrate radius, or more preferably within 70 % of the substrate radius.

[0112] As shown in FIG 31, the semiconductor wafer W is supported on a carrier 4 by a protrusion 550 constructed of an electrically conductive material. FIGS. 60A to 60H show methods of discharging static electricity on the wafers

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stored inside the substrate transport pod. As shown in FIG 60A, wafer discharging from the FOUP structure is carried out by grounding to the apparatus side, through the substrate support member 504 that supports the wafers inside the pod (corresponds to the protrusion 550 shown in FIG 31). The substrate support member 504 is a unified body that includes the pod main body 501, so that the entire member including the substrate support member is made of an electrical conductor. Also, when the substrate support member 504 and the pod main body 501 are separate members, it is preferable that the substrate support member 504 and the pod main body 501 be made of some electrical conductor, and connecting them electrically using an electrical conductor 523, as shown in FIG 60B. Further, as shown in FIG. 60C, it is permissible to make only the bottom section 501a of the pod main body 501 using an electrical conductor. And, as shown in FIG 60D, it is permissible to make only the substrate transport section 501b that is in contact with the substrate support member 504 using an electrical conductor.

[0113] A second method of substrate discharging method for the FOUP structure pod is shown in FIG. 60E. In this method, the charges are grounded through the door to an apparatus that mounts the pod by making the fixation jig 515 (to prevent substrate shifting) and the door 502 using an electrical conductor. Also, as shown in FIG 60F, it is permissible to make only the fixation jig 515 with an electrical conductor and grounding to the grounding terminal 524 so as to connect the bottom section of the pod to an external ground. Here, the external ground refers to a processing apparatus or a transport apparatus.

[0114] A third method of discharging the substrates from the FOUP structure pod, as shown in FIG 60G, is through the robot holding means 512 for transporting the pod in the OHT system. The substrate support member 504 and the flange 512 are made into a unified member, and the charges on the wafers are grounded through the substrate support member 504 to the robot holding means 512 to the OHT system. Also, as shown in FIG 60H, it is permissible to make the robot holding means 512 separate from the substrate support member 504 and connecting them electrically by making a portion 501c of the pod main body 501 using an electrical conductor. Further, it is permissible to make only the portion 501c that contacts the robot holding means and substrate support member using an electrical conductor.

[0115] FIGS. 61, 62 and 63 show another variation of the automation-ready substrate transport pod designed for 300 mm wafers. A power unit 518 housed inside the bottom section of the pod 503 is provided with a contact point to connect to the terminal 519 of the motor fan 507. In the bottom section of the power unit 518 is provided a charging terminal 520 so that the secondary battery can be charged automatically when the pod is seated on a control apparatus for automated opening/closing of the wafer transport door or on a charging station by contacting the terminal on the apparatus side. Also, if the dry gas supply and dehumidification using solid polymer electrolytic film, the dry gas purging port 515 is housed in the bottom section of the pod main body 1. However, the position, size and number of the solid polymer electrolytic film 525 and the dry gas purging port 515 may be altered to suit the desired drying speed and target temperature, and are not limited to those shown in the diagrams.

[0116] FIGS. 64, 65 and 66 shows automation-ready substrate transport pods having a solid polymer electrolytic film in a different location than those shown in FIGS. 61, 62 and 63. In this case, because the solid polymer electrolytic film itself is housed inside the bottom section of the pod 1, direct current can be supplied from the power unit 518 housed inside the pod 503 linked to the main body 1 without going through the terminal 514.

[0117] Next, dehumidifying capacity of the substrate transport pod having the dehumidifying unit 525 based on the solid polymer electrolytic film after repeated use will be explained with reference to FIG. 67. In a clean-room having a relative humidity of 40 % at 22 °C, a wafer carrier 4 having twenty pieces of cleaned semiconductor wafers was placed inside the substrate transport pod, and the pod was sealed with the lid. After waiting for six hours, ultimate humidity inside the pod was measured. The results are shown by Δin the diagram. The horizontal axis relates to the number of operations and the vertical axis relates to eventual humidity generated inside the pod. For comparison, data on ultimate humidity achieved when dehumidifying agent was placed inside the box, and the data are shown by ○ in the same graph. In the substrate transport pod having the dehumidifying agent, the initial capability (i.e., reduction in relative humidify from 40 % to 5 %) was maintained up to fifteen repetitions, but the relative humidity gradually increased with continued use, and after fifty and more repetitions, the humidity did not drop below 20 %. On the other hand, the substrate transport pod containing the dehumidifying unit 10 having the solid polymer electrolytic film continued to maintain its initial capability (that is, reduction in relative humidify from 40% to 10 %).

[0118] In the substrate transport pod described above, the gaseous contaminants filter 506 is constructed, in this embodiment, by wrapping particulate activated charcoal for organic material removal with a non-woven ion exchange cloth for inorganic ion removal, but the filtering medium may include pulverized activated charcoal, activated carbon fibers, high purity silicon, zeolite, ceramics or activated charcoal with addition agents. Activated carbon fibers may be produced from a raw material of rayon, kynol, polyacrylonitryl or crude oil, or pitch, and carbon formed in fiber shape is reacted with steam and carbonic gas at over 800 °C to carry out the so-called activation reaction. Some activated carbon fibers are made with binder addition that does not affect its absorption quality to control strength and dust generation, but as a raw material, it is preferable that the addition should be less than 50 weight % and preferably less than 30 weight %.

[0119] Activated charcoal has numerous fine pores between the base crystals due to removal of unreacted carbon

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during the process of activation. Owing to such fine pores and large specific surface area, activated charcoal exhibits very high adsorption capability. Utilizing this property, activated charcoal filters filled with particulate activated carbon are available commercially. Also, filters using activated carbon fibers having finer pores than particulate activated carbon and higher specific surface area, or filters carrying activated carbon particles of about 0.5 mm on a urethane foam body of open-pore structure are also available commercially.

[0120] Also, it is permissible to use high purity silicon which is the same material as the semiconductor substrate for the absorbing agent. The conditions on the surface of high purity silicon are divided into hydrophilic and hydrophobic types, each of which differs in its absorbing characteristics. Hydrophobic surface produced by washing with diluted hydrofluoric acid is generally more sensitive to the environment, and exhibits a high adsorbing power for hydrocarbons. However, hydrophobic surface of silicon changes to hydrophilic surface when oxide film grows, so that the adsorbing characteristics change with time which is a disadvantage. Hydrophilic surface is excellent in adsorbing polarized organic substances, such as BHT (2, 6-Di-t-butyl-p-cresol) and DBP (dibutyl phthalate).

[0121] Also, because there is no material degradation when high purity silicon is used as the adsorbing agent, the filter can be reused after washing. Also, when there is a contaminant that cannot be removed by using chemical filter or ULPA filter, silicon performs a role of dummy filter. In any case, it is more effective to use silicon not by itself but in combination with activated charcoal.

[0122] On the other hand, non-woven ion exchange cloth and fibers can be obtained by introducing ion exchange sites through radiation graft polymerization. That is, a starting material, a polymer such as polyethylene and polypropylene or natural polymeric material such as cotton and wool is subjected to radiation using electron beam or gamma radiation to produce numerous activation sites. Such activation sites are called radicals which are highly reactive, and by combining such radicals with a monomer, it is possible to impart properties different from the starting material.

[0123] This technology is called graft polymerization because a monomer is grafted to the starting material. By using radiation graft polymerization, a monomer having the sulfone group, carboxyl group or amino group that acts as ion exchange agent, such as styrene sulfonic acid sodium salt, acrylic acid, allylamine, can be bound to a non-woven polyethylene cloth. It is then possible to obtain a non-woven ion exchange cloth that produces much higher ion exchange rate than ion exchange beads, which are normally referred to as ion exchange resin.

[0124] Similarly, an ion exchange medium of the starting material can be converted into an ion exchange medium in the original shape, by first radiation grafting a monomer capable of introducing an ion exchange group such as styrene, chloromethyl styrene, glycidyl methacrylate, acryronitrile, acrolein to a starting material, and then introducing an ion exchange group.

[0125] The filtering medium of ULPA filter or HEPA filter has been using glass fibers, but it has been discovered that glass fibers can form BF_3 by reacting with the vapor of hydrogen fluoride (HF) used in semiconductor processing, and has become a problem. In recent years, PTFE filters and HEPA filters that does no contain boron or metallic impurities and resistant to acids, alkalines and organic solvents are commercialized. In the present applications, glass fibers or PTFE may be selected as appropriate.

[0126] The operation of the substrate transport pod 1, having a plurality of substrates W stored therein, when it is transported inside a copper plating apparatus 34 will be explained with reference to FIG 68.

[0127] In this copper plating apparatus 34 is provided an automatic substrate transport door controller. Inside the copper plating apparatus 18, a fan-filter unit comprised by the fan motor 7, ULPA filter 5, chemical filter 6 and dehumidifier 8 is used to reduce particulate contaminants, gaseous contaminants and moisture. Chemical filter 6 and dehumidifier 8 are employed as needed. The dehumidifier 8 may be placed anywhere at the boundary between outside and inside of the enclosure, but if it is desired to dehumidify more actively, it is preferable to place it in a fast flowing region such as near the fan motor 7 or within the circulation path in the enclosure. When the substrate transport pod 1 is transported inside the copper plating apparatus 34 and is placed in a specific location and the clean-room is isolated by means of the gate valve and the like, the automatic substrate transport door controller opens the substrate transport door 602. After which, using the wafer mapping apparatus 603, wafer storage slots and the number of wafers are selected. After which, a substrate handling robot 621 inside the copper plating apparatus 34 removes the substrate W for processing, and after the processing is completed, the processed substrates W are returned to the substrate transport pod 1. Then, when the processing of all the substrates W is completed, the substrate transport door 602 is closed and sealed by the automatic substrate transport door controller, and from this point, the motor fan 7 is operated through the power input terminal 608 to clean the air inside the substrate transport pod.

[0128] As shown in FIG. 68, the substrate transport pod 1 may be operated such that when the wafers to be processed are removed, the substrate transport door 602 is closed and the wafer to be processed are stored in the pod 1. Also, when the substrate transport door is not opened or closed during the processing of one lot, it is preferable to provide a fan-filter unit having the chemical filter 6 and dehumidifying agent or dehumidifier 8 in the interface section in addition to the ULPA filter, so as to prevent contamination of the wafers yet to be processed by moisture and organic matters. Further, the fan filter unit may circulate the air inside the interface. Also, dehumidification may be performed using dry air or N_2.

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[0129] As shown in FIG. 69, comparing the degree of cleanliness of the interface interior with that of the pod interior, interior of the pod is cleaner because of its smaller volume. Therefore, when the pod 1 is placed in the interface entry, all the wafers in one lot inside the pod 1 are placed on the temporary cassette 604, and the pod is made to standby until all the wafers in one lot are processed while supplying the power to the pod through the power input terminal. By so doing, the interior of the pod can be kept at a desired degree of cleanliness while it is in the standby mode. In this case also, as in the system shown in FIG. 64, in addition to the ULPA filter, it is preferable to place a fan-filter unit that has a chemical filter, dehumidifying agent or dehumidifier in the interface section. Further, the fan-filter unit may be operated so that the air is circulated inside the interface. Also, dehumidification may be performed using dry air or N_2. When the substrate transport door 502 is closed, the pod 1 is transported to a next processing station or to a storing place by OHT or AGV, for example.

[0130] In the pod shown in FIG 57, for example, the fan motor 507 is operated according to a pre-determined program. Accordingly, a flow from the fan motor 507 is created through the gaseous contaminants filter (chemical filter) 506 and ULPA filter 505. The air entering the center chamber 513a is divided smoothly into two streams by the flow regulation plate 514 located in the substrate transport door 502, and air circulation path is created by each flow passing through the side chamber 513b and returning to the fan motor 507.

[0131] The fan motor may be provided with an optical or mechanical detector to detect the status of the door so that it is operated only when the door is closed. The purpose of this arrangement is that, if the fan motor is operated while the door is open, external air that contains various contaminants is introduced into the pod to shorten the life of the chemical filter, and this situation is prevented by adopting this arrangement. Another purpose is to prevent the internal surface of the pod from being contaminated by entry of the external air.

[0132] A method of supplying power to the fan motor and/or dehumidifier will be explained. The apparatus side that supplied power from an external power source comprises a positioning pin for positioning the pod in a specific location, a control board for controlling the supply voltage and current and a power input terminal.

[0133] The air is cleaned by passing through the gaseous contaminants filter 506 and ULPA filter 505, and is guided by the entry flow regulation plate 517 placed at the inner side of the opening section of the partition plate 530 unified with the pod main body to the spaces between the wafers W. By providing the entry flow regulation plate 517, air is prevented from flowing excessively through the space between the substrate W and the partition plate 530 unified with the substrate support member 504. The air that passed through the wafers W flows along the flow regulation plate 514 and the inner surface of the substrate transport door 502, and then inverts to return to the fan motor 507 through the side chamber 513b.

[0134] In this process, solid particulate matters adhered to various parts or gaseous substances emitted from such matters are carried by the circulation air and are cleaned in the two types of filters 505, 506 and flows over the substrates W. Therefore, not only external contaminants but also so-called self-generated contaminants emitted from the objects inside the substrate transport pod are prevented.

[0135] Whether the means for generating air flow is the fan or gas purging, it is preferable that the air is re-circulated at least once or preferably more than three times during the period between storing the substrate in the substrate transport pod and removing the substrates therefrom again, and the number of circulations can be adjusted depending on the environment required by the stored substrates and in relation to the degree of contamination associated with the preceding and succeeding environments to the current environment. Various patterns of operating the fan motor 507 may be considered depending on the operational requirements of the substrate transport pod 1. In general, during the initial stage of processing, continuous operation or fast flow operation to increase the number of circulation in unit time is desirable such that it is operated so as to produce at least more than one circulation in ten minutes, or more preferably, once or more and less than ten times in one minute. By adopting such an operational pattern, contaminants brought into the pod are actively removed. After cleaning is continued for some time, the flow rate may be decreased or intermittent operation may be carried out to reduce contamination that can be produced by the substrates W or construction materials of the interior of the substrate transport pod. By so doing, power consumption by the fan motor 507 is reduced, resulting that the frequency of charging the secondary battery can be reduced.

[0136] The total weight of the substrate transport pod 1 having a width of 389.5 mm, depth of 450 mm and height of 335 mm and containing twenty five pieces of substrates of 300 mm diameter is about 10 kg. In this embodiment, circulation conditions are such that the fan motor 507 is operated to produce a flow rate of 0.12 m^3/min through the substrates W at a wind velocity of 0.03 m/s in the center section of the space between the substrates W. The flow rate can be altered by varying the speed of the fan motor 507.

[0137] FIGS. 70A and 70B show an example of the substrate transport pod 1, and this pod 1 differs from the previous pod in that the size of the substrate W is 200 mm, the door 2 for the mechanical interface is housed in the bottom section of the substrate transport pod 1 and the substrates W are placed in a substrate cassette 4, which is then stored in the substrate transport pod 1. The method of cleaning the air in the substrate transport pod 1 is the same as that described above. Here, in this example, the secondary battery for operating the fan motor 7 and fan motor control circuit are housed inside the door 2.

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[0138] FIG 71 shows another example of the substrate transport pod. In this embodiment, an improvement is that an operational history managing apparatus (information processing apparatus) 429 is attached to the pod described above. In this embodiment also, the air circulated by the fan motor 7 passes through the gaseous contaminants filter 6 and ULPA filter 5, and the flow is made uniform by a punching plate 23 and is supplied to the wafers. The punching plate 23 is designed to have varying size of the openings. Specifically, openings are made larger in the upstream side which is located directly below the filter, and are made smaller in the downstream side. By adopting such a design, air flow in the piling direction of the wafers is made uniform. The air flows through the wafers and returns along the inner walls to the fan motor 7 to circulate and replace the air in the pod. This example illustrates a typical automation-ready substrate transport pod, and is not meant to specify the location of the operational history managing apparatus (information processing apparatus) 429.

[0139] The total weight of the substrate transport pod 1 having a width of 283 mm, depth of 342 mm and height of 254 mm and containing twenty five pieces of substrates of 200 mm diameter is about 6 kg including the cassette 4 and the wafers. In this example, circulation conditions are such that the fan motor 7 is operated to produce a flow rate of 0.05 m^3/min through the substrates W at a wind velocity of 0.03 m/s in the center section of the space between the substrates W.

[0140] The operation of the substrate transport pod for 200 mm substrates, when it is transported into a copper plating apparatus will be explained with reference to FIG 72. The combination of fan filter unit 35 inside the interface and other arrangements are the same as those for the substrate transport pod for 300 mm wafers. The substrate transport door 2 and the carrier 4 are separated from the substrate transport pod 1 by means of an elevator. After transferring the wafers W in the carrier 4 for each lot to the interface side, the elevator 20 is raised and the substrate transport door 2 is returned to the pod main body 1, and the pod may be kept waiting until processing for one lot is completed.

[0141] Also, as shown in FIG 73, during the processing of the one lot of wafers, if the pod main body 1 is left open while the substrate transport door 2 is in the standby mode with the carrier 4 and unprocessed wafers, it is preferable that the air flow from the fan-filter unit 35 be supplied not only to the door 2, carrier 4 and the wafers W but to the interior space of the pod main body 1.

[0142] The substrate transport pod storing silicon wafers having a coating of a low dielectric insulation film is gripped by a robot that engages with a robot holding means attached to the substrate transport pod, for example, and is placed on a transport apparatus such as AGV. It is preferable that the robot arm be provided with sensing means to detect whether the substrate transport pod has been gripped and a locking device to 'prevent the pod from slipping. The AGV detects that the pod has been mounted in the correct position, and whether or not the pod is a type that required power supply, and supplies a portion of the power from the battery on the AGV or a portion from an external source to the substrate transport pod 1, and operates the motor fan 7 provided within the substrate transport pod, so as to transport the wafers to the next processing apparatus such as a coating apparatus, etching apparatus or copper plating apparatus while circulating the air inside the substrate transport pod through the dehumidifying agent or an electrical dehumidifier and controlling the humidity and concentrations of chemicals in the interior of the pod below specified values.

[0143] Whether the means for generating air flow is a fan or gas purging, it is preferable that the air is re-circulated at least once or preferably more than three times during the period between storing the substrate in the substrate transport pod and removing the substrates therefrom again, and the number of circulations can be adjusted depending on the environment required by the stored substrates and in relation to the degree of contamination associated with the preceding and succeeding environments to the current environment. If there is no restriction on the power consumed by the fan, it is most preferable that the gas be circulated constantly. Here, it should be noted that "the nature of the environment required by the stored substrates" refers to the creation of an environment within the pod during transit between the processes so that all or any particular species of contaminants in the pod that may reduce the yield, such as particulate matters, ions, dopants, organic substances, moisture are kept below the target control level. The type of environment demanded by the substrates stored for each processing step will be explained specifically below.

[0144] The wafers coated with a photo-resist in a photo-resist coating apparatus are transported by a substrate transport pod, having an internal chemical filter that absorbs ammonia to create an environment containing a lesser amount of ammonia, from the coating apparatus to an exposure apparatus. This is because chemically-enhanced photo-resist materials having increased sensitivity are being used in recent years, and such materials absorb ammonia in air and react to result in the so-called T-top structure. The level of ammonia inside the substrate transport pod transporting silicon wafers is preferably less than 1 $\mu g/m^3$, or more preferably less than 0.5 $\mu g/m^3$, or most preferably less than 0.1 $\mu g/m^3$.

[0145] Also, another reason for reducing the ammonia level is that the resist-coated wafer surface is exposed to the environment not only inside the substrate transport pod but also inside the coating apparatus, exposure apparatus, developing apparatus and etching apparatus. The environment control may also be exercised in wafer transport section having transport robotic arm.

[0146] The resist layer after insulation film etching is removed by the asher so that the "T-top phenomenon" need

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not be considered. Therefore, only the humidity inside the substrate transport pod needs to be controlled during the transport of wafers from the etching apparatus to the ashing apparatus, transport from the ashing apparatus to the metal film forming apparatus by CVD, and for transporting to the plating apparatus. Further, if chemical contamination of the side surface of the insulation film groove after etching is a problem, wafers may be transported from the etching apparatus to the ashing apparatus and to the metal film forming apparatus, in a substrate transport pod equipped with a chemical filter, in addition to a dehumidifying agent or dehumidifier.

[0147] Further, for transporting inside the substrate transport pod, silicon wafers coated with copper film from a metal film forming apparatus such as CVD or plating apparatus by way of annealing apparatus to a CMP apparatus, and further to an insulation film forming apparatus such as coating and CVD apparatus, it is possible to prevent the growth of oxide film by controlling the humidity in the interior of the substrate transport pod 1 by providing dehumidifying means such as dehumidifier or dehumidifying agent inside the substrate transport pod 1. In this case, it is preferable to control the humidity to be less than 10 %, or more preferably less than 5 %. To prevent the slightest oxidation film growth, it is preferable to reduce the humidity to less than 10 % within ten minutes after opening the door 2 of the pod, or more preferably to 10 % within three minutes or most preferably to less than 5 % within three minutes. Also, from the viewpoint of shortening the operation of clean-rooms, it is desirable to reduce the humidity quickly. Here, when there is a danger of damaging the elements by static electricity due to low humidity, it is preferable to transport/store the wafers for removing the charges by grounding through the surface layer formed with the copper film.

[0148] Conversely, when the wafers are transported between processes that prioritize ion removal, such as the exposure processing that requires ammonia to be reduced, it is necessary to adjust the humidity to a level that enables the ion exchange agent to operate effectively so that, instead of reducing the humidity limitlessly, it is preferable to control the humidity to higher than 10 % and less than 50 %.

[0149] In any event, it is important to establish an environment that contains less than the managing target concentration suitable for each process, to control the environment in all the substrate transport pods that operates between the actual apparatuses (including the fore-shelf of the apparatus) in a plant, it is preferable to mount communication means that enable to communicate operating conditions for electrical drive sections such as fan and dehumidifying unit. Control method for operation of fan and dehumidifying unit to achieve a specific humidity environment will be explained with reference to FIGS. 74 and 75.

[0150] FIG. 74 shows an example of a method for humidity control by controlling the operational pattern of the fan. In all cases, the results were obtained under the same operating conditions that① two dehumidifying units are mounted on the pod, which were operated continually; and② ancillary dehumidifying agent is not used. It was found that when the fan is stopped (shown by ○ in the diagram), the humidity of about 30 % was reached in 20 minutes and about 20 % in 60 minutes, and these levels were maintained. Also, intermittent fan operation (on 30 seconds and off 150 seconds; shown by ∗ in the diagram), the humidity of about 20 % was reached in 25 minutes, and about 10 % in 90 minutes, and these levels were maintained. When the fan was operated continually (shown by ♦ in the diagram), the humidity of about 20 % was reached in 10 minutes, and less than 10 % in 20 minutes. From these results, it can be understood that, for processes that require removal of ions as priority, for example, to perform ion removal only, the dehumidifying unit may be stopped, but if gentle dehumidification is required along with ion removal, intermittent operation of the fan is effective.

[0151] Next, FIG. 75 shows a case of controlling the humidity by operational pattern of the fan, by mounting two dehumidifying units based on solid polymer electrolytic film on the substrate transport pod. In all cases, the results were obtained by varying the operating conditions of the dehumidifying units and using the same operating conditions that① the motor fan is operated continually and② ancillary dehumidifying agent is used. The results obtained when only one dehumidifying unit was used (shown by ♦ in the diagram) show that the humidity of about 20 % was reached in 20 minutes, about 15% in 40 minutes and these levels were maintained. When two units were operated during the first 30 minutes and switched to one unit operation (shown by ∗ in the diagram), the humidity of 10 % was attained in about 5 minutes, and an 8 % level was the maintained. When two units were operated continually (shown by ○ in the diagram), the humidity was also 10 % in about 5 minutes, but the ultimate humidity maintained was less than 5 %. Accordingly, the ultimate humidity reached in the pod is dependent on the film area of the dehumidifying unit, therefore, in the substrate transport pod having the dehumidifying unit based on the solid polymer electrolytic film, it is preferable that the film area be more than 0.3 cm^2/L and less than 10 cm^2/L, or more preferably more than 0.6 cm^2/L and less than 5 cm^2/L of the unit volume of the pod. In any case, it can be understood that, in a process requiring a rapid reduction in humidity, it is effective to use an operational pattern so that the fan is operated continually and is combined with a dehumidifying material. Here, for an absorbing agent that can be combined with the dehumidifying unit based on a solid polymer electrolytic film, a chemical filter (activated charcoal, ion exchange medium and the like) can perform adequately well. It is possible to use only one dehumidifying unit to lower the humidity relative quickly while aiming for the ultimate humidity range to enable removal of ionic species.

[0152] In practice, it is desirable to adjust the humidity level to suit each process by re-writing the operational pattern of the electrical drive section such as the fan and dehumidifying unit through the communication means described

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earlier. Further, the dehumidifying unit may be operated automatically by providing a humidity sensor inside the pod, and operate the dehumidifying unit according to its humidity data.

[0153] In the process described below, silicon wafers are transported inside a processing apparatus by following steps reverse to those related to transporting from the processing apparatus to AGV. Power supply to the substrate transport pod may be performed while the substrate transport pod is mounted on the processing apparatus in the standby mode.

[0154] Further, it is permissible that the substrate transport pod need not be directly mounted on the processing apparatus but it may be in the standby mode or in the waiting mode for the processing apparatus by placing the pod on a charging apparatus provided on the temporary fore-shelf of the processing apparatus while power is being charged to maintain clean environment, and then transport the pod to the processing apparatus when appropriate. Also, it is permissible that not only the substrate transport pod but also the loading/unloading section of the processing apparatus may be subjected to cleaning to reduce organic substances and ionic contaminants by using chemical filter and the like, and to control the level of humidity around the wafers by operating the dehumidifying means.

[0155] Also, the interior of the substrate transport pod 1 is normally filled with air, but by using an inert gas having a controlled oxygen level, oxidation of copper film can be prevented. It is preferable that oxygen be less than 10,000 ppm, or more preferably less than 1,000 ppm.

[0156] Further, by providing a particle filter 5 and a fan motor 7 inside the substrate transport pod 1 to prevent chemical and particulate contamination of metallic surfaces to circulate and clean the interior air, cross contamination of wafers can be prevented. Also, by providing both a chemical adsorption filter 6 and a particle filter 5 inside the substrate transport pod 1, particles and ions can be removed. Here, it is permissible to provide only the particle filter or only an ionic filter for the chemical filter. Also, when the fan motor 7 and others are provided inside the substrate transport pod 1, the fan motor 7 may be operated without providing a battery inside the substrate transport pod 1, by supplying the power to the fan motor 7 through the receptacle provided on the base member when the substrate transport pod 1 is mounted on the base member.

[0157] As described above, the internal wiring processes for semiconductor chip comprised by low dielectric insulation film and copper wiring demand different environments inside the substrate transport pod, depending on the characteristics of the films formed on the silicon wafer surface. Therefore, for each processing of wafer surface, it is preferable that the wafers be transported inside respective substrate transport pods having dehumidifying device and chemical filter and the like so as to meet the requirements of processing of surfaces comprised by a low dielectric insulation, processing of surfaces comprised by a photo-resist material, or processing of surfaces comprised by a metallic film such as copper film.

[0158] Further, one substrate transport pod having dehumidifying device, chemical filter and particle filter may be used through all the wiring processes of semiconductor wafers.

[0159] In any event, it is important to establish an environment that contains less than the target concentration suitable for each process, to control the environments in all the substrate transport pods that operate between the actual apparatuses (including the fore-shelf of the apparatus) in a plant, and it is preferable to mount communication means to enable to communicate operating conditions for electrical drive sections such as fan and dehumidifying unit.

[0160] Also, as shown in FIG. 76, when a substrate transport pod having data storing device of data related to various processes explained above, after completing wiring of all the layers, process data such as the apparatus identification numbers that the pod has passed through are given to the process managing computer, and at the same time, electrical properties of the chip wiring are measured. Then, the process managing computer performs data processing, such as statistical analysis of the data, using the data of the processing apparatuses that the wafers had passed through, and the results are sent as feedback data for the next lot of manufacturing.

[0161] The above process data will be explained in conjunction with the substrate management aspect of the operational history managing apparatus (information processing apparatus) 429 shown in FIG 71. In normal manufacturing plants, there are several processing apparatuses, and each apparatus performing the same process often has different recipes. For this reason, operational history management refers to managing the information related to processing of one lot of wafers through steps performed by different processing apparatuses, including time information as to when the process was carried out. The recipes refer to parameters in respective processing programs such as processing sequence of various apparatuses and control parameters (control target values of temperature, pressure, type and quantity of gas, and time and the like). The processing apparatus referred here relates to semiconductor manufacturing apparatus, and "between the apparatuses" relates to components in the exterior of the pod, including such items as load-ports, transport apparatus, transfer apparatus, fore-shelf and storage depot. The substrate transport pod is washed and dried, and the stored data are cleared so as to be ready for the next lot. Also, as shown in FIG 76, inspection of each wiring layer may be performed after completing wiring of all layers.

[0162] FIGS. 77A to 77D show another substrate transport pod of the present invention. This substrate transport pod is designed so that a filter block 311 having filters 305, 306 and the fan motor 307 is freely detachable from the pod main body 301. Then, a control board 309 and a secondary battery 310 are mounted on an electrical parts block

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312, which is hermetically sealed to be water proof. The flange section 312a of the electrical parts block 312 and the flange section 301a of the pod main body 301 are joined via a packing or an O-ring 315, and are affixed in a binder-like clamping manner by means of a flange guide 316. As shown in FIG 77D, the flange guide 316 is a ⊐-shaped part, and clamps the electrical parts block 312 to the pod main body 1 from three directions. Also, a clamp that binds the flange section 312a and the flange section 301a of the pod main body 301 may be used. The filter block 311 is freely detachably fixed by means of a hook 313 protruding into the interior of the pod.

[0163] To wash the substrate transport pod 301, the filter block 311 is detached from the pod main body 301 by disengaging the hook 313 to release the filter block 311. The electrical parts block 312 is water-proofed as mentioned above so that the pod main body 301 can be washed directly by detaching the filter block 311. Also, the electrical parts block 312 can also be freely detached by removing the flange guide 316. Therefore, by removing the electrical parts block 312 and replacing it with a plate and clamping the plate using the flange guide 316, the opening section can be sealed, so that the pod 301 may be washed in this condition. Filter exchange in the filter section 311 can be carried out readily by removing the filter block 311 from the pod main body 301.

[0164] FIG. 78 shows another substrate transport pod that enables easy washing. In this embodiment, filters 305, 306, a motor fan 307, a control board 309, a secondary battery 310 and the connectors for connecting these components are integrally fixed to a block 318, and are freely detachable as a whole from the pod main body 301. The block 318 is provided with a flange section 318a, and is joined and affixed by the flange guide 316. Between the flange section 301a of the pod main body and the flange section 318a of the casing 318 is provided a packing or an O-ring for hermetic sealing.

[0165] The pod is washed by removing the flange guide 316 to remove the filter block 318. Then, the plate 319 is attached. The washing plate 319 is attached against the flange section 301a of the pod main body with a packing or an O-ring by pressing and clamping with the flange guide 316. The flange guide 316 is ⊐-shaped as in the embodiment shown in FIG. 77. Here, to facilitate attachment, each flange section may contain a magnet in some locations so as to provide temporary fixation.

[0166] The substrate transport pods with air cleaning capability have components (moisture aversion parts) that are not suitable for washing, so that they cannot be immersed in water in a washing machine as can the conventional substrate transport pods. To wash the present pods, the moisture aversion parts may be made water-proof, but the filters need to be exchanged sometimes so that it is necessary to design the filters to be readily detachable. The present substrate transport pod has been made washable without having to remove the moisture aversion parts by separating the filter section from the moisture aversion parts such as electrical parts into self-contained units. The moisture aversion parts (secondary battery and control boards) are sealed to be water-proofing and affixed to the substrate transport pod, so as to facilitate washing the substrate transport pod without detaching the moisture aversion parts.

[0167] Such a structure is effective when using special washing machines designed for the present substrate transport pod, but normal substrate transport pods that do not have air cleaning capabilities cannot be washed in the same machine. This is because the dimensions of the present pod are different from the dimensions for normal pods because of the air cleaning apparatuses mounted on the pod. In this case, it is necessary to design so that the moisture aversion parts including filters, electrical parts are wholly detachable. When the air cleaning apparatuses are detached, the pod can be fitted to a normal washing machine. However, when the air cleaning apparatuses are detached from the pod main body, there will be vacant portions that create holes on the pod main body, so that if the pod is subjected washing as it is, it means that detergent enters into the interior of the pod is scattered outside thereof. Therefore, by setting the plate to the vacant portions, it has been enabled to use general purpose washing machines for washing the present substrate transport pods.

[0168] The joint sections between the block containing water aversion parts and the pod main body must be easily detachable while providing hermetic sealing to be water-proof. Therefore, it is necessary that the joint sections between parts, that are subjected to washing while being attached to the pod, be made in a flange shape, and a packing or an O-ring should be inserted into the interface as described above. To facilitate the pod and the flange to be attached temporarily, magnets may be mixed in respective parts. Method for drying may include dry gas purging, warm air drying, vacuum drying, and spin drying, and it is preferable that the cleaned and dried parts are assembled with the water aversion parts in clean environment.

[0169] FIG. 84 shows another structure of the substrate transport pod. The feature of this structure is that the area of the opening section other than the substrate transport door has been minimized. An expanded section 301a is integrally formed on the side wall section on the pod main body 301 for containing the filter block 311. The expanded section 301a is provided with a dehumidifying unit 324 of a circular or polygonal shape, and a dehumidifying unit cover member 326 is attached thereto. The electrical parts block 312 is isolated from the interior of the pod that needs to be clean, and is fixated from the exterior of the pod 301 by means of a one-touch-hook, for example. The electrical drive parts such as the fan motor and electrical dehumidifier are connected to the electrical parts block 312 from the exterior of the pod main body by way of wiring means 325. It is preferable that filter exchange be carried out by means of a unified filter block 311 that integrates the particle filter, gas contaminants filer, filter case and air circulation apparatus

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so as to maintain its performance capability. In the present structure, it is possible to exchange only the filter block without dismantling other components. When the pod is to be washed, the dehumidifier unit cover 326 is detached first. Next, the dehumidifying unit 324 is detached. Next, the filter block 311 is removed from the interior of the pod main body 301, and lastly, the electrical parts block 312 is removed. An opening generated by the removal of the dehumidifying unit 324 may be sealed with a stopper when the pod is to be washed.

[0170] Next, the substrate transport pod that can be powered through external source will be explained with reference to FIGS. 79A, 79B and 79C. This pod is used to hold a plurality of substrates W of 200 mm diameter, for example, in a substrate cassette, which is housed in a pod 410 to be transported or stored. This substrate transport pod 410 is comprised by: a pod main body 1 of a square shape having a side wall opening section; a substrate transport door 2 linked to a substrate transport door operating apparatus so as to operate the opening section provided on the bottom surface of the pod main body by mechanical means; a lid member 3 for covering the opening section for mounting or detaching filters and fan motor; a cassette 4 for holding wafers; a ULPA filter 5; a gaseous contaminants filter 6; a fan motor 7; a dehumidifying unit 8; a secondary battery for operating the fan motor 7 and the dehumidifying unit 8; and an operation control board 9. On the bottom surface of the substrate transport pod 410 are provided a latching device 411 for mechanically operating the substrate transport door 2, a positioning hole 412; and a secondary battery charging terminal 413.

[0171] In this embodiment, charging terminal 413 on the substrate transport pod-side is located on its bottom surface, but the terminal may be located on the side surface or upper surface as necessary. FIG 79 shows a managing information storage (information processing apparatus) 414 also for reference. Also, in this embodiment, the door of the substrate transport pod is located on the bottom section, but the pod is applicable to a structure in which the door is located on the side surface or upper surface. Also, in this embodiment, the substrate is stored in the horizontal position, but the pod is applicable if they are located in the vertical direction.

[0172] The power input apparatus for charging the secondary battery disposed on the substrate transport pod is an example of a charging setup to receive the substrate transport pod 410 in the vertical position and the charging terminals on the apparatus side and the pod-side contact each other to carry out charging and/or supplying power, as shown in FIGS. 80A and 80B. The power input apparatus comprises a charging system and a supply system for converting commercial voltage source to a specific voltage required and supplying power directly to the fan motor and dehumidifying unit. By obtaining the power from such commercial power source to the fan motor or dehumidifying unit, it is possible to operate continually over a long period. The power input apparatus is comprised by: a power supply main body 415; a guide member 416 for guiding the bottom four corners of the pod; a positioning pin 417 linked to the guide member for seating the pod in a specific location; detection means 418 disposed in the interior of the power supply main body 415 for detecting whether the pod is present and/or the necessity for supplying power; a terminal moving mechanism 420 also disposed in the inferior of the power supply main body 415 for raising or lowering of the powering connector 419 according to detected information from the detection switch 418; powering connector 419; and a pod fixation mechanism 421 for mechanically affixing the substrate transport pod. The power input apparatus referred to above relates not only to a simple charging device to supply or receive charges but relates all inclusively to the door operating apparatus having charging capability, temporary holding apparatus, semiconductor manufacturing apparatus, automated transport apparatus, and performance inspection apparatus. Of the constituting elements mentioned above, the guide member 417 and the pod fixation mechanism 421 may be omitted. Here, in this embodiment, although the secondary battery is disposed on the substrate transport pod, but the system is similarly applicable to a substrate transport pod that does not have a secondary battery, that is, a pod having air cleaning apparatus and dehumidifying device that operate only through an external power supply.

[0173] Another embodiment of the method for supplying power relates to a non-contacting manner of supplying the power. This method is based on a proven method of electromagnetic induction, being used for electric shaver, electric brush and electric car. Electromagnetic induction is realized by receiving or amplifying the magnetic flux generated by the current flowing in a wire or coil from an external AC source so as to supply necessary power, and is a type of transformer. The feature of electromagnetic induction type power supply is that no wear of terminals occurs because on non-contact, no generation of sparks, no danger of electrical shock, and no danger of shorting when used in wet environment. The outline is shown in FIGS. 81A and 81B. This power input apparatus is comprised by a charging system and a supply system that supplies power directly to the fan motor and dehumidifying unit after converting the commercial power to a specific voltage. By obtaining the power from such commercial power source to the fan motor or dehumidifying unit, it is possible to operate continually over a long period. The power input apparatus is comprised by: a power supply main body 415; a guide member 416 for guiding the bottom four corners of the pod; a positioning pin 417 linked to the guide member for seating the pod in a specific location; a detection device 418 disposed in the interior of the power supply main body 415 for detecting whether the pod is present and/or the necessity for supplying power; a control section 422 also disposed in the inferior of the power supply main body 415 for controlling supply voltage and current and the like; a powering connector 419 having a supply line or a coil; and a pod fixation mechanism 421 for mechanically affixing the substrate transport pod. The power input apparatus referred to above relates not only

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to a simple charging device to supply or receive charges but relates all inclusively to the door operating apparatus having charging capability, temporary holding apparatus, semiconductor manufacturing apparatus, automated transport apparatus, and performance inspection apparatus. Of the constituting elements mentioned above, the guide member 417 and pod fixation mechanism 421 may be omitted. Here, in this embodiment, although the secondary battery is disposed on the substrate transport pod, but the system is similarly applicable to a substrate transport pod that does not have a secondary battery, that is, a pod having air cleaning apparatus and dehumidifying device that operate only through an external power supply.

[0174] Next, of the actions of the various components carried out during charging, a contact system of charging will be explained with reference to FIGS. 80 and 82. When a pod is transported to a charging apparatus by various transport means (AGV or OHT and the like) to be charged, it is seated in a specific position by the guide member 416 and the positioning pin 417. In some cases, the pod is fixed to the apparatus by the pod fixation mechanism 421. This state is shown in FIG 82. When the pod 410 is seated, the detection switch 418 in the charging apparatus main body detects seating and/or determines whether charging is necessary, and if it is determined that charging is required, the terminal moving mechanism 420 is operated. The connector attached to the tip of the terminal moving mechanism contacts the charging terminal 411 on the pod-side, and begins charging. Before commencing charging, connection confirmation may be carried out to determine whether the terminals are in contact properly. When charging and/or power supply is completed or when the pod is to be transferred due to processing needs, the apparatus side first transmits clear-process information to the power supply control board, and stops supplying of power. Next, the power input terminal retreats to a position to not to interfere with the movement of the pod, and the pod fixation mechanism 415 is released so as to enable process clearing. In this embodiment, the power input connector on the power supply side is disposed on the top surface, but this is not meant to specify the location of the terminal, so that it may be located on the side surface or the top surface as needed. Also, the direction of movement of the power input terminal is not required to be vertical so that the horizontal or slant direction, or a suitable combination of vertical, horizontal, slant or rotation movement may be used.

[0175] Next, of the actions of the various components carried out during charging, a non-contact system of charging will be explained with reference to FIGS. 81 and 83. When a pod is transported to a charging apparatus by various transport means (AGV or OHT and the like) to be charged, it is seated in a specific position by the guide member 416 and the positioning pin 417. In some cases, the pod is fixed to the apparatus by the pod fixation mechanism 421. This state is shown in FIG 83. When the pod 410 is seated, the detection switch 418 in the charging apparatus main body detects seating, and it determines whether charging and/or powering is necessary, and if it is determined that the substrate transport pod requires charging, charging is commenced. Before commencing charging, connection confirmation may be carried out to determine whether the terminals are in contact properly. When charging and/or powering is completed or when the pod is to be transferred due to processing needs, the apparatus side first transmits clear-process information to the power supply control board 422, and stops supplying of power. Next, the pod fixation mechanism is released so as to enable the state of clear-process. In this embodiment, although the power input connector on the power supply side is disposed on the top surface, this is not meant to specify the location of the terminal so that it may be located on the side surface or the top surface as needed. Also, the power input terminal on the apparatus side may be a movable type as in the contact type. The direction of movement may be vertical or horizontal or slant direction, or a suitable combination of vertical, horizontal, slant or rotation movement may be used.

[0176] Seating detection mechanism of the substrate transport pod may include mechanical switch, proximity switch or photo-electric sensor. Mechanical switches are the most common means of detection, and include button type, rotary type, sliding type, joy stick, torque type, and miniature models are available in the marketplace. Proximity switches detect an approaching object by means of magnetic or electric field. They are non-contacting type detectors, and are effective when the detection object is metallic or non-metallic. Photo-electric sensors include scatter reflection type, mirror reflection type and transmission type. In the scatter reflection type, its operation is based on light emitting from the emission section illuminates an object and is scattered/reflected, and a portion of the reflected light returns to the receiver section. In the mirror reflection type light emitted from the emission section is reflected by the mirror to return to the receiver section, and operates when an object shields the light. In the transmission type, emission section and receiver section are placed in different locations, and an object is detected when it shields the light path between the emission and receiver sections. In the above embodiment, any of these methods may be used by considering the size, shape, price and reliability of each method.

[0177] For the connectors, there are coupling type, clip type or contact type. In the coupling type, a plug section is inserted into a socket section, and it is widely used for power and communication cables. For those applications that require little plugging and unplugging, this method is the most reliable. In the clip type, the conductive area is. clamped by the clip, and it is used often when making temporary connections so that it is not well suited to the present embodiment. In the contact type, a spring section and a plate section are in contact at a point. This method is useful when the space available for the connector is narrow. The contact type spring section includes plate spring and coil spring, and many commercial products are available. In this embodiment, the above connection devices, excepting the clip

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type, are useful but from the viewpoint of low space requirement, the contact type is the most preferable.

[0178] As described above, a drive power source is required when the cleaning and/or electric dehumidifier are to be mounted on the substrate transport pod. There are two methods of obtaining a drive power source: one method is to provide a power source such as secondary battery on the pod, and another method is to supply power from an external source.

[0179] First, the method based on mounting a secondary battery will be explained. The purpose of mounting a battery on the pod is to maintain low levels of contaminants and humidity, even when external power supply cannot be provided, by operating the air cleaning apparatus and/or electric dehumidifier. Batteries that may be considered for mounting may include: rechargeable secondary batteries, for example, lead storage battery, NiCd battery, nickel/metal hydride battery (Ni-MH), lithium ion battery (Li-ion), polymer battery. Polymer batteries use a solid or gel type polymeric electrolyte, and therefore, they are different from other type of batteries, so that there is no danger of liquid leaking and a metal container is not required leading to improved safety. Also, there is an advantage that it allows freedom in designing the shape. Other power sources include solar batteries. Two methods of using the solar battery are to use it to drive the fan motor and the like directly or to use it to charge secondary battery mounted on the pod. The substrate transport pod having the air cleaning apparatus and/or electric dehumidifier may utilize a secondary battery or a solar battery or a combination of secondary battery and solar battery.

[0180] The location for charging the battery may include, for example, door operating apparatus, transport apparatus, storage depot or specialized local charger. When a secondary battery is mounted, it is necessary that the charger be provided only where the pod stays for prolong period. The pod may stay for a long time on the door operating apparatus and in storage depot. Therefore, operation by secondary battery may be chosen only while transporting in the transporting apparatus, so that, even if the transport apparatus should experience problems and the pod is delayed, clean interior atmosphere can be maintained in the pod.

[0181] The quickest general method of charging the battery is to follow the procedure shown in FIG 84. First, preliminary charging is performed at 0.2~0.3 cmA, and the battery voltage is confirmed at this stage. If the battery voltage is higher than a specific voltage, the process is shifted to quick charging. Next, quick charging is performed at the maximum of 1 cmA. The end point of quick charging is reached when the battery temperature rise per unit time (dT/dt) reaches a pre-determined value. This is based on the method of judging the completion time of charging according to the amount of electrical energy injected into the battery manifesting in a given rate of temperature rise. When the quick charging is completed, the battery has been charged to 80~90 % of its full capacity. Then, trickle charging is performed at a low current of 1/20~1/30 cmA. When the trickle charging is completed, the battery is charged to the 100 % capacity.

[0182] General quick charging method follows the following sequence.

① Charging is performed at 0.2~0.3 cmA, and the battery voltage is confirmed. If the battery voltage is higher than a specific voltage, it changes to quick charging.

② Quick charging is performed at the maximum current of 1 cmA. The end of quick charging is reached when the temperature rise per unit time (dT/dt) reaches a specific value. At the completion of quick charging, 80~90 % of the full charge is attained.

③ Charging is continued at a low current of 1/20~1/30 cmA. When the trickle charging is completed, 100 % of the battery capacity is reached.

[0183] FIG 85 shows a control section on the pod-side for providing battery protection and showing accurate residual capacity. This apparatus has a control board on the pod-side having the information processing function shown in FIG 85, and a control board on the charger side having the information processing function shown in FIG. 86. The "measurement results input/output section" on the pod-side receives battery capacity, operation times and power consumption rate and others for the fan motor and/or electric dehumidifier, and next, necessary data are computed in the "control computation section" and the data are stored in the "memory" as information on the battery capacity, accumulated power consumption and the like. The "operational control signal input/output section" receives dedicated ID number of the pod, operation conditions such as operation patterns of the fan motor and/or electric dehumidifier and the like, which are stored in the "memory". Operational state of the pod, such as the battery residual capacity, is output from the "memory" according to the control computation actions stored in the "memory". The "interface section" has the capability to transmit information stored in the "memory" by wire or radio to the charger.

[0184] The "interface section" on the charger side receives information such as ID number of the pod and accumulated power consumption and others, and necessary data are computed in the "control computation section", and the data such as charging times are stored in the "memory". The "charging control circuit section" performs charging of the battery according to various information such as charging times stored in the "memory" and according to computed control actions including information on the voltage or current and the like output from the "measured results input section" through the "interface section".

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[0185] That is, because residual charge and operation times and accumulated power consumption are stored in the "memory" by the control board on the pod-side, this method enables to display more accurate information on the residual battery life. Also, because the battery capacity is computed constantly, performance degradation due to over-charging of secondary battery can be prevented. Also, the charging side is able to compute the shortest charging time based on the residual capacity of the secondary battery on the pod-side, and display the results.

[0186] Next, the structure of the electrical system will be explained. For example, if a charging system for charging the secondary battery is combined with a powering system for operating the air cleaning apparatus and/or electric dehumidifier, the power to operate the air cleaning apparatus and/or electric dehumidifier is consumed from the secondary battery. In this method, charging and discharging of the secondary battery is repeated to result in shortening the service life. When the pod is connected to the dedicated charger, it is preferable to separate the charging system from the powering system. By isolating the charging system from the powering system, when the pod is connected to the charger, the secondary battery is subjected only to charging process, and the service life can be increased. The longer the time of connection to the charger, this effect becomes more significant.

[0187] Next, the method of supplying power from external source will be explained. The purpose of supplying total power to operate the air cleaning apparatus and/or electric dehumidifier externally is to reduce the weight and cost of the pod by not mounting the battery on the pod. The power to the pod may be supplied when the pod is in the standby mode on the door operating apparatus, on the transport apparatus, in storage depot, or in the standby mode at a local charger. This method has a disadvantage such as the necessity for the power source to be located within the movement range of the pod, but the weight of the pod can be reduced and the cost lowered.

[0188] The substrate transport pod of the present invention having the air cleaning apparatus and/or electric dehumidifier may have a secondary battery or driven by external power source.

[0189] Examples of methods for powering the pod will be explained in the following with reference to the drawings.

[0190] FIGS. 87A, 87B and 87C will be used to explain the process of powering the substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a secondary battery 451; an operational control board 453; a power input terminal 454; a door 2 having reaction plate 455 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air circulation apparatus 7; a flow regulation plate 23; and a connection terminal 19. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving mechanism 467; a pod identifier sensor 468 and others. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the side surface of the pod, the reaction plate and reaction seal may be disposed on the pod bottom section.

[0191] FIGS. 88A, 88B and 88C will be used to explain the process of powering the substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a reaction plate or reaction seal 455 and a door open/close detection sensor 469 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 9; a flow regulation plate 23; a secondary battery 9; an operation control board 453; a power input terminal 454; and a door open/close sensor. The door open/close sensor 469 is provided for sensing the status of the door and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. Or, the power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving apparatus 467; a pod identifier sensor 468 and the like. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the side surface of the pod, the reaction plate and reaction seal may

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be disposed on the pod bottom section.

[0192] FIGS. 89A, 89B and 89C show, respectively, the pod in the transport state, seating state and door descended state. The diagrams explain the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a reaction plate or reaction seal 455, and a door open/close detection sensor 469 housed internally or attached; and an air cleaning unit having a particle filter 5, a gaseous contaminants filter 6, a dehumidifier 8, an air blower 7, a flow regulation plate 23, an operation control board 453, a power input terminal 454, and a door open/close sensor. The door open/close sensor is provided for sensing the status of the door and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving apparatus 467; a pod identifier sensor 468. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal 455 that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the pod-side, the reaction plate and reaction seal may be disposed on the pod bottom section.

[0193] FIGS. 90A, 90B and 90C show, respectively, the pod in the transport state, seating state and door descended state. The diagrams explain the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a reaction plate or reaction seal 455, a door open/close detection sensor 469, a gas intake opening 470, and a gas discharge opening 471 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 7; a flow regulation plate 23; an operation control board 453; a power input terminal 454; and a door open/close sensor 469. The door open/close sensor 469 is provided for sensing the status of the door and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. The gas intake opening 470 and the gas discharge opening 471 are provided with internal one-way valve and the particle filter, but it may be filled with the gaseous contaminants filter medium. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving apparatus 467; a pod identifier sensor 468 and a gas intake pipe 472 and a gas discharge pipe 473 for gas replacement by linking with the gas intake opening 470 and the gas discharge opening 471. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. When transporting the wafers inside the pod or clear the process, the interior atmosphere may be replaced with nitrogen gas by utilizing the gas intake pipe 472, gas intake opening 470, gas discharge opening 471 and the gas discharge pipe 473. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the side surface of the pod, the reaction plate and reaction seal may be disposed on the pod bottom section. The gas intake opening and gas discharge opening may be disposed on the pod main body side.

[0194] FIG 91 shows the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a door open/close detection sensor 469 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 7; a flow regulation plate 23; a secondary battery 9; an operation control board 453; a power input terminal 454; a rectifier 474. The door open/close sensor 469 is provided for sensing the status of the door 2 and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is

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permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a pod fixation arm 465; a power input terminal 466; a power control board 475 and the like. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465. It is permissible to supply power by adding a pod identifier sensor and a reaction plate, and detecting whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. This embodiment relates to a non-contact type powering system, and the power receiving terminal is wire, coil or core. The power input terminal is also wire, coil or core. The rectifier 474 is a device for converting the alternating current received from the power input terminal 454 to the direct current. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted.

[0195] FIG 92 shows the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a robot holding means 476; a door 2 having a door open/close detection sensor 469 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 7; a flow regulation plate 23; an operation control board 453; a power input terminal (coil) 454; and a rectifier 474. The power input apparatus for the substrate transport pod having the air cleaning apparatus is a ceiling-based transport apparatus such as OHT. As shown in FIG 93, OHT is comprised by a guide rail 477 affixed to the ceiling; a hoist 478, and a handling arm 479, and its forward thrust is generally provided by a linear motor. The guide rail has at least a magnetic body 480 and powering line 481. The moving body 482 has a primary coil 483, wheels 484 for supporting the vertical load; wheels 485 for supporting the horizontal load, and a moving-side powering coil 486. The handling arm 479 has a powering coil 487, and the current flows via the power input coil on the moving-side powering coil through the power input line 481, such that a portion of the input power is used for forward thrust power, and a portion is used for the hoist winding power, and the current flows from the powering coil 487 of the handling arm to the pod-side receiving coil 454, and the alternating current is rectified in the rectifier 474, and is further converted to a desired voltage to operate the fan motor and/or dehumidifier. It is permissible to supply power by adding a pod identifier sensor and a reaction plate, and detecting whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted.

[0196] Instead of the door open/close detection sensor, a sensor to detect the presence of a cassette may be attached. Attachment location of the sensor may be chosen anywhere, for example, bottom section, side surface, upper surface or front surface of the cassette. Methods for cassette detection include mechanical sensors, photo-electric sensors, magnetic sensors, and proximity sensors, but non-contact type sensors that do not touch the cassette are preferable.

[0197] Next, information management system of the substrate transport pod will be explained with reference to FIGS. 94 to 99.

[0198] In this embodiment, the substrate transport pod 1 is provided with data storage means 700 for storing information on contents housed inside the pod such as wafer and the like. Information on wafers stored inside refers to such data as the number of wafers, processing status, processing procedure and lot identification ID, but if the contents are masks, information relates to such objects.

[0199] FIG. 94 shows a system for use in the centralized management method. A communication antenna 701 is placed in a location for which information is required, and information arriving in the data storage means at this location is forwarded to the host computer 703 through a controller 702. The control section for the various on-site manufacturing apparatuses 704 and the stocker 705 for pod storage is also linked to the host computer, and the information on the wafers housed in the interior of the pod 1 is instantly confirmed, and the control section for a manufacturing apparatus instructs to perform processing exactly as the information stored inside the pod 1. When the processing is completed, such information is newly recorded in the data storage means 700, and the pod 1 is transported to the next apparatus by an automatic transport tool (for example, AGV and the like) instructed by the host computer.

[0200] FIG 95 shows a system for use in the on-site management method. The site is provided with interface module 707 for use in reading and writing information in information storage means 700 provided for the pod 1. Information storage means 700 is a data memory means for memorizing information on an object whose carrier, pod and other information are to be managed. Also, storage means 700a is able to read the information in the memory on-site. Accordingly, it is also possible to confirm or overwrite the information on the contents, such as wafers, stored inside the pod, on-site without the intervention of the host computer.

[0201] Next, with reference to FIG 96, a management system for managing information on filter service life and pod cleaning will be explained.

[0202] The substrate transport pod 1 is provided with data storage means 700 for accumulating the cumulative operation time γ of the driving section for managing the information on filter service life and pod cleaning frequency. This

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storage means 700 may be provided with computation means. It is obvious that a common storage medium should be used for the data storage means of the pod and for the data storage means for accumulating information on the contents stored inside the pod.

[0203] In the computation element, computed information is stored in the data storage means 700 so that the pod is washed when the cumulative operation time γ exceeds a certain value and the filter is exchanged when a certain value is exceeded. This information is sent from the host computer 703 to the AGV 706 and the pod washing machine 708 to enable the pod to be washed or filter 709 to be exchanged. For example:

γ = 480 hours for washing

γ = 7200 hours for filter exchange

[0204] It is obvious that, in the case of the on-site management system, the operator can be notified by displaying information regarding filter exchange and pod washing.

[0205] In another example of the management system, in order to increase the accuracy of filter service life management, the pod 1 is provided with data storage means 700 for accumulating the processed gas volume α per unit time and the cumulative operation time γ. This device may have computation means. It is preferable that a common storage medium should be used for the data storage means of the pod and for the data storage means for accumulating information on the contents stored inside the pod.

[0206] The computation means stores computation results so that the pod will be washed when the cumulative operation time γ exceeds a certain duration, and so that the filter will be changed when a product of the processed gas volume α per unit time and the cumulative operation time γ exceeds a certain value X, for example:

γ = 480 hours for washing

α (NH_3-mg/h) $\times$ γ (hours) = X(NH_3-mg) for filter change

[0207] In the case of central management system, this information is forwarded from the host computer 703 to AGV 706 and pod washing machine 708 to enable to confirm the need for pod cleaning and filter exchange. It is obvious that, in the case of on-site management system, the operator can be notified by displaying information regarding filter exchange and pod washing.

[0208] In still another management system, in order to improve the accuracy of filter service life management, the substrate transport pod is provided with a gas sensor, and has a data storage means for accumulating the processed gas volume β per unit time obtained from the results of sensor measurements and the cumulative operation time γ of the drive section, and a computation element may also be provided. It is obvious that a common storage medium should be used for the data storage means of the pod and for the data storage means for accumulating information on the contents stored inside the pod.

[0209] Gas sensor may include color indicating monitor, semiconductor sensor and quartz oscillator sensor, but it is not necessary to limit to these methods. In the computation element, computed results information is stored in the data storage means that indicates washing is needed when a pre-determined value of cumulative operation time γ of the drive section is exceeded. For example,

γ = 480 hours for washing,

β = monitored value (NH_3-mg)÷measuring duration in hours, and

$\beta \times \gamma$ = X (NH_3-mg) for filter change.

[0210] Processed gas volume β per unit time is computed using the indicated value of the gas sensor and the measuring duration, which is stored in the data storage means. For the centralized management system, various pieces of information are sent from the host computer to AGV and pod washing machine to enable pod washing and filter change. It is also possible, in the case of the on-site management system, to display information on filter change and pod washing on a display section to notify the operator.

[0211] Further, in order to operate the entire system smoothly, it is preferable that the computation element on the pod-side has a timing mechanism and data storage means for accumulating malfunction information of the drive parts. For example:

γ = 480 hours for washing, 2000/12/31/12:00,
2001/01/30/00:00,
2001/02/28/20:00,

α(NH_3-mg/h) $\times$ γ (hours) = X(NH_3-mg) for filter change,
2000/01/25/08:00,
2001/10/10/12:00, and

fan stop 2001/12/31/12:00.

[0212] By providing timing mechanism on the substrate transport pod 1 itself, it is possible to provide some estimate of the frequency of need for cleaning, change the filter and malfunction of drive parts, and such data are extremely effective for operational purposes. Also, even if malfunction of drive parts occurs during transport of substrates, search time for rejection lot is shortened because priority inspection can be provided for the processes that follows such breakdown.

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[0213] With reference to the flowchart for the wiring process in FIG 76, an example of operation of the information management system for substrate transport pod will be explained in the case of using a common medium for the data storage medium to store environment control information for the pod (pod data) and lot history (contents data).

[0214] When insulation film forming processing is completed, process completion information is newly entered in the data storage means. Also, receiving pre-stored or externally input information on environmental control during the period for the pod to reach its next processing, the electrical drive section is operated in such a way that moisture and organic control are prioritized for suppressing formation of oxidation film. For example, a plurality of dehumidifying units is operated and the fan is operated continually or intermittently. Also, transport to the target apparatus for resist coating (coater) is carried out by means of automated transport tool (for example, AGV) 706 that received instruction from the host computer. When the pod reaches the target coater, the matching of the coater recipe and processing requirements for the pod content is checked, and processing is carried out only when matching is confirmed.

[0215] When resist coating, exposure and development are continuously performed in the interface section, the pod is not used, and therefore, environmental control information may be blank during the period of transport between development to etching processes, but if an emergency situation arises relating to apparatus problems and the like, the memory contents need to be stored in the pod in such a way that instructions are externally entered into the data storage means to operate the electrical drive section to prioritize control of base substances in the environmental control so as to suppress the T-top formation. For example, the dehumidifying units are stopped or only one unit is operated and the fan is operated continually or intermittently. Procedures for lot history (contents information) manufacturing apparatus, and communication of transport apparatus are the same, and therefore, the following process describes only the environmental control aspects.

[0216] During transport between the developing apparatus and the etching apparatus, base substance control need not be prioritized to the extent required between the processes of photo-resist coating, exposure and development. When a metal film forming process is performed by etching, asher and CVD, environmental control is not necessary because the processes are carried out on whole substrates in a vacuum using a multi-chamber such as cluster tool and the like. However, when a metal film forming process involves etching, asher and electro-plating, or when processing cannot be carried out on whole substrates due to malfunction of multi-chambers and the like, or chemical contamination of the insulation film after etching on the side wall of the groove is a problem, transport from the etching apparatus to the metal film forming apparatus is carried out using a substrate transport pod having a chemical filter in addition to a dehumidifying agent or a dehumidifier. In such a case, priority controls are performed for all or some of moisture, acid and organic substances.

[0217] Further, when transporting copper-coated silicon wafers in the pod from the metal film forming apparatus such as CVD and electro-plating apparatus to the CMP apparatus, by way of the annealing apparatus, further to coater, and to the insulation film forming apparatus such as CVD apparatus, growth of oxidation film can be prevented by providing dehumidifying means such as the dehumidifier or dehumidifying agent inside the pod to control its humidity. In such a case, it is preferable to control to dehumidify inside the pod to less than 10 %, or more preferably to less than 5 %. To prevent the growth of even slightest oxide film, it is preferable to lower to dehumidify to a specific value within 10 minutes of opening the door 2, or more preferably, within 3 minutes. The electrical drive section is operated to control moisture and organic substances, in particular, priority should be given to controlling the humidity. For example, a plurality of dehumidifying units is operated and the fan is operated continually or intermittently.

[0218] Next, another example of the information management system for the substrate transport pod will be explained.

[0219] This substrate transport pod, as described above, is provided with computation element, memory element and computation processing unit 558 (refer to FIGS. 34A and 34B) having data input/output means. The computation processing unit stores information not only on cumulative operation time of electrical drive section parts such as fan motor or dehumidifying unit, malfunction information, and information on pod itself such as residual voltage of the secondary battery, but also stores information on externally-input information on the amount of processed gas per unit time, operational protocol for electrical drive parts, voltage target for charging and lot process history management. Of course, when the gas sensor is provided inside the pod, it is possible to compute and store actual measured value of the contaminated gas volume, not as pre-determined data. Here, as described in the following, the particle filter, gaseous contaminants filter 6, and fan motor may be used singly or in combination, and their attachment location and properties may be different depending on the process to be applied.

[0220] The substrate transport pod having contaminants removal means uses particle filter to remove particulate and metallic contaminants, and uses gaseous contaminants filter to remove ionic and organic contaminants. Also, moisture is removed by using dehumidifying means based on solid polymer electrolytic film for decomposing water or by using dehumidifying agent. There are various target substances to be removed from the interior of the substrate transport pod, as described above, but the target composition for removal is different in each process so that it is not necessary to mount all the means for removing contaminants in the pod. For example, for storage of exposed substrates inside the pod, it is sufficient if a pod has specialized capabilities for removing particulate contaminants and base

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substances. Also, after forming metallic film on semiconductor substrates, it is sufficient if a pod has specialized capabilities for removing particulate contaminants, organic contaminants and moisture. On the other hand, for storing exposed semiconductor substrates in the pod, the pod should have specialized capability for removing particle contaminants and chloride contaminants. Also, semiconductor substrates that have been processed with metal film, the pod should have specialized capability for removing particle contaminants, organic contaminants and moisture. On the other hand, for storing washed semiconductor substrates inside the pod, the target substances to be removed depend on the nature of the succeeding process. Further, it is anticipated that new materials will be adopted in the field of film forming, and it is said that adoption of such new materials is largely affected by whether environmental control for the new material is possible or not.

[0221] On the other hand, in some processes, filter service life is shortened by the release of large amounts of gases from the processed semiconductor substrates. Examples are found in degassing from organic solvents and the like brought into the pod during the exposure process. It can be anticipated that filter service life can be shortened when one pod is used for one process as in the conventional approach because of needless cleaning of the interior environment of the pod in some processes, so that the filter is no longer capable of performance in processes that require high degree of cleanliness. However, by adopting the present method of using the substrate transport pod, that is, by transporting the substrate in a pod having only those contaminants removal means customized for the processes being applied to the substrates, only those targeted contaminants relevant to the processes under consideration are removed effectively.

[0222] When the operation is based on a substrate lot being transported in a given substrate transport pod on a one-to-one basis as in the conventional method, types and concentrations of the contaminant gases brought into the interior of the pod and types and target levels of the gases to be removed are different in every process, and it is difficult to manage whether the cleaning functions are being sustained sufficiently. However, when the substrates are transported between each process in pods having contaminant removal means, the target gas types and the amount of gas generated are clearly known for each process. For this reason, it is preferable to pre-measure the amount of gas processed per unit time α during storage of the semiconductor wafers for each process, and to determine the need for changing the filter according to whether or not a threshold value, stored in the data storage means, has been reached, where the threshold value is given by a product of the measured value of processed gas volume α and the cumulative operation time γ of a drive part. Similarly, by pre-determining the frequency of washing the pod for each process, the need to wash a pod can be determined from the cumulative operation time γ of the drive part.

[0223] When the operation is based on a substrate lot being transported in a given substrate transport pod on a one-to-one basis as in the conventional method, types and concentrations of the contaminant gases brought into the interior of the pod and types and target levels of the gases to be removed are different in every process, and even if the gas level inside the pod is measured with a gas sensor, it is necessary to provide a sensor for each type of gas, so that this approach is not realistic. However, when a pod having suitable contaminant removal means is used for return transport of substrates between processes, the target gas types are known clearly for each process. For this reason, only sensors dedicated to the targeted gas species need to be mounted. Then, by determining the gas processed amount per unit time β by a filter according to measured results by the sensor, it is possible determine the need for washing the pod, according to whether or not a threshold value, stored in the data storage means, has been reached, where the threshold value is given by a product of the processed gas amount per unit time β and the cumulative operation time γ of a drive part. Similarly, by pre-determining the frequency of washing the pod for each process, the need to wash a pod can be determined from the cumulative operation time γ of the drive part.

[0224] Specific examples of selection of contaminants removal means and service life of the filters will be described in the following. For example, focusing on a case of the exposure process, the target contaminants for removal are particulate contaminants and base gases that can be found in the pod after processing, and it is not necessary to have removal capabilities for organic contaminants and moisture. Moreover, the exposure process uses a large quantity of organic substances such as photo-resist solvents, so that the filter service life is shortened if organic substance filter is used. Further, because the performance of base substance removal filter depends on humidity, so that if moisture removal is also used, service life of the base substance removal filter is shortened. When the pod is used as a dedicated transport apparatus having only the required filtering functions and unnecessary filtering functions are deleted, the filter is loaded only with particles entering from the clean-room environment when the substrate transport door is opened, and base gas substances. Therefore, the filter need not be changed until the guarantee periods are expired.

[0225] Similarly, taking an example of metal film forming process for Cu, the target contaminants for removal are primarily particulate contaminants, organic contaminants and moisture. There is no need for active removal of ionic contaminants. There is very little emission of target gases to be removed from the processed substrates, and therefore, in the dedicated pod operation, filter is loaded with particles entering from the clean-room environment when the substrate transport door is opened and organic contaminants.

[0226] Although the details regarding other processes will not be described here, in any operations according to the present method, when the pods having contaminants removal means are used to transport substrates back and forth

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between the processes, filters need not be changed until the guarantee periods are expired.

[0227] Table 1 shows an example of comparing the filter lives when used in the conventional one-to-one method and in the present process-specific pod method. In the method based on one-to-one correspondence of pod and substrate lot, service life of filter is shortened in some processes for which cleaning is superfluous, resulting that the degree of cleanliness required cannot be sustained for the process that requires it, so that the filter must be changed. However, by adopting the present method, that is, by transporting the substrates using substrate transport pods having contaminants removal means matched to the specific needs of each process, cleaning is carried out effectively to remove only those contaminants relevant to the processing of individual processes. The result is that the filter service life is extended while minimizing the contaminants that adhere to the substrates.

TABLE 1

Process Type	1:1 Lot-Pod		Process-Specific Pod
	Filter life	Short life cause	Filter life
Exposure	6 months	Loss of basic gas cleaning capability caused by NH_3 contaminations from wash process	Over 2 years*
Metal film (Cu)	6 months	Loss of organic gas cleaning capability caused by organic contaminations from organic. coating process	Over 2 years*
Metal wiring (Al)	3 months	Loss of acidic gas cleaning capability caused by acidic contaminations from RIE process	Over 2 years*
Washing (→film forming)	3 months	Loss of organic gas cleaning capability caused by organic contaminations from organic film coating process	Over 2 years*

* Guarantee period of gaseous contaminants filter

[0228] FIG 100 shows a flowchart for determining the charging times for a secondary battery. A substrate transport pod having the contaminants removal means described above has a fan motor and a drive section for operating the dehumidifying unit, so that it is necessary to carry out charging or powering (charging of secondary battery or powering the drive section). If full charge is maintained by connecting constantly to the powering station disposed in the loading port or fore-shelf of the processing apparatus, the process takes too long to match the cycle timing of the substrates returning from the processing apparatus. Therefore, it is necessary to stop charging when sufficient charges are given to enable to operate the longest interval between the preceding charging and the succeeding charging to meet the process cycle timing of the wafers returning from the apparatus. In this embodiment, the following procedure is used to shorten the charging time to meet the process cycle timing of the wafers returned from the processing apparatus. First, when the substrate transport pod 1 having the contaminants removal means is seated in the powering station 721, the residual voltage ε is measured and charging is started. At the same time, communication is started with the controller 702 of the processing apparatus A through the interface 701. Then, the time duration required by the pod to arrive at the next powering station is computed by obtaining a sum of the clean-room operation time (a sum of transport time, batch matching time, holding time for the operator and apparatus, and maintenance time) and the actual processing time (a sum of theoretical processing time, lot loading/unloading time, time for obtaining conditions for preceding wafers, time required for lot linking and quality control), and multiplying the sum by a factor of safety. That is,

Charge level = battery usage duration x power consumption - residual power

[0229] Battery usage duration = (actual processing time + clean-room operation time) x factor of safety.

[0230] Then, charging is carried out only to the extent of the charging to the voltage required ξ. Accordingly, it is possible to reduce the charging time.

[0231] The substrate transport pod 1 seated in the powering station 721a disposed in front of the apparatus 704a for process A must be charged sufficiently to enable to operate until it can be charged by the powering station 721b disposed in front of the apparatus 704b for process B. Battery driven operation should last for a period of time computed by obtaining a sum of the duration of actual processing for process A and the duration of clean-room operation (a sum of transport time, batch matching time, waiting time for the operator and apparatus, and maintenance time), and multiplying the sum by a factor of safety. Therefore, the amount of charge to be supplied by the powering station disposed in front of the apparatus for process A is computed by obtaining a product of the battery driving time and the power

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consumption (different depending on the process recipe for the drive parts) and subtracting the residual battery power. Here, the method of charging includes coupling through plus/minus terminal connections provided on the charging apparatus, non-contact method based on excitation of charging current in the coil of an object for power input, or charging double layer electrical condenser. Also, charging/powering may be carried out from the rail of the transport apparatus (AGV or OHT, for example).

[0232] Most of the conventional substrate transport pods having no air cleaning capabilities are almost always based on one-to-one correspondence of substrate lot and pod, and are used for transport of substrates through all the processes. It is thought that this method is chosen because the substrates are subjected to hundreds of processes starting from the bare stage to the product stage, so that it is considered necessary to leave processing history management information for each substrate lot as bar codes or memory information on the pod-side. Also, because the required processing duration is different for each process, there is a high probability that the pods tend to accumulate at particular processes. However, according to the present method based on using the pod specialized for transporting between particular processes only, conventional process management methodology cannot be used as it is. Therefore, by transferring the processing history management information for each lot stored or transported from a pod used in a preceding process to a pod used in a succeeding process, processing history management information for each lot can be carried out as smoothly as in the conventional method of using the substrate transport pods based on the one-to-one method.

[0233] FIG. 101 shows a conceptual diagram for network management of substrate transport pods. The substrate transport pod 1 provided with data storage means and computation means mounted on the charging station 721 and receives charge, and at the same time, exchanges information with the data collection server (controller) 725 and the server 703 by way of the hub 723. Information is exchanged with the washing machine 708 in addition to each processing apparatus. The substrate transport pod provided with individual contaminants removal means have identifier ID (for example, reference item 558 in FIGS. 34A and 34B), and it is necessary to manage the following information.

① identifier ID
② processed amount of gaseous contaminants per unit time α
③ amount of contaminant gas emitted per unit time β obtained by a sensor
④ cumulative operation time γ of a drive part
⑤ operating condition δ of a drive part
⑥ residual battery voltage ε
⑦ required charged voltage ξ
⑧ malfunction information η on a drive part and
⑨ processing history management information θ of a lot

[0234] A computation process unit containing memory element that stores at least the nine such parameters is mounted on the pod, and this information is transmitted when it is seated on a powering station. Also, when the pod is not seated on a powering station, information can be managed through the pods network by exchanging radio signals directly with a data collection PC. Here, because it is presumed that the substrate transport pods are used for transporting between processes, so that, for each process, a given value is normally assigned to parameters such as ② processed amount of gaseous contaminants per unit time α, ⑤ operating condition δ of a drive part ⑦ required charged voltage ξ. And, the parameters ③ amount of contaminant gas emitted per unit time β obtained by a sensor, ④ cumulative operation time γ of a drive part. ⑥ residual battery voltage ε and ⑧ malfunction information η on a drive part vary chronologically according to individual pods. By reading the contents of individual data stored in the memory elements of individual substrate transport pods from the data collection PC, the states of individual pods can be confirmed remotely by using a network such as the LAN shown in FIG 101.

[0235] That is, it is possible to manage the need for filter change (=value of an interval $\alpha \times \gamma$ to $\beta \times \gamma$), for washing (= value of γ), or if there is malfunction of pod (= value of η), to enable to prevent yield drop caused by storing a substrate lot in a pod that does not have sufficient cleaning abilities. Also, when it is necessary to alter the information due to malfunction in the processing apparatus side or changes in the operation condition of a drive part, changes in ② processed amount of gaseous contaminants per unit time α, ⑤ operating condition δ of a drive part or ⑦ required charged voltage ξ can be entered remotely in the data memory means of the pod. This entry of information is possible at on-site clean-room by exchanging data directly between the data collection controller 725 and the substrate transport pod 1, and such a procedure can also be used for entering trial parameters and the like for development work.

[0236] Also, it is possible to send the information on individual pods 1 to the washing machines 708 through the network to select those pods that require washing. Also, those pods that require filter change can also be selected at the same time as washing these pods.

[0237] On the other hand, the parameter ⑨ processing history management information of a lot θ can be used to understand the process history of a lot, even when the pods do not relate, one-to-one, to the lots, by having the information transferred from a pod used in the preceding process to a pod to be used in the succeeding process. The

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information can be transferred through the powering station directly, without resorting to the data collection controller 725, and it is normally carried out automatically.

[0238] It should be noted that, although the embodiment of the present invention related primarily to the substrate transport pods having a door on the bottom section, but various aspects of the present invention are applicable also to FOUPs (front opening unified pods).

[0239] Also, in the above embodiments, examples related to substrate transport pods used in wiring process of semiconductor manufacturing, but the present invention is not limited to wiring processes, and is applicable to all processes of semiconductor manufacturing that require various environments customized to processing conditions. According to the present invention, a structure of a substrate transport pod is provided for use in manufacturing of semiconductor chips comprised by copper wiring of less than 0.18 μm line width and low dielectric insulation film of less than 3.0 dielectric constant, in which the substrates are stored in the pod in an environment that maintains at least one parameter of air quality, including the level of particles, humidity, the level of organic substances, and the level of ionic gaseous substances, below a constant value. Further, a method is provided for using the pods in an automated semiconductor manufacturing plant in a logical and efficient manner.

[0240] It should be noted that, although various structures and methods of operating the substrate transport pods are described, these are meant to be illustrative and not restrictive of the essence of the invention. That is, it is obvious that various variations of basic invention are possible by combining the elements described in the above embodiments, thereby enabling various variations within the scope of the present invention.

[0241] As explained above, the present invention is applicable to manufacturing of semiconductor devices based on highly conductive wiring, such as copper wiring, and insulation films having a low dielectric constant. Therefore, it is suitable for use in storing or transporting an object to be subjected to processing, such as semiconductor wafers.

Industrial Applicability

[0242] The present invention relates to the structures, capabilities and methods of operating a substrate transport pod suitable for storing or transporting objects such as semiconductor wafers, photo-masks or hard-disks in a highly clean environment, and relates in particular to a method of managing the operation of the substrate transport pod to be used in semiconductor manufacturing processes. Therefore, it is applicable to manufacturing of semiconductor devices based on highly conductive wiring, such as copper wiring, and insulation films having a low dielectric constant.

Claims

1. A method for transporting substrates between a plurality of processes, comprising:

   loading the substrates into a pod from an atmosphere of a first process;
   circulating a gaseous atmosphere through interior of the pod intermittently or continually in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, to expose the substrates to a controlled atmosphere while the substrates are retained in the pod; and
   unloading the substrate from the pod to introduce into a second process.

2. A method according to claim 1, wherein an atmosphere in the first process is different than an atmosphere in the second process.

3. A method according to claim 1, wherein a gas circulated in the pod contains no particles of larger than 0.1 μm in excess of 10 particles/m^3, or organic substances in excess of 1 μg/m^3.

4. A method according to claim 1, wherein a gas in the pod is circulated and/or controlled in any selective pattern or atmosphere.

5. A method according to claim 4, wherein an interior environment of the gaseous atmosphere is controlled in any selective pattern by operating a circulation apparatus and/or dehumidifying apparatus.

6. A method according to claim 1, wherein an interior environment of the pod is controlled in any selective pattern according to information on an atmosphere used in the first process.

7. A method according to claim 1, wherein a pod having most suitable function is selected for use according to an information on an atmosphere of the first process.

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8. A substrate transport apparatus comprising a substrate transport pod that can be sealed hermetically for holding substrates therein, said substrate transport pod comprising:

at least one filter for purifying the gas, including a filter for removing particular substances, a filter for removing chemical substances or a dehumidifying apparatus for removing moisture;
a circulation apparatus for circulating a purified gas; and
a holding apparatus for holding the substrates so as to match the state of the substrates by exposing the substrates to the purified gas.

9. An apparatus according to claim 8, wherein the pod is provided with a gas sensor for detecting a processing gas.

10. An apparatus according to claim 9, wherein the circulation apparatus is controlled according to information provided by the gas sensor.

11. A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body, which is formed primarily of a material having moisture absorption coefficient of not more than 0.1 %, wherein the pod main body is in contact with the substrates directly or indirectly and has a conductive part so as to enable static charges to be drained from the pod main body.

12. A substrate transport pod according to claim 11, wherein a flow guiding structure is provided in interior of the pod main body for guiding a flow of a gas to the substrates.

13. A substrate transport pod according to claim 11, wherein a sensor is provided for detecting whether the door is opened or closed.

14. A substrate transport pod according to claim 11, wherein a sensor is provided for detecting presence of the substrates.

15. A substrate transport pod according to claim 13, wherein the gas circulation means for circulating a gas through the pod is provided, and stopped when the door is in the closed state.

16. A substrate transport pod according to claim 14, wherein the gas circulation means is provided, and operated only when it is detected that the door is closed and the pod contains the substrates.

17. A substrate transport pod according to claim 11, wherein the pod is provided with a gas circulation means in its interior space for circulating an internal gas.

18. A substrate transport pod according to claim 11, wherein the pod is provided with a humidifying means in its interior space for removing moisture from an internal gas.

19. A substrate transport pod according to claim 11, wherein the pod is provided with powering means for supplying electrical power.

20. A substrate transport pod according to claim 19, wherein the powering means comprises secondary batteries installed on the pod.

21. A substrate transport pod according to claim 20, wherein a powering means is further provided for charging the secondary batteries.

22. A substrate transport pod according to claim 19, wherein the powering means is constructed to be non-contacting and is operated electromagnetically.

23. A substrate transport pod according to claim 19, wherein the powering means is constructed to be contacting through point contacts.

24. A substrate transport pod according to claim 19, wherein the powering means is provided at least on a load port

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of a manufacturing apparatus, in a storage facility or on a transport apparatus.

25. A substrate transport pod according to claim 19, wherein powering is started as the pod is seated in the powering means.

26. A substrate transport pod according to claim 11, wherein the pod is provided with a circulation apparatus for circulating a gas inside the pod and at least one of a particle filter, a chemical filter and a dehumidifying apparatus.

27. A substrate transport pod according to claim 26, wherein a filter and a gas circulation means are formed as a unit in a form of a rod.

28. A substrate transport pod according to claim 26, wherein a filter is cylinder shaped and the gas flows in a radial direction of the cylindrical filter.

29. A substrate transport pod according to claim 26, wherein a filter is rod shaped and the gas flows in a longitudinal direction of the rod filter.

30. A substrate transport pod according to claim 26, wherein a ducting and/or a flow regulation apparatus is provided for guiding the gas.

31. A substrate transport pod according to claim 11, wherein the pod has a gas intake opening and a gas discharge opening for the gas circulated inside the pod.

32. A substrate transport pod according to claim 31, wherein a reverse flow prevention mechanism is provided at least on the gas intake opening or the gas discharge opening.

33. A substrate transport pod according to claim 31, wherein a ducting and/or a flow regulation apparatus is provided to connect to the gas intake opening.

34. A substrate transport pod according to claim 31, wherein a chemical filter, and a particle filter and/or a dehumidifying apparatus is provided in the vicinity of the gas intake opening and/or a gas discharge opening.

35. A substrate transport pod according to claim 11, wherein a center of gravity of the pod is adjusted in a horizontal direction within a circle having a radius of at least 90 % or preferably 70 % of a radius of substrates.

36. A substrate transport pod according to claim 11, wherein the pod is provided with an internal environment matching a processing atmosphere for substrates contained in the pod, and is used to transport the substrates between a plurality of processes.

37. A substrate transport apparatus comprising: a substrate transport pod that can be sealed hermetically for holding substrates therein, said substrate transport pod comprising:

at least one of a particle filter, a chemical filter, and a dehumidifying apparatus for removing, respectively, particulate substances, chemical substances, and moisture from a gas circulated inside the pod;
a gas circulation apparatus for circulating a purified gas;
a holding apparatus for holding the substrates so as to keep the state of the substrates by exposing the substrates to the purified gas; and
an identifier for distinguishing individual pods, whose historical data is managed by a computing apparatus.

38. An apparatus according to claim 37, wherein the pod is provided with a data storing apparatus.

39. An apparatus according to claim 37, wherein the pod has a means for receiving external signals, and controls internal environment in the pod according to the external signals.

40. An apparatus according to claim 37, wherein an internal environment is controlled by sending and receiving information between the pod and a processing apparatus.

41. An apparatus according to claim 37, wherein the pod is provided with processing history management information

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on substrates, and processing of the substrates is managed by transferring the processing history management information from one pod to other pod.

42. An apparatus according to claim 41, wherein the processing history management is carried out by way of a host computer network.

43. An apparatus according to claim 41, wherein a processing history is transferred from one pod to other pod by a controller provided on a processing apparatus.

44. An apparatus according to claim 37, wherein a washing interval for a pod is managed by information stored in memory means of the pod.

45. An apparatus according to claim 37, wherein a filter change interval of a pod is computed from a product of a processed gas volume and a duration of pod operation.

46. An apparatus according to claim 37, wherein a washing interval is estimated from a duration of pod operation.

47. An apparatus according to claim 37, wherein residual power of the secondary batteries provided for the pod is measured, and charging is carried out to a necessary level of the power.

48. An apparatus according to claim 37, wherein management of information on individual pods is carried out by sending and receiving information for individual pods by wire or radio transmission through a network.

49. An apparatus according to claim 37, wherein processing history management information for a lot is transferred from a pod used in a preceding step to a pod to be used in a succeeding step.

50. An apparatus according to claim 37, wherein information on a pod to be washed is sent to a pod washing machine so that the pod can be selected and subjected to washing.

51. An apparatus according to claim 8, wherein a level of ammonia in an interior atmosphere of a pod is maintained below a given level when the pod contains substrates whose surfaces are resist-coated.

52. An apparatus according to claim 51, wherein an ammonia level in interior of the pod is controlled by adsorbing ammonia gas by means of a chemical filter.

53. An apparatus according to claim 51, wherein a humidity level in interior of the pod is controlled by removing moisture using a dehumidifying apparatus provided for the pod.

54. An apparatus according to claim 8, wherein the pod is provided with a contaminant removal means and target components are selectively chosen for removing particulate contaminants, metallic contaminants, ionic contaminants, organic contaminants and moisture, and the pod is used for return transport for each process.

55. A method for manufacturing a semiconductor device by transporting substrates between a plurality of processes, comprising:

loading the substrates into a pod from an atmosphere of a first process;
circulating a gaseous atmosphere through interior of the pod in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, to expose the substrates to a controlled atmosphere intermittently or continually while the substrates are retained in the pod; and
unloading the substrates from the pod and introducing the substrates into a second process.

Amended claims under Art. 19.1 PCT

1. (Amended) A method for transporting substrates between a plurality of processes, comprising:

loading the substrates into a pod from an atmosphere of a first process;
removing selectively at least one contaminant including moisture, particulate substances or chemical sub-

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stances intermittently or continually, to expose the substrates to a controlled atmosphere that organic substances be lower than 1 $\mu g/m^3$ and/or moisture be lower than $4x10^{-3}$ g/g while the substrates are retained in the pod; and
unloading the substrate from the pod to introduce into a second process.

2. (Cancelled)

3. (Amended) A method according to claim 1, wherein a gas circulated in the pod contains particles of larger than 0.1 μm lower than 10 particles/m^3.

4. (Cancelled)

5. (Amended) A method according to claim 1, wherein an interior environment of the gaseous atmosphere is controlled by operating a circulation apparatus and/or dehumidifying apparatus.

6. (Amended) A method according to claim 1, wherein an interior environment of the pod is controlled according to information on an atmosphere used in the first process.

7. A method according to claim 1, wherein a pod having most suitable function is selected for use according to an information on an atmosphere of the first process.

8. (Amended) A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body, which is formed primarily of a material having moisture absorption coefficient of less than 0.1 %, wherein the pod main body is in contact with the substrates directly or indirectly and has a conductive part so as to enable static charges to be drained from the pod main body.

9. (Amended) A substrate transport pod according to claim 8, wherein the pod is provided with a sensor for detecting a gas or for detecting a moisture.

10. (Amended) A substrate transport pod according to claim 9, wherein a circulation apparatus and/or a dehumidifying apparatus is provided, which is controlled according to an information by the sensor.

11. (Amended) A substrate transport pod according to claim 8, wherein the pod is provided with at least one of a filter for removing particulate substance, a filter for removing chemical substance and a dehumidifying apparatus.

12. (Amended) A substrate transport pod according to claim 11, wherein a sensor is provided for detecting whether the door is opened or closed.

13. (Amended) A substrate transport pod according to claim 11, wherein a sensor is provided for detecting presence of the substrates in the pod.

14. (Amended) A substrate transport pod according to claim 12, wherein the gas circulation apparatus and/or the dehumidifying apparatus is controlled to operate by detecting that the door is closed or opened.

15. (Amended) A substrate transport pod according to claim 13, wherein the gas circulation apparatus and/or dehumidifying apparatus is controlled to operate in accordance with detection signal of the sensor for detecting a presence of said substrates.

16. (Amended) A substrate transport pod according to claim 11, wherein the pod is provided with a gas circulation apparatus in its interior space for circulating an internal gas.

17. (Amended) A substrate transport pod according to claim 11, wherein the pod is provided with a dehumidifying means in its interior space for removing moisture from an internal gas.

18. (Amended) A substrate transport pod according to claim 16 or 17, wherein the pod is provided with powering means for supplying electrical power to the gas circulation apparatus or the dehumidifying means.

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19. (Amended) A substrate transport pod according to claim 18, wherein the powering means comprises secondary batteries installed on the pod.

20. (Amended) A substrate transport pod according to claim 19, wherein the powering means is further provided for charging the secondary batteries.

21. (Amended) A substrate transport pod according to claim 18, wherein the powering means is constructed to be non-contacting and is operated electromagnetically.

22. (Amended) A substrate transport pod according to claim 18, wherein the powering means is constructed to be contacting through contacts.

23. (Amended) A substrate transport pod according to claim 18, wherein the powering means is provided at least on a load port of a manufacturing apparatus, in a storage facility or on a transport apparatus.

24. (Amended) A substrate transport pod according to claim 18, wherein powering is started as the pod is seated in the powering means.

25. (Amended) A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body;
a conductive part for contacting with the substrates directly or indirectly so as to enable static charges to be drained outside from the pod main body;
at least one of a particle filter, a chemical filter, and a dehumidifying apparatus for removing particulate substances, chemical substances, and moisture; and
a gas circulation apparatus for circulating an inner gas inside the pod.

26. (Amended) A substrate transport pod according to claim 25, wherein the filter and the gas circulation apparatus are formed as a unit in a form of a rod.

27. (Amended) A substrate transport pod according to claim 25, wherein a filter is cylinder shaped and the gas flows in a radial direction of the cylindrical filter.

28. (Amended) A substrate transport pod according to claim 25, wherein a filter is rod shaped and the gas flows in a longitudinal direction of the filter.

29. (Amended) A substrate transport pod according to any one of claims 26 through 28, wherein a ducting and/or a flow regulation apparatus is provided for guiding the gas, which is passed through the filter.

30. (Amended) A substance transport pod according to claim 16, wherein a flow regulation structure is provided for guiding the gas flow to the substrates.

31. (Amended) A substrate transport pod according to claim 8, wherein the pod has a gas intake opening and a gas discharge opening for the gas flowing inside the pod.

32. A substrate transport pod according to claim 31, wherein a reverse flow prevention mechanism is provided at least on the gas intake opening or the gas discharge opening.

33. A substrate transport pod according to claim 31, wherein a ducting and/or a flow regulation apparatus is provided to connect to the gas intake opening.

34. (Amended) A substrate transport pod according to claim 31, wherein at least one of a chemical filter, a particle filter and a dehumidifying apparatus is provided in a vicinity of the gas intake opening and/or a gas discharge opening.

35. A substrate transport pod according to claim 11, wherein a center of gravity of the pod is adjusted in a horizontal direction within a circle having a radius of at least 90 % or preferably 70 % of a radius of substrates.

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36. A substrate transport pod according to claim 11, wherein the pod is provided with an internal environment matching a processing atmosphere for substrates contained in the pod, and is used to transport the substrates between a plurality of processes.

37. (Amended) A substrate transport apparatus comprising:

a substrate transport pod that can be sealed hermetically for holding substrates therein, which are taken out from a processing apparatus;
at least one of a particle filter, a chemical filter, and a dehumidifying apparatus for removing, respectively, particulate substances, chemical substances, and moisture from a gas circulated inside the pod;
a gas circulation apparatus for circulating a purified gas or purge means;
a holding apparatus for holding the substrates;
data storing means for controlling an operation of the dehumidifying apparatus and the circulation apparatus; and
a power supply for driving the dehumidifying apparatus and/or the circulation apparatus and the data storing means.

38. (Amended) An apparatus according to claim 37, further comprising:

an identifier ID for distinguishing individual pods; and
means for sending and receiving control information with outside data storing means.

39. (Amended) An apparatus according to claim 38, wherein a change of control information for electrical driving portion is conducted by communication with outside data storing means by signal input/output portion.

40. (Amended) An apparatus according to claim 38, wherein a change of processing history management information is conducted by signal input/output portion by sending and receiving information with outside data storing means.

41. (Amended) An apparatus according to claim 38, wherein a change of lot history information is conducted by signal input/output portion by sending and receiving information with outside data storing means.

42. (Amended) An apparatus according to claim 37, wherein a washing interval for the pod is managed by information stored in memory means of the pod.

43. (Amended) An apparatus according to claim 38, wherein a washing interval, a filter change interval, or information of secondary battery is managed by signal input/output portion by sending and receiving information with outside data storing means.

44. (Amended) An apparatus according to claim 37, wherein a washing interval of the pod is managed by an information stored in data memory means of the pod.

45. (Amended) An apparatus according to claim 42, wherein a filter change interval of the pod is managed from a product of a processed gas volume and an operation time of the circulation apparatus or the dehumidifying apparatus.

46. (Amended) An apparatus according to claim 44, wherein a washing interval is estimated from an operation time of the circulation apparatus.

47. An apparatus according to claim 37, wherein residual power of the secondary batteries provided for the pod is measured, and charging is carried out to a necessary level of the power.

48. (Amended) An apparatus according to claim 38, wherein management of information on individual pods is carried out by sending and receiving information for individual pods by wire or radio transmission through a network.

49. (Amended) A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body; and

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a moisture aversion part including at least one of filter, dehumidifying apparatus, and circulation apparatus, being detachable for washing.

50. (Amended) An apparatus according to claim 38, wherein information on the pod to be washed is sent to a pod washing machine so that the pod can be selected and subjected to washing.

51. (Amended) A method according to claim 1, wherein a level of ammonia in an interior atmosphere of the pod is maintained below a given level when the pod contains substrates whose surfaces are resist-coated.

52. (Amended) A method according to claim 51, wherein an ammonia level in interior of the pod is controlled by adsorbing ammonia gas by means of a chemical filter.

53. (Amended) A substrate transport pod according to claim 49, wherein the pod is washable by a pod washing machine after detaching the moisture aversion part and attaching a plate.

54. (Amended) A method according to claim 1, wherein the pod is provided with a contaminant removal means and target components are selectively chosen for removing particulate contaminants, metallic contaminants, ionic contaminants, organic contaminants and moisture, and the pod is used for return transport for each process.

55. A method for manufacturing a semiconductor device by transporting substrates between a plurality of processes, comprising:

loading the substrates into a pod from an atmosphere of a first process;
circulating a gaseous atmosphere through interior of the pod in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, to expose the substrates to a controlled atmosphere intermittently or continually while the substrates are retained in the pod; and
unloading the substrates from the pod and introducing the substrates into a second process.

56. (Added) A method according to claim 1, wherein the pod is used in wiring process in which copper wiring and low dielectric insulation film are used.

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FIG. 1A

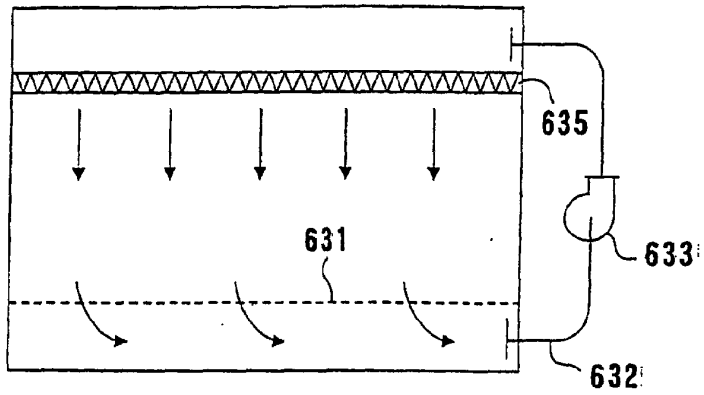


FIG. 1B

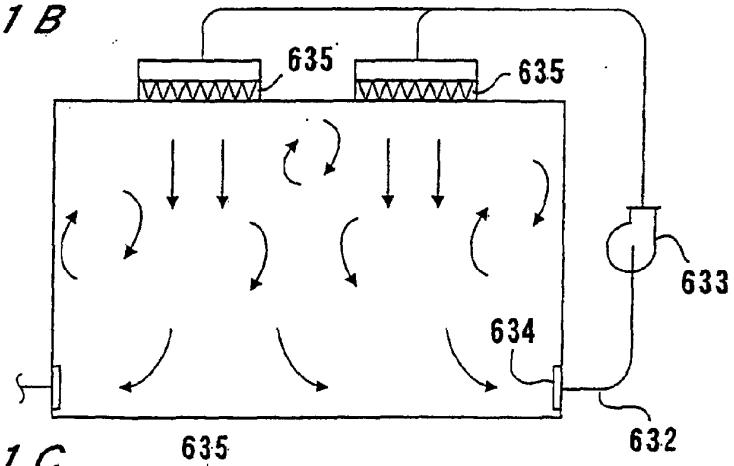
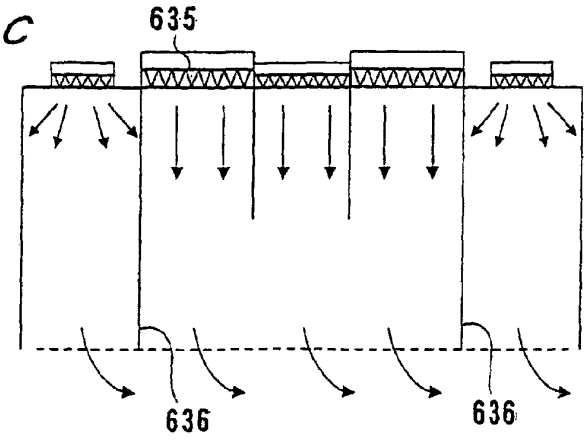
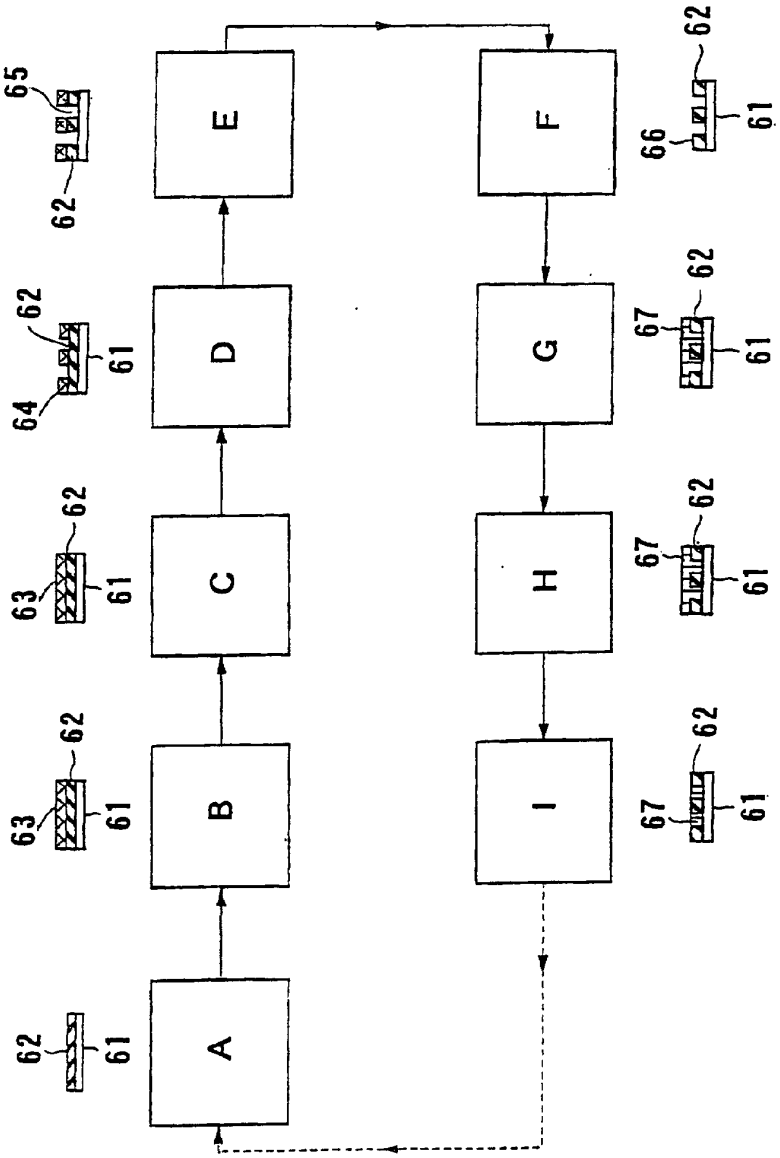


FIG. 1C



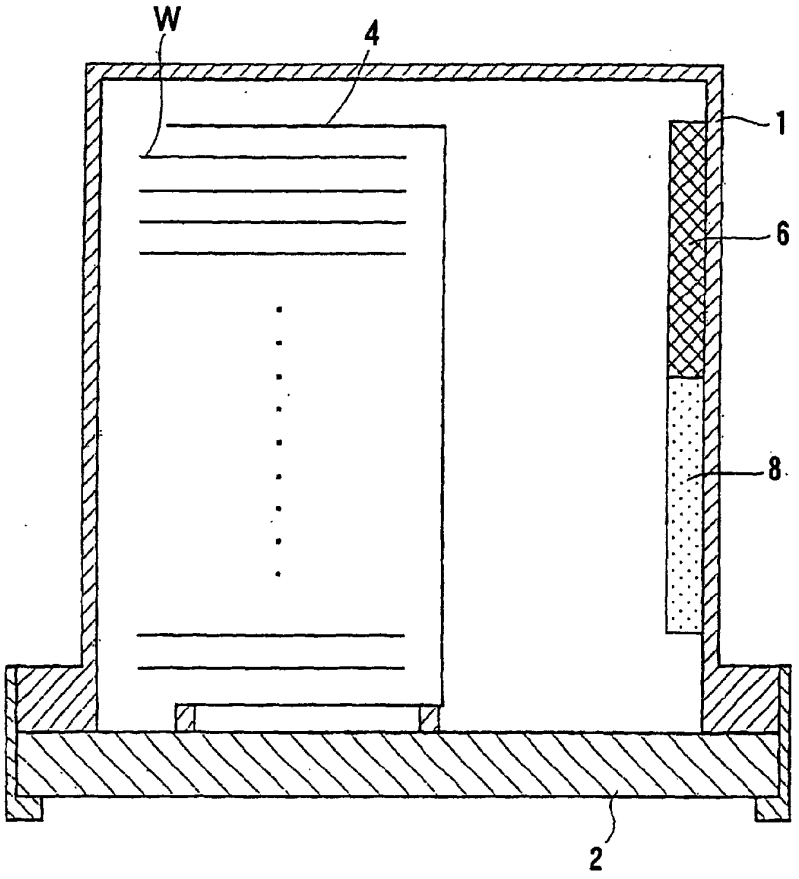
Entegris, EX1002, p. 297

FIG. 2



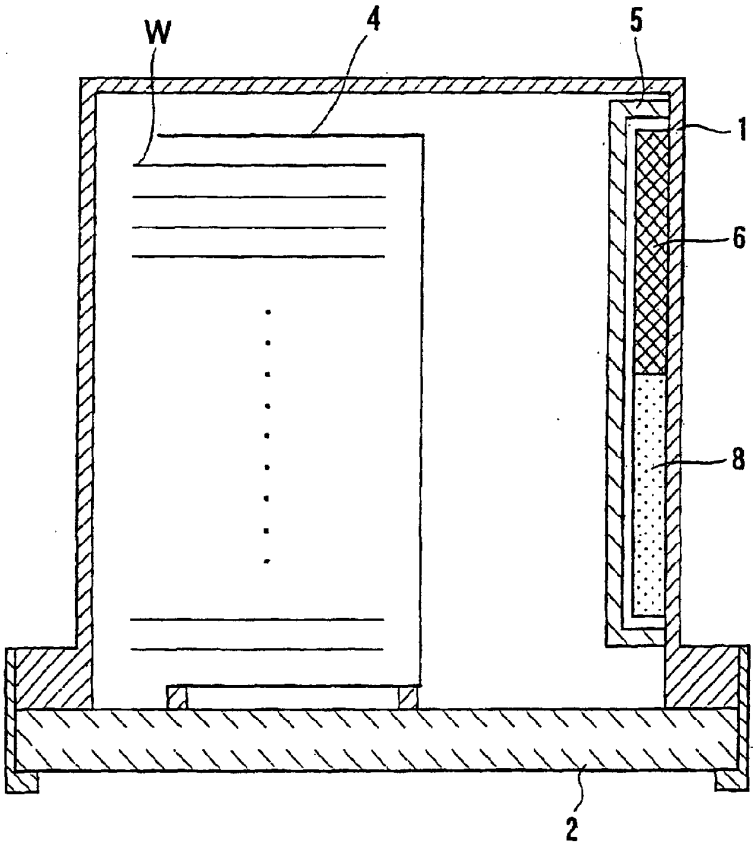
Entegris, EX1002, p. 298

FIG. 3



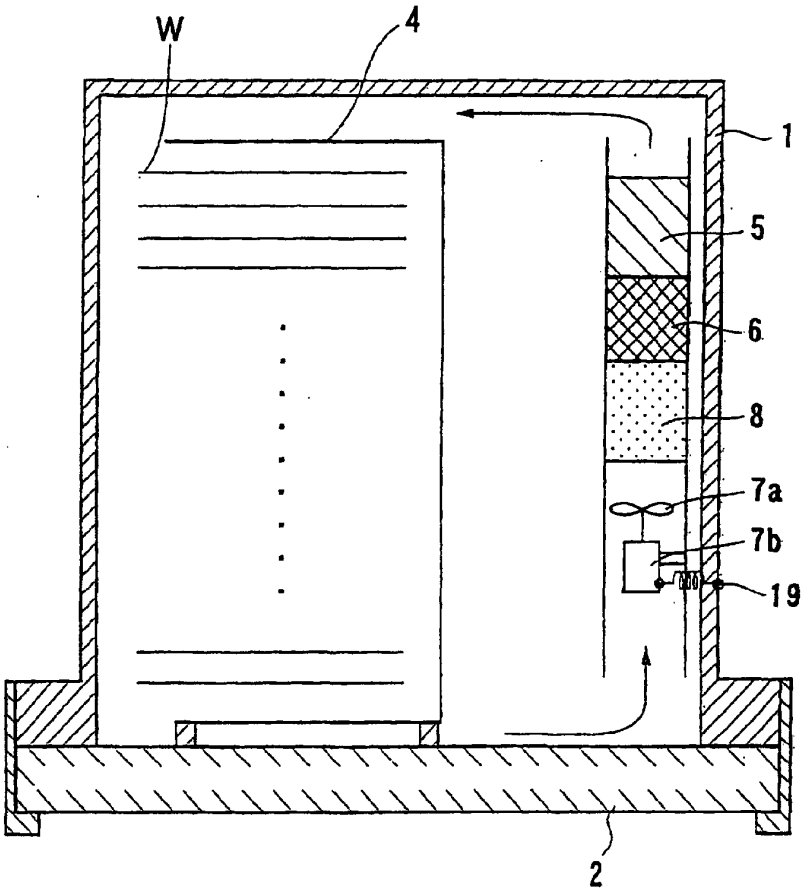
Entegris, EX1002, p. 299

FIG. 4



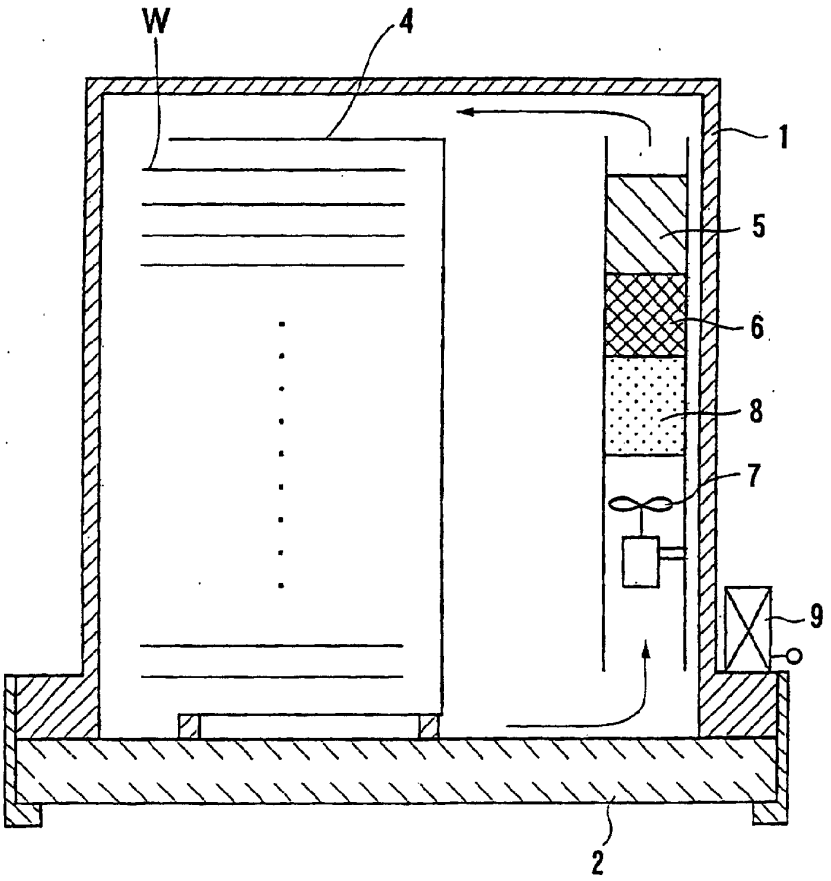
Entegris, EX1002, p. 300

FIG. 5



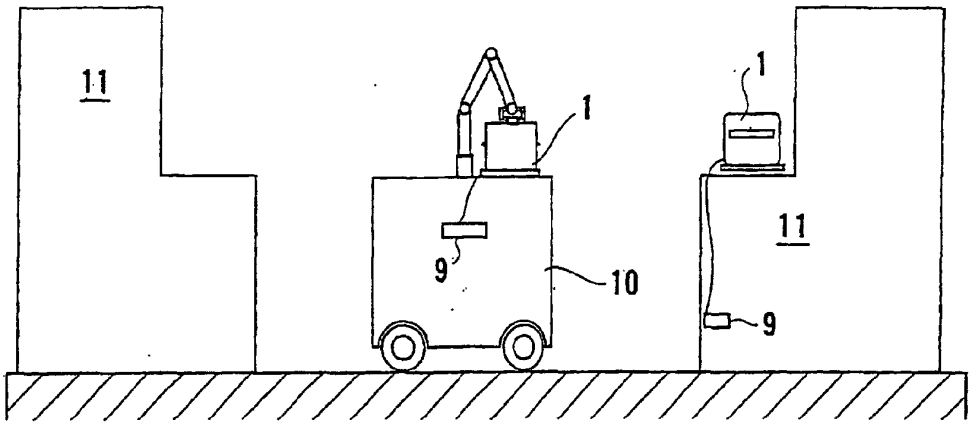
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FIG. 6



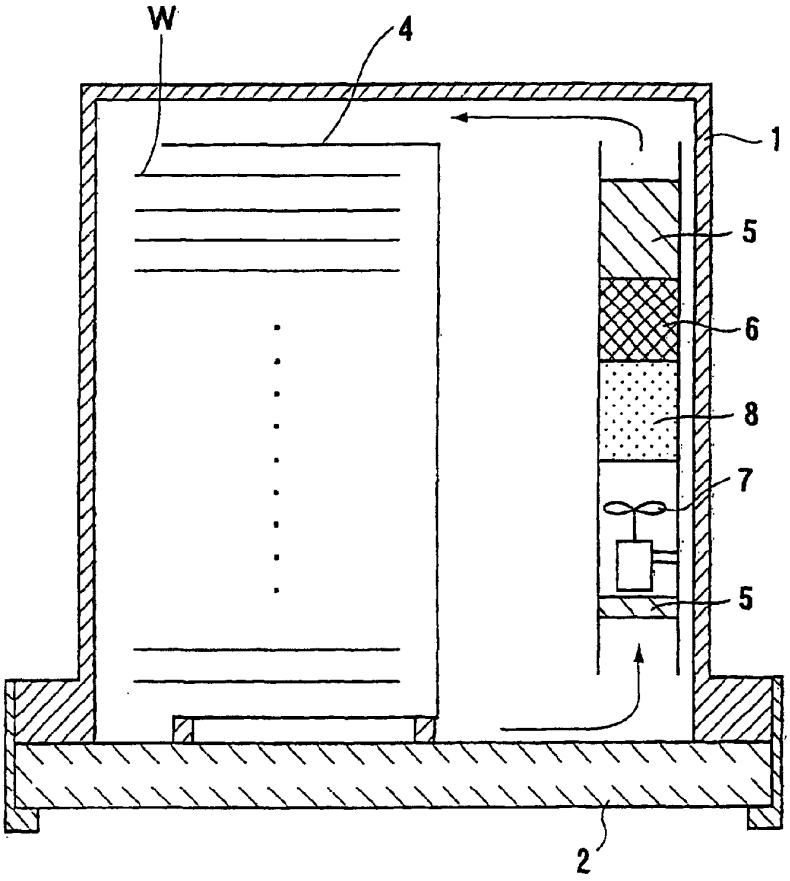
Entegris, EX1002, p. 302

FIG. 7



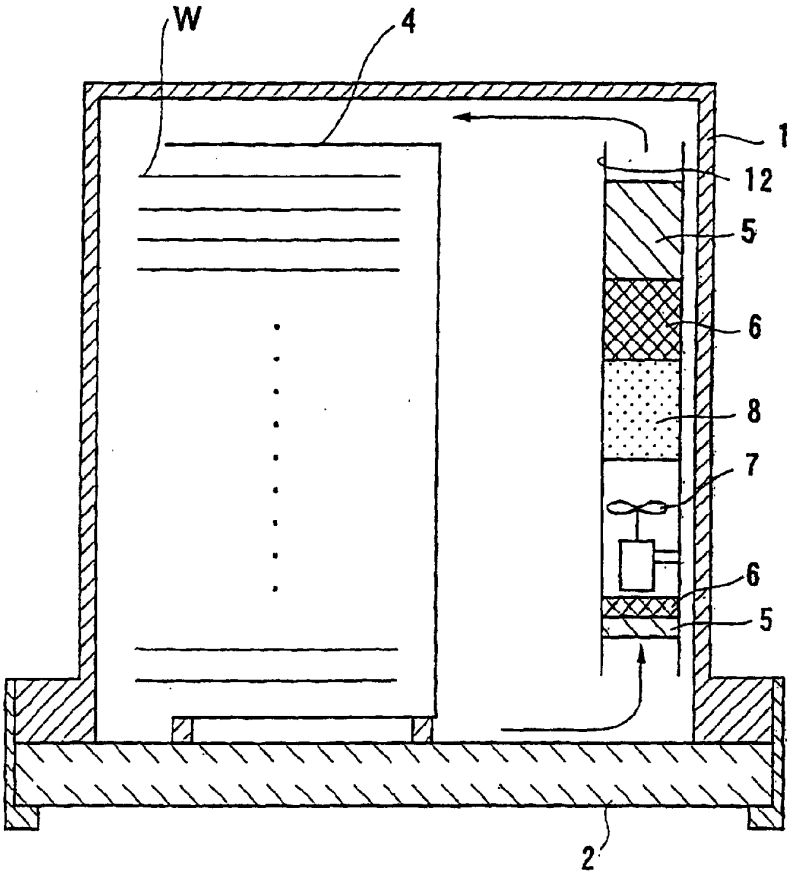
Entegris, EX1002, p. 303

FIG. 8



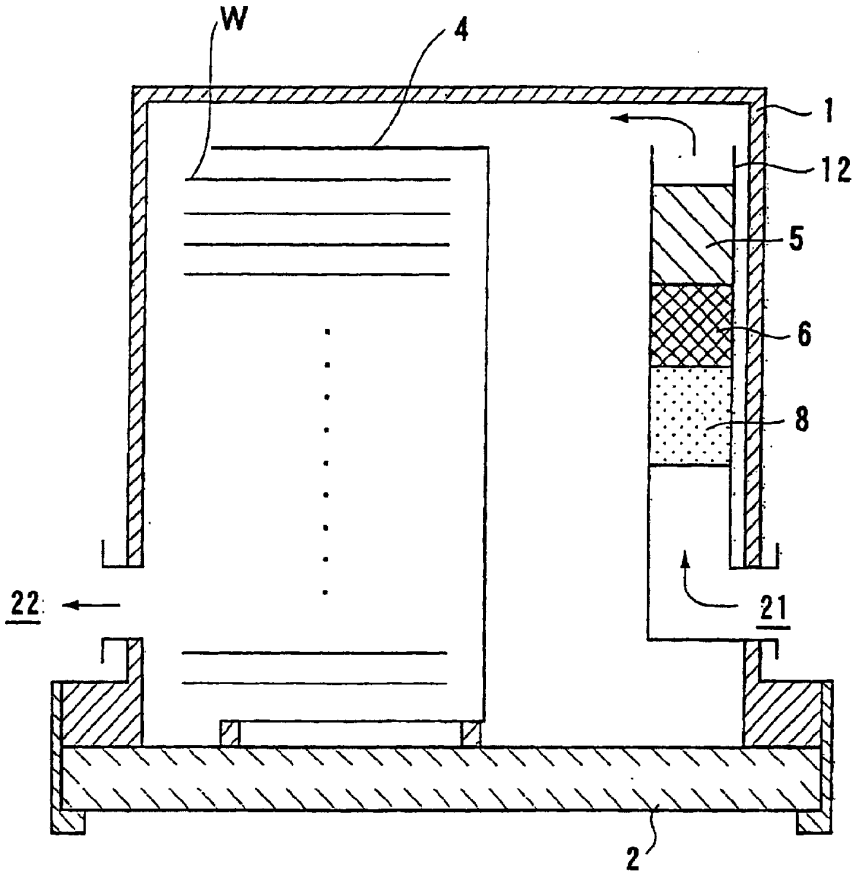
Entegris, EX1002, p. 304

FIG. 9



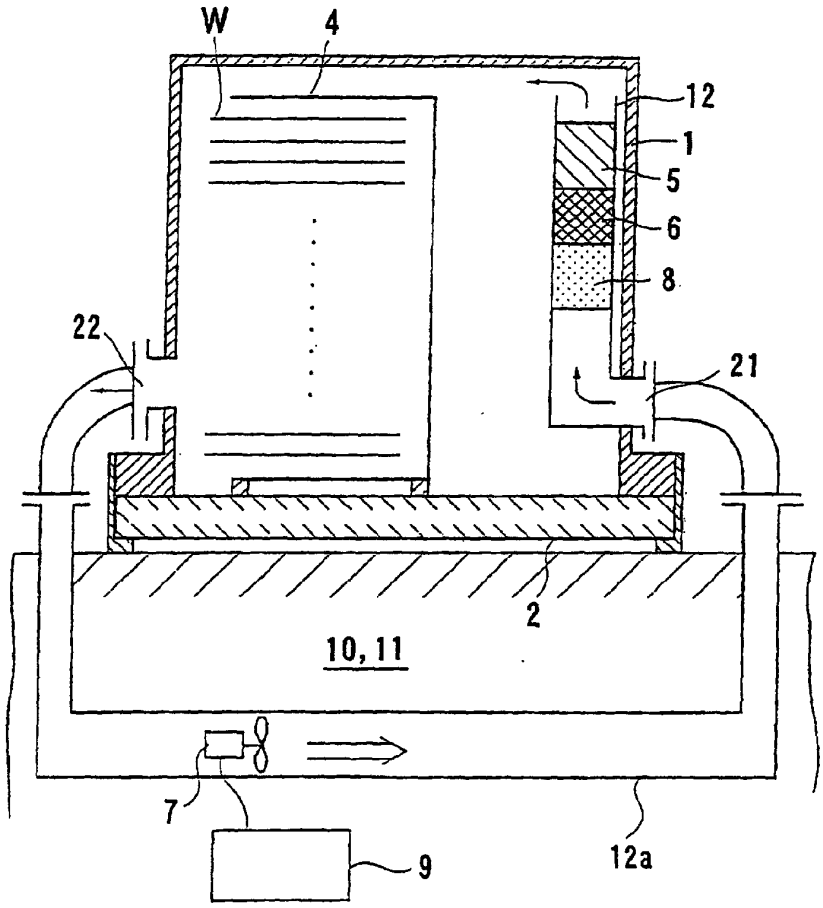
Entegris, EX1002, p. 305

FIG. 10



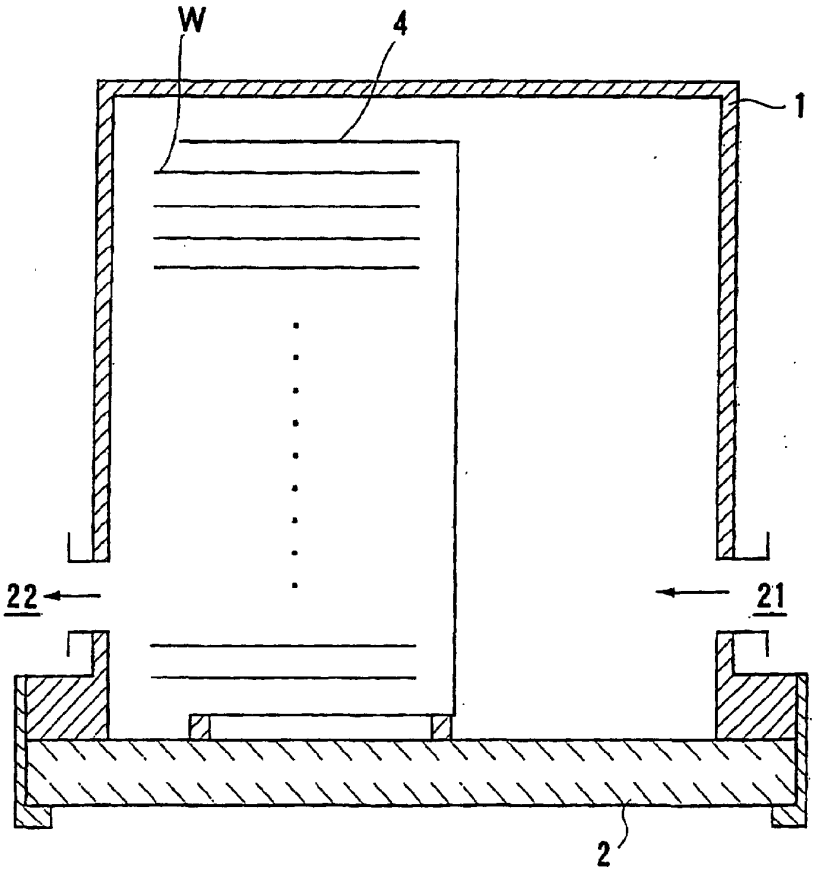
Entegris, EX1002, p. 306

FIG. 11



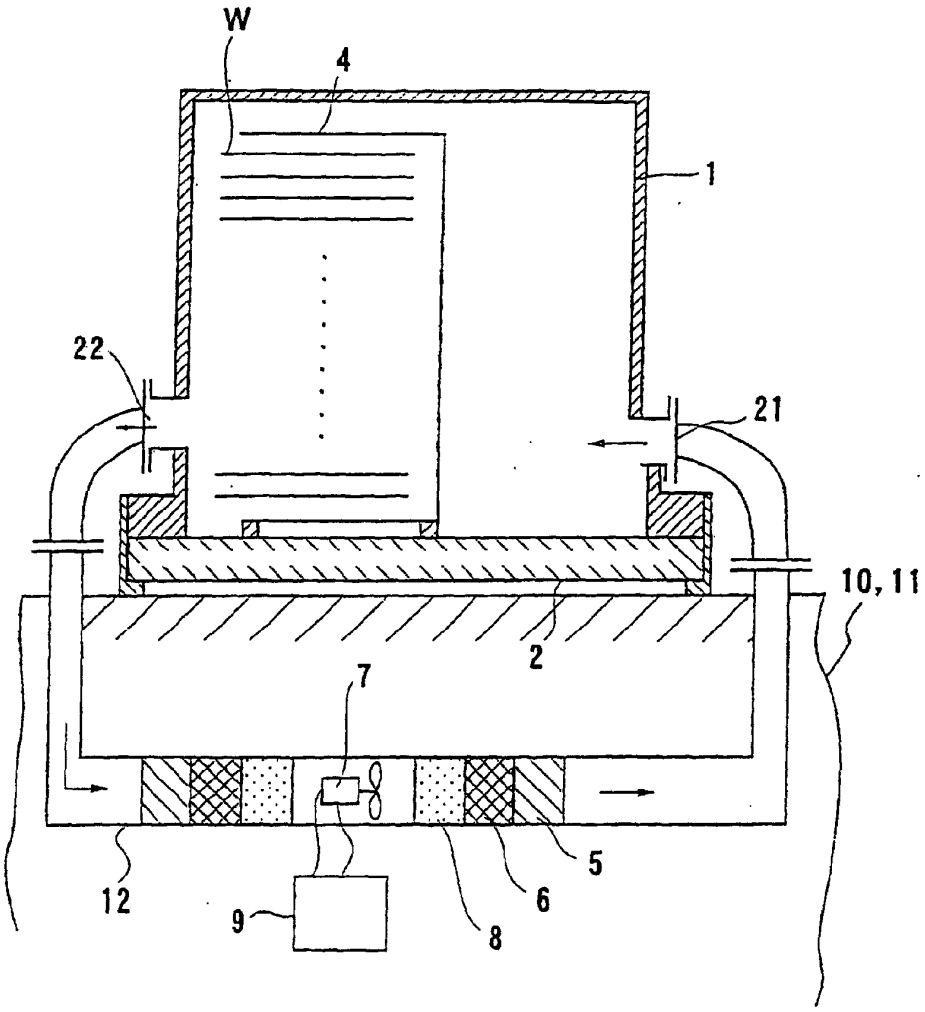
Entegris, EX1002, p. 307

FIG. 12



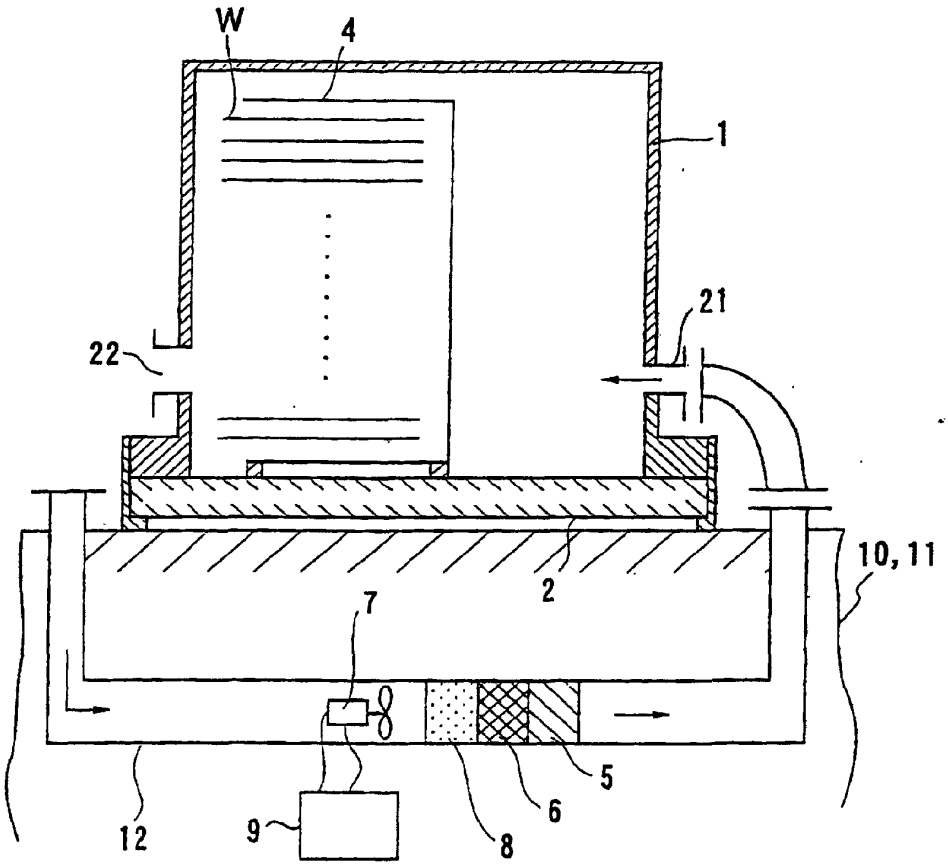
Entegris, EX1002, p. 308

FIG. 13



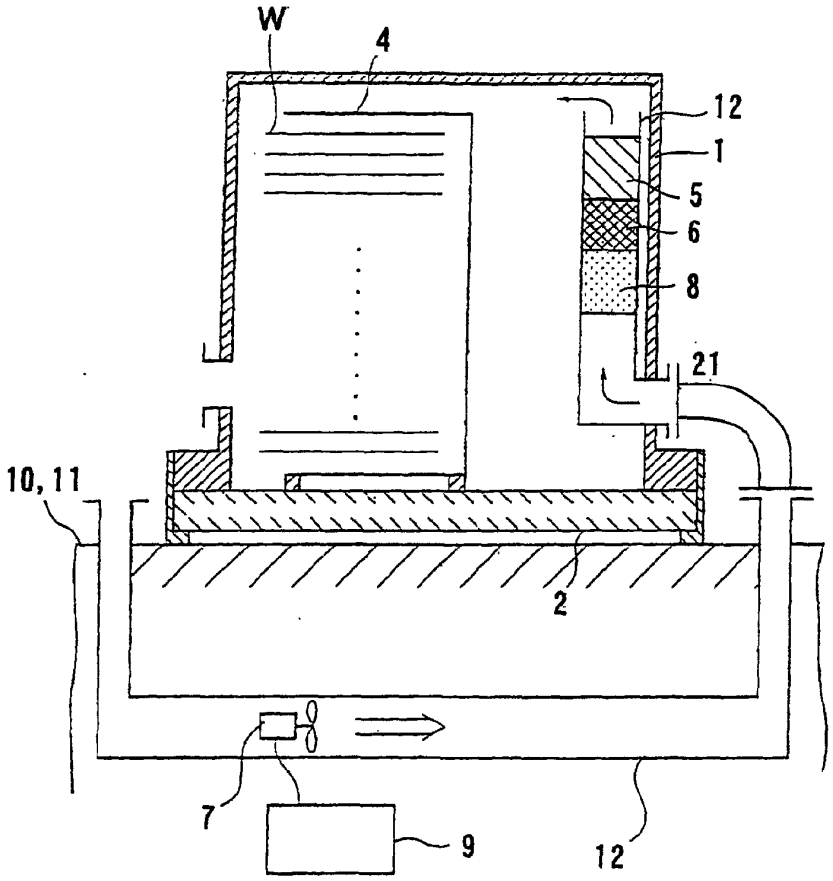
Entegris, EX1002, p. 309

FIG. 14



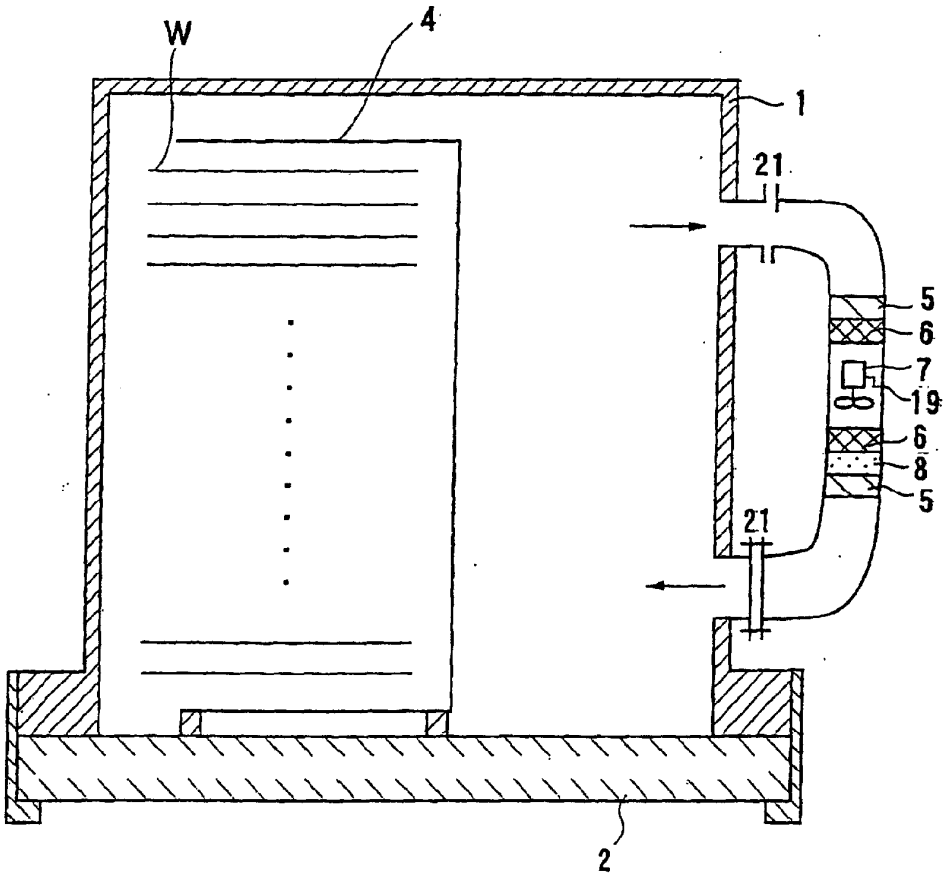
Entegris, EX1002, p. 310

FIG. 15



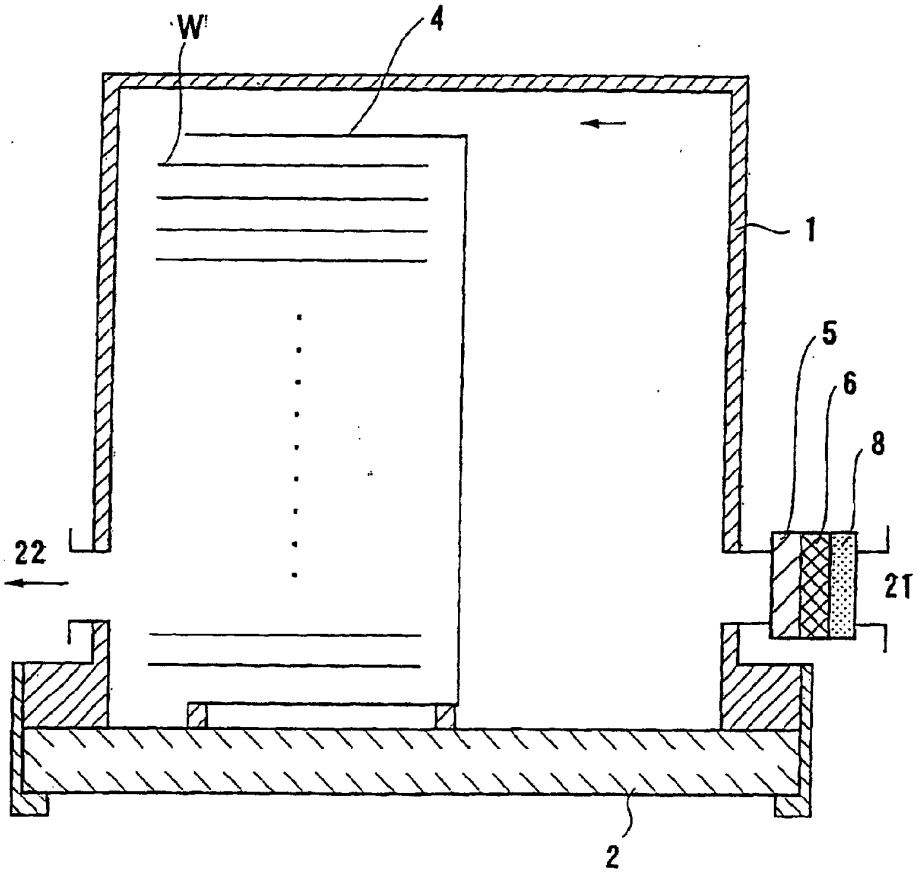
Entegris, EX1002, p. 311

FIG. 16



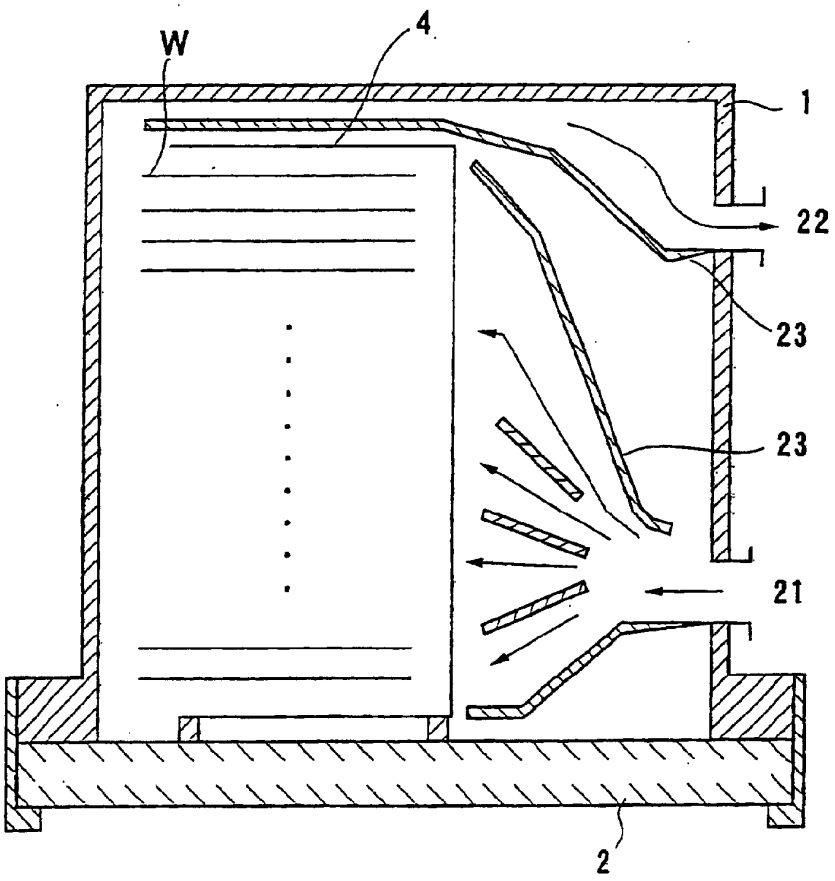
Entegris, EX1002, p. 312

FIG. 17



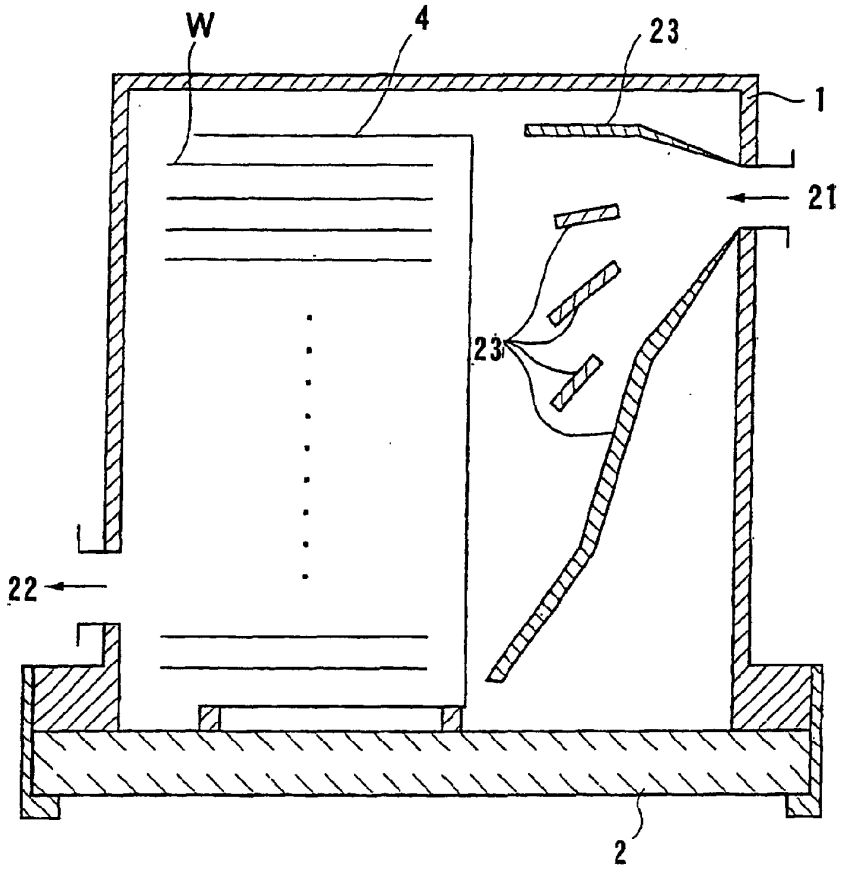
Entegris, EX1002, p. 313

FIG. 18



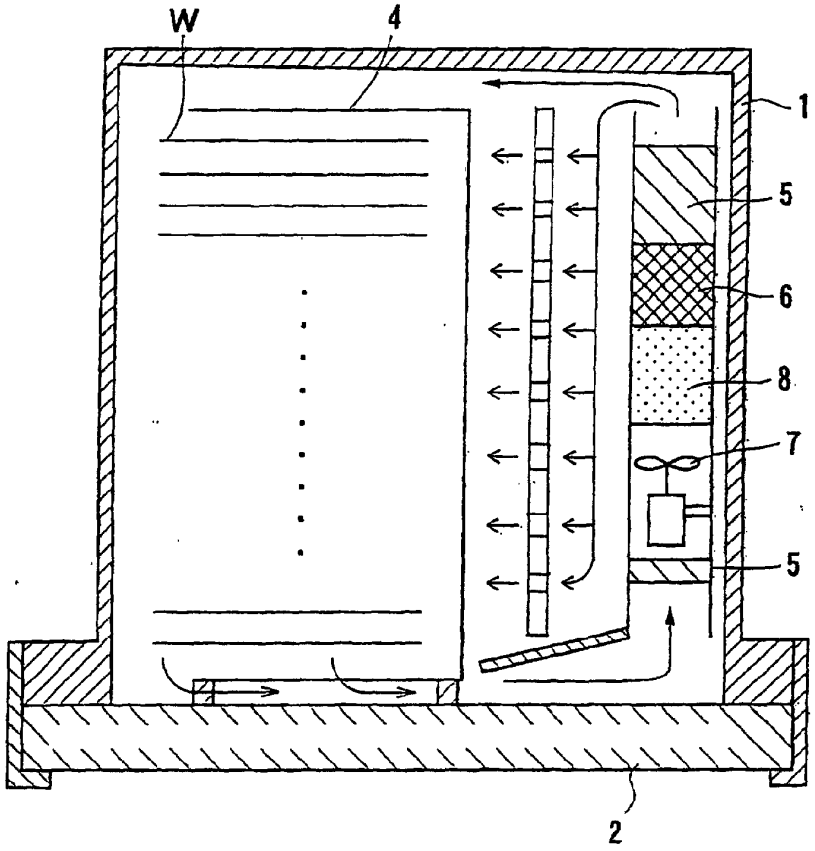
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FIG. 19



Entegris, EX1002, p. 315

FIG. 20



Entegris, EX1002, p. 316

FIG. 21A

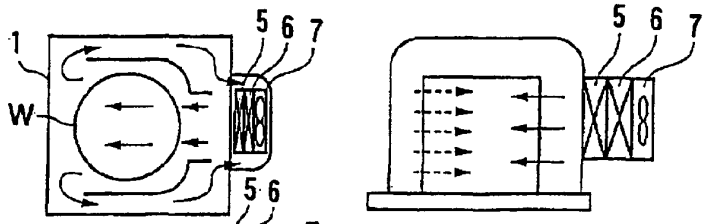


FIG. 21B

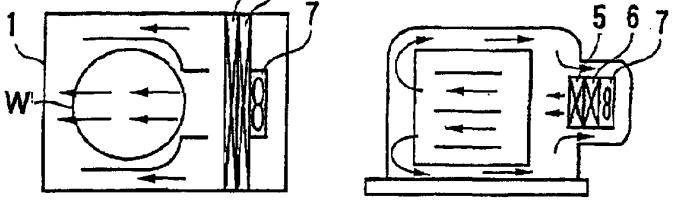


FIG. 21C

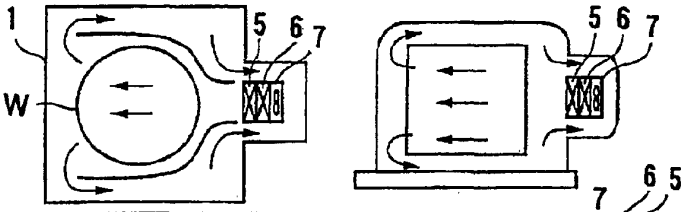


FIG. 21D

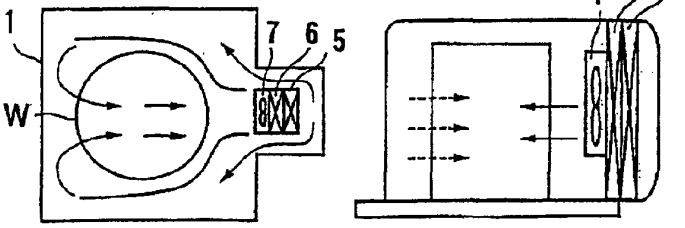


FIG. 21E

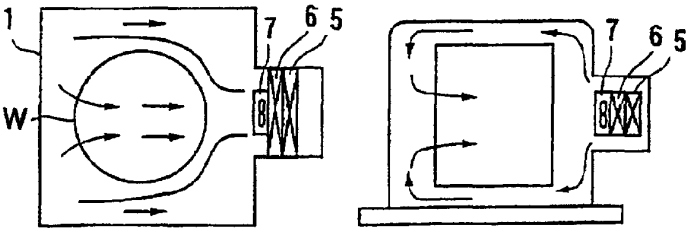
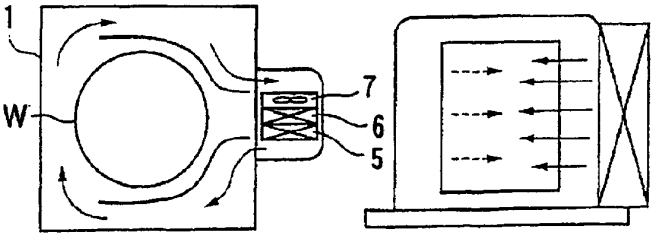
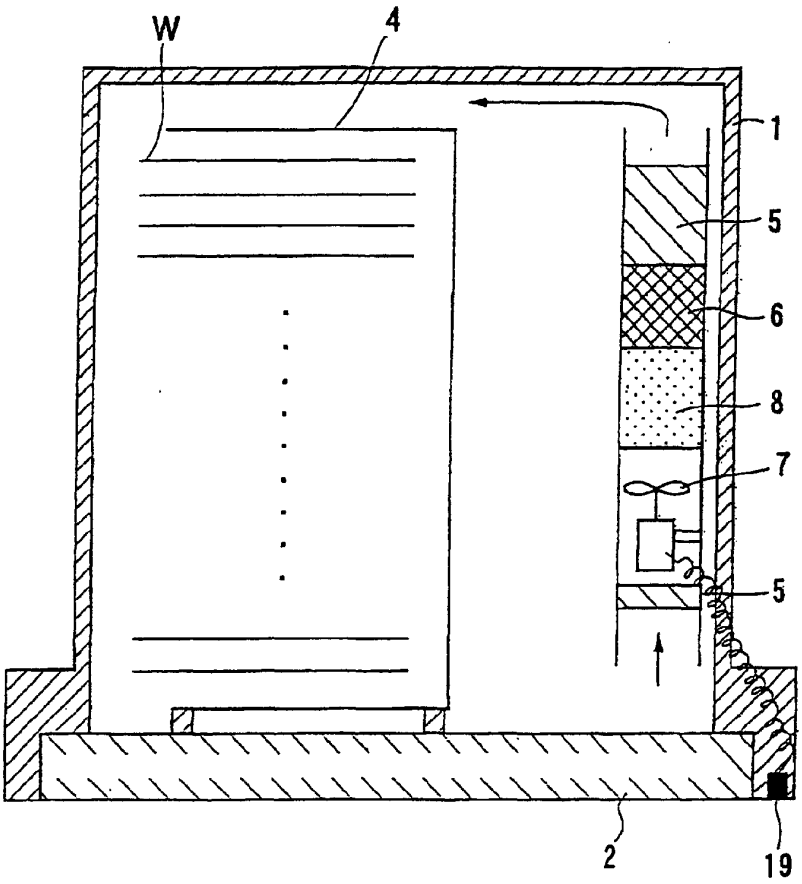


FIG. 21F



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FIG. 22



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FIG. 23A

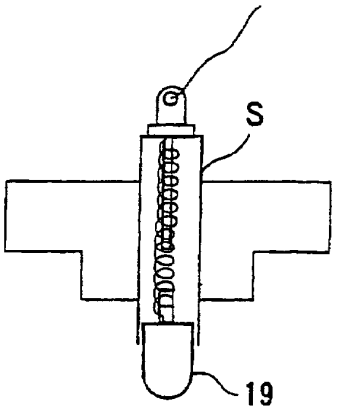
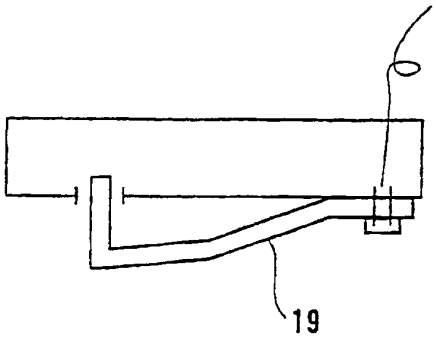
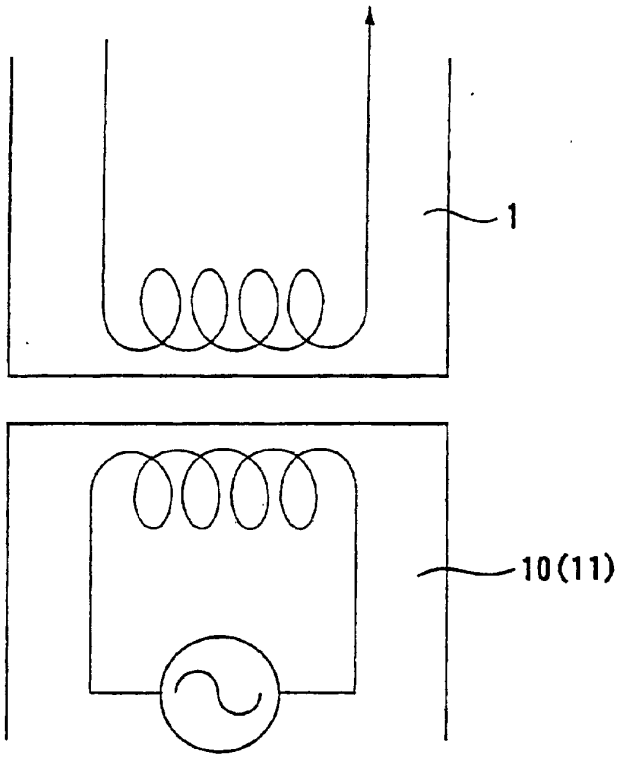


FIG. 23B



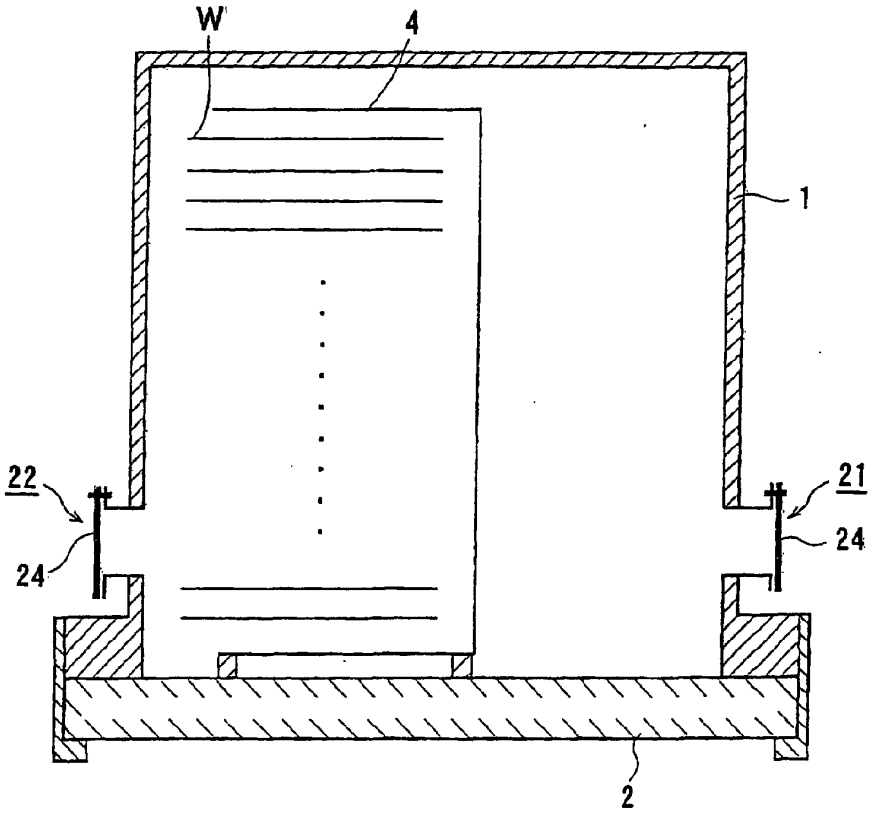
Entegris, EX1002, p. 319

FIG. 24



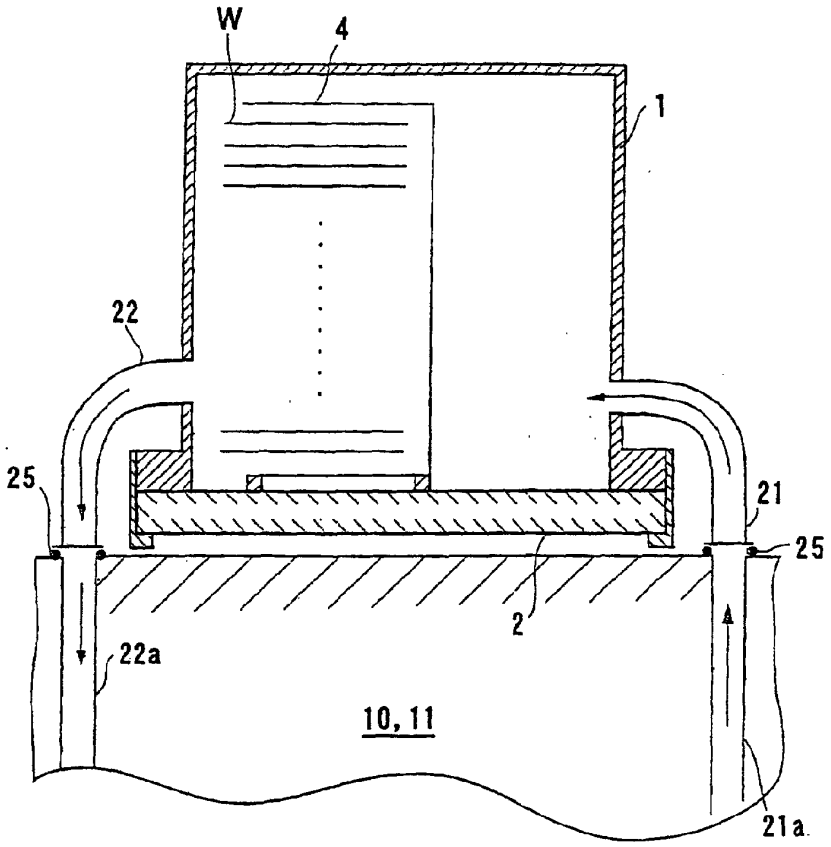
Entegris, EX1002, p. 320

FIG. 25



Entegris, EX1002, p. 321

FIG. 26



Entegris, EX1002, p. 322

FIG. 27A

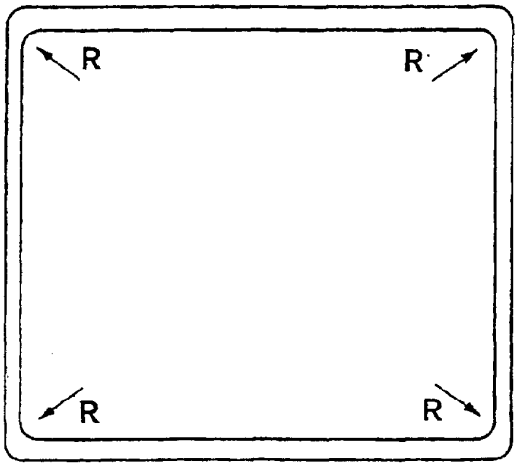
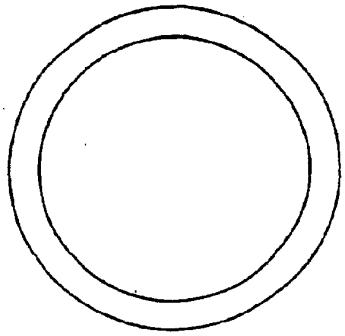
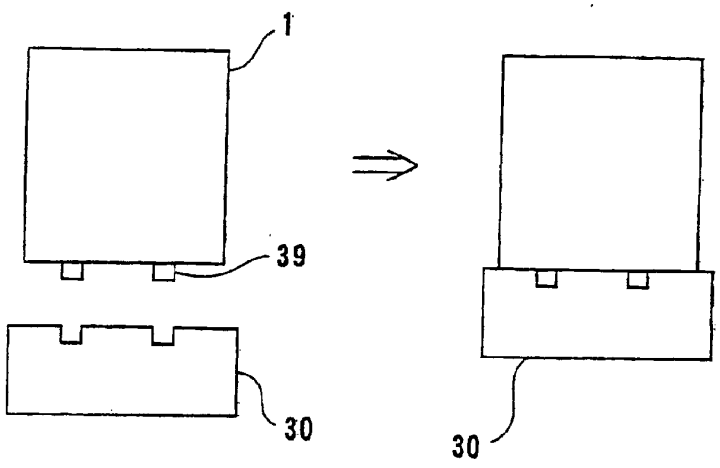


FIG. 27B



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FIG. 28



Entegris, EX1002, p. 324

FIG. 29A

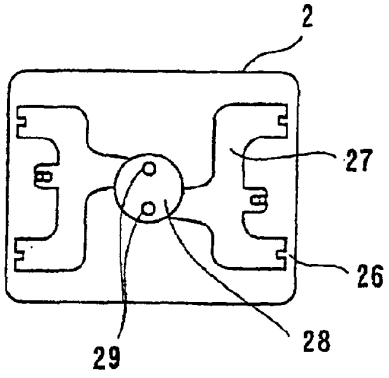


FIG. 29B

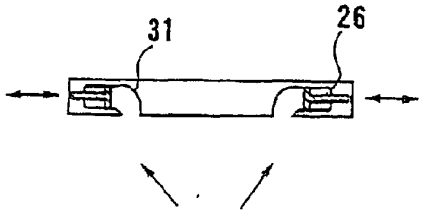


FIG. 29C

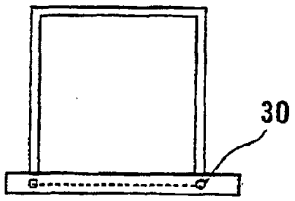


FIG. 29D

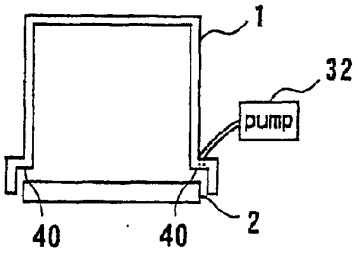


FIG. 29E

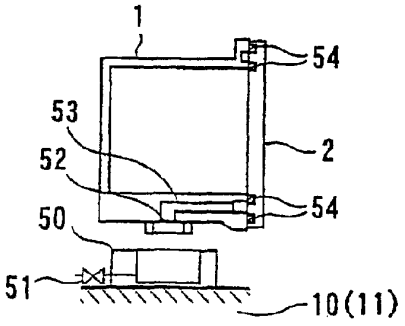
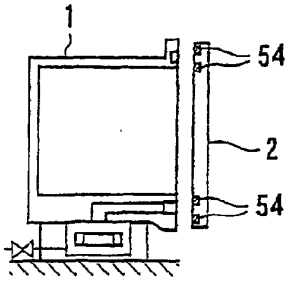
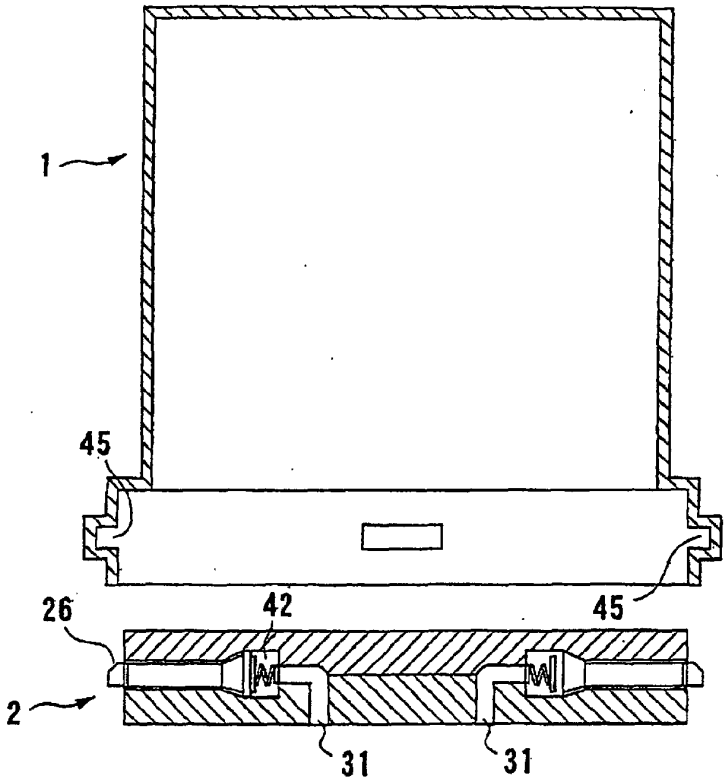


FIG. 29F



Entegris, EX1002, p. 325

FIG. 30



Entegris, EX1002, p. 326

FIG. 31A

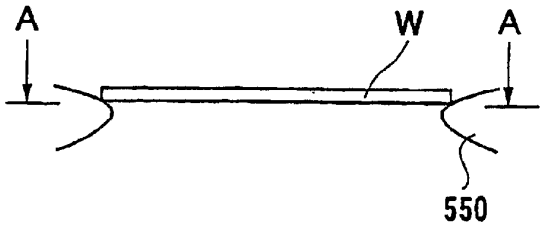
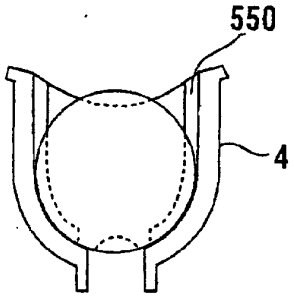


FIG. 31B



Entegris, EX1002, p. 327

FIG. 32A

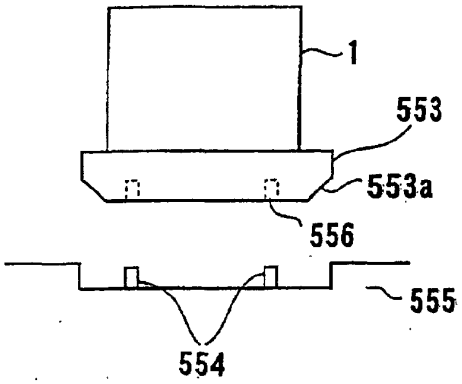


FIG. 32B

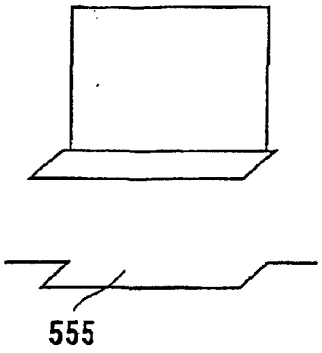
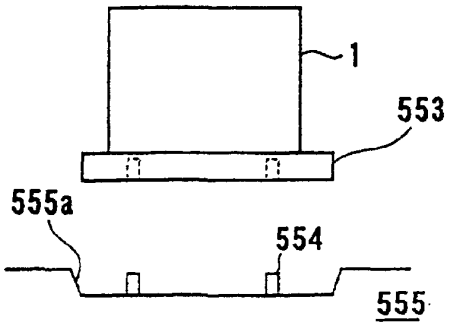


FIG. 32C



Entegris, EX1002, p. 328

FIG. 33A

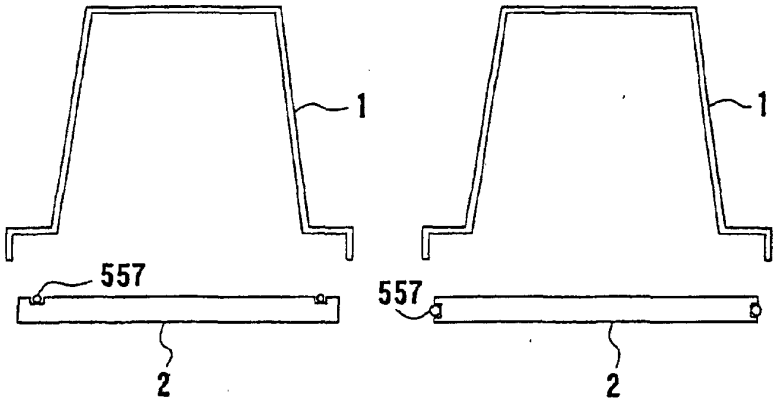
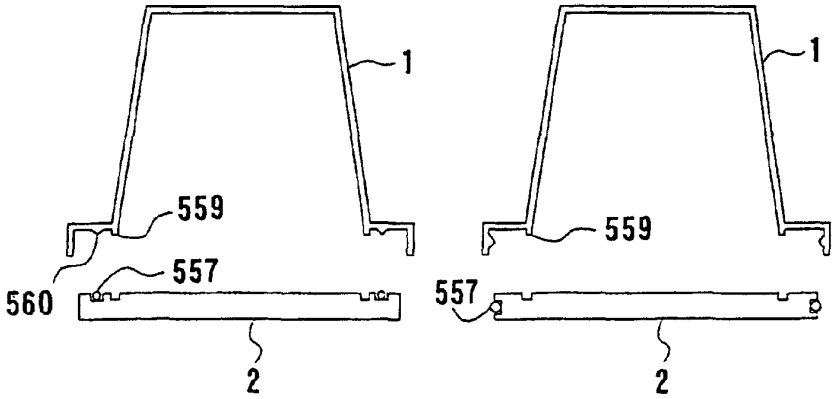


FIG. 33B



Entegris, EX1002, p. 329

FIG. 34A

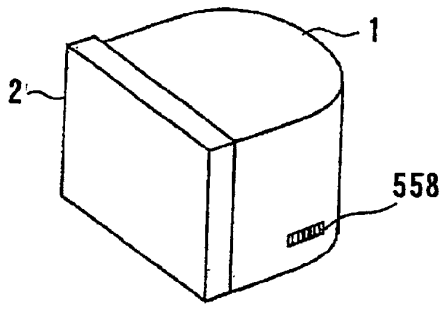
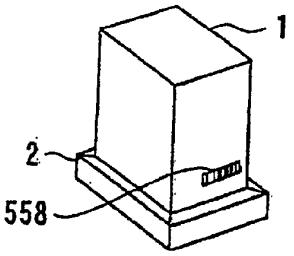


FIG. 34B



Entegris, EX1002, p. 330

FIG. 35A

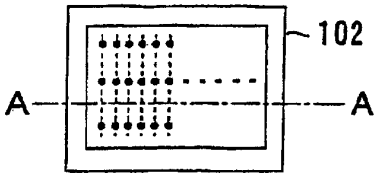


FIG. 35B

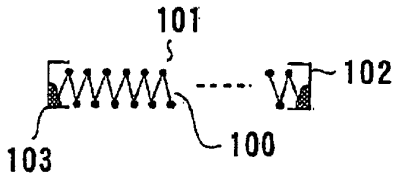


FIG. 35C



Entegris, EX1002, p. 331

FIG. 36A

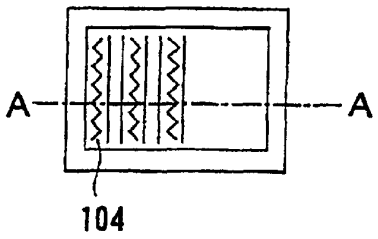


FIG. 36B

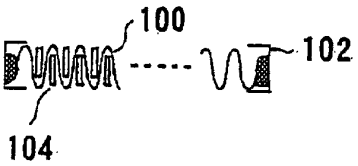
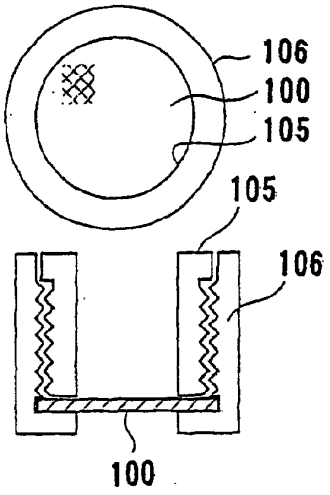


FIG. 36C



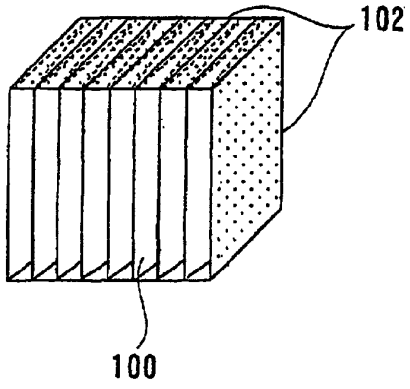
Entegris, EX1002, p. 332

FIG. 37



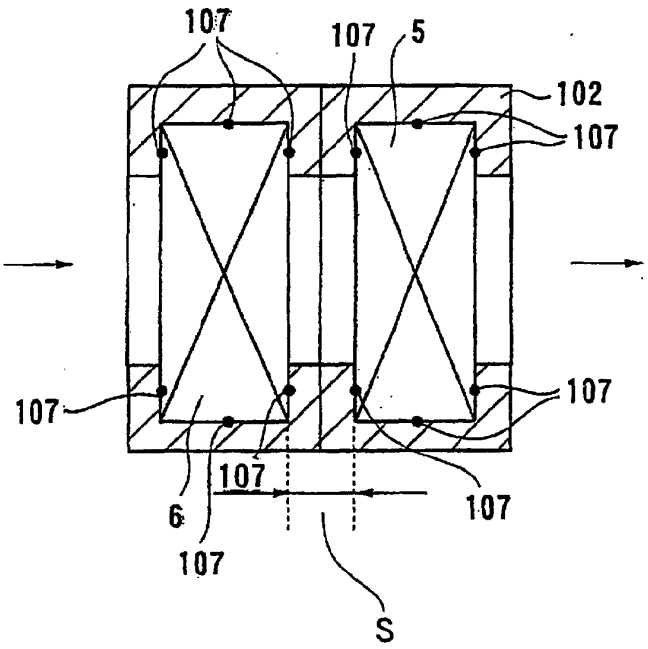
Entegris, EX1002, p. 333

FIG. 38



Entegris, EX1002, p. 334

FIG. 39



Entegris, EX1002, p. 335

FIG. 40A

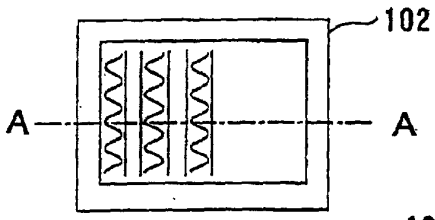


FIG. 40B

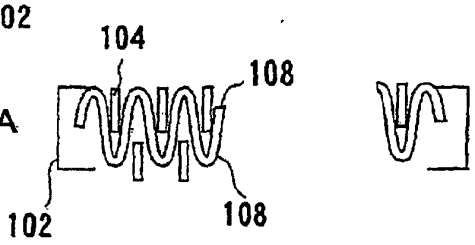
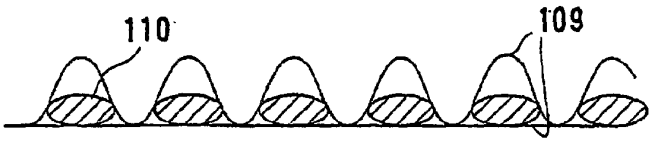


FIG. 40C



Entegris, EX1002, p. 336

FIG. 41



Entegris, EX1002, p. 337

FIG. 42A

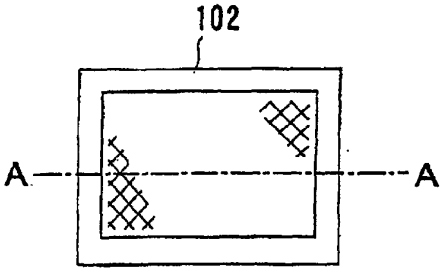


FIG. 42B

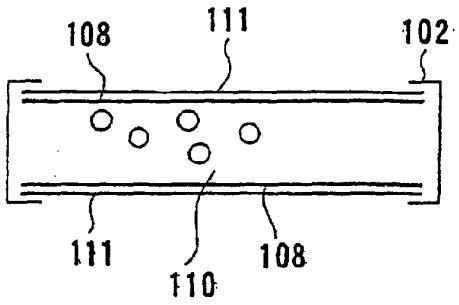


FIG. 42C



Entegris, EX1002, p. 338

FIG. 43A

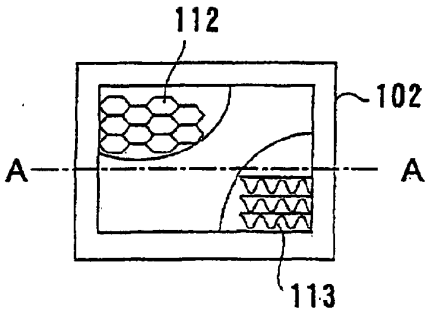


FIG. 43B

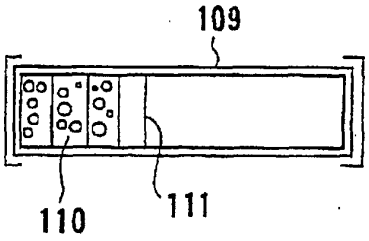


FIG. 43C



Entegris, EX1002, p. 339

FIG. 44A

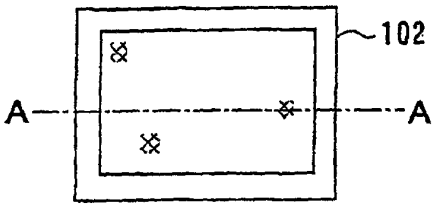


FIG. 44B

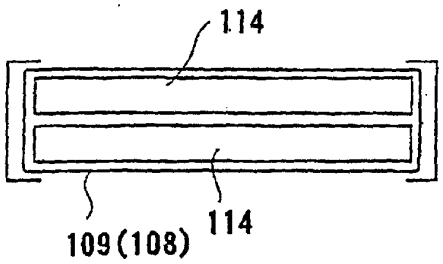


FIG. 44C



Entegris, EX1002, p. 340

FIG. 45A

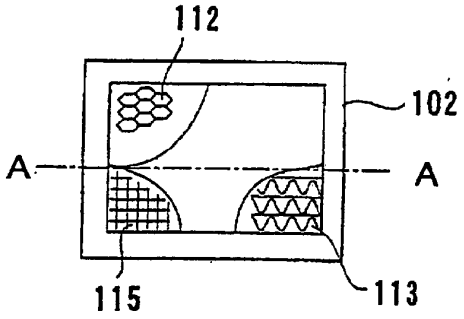
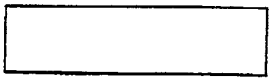


FIG. 45B



Entegris, EX1002, p. 341

FIG. 46A

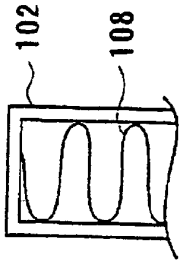


FIG. 46B

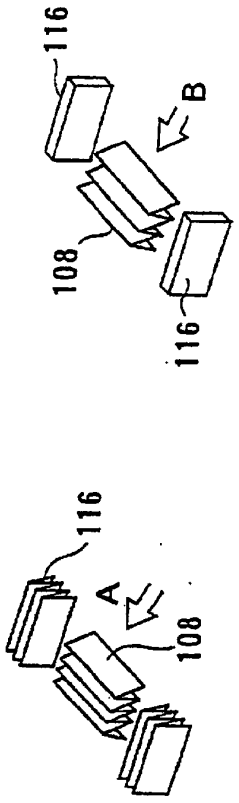
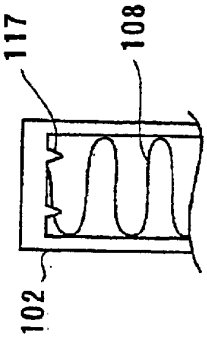
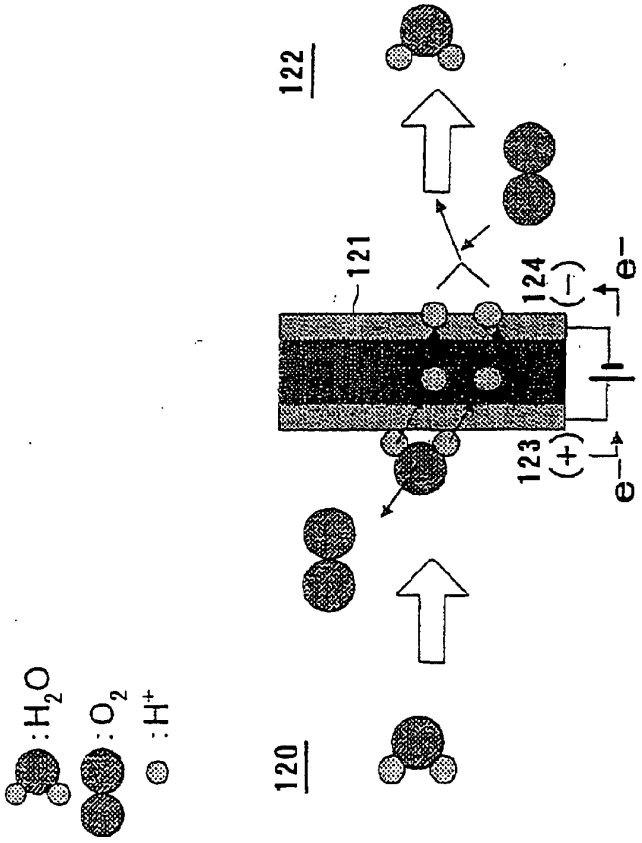


FIG. 46C



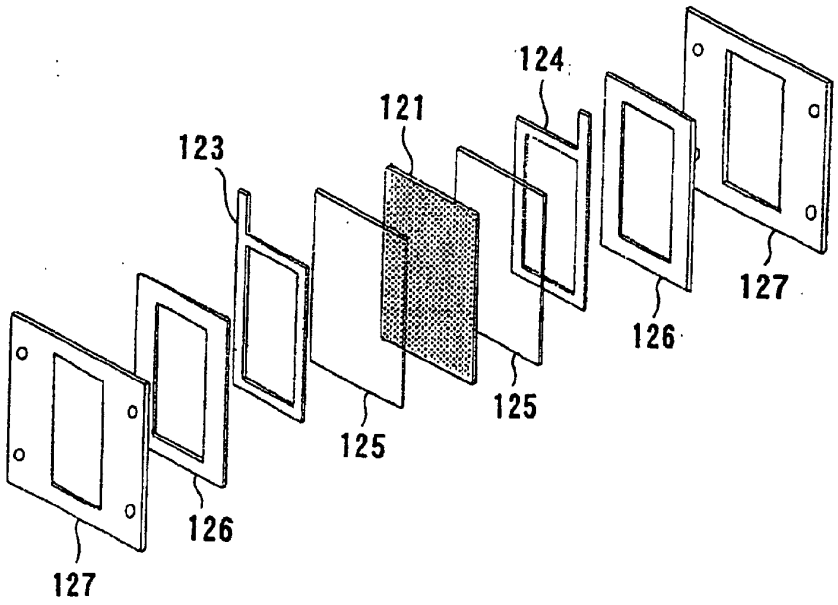
Entegris, EX1002, p. 342

FIG. 47



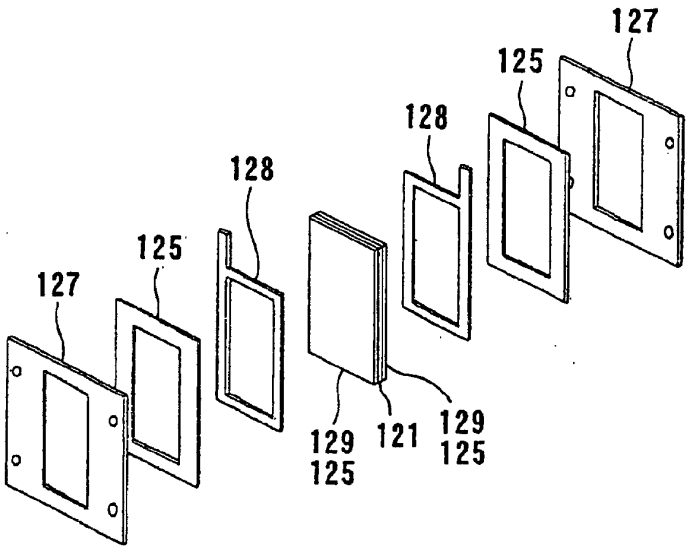
Entegris, EX1002, p. 343

FIG. 48



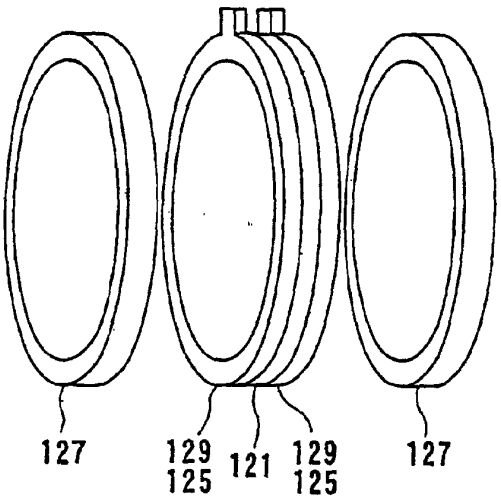
Entegris, EX1002, p. 344

FIG. 49



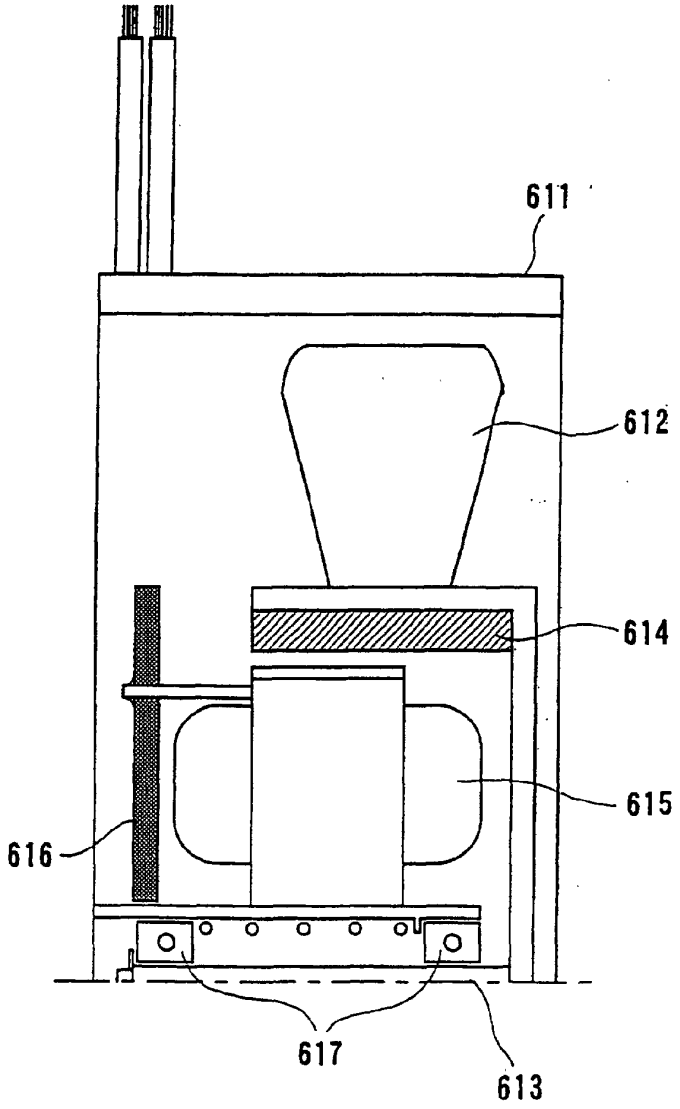
Entegris, EX1002, p. 345

FIG. 50



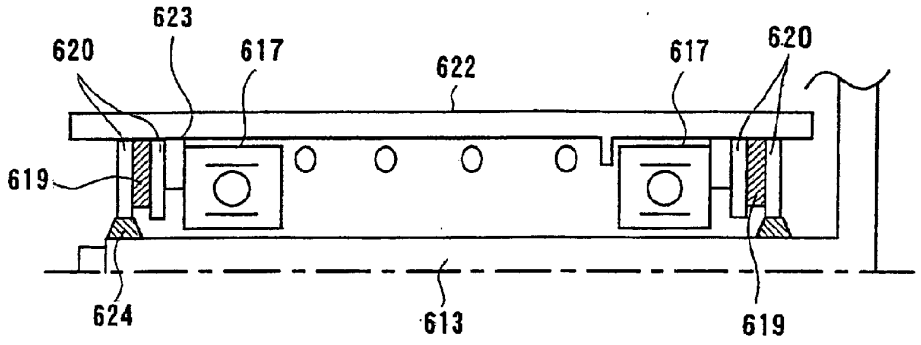
Entegris, EX1002, p. 346

FIG. 51



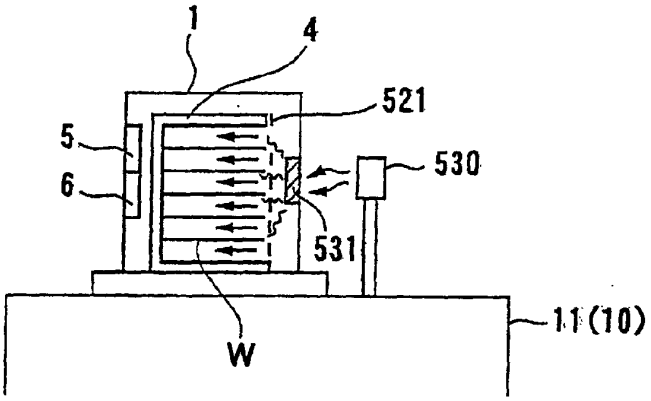
Entegris, EX1002, p. 347

FIG. 52



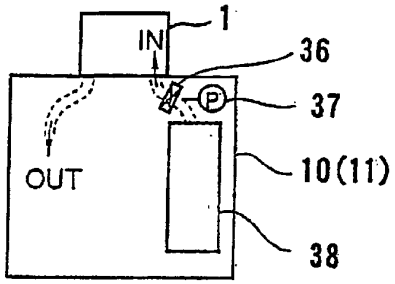
Entegris, EX1002, p. 348

FIG. 53



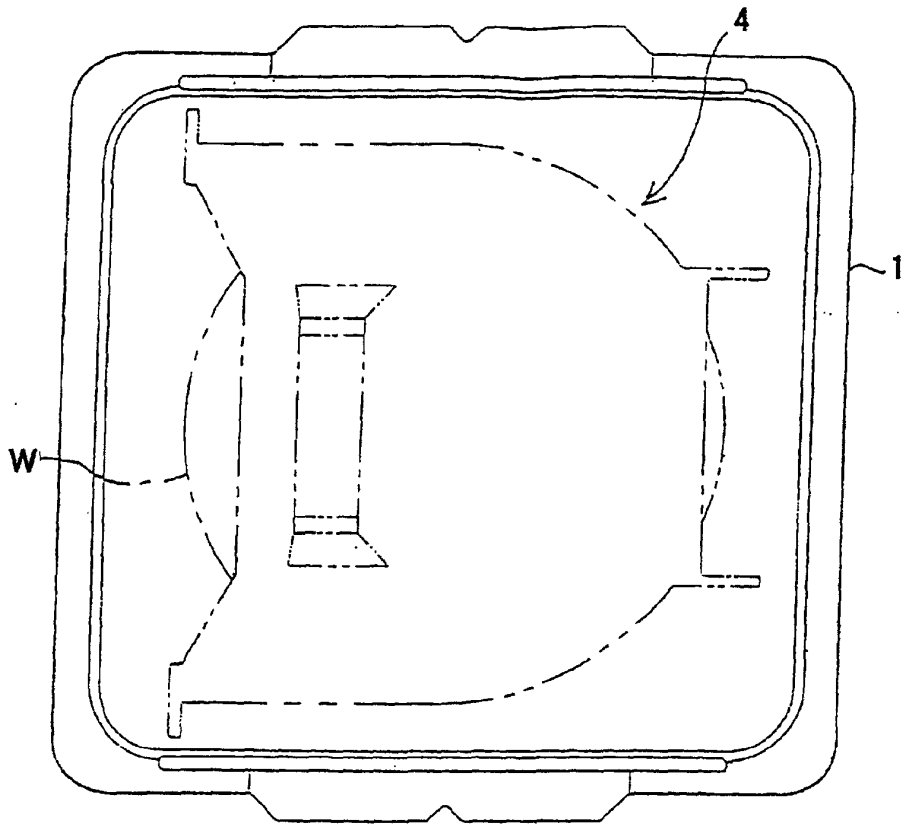
Entegris, EX1002, p. 349

FIG. 54



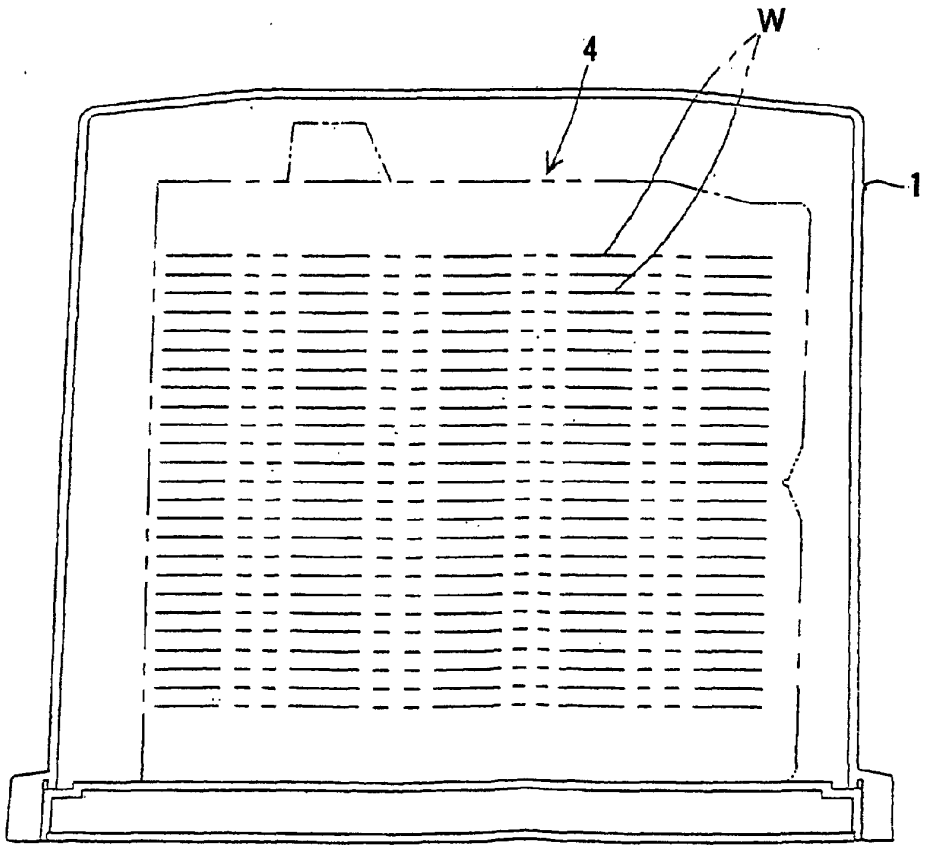
Entegris, EX1002, p. 350

FIG. 55



Entegris, EX1002, p. 351

FIG. 56



Entegris, EX1002, p. 352

FIG. 57A

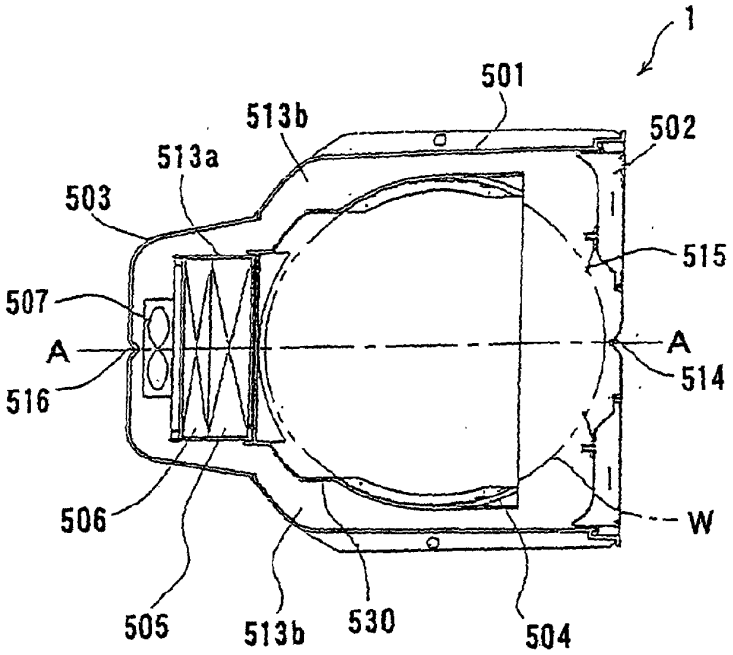
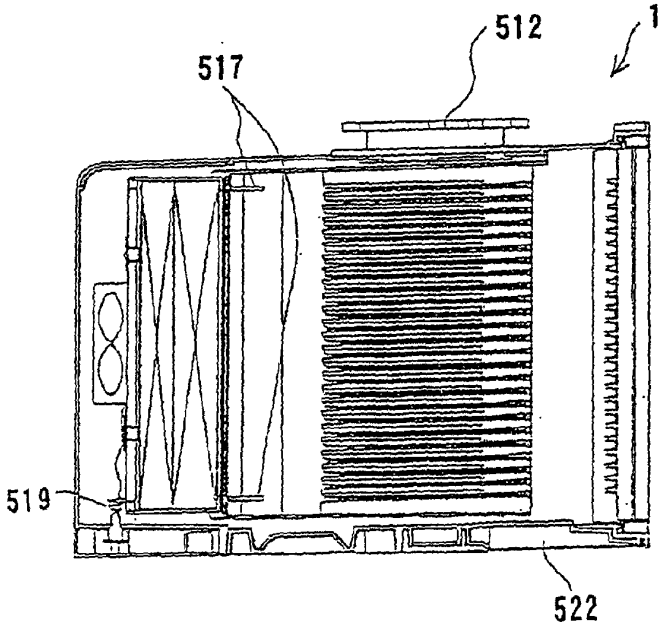


FIG. 57B



Entegris, EX1002, p. 353

FIG. 58A

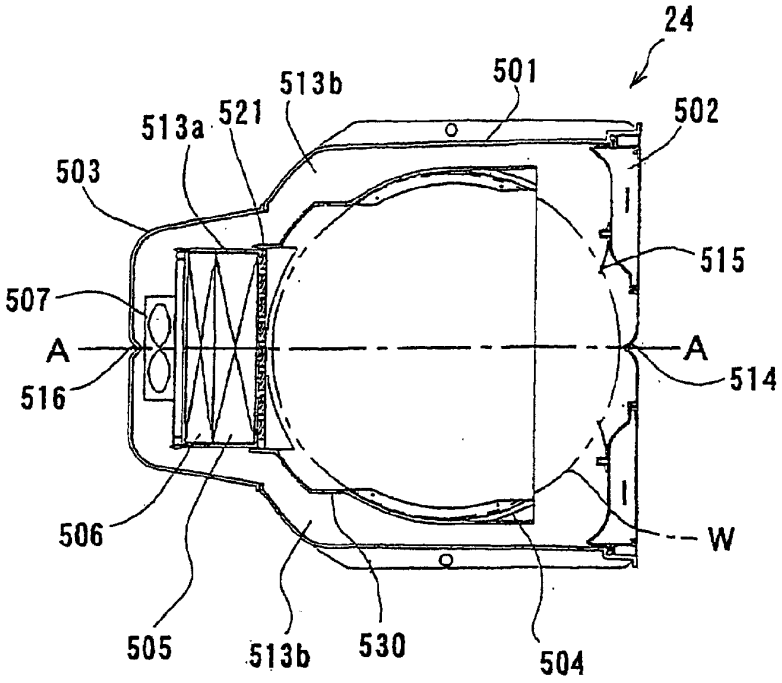
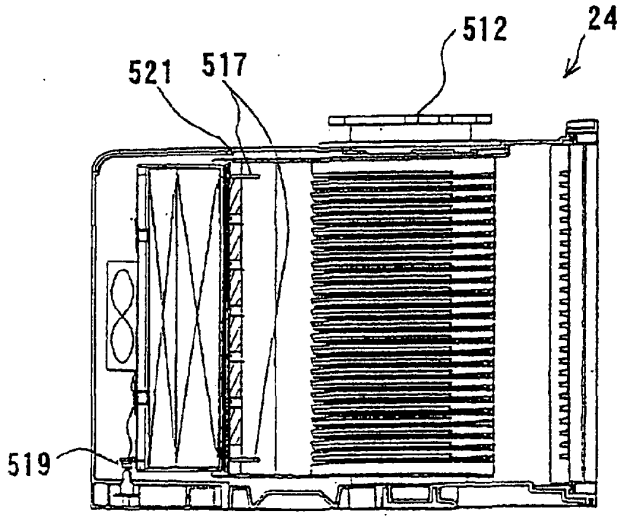


FIG. 58B



Entegris, EX1002, p. 354

FIG. 59A

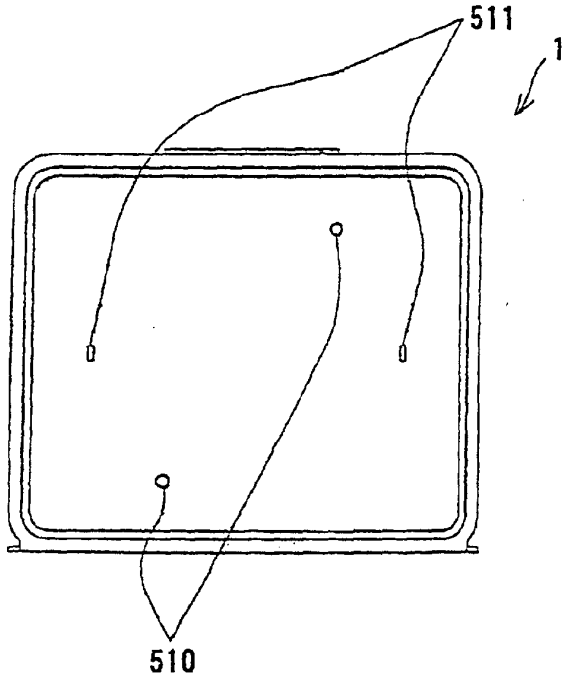
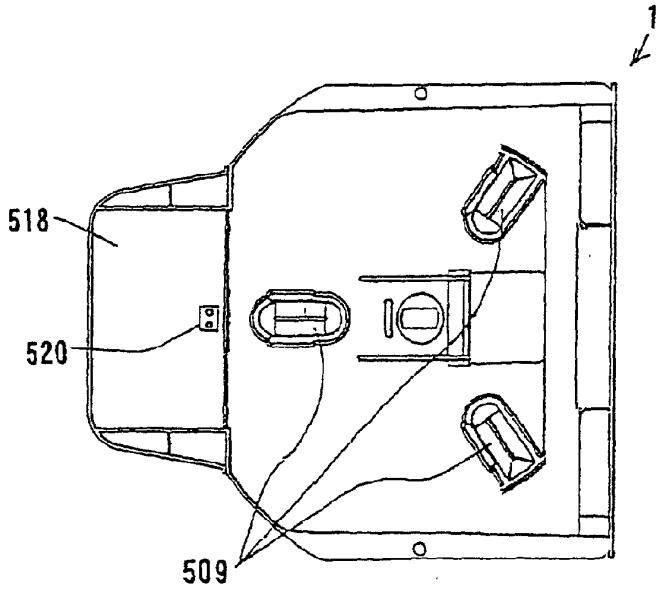


FIG. 59B



Entegris, EX1002, p. 355

FIG. 60A

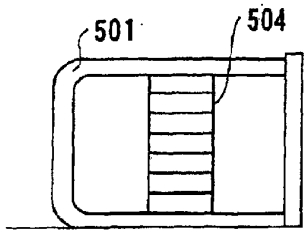


FIG. 60B

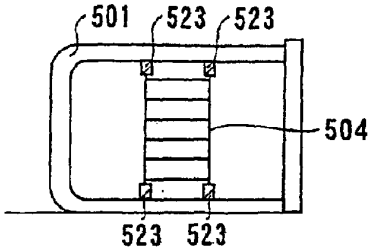


FIG. 60C

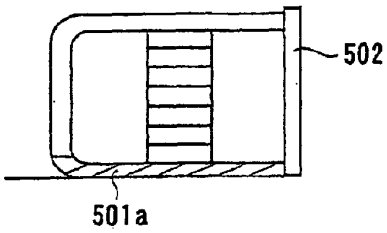


FIG. 60D

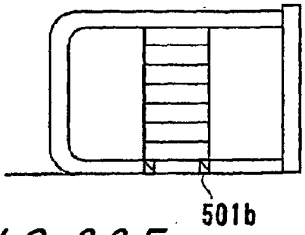


FIG. 60E

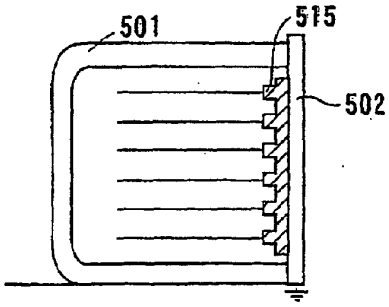


FIG. 60F

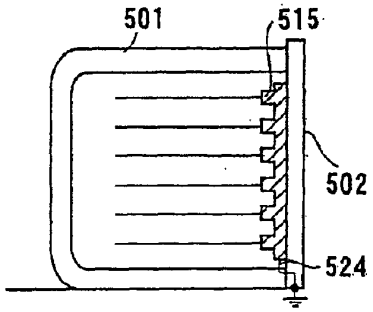


FIG. 60G

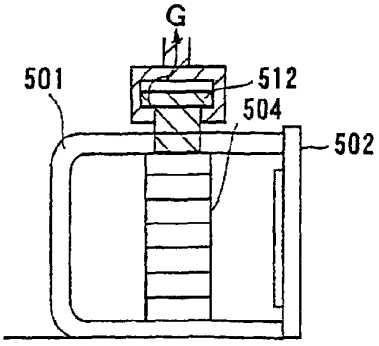
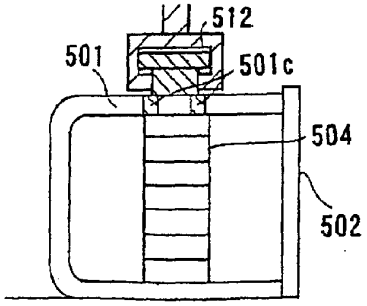
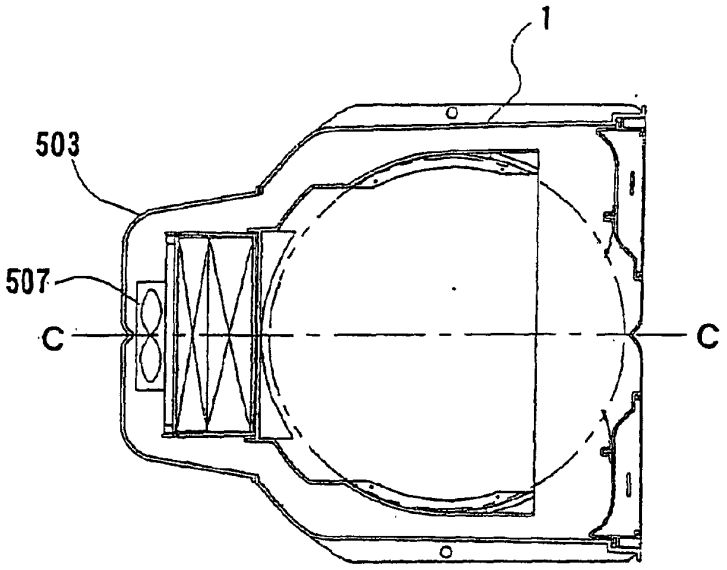


FIG. 60H



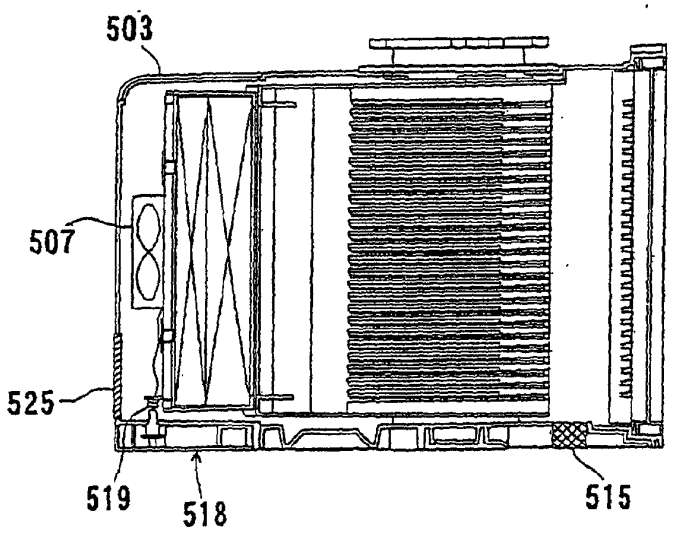
Entegris, EX1002, p. 356

FIG. 61



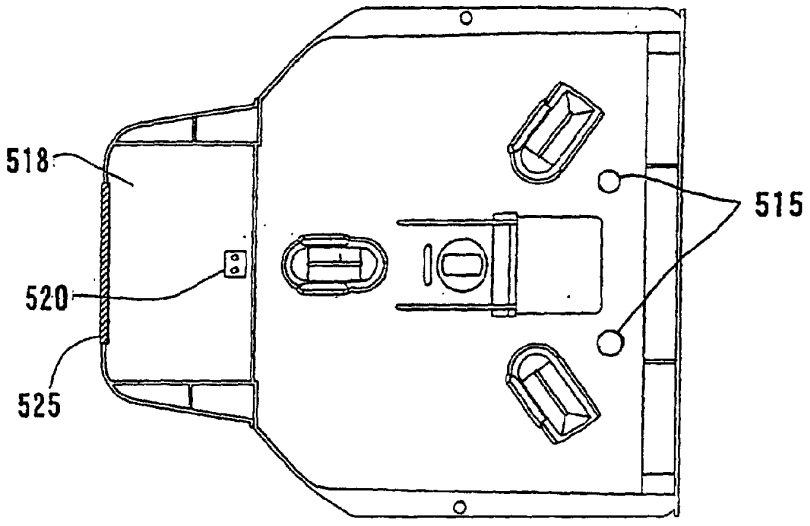
Entegris, EX1002, p. 357

FIG. 62



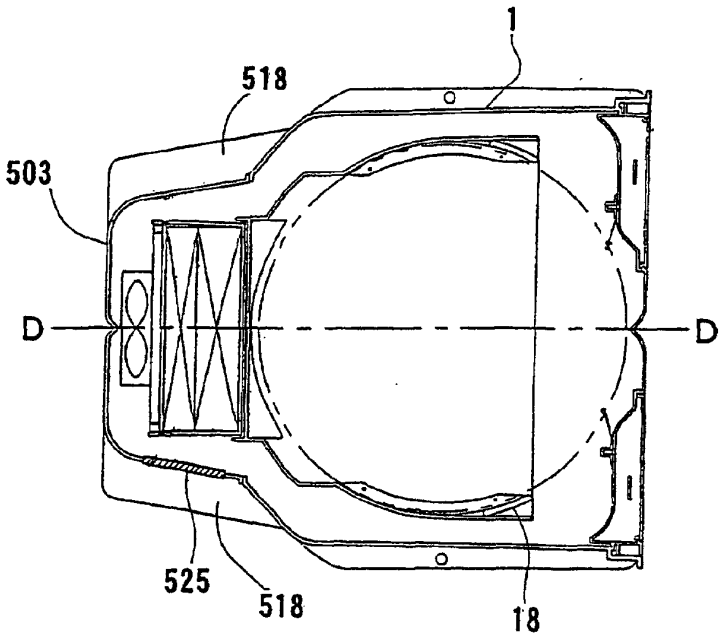
Entegris, EX1002, p. 358

FIG. 63



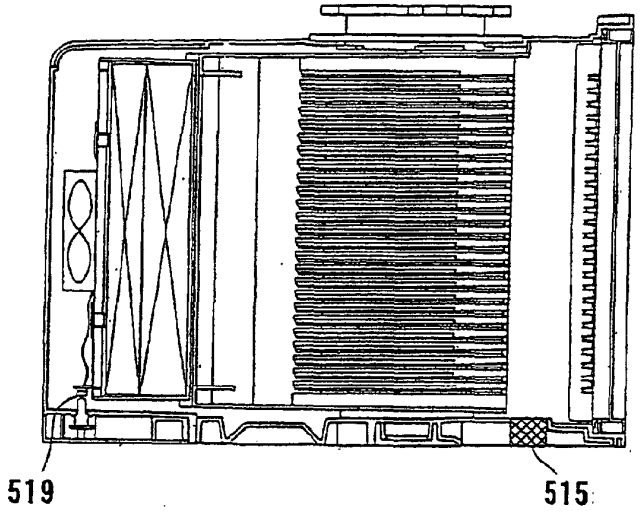
Entegris, EX1002, p. 359

FIG. 64



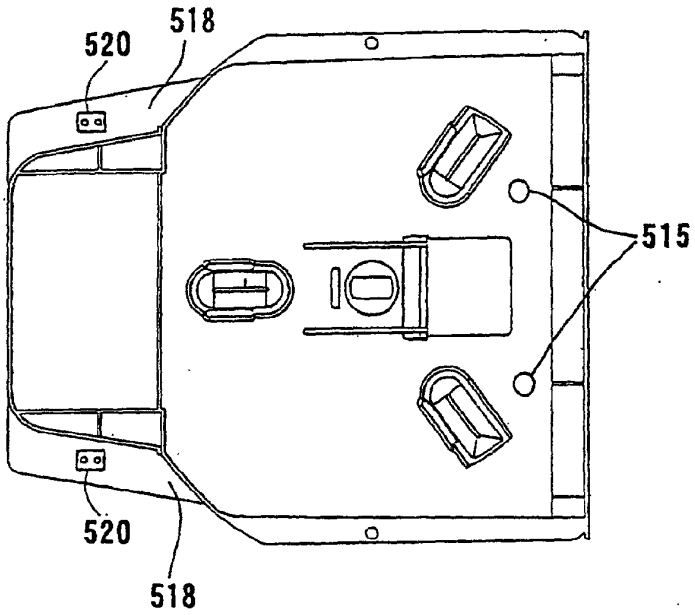
Entegris, EX1002, p. 360

FIG. 65



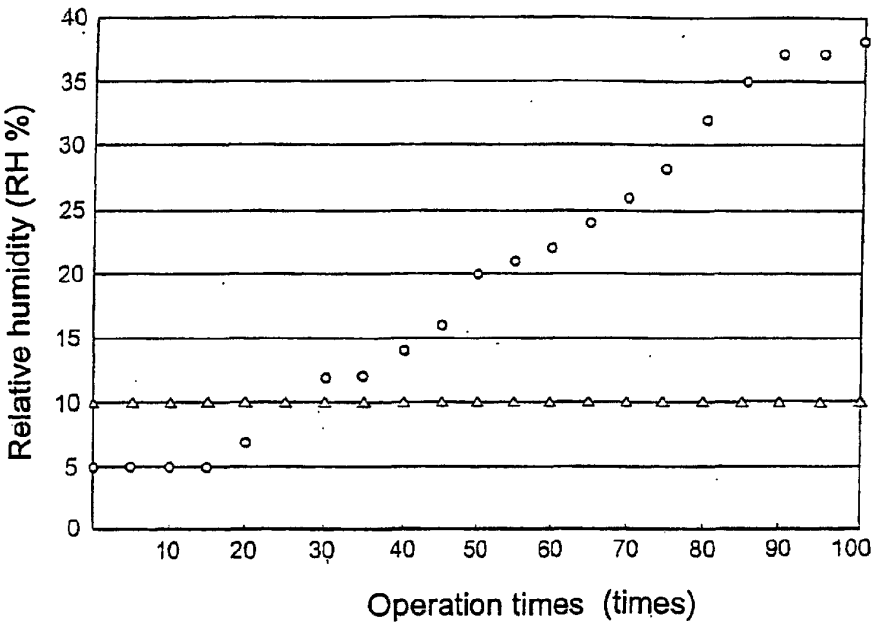
Entegris, EX1002, p. 361

FIG. 66



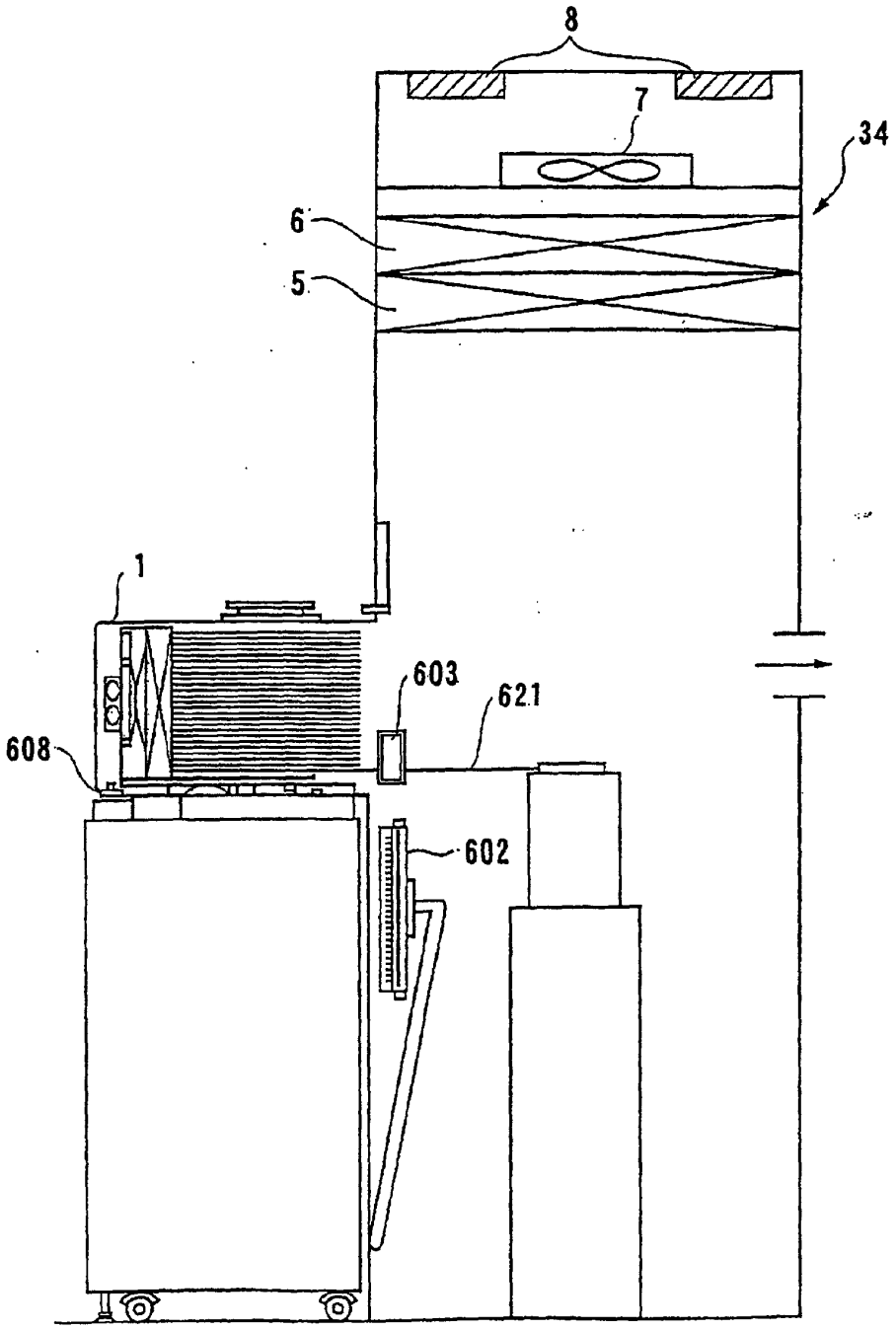
Entegris, EX1002, p. 362

FIG. 67



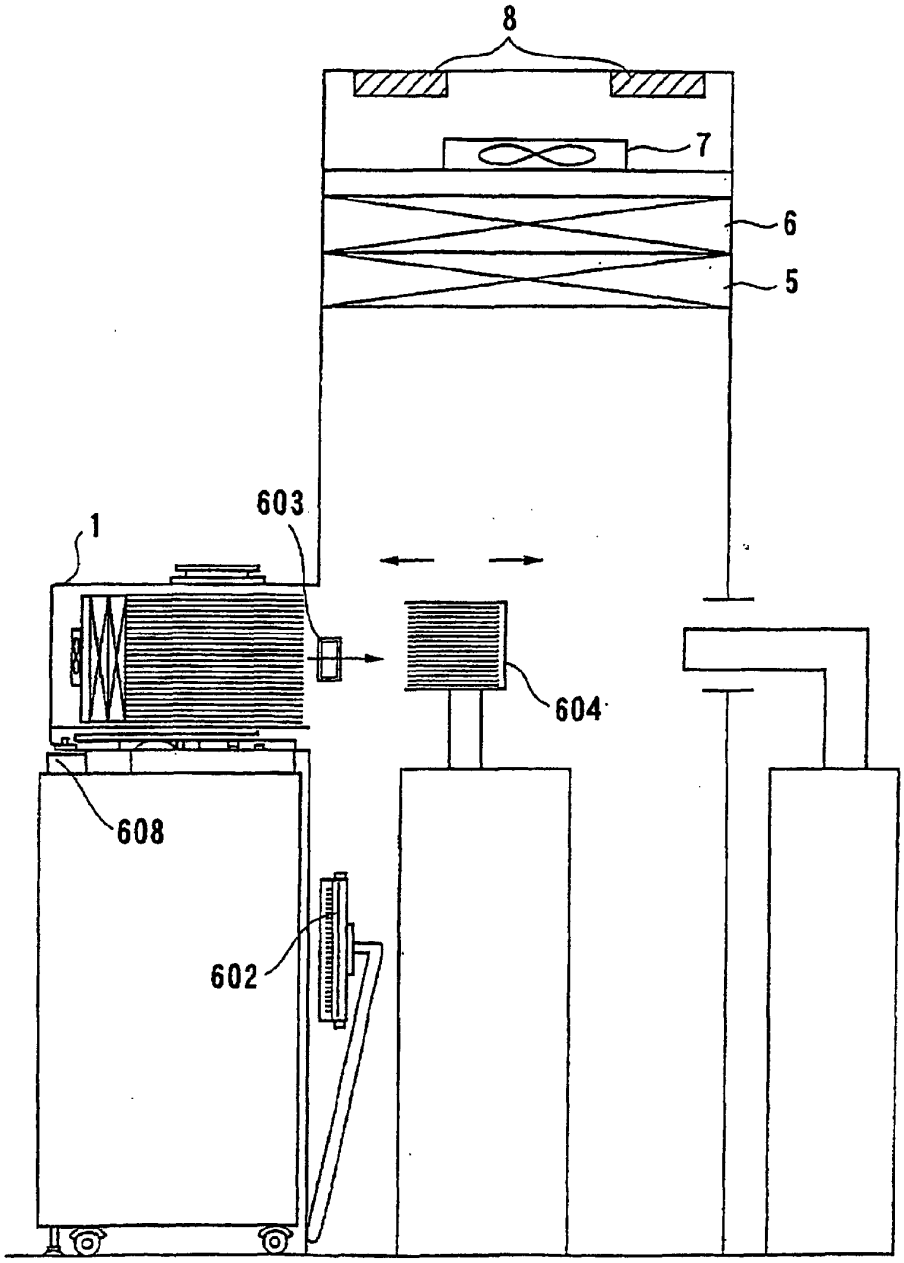
Entegris, EX1002, p. 363

FIG. 68



Entegris, EX1002, p. 364

FIG. 69



Entegris, EX1002, p. 365

FIG. 70A

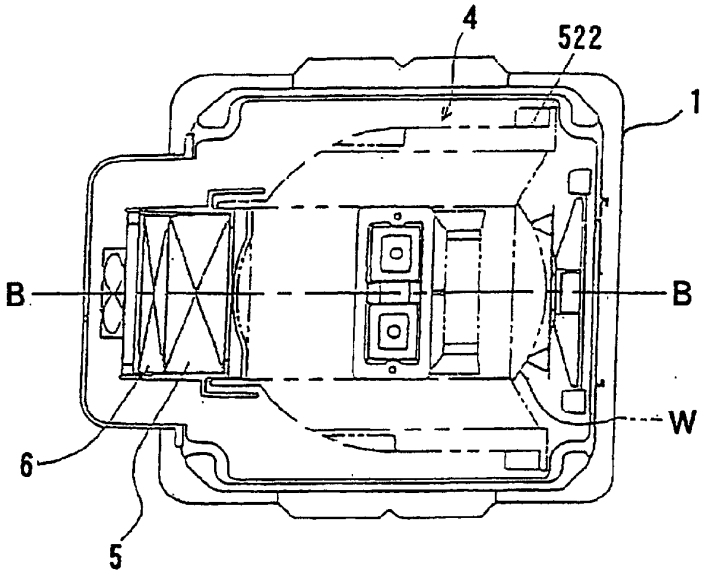
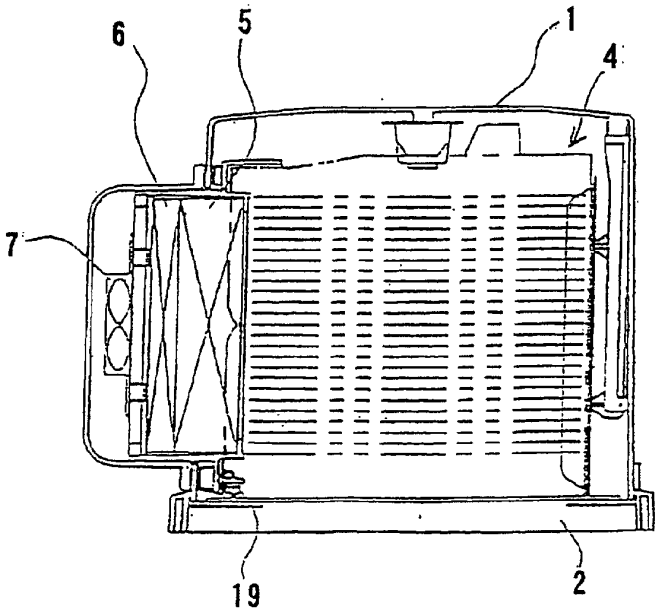


FIG. 70B



Entegris, EX1002, p. 366

FIG. 71A

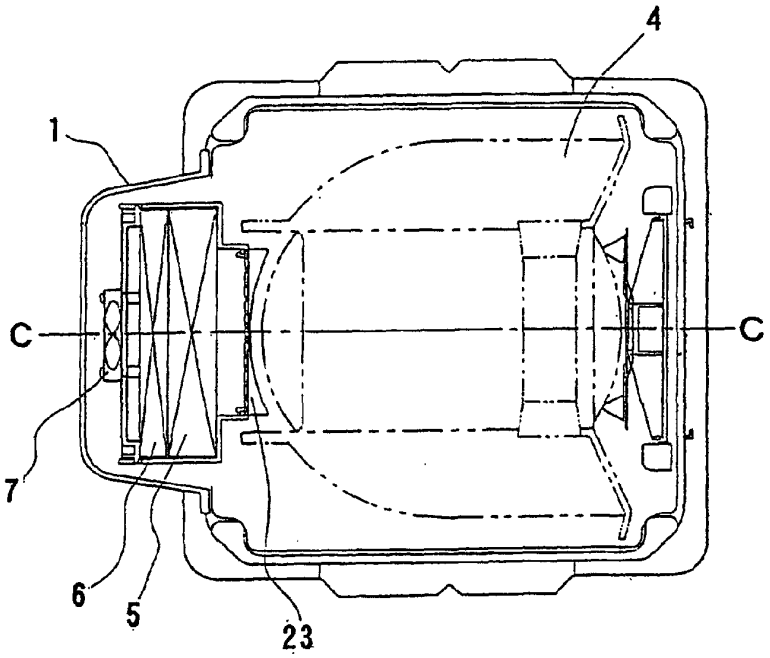
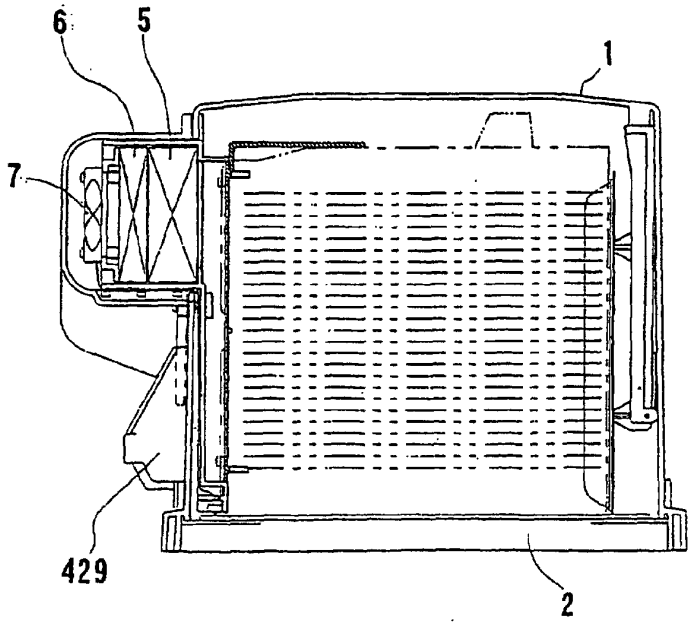
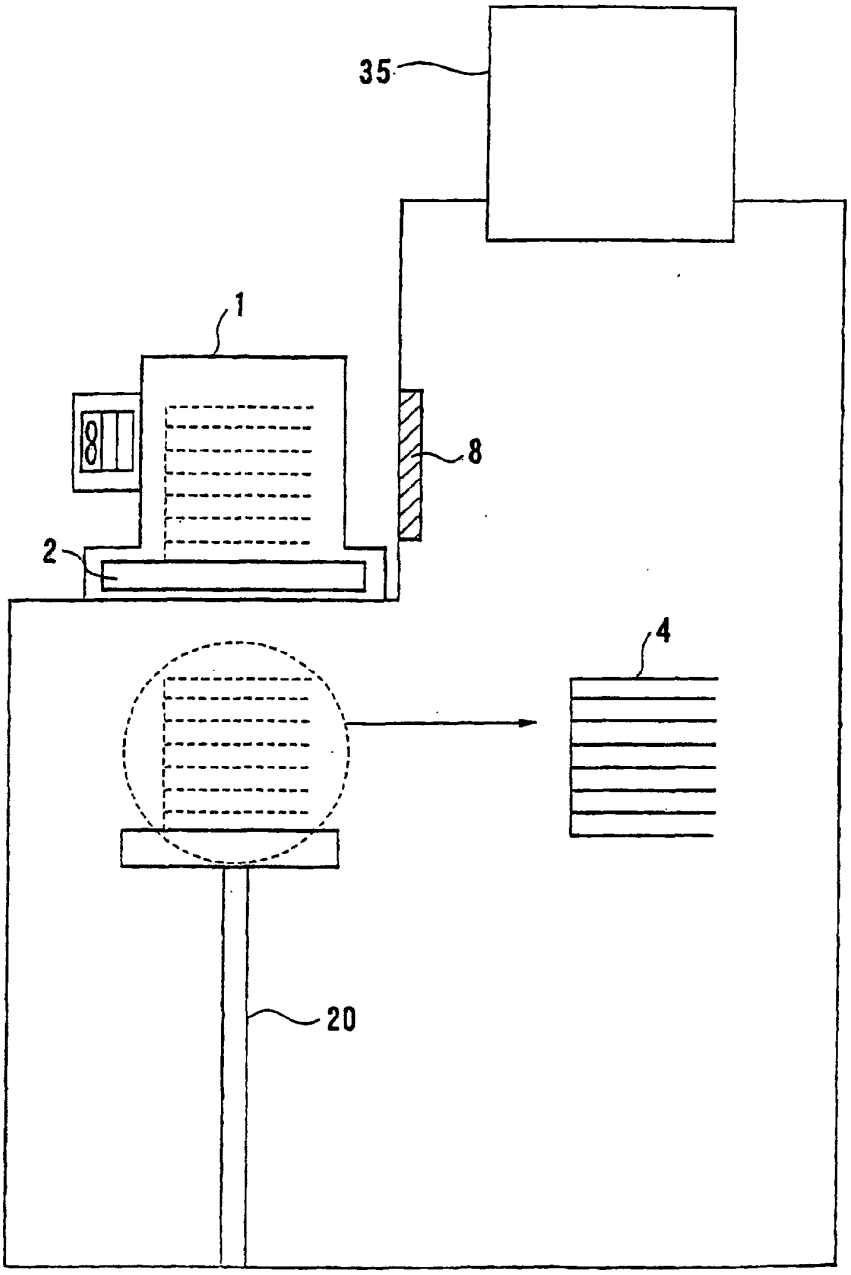


FIG. 71B



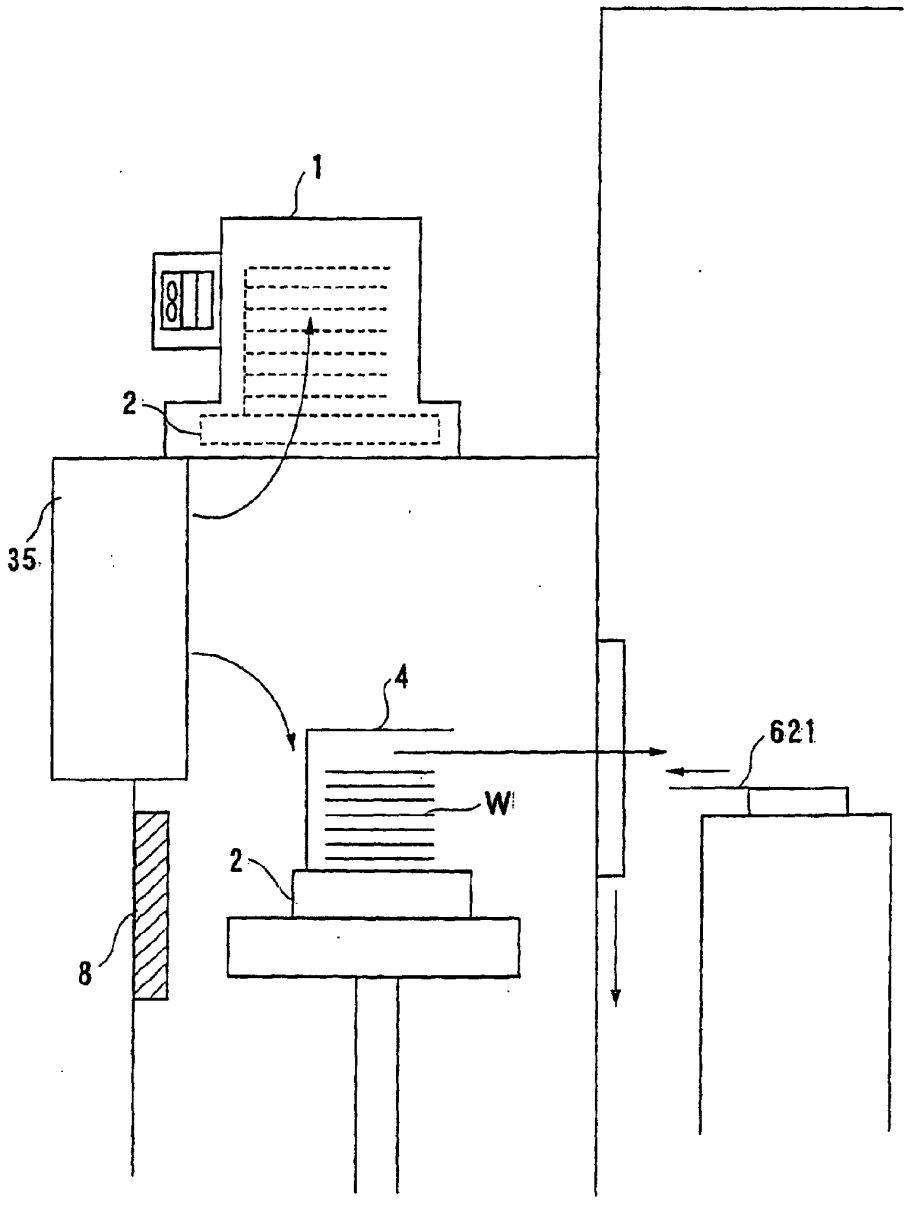
Entegris, EX1002, p. 367

FIG. 72



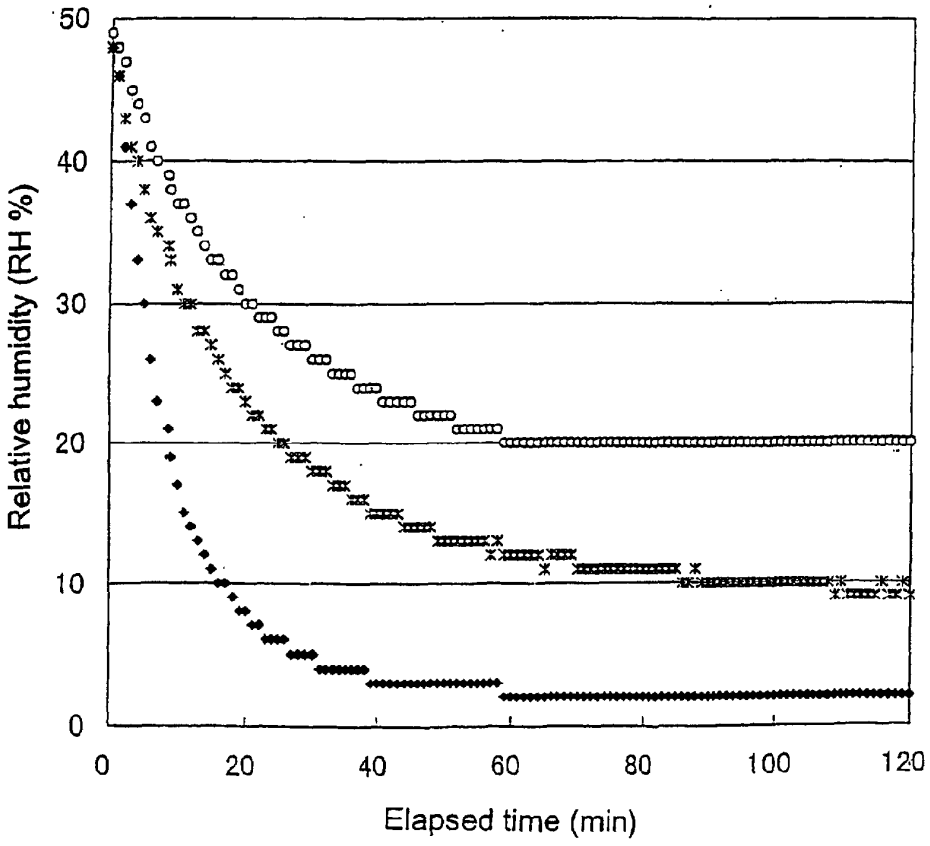
Entegris, EX1002, p. 368

FIG. 73



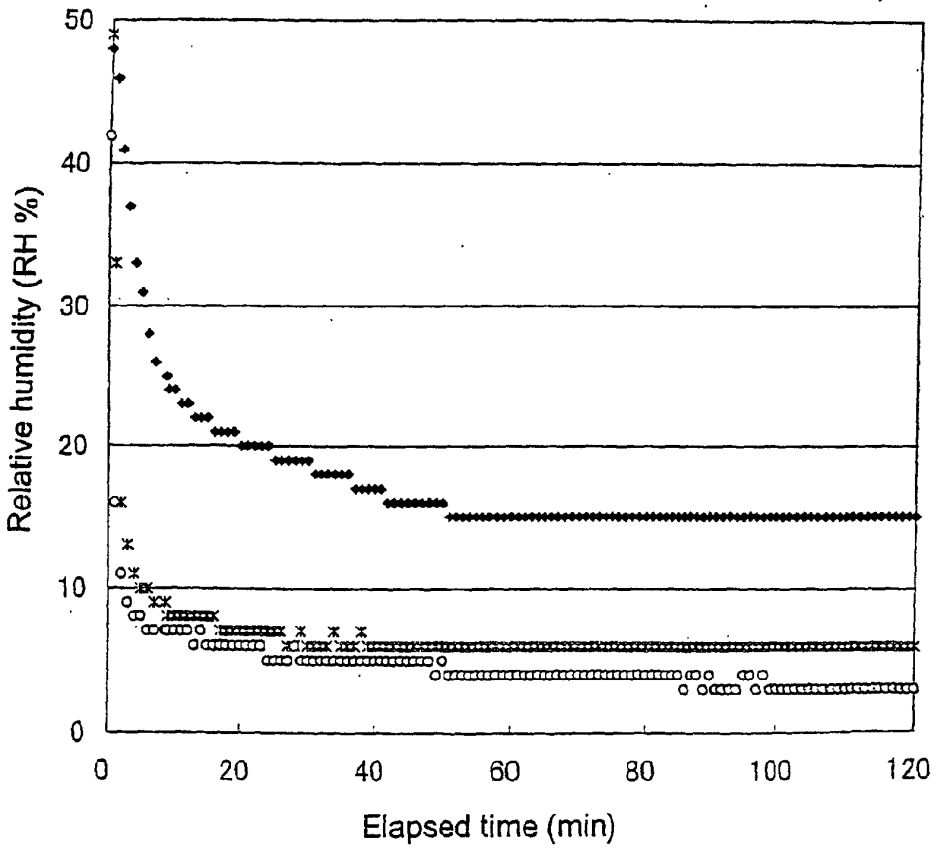
Entegris, EX1002, p. 369

FIG. 74



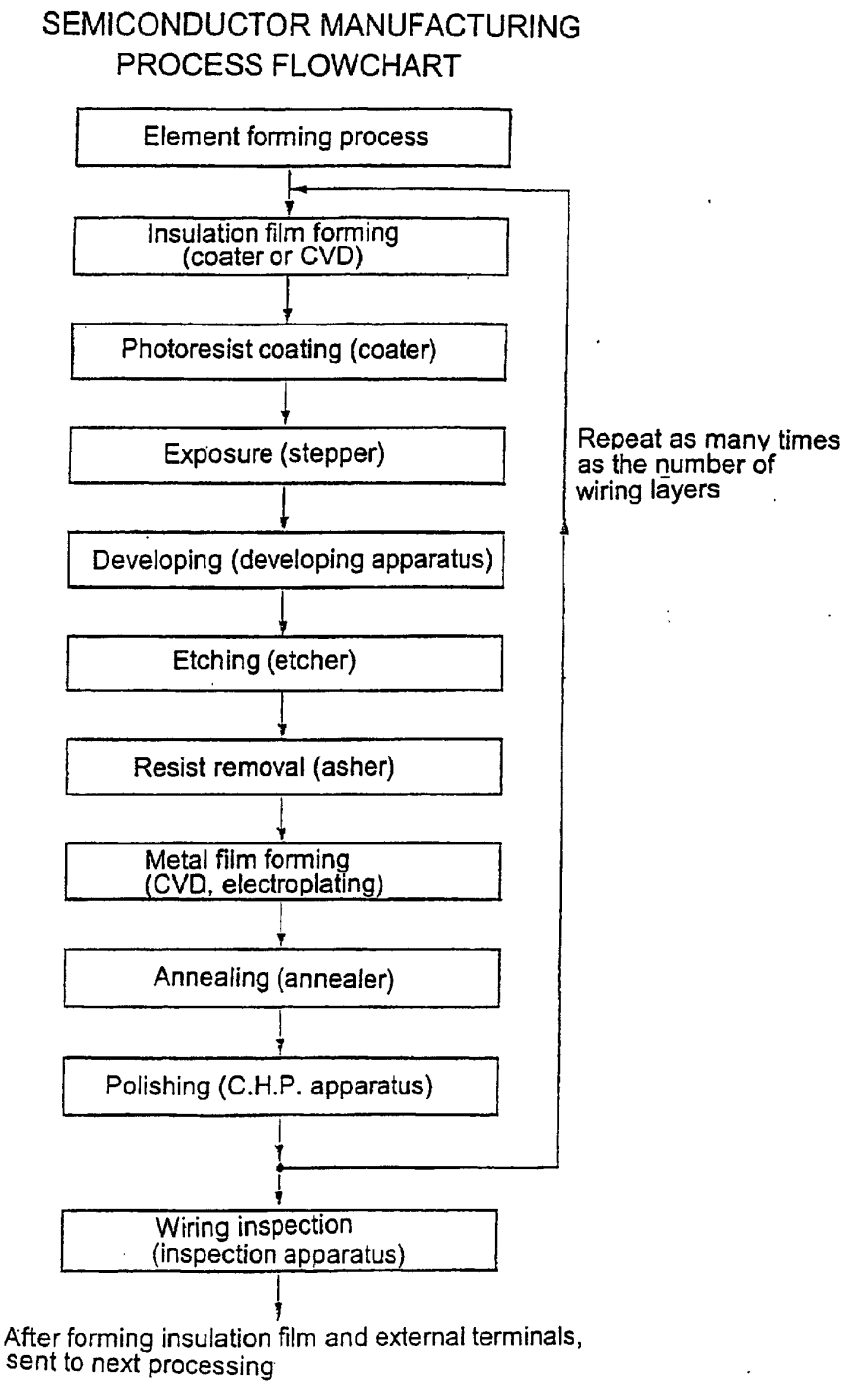
Entegris, EX1002, p. 370

FIG. 75



Entegris, EX1002, p. 371

FIG. 76



Entegris, EX1002, p. 372

FIG. 77A

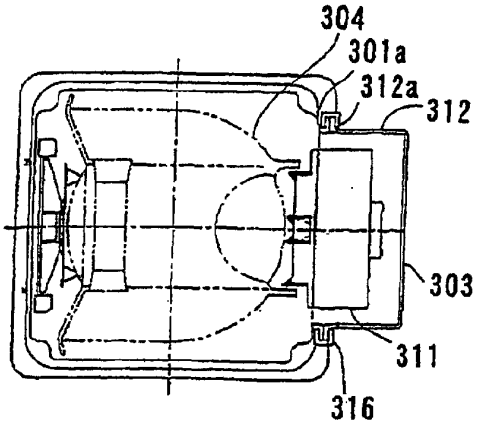


FIG. 77B

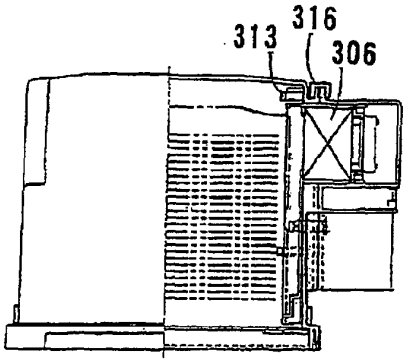


FIG. 77C

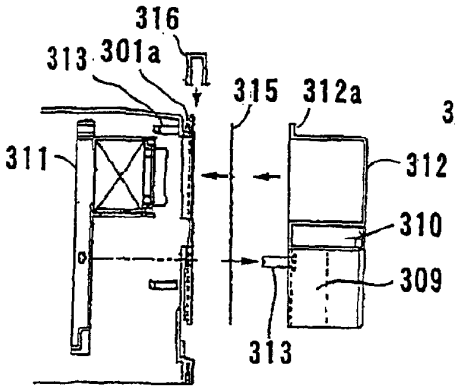
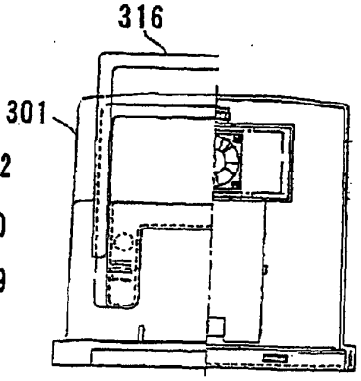


FIG. 77D



Entegris, EX1002, p. 373

FIG. 78A

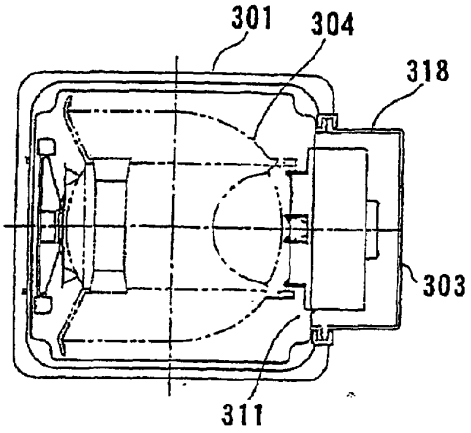


FIG. 78B

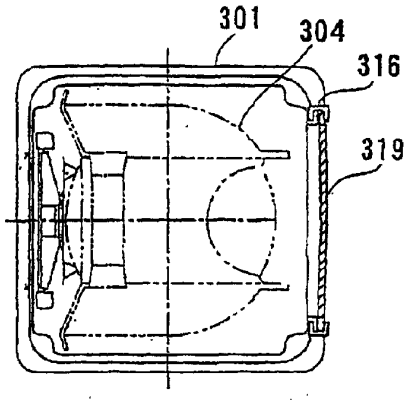


FIG. 78C

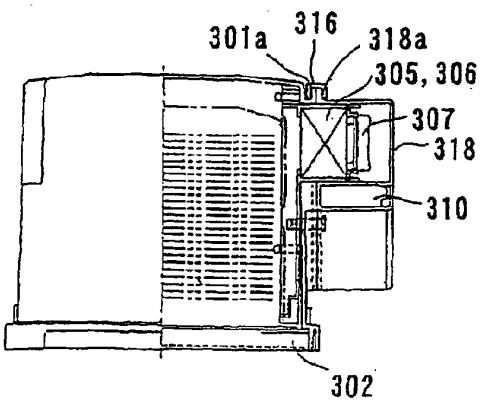
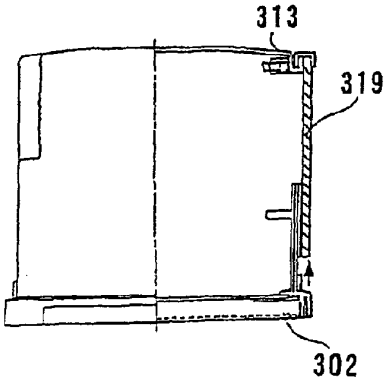


FIG. 78D



Entegris, EX1002, p. 374

FIG. 79A

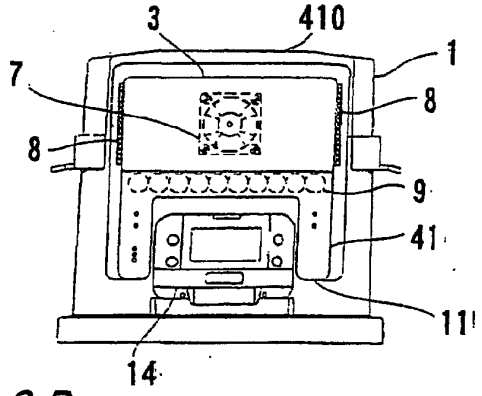


FIG. 79B

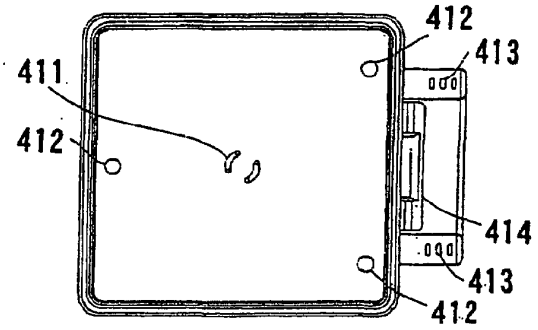
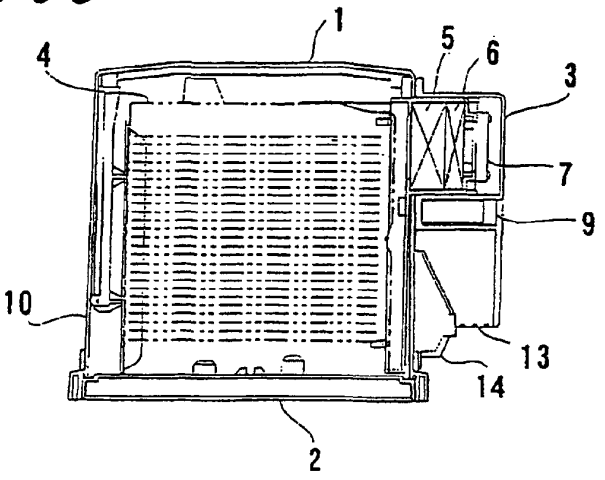


FIG. 79C



Entegris, EX1002, p. 375

FIG. 80A

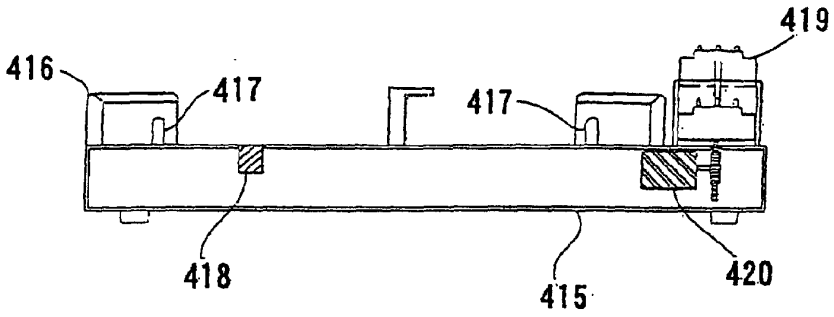
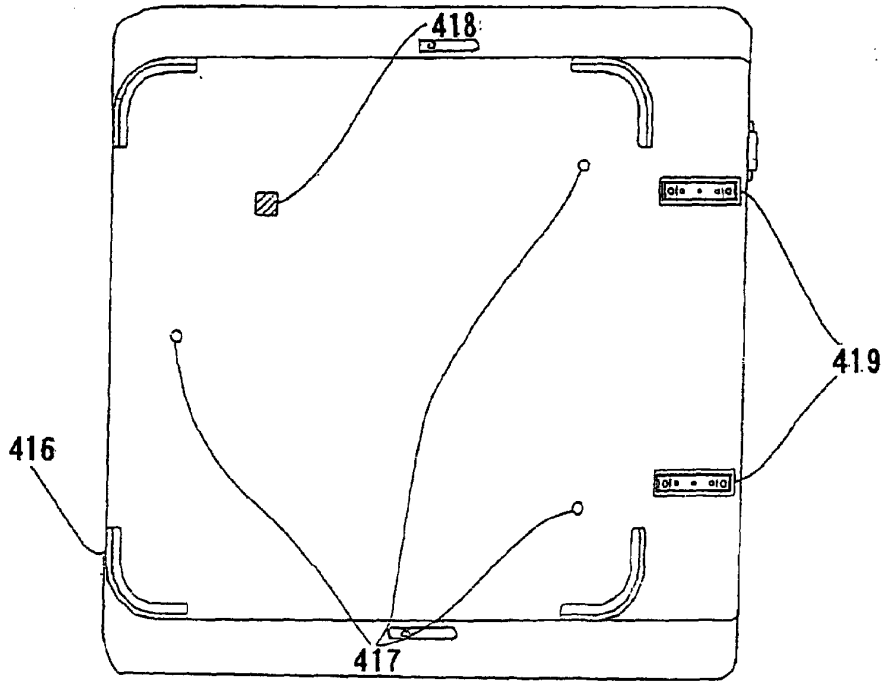


FIG. 80B



Entegris, EX1002, p. 376

FIG. 81A

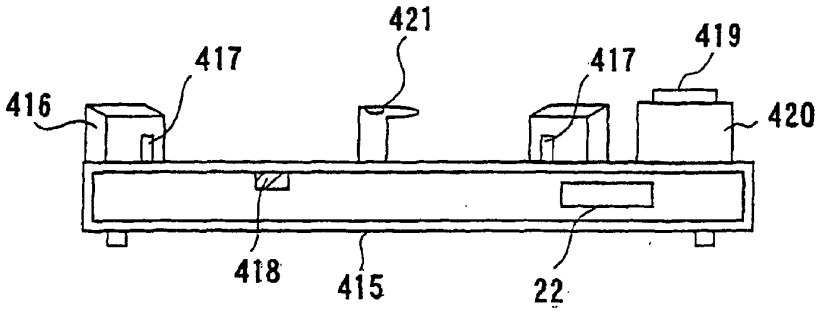
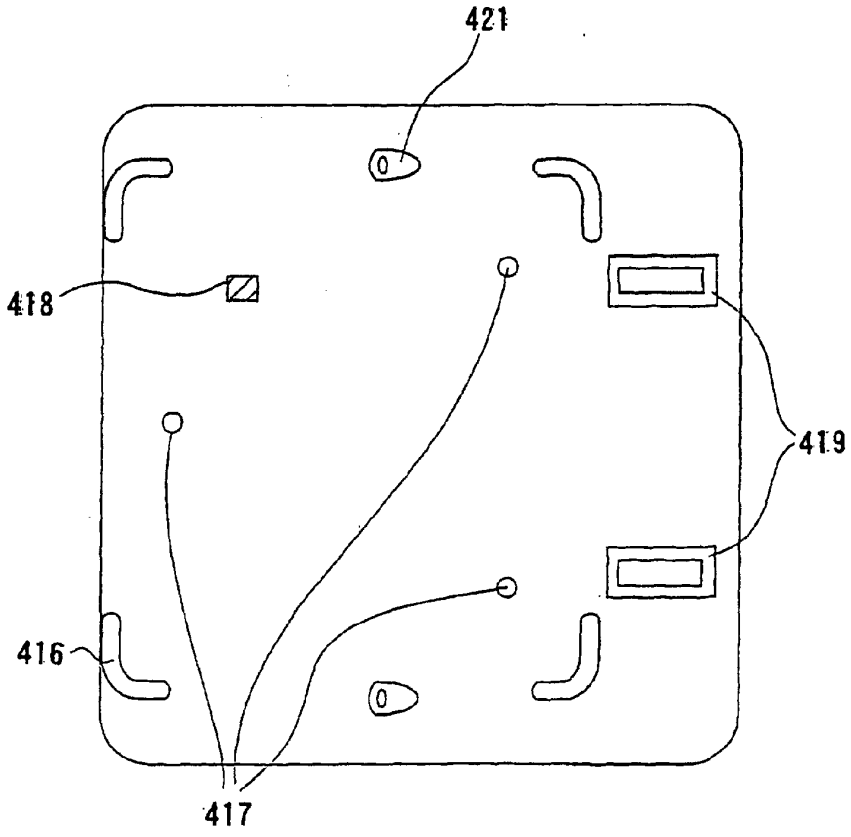
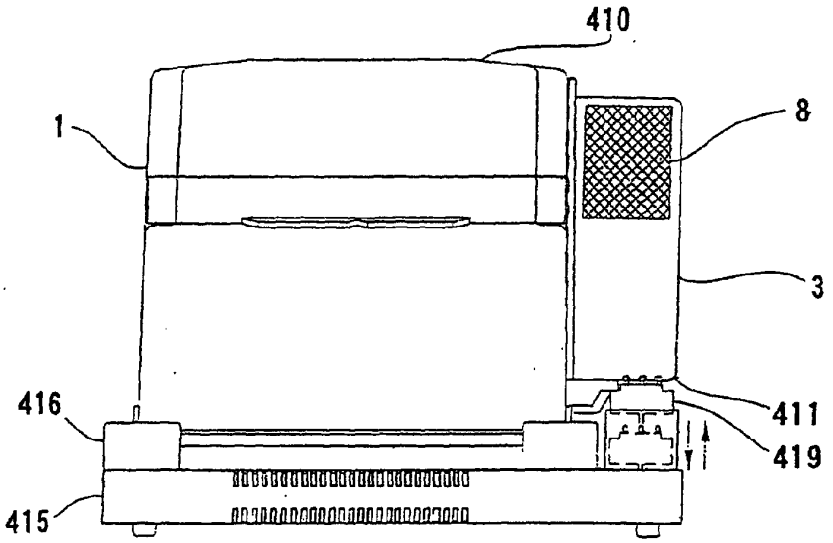


FIG. 81B



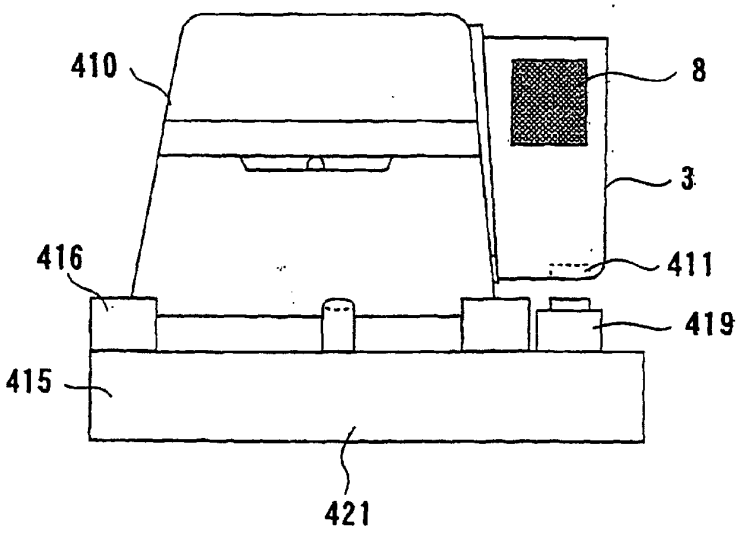
Entegris, EX1002, p. 377

FIG. 82



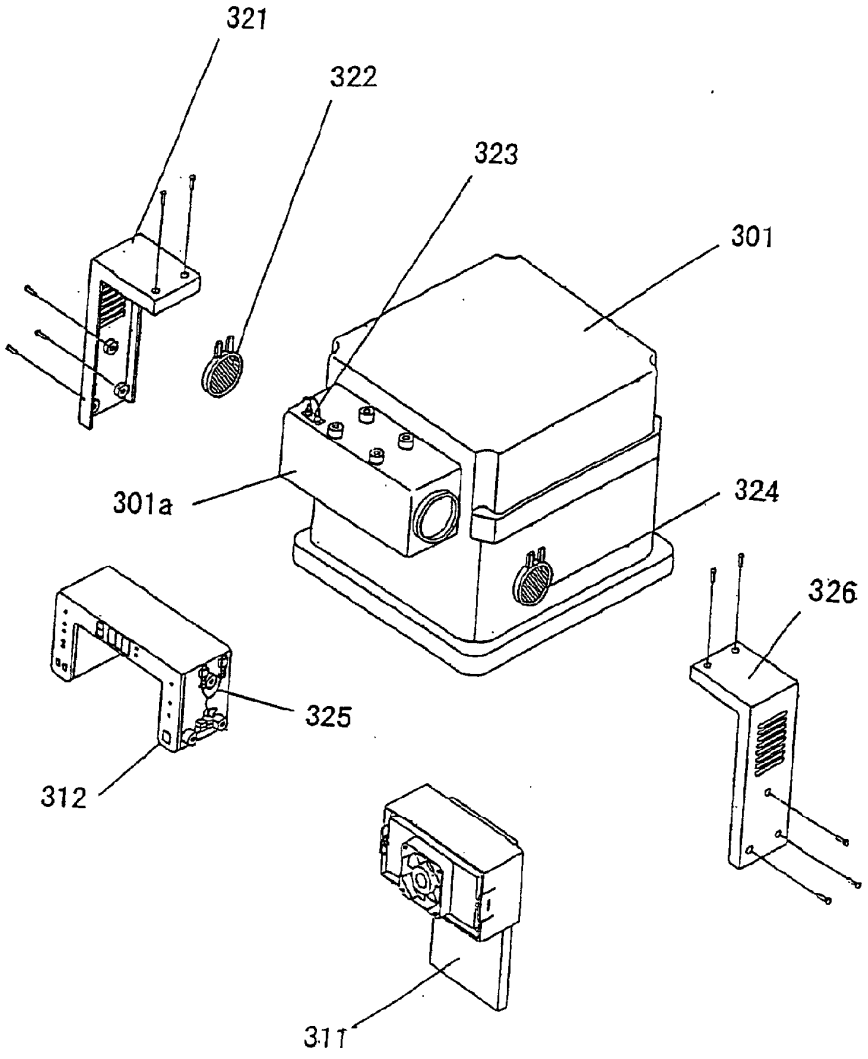
Entegris, EX1002, p. 378

FIG. 83



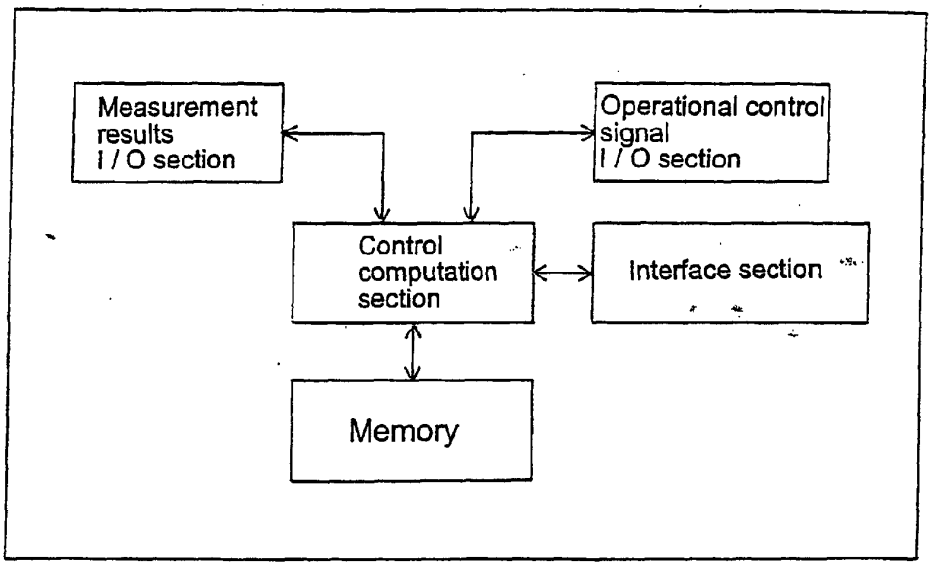
Entegris, EX1002, p. 379

FIG. 84



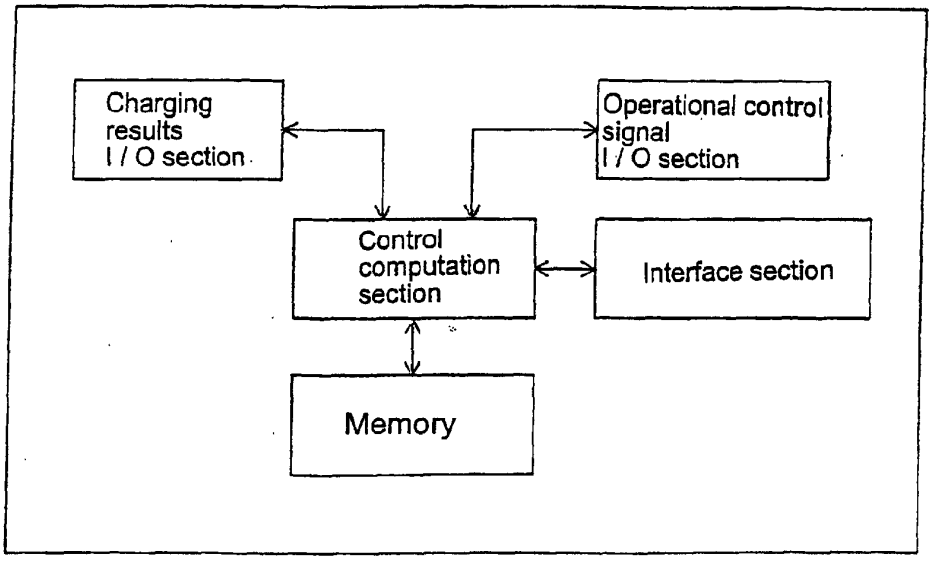
Entegris, EX1002, p. 380

FIG. 85



Entegris, EX1002, p. 381

FIG. 86



Entegris, EX1002, p. 382

FIG. 87A

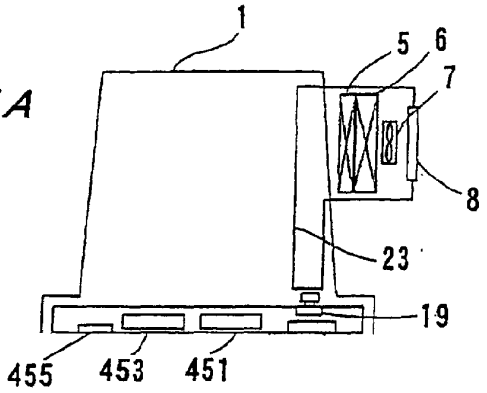


FIG. 87B

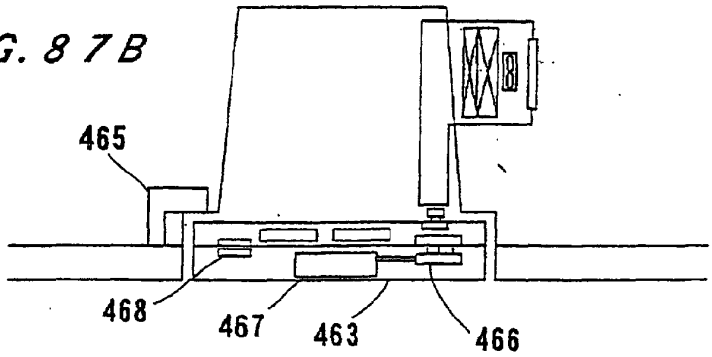
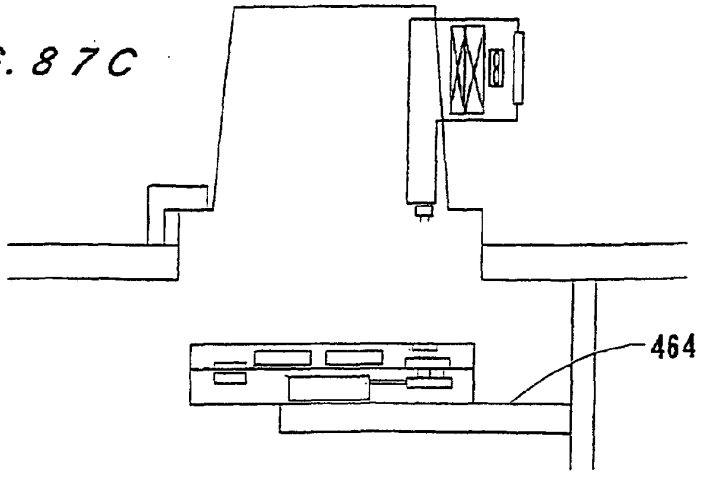


FIG. 87C



Entegris, EX1002, p. 383

FIG. 88A

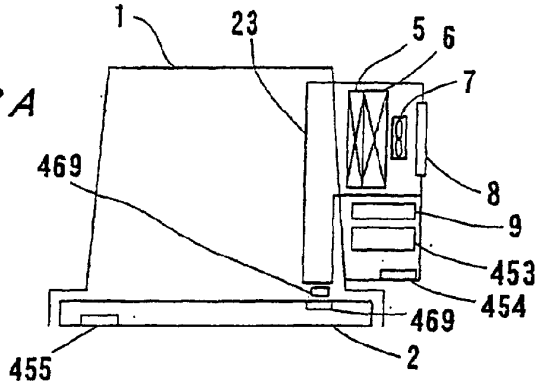


FIG. 88B

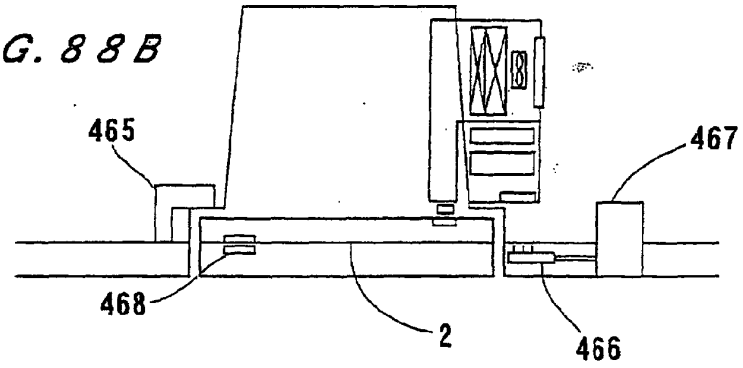
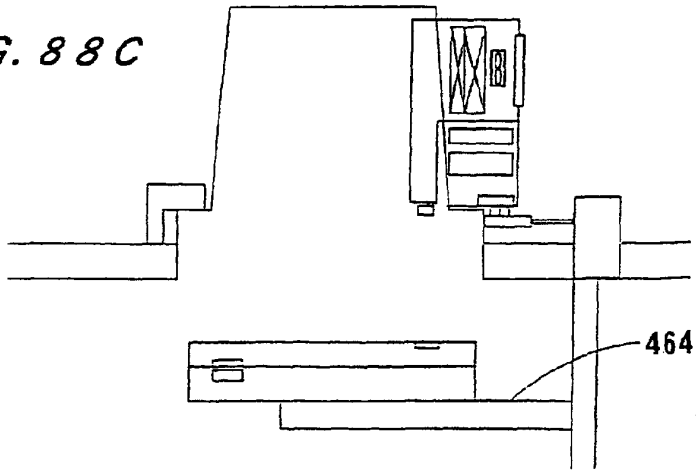


FIG. 88C



Entegris, EX1002, p. 384

FIG. 89A

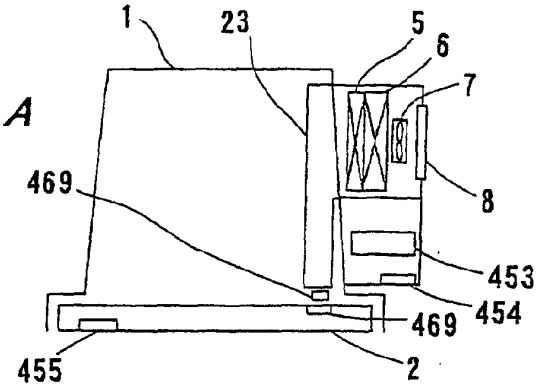


FIG. 89B

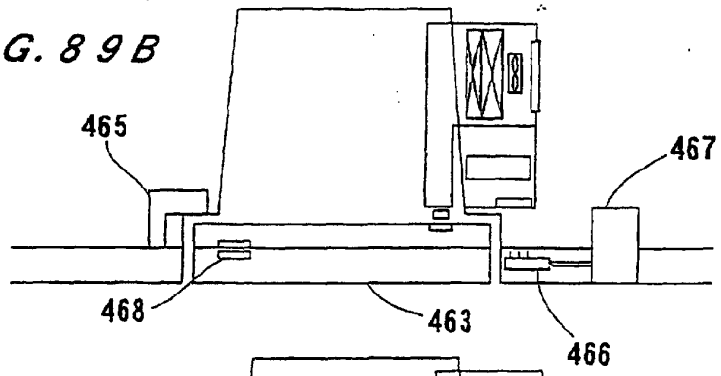
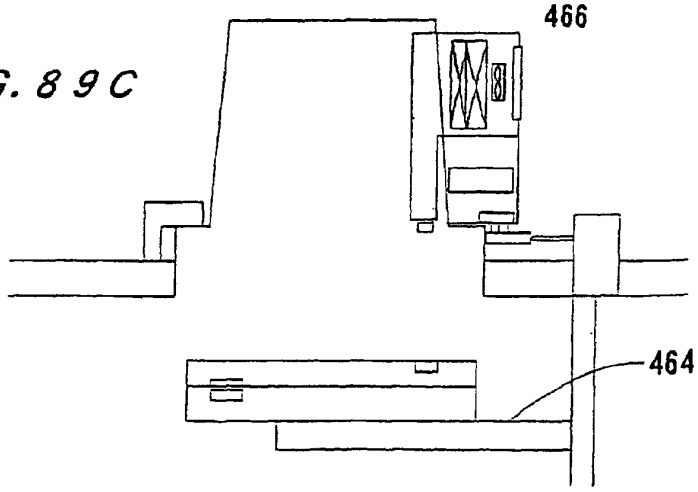


FIG. 89C



Entegris, EX1002, p. 385

FIG. 90A

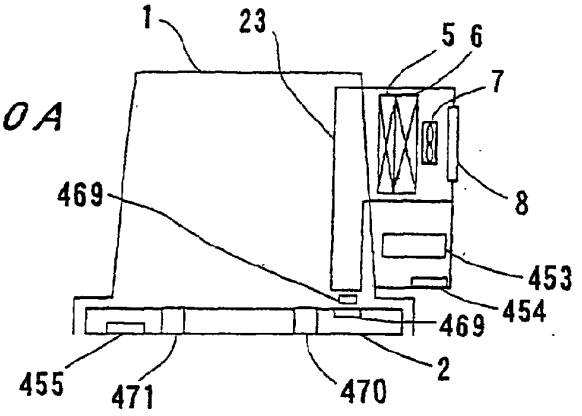


FIG. 90B

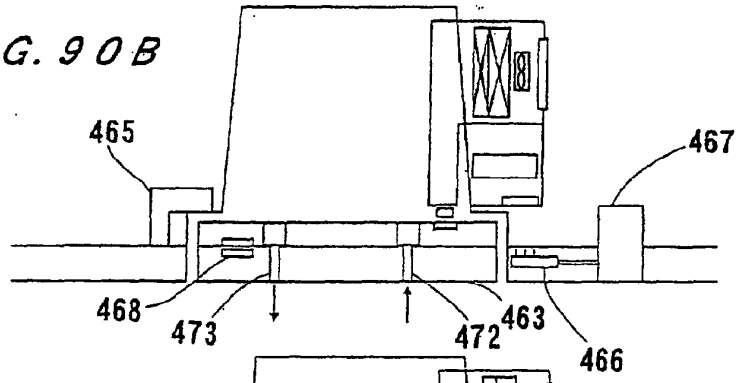
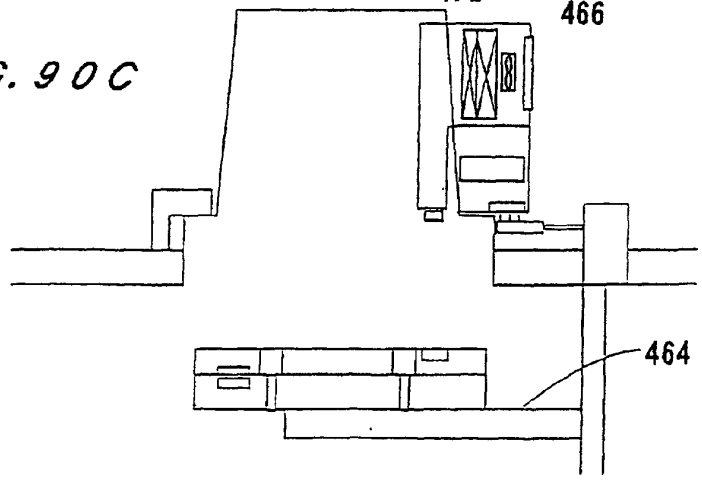
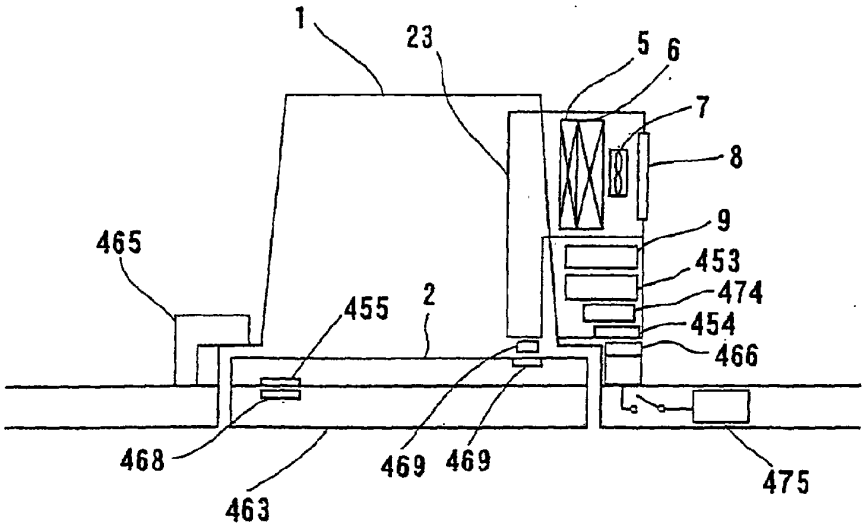


FIG. 90C



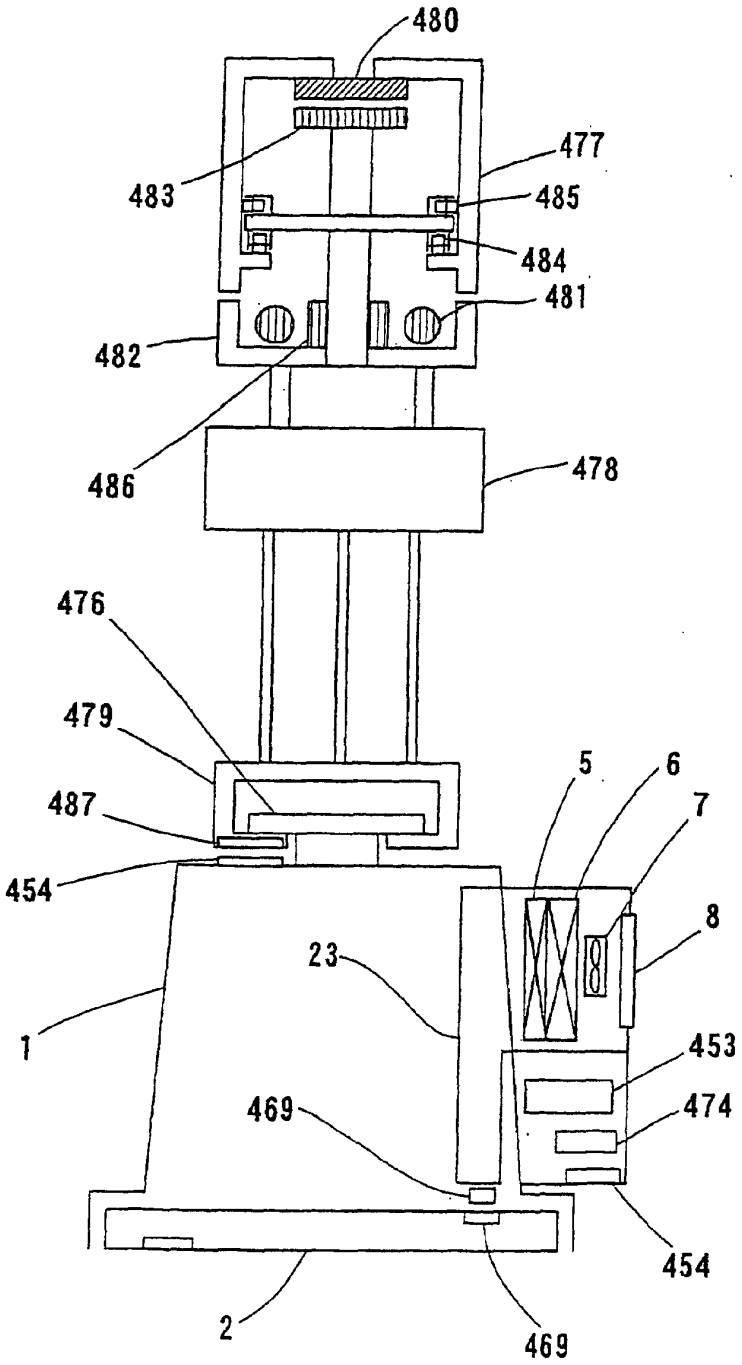
Entegris, EX1002, p. 386

FIG. 91



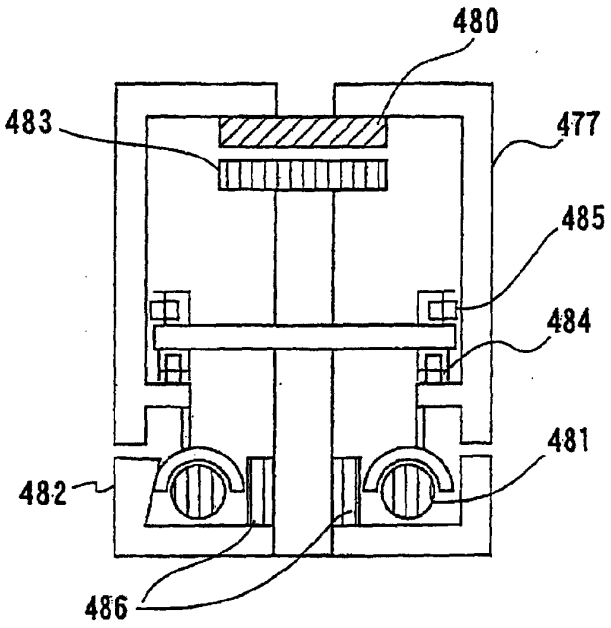
Entegris, EX1002, p. 387

FIG. 92



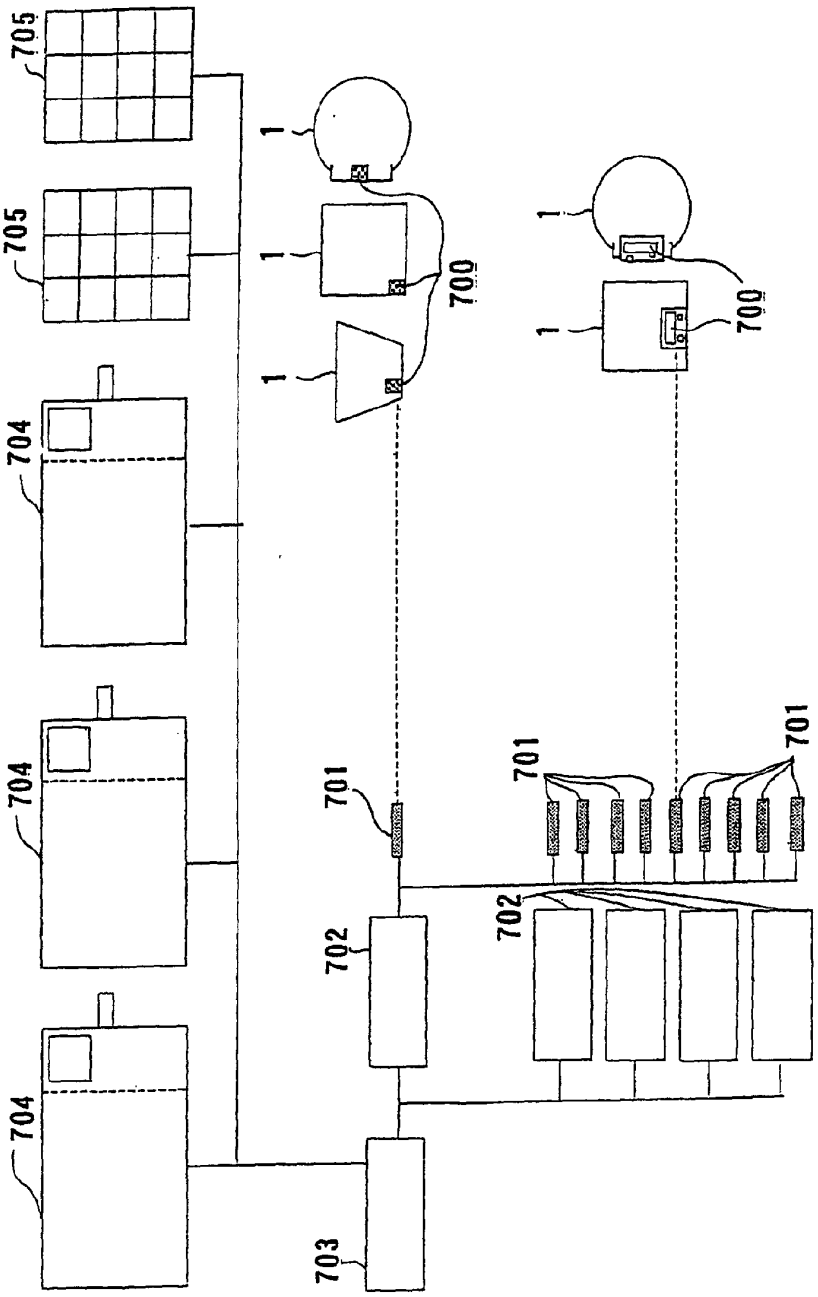
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FIG. 93



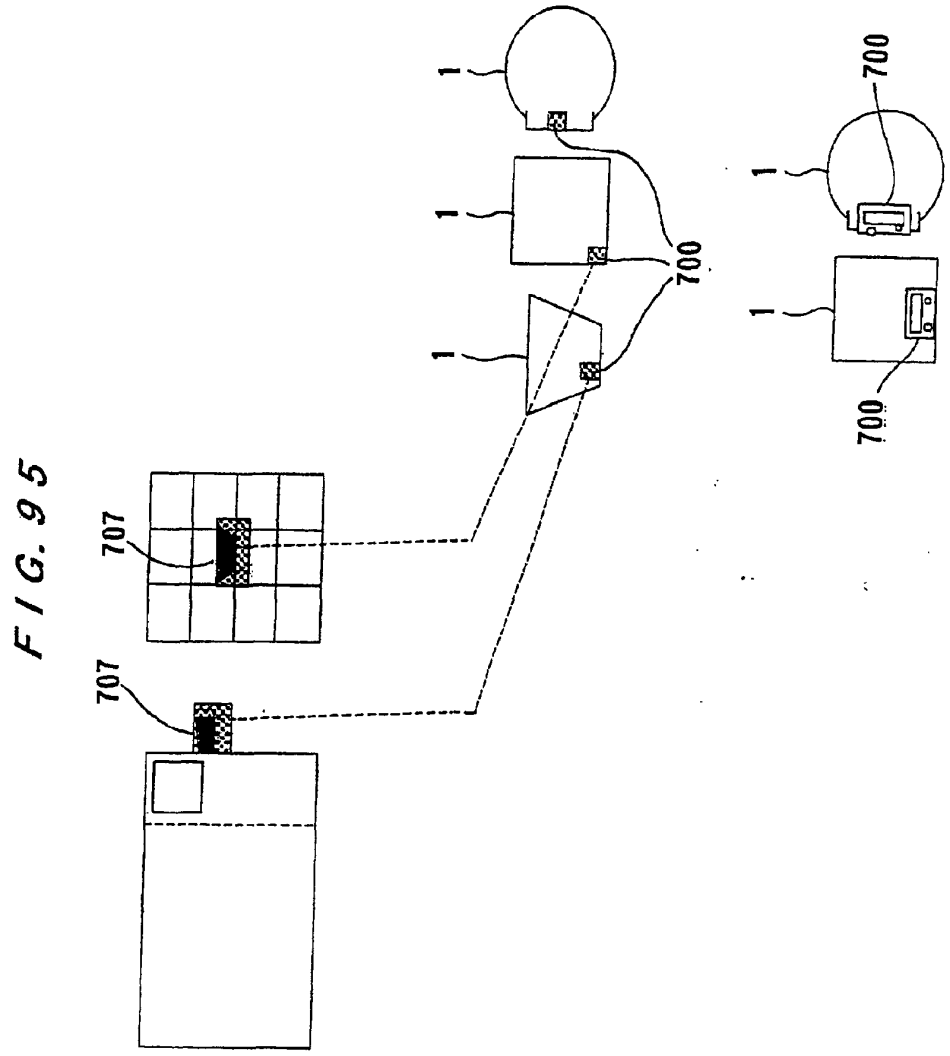
Entegris, EX1002, p. 389

FIG. 94



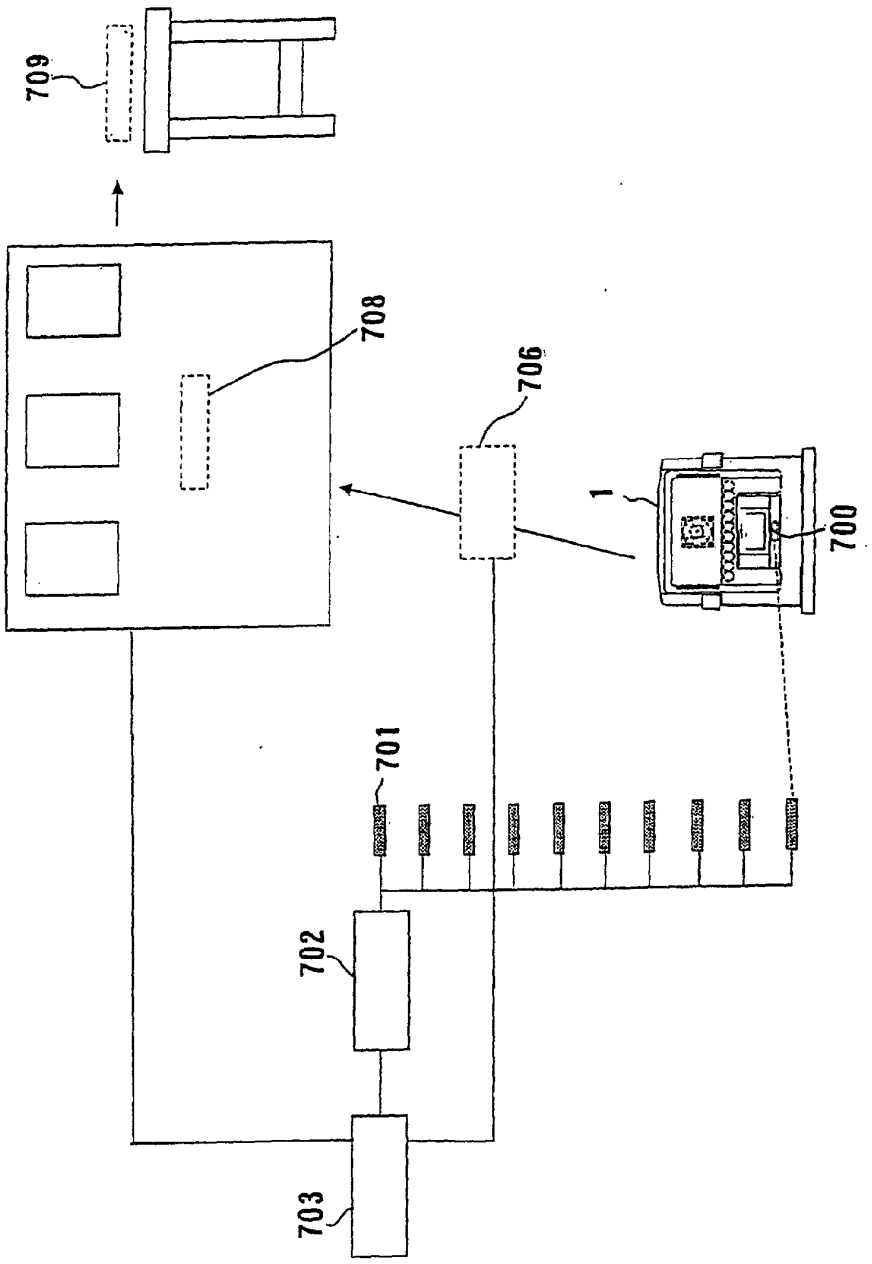
Entegris, EX1002, p. 390

FIG. 95



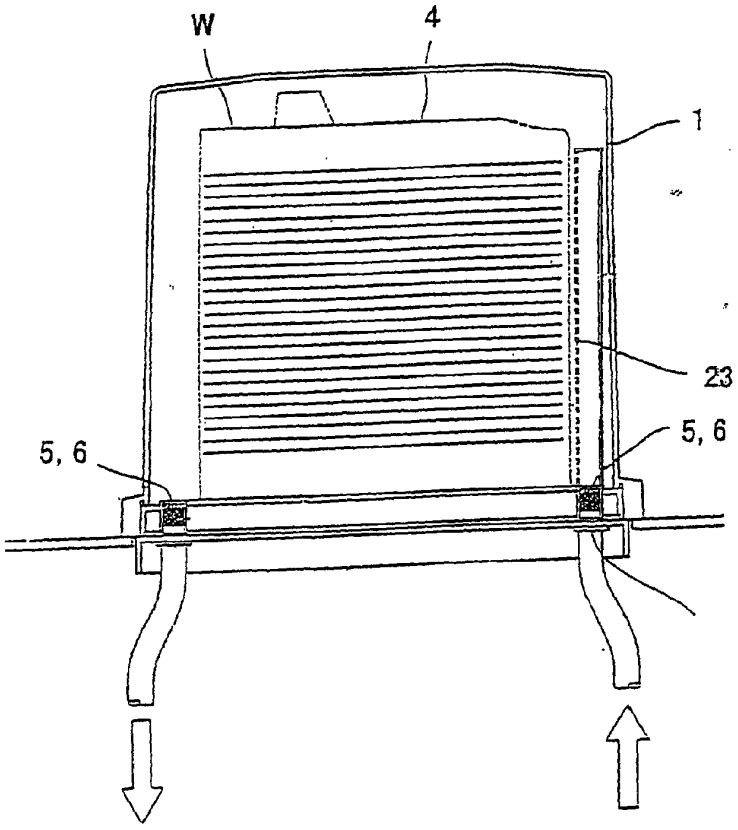
Entegris, EX1002, p. 391

FIG. 96



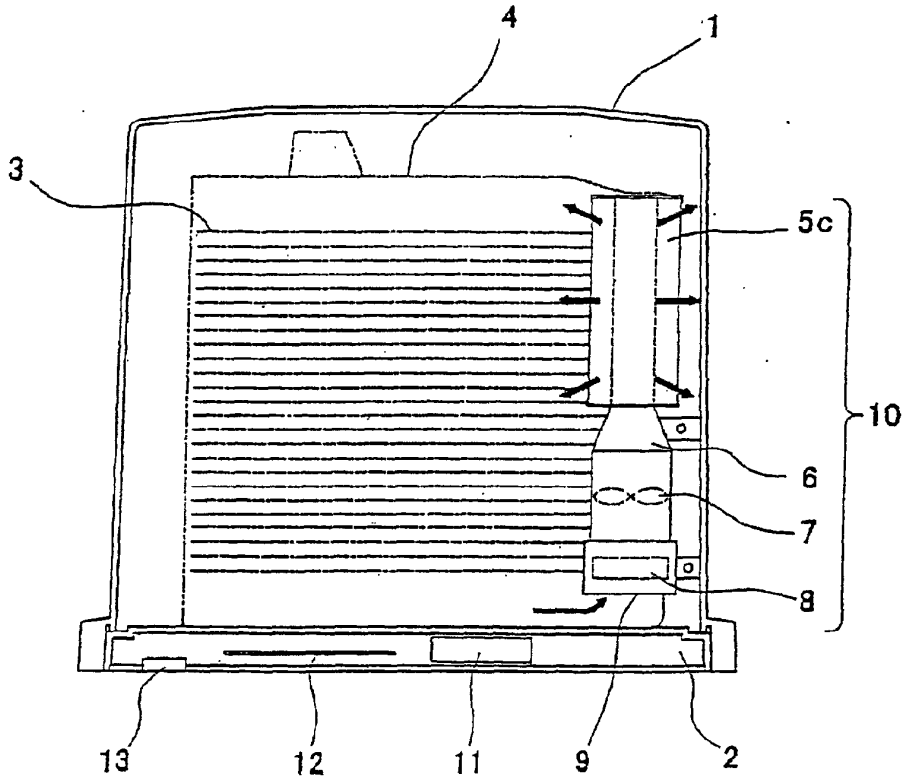
Entegris, EX1002, p. 392

FIG. 97



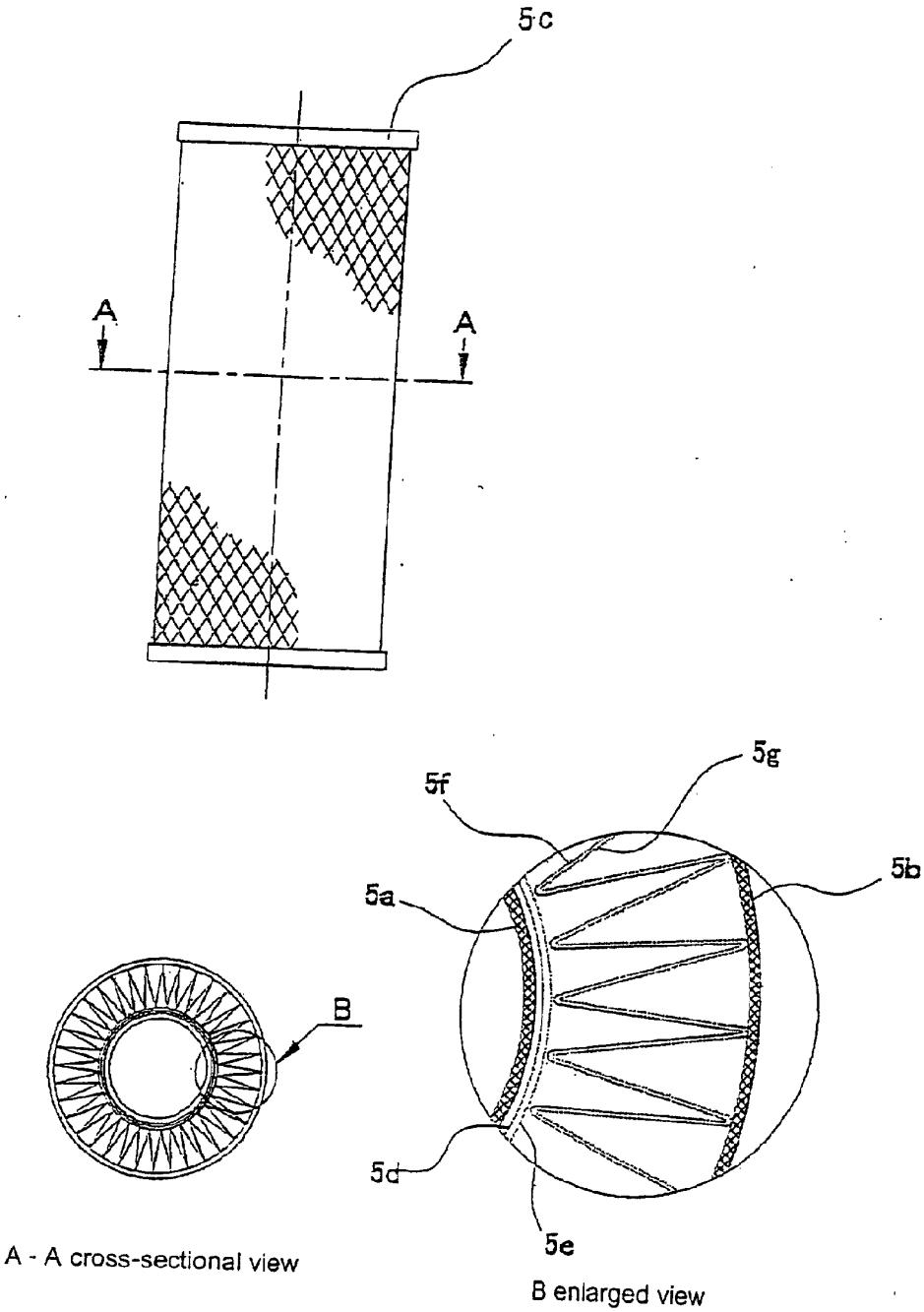
Entegris, EX1002, p. 393

FIG. 98



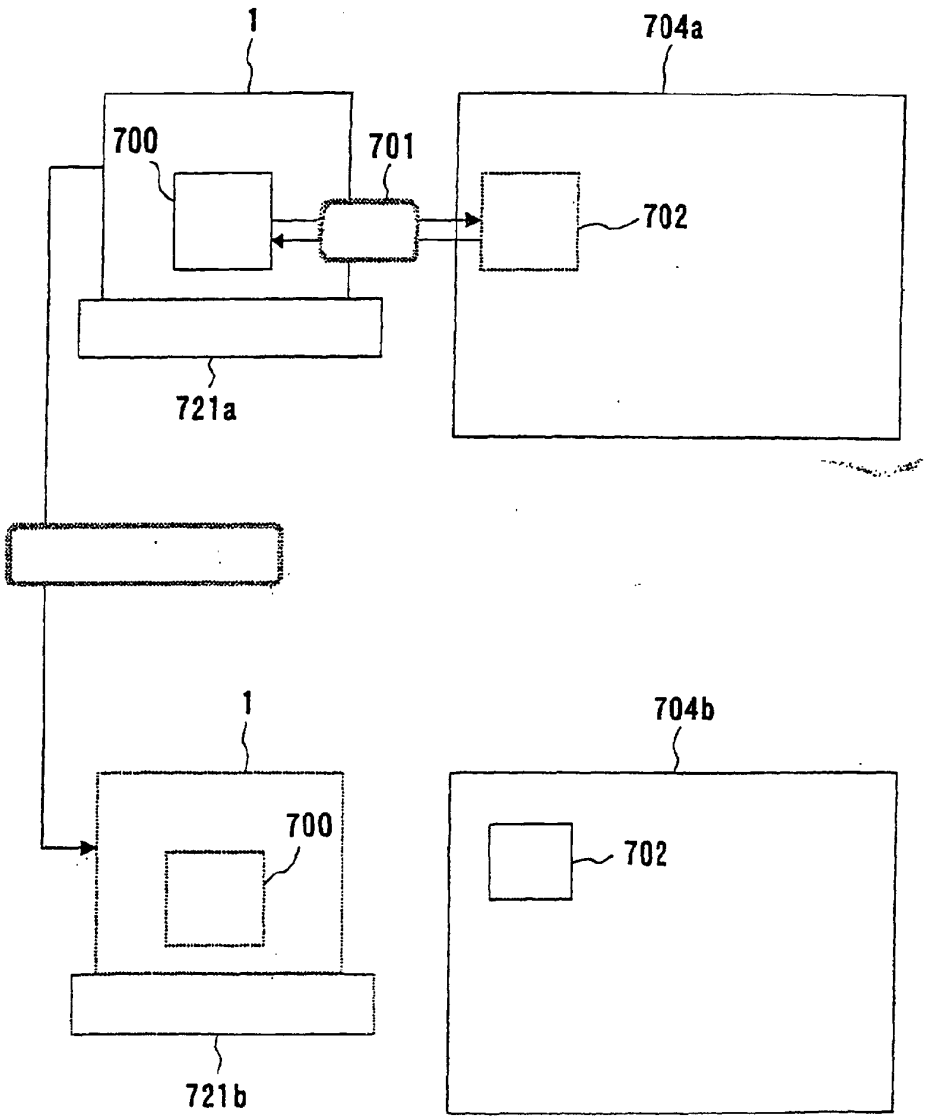
Entegris, EX1002, p. 394

FIG. 99



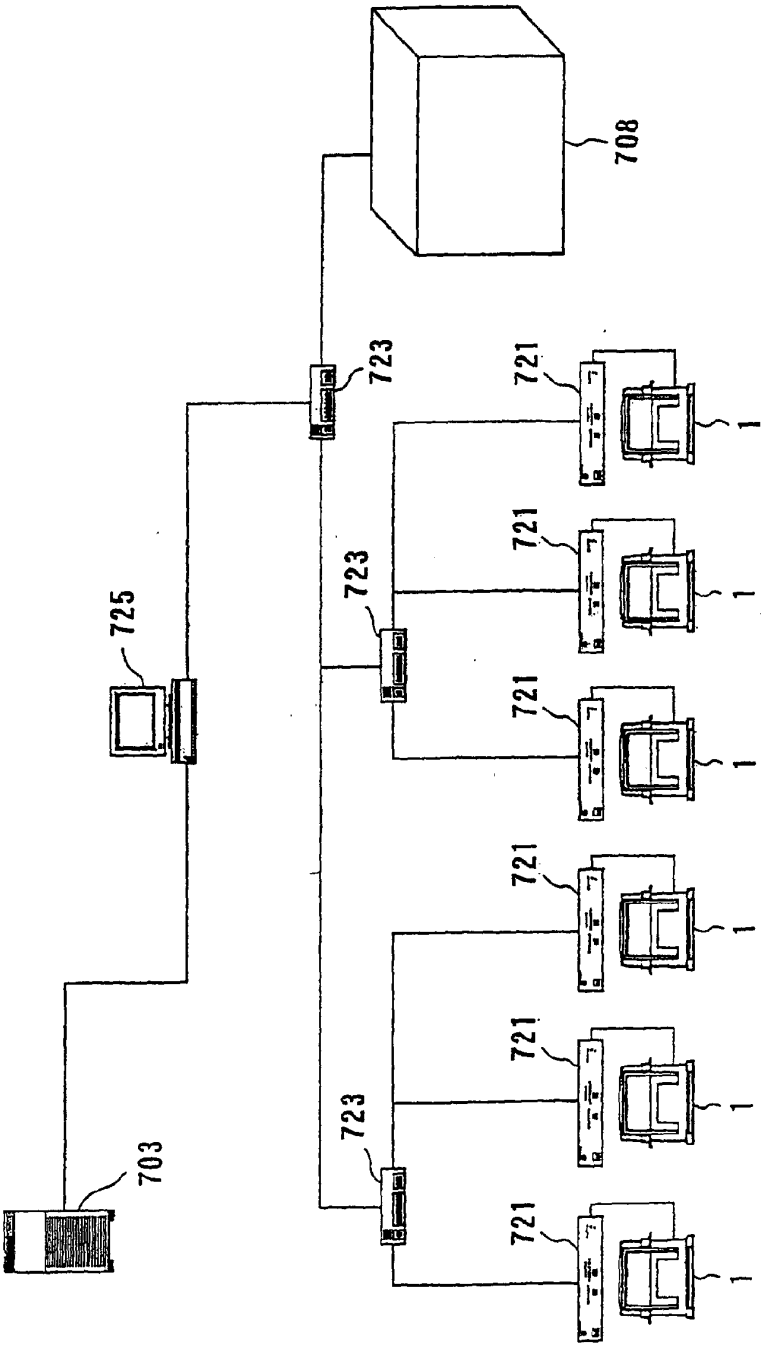
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FIG. 100



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FIG. 101



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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01L21/68, B65G49/06-49/07, B65D85/86, B65G1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] H01L21/68, B65G49/06-49/07, B65D85/86, B65G1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP, 2000-174109, A (Toshiba Corp.), 23 June, 2000 (23.06.00), Full text; Figs. 1, 3, 4, 7 (Family: none)	1,2,4-10, 51-55 3,11-15, 17-38,41-50
A		16,39,40
Y	JP, 9-29020, A (Taisei Corp.), 04 February, 1997 (04.02.97), Par. No. [0058]; Table 5 (Family: none)	3
Y	JP, 6-291177, A (Sony Corp.), 18 October, 1994 (18.10.94), Claims; Fig. 2 (Family: none)	11-15,17-36

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 February, 2002 (26.02.02)	12 March, 2002 (12.03.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

Entegris, EX1002, p. 398

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, 5346518, A1 (International Business Machines Corp.), 13 September, 1994 (13.09.94), Column 16, lines 3 to 22; Fig. 11 & JP 7-94577 A Par. Nos. [0101] to [0102]; Fig. 12 & EP 617573 A & DE 69401023 C	12,30,33
Y	JP, 11-195699, A (Kokusai Electric Co., Ltd.), 21 July, 1999 (21.07.99),	13,15
A	Claims; Figs. 1 to 2 (Family: none)	16
Y	JP, 2000-223554, A (Shinko Electric Co., Ltd.), 11 August, 2000 (11.08.00),	14
A	Claims; Figs. 1 to 2, 5 (Family: none)	16
Y	JP, 11-314703, A (Ebara Corp.), 16 November, 1999 (16.11.99),	15
A	Par. Nos. [0065] to [0067]; Figs. 2 to 3, 29 (Family: none)	16
Y	US, 6040680, A1 (Sanyo Electric Co., Ltd.), 21 March, 2000 (21.03.00), Column 1, lines 10 to 37; Fig. 4 & JP 11-40207 A Par. Nos. [0001] to [0002]; Fig. 4 & TW 381356 B	19-25
Y	EP, 560379, A1 (Ebara Research Co., Ltd.), 15 September, 1993 (15.09.93), Page 7, lines 46 to 53; Fig. 7 & JP 6-29373 A Par. No. [0034]; Fig. 7 & US 5380503 A1 & DE 69304570 C	27
Y	JP, 2000-311936, A (Mitsubishi Materials Silicon Corp.), 07 November, 2000 (07.11.00), Par. No. [0030]; Figs. 1, 8 (Family: none)	31-34
Y	JP, 7-293956, A (Hitachi Plant Engineering & Construction Co., Ltd.), 10 November, 1995 (10.11.95), Column 4, lines 27 to 44; Fig. 1 (Family: none)	32
Y	JP, 7-125806, A (Hitachi, Ltd.), 16 May, 1995 (16.05.95),	37,38,41-50
A	Full text; Figs. 1 to 3 (Family: none)	39,40
Y	JP, 3-143518, A (Mitsubishi Electric Corp.), 19 June, 1991 (19.06.91), Page 2, lower right column, lines 9 to 17; page 3, lower right column, line 9 to page 4, upper right column, line 10; Fig. 6 (Family: none)	45

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

C (Continuation). *DOCUMENTS CONSIDERED TO BE RELEVANT*

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 11-274282, A (TDK Corp.), 08 October, 1999 (08.10.99), Par. No. [0011] (Family: none)	46,50
Y	JP, 2000-253596, A (Matsushita Electric Industrial Co., Ltd.), 14 September, 2000 (14.09.00), Claims; Fig. 1 (Family: none)	47

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1, 8, 37, and 55 relate to a technological matter for removing moisture, particulate matter, and chemical substances from a container.
Claim 11 relates to a technological matter for removing static electricity from a substrate in a container.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

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F16K 15/06 *(2006.01)*

(86) International application number:
PCT/JP2003/012612

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WO 2004/038789 (06.05.2004 Gazette 2004/19)

(54) **SUBSTRATE STORAGE CONTAINER**

SUBSTRATSPEICHERBEHÄLTER

RECIPIENT DE STOCKAGE DE SUBSTRAT

(84) Designated Contracting States:
DE FR IT

(30) Priority: **25.10.2002 JP 2002311275**
28.11.2002 JP 2002344954

(43) Date of publication of application:
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(73) Proprietor: **SHIN-ETSU POLYMER CO., LTD.**
Tokyo 103-0023 (JP)

(72) Inventors:
- **SUMI, Atsusi**
  Itoigawa-shi, Niigata 941-0067 (JP)
- **TODA, Junya**
  Itoigawa-shi, Niigata 941-0067 (JP)
- **NAKAYAMA, Takayuki**
  Itoigawa-shi, Niigata 941-0062 (JP)

(74) Representative: **Oppermann, Frank**
Luderschmidt, Schüler & Partner
Patentanwälte
John-F-Kennedy-Strasse 4
65189 Wiesbaden (DE)

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JP-A- 2000 315 724	**JP-U- 5 034 371**
JP-U- 6 006 843	**JP-U- 62 193 537**
US-A- 4 909 276	**US-A- 5 879 458**
US-A- 6 044 874	**US-B1- 6 199 604**

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EP 1 555 689 B1

Description

Technical Field

[0001] The present invention relates to a gas-purgeable, substrate storage container for storing substrates such as semiconductor wafers, photomask glass, and detailedly relates to a valve unit for gas purging, for controlling the gas flow, both into and from, the substrate storage container.

Background Art

[0002] In the recent semiconductor industry, as seen in the case of DRAM (Dynamic Random Access Memory) production, while there has been competition for acquisition of market-share due to cost reduction of semiconductor devices, revision of the production system, for cost reduction, as well as development of semiconductor wafers used for production of semiconductor devices into large sizes (300 mm or greater) have been in progress.

[0003] As to the revision of the production system, there is an example where the system in which the whole semiconductor manufacturing plant is kept as a highly clean environment (e.g., class 10 clean or above) to manufacture semiconductor devices is transferred to the system in which multiples processing steps of semiconductor wafers are divided into sections, each interior space being maintained to be highly clean while semiconductor wafers are conveyed by substrate storage containers between the processing steps.

[0004] According to such a new system, the installation cost for clean room construction as well as the running cost for its maintenance can be sharply cut down, and yet with increased production yield in the semiconductor device manufacturing.

[0005] The standards of the substrate storage containers used in the semiconductor production plant using this new system are specified by SEMI standards (E19, E47.1, E62, E63 and others), so that the container has a conveyance device for automated in-plant transportation and a door in compliance with FIMS, which can be attached and removed by automation. Further, the substrate storage container is demanded to have high hermetic sealing property for avoiding contamination of the semiconductor wafers and also, in order to keep the interior of the container body clean it should be formed using clean material that emits a lower amount of volatile gases.

[0006] The minimum conductor width of electronic circuits formed on semiconductor devices tends to be smaller and smaller (0.01 pm or below). In order to facilitate this, it is necessary to prevent the surfaces of the semiconductor wafers held in the substrate storage container from being formed with a natural oxide film and being contaminated with organic matter. As a countermeasure against this, there is a method called the gas purge (replacement) technique, which drives out the interior of the substrate storage container with an inert gas such as nitrogen or dry air with moisture removed (equal to or below 1%).

[0007] With regard to this, some techniques have been proposed: a filter is attached by providing a partial opening in the substrate storage container; or valves such as check valves, etc., are provided at the periphery of the opening so as to achieve gas purging (see Japanese Patent Application Laid-open Hei 11 No.191587 and Japanese Patent Application Disclosure 2002-510150).

[0008] The conventional substrate storage containers, which are constructed and gas purged as above, suffer from the following problems.

[0009] First, in the case where gas purge is performed with a valve attached to the substrate storage container, an engagement structure for valve attachment is needed. However, this engagement structure increases the complexity of the arrangement. An ordinary valve has a hollow portion with a narrow opening, and a shutoff valve that closes this opening is provided to come into contact with a tapered portion of the opening, creating a sealing structure. This shutoff valve is readily displaced by repeated usage, resultantly presenting a leakage problem due to imperfect seal. Further, since the ordinary valve incorporates more than a few metallic parts such as a spring for valve control and the like, there is a fear that a very small quantity of metal ions, discharged from the metal parts while the substrate storage container is put in storage or during its cleaning, infiltrates into the substrate storage container, contaminating semiconductor wafers.

[0010] On the other hand, in the case where a filter is merely attached to the substrate storage container, gas purge can be done with a simple configuration. In this case, however, there is a problem in that the purging gas charged through the filter, however, cannot be kept inside the substrate storage container. Therefore, the gas in the substrate storage container can easily leak out, so that the gas purge effect can be maintained in only a short period. There is also a problem in that it is impossible to effectively prevent a trace amount of organic matter in the clean room from flowing into the interior of the substrate storage container from exterior because there is a passage between inside and outside of the substrate storage container.

[0011] US 5,879,458 describes a system for molecular contamination control comprising a housing forming a chamber. A valve unit is inserted in a through-hole of the housing. The valve unit comprises a fixed sleeve fitted in the through-hole and a check valve fitted in the fixed sleeve. The check valve comprises an outer sleeve and a ball inserted into the outer sleeve so as to allow one-way flow of working fluid through the opening of the outer sleeve only.

[0012] US 6,199,604 discloses a substrate storage container comprising an inlet and outlet valve unit. The valve unit comprises a fixed sleeve fitted in a through-hole of the housing and a holding sleeve connected to the fixed sleeve. An elastic check-valve comprising an

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elastically deformable element is arranged between the holding sleeve and the fixed sleeve.

[0013] In view of the above, it is an object of the present invention to provide a substrate storage container according to claim 1 in which the engagement structure for valve attachment can be simplified, which can prevent displacement of the valve due to repeated usage and hence prevent incomplete sealing and which is free from the risk of traces of discharged metal ions contaminating the substrates. It is also another object to enable relatively long-term holding of purging gas and to efficiently prevent inflow of contaminant from the outside to the inside of the container.

[0014] Here, the container bodies within the range of the claims are mainly of a front-open box type. However, a top-open, bottom-open or side-open type may be used. Also, whether it is transparent or opaque is not particularly limited. This container body accommodates a single or a multiple number of substrates or the like such as semiconductor wafers, photomask glass, etc. The gas is usually inert gas or dry air, but is not particularly limited.

[0015] Also, the valve units maybe attached to the through-holes in both the container body and the door, or may be the through-holes in either the container body or the door. One or plural valve units may be used. The elastic check valve can be formed of a single part or made up of separate parts, i.e., a check valve and an elastically deformable element. A single or multiple sealing elements may be attached to the check valve, so that the sealing element(s) is placed into deforming contact with the fixed sleeve or the interior lid sleeve. The elastically deformable element may be built in the holding sleeve, leaving a clearance therebetween, but not necessary so. Further, the interior lid sleeve may be supported by the holding sleeve by an engaging means made up of concave and convex shapes.

Brief Description of Drawings

[0016]

Fig.1 is a perspective exploded view showing the embodiment of a substrate storage container according to the present invention.

Fig.2 is a bottom view showing a container body in the embodiment of a substrate storage container according to the present invention.

Fig.3 is a perspective exploded view showing a valve unit, cut along a chain line I-I in Fig.1, in the embodiment of a substrate storage container according to the present invention.

Fig.4 is a sectional illustrative view showing a gas inlet valve in the embodiment of a substrate storage container according to the present invention.

Fig.5 is a sectional illustrative view showing the gas inlet valve, shown in Fig.4, to which gas is supplied.

Fig.6 is a sectional illustrative view showing a gas discharge valve in the embodiment of a substrate storage container according to the present invention.

Fig.7 is a sectional illustrative view showing the gas discharge valve, shown in Fig. 6, from which gas is discharged.

Fig.8 is an illustrative plan view showing a jig for gas purge in the embodiment of a substrate storage container according to the present invention.

Fig.9 is a side view showing the jig for gas purge in Fig.8 in its usage state.

Fig.10 is a sectional illustrative view showing a gas inlet valve in the second embodiment of a substrate storage container according to the present invention.

Fig.11 is a sectional illustrative view showing a gas discharge valve in the second embodiment of a substrate storage container according to the present invention.

Fig.12 is a perspective exploded view showing the third embodiment of a substrate storage container according to the present invention.

Fig.13 is a bottom view showing a container body in the third embodiment of a substrate storage container according to the present invention.

Fig.14 is a perspective exploded view showing a valve unit, cut along a chain line II-II in Fig.12, in the third embodiment of a substrate storage container according to the present invention.

Fig.15 is a sectional illustrative view showing a gas inlet valve in the third embodiment of a substrate storage container according to the present invention.

Fig.16 is a sectional illustrative view showing the gas inlet valve, shown in Fig.15, to which gas is supplied.

Fig.17 is a sectional illustrative view showing a gas discharge valve in the third embodiment of a substrate storage container according to the present invention.

Fig.18 is a sectional illustrative view showing the gas discharge valve shown in Fig.17, from which gas flows out to the outside.

Fig.19 is a partial sectional illustrative view showing the fourth embodiment of a substrate storage container according to the present invention.

Fig.20 is a partial sectional illustrative view showing the fifth embodiment of a substrate storage container according to the present invention.

Fig.21 is a sectional illustrative view showing a gas inlet valve in the sixth embodiment of a substrate storage container according to the present invention.

Fig.22 is a sectional illustrative view showing a gas discharge valve in the sixth embodiment of a substrate storage container according to the present invention.

Fig.23 is a sectional illustrative view showing a gas discharge valve in the seventh embodiment of a substrate storage container according to the present invention.

Fig.24 is a sectional illustrative view showing a gas inlet valve in the seventh embodiment of a substrate storage container according to the present invention.

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Best Mode for Carrying Out the Invention

[0017] The preferred embodiment of the present invention will be described hereinbelow with reference to the drawings. The substrate storage container of the present embodiment is comprised of, as shown in Figs. 1 to 7, a container body 1 for accommodating and aligning a plurality of semiconductor wafers W in horizontal layers along the vertical direction, a door 10 which is removably attached to the front opening of the container body 1 to open and close it, and a pair of valve units 20 disposed in the bottom of container body 1 for controlling gas flow with respect to container body 1. Of the pair of valve units 20, one valve unit 20 is used as a gas inlet valve 20A, the other valve unit 20 as a gas discharge valve 20B.

[0018] As the semiconductor wafers W, 25 or 26 pieces of 300 mm silicon wafers, for example, may be accommodated therein.

[0019] As shown in Fig.1, container body 1 is formed as a front-open box type, having an opening on one side or on the front, using polycarbonate or the like, added with carbon fibers, conductive polymers or the like so as to present conductivity. Provided on both the interior sides are supporting structures (not shown) for supporting the rims of semiconductor wafers W at both sides by supporting pieces. As shown in Fig.2 an approximately Y-shaped, in plan view, bottom plate 2 having through-holes for detection and discrimination of the substrate storage container type is removably attached to the bottom of this container body 1. This bottom plate 2 has positioning members 3 having an approximately V-shaped section and arranged at both sides in front and one in the rear for positioning with respect to processing equipment. Other than these plurality of positioning members 3, bottom plate 2 has through-holes for attachment of an identification maker and clamp holes for fixture to the container body are bored, respectively.

[0020] Formed on both sides on the front part of the bottom of the container body, or in other words, in the area not overlapping the projected area of semiconductor wafers W, are round through-holes 4, respectively, as shown in Figs.1 to 3. At the periphery of each through-hole 4, a cylindrical rib 5 externally projected downwards is integrally formed. A handle 6 is removably attached to the top of container body 1. This handle 6 is held by an automaton called OHT (overhead hoisting transfer), whereby the substrate storage container is transferred from one step to another. A wide rim portion 7 for door fitting is integrally formed around the periphery of the front opening of container body 1. Formed in the interior of the rib portion 7 at both the top and bottom are hollow, door engagement slots 8. A pair of carrying handles 9 for manual handling are removably attached externally on both side of container body 1.

[0021] Door 10 is formed in a laterally long, approximately rectangular shape with four rounded corners, and incorporates an unillustrated interlocking mechanism. This interlocking mechanism includes a multiple number of retractable engagement prongs, which can project and retract from retraction holes 11 on the peripheral wall, and project and fit into engagement slots 8 of rim portion 7, so that the door 10 fitted to container body 1 will be tightly closed. A stepped portion that fits rim portion 7 of container body 1 is projectively formed on the rear side of door 10. Attached in a removable manner to this stepped portion is a front retainer 12 for supporting and aligning multiple semiconductor wafers W in their horizontal position with a predetermined pitch along the vertical direction. An endless gasket 13 for seal with container body 1 is fitted on the peripheral wall of door 10.

[0022] Here, container body 1, bottom plate 2, handle 6, carrier handles 9 and door 10 are formed of thermoplastic resin such as, for example, polycarbonate, polyetherimide, polyetheretherketone, cyclic olefine polymer (COP), or one of these added with conductivity.

[0023] As shown in Fig.3 and others, each valve unit 20 is constructed of a fixed sleeve 21 that is removably attached to rib 5 of through-hole 4 of container body 1 from below and forms the gas flow passage, a holding sleeve 25, removably attached to through-hole 4 of container body 1 from above with an O-ring 31 for seal interposed therebetween and screw fitted with fixed sleeve 21, a check valve 32 built in for defining a clearance 33 between the fixed sleeve 21 and holding sleeve 25, an elastically deformable element 36 for opening and closing this check valve 32, an interior lid sleeve 37 that opposes check valve 32 and holds elastically deformable element 36 and forms the gas flow passage, and a disk-shaped filter 42 interposed between holding sleeve 25 and interior lid sleeve 37. Check valve 32 and elastically deformable element 36 constitute an elastic check valve, which controls gas flow from fixed sleeve 21 to holding sleeve 25.

[0024] As shown in Figs.3 to 7, fixed sleeve 21 is basically a cylinder with a base, formed using polycarbonate, polyetherimide, polyetheretherketone, or the like, with a threaded groove 22 incised for fastening formed on the inner periphery thereof. This fixed sleeve 21 has a round vent port 23 formed at the bottom center for creating a gas flow passage. An annular flange 24 extending radially outwards is formed around the outer periphery at the bottom. This flange 24 abuts from below against the rim of the opening of rib 5.

[0025] As shown in Figs. 3 and 4, holding sleeve 25 is basically formed of the same resin as fixed sleeve 21, for example, in a cylindrical shape that is formed in a size smaller to snugly fit into fixed sleeve 21. In the opening top, sectioning ribs 27 for sectioning the opening into multiple vents 26 for gas flow passage are formed in a lattice-like or radial configuration. The underside of these sectioning ribs 27 serve as an abutment face 28 having a corresponding shape to a filter 42 and receiving it. This holding sleeve 25 has an annular flange 29 that extends radially outwards from the upper peripheral side. This flange 29 comes into contact from above with the rim of through hole 4. A thread 30 for fastening is formed on

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the outer periphery of holding sleeve 25 so that this thread 30 will mesh with threaded groove 22 of fixed sleeve 21.

[0026] O-ring 31 is disposed between through-hole 4 and the outer periphery of holding sleeve 25 to effectively prevent infiltration of gas into container body 1 and gas leakage from container body 1.

[0027] Check valve 32, as shown in Figs.3 to 7 and others, is formed in a disk-like configuration having an approximately plate-shaped section or an approximately hat-like section, using predetermined material based on the usage of valve unit 20, and is fitted and placed on the interior base of fixed sleeve 21 so as to cover the round vent port 23 and define clearance 33 as gas flow passage in cooperation with the inner periphery of holding sleeve 25. As the material for this check valve 32, polyethylene, polypropylene, polycarbonate, cyclic polyolefin polymer, thermoplastic polyester elastomer can be referred to, for example. A guided part 34 having an approximate concave-top section for preventing displacement is projectively formed from the center of the check valve 32 surface while an endless sealing element 35 is fitted along the periphery on the undersurface. This sealing element 35 provides the function of a sealing contact, by deformation, with the inner base of fixed sleeve 21.

[0028] Sealing element 35 is an O-ring, for example, or an elastic ring formed of fluoro rubber, NBR rubber, urethane rubber, EPDM rubber, silicone rubber or the like, coated with fluorine or silicone on the surface thereof, as appropriate. When formed with metal, the surface is coated with resin. When valve unit 20 is used as a gas discharge valve 20B instead of its usage as a gas inlet valve 20A as shown in Figs. 4 and 5, this sealing element 35 is fitted to the stepped periphery on the surface side of check valve 32 and pressed against the opening rim of interior lid sleeve 37, as shown in Figs. 6 and 7.

[0029] When valve unit 20 is used as a gas inlet valve 20A, the thus constructed check valve 32 covers vent port 23 of fixed sleeve 21 by the elastically repulsive action of elastically deformable element 36, as shown in Fig.4. On the other hand, when valve unit 20 is used as a gas discharge valve 20B, the check valve and elastically deformable element 36 are arranged upside down, and is placed on and supported by elastically deformable element 36 and pressed against the opening rim of interior lid sleeve 37 (see Figs.6 and 7).

[0030] Elastically deformable element 36 is comprised of a coil spring formed of SUS, synthetic resin or the like, and is disposed between guided part 34 of check valve 32 and interior lid sleeve 37 or between the inside of check valve 32 and fixed sleeve 21. This elastically deformable element 36, in most cases, employs a coil spring shown in the drawings, but is not limited to this. Elastic rubbers, elastomers, foamed materials, leaf springs and the like can also be used. Further, coil springs with their surface coated with a synthetic resin or elastomer can be used. In this case, discharge of a trivial amount of metal ions can be preferably prevented.

[0031] When valve unit 20 is used as a gas inlet valve 20A, the elastically deformable element 36 is fitted to the recessed surface side of check valve 32 as seen in Figs. 3 to 5. When valve unit 20 is used as a gas discharge valve 20B, the elastically deformable element is arranged upside down with respect to check valve 32 and placed at the periphery of vent port 23 of fixed sleeve 21 (see Figs.6 and 7).

[0032] Interior lid sleeve 37 is basically formed in a cylindrical shape, as shown in Figs.3 to 7, of the same material as fixed sleeve 21, with sectioning ribs 39 for sectioning its top opening into multiple vents 38 for gas flow passage in a lattice-like or radial configuration, and is held in holding sleeve 25 and placed in contact with elastically deformable element 36. This interior lid sleeve 37 is fitted and supported by means of a concavo-convex mating structure into holding sleeve 25 while an O-ring 40 for sealing is disposed between the interior lid sleeve and the upper interior part of holding sleeve 25. A guide element 41 having an approximate convex-top section for assembly convenience and limiting displacement is projectively formed from the center of the undersurface of sectioning ribs 39 of interior lid sleeve 37. This guide element 41 slidably mates into guided element 34. One example of the concavo-convex mating structure can be constructed such that a slot formed on the inner periphery of holding sleeve 25 or on the outer periphery of interior lid sleeve 37 may be engaged with a projection to fit into the slot, formed on the outer periphery of interior lid sleeve 37 or on the inner periphery of holding sleeve 25.

[0033] When valve unit 20 is used as a gas inlet valve 20A, this interior lid sleeve 37 is in contact with elastically deformable element 36, while, when valve unit 20 is used as a gas discharge valve 20B, this interior lid sleeve 37 is in contact with elastically deformable element 36, its open bottom is pressed against the peripheral part of check valve 32 with sealing element 35 in between (see Figs.6 and 7).

[0034] Filter 42 is composed of a molecular filter consisting of tetrafluoroethylene, polyester fiber, porous Teflon (registered trademark) film and glass fiber and/or a chemical filter in which chemical adsorbents are deposited on filter media such as activated carbon fiber and the like. A single or multiple number of filters are interposed and held between abutment face 28 of holding sleeve 25 and sectioning ribs 39 of interior lid sleeve 37 so as to cover the vents 38 of interior lid sleeve 37. A protective member made of polypropylene, polyethylene or the like is laminated as appropriate over the front and rear sides of filter 42.

[0035] When a multiple number of filters 42 are employed, the same type of filters may be used or different types of filters may be used. For example, if a molecular filter and a chemical filter are used in combination, organic gas contamination in addition to particle contamination of wafers W can be prevented.

[0036] Though assembly of valve unit 20 may be done by thread joint, another joint may be used alone or in combination with thread joint. For example, a recessed

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portion may be formed in one of fixed sleeve 21 and holding sleeve 25 while a projected portion may be formed in the other, so that these recess and projection can mate each other to complete fixture. It is also possible to form a recessed portion in one of holding sleeve 25 and interior lid sleeve 37 and a projected portion in the other, so that these recess and projection can be mated to each other to complete fixture.

[0037] Gas purge of the substrate storage container having the thus configured valve units 20 is carried out during being docked to the door opening/closing machine (load port or door opener), during storage at the stocker, during engagement in the process and/or during conveyance on the way to the stocker. For this purpose, if the machine side is equipped with a gas purge jig 60 and the substrate storage container is set to the gas purge jig 60, smooth, efficient and easy performance of gas purging can be expected.

[0038] Gas purge jig 60 may be configured of, as shown in Figs.5 and 7 to 9, for example, a housing body 62 having substrate storage container positioning pins 61 laid out in an approximate Y-arrangement, an air feed nozzle 63 disposed in the housing body 62 and connected to one valve unit 20, an air discharge nozzle 64 disposed in housing body 62 and connected to another valve unit 20, an air feed path built in housing 62 for connection between air feed nozzle 63 and a gas feed source and an air discharge path built in housing 62 for connection between air discharge nozzle 64 and a discharge device.

[0039] For air feed nozzle 63 and air discharge nozzle 64, seal forming means for prevention against gas leakage is formed appropriately around their projected portions. For example, air feed nozzle 63 is configured so that it projects from the contact surface of housing body 62 so as to be connected to valve unit 20 when it is used and it sinks in to housing body 62 so as to flatten the contact surface of housing body 62 when it is not used.

[0040] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, check valve 32 of gas inlet valve 20A is pressed against the interior bottom face of fixed sleeve 21 via sealing element 35 by the repulsive force of elastically deformable element 36 so as to close vent port 23, completing a sealed state (see Fig.4).

[0041] In contrast, when a gas such as an inert gas etc., is fed from air feed nozzle 63 of gas purge jig 60 to gas inlet valve 20A, the pressure of the gas ejected from air feed nozzle 63 urges check valve 32 of gas inlet valve 20A toward interior lid sleeve 37, compressing elastically deformable element 36 in the same direction, whereby check valve 32 forms a gap with respect to vent port 23 of fixed sleeve 21, releasing the sealed state (see Fig. 5). This cancellation of the sealed state causes gas to flow from the substrate storage container exterior, passing through the clearance 33 between vent port 23 of fixed sleeve 21 and check valve 32, the gap, interior lid sleeve 37 and filter 42, in the order mentioned, into the interior of the substrate storage container.

[0042] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, elastically deformable element 36 of gas discharge valve 20B presses check valve 32 over sealing element 35 and toward and against the opening rim of interior lid sleeve 37, forming a sealed state.

[0043] In contrast, when the substrate storage container interior is filled up with a gas, the pressure of the filling gas presses check valve 32 of gas discharge valve 20B toward fixed sleeve 21, expanding elastically deformable element 36 in the same direction, forming clearance 33 between check valve 32 and interior lid sleeve 37 to cancel the sealed state. This cancellation of the sealed state causes gas to flow out from the substrate storage container interior, passing through filter 42, interior lid sleeve 37, the clearance between check valve 32 and interior lid sleeve 37, the gap and vent port 23 of fixed sleeve 21, in the order mentioned, to the outside of the substrate storage container. In this case, gas purge can be efficiently done if air discharge nozzle 64 of gas purge jig 60 is connected to gas discharge valve 20B so as to reduce the pressure.

[0044] According to the above configuration, it is possible to create a firm engagement structure which is free of possible dislodgment by abutting flanges 24 and 29 of fixed sleeve 21 and holding sleeve 25 mating each other, against through-hole 4 and rib 5 of container body 1. Therefore, the configuration of the engagement structure can be made simple, and still the metallic mold for container body 1 can be simplified. Further, since guided part 34 and guide element 41 mate each other, providing the function of controlling positional displacement, check valve 32 can operate stably never causing positional displacement even with repeated use. Accordingly, it is possible to provide an efficient solution to the problem whereby leakage occurs due to imperfect sealing hence beneficial gas purge can be expected. Further, since valve unit 20 does not need to incorporate a number of metallic parts, it is possible to inhibit a trace amount of metal ions from being released from such a metal part when the substrate storage container is kept in storage or washed, and it is also possible to expect simplification and cost reduction of valve unit 20.

[0045] Moreover, fitting of a sealing element 35 to check valve 32 at the peripheral part of the front or rear surface, as appropriate so that it will be pressed in the perpendicular direction, makes it possible for valve unit 20 to be effectively used as a gas inlet valve 20A or as a gas discharge valve 20B. As a result, it is possible to lengthen the retention duration of the replaced gas in the interior of the substrate storage container, hence maintain the gas purge effect for a long period. Also, since the clearance 33 between holding sleeve 25 and the periphery of check valve 32 can be made wide open, efficient gas purge can be greatly expected. Further, since valve unit 20 incorporating filter 42 is attached to the sub-

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strate storage container, the filter 42 is not only effective in gas purging but also in retaining the purging gas in the substrate storage container interior. Accordingly, the gas will not readily flow outside from the substrate storage container, hence it is possible to maintain the gas purge effect for a prolonged period of time. Moreover, since provision of valve units 20 allow for indirect communication between the interior and exterior of the substrate storage container, it is possible to almost perfectly prevent the organic matter that trivially exists in the clean room from infiltrating into the inside from the outside of the substrate storage container.

[0046] Next, Figs.10 and 11 show the second embodiment of the present invention. In this case, a check valve 32A is constructed so as to be used both in a gas inlet valve 20A and in a gas discharge valve 20B.

[0047] Check valve 32A basically is a solid form having an approximately convex-top section, with a pair of round holes for guided parts 34, formed at the center thereof in both the front and rear sides. An annular sealing element 35 is fitted along the periphery of the underside. The check valve is formed marginally smaller than the inside diameter of an interior lid sleeve 37. A pair of guided parts 34, not being connected to each other, have a partition therebetween. When the valve is used as a gas inlet valve 20A, this check valve 32A is set with its projected portion up, as shown in Fig.10. When the valve is used as a gas discharge valve 20B, the check valve is set upside down as shown in Fig.11.

[0048] Interior lid sleeve 37 basically has a configuration similar to that of the above embodiment, however, an annular sealing element 35 that will be in contact with the periphery of check valve 32A or sealing element 35, is additionally bonded to the interior ceiling of the interior lid sleeve. Other components are the same as in the above embodiment so that description is omitted.

[0049] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. In addition, since common parts can be used, it is no longer necessary to provide plural types of check valves 32A depending on the usage of valve units 20. Accordingly, it is evidently expected that assembly work and management can be greatly made efficient.

[0050] Here, a grooved hole may be formed along the periphery on each of both the front and rear sides of check valve 32A so that a sealing element 35 is selectively fitted into these paired grooved holes.

[0051] Next, Figs.12 to 18 show the third embodiment of the present invention. In this case, each valve unit 20 is constructed of a fixed sleeve 21 that is removably attached to rib 5 of a through-hole 4 of a container body 1 from below and forms the gas flow passage, a holding sleeve 25, removably attached to through-hole 4 of container body 1 from above with an O-ring 31 for sealing interposed therebetween and screw fitted with fixed sleeve 21, an elastic check valve 32B built in for defining a clearance 33 between the fixed sleeve 21 and the holding sleeve 25, an elastically deformable element 36A having air permeability and continuous porosity, deforming the check valve 32B, an interior lid sleeve 37 that is in contact with elastically deformable element 36A and forms the gas flow passage and a disk-shaped filter 42 interposed between holding sleeve 25 and interior lid sleeve 37 while no guided part 34 and guide element 41 is provided. Each valve unit 20 is used for plural gas inlet valves 20A and gas discharge valves 20B.

[0052] Formed on both sides on the front and rear parts of the bottom of container body 1, or in other words, in the area not overlapping the projected area of semiconductor wafers W, are round through-holes 4, respectively, as shown in Fig.13. At the periphery of each through-hole 4, a cylindrical rib 5 externally projected downwards is integrally formed. Fixed sleeve 21, holding sleeve 25 and filter 42 in each valve unit 20 are the same as those in the above embodiment, so that description is omitted.

[0053] As shown in Fig.14, check valve 32B is formed of a predetermined elastomer, in an approximately disk-shape, in plan view, having an approximately H-shaped section and is fitted and mounted in the interior base of fixed sleeve 21 so as to cover a round vent port 23 and form a small clearance 33 for gas flow passage between itself and the inner peripheral surface of holding sleeve 25. For the material of this flexible check valve 32B, rubbers including melamine rubber, isoprene rubber, butyl rubber, silicone rubber and fluororubber, polyester thermoplastic elastomer and other thermoplastic elastomers can be used. The check valve 32B side that opposes fixed sleeve 21 is appropriately formed with a concavo-convex surface for sealing.

[0054] When the valve unit 20 is used as gas inlet valve 20A, the check valve 32B covers vent port 23 of fixed sleeve 21 by the repulsive force of elastically deformable element 36A as shown in Fig. 15. On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, the check valve 32B and elastically deformable element 36A are laid upside down so that the check valve rests on elastically deformable element 36A and comes into press contact with the opening periphery of interior lid sleeve 37 (see Figs.17 and 18).

[0055] As shown in Fig.14, elastically deformable element 36A is given in the form of a continuous porous ring made of a predetermined foaming material so as to enable communication between the interior and exterior of container body 1, and is fitted to the interior of holding sleeve 25 and rests on the outer periphery of check valve 32B while defining a small clearance 33 for gas flow passage in cooperation with the interior peripheral surface of holding sleeve 25. This endless elastically deformable element 36A is made from, for example, rubbers such as melamine rubber, isoprene rubber, butyl rubber, silicone rubber and fluororubber, polyethylenes, elastic and permeable unwoven cloth and the like. Because check valve 32B is compressed and deformed when operated, the degree of compressive strain is set to be low. The shape of elastically deformable element 36A is not limited to annular forms, but may be given in any other form, for

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example, in a cylindrical form, etc. , as long as it can provide the necessary air permeability.

[0056] When valve unit 20 is used as a gas inlet valve 20A, the thus constructed elastically deformable element 36A is set on the periphery of check valve 32B as shown in Fig.15. On the other hand, when valve unit 20 is used as a gas discharge valve 20B, the check valve 32B and elastically deformable element 36A are laid upside down so that the elastically deformable element is fitted and placed on the inner base surface of fixed sleeve 21 (see Figs.17 and 18). Other components are the same as in the above embodiment so that description is omitted.

[0057] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, check valve 32B of gas inlet valve 20A is pressed against the interior base face of fixed sleeve 21 via sealing element 35 by the repulsive force of elastically deformable element 36A so as to close vent port 23, completing a sealed state (see Fig.15).

[0058] In contrast, when a gas such as an inert gas etc., is fed from an air feed nozzle 63 of a gas purge jig 60 to gas inlet valve 20A as indicated by the arrows in Fig.16, the pressure of the gas ejected from air feed nozzle 63 urges check valve 32B of gas inlet valve 20A toward interior lid sleeve 37, compressing elastically deformable element 36A in the same direction, whereby the deformed check valve 32B forms clearance 33 with respect to vent port 23 of fixed sleeve 21, releasing the sealed state. This cancellation of the sealed state causes gas to flow from the substrate storage container exterior, passing through the clearance 33 between vent port 23 of fixed sleeve 21 and check valve 32B, the gap, interior lid sleeve 37 and filter 42, in the order mentioned, into the interior of the substrate storage container.

[0059] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, elastically deformable element 36A of gas discharge valve 20B presses check valve 32B over sealing element 35 against the opening rim of interior lid sleeve 37, forming a sealed state (see Fig.17).

[0060] In contrast, when the substrate storage container interior is filled up with a gas as indicated by the arrows in Fig. 18, the pressure of the filling gas presses check valve 32B of gas discharge valve 20B toward fixed sleeve 21, compressing elastically deformable element 36A in the same direction, forming clearance 33 between deformed check valve 32B and interior lid sleeve 37 to cancel the sealed state. This cancellation of the sealed state causes gas to flow out from the substrate storage container interior, passing through holding sleeve 25, filter 42, interior lid sleeve 37, the clearance 33 between check valve 32B and interior lid sleeve 37, the gap and vent port 23 of fixed sleeve 21, in the order mentioned, to the outside of the substrate storage container. In this case, gas purge can be efficiently done if air discharge nozzle 64 of gas purge jig 60 is connected to gas discharge valve 20B so as to reduce the pressure.

[0061] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since guided part 34 and guide element 41 are omitted, it is obvious that a further simplified configuration can be obtained. Further, since no metal part is used inside valve unit 20, it is possible to avoid any discharge of a trace amount of metal ions from metal parts when the substrate storage container is kept in storage or washed.

[0062] Next, Fig.19 shows the fourth embodiment of the present invention. In this case, a nozzle tower 43 that is connected to a valve unit 20 is made to stand at some or all of through-holes 4 in a container body 1.

[0063] Nozzle tower 43 is basically a hollow cylinder, formed of a predetermined resin such as, for example, polycarbonate, polyetherimide, polyetheretherketone, cycloolefin polymer or the like, and has a row of holes arranged vertically at intervals of a predetermined distance as gas ejection ports 44, on the peripheral wall thereof opposing the side of semiconductor wafers W, whereby gas is fed from these ejection ports 44 toward the semiconductor wafers W. Sectional size of these ejection ports 44 may be all equal in size or may be formed to be gradually greater from the bottom to the top. Other components are the same as that of the above embodiment so the description is omitted.

[0064] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since gas is moved from multiple ejection ports 44 towards semiconductor wafers W, it is obvious that stagnation inside the container body 1 can be cancelled during gas feeding, thus making it possible to sharply reduce the time of purging.

[0065] Next, Fig.20 shows the fifth embodiment of the present invention. In this case, a deflecting plate 45 is provided to stand near any of through-holes 4 in a container body 1, and an elongated part 46 of this deflecting plate 45 is made to oppose valve unit 20 with a gap therebetween.

[0066] Deflecting plate 45 is basically formed so as to have an approximately, inverted L-shaped section, using a predetermined resin such as, for example, polycarbonate, polyetherimide, polyetherketone, cycloolefin polymer and the like, and functions to guide gas flow from the valve unit 20 toward semiconductor wafers W or guide the gas in the substrate storage container to the valve unit 20. Other components are the same as that of the above embodiment so the description is omitted.

[0067] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since deflecting plate 45 regulates gas flow, obviously it is possible to effectively prevent gas from rushing onto the semiconductor wafer W held at the lower most stage and blowing particles over it, or flinging up particles.

[0068] Next, Figs.21 and 22 show the sixth embodiment of the present invention. In this case, the elastic

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check valve for each valve unit 20 is formed of an elastic check valve 32C having an approximately U-shaped section and fitted to a holding sleeve 25 at least leaving a clearance 33 as a flow passage, and an extensible bellows 47 fitted in the check valve 32C in the form of a cylinder with a base, for deforming check valve 32C, with elastically deformable element 36A omitted.

[0069] Bellows 47 is formed in a hollow cylindrical form having flexibility and elasticity, having a multiple number of vent holes 48 for ventilation formed at intervals of a predetermined distance on its peripheral wall. This bellows is laminated to check valve 32C which is located between a fixed sleeve 21 and the bottom of the peripheral wall of an interior lid sleeve 37. This bellows 47 is arranged at either the top or bottom with respect to check valve 32C, depending on whether the valve unit 20 is used as a gas inlet valve 20A or a gas discharge valve 20B. Other components are the same as in the above embodiment so that description is omitted.

[0070] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, bellows 47 of gas inlet valve 20A presses check valve 32C against the interior bottom face of fixed sleeve 21 so as to close a vent port 23, creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0071] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, bellows 47 presses check valve 32C located above, against the opening bottom of interior lid sleeve 37, thus creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0072] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since, instead of being formed of a multiple number of separate parts, the elastic check valve is formed of a check valve 32C for allowing gas to flow when deformed and a bellows 47 providing a spring function, it is expected to reduce the number of parts, hence it is possible to achieve a simple configuration with improved assembly performance and simplified product management.

[0073] Next, Figs. 23 and 24 show the seventh embodiment of the present invention. In this case, the elastic check valve for each valve unit 20 is formed of an elastic check valve 32D fitted to a holding sleeve 25, leaving a clearance 33 for the flow passage and an elastic skirt body 49 for check valve 32D, which is integrated with check valve 32D with a gap in between, with elastically deformable element 36A omitted.

[0074] For the material of check valve 32C and skirt body 49, rubbers including melamine rubber, isoprene rubber, butyl rubber, silicone rubber and fluororubber, polyester thermoplastic elastomer and other thermoplastic elastomers can be used. Formed in check valve 32D are a multiple number of passage holes 50 for ventilation at intervals of a predetermined distance.

[0075] The skirt body 49 is formed in a disk-like form or a cylindrical form having an approximate concave-top section. A thin elastic skirt piece 51 is flexibly extended from the rim of the skirt body, has a hollow, approximately frustoconical shape, and is fitted on the periphery of check valve 32D and integrated with it. This skirt body 49 is arranged at either the top or bottom with respect to check valve 32D, depending on whether the valve unit 20 is used as a gas inlet valve 20A or a gas discharge valve 20B. Other components are the same as in the above embodiment so that description is omitted.

[0076] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, skirt body 49 of gas inlet valve 20A, presses check valve 32D located below by skirt piece 51, against the interior bottom face of fixed sleeve 21 so as to close a vent port 23, creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0077] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, skirt body 49 located below presses check valve 32D located above, by skirt piece 51, against the opening bottom of an interior lid sleeve 37, thus creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0078] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since the elastic check valve is formed of a check valve 32D for allowing gas to flow when deformed and a skirt body 49 providing a spring function, it is expected to reduce the number of parts, hence it is possible to achieve a simple configuration with improved assembly performance and simplified product management.

[0079] In the above, though engagement slots 8 are formed on the interior peripheral surface of rim portion 7 of container body 1, these can be omitted. In this case, the interlocking mechanism for door 10 which operates by external control can be omitted. Further, with some modification of the shape of the check valve 32 shown in Figs.10 and 11, usage mode can be switched by changing the attachment position of elastically deformable element 36 without inverting the check valve 32 itself. It is also possible to provide some projections for valve opening and closing, suctioning hands and other components for the processing equipment for gas feed and discharge.

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[0080] Next, an example of a substrate storage container of the present invention will be explained with a comparative example.

[0081] Using a substrate storage container having the valve units shown in Figs.4 and 6, the oxygen concentration was measured when the interior of the substrate storage container was replaced by nitrogen gas while the retention time the low-oxygen state could be maintained was measured.

[0082] From the measurement results, the system of this example, using nitrogen gas at a flow rate of 20 L/min, could reach levels of 10 ppm oxygen concentration or lower in about 15 minutes. In the examination of the change of the oxygen concentration when the substrate storage container was left without any supply of nitrogen gas, it took about five hours until the oxygen concentration increased up to 1%.

[0083] Thereby, it was confirmed that the low-oxygen state can be maintained for a fixed period when the semiconductor wafers need to be temporarily stored in the course of processing, whereby it is possible to inhibit contamination and surface oxidation of semiconductor wafers.

[0084] In contrast to this, using a substrate storage container having the conventional valve units, the retention time the low-oxygen state could be maintained in the substrate storage container was measured.

[0085] Upon measurement, a pair of through-holes were formed in the bottom of the container body, and a piping route for measurement was prepared so as to connect these through-holes. An oximeter was interposed in this piping route so that the oxygen concentration was measured every one minute. The formed pair of through-holes were sealed at their periphery, and nitrogen gas was fed at a fixed rate into the substrate storage container via an inlet valve. The oximeter used was of a product of Toray Engineering Co., Ltd., having a measurement rage 0.1 ppm to 100 VOL%.

[0086] From the measurement result, change of the oxygen concentration after the substrate storage container was left without any supply of nitrogen gas was examined, and it was found that the oxygen concentration increased to 1% after only 70 minutes or thereabouts.

Industrial Applicability

[0087] The present invention is able to simplify the engagement structure for valve attachment, and provides a configuration that will not allow displacement of the valves even with repeated use. It is also possible to prevent sealing leakage, and hence inhibit the risk of a trace amount of discharged metal ions contaminating the substrates. Further, it is possible to maintain the purging gas for a relatively long period, and prevent contaminants from infiltrating into the container from outside.

Claims

1. A substrate storage container including:

   a container body (1);
   a door (10) for opening and closing the container body (1);
   a valve unit (20) attached to a through-hole (4) formed in, at least, one of the container body (1) and the door (10), for controlling the gas flow with respect to the container body as a gas inlet valve or a gas outlet valve, the valve unit (20) comprising:

   a fixed sleeve (21) for gas flow, fitted in the through-hole (4);
   a holding sleeve (25) for gas flow, threadably mated with the fixed sleeve (21);
   an elastic check valve (32) for controlling gas flow with respect to the container body (1), the check valve being built in between the fixed sleeve (21) and the holding sleeve (25);
   and
   an interior lid sleeve (37) for gas flow, the interior lid sleeve (37) opposing the elastic check valve (32);
   and one of the interior lid sleeve and the fixed sleeve (21) is adapted to be opened and closed by the elastic check valve (32), so that gas will pass through the check valve when the elastic check valve is open while gas will be prevented from passing into the substrate container when the elastic check valve is closed,
   wherein the valve unit is fitted to the through hole as a gas inlet valve or gas discharge valve,
   characterized in that a rib (5) is formed and extended outward from the periphery of the through-hole (4) and the fixed sleeve (21) is formed with a flange (24) that is in contact with the periphery of the rib (5) while the holding sleeve (25) is formed with a flange (29) that is in contact with the periphery of the through-hole (4).

2. The substrate storage container according to claim 1, wherein the through-hole (4) is formed in the bottom of the container body (1).

3. The substrate storage container according to claim 1, or 2, wherein a clearance (33) for gas flow is formed at least between the holding sleeve (25) and the periphery of the elastic check valve (32).

4. The substrate storage container according to any one of claims 1 through 3, wherein the interior lid

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sleeve (37) is fitted in the holding sleeve (25) with an air filter(42) interposed therebetween.

5. The substrate storage container according to any one of claims 1 through 4, wherein the elastic check valve (32) is at least made up of a check valve that is built in the fixed sleeve (21), leaving a clearance, and an elastically deformable element (36) interposed between the check valve (32) and the interior lid sleeve (37), and the opening of the fixed sleeve (21) is adapted to be opened and closed by the check valve, so that gas will pass through when the check valve is open while gas will be prevented from passing when the check valve is closed.

6. The substrate storage container according to any one of claims 1 through 4, wherein the elastic check valve (32) is at least made up of a check valve that is built in the fixed sleeve (21), leaving a clearance, and an elastically deformable element (36) interposed between the check valve (32) and the fixed sleeve (21), and the opening of the interior lid sleeve (37) is adapted to be opened and closed by the check valve, so that gas will pass through when the check valve is open while gas will be prevented from passing when the check valve is closed.

7. The substrate storage container according to any one of claims 1 through 4, wherein the elastic check valve (32) is at least made up of a check valve that is built in the fixed sleeve (2), leaving a clearance (33), and an elastically deformable element for the check valve, and either the check valve (32) or the elastically deformable element (36) is in contact with the interior lid sleeve (37), so that gas will pass through when the check valve is open while gas will be prevented from passing when the check valve is closed.

8. The substrate storage container according to any one of claims 5 through 7, wherein a guide element (34, 41) is provided for either the check valve of the elastic check valve (32) or the interior lid sleeve (37) while a guided part (41, 34) is provided for the other, so that the guide element and the guided part fit to each other in a slidably manner.

9. The substrate storage container according to claim 8, wherein the guide element (41) is formed in the interior lid sleeve (37) so as to have an approximately convex-top section while the guided part (34) is formed in the check valve of the elastic check valve (32) so as to have an approximately concave-top section.

10. The substrate storage container according to any one of claims 5 through 9, wherein a sealing element (35) is attached to the check valve of the elastic check valve (32), and the sealing element is placed into deforming contact with the opening of the fixed sleeve (21) or the interior lid sleeve (37) to seal.

11. The substrate storage container according to any one of claims 1 through 10, wherein the through-hole (4) is formed in the bottom of the container body (1), and a hollow nozzle tower (43) communicating with the valve unit (20) is made to stand, the peripheral wall thereof being formed with gas ejection holes.

12. The substrate storage container according to any one of claims 1 through 10, wherein the through-hole (4) is formed in the bottom of the container body (1), and a deflecting plate (45) is attached in the vicinity of the hole, the deflection plate being formed having an approximately L-shaped section with its longer part opposed to the valve unit (20) with a gap therebetween.

13. The substrate storage container according to any one of claims 1 through 4, 11 and 12, wherein the elastic check valve (32) is at least made up of a check valve (32C) that is build in the fixed sleeve (21), leaving a clearance (33) and an extensible bellows (47) fitted in the check valve, the peripheral wall of the bellows is formed with a passage opening, and the check valve (32C) is designed to be opened and closed by the extension and compression of the bellows.

14. The substrate storage container according to any one of claims 1 through 4, 11 and 12, wherein the elastic check valve (32) is at least made up of a check valve (32D) that is built in the fixed sleeve (21), leaving a clearance (33) and an elastic skirt body (49) integrated with the check valve (32D), a passage opening is formed in the check valve (32D), an approximately cylindrical skirt piece (51) is flexibly extended from the rim of the skirt body and is fitted on the periphery of the check valve, and the check valve is designed to be opened and closed by the deformation of the skirt body.

Patentansprüche

1. Substratspeicherbehälter, mit:

einem Behälterkörper (1);
einer Tür (10) zum Öffnen und Schließen des Behälterkörpers (1);
einer Ventileinheit (20), die an einem Durchgangsloch (4) befestigt ist, das in mindestens dem Behälterkörper (10) oder der Tür gebildet ist, zum Steuern der Gasströmung mit Bezug auf den Behälterkörper als ein Gaseinlassventil oder ein Gasauslassventil, wobei die Ventilein-

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heit (20) umfasst:

einer fest sitzenden Hülse (21) für eine Gasströmung, die in das Durchgangsloch (4) eingefügt ist;
einer Haltehülse (25) für eine Gasströmung, die gewindemäßig mit der fest sitzenden Hülse (21) gepaart ist;
einem elastischen Prüfventil (32) zum Steuern einer Gasströmung mit Bezug auf den Behälterkörper (1), wobei das Prüfventil zwischen der fest sitzenden Hülse (21) und der Haltehülse (25) eingebaut ist;
und
einer inneren Deckelhülse (37) für eine Gasströmung, wobei die innere Deckelhülse (37) dem elastischen Prüfventil (32) gegenüberliegt;
und die innere Deckelhülse oder die fest sitzende Hülse (21) angepasst ist, um durch das elastische Prüfventil (32) geöffnet und geschlossen zu werden, sodass Gas durch das elastische Prüfventil treten wird, wenn das elastische Prüfventil offen ist, während Gas am Durchtreten in den Substratbehälter gehindert wird, wenn das elastische Prüfventil geschlossen ist,
wobei die Ventileinheit an dem Durchgangsloch als ein Gaseinlassventil oder ein Gasauslassventil eingefügt ist,
dadurch gekennzeichnet, dass eine Rippe (5) gebildet wird und sich nach außen von dem Umfang des Durchgangslochs (4) erstreckt, und die fest sitzende Hülse (21) mit einem Flansch (24) gebildet wird, der in Kontakt mit dem Umfang der Rippe (5) ist, während die Haltehülse (25) mit einem Flansch (29) gebildet ist, der in Kontakt mit dem Umfang des Durchgangslochs (4) ist.

2. Substratspeicherbehälter gemäß Anspruch 1, bei dem das Durchgangsloch (4) in dem Boden des Behälterkörpers (1) gebildet ist.

3. Substratspeicherbehälter gemäß Anspruch 1 oder 2, bei dem ein Zwischenraum (33) für eine Gasströmung mindestens zwischen der Haltehülse (25) und dem Umfang des elastischen Prüfventils (32) gebildet ist.

4. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 3, bei dem die innere Deckelhülse (37) in der Haltehülse (25) mit einem dazwischen angeordneten Luftfilter (42) eingefügt ist.

5. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil, das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum (32) belassen wird, und einem elastisch verformbaren Element (36), das zwischen dem Prüfventil (32) und der inneren Deckelhülse (37) angeordnet ist, gebildet wird, und die Öffnung der fest sitzenden Hülse (21) angepasst ist, um durch das Prüfventil geöffnet und geschlossen zu werden, sodass Gas durchtreten wird, wenn das Prüfventil offen ist, während Gas am Durchtreten gehindert wird, wenn das Prüfventil geschlossen ist.

6. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil, das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum belassen wird, und einem elastisch verformbaren Element (36), das zwischen dem Prüfventil (32) und der fest sitzenden Hülse (21) angeordnet ist, gebildet wird, und die Öffnung der inneren Deckelhülse (37) angepasst ist, um durch das Prüfventil geöffnet und geschlossen zu werden, sodass Gas durchtreten wird, wenn das Prüfventil offen ist, während Gas am Durchtreten gehindert wird, wenn das Prüfventil geschlossen ist.

7. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil, das in der fest sitzenden Hülse (2) eingebaut ist, wobei ein Zwischenraum (33) belassen wird, und einem elastisch verformbaren Element für das Prüfventil gebildet wird, und entweder das Prüfventil (32) oder das elastisch verformbare Element (36) in Kontakt mit der inneren Deckelhülse (37) ist, sodass Gas durchtreten wird, wenn das Prüfventil offen ist, während Gas am Durchtreten gehindert wird, wenn das Prüfventil geschlossen ist.

8. Substratspeicherbehälter gemäß einem der Ansprüche 5 bis 7, bei dem ein Führungselement (34, 41) entweder für das Prüfventil des elastischen Prüfventils (32) oder die innere Deckelhülse (37) bereitgestellt wird, während ein geführtes Teil (41, 34) für das Andere der beiden bereitgestellt wird, sodass das Führungselement und das geführte Teil auf eine verschiebbare Art und Weise zueinander eingefügt sind.

9. Substratspeicherbehälter gemäß Anspruch 8, bei dem das Führungselement (41) in der inneren Dekkelhülse (37) gebildet ist, um einen näherungsweise konvexen oberen Abschnitt aufzuweisen, während das geführte Teil (34) in dem Prüfventil des elastischen Prüfventils (32) gebildet ist, um einen näherungsweise konkaven oberen Abschnitt aufzuweisen.

10. Substratspeicherbehälter gemäß einem der Ansprü-

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che 5 bis 9, bei dem ein Dichtungselement (35) an dem Prüfventil des elastischen Prüfventils (32) befestigt ist, und das Dichtungselement in verformenden Kontakt mit der Öffnung der fest sitzenden Hülse (21) oder der inneren Deckelhülse (37) platziert ist, um zu dichten.

11. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 10, bei dem das Durchgangsloch (4) in dem Boden des Behälterkörpers (1) gebildet ist, und ein hohler Düsenturm (43), der mit der Ventileinheit (20) kommuniziert, dazu gebracht wird, zu stehen, wobei die periphere Wand davon mit Gasausstoßlöchern gebildet wird.

12. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 10, bei dem das Durchgangsloch (4) in dem Boden des Behälterkörpers (1) gebildet ist, und eine Ablenkplatte (45) in der Nähe des Loches befestigt ist, wobei die Ablenkplatte mit einem näherungsweise L-förmigen Abschnitt gebildet wird, wobei sein längeres Teil der Ventileinheit (20) mit einem Spalt dazwischen gegenüberliegt.

13. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, 11 und 12, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil (32C), das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum (33) belassen wird, und einem in das Prüfventil eingefügten, ausdehnbaren Balg (47) gebildet wird, wobei die periphere Wand des Balgs mit einer Durchtrittsöffnung gebildet ist, und das Prüfventil (32C) ausgestaltet ist, um durch die Ausdehnung und Zusammendrückung des Balgs geöffnet und geschlossen zu werden.

14. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, 11 und 12, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil (32D), das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum (33) belassen wird, und einem mit dem Prüfventil (32D) integrierten, elastischen Schürzenkörper (49) gebildet wird, wobei eine Durchtrittsöffnung in dem Prüfventil (32D) gebildet ist, ein näherungsweise zylindrisches Schürzenstück (51) vom Rand des Schürzenkörpers biegsam verlängert und am Umfang des Prüfventils angebracht ist, und das Prüfventil ausgestaltet ist, um durch die Verformung des Schürzenkörpers geöffnet und geschlossen zu werden.

Revendications

1. Contenant de stockage de substrat, comprenant :

un corps de contenant (1) ;
une porte (10) pour ouvrir et fermer le corps de contenant (1) ;
une unité de soupape (20) fixée à un orifice de passage (4) formé dans, au moins, un élément parmi le corps de contenant (1) et la porte (10), pour réguler l'écoulement de gaz par rapport au corps de contenant en tant que soupape d'entrée de gaz ou soupape de sortie de gaz, l'unité de soupape (20) comprenant :

un manchon fixe (21) pour l'écoulement de gaz, installé dans l'orifice de passage (4) ;
un manchon de support (25) pour l'écoulement de gaz, accouplé de façon filetée avec le manchon fixe (21) ;
une soupape de non-retour élastique (32) pour réguler l'écoulement de gaz par rapport au corps de contenant (1), la soupape de non-retour étant construite entre le manchon fixé (21) et le manchon de support (25) ;
et
un manchon de couvercle intérieur (37) pour l'écoulement de gaz, le manchon de couvercle intérieur (37) étant opposé à la soupape de non-retour élastique (32) ;
et un élément parmi le manchon de couvercle intérieur et le manchon fixe (21) est adapté pour être ouvert et fermé par la soupape de non-retour élastique (32), de sorte que le gaz passera à travers la soupape de non-retour lorsque la soupape de non-retour élastique est ouverte alors que le gaz sera empêché de passer dans le contenant de substrat lorsque la soupape de non-retour élastique est fermée,
dans lequel l'unité de soupape est installée sur l'orifice de passage en tant que soupape d'entrée de gaz ou soupape de décharge de gaz, **caractérisé en ce qu'**une nervure (5) est formée et étendue vers l'extérieur à partir de la périphérie de l'orifice de passage (4) et le manchon fixe (21) est formé avec une bride (24) qui est en contact avec la périphérie de la nervure (5) alors que le manchon de support (25) est formé avec une bride (29) qui est en contact avec la périphérie de l'orifice de passage (4).

2. Contenant de stockage de substrat selon la revendication 1, dans lequel l'orifice de passage (4) est formé dans le fond du corps de contenant (1).

3. Contenant de stockage de substrat selon la revendication 1 ou 2, dans lequel un espace libre (33) pour l'écoulement de gaz est formé au moins entre le manchon de support (25) et la périphérie de la soupape de non-retour élastique (32).

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4. Contenant de stockage de substrat selon une quelconque des revendications 1 à 3, dans lequel le manchon de couvercle intérieur (37) est installé dans le manchon de support (25) avec un filtre à air (42) interposé entre ceux-ci.

5. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour, qui est construite dans le manchon fixe (21), laissant un espace libre, et d'un élément déformable de façon élastique (36) interposé entre la soupape de non-retour (32) et le manchon de couvercle intérieur (37), et l'ouverture du manchon fixe (21) est adaptée pour être ouverte et fermée par la soupape de non-retour, de sorte que le gaz passera à travers lorsque la soupape de non-retour est ouverte alors que le gaz sera empêché de passer lorsque la soupape de non-retour est fermée.

6. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour qui est construite dans le manchon fixe (21), laissant un espace libre, et d'un élément déformable de façon élastique (36) interposé entre la soupape de non-retour (32) et le manchon fixe (21), et l'ouverture du manchon de couvercle intérieur (37) est adaptée pour être ouverte et fermée par la soupape de non-retour, de sorte que le gaz passera à travers lorsque la soupape de non-retour est ouverte alors que le gaz sera empêché de passer lorsque la soupape de non-retour est fermée.

7. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour qui est construite dans le manchon fixe (2), laissant un espace libre (33), et d'un élément déformable de façon élastique pour la soupape de non-retour, et la soupape de non-retour (32) ou l'élément déformable de façon élastique (36) est en contact avec le manchon de couvercle intérieur (37), de sorte que le gaz passera à travers lorsque la soupape de non-retour est ouverte alors que le gaz sera empêché de passer lorsque la soupape de non-retour est fermée.

8. Contenant de stockage de substrat selon une quelconque des revendications 5 à 7, dans lequel un élément de guidage (34, 41) est prévu pour la soupape de non-retour de la soupape de non-retour élastique (32) ou le manchon de couvercle intérieur (37) alors qu'une partie guidée (41, 34) est prévue pour l'autre, de sorte que l'élément de guidage et la partie guidée soient installés l'un sur l'autre de manière coulissante.

9. Contenant de stockage de substrat selon la revendication 8, dans lequel l'élément de guidage (41) est formé dans le manchon de couvercle intérieur (37) afin d'avoir une section supérieure approximativement convexe alors que la partie guidée (34) est formée dans la soupape de non-retour de la soupape de non-retour élastique (32) afin d'avoir une section supérieure approximativement concave.

10. Contenant de stockage de substrat selon une quelconque des revendications 5 à 9, dans lequel un élément d'étanchéité (35) est fixé à la soupape de non-retour de la soupape de non-retour élastique (32), et l'élément d'étanchéité est placé en contact de déformation avec l'ouverture du manchon fixe (21) ou le manchon de couvercle intérieur (37) pour réaliser une étanchéité.

11. Contenant de stockage de substrat selon une quelconque des revendications 1 à 10, dans lequel l'orifice de passage (4) est formé dans le fond du corps de contenant (1), et une tour d'éjection creuse (43) communiquant avec l'unité de soupape (20) est disposée verticalement, la paroi périphérique de celle-ci étant formée avec des orifices d'éjection de gaz.

12. Contenant de stockage de substrat selon une quelconque des revendications 1 à 10, dans lequel l'orifice de passage (4) est formé dans le fond du corps de contenant (1), et une plaque de déflexion (45) est fixée dans le voisinage de l'orifice, la plaque de déflexion étant formée pour avoir une section de forme approximativement en L avec sa partie plus longue opposée à l'unité de soupape (20) avec un écart entre celles-ci.

13. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, 11 et 12, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour (32C) qui est construite dans le manchon fixe (21), laissant un espace libre (33), et d'un soufflet extensible (47) installé dans la soupape de non-retour, la paroi périphérique du soufflet est formée avec une ouverture de passage, et la soupape de non-retour (32C) est conçue pour être ouverte et fermée par l'extension et la compression du soufflet.

14. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, 11 et 12, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour (32D) qui est construite dans le manchon fixe (21), laissant un espace libre (33), et d'un corps de jupe élastique (49) intégré avec la soupape de non-retour (32D), une ouverture de passage est formée dans

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la soupape de non-retour (32D), une pièce de jupe approximativement cylindrique (51) est étendue de façon flexible à partir du rebord du corps de jupe et est installée sur la périphérie de la soupape de non-retour, et la soupape de non-retour est conçue pour être ouverte et fermée par la déformation du corps de jupe.

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FIG. 1

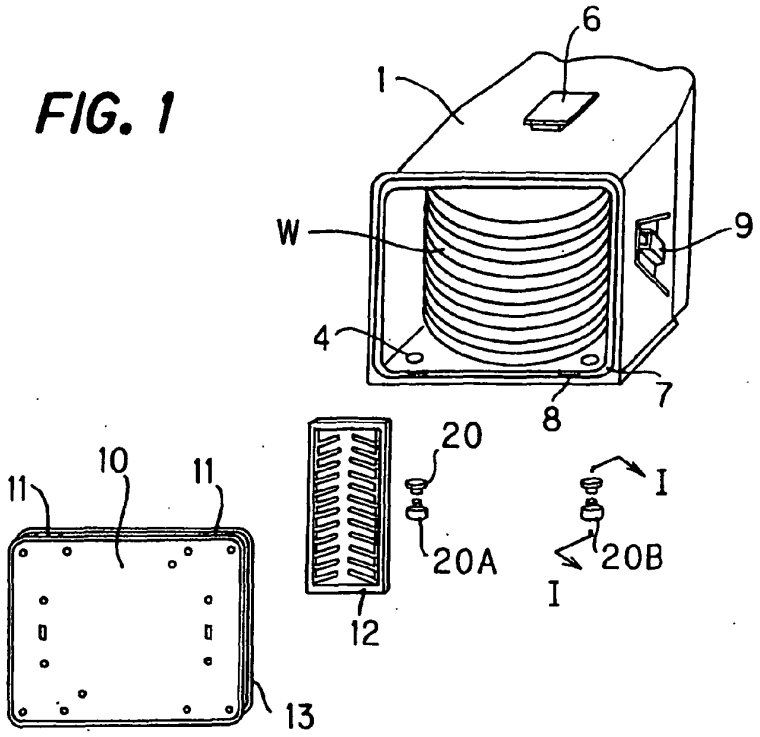
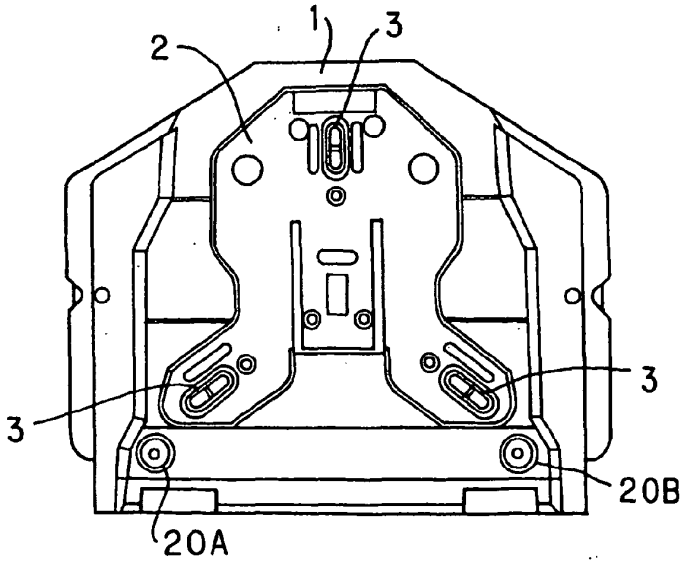


FIG. 2



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FIG. 3

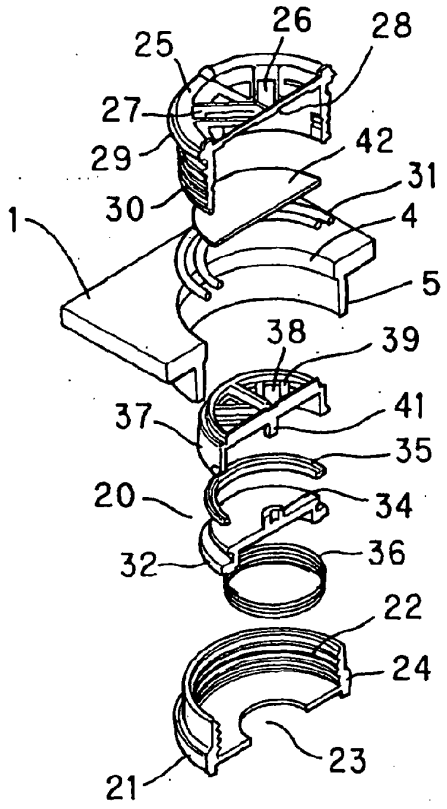
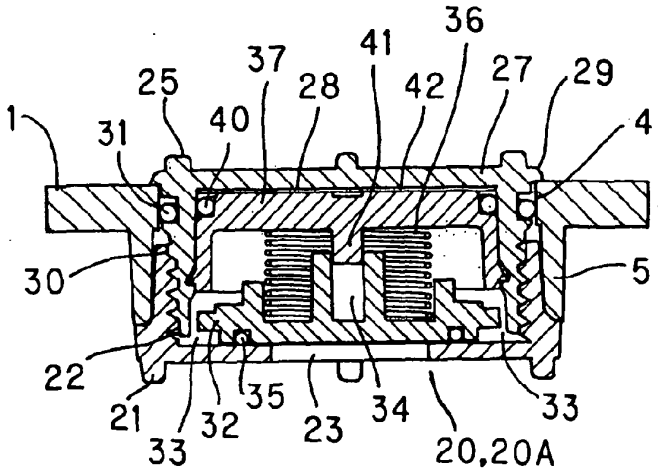


FIG. 4



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FIG. 5

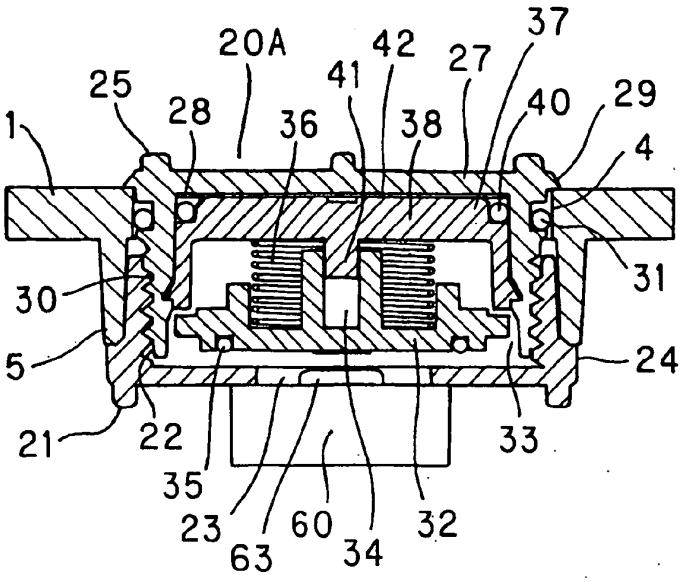
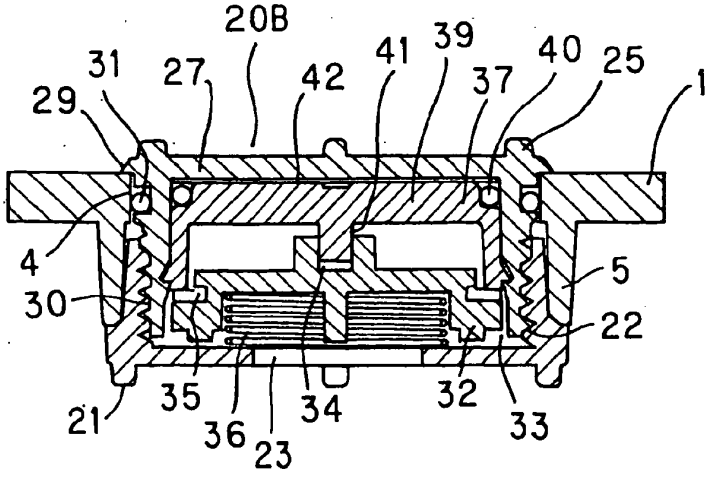


FIG. 6



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FIG. 7

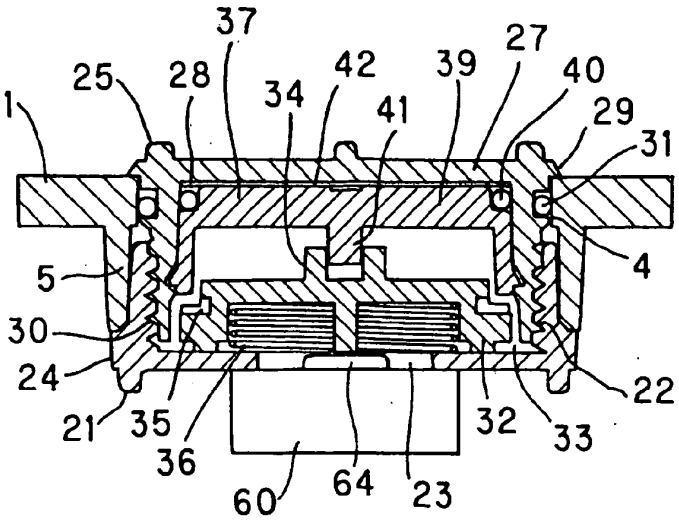
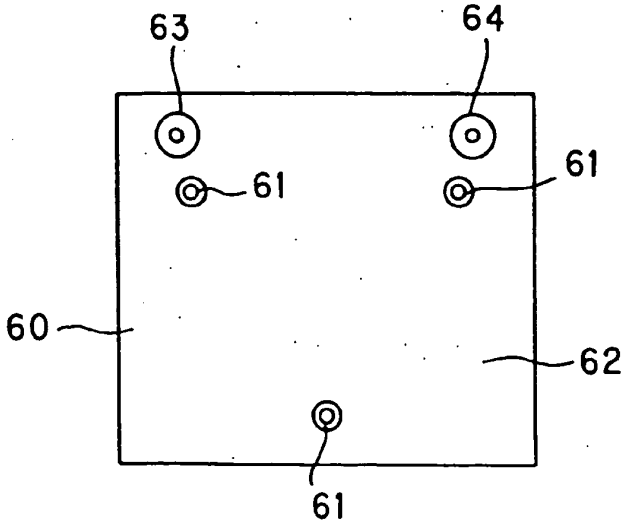


FIG. 8



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FIG. 9

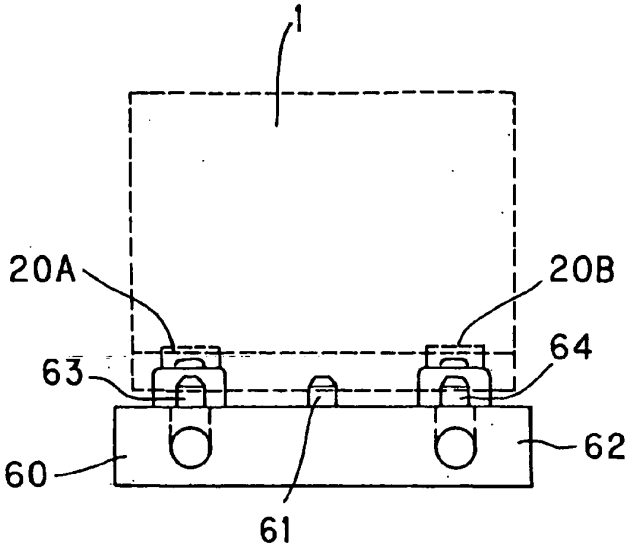
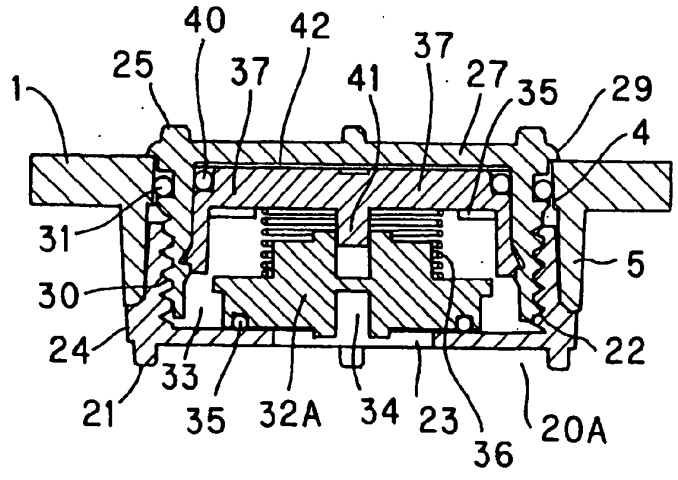
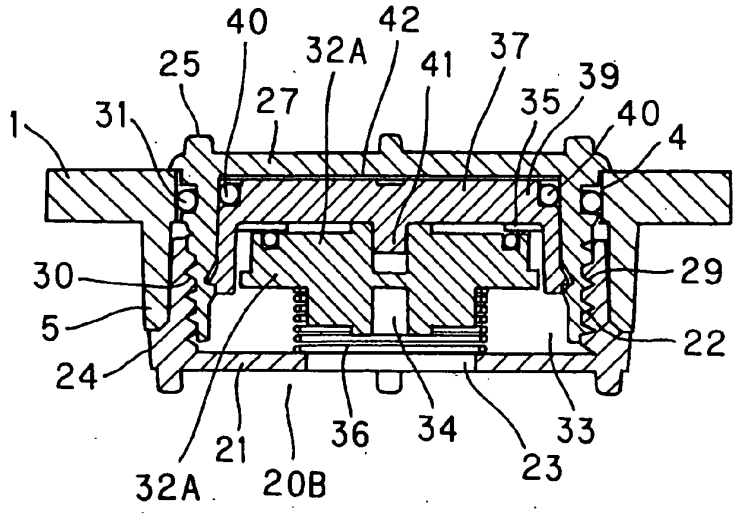


FIG. 10



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FIG. 11



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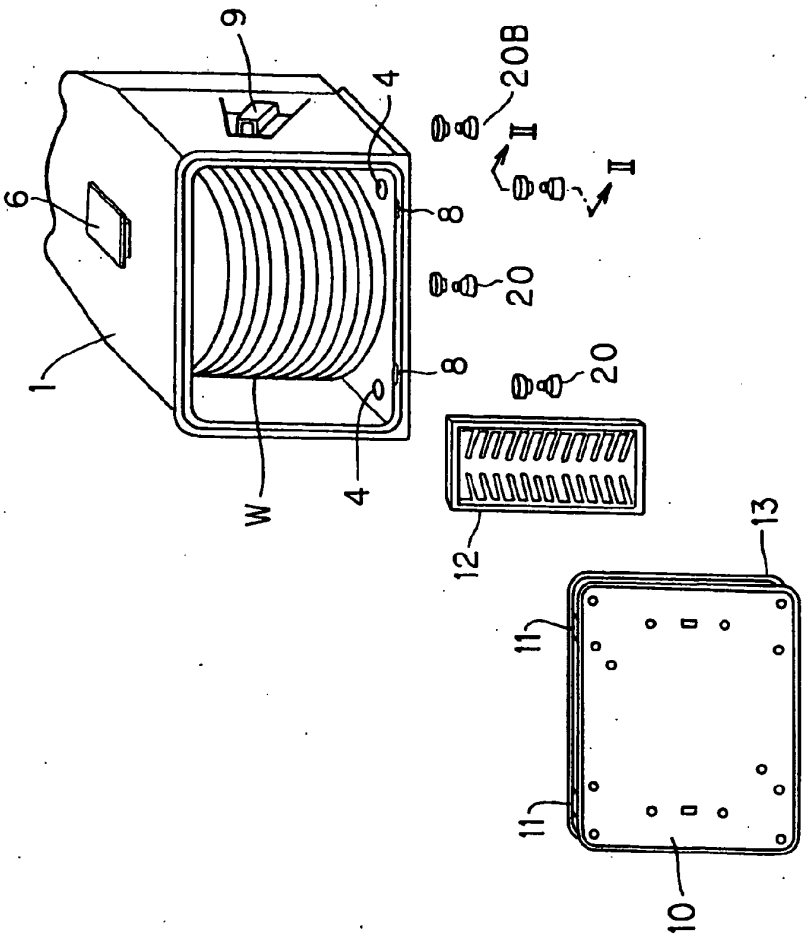
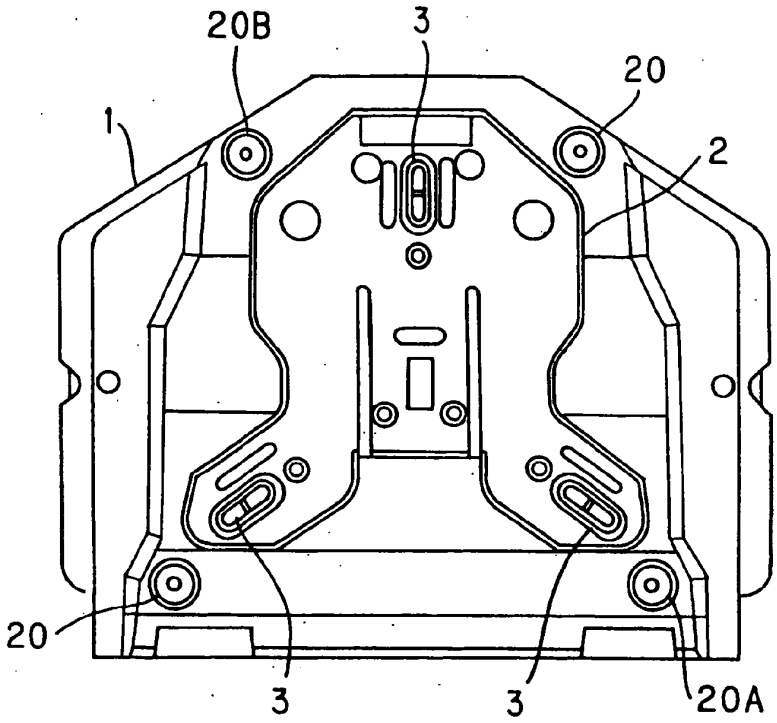


FIG. 12

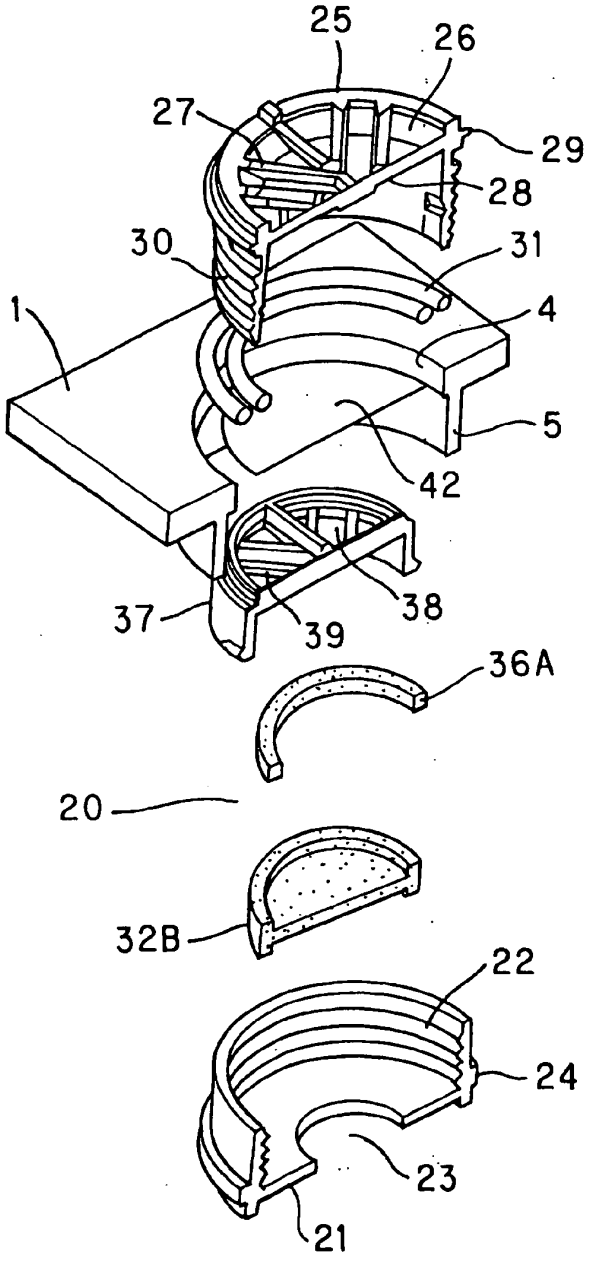
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FIG. 13



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FIG. 14



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FIG. 15

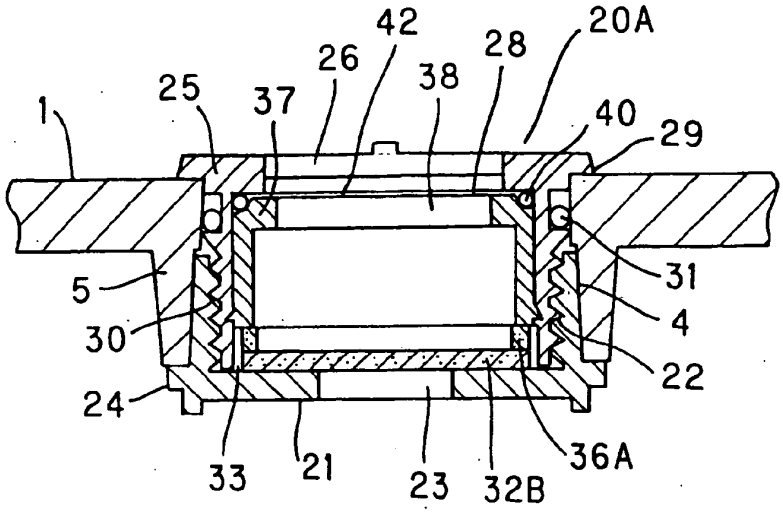
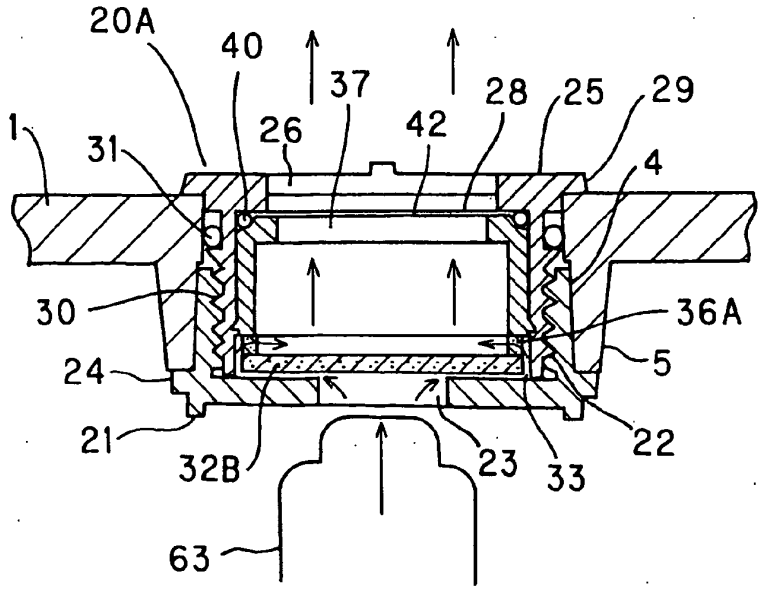


FIG. 16



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FIG. 17

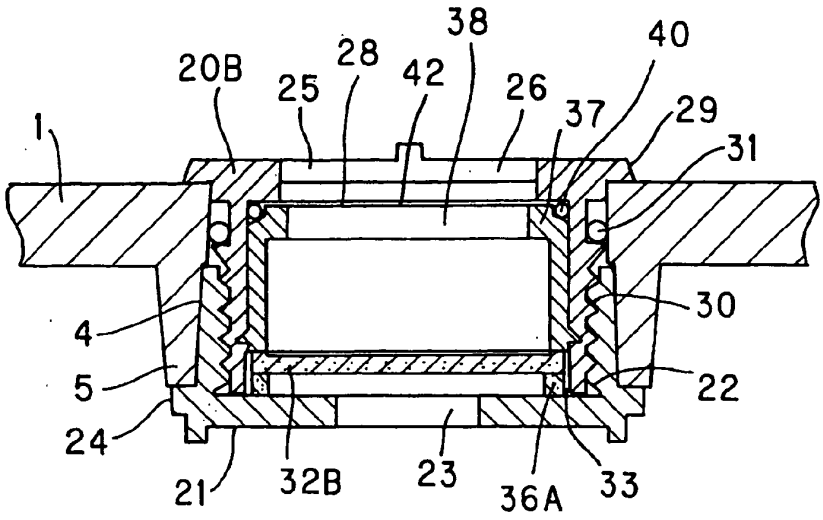
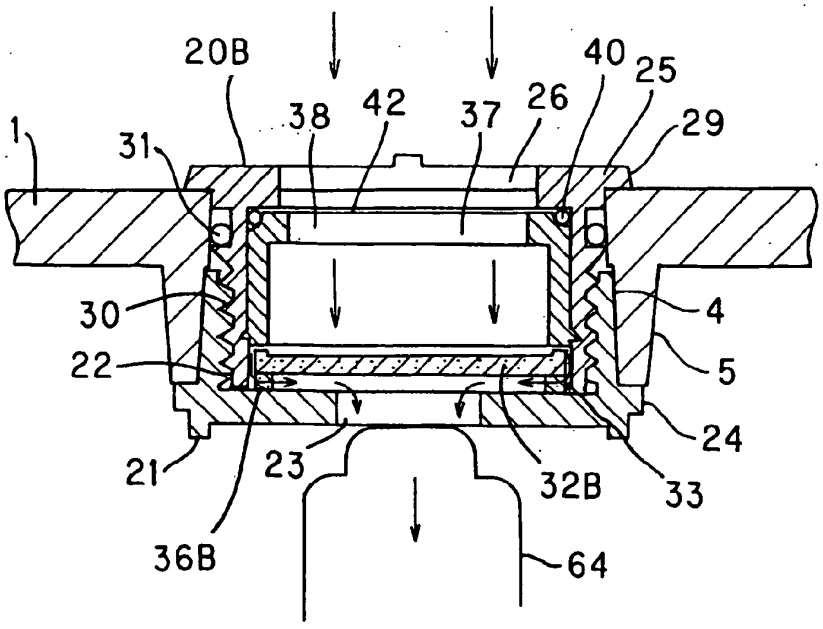
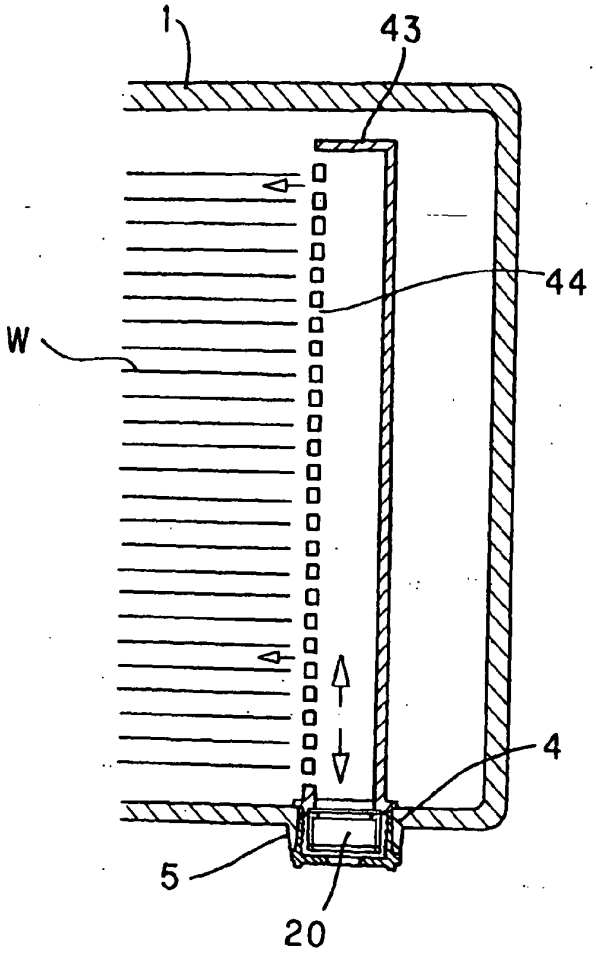


FIG. 18



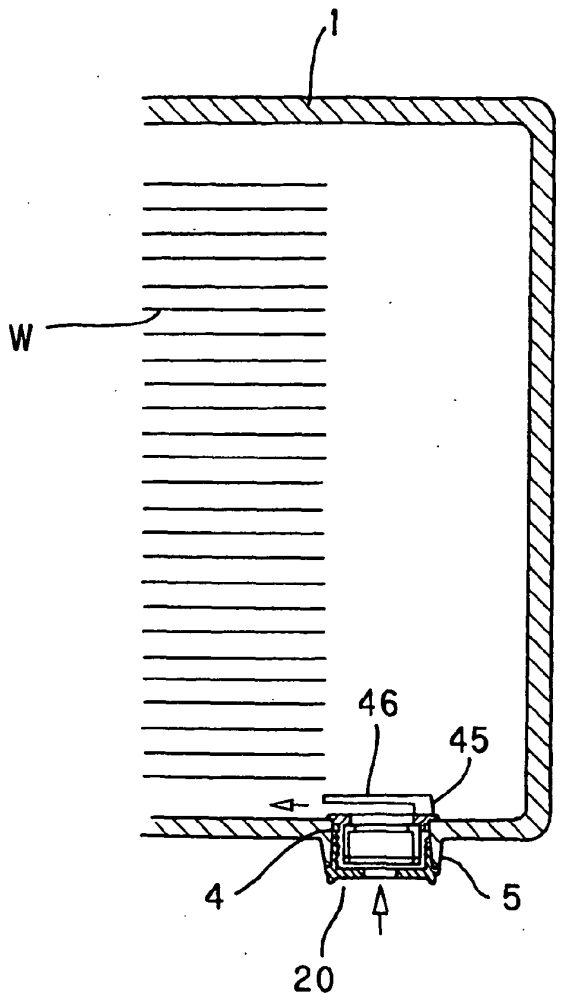
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FIG. 19



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FIG. 20



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FIG. 21

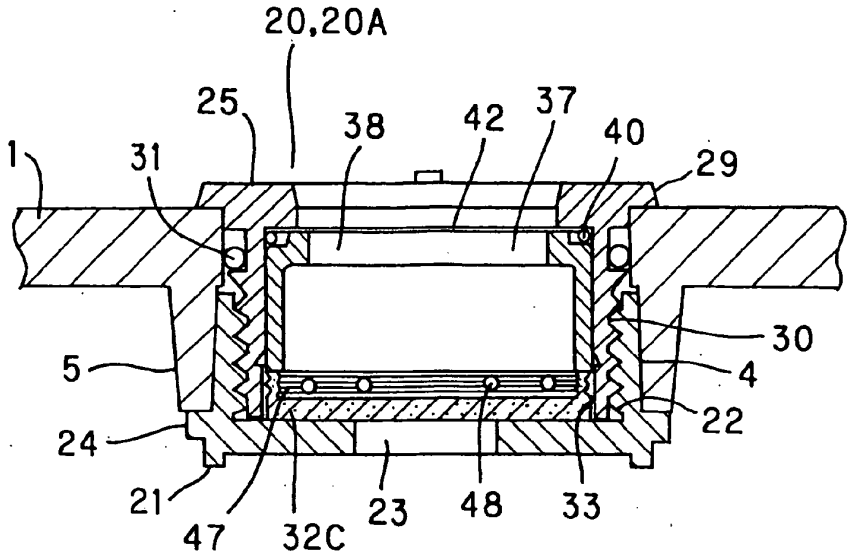
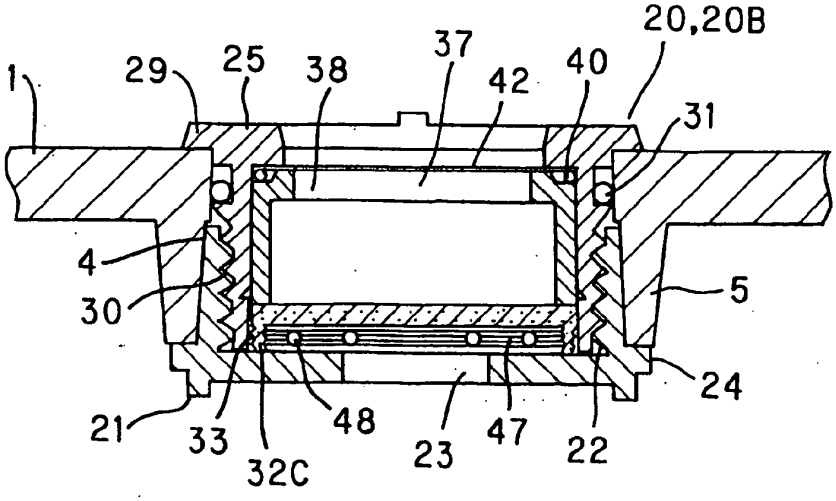


FIG. 22



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FIG. 23

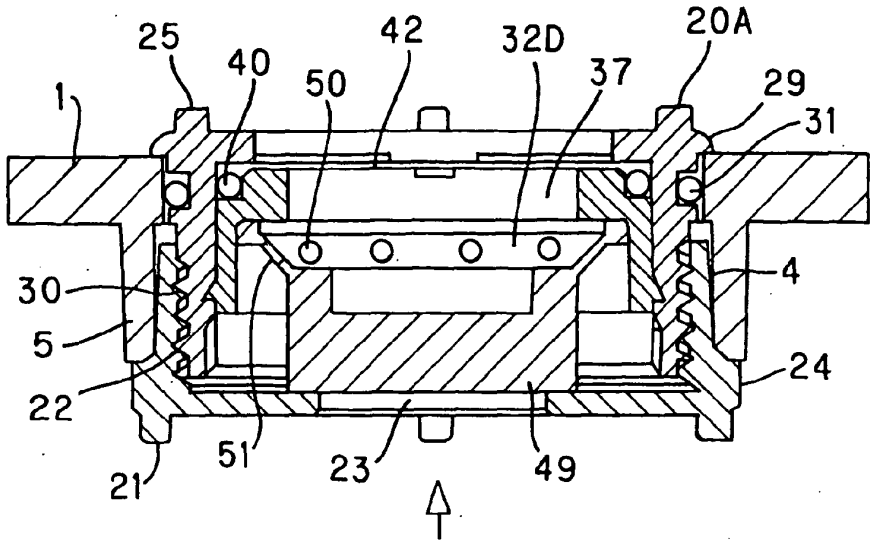
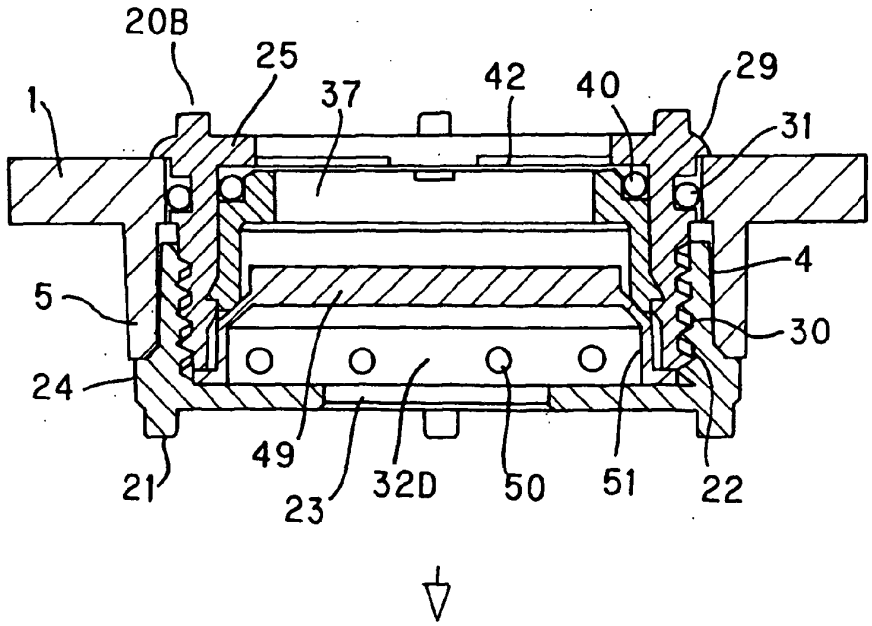


FIG. 24



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REFERENCES CITED IN THE DESCRIPTION

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(54) **WAFER CONTAINER WITH TUBULAR ENVIRONMENTAL CONTROL COMPONENTS**

WAFER-CONTAINER MIT RÖHRENFÖRMIGEN UMWELTSTEUERKOMPONENTEN

RÉCIPIENT À PLAQUETTES POURVU DE COMPOSANTS DE CONTRÔLE ENVIRONNEMENTAL TUBULAIRES

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(73) Proprietor: **Entegris, Inc.**
Billerica, MA 01821 (US)

(72) Inventors:
- **WATSON, James, A.**
  Eden Prairie
  MN 55346 (US)
- **BURNS, John**
  Colorado Springs
  CO 80918 (US)
- **FORBES, Martin, L.**
  Divide
  CO 80814 (US)
- **FULLER, Matthew, A.**
  Colorado Springs
  CO 80907 (US)
- **SMITH, Mark, V.**
  Colorado Springs
  CO 80908 (US)

(74) Representative: **Patentanwälte Geyer, Fehners & Partner mbB**
Perhamerstrasse 31
80687 München (DE)

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a front opening container for wafers 300 mm and larger, comprising a container portion having a container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving section in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the backside has a pair of corner regions extending from the top of the container portion to the bottom of the container portion, a door to fit in the open front and latchable to the door frame, a pair of elongate tubular environmental control components positioned in the corner regions, each elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein each of the elongate tubular environment control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port.

[0002] Wafer containers and reticle pods generally are sealed containers known as FOUPs (front opening unified pods), FOSBs (front opening shipping boxes), or SMIF (standard mechanical interface) pods. These containers provide a microenvironment to isolate and control the environment surrounding a wafers and substrates used in manufacturing integrated circuits, during storage, transport and processing of the materials. Processing of such materials traditionally has been carried out in a particulate free environment generally known as a "clean room". However, maintenance of such "clean rooms" in a contaminant free state can require a great deal of care and effort, particularly during processing of the materials.

[0003] The internal atmosphere of such microenvironments can be more readily controlled and maintained. Often, such containers are purgible with inert gas or clean dry air (CDA) or extra CDA. It has been observed that contamination of reticles in such containers can be caused not only by discrete particles but also by hazing occurring on wafers or reticles. See Publication WO 2007/149513 A2, owned by the owner of the instant application, which is incorporated herein by reference and included in the Appendix to this application. Such hazing can also occur on wafers in wafer containers and be detrimental thereto, see U.S. Patent No. 5,346,518 which is incorporated herein by reference. Also relevant, U.S. Patent No. 6,042,651, owned by the owner of the instant application, discloses using nozzled towers in bottom opening SMIF pods and a front opening wafer container that uses wafer shelf assemblies as purge outlets. Problems associated with such structures and optimal use of such structures has not been adequately addressed.

[0004] For example, the use of desiccants and vapor getters in substrate containers typically require removal or disassembly of same before washing and such substrate containers as the fluids utilized can destroy the media for filtering and/or vapor absorption. Moreover, purge port plumbing within substrate containers is, aside from the media issues, difficult to clean and dry due to the enclosed areas used for transferring purge gases. A means for facilitating cleaning of such substrate containers without disassembly and removal of media and purge components would be very advantageous. Particularly, problematic in cleaning are free standing towers such as disclosed in U.S. Pat. No. 6,042,651. Moreover, such towers are subject to movement and potential dislocation due to their conventional positioning where they may be inadvertently contacted and their connection only at the base of the substrate container. Better positioning and attachment methods and structures would be advantageous, particularly methods that do not rely on holes or fasteners that extend through walls or other barriers separating the enclosed interior of the container from the exterior.

[0005] The use of discrete towers in a front opening pod, the use of more than one discharge tower, and the optimal placement and securement of discharge towers or tubular environmental control components has not heretofore been adequately considered and optimized to satisfactorily address reliability, haze, contamination and particulate control, and cleaning issues in front opening large diameter wafer containers. As a transition is made from 300mm wafers to 450mm wafers, improvements in these areas will be even more important.

[0006] JP 2003 168728 A describes a front opening wafer container of the type as mentioned at the beginning. The known container is provided with through-holes through which gas inside the container can be replaced. On a part of the through-holes a nozzle member provided with nozzles blowing out the gas against both sides of a wafer is fitted and the residual through-holes serve as exhaust vents. The nozzles of the nozzle member blow out clean air or inert gas directly against the wafers along both of their surfaces, by which a space where gas is stagnant can be eliminated.

SUMMARY OF THE INVENTION

[0007] In an embodiment of the invention, a wafer container includes a tubular environmental control component that is configured with an open interior and slots communicating with the interior of the wafer container. One or two of the tubular component may be strategically placed in back corners or compartments of the wafer container and may be connected to purge inlets on the bottom of the wafer container. Certain embodiments may have a filter in addition to or alternatively to the absorbent

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material. In certain embodiment an additional purge inlet port may be utilized for a total of three purge inlets. The tubular components or the purge ports may have a check valve therein to control the flow direction of gas (including air) into and out of the container and with respect to the tower. The purge port may utilize an elastomeric grommet and the tubular component sealingly connected thereto. The tubular component may have a getter media piece rolled in an elongate circular fashion forming or shaped as a tube and disposed within the tower. The media can provide active and/or passive filtration as well as having capabilities to be recharged.

[0008] One configuration of front opening wafer containers for 300mm sized wafers have a pair of compartments on each of the left and right side in the inside rear of the container portions. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. A feature and advantage of certain embodiments is utilizing these compartments for containing, completely or partially, elongate tubular environmental control components that extend substantially from a bottom wafer position to a top wafer position or from the bottom of the container portion to the top. In one embodiment, a tubular shape of getter material is exposed within the front opening container in one or both compartments with minimal containment of the getter and without being part of an active purge system. In another embodiment, a tubular environmental control component configured as a purge tower may be placed in one or both compartments. The tower may be configured as a containment portion that may contain media. The media can be filter and/or absorbent media.

[0009] In particular embodiments, the tubular environmental control component has apertures either for exuding purge gas into the open interior of the container portion or for allowing absorbant media in the component to absorb vapors, including humidity from the interior of the container portion. A feature and advantage is that such apertures may be selectively obstructed to stop communication between the interior of the tubular component and the open interior of the wafer container. This is highly advantageous for washing the container so that filters, getters, or other contents of the tubular component can be protected from the washing fluids without removing the components. The obstruction may be by an elastomeric strip that seals the apertures as by a rigid slidably attached member that can cover and uncover the apertures. Moreover such selective blocking can be adjustable to change the size of the openings between the interior of the container portion and the interior of the tubular component.

[0010] A feature and advantage of certain embodiments is that the tubular component with apertures may be horizontally offset form the purge inlet connected thereto. This provides clearance with respect to the wafers. Moreover, positioning the discharge aperture in the tubular component back in the recess or compartment is believed to provide better fluid flow characteristics for the purge gas. Positioning the tubular components in the back recess provides the advantage of protection of the purge component from bumping or inadvertent contact.

[0011] A feature and advantage of certain embodiments is the methods of attachment of environmental control components in the rear compartments. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. These internal compartments have walls that generally converge rearwardly. In a particular embodiment, a flexible elastomeric attachment member is secured intermediate the top of a tubular environmental control component and the polymer wall of the container portion. Such elastomeric attachment member secures the tower in place without apertures through the walls and optimally utilizes the high coefficient of friction between the polycarbonate container portion wall and the elastomeric material. The member may be shaped as a cap further providing the advantageous function of securing together elongate components that comprising the containment portion of tubular environmental control components. A tubular component may have such a member on both ends to utilize the high coefficient of friction and the compression of the elastomeric members to retain said tubular environmental control component within, totally or partially, the rearward compartment. In another embodiment a rigid bracket formed from metal or a rigid polymer may have spring teeth to wedge the bracket between opposing walls of the compartment wherein the teeth dig into the surface of the container portion wall. A feature and advantage of these attachment methods and structures is that the attachment utilizes the opposing walls for engagement of the attachment components without separate structure or fasteners that extend through walls of the wafer container. Therefore, wafer containers may be readily retrofitted with no modifications or reduced modifications to the product.

[0012] A feature and advantage of embodiments utilizing the tubular getter media is that a relatively high area of media is effectively exposed in a confined area in the wafer container. Moreover, the rear compartments work well for the tubular components that have no media and are utilized for pure purging.

[0013] A further feature and advantage of certain embodiments is that where purge gas is exhausted through the tower, the tubular getter media may be effectively recharged for periods when the environment therein is static.

[0014] A further feature and advantage of embodiments herein is that accommodation of the invention in existing configurations of 300 wafer containers requires minimal changes in such containers. A further feature and advantage is that aspects of the invention are highly

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suitable for larger wafer containers.

DESCRIPTION OF THE FIGURES

[0015]

Figure 1 is a perspective view of a front opening wafer container according to an embodiment of the invention;

Figure 2 is a bottom view of the wafer container of Figure 1;

Figure 3 is a front perspective view into the open front of a different embodiment of a container portion;

Figure 4 is a detail top view cross-sectional of the embodiment of Figure 3 showing the location of tubular components and purge ports with respect to the walls of the container portion and wafers therein;

Figure 5 is an elevational view of a tubular component;

Figure 6 is a detail view of attachment features suitable for securing the tower component to the bottom wall of a container portion of a front opening wafer container;

Figure 7 is a front elevation view of a container portion with a pair of tubular environmental control components configured as filter cartridges mounted therein with brackets;

Figure 8 is a perspective view of tubular environmental control components configured as an absorbent filter cartridge according to an embodiment of the present invention;

Figure 9 is a bracket suitable for attaching a tubular environmental control component to the back region of a wafer container such as is shown in Figures 4 and 5;

Figure 10 is a top cross sectional view illustrating an attachment means for a tubular environmental control component of a wafer container;

Figure 11 is a perspective view of a filter cartridge in a bracket;

Figure 12 is a perspective view of the bracket of Figure 11;

Figure 13 is a cross sectional view taken at line 13-13 of Figure 4;

Figure 14 is an exploded view of a tubular environmental control component according to an embodiment of the invention;

Figure 15 is an exploded view of a tubular environmental control component of the tubular environmental control component of Figure 14;

Figure 16 is a front side perspective view of a tubular environmental control component;

Figure 17 is a rear side view of the tubular environmental control component of Figure 16;

Figure 18 is a front perspective view of the tubular environmental control component of Figures 16 and 17 with a blocking member engaged therewith;

Figure 19 is a front side perspective view of a tubular environmental control component according to an embodiment of the invention;

Figure 20 is a detail view of the tubular environmental control component of Figure 19 opened revealing a living hinge;

Figure 21 is a container portion according to an embodiment of the invention; and

Figure 22 is a perspective view of an alternative embodiment of a blocking member 800 according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] Referring to Figures 1 and 2, a front opening wafer container 20 is depicted and generally includes door 24 and container portion 26. Container portion 26 has front opening 30 leading into open interior 32 where a plurality of wafers W are retained on wafer shelves 35. Door 24 has key access holes 36 with latch mechanism 38 partially illustrated in the interior of the door enclosure with latch tips 41 that engage recesses 39 in the container portion door frame 40. The wafer container has purge capabilities with a pair of forward purge ports 48 with purge grommets 50 which are secured into grommet receiving structure 51 on the bottom 52 of the container portion and rearward purge ports 54. Check valves 56 may be inserted into the grommets to control the direction of purging gas fluid flow. Tubular environmental control components configured as a first type of tubular environmental control component as purge towers 60 are illustrated which also may utilize grommets 62 and check valves 63. An exemplary location of purge ports is illustrated in Figure 2 with reference to the wafers W.

[0017] Referring to Figures 3, 4, and 13, further details of a wafer container with a different configuration portion 64 embodying the inventions are illustrated with appro-

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priate component placement. The container portion 64 has a shell 65 and closed top 66, a closed bottom 66.1, a closed left side 66.2, a closed right side 66.3, an open front 67, and a closed back 67.1. The interior of the container has a plurality of shelves 70 which may be secured to the container portion at the top and bottom of same. A kinematic coupling plate 74 (not shown in Figure 4) is positioned at the bottom of the container portion and has appropriate openings for receiving the front side grommets and rear side grommet 77 at rear ports 54. The openings will extend through the shell 65. The container portion has two rearward apertures 80 which extend from the interior 32 of the wafer container to the exterior.

[0018] A second type of tubular environmental control component 78 configured as a tower component as depicted in Figures 3 and 13 is inserted into the container portion 64 from the interior into the aperture 80. The tubular component has a containment portion 81, an offset portion 83, and port portion 85. Elastomeric grommet 77 may be sealingly placed in the lower portion 94 of the tubular component and a check valve 63 may be placed therein. A cylindrical shaped filter and/or getter media material 100 may be included in the containment portion and is configured to conform to the interior of the tubular component. Said tubular component has a plurality of axially-extending apertures 110 configured as horizontal slots disclosed therein. In a preferred embodiment, there may be a slit for each wafer with the slit position to discharge purge gas over the surface of the respective wafer. The media material, if in the containment portion, is thus exposed to the interior of the wafer container by way of said axially-extending openings. Of particular note of this container portion 64 are the rearward compartments 111 that are defined by rearward protrusions 112 at the back 67.1. The wall 113 is configured to provide two feet 114 when the container is tipped rearward 90 degrees whereby the front with door 24 is upward, such as for shipping. Each compartment 111 has a pair of sidewall portions 115, a back wall portion 116 and a compartment opening 117.

[0019] Referring to Figures 5 and 6, the tubular component 119 in this embodiment has vertical slits and has a plurality of fingers 122 that extend downwardly into the apertures 80 through the shell and kinematic coupling plate 74. Said fingers resiliently flex radially inward and allow a secure fit in the aperture in the bottom of the container portion. A flange 113 may facilitate proper seating of the component.

[0020] Referring to Figures 7-11, additional embodiments are depicted with a pair of tubular environmental control components configured as filter cartridges 200 mounted in approximately the same position, in rearward 3-sided compartments 111, and configured as getters without the associated active purge capability of the containers illustrated in Figures 1-4. Such cartridges may have an outer housing 210 formed of a polymer or other suitable material with media 211 positioned therein. In a preferred embodiment the cartridge and media will be tubular shaped. Bosses 212 on the cartridge of Figure 8 can be utilized to attach the cartridge directly to the container portion wall by way of screws extending through the exterior wall. Alternatively the bracket 220 as illustrated in Figure 9 and Figure 7 may be attached to the back wall of the container portion with the cartridge clamped therein.

[0021] Referring in particular to Figures 10, 11 and 12 a further embodiment of a filter cartridge 200 is illustrated and again has media 304 closed within a housing 308. The cartridge 200 is clamped within the clamp 320 which has resilient catch legs 330 with tabs 322 which can bite into the walls of the container simply by insertion therein with no further attachment mechanisms. Spring arms 336 secure the cartridge in the bracket.

[0022] Specific getter media which may be utilized in the cartridges and the towers illustrated herein is disclosed in international publication no. WO 2007/149513 A2 which is incorporated herein by reference. Similarly the methodology and system for recharging a getter that is part of a purge system within the wafer container as illustrated herein in Figures 2, 3 and 4 are described in detail with reference primarily to a reticle pod in said publication. Said systems and methodologies and equipment are also applicable herein and said references incorporated for the disclosure relating directly thereto.

[0023] Referring to Figures 14-18, details of a third type of tubular environmental control component 400 in accord with the inventions herein is illustrated. The component has a pair of a first type of elongate portions 402, that assemble together to form a containment portion 410 with a containment interior 414. The containment portion has an axis 418 and connects to an offset portion 83 that connects to a purge port portion 85. An elastomeric grommet 432 may fit in a grommet receiver 440. The two elongate portions are configured as elongate clam shell portions. A rearward portion 402 has edge portions 444 with latch portions 449 configured as loops. The forward portion 402 also has edge portions 448 with latch portions 452 configured as tabs to engage the loops. The latch portion operates to secure the elongate portion together while allowing disassembly for cleaning or media placement or replacement. The forward portion 402 has an aperture portion 451 with a plurality of apertures 453 that provide communication between the containment interior 414 and the open interior of the container portion.

[0024] Referring in particular to Figures 13-18, an elastomeric elongate blocking member 460 is configured as a strip to engage the aperture portion by having tabs 464 fit into and seal the aperture 453. Figures 13 and 18 illustrate the member 460 in a blocking position. Thus, the blocking member can selectively block or expose the interior of the containment portion to the interior of the container portion.

[0025] Referring still to Figures 13-18, an elastomeric retainer, configured as an elastomeric cap 500, resiliently expands and fits over the upper end portion 506 of the tubular component 400. The cap 500 has a dome shape

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and has an extension portion 516 that is configured to engage the interior surface 520 of the container portion at the top. The cap functions to secure the elongate portions together and further to engage resiliently the container portion whereby the vibration of tubular component and plastic to plastic contact, the plastic component portion and the shell, is minimized. The tubular component is inserted putting the cap under compression and the high friction between the elastomeric material of the cap and the hard plastic of the shell, typically polycarbonate, holds the tubular component in place.

[0026] Referring to Figures 19 and 20, a fourth type of tubular environmental control component 600 is shown. The component has a pair of a second type of clam shell portions 604 that are hinged together by a living hinge 610 or the like and a rear corner 670. The two shell portions may be latched with latch portions (620, 624). Apertures 630 provide communication between the interior 634 of the capsule portion or containment portion 644 and the open interior of the wafer container. The containment portion also may connect to an offset portion 83 and then to a purge port portion 85.

[0027] Referring to Figure 21, an embodiment of a wafer container 692 with a fifth type of tubular environmental control component 700 is placed in recesses 710 on the backside wall 714 of the container portion 718. The recesses may have apertures positioned and spaced from the top 720 to the bottom 722. Offset portion 83 may provide communication between the containment portion 730 and the purge port portion (not shown) positioned in the interior. This arrangement allows the tubular environmental control components to be changed without disturbing the interior of the container portion to the same level as some of the other embodiments.

[0028] Referring to figure 22, an alternative embodiment of a blocking member 800 is illustrated. This rigid plastic, for example polycarbonate, piece clamps around a tubular environmental control component, such as the configuration of Figure 19. Gripping fingers 810 may secure the member to the tubular member by locking on to the rear corner 670 with wedge shape teeth 812. In a further embodiment the blocking member may have apertures 820 that correspond with the apertures 630 on the tubular component. This component can then sidably engage with the tubular environmental control component by sliding vertically, can open, close or adjust the communication between the interior of the tubular component and the interior of the container portion. Similarly shaped rigid blocking components can have arcuate fingers that partially wrap around the tubular components with cylindrical or oval cross-sectional shapes.

[0029] The illustrated embodiments should be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Claims

1. A front opening wafer container (20) for wafers 300 mm and larger, comprising:

   a container portion (26) having container wall that extends around a closed left side (66.2), a closed right side (66.3), a closed bottom (66.1), a closed top (66), and a closed backside (67.1) defining an open interior (32), the container portion (36) having a plurality of horizontal wafer shelves (35) spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior (32) for holding a stack of horizontal spaced apart wafers (W) seated in the shelves (35), a door frame (40) defining an open front (30), wherein the container portion wall (116) at the back side has a pair of corner regions extending from the top (66) of the container portion (26) to the bottom (66.1) of the container portion (26);
   a door (24) to fit in the open front (36) and latchable to the door frame (40);
   a pair of elongate tubular environmental control components (60, 78, 119, 400, 600, 700) positioned in the corner regions, each elongate tubular environmental control component (60, 78, 119, 400, 600, 700) having a containment portion (81, 420, 644, 730) with an interior and a plurality of apertures (110, 464) providing communication between the interior of the containment portion (81, 410, 644, 730) and the open interior (32) of the container portion (26), and wherein each of the elongate tubular environmental control component (60, 78, 119, 400, 600, 700) has an axis (418) that is upright and the elongate tubular environmental control component is connected to the bottom (66.1) of the container portion (26) at a purge port (54) **characterized in that** the purge port (54) is offset from the axis (418) of the tubular environmental control component (60, 78, 119, 400, 600, 700).

2. The front opening wafer container of claim 1 **characterized in that** each elongate tubular environmental control component (400, 600) is comprised of two elongate portions (402, 604), each elongate portion (402, 604) connected to the other by at least one of a plurality of latches (448, 452) and hinges (610), the two portions (402, 604) defining a containment portion (410, 644).

3. The front opening wafer container of claim 1 **characterized in that** the elongate tubular environmental control components (400) are each comprised of two elongate portions (402, 604) defining a containment portion (410), and wherein the elongate tubular control component (400) further comprises an elasto-

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meric cap (500) that resiliently expands to adheringly cover the top of the containment portion (410).

4. The front opening wafer container of claim 1 **characterized in that** the pair of elongate tubular environmental control components (700) are both outwardly exposed on the backside.

5. The front opening wafer container of claim 1 **characterized in that** the pair of elongate tubular environmental control components (60, 78, 119, 400, 600, 700) are spaced from the wall portions and the back side (67.1) and each elongate tubular environmental control component has a length and the length extends substantially a distance between the top wall portion (66) and the bottom wall portion (66.1).

6. The front opening wafer container of claim 2 further **characterized in that** it comprises an enlongate blocking member (460, 800) that is positionable on at least one of the tubular environmental control component (78, 400) to selectively obstruct the communication between the interior (414) of the containment portion (410) and the open interior of the container portion (26).

7. The front opening wafer container of claim 6 **characterized in that** the elongate blocking member (460) is formed of an elastomeric material and the tubular environmental control component (78, 400) has attachment structure extending around the plurality of apertures (110, 453) and said blocking component (460) resiliently engages to said attachment structure to sealingly block the communication between the interior (414) of the containment portion (410) and the open interior (32) of the container portion (26).

8. The front opening wafer container of claim 7 **characterized in that** the elongate blocking member (460, 800) is slidably engagable with one of the containment portions (410, 644) and is slidingly shiftable on said containment portion (410, 644) between a blocking position and an aperture open position.

9. The front opening wafer container of claim 1 **characterized in that** each of the containment portions (81, 420, 644, 730) has therein at least one of a filter material and an absorbent material.

Patentansprüche

1. Ein Wafer-Container (20) mit Frontöffnung für Wafer von 300 mm und größer, der folgendes umfaßt:

einen Containerabschnitt (26) mit einer Containerwand, die sich um eine geschlossene linke Seite (66.2), eine geschlossene rechte Seite (66.3), einen geschlossenen Boden (66.1), eine geschlossene Decke (66) und eine geschlossene Rückseite (67.1) erstreckt, welche einen offenen Innenraum (32) festlegen, wobei der Containerabschnitt (26) eine Vielzahl horizontaler, voneinander entfernter, darin befestigter Waferfächer (35) aufweist, die einen im allgemeinen zylindrischen Waferaufnahmebereich im offenen Innenraum (32) zum Haltern eines Stapels horizontaler, voneinander entfernter Wafer (W) festlegen, die in den Fächern (35) sitzen,
einen Türrahmen (40), der eine offene Front (30) festlegt, wobei die Wand (116) des Containerabschnitts an der Rückseite ein Paar Eckabschnitte aufweist, die von der Decke (66) des Containerabschnitts (26) bis zum Boden (66.1) des Containerabschnitts (26) verlaufen;
eine Türe (24) zum Einfügen in die offene Front (36) und an dem Türrahmen (40) verriegelbar;
ein Paar länglicher rohrförmiger Umwelt-Steuerkomponenten (60, 78, 119, 400, 600, 700), die in den Eckabschnitten positioniert sind, wobei jede längliche rohrförmige Umwelt-Steuerkomponente (60, 78, 119, 400, 600, 700) einen Einhausungsabschnitt (81, 420, 644, 730) mit einem Inneren und einer Vielzahl von Öffnungen (110, 464) aufweist, die eine Verbindung zwischen dem Inneren des Einhausungsabschnitts (81, 410, 644, 730) und dem offenen Innenraum (32) des Containerabschnitts (26) schaffen, und wobei jede der länglichen rohrförmigen Umwelt-Steuerkomponenten (60, 78, 119, 400, 600, 700) eine Achse (418) hat, die senkrecht steht, und die längliche rohrförmige Umwelt-Steuerkomponente mit dem Boden (66.1) des Containerabschnitts (26) an einem Spülport (54) verbunden ist, **dadurch gekennzeichnet, daß** der Spülport (54) gegenüber der Achse (418) der länglichen rohrförmigen Umwelt-Steuerkomponente (60, 78, 119, 400, 600, 700) versetzt ist.

2. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** jede längliche rohrförmige Umwelt-Steuerkomponente (400, 600) zwei längliche Abschnitte (402, 604) umfaßt, wobei jeder längliche Abschnitt (402, 604) am anderen befestigt ist durch zumindest einen aus einer Vielzahl von Riegeln (448, 452) und Scharnieren (610), wobei die beiden Abschnitte (402, 604) einen Einhausungsabschnitt (410, 644) festlegen.

3. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** jede der länglichen rohrförmigen Umwelt-Steuerkomponenten (400) zwei längliche Abschnitte (402, 604) umfaßt, die einen Einhausungsabschnitt (410) festle-

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gen, und wobei die längliche rohrförmige Steuerkomponente (400) zudem eine elastomere Kappe (500) aufweist, die sich elastisch dehnt, um die Oberseite des Einhausungsabschnitts (410) durch Anhaften abzudecken.

4. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** von dem Paar länglicher rohförmiger Umwelt-Steuerkomponenten (700) beide auf der Rückseite nach außen hin freiliegen.

5. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** das Paar länglicher rohrförmiger Umwelt-Steuerkomponenten (60, 78, 119, 400, 600, 700) von den Wandabschnitten und der Rückseite (67.1) beabstandet sind und jede längliche rohrförmige Umwelt-Steuerkomponente eine Länge aufweist und die Länge sich im wesentlichen über eine Entfernung zwischen dem Deckenwandbereich (66) und dem Bodenwandbereich (66.1) erstreckt.

6. Der Wafer-Container mit Frontöffnung nach Anspruch 2, weiter **gekennzeichnet dadurch, daß** er ein längliches Blockierglied (460, 800) umfaßt, das auf wenigstens einer der rohrförmigen Umwelt-Steuerkomponenten (78, 400) positionierbar ist, um wahlweise die Verbindung zwischen dem Inneren (414) des Einhausungsabschnitts (410) und dem offenen Innenraum des Containerabschnitts (26) zu versperren.

7. Der Wafer-Container mit Frontöffnung nach Anspruch 6, **dadurch gekennzeichnet, daß** das längliche Blockierglied (460) aus einem elastomeren Material gebildet ist und die längliche Umwelt-Steuerkomponente (78, 400) eine Befestigungsstruktur aufweist, die um die Vielzahl von Öffnungen (110, 453) herum verläuft, und die Blockierkomponente (460) elastisch mit der Befestigungsstruktur in Eingriff steht, um dichtend die Verbindung zwischen dem Inneren (414) des Einhausungsabschnitts (410) und dem offenen Innenraum (32) des Containerabschnitts (26) zu blockieren.

8. Der Wafer-Container mit Frontöffnung nach Anspruch 7, **dadurch gekennzeichnet, daß** das längliche Blockierglied (460, 800) in Gleiteingriff mit einem der Einhausungsabschnitte (410, 644) bringbar und gleitend verschieblich auf diesem Einhausungsabschnitt (410, 644) zwischen einer Blockierstellung und einer Offenstellung für die Öffnungen angebracht ist.

9. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** jeder der Einhausungsabschnitte (81, 420, 644, 730) von einem Filtermaterial und einem absorbierenden Material in sich wenigstens eines aufweist.

Revendications

1. Récipient à plaquettes à ouverture frontale (20) pour plaquettes de 300 mm et supérieures, comprenant :

   une partie de récipient (26) ayant une paroi de récipient qui s'étend autour d'un côté gauche fermé (66.2), d'un côté droit fermé (66.3), d'un fond fermé (66.1), d'un sommet fermé (66) et d'un côté arrière fermé (67.1) définissant un intérieur ouvert (32), la partie de récipient (26) ayant une pluralité d'étagères de plaquette horizontales (35) espacées, fixées à l'intérieur de cette dernière et définissant une région de réception de plaquette généralement cylindrique dans l'intérieur ouvert (32) pour contenir un empilement de plaquettes espacées horizontales (W) installées dans les étagères (35), un bâti de porte (40) définissant une partie avant ouverte (30), dans lequel la paroi de partie de récipient (116) au niveau du côté arrière a une paire de régions de coin s'étendant à partir du sommet (66) de la partie de récipient (26) jusqu'au fond (66.1) de la partie de récipient (26) ;
   une porte (24) destinée à être montée dans la partie avant ouverte (36) et verrouillable par rapport au bâti de porte (40),
   une paire de composants de contrôle environnemental tubulaires allongés (60, 78, 119, 400, 600, 700) positionnés dans les régions de coin, chaque composant de contrôle environnemental tubulaire allongé (60, 78, 119, 400, 600, 700) ayant une partie de confinement (81, 420, 644, 730) avec un intérieur et une pluralité d'ouvertures (110, 464) fournissant la communication entre l'intérieur de la partie confinement (81, 410, 644, 730) et l'intérieur ouvert (32) de la partie de récipient (26), et dans lequel chacun des composants de contrôle environnemental tubulaires allongés (60, 78, 119, 400, 600, 700) a un axe (418) qui est droit et le composant de contrôle environnemental tubulaire allongé est raccordé au fond (66.1) de la partie de récipient (26) au niveau d'un orifice de purge (54),
   caractérisé en ce que l'orifice de purge (54) est décalé de l'axe (418) du composant de contrôle environnemental tubulaire (60, 78, 119, 400, 600, 700).

2. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** chaque composant de contrôle environnemental tubulaire allongé (400, 600) est composé de deux parties allongées (402, 604), chaque partie allongée (402,

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604) étant raccordée à l'autre par au moins l'un d'une pluralité de verrous (448, 452) et de charnières (610), les deux parties (402, 604) définissant une partie de confinement (410, 644).

3. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** les composants de contrôle environnemental tubulaires allongés (400) sont chacun composés de deux parties allongées (402, 604) définissant une partie de confinement (410), et dans lequel le composant de contrôle tubulaire allongé (400) comprend en outre un capuchon élastomère (500) qui subit une expansion résiliente pour recouvrir, par adhérence, le sommet de la partie de confinement (410).

4. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** la paire de composants de contrôle environnemental tubulaires allongés (700) sont tous deux exposés vers l'extérieur sur le côté arrière.

5. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** la paire de composants de contrôle environnemental tubulaires allongés (60, 78, 119, 400, 600, 700) sont espacés des parties de paroi et du côté arrière (67.1) et chaque composant de contrôle environnemental tubulaire allongé a une longueur et la longueur s'étend sensiblement sur une distance entre la partie de paroi supérieure (66) et la partie de paroi inférieure (66.1).

6. Récipient à plaquettes à ouverture frontale selon la revendication 2, **caractérisé en outre en ce qu'**il comprend un élément de blocage allongé (460, 800) qui peut être positionné sur au moins l'un des composants de contrôle environnemental tubulaires (78, 400) pour obstruer sélectivement la communication entre l'intérieur (414) de la partie de confinement (410) et l'intérieur ouvert de la partie de récipient (26).

7. Récipient à plaquettes à ouverture frontale selon la revendication 6, **caractérisé en ce que** l'élément de blocage allongé (460) est formé avec un matériau élastomère et le composant de contrôle environnemental tubulaire (78, 400) a une structure de fixation s'étendant autour de la pluralité d'ouvertures (110, 453) et ledit composant de blocage (460) met en prise de manière résiliente ladite structure de fixation pour bloquer de manière étanche la communication entre l'intérieur (414) de la partie de confinement (410) et l'intérieur ouvert (32) de la partie de récipient (26).

8. Récipient à plaquettes à ouverture frontale selon la revendication 7, **caractérisé en ce que** l'élément de blocage allongé (460, 800) peut se mettre en prise de manière coulissante avec l'une des parties de confinement (410, 644) et peut être déplacé de manière coulissante sur ladite partie de confinement (410, 644) entre une position de blocage et une position ouverte d'ouverture.

9. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** chacune des parties de confinement (81, 420, 644, 730) a, à l'intérieur de cette dernière, au moins l'un parmi un matériau de filtre et un matériau absorbant.

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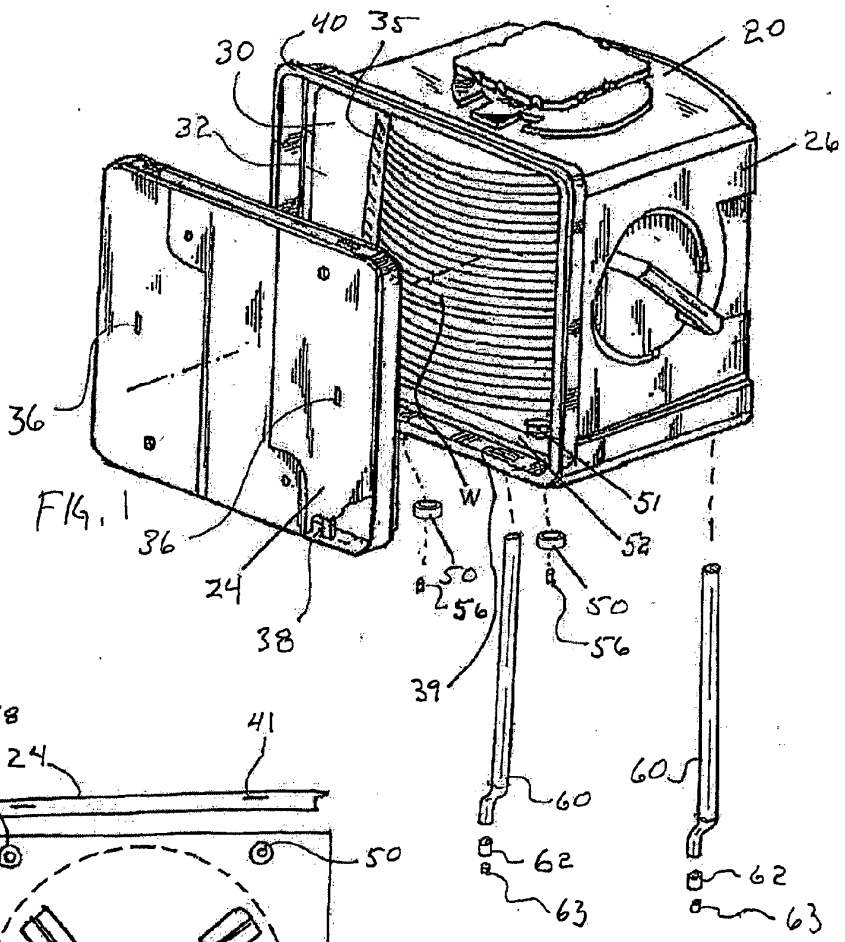


FIG. 1

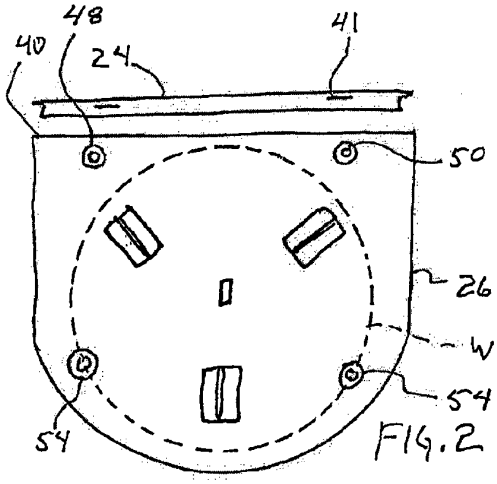


FIG. 2

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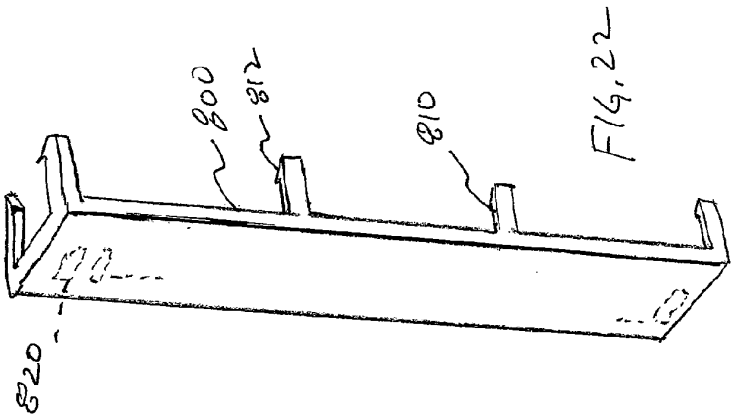


Fig. 22

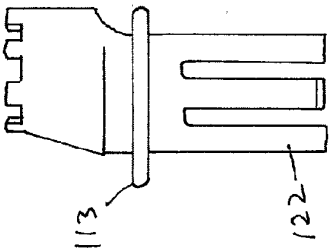


Fig. 6.

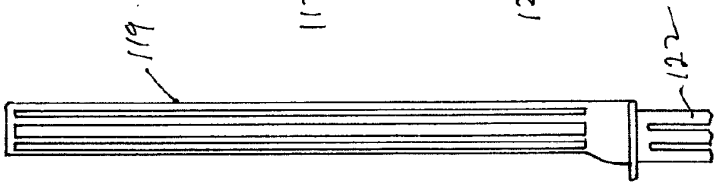


Fig. 5.

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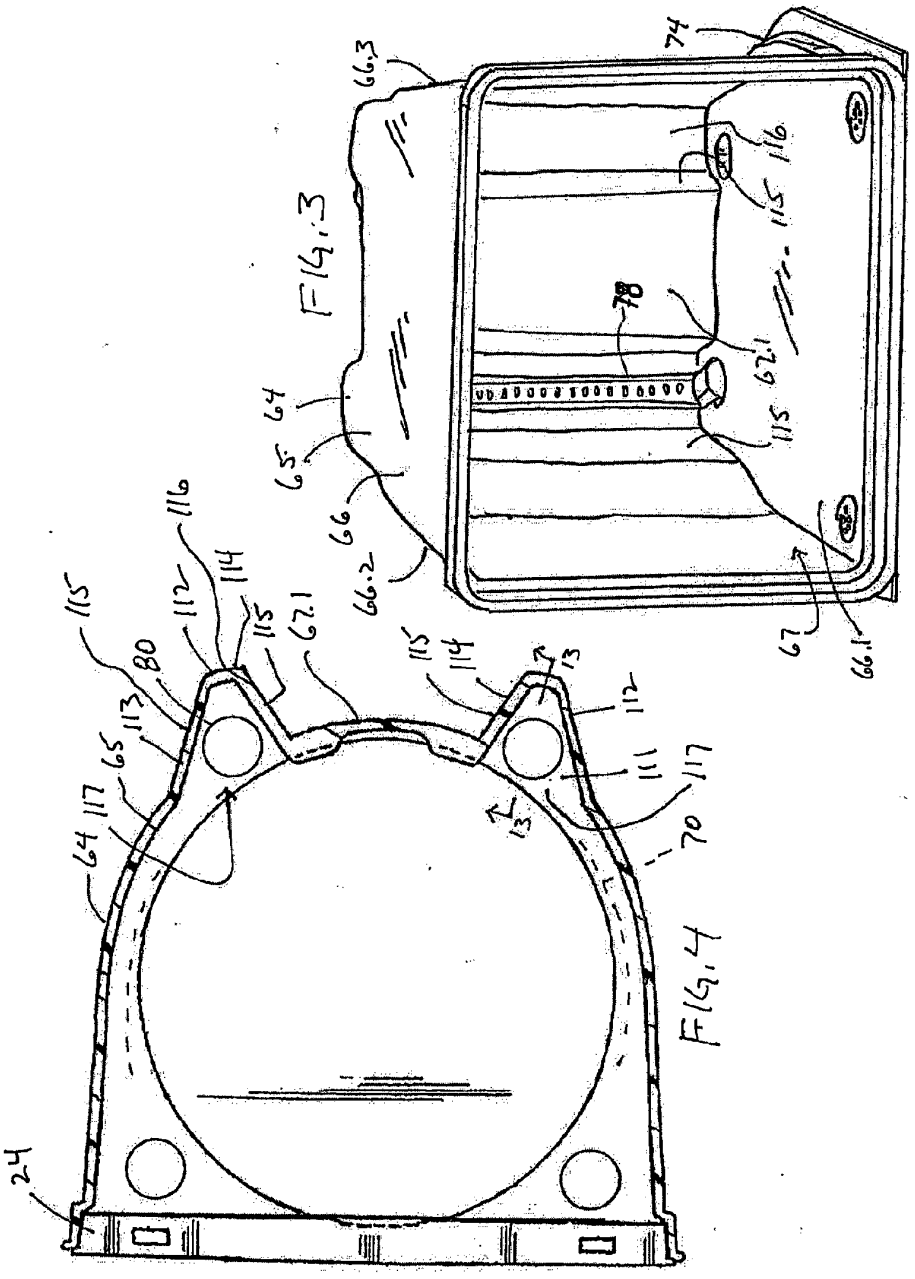


FIG. 3

FIG. 4

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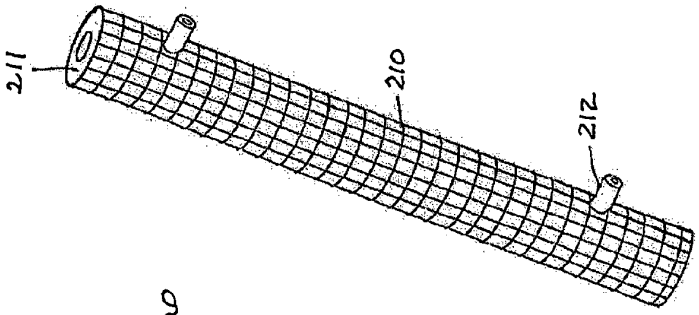


Fig. 8.

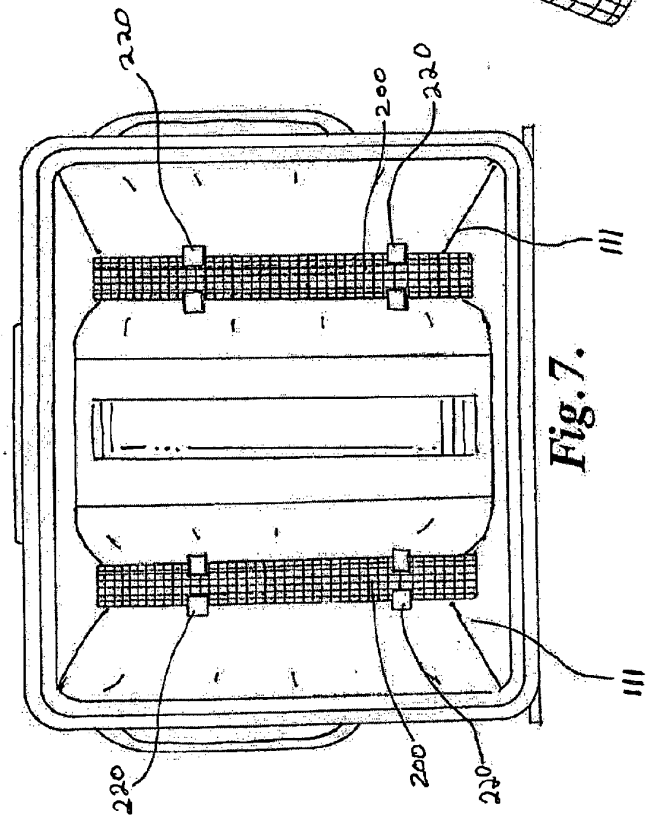


Fig. 7.

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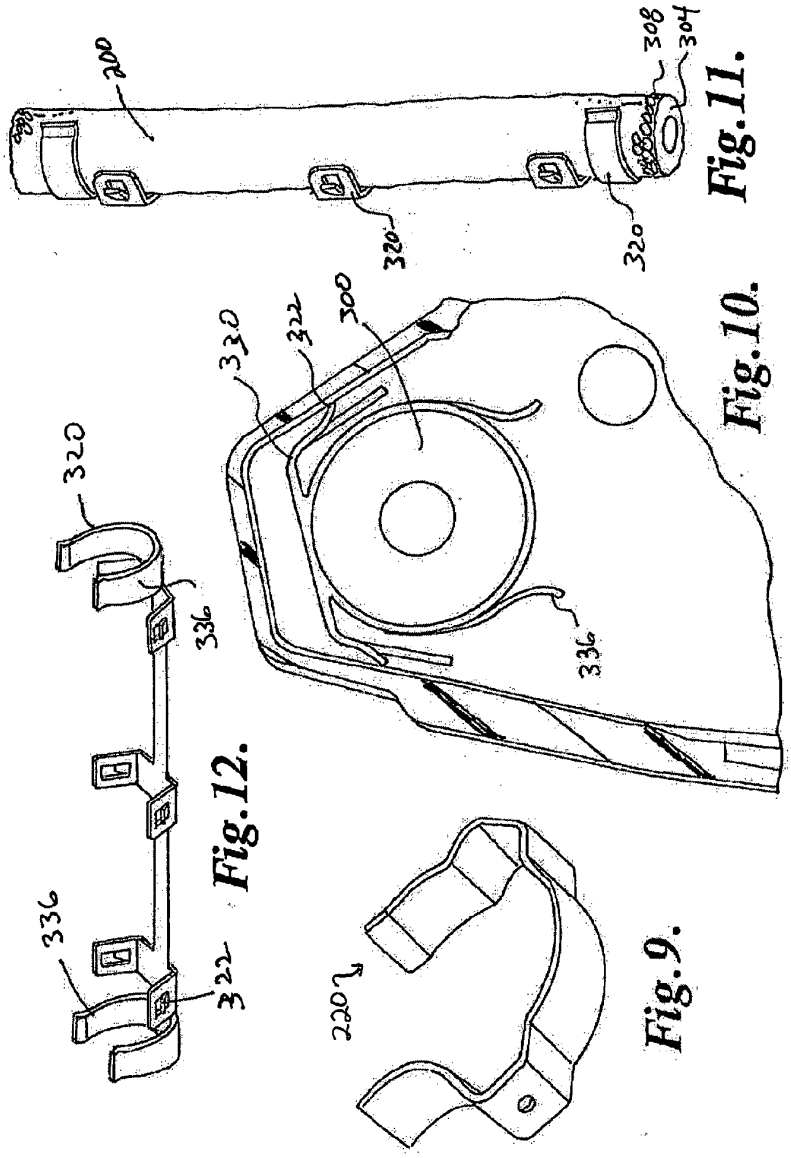


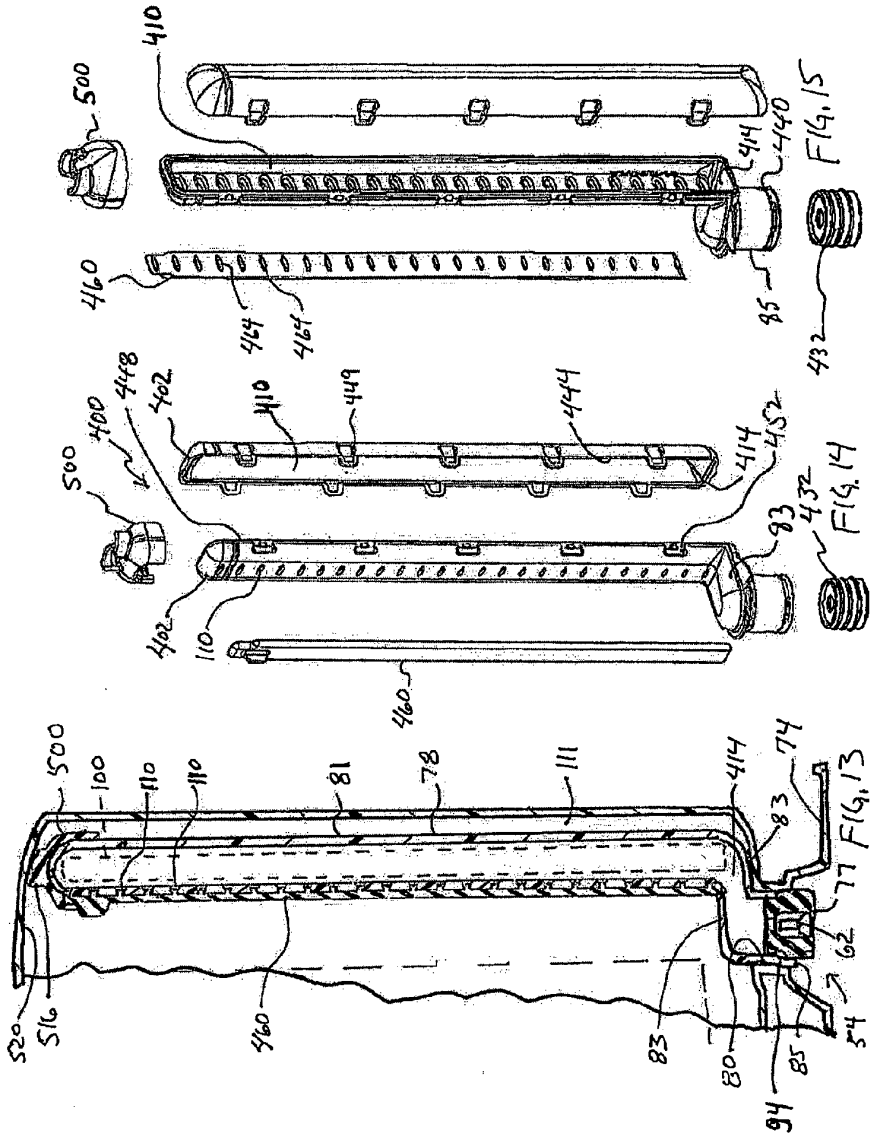
Fig.11.

Fig.10.

Fig.12.

Fig.9.

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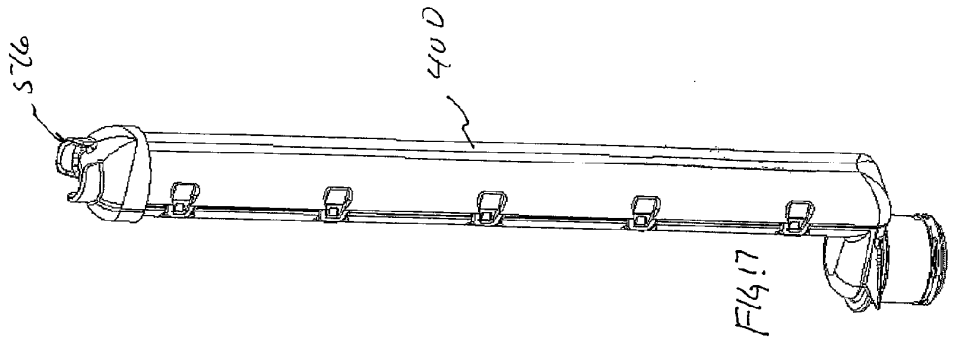


Fig 17

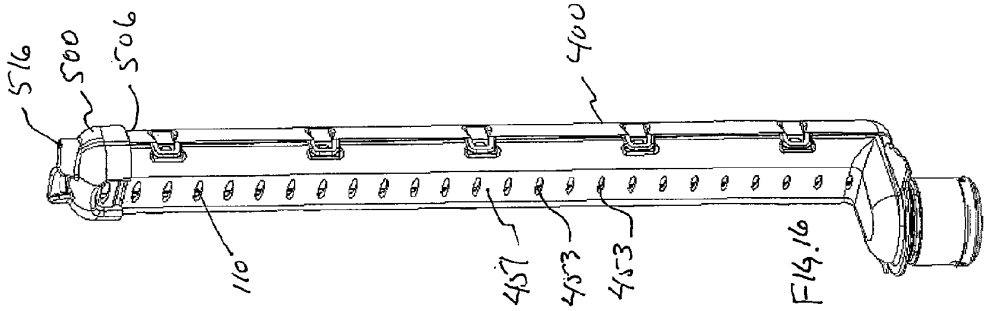


Fig 16

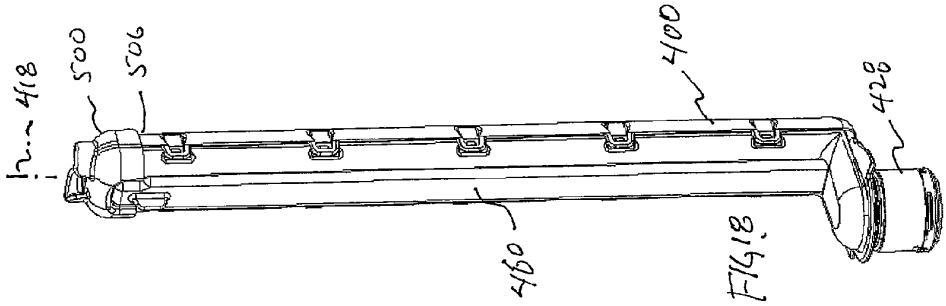


Fig 18

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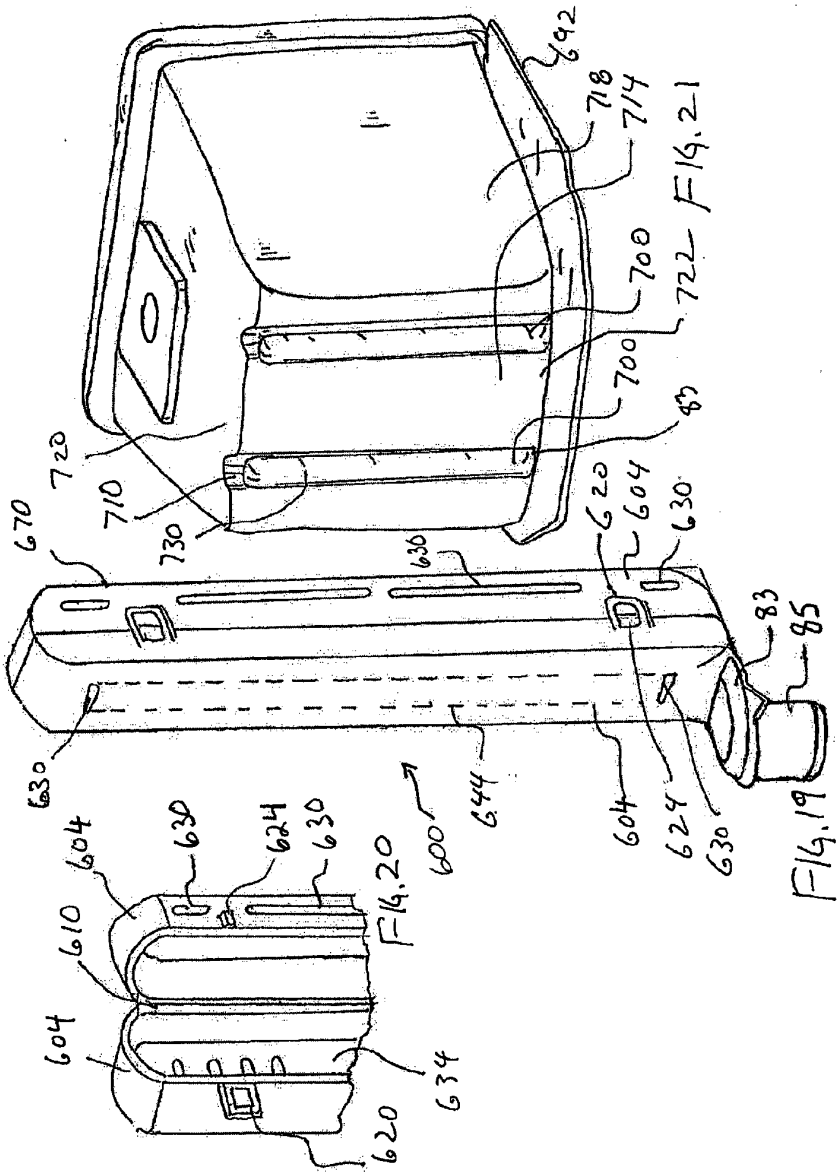


FIG. 19

FIG. 20

FIG. 21

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REFERENCES CITED IN THE DESCRIPTION

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Espacenet

Bibliographic data: JP3960787 (B2) — 2007-08-15

PRECISION SUBSTRATE CONTAINER

Inventor(s): NAKAYAMA TAKAYUKI, ; SHINTANI WATARU

Applicant(s): SHIN ETSU POLYMER CO LTD

Classification: **- international:** ***B65D81/24; B65D85/86; H01L21/673; H01L21/68***

- cooperative:

Application number: JP20010366763 20011130

Priority number(s): JP20010366763 20011130

Also published as: JP2003168728 (A)

Abstract of JP2003168728 (A)

PROBLEM TO BE SOLVED: To provide a substrate container which is capable of eliminating a space where gas stays stagnant and replacing gas inside the container completely with another. ;SOLUTION: This precision substrate container is composed of a container main body 2 and a lid 3 and provided with through-holes through which inner gas inside the container can be replaced with another. A nozzle member 5 provided with nozzles blowing out the gas against both sides of a precision substrate W is fitted on a part of the through-holes, and the residual through- holes are made to serve as exhaust vents. The nozzles of the nozzle member 5 blow out clean air or inert gas direct against the precision substrates along both of their surfaces, by which a space where gas stays stagnant can be eliminated, dust or the like can be prevented from adhering to the substrates, and gas inside the container can be completely replaced with another. ;COPYRIGHT: (C)2003,JPO

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(51)Int.Cl.　F I
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B65D 81/24 (2006.01)　B65D 81/24　C
B65D 85/86 (2006.01)　B65D 85/38　R

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(73)特許権者　000190116
信越ポリマー株式会社
東京都中央区日本橋本町４丁目３番５号
(74)代理人　100093735
弁理士　荒井　鐘司
(74)代理人　100105429
弁理士　河野　尚孝
(74)代理人　100108143
弁理士　嶋崎　英一郎
(72)発明者　中山　孝行
新潟県糸魚川市大字大和川７１５　新潟ポリマー株式会社内
(72)発明者　新谷　渉
新潟県糸魚川市大字大和川７１５　新潟ポリマー株式会社内

最終頁に続く

(54)【発明の名称】精密基板収納容器

(57)【特許請求の範囲】

【請求項1】

開口部を有し、基板を横置きにして上下方向に並べて収納する容器本体と、前記開口部をシール可能に閉鎖する蓋体とからなり、内外に連通する複数の貫通孔を利用して容器内部の気体を置換できる精密基板収納容器において、前記貫通孔は、ノズル部材が取り付けられるか、あるいは排気孔として用いられ、前記ノズル部材は、一端に開口部と、開口部の外周部に形成されたねじ部と、つば部とを有する中空円筒状をなし、さらに、ノズル部材は、その側周壁に容器本体内に収納された精密基板の両面に気流を吹き付ける吹出孔と、前記開口部の内周には、フィルタ保持部材を取り付けるための係止凹部とを有し、リング状に形成された取り付けパーツを介して前記貫通孔に取り付けられ、残りの前記貫通孔を排気孔とすることを特徴とする精密基板収納容器。

【請求項2】

前記ノズル部材の吹出孔が、前記容器本体内に精密基板が収納された際の該精密基板の中心に向けている請求項１記載の精密基板収納容器。

【請求項3】

前記ノズル部材が、リング状に形成された取り付けパーツを介して容器本体の貫通孔に取り付けられ、前記取り付けパーツには、内周にねじ部が形成され、外周にはつば部が形成されていて、前記貫通孔に挿通されたノズル部材のねじ部と前記貫通孔の内周との間に取り付けパーツを差し込み、この取り付けパーツのねじ部をノズル部材のねじ部に螺合していくときに、ノズル部材に形成されたつば部が貫通孔の外周リブの上縁に接触し、取り

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付けパーツのつば部が貫通孔の端縁下部に接触して、固定される請求項１または２記載の精密基板収納容器。
【請求項4】
前記容器本体が、前面に開口部を有し、前記排気孔となる貫通孔が蓋側の容器本体に設けられ、前記ノズル部材が取り付けられる貫通孔が、前記容器本体の奥側に設けられ、かつ前記各貫通孔が、前記容器本体内に精密基板が収納された際の該精密基板の投影部分以外の部分に設けられてなる請求項１～３のいずれか１項に記載の精密基板収納容器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、半導体ウェーハやマスクガラス等の精密基板（以下、単に基板と略記することもある）を収納して、保管、運搬等に使用される精密基板収納容器に関し、特には基板収納容器内部の気体を置換するためのノズル部材を有する精密基板収納容器に関する。
【０００２】
【従来の技術】
従来、精密基板収納容器は、開口部を有する容器本体とこの開口部を密閉する蓋体とからなり、容器本体内の対向する内側壁に形成された支持部に複数枚の精密基板を収納し、蓋体に取り付けられたシールガスケットを用いて、基板収納容器内部を密閉状態として、精密基板の保管や搬送に使用されている。
このような精密基板収納容器では、保管中に基板が汚染されることがないように、基板収納容器内の空気を窒素若しくは不活性ガスまたは乾燥空気等に置換して保管することが知られている（特開平８－１９１１００号公報、特開平９－１３４９５２号公報参照）。
【０００３】
【発明が解決しようとする課題】
上記密閉した精密基板収納容器には、一般にフィルタを備えた吹込孔と排気孔が設けられ、これらの孔を用いて基板収納容器内の気体交換を行っているが、基板収納容器の内部は、収納した複数の基板によって仕切られているため、基板収納容器内の完全な気体交換を行おうとすると、一回の気体交換に５分～１０分も時間がかかり効率が悪かった。
また、基板収納容器内は、収納した基板の数だけ内部が仕切られて複雑な空間をなすため、気体の置換がうまく行われない澱み部分が形成され、この澱み部分に、酸素や基板収納容器の材料、あるいは加工及び／または処理された基板表面から僅かに出る有機汚染ガスや金属イオン等が貯まったままで吹き込まれたガスと置換されず、精密基板が汚染されたり、酸化されてしまうという問題があった。
【０００４】
本発明は、このような問題点を解決するためになされたもので、クリーンエアーや不活性ガスを直接精密基板の両面に吹き付けるようにすることにより、基板収納容器内の澱み部分を無くして容器内部のガスの置換を完全に行い、精密基板への塵挨等の付着を防ぎ、基板の汚染を防止できる基板収納容器を提供するものである。
【０００５】
【課題を解決するための手段】
前記課題を解決するために、請求項１の精密基板収納容器は、開口部を有し、基板を横置きにして上下方向に並べて収納する容器本体と、前記開口部をシール可能に閉鎖する蓋体とからなり、内外に連通する複数の貫通孔を利用して容器内部の気体を置換できる精密基板収納容器において、前記貫通孔は、ノズル部材が取り付けられるか、あるいは排気孔として用いられ、前記ノズル部材は、一端に開口部と、開口部の外周部に形成されたねじ部と、つば部とを有する中空円筒状をなし、さらに、ノズル部材は、その側周壁に容器本体内に収納された精密基板の両面に気流を吹き付ける吹出孔と、前記開口部の内周には、フィルタ保持部材を取り付けるための係止凹部とを有し、リング状に形成された取り付けパーツを介して前記貫通孔に取り付けられ、残りの前記貫通孔を排気孔とすることを特徴とする。

請求項２の精密基板収納容器は、前記ノズル部材の吹出孔が、前記容器本体内に精密基板が収納された際の該精密基板の中心に向けている

【０００６】

また、請求項３の精密基板収納容器は、前記ノズル部材が、リング状に形成された取り付けパーツを介して容器本体の貫通孔に取り付けられ、前記取り付けパーツには、内周にねじ部が形成され、外周にはつば部が形成されていて、前記貫通孔に挿通されたノズル部材のねじ部と前記貫通孔の内周との間に取り付けパーツを差し込み、この取り付けパーツのねじ部をノズル部材のねじ部に螺合していくときに、ノズル部材に形成されたつば部が貫通孔の外周リブの上縁に接触し、取り付けパーツのつば部が貫通孔の端縁下部に接触して、固定される。

さらに、請求項４の精密基板収納容器は、前記容器本体が、前面に開口部を有し、前記排気孔となる貫通孔が蓋側の容器本体に設けられ、前記ノズル部材が取り付けられる貫通孔が、前記容器本体の奥側に設けられ、かつ前記各貫通孔が、前記容器本体内に精密基板が収納された際の該精密基板の投影部分以外の部分に設けられてなる。

【０００７】

【発明の実施の形態】

以下、本発明の一実施の形態を添付図面に基づいて説明する。

図１は本発明の基板収納容器を表す斜視図であり、図２は本発明のノズル部材を基板収納容器に配置した状態を表す図１のII－II面による切断平面図であり、図３は本発明のノズル部材を配置した図１に表す基板収納容器のIII－III面による切断平面図である。また、図４は本発明の基板収納容器に取り付けられるノズル部材を表す正面図であり、図５はノズル部材の拡大底面図である。図６は本発明のノズル部材の取付け状態を表す図２のVI－VI面による断面図、図７は本発明のノズル部材の別の取付け状態を表す、図６に相当する断面図であり、図８は本発明の別の実施形態を表す基板収納容器の図２に相当する断面図である。

【０００８】

図１～図３に示す本発明の基板収納容器１は、前面に開口部を有し基板を横置きにして上下方向に並べて収納する容器であって、容器本体２と蓋体３とからなり、容器本体２には、その対向する左右の内側壁に、精密基板Ｗ（図３では１枚のみを示す）の周縁部を断面コ字状の開放部内で係止して水平に支持する支持部４，４が、上下方向にそれぞれ一定間隔で形成されており、蓋体３の内面には、精密基板Ｗの端縁部を押圧保持するリテーナ３０が取り付けられ、蓋体の側壁にはシールガスケット３１が取り付けられて、容器本体の開口部１２を蓋体３でシール可能に密閉できるようになっている。

また、容器本体２には、内外に連通する４個の貫通孔a_1、a_1，a_2、a_2が設けられ、これらの一部の貫通孔a_1には、容器本体２内に収納された精密基板Ｗの両面に気流を吹き付けるノズル部材５が取り付けられ、残りの貫通孔a_2は、排気孔６として使用されている。

【０００９】

このノズル部材５は、図４に示すように、一端に開口部７を有する中空円筒状に形成され、その側周壁には、円周方向に延びた複数の長円状の吹出孔８，８が軸方向に一定間隔で形成されている。

また、開口部７の外周壁には、容器本体２に設けられた貫通孔a_1に取り付けるためのねじ部９が螺刻形成され、このねじ部９の内周壁には、図５に示すように、フィルタを取り付けるための係止凹部１０が形成され、かつ開口には、内周壁から放射状に伸びるリブ１１が形成されている。フィルタ１８は、このリブ１１と後述するフィルタ保持部材１５に設けられる同様のリブ１６（図６）との間で、挟持状に取り付けられる。

【００１０】

本発明のノズル部材５は、図２、図６に示すように、容器本体２の開口部１２と対向する奥側の二箇所に形成された貫通孔a_1の内周面に形成されたねじ部１３に、ノズル部材５のねじ部９が螺着されて容器本体２の内部に取り付けられる。

この取付け構造では、上記螺着部以外のノズル部材５と容器本体２の接触部に気密性を高めるためのＯリング１４を設けることが好ましい。
ノズル部材５は、容器本体２に取り付けられた際、その各吹出孔８，８が、一対の支持部４，４に支持された基板Ｗに指向する向きに配置され、かつ各吹出孔８が隣接する基板と基板の間隙部に近接した位置に配設されるようになっている。
なお、図３では、ノズル部材５の吹出孔８は判り易くするため、容器本体２の対向する内壁面に向けて描かれているが、上述したように基板Ｗに指向する向きであれば、吹出孔の中心が精密基板Ｗの中心に向くようにノズル部材が配置されることが好ましい。
【００１１】
フィルタをノズル部材５の開口部７に取り付けるために使用されるフィルタ保持部材１５は、図６及び図１０に示すように、リング（筒）状に形成され、一端のノズル部材５側の開口部に形成された放射状のリブ１６を有し、ノズル部材５の開口部７の内周壁に設けられた係止凹部１０に、フィルタ保持部材１５の外周壁に設けた係止突起１７を嵌め込むことにより、ノズル部材５の開口部７の内周に取り付けられる。
【００１２】
この取り付けに際し、放射状のリブ１６にフィルタ１８を載せて、フィルタ保持部材１５をノズル部材５の開口部７に挿入することにより、フィルタ１８は、ノズル部材５の放射状のリブ１１とフィルタ保持部材１５の放射状のリブ１６との間に挟持状に取り付けられる。
なお、フィルタ保持部材１５とノズル部材５の接触部には、気密性を高めるためにＯリング１９を取り付けることが望ましい。
【００１３】
フィルタ１８は、ＨＥＰＡ、ＵＬＰＡなどの塵挨除去用フィルタや、各種ケミカルフィルタ（活性炭、アニオン、カチオン）などが使用でき、これらを一種または複数種併用して使用することができる。なおフィルタの厚さや外形寸法等は限定されない。
【００１４】
図２に示すように、ノズル部材５が取り付けられる貫通孔a_1に対向する容器本体２の開口部１２側に設けられた貫通孔a_2は、ガスパージする際の排気孔６として使用される。
この排気孔６は、図に示したようにノズル部材５と同数設ける必要はなく、ノズル部材より少く若しくは多く設けるようにしてもよく、また、容器本体２のみならず蓋体３に設けるようにしてもよい。
排気孔６には、ノズル部材５に取り付けたのと同様に、フィルタ保持部材１５を取り付けてフィルタ１８を介して、基板収納容器内部の気体を外部へ排気することが好ましい。
この場合、排気孔となる容器本体の貫通孔の内周にフィルタ部材を取り付ける係止凹部と放射状や格子状のフィルタ保持リブを設けておくとよい。
【００１５】
なお、排気は容器内に供給されるガスにもよるが、自然排気の他にも、排気孔に開閉弁を取り付けておき、排気管路に連通された部品を開閉弁に挿入して連通させて外部に排気したり、真空ポンプ等を使って強制排気させるようにしてもよい。
ノズル部材５が取り付けられる貫通孔a_1及び排気孔６として使用される貫通孔a_2は、いずれも収納した精密基板の貫通孔設置面（図示の場合、基板収納容器の底面）への投影部分の外側に設けることが好ましく、これにより収納した基板に邪魔されず容器内の気流がスムーズになって効率のよい吹込み及び排気が可能となる。
【００１６】
　ノズル部材５の容器本体２への取り付けは、前記したように、容器本体２の貫通孔a_1に形成したねじ部１３に、ノズル部材５に設けられたねじ部９を直接螺合させて行うこともできるが、図７に示すように取付けパーツ２２を用いて行うこともできる。
　この取付けパーツ２２は、リング（筒）状に形成され内周に、ノズル部材５のねじ部９と噛み合うねじ部２３が螺刻され、外周部にはつば部２４が形成されている。
【００１７】

取付けパーツ２２を使用してノズル部材５を容器本体２に取り付けるには、まず、ノズル部材５の開口部７を容器本体２の貫通孔a_1に内側から挿通させて、貫通孔a_1の内周面とノズル部材５のねじ部９との間隙に、取付けパーツ２２を差し込む。
次いで、取付けパーツ２２のねじ部２３をノズル部材５のねじ部９に螺合させて締付けていくと、ノズル部材５の外周に設けられたつば部２０が、容器本体２の貫通孔a_1の上端部周縁に形成された外周リブ２１に、取付けパーツ２２の外周面から突出したつば部２４が貫通孔a_1の端縁下部に、それぞれ圧接されて、ノズル部材５が容器本体２に強固に取り付けられる。
このような取付けパーツ２２を使用すれば、図６に示した取付構造と異なり、容器本体２の貫通孔a_1にねじ加工をする必要がないので、容器本体の生産性が向上する。
【００１８】
また、ノズル部材は、図８に示すように、容器本体２の蓋体３に取り付けるようにしてもよい。
この場合、排気孔６はノズル部材５から離れた容器本体２の奥側に設けた貫通孔a_2に、一ないし複数箇所に設けることが望ましく、また、ノズル部材５は、図９に示すように、開口部７のねじ部９を、蓋体３の内部に形成した貫通孔a_1から蓋体３の内側に突出した取付部２５を使って蓋体３に取り付けることができる。
この取付部２５は、蓋体３の貫通孔a_1を、蓋体３に沿って上方に折曲した中空構造になっていて、内周壁にはノズル部材５のねじ部９に螺合できるねじ部２６が螺刻されており、蓋体３の外に連通する開口部２７に配管等を連結させて、ここからガスパージをすることができるようになっている。
【００１９】
本発明によるノズル部材は、ポリエチレン、ポリプロピレン、ＡＢＳ樹脂、ポリスチレン、ポリカーボネート、ポリブチレンテレフタレートなどの熱可塑性樹脂およびポリエステル系、ポリオレフィン系、ポリスチレン系などの熱可塑性エラストマーを用いることができる。
【００２０】
次に、本発明の精密基板収納容器のガスパージについて説明する。
本発明の精密基板収納容器のガスパージは、容器本体２に取り付けられたノズル部材５の開口部７に、外部に設けられたドライクリーンエアーや窒素等の不活性ガス等の供給源に連通したガス注入口（図示せず）を連結し、前記気体を基板収納容器の内部に供給して行われる。
ノズル部材５に注入されたガスは、フィルタ１８を介してクリーンな状態でノズル部材５の中空部に充満され、吹出孔８，８から基板収納容器１の内部へ充満していく。
【００２１】
このとき新たに供給されるガスは、容器本体２の支持部４，４に支持された精密基板Ｗの上面と下面に沿うように流れて、ガスパージ前に精密基板収納容器に充満していた空気は、排気孔６，６からフィルターを介して外部へ排気されていく。
このように、ノズル部材を使用して精密基板収納容器内に供給ガスの流れを作ることで、精密基板を汚染するおそれのある精密基板収納容器の材料や金属配線等の加工処理された基板表面からの微量の揮発性ガスを、精密基板表面から取り除きながらガスパージすることができ、精密基板の汚染防止効果がきわめて有効に得られる。
特に多数の精密基板を収納した基板収納容器では、多数の基板によって細かく区切られた容器内部の隅々まで、澱み無く流れ効率よくガスパージができる。
【００２２】
また、本発明のノズル部材を使って、ドライクリーンエアーや不活性ガスを注入して精密基板に沿う供給ガスの流れを作り外部に排気することにより、基板収納容器内に僅かに存在するパーティクルを供給ガスで容器内に巻き上げて精密基板に付着させてしまうこともなく、基板の汚染を防止でき、かつ基板によって遮られる空間部を短時間で効率よくパージすることができるので生産性が向上する。

Entegris, EX1002, p. 456

さらに、本発明の基板収納容器を使って、精密基板を保管している間中、常に不活性ガスを基板表面に吹き付けておくことができるので、揮発性ガスによる保管中の基板汚染を防止できると共に、基板表面の自然酸化膜形成を防止できるので、基板表面の厚さが変動せず精度の良い加工や処理ができる。

【００２３】

ノズル部材５の開口部７や容器本体２の排気孔６に、外部に設けられるガスパージ用の供給口及び排気口に挿入して係合可能な開閉弁を設けておくと、基板収納容器内に外界のエアーが自然吸気されることがなくなるので、基板収納容器を不活性ガスで満たした状態で長期間保管しておくことができる。

以上、本発明を前記実施の形態に基づき説明したが、本発明は前記実施の形態例に限定されるものではなく、その要旨を逸脱しない範囲で種々変更が可能である。

【００２４】

【発明の効果】

本発明の精密基板収納容器によれば、収納した複数の精密基板の表裏両面に沿って、クリーンエアーや不活性ガスを直接吹き付けることができるので、保管中でも精密基板を汚染することなく、ガスパージの際の滞留部分もないため短時間で効率よくガスパージすることができる。

【図面の簡単な説明】

【図１】　本発明の精密基板収納容器を表す斜視図である。

【図２】　本発明のノズル部材を精密基板収納容器に配置した状態を表す図１のII-II面による切断平面図である。

【図３】　本発明のノズル部材を配置した図１に表す精密基板収納容器のIII-III面による切断平面図である。

【図４】　本発明の精密基板収納容器に取り付けられるノズル部材を表す正面図である。

【図５】　図４のノズル部材の拡大底面図である。

【図６】　本発明のノズル部材の取付け状態を表す図２のVI－VI面による断面図である。

【図７】　本発明のノズル部材の別の取付け状態を表す図６に相当する断面図である。

【図８】　本発明の別の実施形態を表す精密基板収納容器の図２に相当する断面図である。

【図９】　本発明のノズル部材用取付具の取付け状態を示す模式的断面図である。

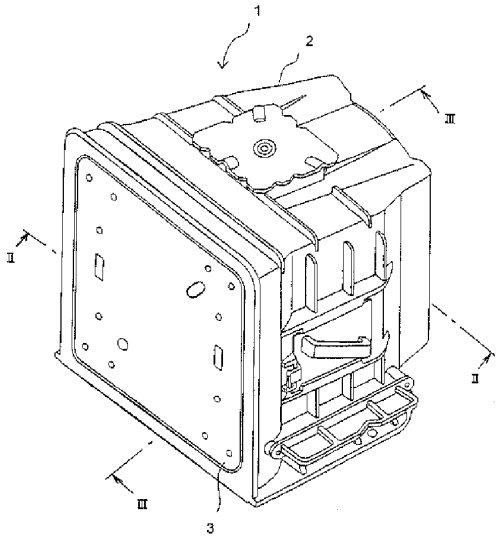
【図１０】　本発明に使用するフィルタ部分の組立斜視図である。

【符号の説明】

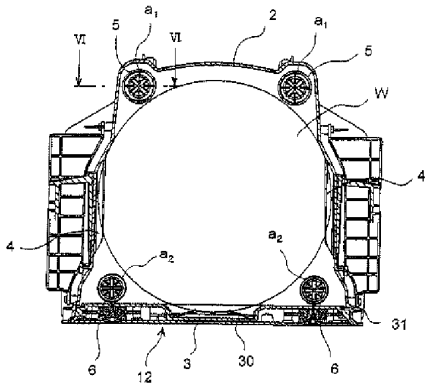
１　精密基板収納容器
２　容器本体
３　蓋体
４　支持部
５　ノズル部材
６　排気孔
７　ノズル部材の開口部
８　吹出孔
９　ねじ部
１０　係止凹部
１１　リブ
１２　容器本体の開口部
１３　ねじ部
１４　Ｏリング
１５　フィルタ保持部材
１６　放射状のリブ
１７　係止突起
１８　フィルタ

１９　Ｏリング
２０　つば部
２１　外周リブ
２２　取付けパーツ
２３　ねじ部
２４　取付けパーツのつば部
２５　取付部
２６　取付部のねじ部
２７　取付部の開口部
３０　リテーナ
３１　シールガスケット
a_1，a_2　貫通孔
Ｗ　基板

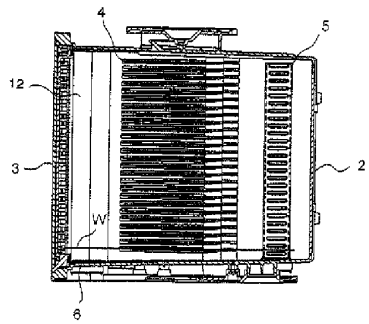
【図1】



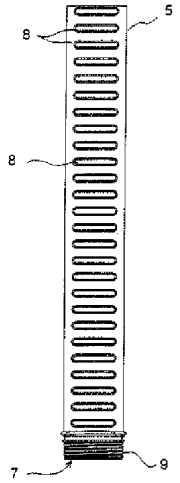
【図2】



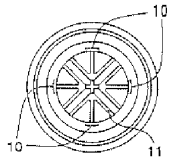
【図3】



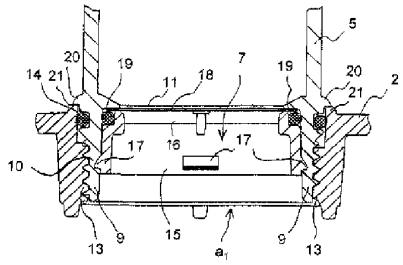
【図4】



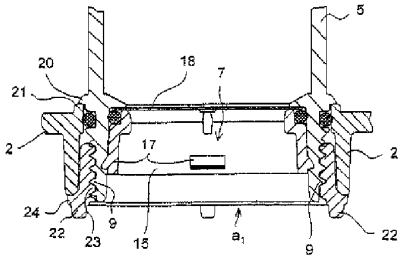
【図5】



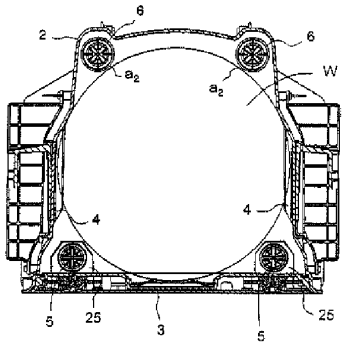
【図6】



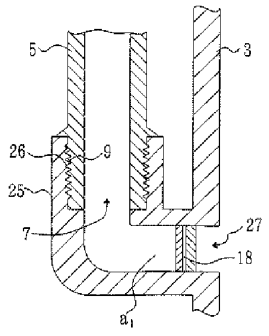
【図7】



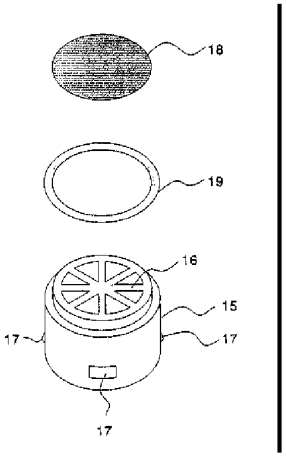
【図8】



【図9】



【図10】



審査官　植村　森平

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特表２００１－５１６５００（ＪＰ，Ａ）

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PURGE VALVE AND SUBSTRATE STORING CONTAINER

Inventor(s): OGAWA OSAMU

Applicant(s): SHIN ETSU POLYMER CO LTD

Classification: **- international:** ***B65D85/86; F16K15/06; H01L21/673***
- cooperative:

Application number: JP20090122802 20090521 Global Dossier

Priority number(s): JP20090122802 20090521

Also published as: JP2010270823 (A)

Abstract of JP2010270823 (A)

PROBLEM TO BE SOLVED: To provide a purge valve configured so that mounting operation can be further easily or rapidly performed by imparting bidirectionality to the valve, and the number of gas supply ports or the like can be also increased as needed, and a substrate storing container. SOLUTION: The purge valve includes a valve case 21 fitted to a through-hole 4 of a bottom plate 3 of a container body; a hollowed internal pressure regulating valve element 39 reciprocatingly inserted to the valve case 21 through a coil spring 27 to open and close the valve case 21; an external pressure regulating valve element 44 reciprocatingly inserted to the internal pressure regulating valve element 39 through a coil spring 41 to open and close the internal pressure regulating valve element 39; and a gas filtering filter 48 interposed between the valve case 21 and the internal pressure regulating valve element 39 and external pressure regulating valve element 44. When gas is distributed from one end toward the other end of the valve case 21, the external pressure regulating valve element 44 is moved backward to open the closed internal pressure regulating valve element 39, and when the gas is distributed from the other end toward one end of the valve case 21, the internal pressure regulating valve element 39 is moved backward to open the closed valve case 21. ;COPYRIGHT: (C)2011,JPO&INPIT

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H01L 21/673	(2006.01)	H01L	21/68	T
B65D 85/86	(2006.01)	B65D	85/38	R

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(73)特許権者　000190116
信越ポリマー株式会社
東京都千代田区神田須田町一丁目９番地
(74)代理人　100112335
弁理士　藤本　英介
(74)代理人　100101144
弁理士　神田　正義
(74)代理人　100101694
弁理士　宮尾　明茂
(72)発明者　小川　統
埼玉県さいたま市北区吉野町１－４０６－１　信越ポリマー株式会社内

審査官　所村　陽一

最終頁に続く

(54)【発明の名称】基板収納容器

(57)【特許請求の範囲】
【請求項１】
基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換する基板収納容器であって、
複数のパージバルブの構成を同一とし、
各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の内圧調整弁体と、この内圧調整弁体に往復動可能に挿入支持され、内圧調整弁体を開閉する外圧調整弁体と、バルブケースと内圧調整弁体及び外圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と内圧調整弁体及び外圧調整弁体との間にフィルタを介在し、
バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じた内圧調整弁体との間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じたバルブケースとの間を開放するようにしたことを特徴とする基板収納容器。
【請求項２】

基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換する基板収納容器であって、

複数のパージバルブの構成を同一とし、

各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の外圧調整弁体と、この外圧調整弁体に往復動可能に挿入支持され、外圧調整弁体を開閉する内圧調整弁体と、バルブケースと外圧調整弁体及び内圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と外圧調整弁体及び内圧調整弁体との間にフィルタを介在し、

バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じたバルブケースとの間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じた外圧調整弁体との間を開放するようにしたことを特徴とする基板収納容器。

【請求項３】

容器本体を構成する底板の基板の投影領域と重ならない箇所に複数の貫通孔を穿孔し、各貫通孔にパージバルブをスペーサリングと緩み防止リングとを介して嵌め付けた請求項１又は２記載の基板収納容器。

【請求項４】

容器本体の内部後方に、容器本体の背面壁内面との間に気体隔離用のチャンバ領域を形成する区画遮蔽板を取り付け、チャンバ領域にパージバルブを連通させ、区画遮蔽板には、基板方向に不活性ガスを噴出する噴出口を形成した請求項１、２、又は３記載の基板収納容器。

【請求項５】

バルブケースを、内圧調整弁体と外圧調整弁体とを収納する筒形ケースと、フィルタを収納して筒形ケースに着脱自在に嵌め合わされる少なくとも中空の保持ケースとに分割し、筒形ケースの一端部側を略漏斗形に形成してその内面を内圧調整弁体に密接してシールするガイド傾斜面とし、筒形ケース内の一端部側と残部との境界付近には、内圧調整弁体を支持する支持部を形成した請求項１、３、又は４記載の基板収納容器。

【請求項６】

内圧調整弁体を筒形に形成してその一端部側の周面には筒形ケースのガイド傾斜面に密接するシール部材を取り付け、内圧調整弁体の他端部側を略漏斗形に形成してその内面をガイド支持斜面とし、外圧調整弁体を略柱形に形成してその周面には内圧調整弁体のガイド支持斜面に密接するシール部材を取り付けた請求項５記載の基板収納容器。

【発明の詳細な説明】

【技術分野】

【０００１】

本発明は、半導体ウェーハやマスクガラスからなる基板等を収納して保管、搬送、輸送等する際に使用される基板収納容器に関するものである。

【背景技術】

【０００２】

近年、半導体部品の配線の狭ピッチ化や微細化が進んでいるが、このような動向に鑑み、半導体ウェーハを収納する基板収納容器には、高度な密封性と取扱いの自動化とが求められている。係る要望に鑑み、基板収納容器は、ガスパージの際に利用される逆止弁付きのタイプが開発されている（特許文献１、２、３参照）。

【０００３】

逆止弁付きの基板収納容器は、図示しないが、複数枚の半導体ウェーハを整列収納する

Entegris, EX1002, p. 463

容器本体と、この容器本体の開口部を開閉する蓋体とを備え、容器本体の周壁に、複数の逆止弁がそれぞれ装着されている。各逆止弁は、円筒形のバルブケースと、このバルブケースにバネを介し往復動可能に支持され、円環形のシール面を有する弁体とを備えて構成されている。バルブケースは、容器本体の外部に露出する筒形ケースと、この筒形ケースに着脱自在に螺嵌されて容器本体内に位置する保持筒とに分割構成されている。

【先行技術文献】

【特許文献】

【０００４】

【特許文献１】特開２００４－１４６６７６号公報

【特許文献２】特開２００４－１７９４４９号公報

【特許文献３】特開２００２－５２１１８９号公報

【発明の概要】

【発明が解決しようとする課題】

【０００５】

従来における基板収納容器は、以上のように構成され、逆止弁のバルブケースに弁体が単に弾性支持されているので、ガス給気用の逆止弁とガス排気用の逆止弁の双方が必要となり、その結果、容器本体の周壁に複数の逆止弁を取り付ける作業が実に複雑かつ煩雑で、作業の簡素化や迅速化を図ることができないという問題がある。

【０００６】

また従来、ストッカーでの保管時のガスパージ等、ゆっくりとガスを給気可能な工程においては、ガス供給ポートとガス排気ポートとが１：１の比率で割り当てて運用されているが、急速にガスを給気する工程では、ガス供給ポート数を増加したい場合がある。しかしながら、ガス給気用の逆止弁とガス排気用の逆止弁の仕様が異なるときには、各逆止弁が専用品なので、ガス供給ポートの数を迅速に増やすことができないおそれが少なくない。

【０００７】

本発明は上記に鑑みなされたもので、バルブに双向性を付与して取付け作業の簡素化や迅速化を図ることができ、しかも、必要に応じてガス供給ポートの数等を迅速に増やすことのできる基板収納容器を提供することを目的としている。

【課題を解決するための手段】

【０００８】

本発明においては上記課題を解決するため、基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換するものであって、

複数のパージバルブの構成を同一とし、

各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の内圧調整弁体と、この内圧調整弁体に往復動可能に挿入支持され、内圧調整弁体を開閉する外圧調整弁体と、バルブケースと内圧調整弁体及び外圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と内圧調整弁体及び外圧調整弁体との間にフィルタを介在し、

バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じた内圧調整弁体との間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じたバルブケースとの間を開放するようにしたことを特徴としている。

【０００９】

また、本発明においては上記課題を解決するため、基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換するものであって、

複数のパージバルブの構成を同一とし、

各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の外圧調整弁体と、この外圧調整弁体に往復動可能に挿入支持され、外圧調整弁体を開閉する内圧調整弁体と、バルブケースと外圧調整弁体及び内圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と外圧調整弁体及び内圧調整弁体との間にフィルタを介在し、

バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じたバルブケースとの間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じた外圧調整弁体との間を開放するようにしたことを特徴としている。

【００１０】

なお、容器本体を構成する底板の基板の投影領域と重ならない箇所に複数の貫通孔を穿孔し、各貫通孔にパージバルブをスペーサリングと緩み防止リングとを介して嵌め付けることができる。

また、容器本体の内部後方に、容器本体の背面壁内面との間に気体隔離用のチャンバ領域を形成する区画遮蔽板を取り付け、チャンバ領域にパージバルブを連通させ、区画遮蔽板には、基板方向に不活性ガスを噴出する噴出口を形成することができる。

【００１１】

また、バルブケースを、内圧調整弁体と外圧調整弁体とを収納する筒形ケースと、フィルタを収納して筒形ケースに着脱自在に嵌め合わされる少なくとも中空の保持ケースとに分割し、筒形ケースの一端部側を略漏斗形に形成してその内面を内圧調整弁体に密接してシールするガイド傾斜面とし、筒形ケース内の一端部側と残部との境界付近には、内圧調整弁体を支持する支持部を形成することもできる。

【００１２】

また、内圧調整弁体を筒形に形成してその一端部側の周面には筒形ケースのガイド傾斜面に密接するシール部材を取り付け、内圧調整弁体の他端部側を略漏斗形に形成してその内面をガイド支持斜面とし、外圧調整弁体を略柱形に形成してその周面には内圧調整弁体のガイド支持斜面に密接するシール部材を取り付けることが可能である。

【００１３】

また、スペーサリングに、バルブケースの保持ケースを位置決めする位置決め部を形成することが可能である。

また、区画遮蔽板に、区画遮蔽板の内部と噴出口とを隔離するフィルタを取り付け、このフィルタにより、所定の圧力に蓄積された気体を噴出口から外部に噴出させることが可能である。

【００１４】

また、バルブケースの筒形ケースに、弾性を有する接触キャップを交換可能に取り付け、この接触キャップに流通口を設けても良い。

また、バルブケースの保持ケースに中空のノズルタワーを突出形成し、このノズルタワーには、気体用の噴出孔を設けても良い。

さらに、ノズルタワーの噴出孔を、ノズルタワーの内部から外部に向かうにしたがい徐々に広がるよう形成しても良い。

【００１５】

ここで、特許請求の範囲におけるバルブケースには内圧調整弁体を各種のバネ部材を介して挿入し、この内圧調整弁体には外圧調整弁体を各種のバネ部材を介して挿入することができる。このバルブケースの他端部は、通気性があれば、開口していても良いし、必要数の孔を備えた閉塞面でも良い。また、気体には、少なくともドライエアー、窒素ガス、アルゴンガス等の不活性ガスが含まれる。シール部材には、少なくとも弾性のOリングやガスケット等が含まれる。本発明に係るパージバルブは、半導体関連の分野のみならず、化学、測定分析、製薬、バイオ等の分野でも使用することができる。

【００１６】

パージバルブは、必要に応じ、上下、前後、左右、斜め方向に向けて使用することができる。このパージバルブは、基板収納容器に取り付けられる場合には、容器本体の貫通孔に取り付けることもできるし、蓋体に貫通孔を設け、この貫通孔に取り付けることもできる。また、基板には、少なくとも単数複数の半導体ウェーハ、液晶基板、ガラス基板、マスクガラス等が該当する。基板収納容器の容器本体は、透明、不透明、半透明を特に問うものではない。

【００１７】

本発明によれば、容器本体あるいは蓋体の開口に分割構造のパージバルブを取り付ける場合には、バルブケースの筒形ケースに内圧調整弁体と外圧調整弁体とを組み合わせて収納するとともに、バルブケースの保持ケースにフィルタを収納して固定し、開口に保持ケースを一方向から嵌め入れ、開口から他方向に露出した保持ケースの露出部にバルブケースの筒形ケースを嵌め合わせれば、開口にパージバルブを取り付けることができる。

【００１８】

次に、バルブケースの開口した一端部側から通気性の他端部方向に気体が供給される場合には、気体の圧力により、外圧調整弁体が往動して内圧調整弁体から離れ、内圧調整弁体と外圧調整弁体との間の流路が開放される。この流路の開放により、気体は、バルブケースの一端部側からパージバルブの流路を経由してバルブケースの他端部方向に流れる。

【００１９】

これに対し、バルブケースの他端部側から一端部方向に気体が供給される場合には、気体の圧力により、内圧調整弁体が往動してバルブケースの内面から離れ、バルブケースと内圧調整弁体との間の流路が開放される。この流路の開放により、気体は、バルブケースの他端部側からパージバルブの流路を経由してバルブケースの一端部側に流れる。

【発明の効果】

【００２０】

本発明によれば、ガス給気用としても、ガス排気用としても使用可能な双方向性のパージバルブを用いるので、ガス給気用の逆止弁とガス排気用の逆止弁の双方を個別に要したり、パージバルブの取付位置に留意する必要がない。したがって、容器本体や蓋体に複数のパージバルブを取り付ける作業が容易になり、作業の簡素化や迅速化を図ることができるという効果がある。また、ガス給気用とガス排気用の仕様が異なることがなく、専用品のバルブを省略することができるので、急速にガスを給気する工程でも、ガス供給ポートの数を迅速に増やすことができる。

【００２１】

また、容器本体を構成する底板の基板の投影領域と重ならない箇所に複数の貫通孔を穿孔し、各貫通孔にパージバルブをスペーサリングと緩み防止リングとを介して嵌め付ければ、成形された容器本体が金型から脱型されるときの抜きテーパに伴う加工誤差を補正したり、基板収納容器の貫通孔からのバルブケースの脱落を防止することができる。

【００２２】

また、容器本体の内部後方に、容器本体の背面壁内面との間に気体隔離用のチャンバ領域を形成する区画遮蔽板を取り付け、チャンバ領域にパージバルブを連通させ、区画遮蔽板には、基板方向に不活性ガスを噴出する噴出口を形成すれば、容器本体に収納された基板方向に向けて気体を効果的に噴射することができ、基板の汚染や酸化の防止を図ることが可能になる。

Entegris, EX1002, p. 466

【００２３】
また、バルブケースを、内圧調整弁体と外圧調整弁体とを収納する筒形ケースと、フィルタを収納して筒形ケースに着脱自在に嵌め合わされる少なくとも中空の保持ケースとに分割すれば、内圧調整弁体、外圧調整弁体、あるいはフィルタを必要に応じ、簡単に交換等することが可能になる。
【００２４】
また、筒形ケースの一端部側を略漏斗形に形成してその内面を内圧調整弁体に密接してシールするガイド傾斜面とすれば、内圧調整弁体がガイド傾斜面に案内されて適切な位置で密接し、良好なシール状態を得ることが可能になる。また、筒形ケース内の一端部側と残部との境界付近に、内圧調整弁体を支持する支持部を形成すれば、バルブケースからの内圧調整弁体の脱落を簡易な構成で防ぐことができる。
【００２５】
さらに、内圧調整弁体を筒形に形成してその一端部側の周面には筒形ケースのガイド傾斜面に密接するシール部材を取り付けたり、外圧調整弁体を略柱形に形成してその周面には内圧調整弁体のガイド支持斜面に密接するシール部材を取り付ければ、シール部材の密接により、バルブケースからの気体の漏洩を防ぐことができる。
【図面の簡単な説明】
【００２６】
【図１】本発明に係る基板収納容器の実施形態を模式的に示す分解斜視図である。
【図２】本発明に係る基板収納容器の実施形態を模式的に示す断面平面図である。
【図３】本発明に係る基板収納容器の実施形態を模式的に示す平面図である。
【図４】本発明に係る基板収納容器の実施形態を模式的に示す正面図である。
【図５】本発明に係る基板収納容器の実施形態を模式的に示す底面図である。
【図６】本発明に係る基板収納容器の実施形態を模式的に示す断面説明図である。
【図７】本発明に係る基板収納容器の実施形態におけるパージバルブの給気状態を模式的に示す断面説明図である。
【図８】本発明に係る基板収納容器の実施形態におけるパージバルブの排気状態を模式的に示す断面説明図である。
【図９】本発明に係る基板収納容器の第２の実施形態を模式的に示す断面側面図である。
【図１０】本発明に係る基板収納容器の第２の実施形態を模式的に示す正面図である。
【図１１】本発明に係る基板収納容器の第２の実施形態を模式的に示す底面図である。
【図１２】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す斜視説明図である。
【図１３】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す正面図である。
【図１４】図１３のＸＩＶ－ＸＩＶ線断面説明図である。
【図１５】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す平面図である。
【図１６】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す底面図である。
【図１７】本発明に係る基板収納容器の第３の実施形態を模式的に示す断面説明図である。
【図１８】本発明に係る基板収納容器の第３の実施形態における区画遮蔽板を模式的に示す説明図である。
【図１９】本発明に係る基板収納容器の第３の実施形態における他の区画遮蔽板を模式的に示す説明図である。
【図２０】本発明に係る基板収納容器の第４の実施形態を模式的に示す断面説明図である。
【発明を実施するための形態】
【００２７】

以下、図面を参照して本発明の実施形態を説明すると、本実施形態における基板収納容器は、図１～図８に示すように、複数枚の半導体ウェーハＷを収納する容器本体１と、この容器本体１の開口した正面を開閉する蓋体１０とを備え、容器本体１に複数の貫通孔４を穿孔し、各貫通孔４には、ガスを給排気する双方向性のパージバルブ２０を嵌着して容器本体１内の空気を窒素ガス等の不活性ガスに置換し、半導体ウェーハＷの表面酸化等を防止するようにしている。

【００２８】

半導体ウェーハＷは、図２に示すように、例えば７７５μｍの厚さを有するφ３００ｍｍのシリコンウェーハからなり、周縁部に図示しない位置合わせや識別用のノッチが平面半円形に切り欠かれており、容器本体１に２５枚が整列して収納される。

【００２９】

容器本体１と蓋体１０とは、所定の樹脂を含有する成形材料によりそれぞれ射出成形される。この成形材料中の所定の樹脂としては、例えば力学的性質や耐熱性等に優れるポリカーボネート、ポリエーテルエーテルケトン、ポリエーテルイミド、あるいは環状オレフィン樹脂等があげられる。成形材料には、カーボン、カーボン繊維、金属繊維、カーボンナノチューブ、導電性ポリマー、帯電防止剤、又は難燃剤等が必要に応じて選択的に添加される。

【００３０】

容器本体１は、図２～図５に示すように、複数枚の半導体ウェーハＷを上下方向に並べて整列収納する不透明のフロントオープンボックスタイプに形成され、開口した横長の正面を水平横方向に向けた状態で半導体加工装置や気体置換装置上に位置決めして搭載されたり、洗浄槽の洗浄液により洗浄される。この容器本体１の内部両側、すなわち両側壁の内面には、半導体ウェーハＷを水平に支持する左右一対の支持片２が対設され、この一対の支持片２が上下方向に所定のピッチで配列される。

【００３１】

容器本体１の底板３は、収納された半導体ウェーハＷの投影領域と重ならない箇所、例えば前後両側の四隅部付近に貫通孔４がそれぞれ穿孔して配設され、この複数の貫通孔４に、容器本体１の内外を連通するパージバルブ２０がそれぞれＯリング３２を介し着脱自在に嵌合される。底板３には、ボトムプレート５が締結ビスを介して下方から水平に螺着され、この底板３あるいはボトムプレート５の前部両側と後部中央とには、基板収納容器、具体的には容器本体１を位置決めする位置決め具６が締結ビスやボスを介しそれぞれ螺着される。

【００３２】

複数の位置決め具６は、図５に示すように、前部一側の位置決め具６Ａが中空の円錐台形に形成されて半導体加工装置や気体置換装置の位置決めピンによりＸ方向（左右幅方向）、Ｙ方向（奥行き方向）、Ｚ方向（高さ方向）に一義的に嵌合位置決めされ、前部他側の位置決め具６Ｂが断面Ｖ溝形に形成されて半導体加工装置や気体置換装置の位置決めピンに対して左右横方向に自由度を確保するとともに、位置決め具６Ａと共にＹ方向の位置決めを行い、半導体加工装置や気体置換装置に基板収納容器が搭載された際の正面の平行度に資するよう機能する。また、後部中央の位置決め具６Ｃは、平面に形成され、位置決めピンに接触して高さ方向に位置決めする。

【００３３】

容器本体１の天板には、工場の天井搬送機構に把持される搬送用のトップフランジが締結ビスを介し水平に螺着される。また、容器本体１の背面壁７には、透明の覗き窓が選択的に形成され、この覗き窓により、容器本体１の内部が外部から視覚的に観察・把握される。容器本体１の両側壁の表面には、補強や変形防止の他、指等を干渉させることのできるグリップ部が設けられる。また、容器本体１の正面の周縁には、外方向に張り出すリムフランジ８が膨出形成され、このリムフランジ８内に着脱自在の蓋体１０がガスケットを介し蓋体開閉装置により嵌合される。

【００３４】

蓋体１０は、図２に示すように、容器本体１の正面内に嵌合する横長の筐体１１と、この筐体１１の開口した表面（正面）を被覆する表面プレート１２と、これら筐体１１と表面プレート１２との間に介在される施錠機構１４とを備えて構成される。この蓋体１０の筐体１１は、基本的には浅底の断面略皿形に形成され、裏面の中央部には、半導体ウェーハＷを弾発的に保持するフロントリテーナ１３が着脱自在に装着される。

【００３５】

施錠機構１４は、特に限定されるものではないが、例えば表面プレート１２の操作口を貫通した蓋体開閉装置の操作ピンに回転操作される左右一対の回転プレートと、各回転プレートの回転に伴い上下方向にスライドする複数のスライドプレートと、各スライドプレートのスライドに伴い筐体１１から突出してリムフランジ８の施錠穴に係止する複数の施錠爪とを備えて構成される。

【００３６】

複数のパージバルブ２０は、給気用としても、排気用としても使用可能であるが、好ましくは容器本体１の内部後方に位置する左右一対のパージバルブ２０が給気用として使用され、容器本体１の正面側の内部前方に位置する左右一対のパージバルブ２０が排気用として使用される。各パージバルブ２０は、中空のバルブケース２１の一端部である下端部が開口し、このバルブケース２１の他端部である上端部には少なくとも通気性が付与されており、バルブケース２１の上下両端部間にかけて空気や不活性ガス等からなるガス（図の矢印参照）を流通させ、かつガスの流通を制御するバルブである。

【００３７】

パージバルブ２０は、図１、図６～図８に示すように、容器本体１の底板３の貫通孔４に嵌着される分割構造のバルブケース２１と、このバルブケース２１内に拡径のコイルバネ２７を介し往復動可能に挿入支持され、バルブケース２１を開閉する中空の内圧調整弁体３９と、この内圧調整弁体３９内に縮径のコイルバネ４１を介し往復動可能に挿入支持され、内圧調整弁体３９を開閉する外圧調整弁体４４と、バルブケース２１の上端部内と内圧調整弁体３９及び外圧調整弁体４４との間に介在されるフィルタ保持具４６とを備え、このフィルタ保持具４６に、ガス濾過用のフィルタ４８が保持される。

【００３８】

パージバルブ２０のバルブケース２１、内圧調整弁体３９、外圧調整弁体４４、フィルタ保持具４６は、特に限定されるものではないが、例えば容器本体１や蓋体１０と同様の成形材料によりそれぞれ成形される。

【００３９】

バルブケース２１は、図１、図６～図８に示すように、組み合わされた内圧調整弁体３９と外圧調整弁体４４とを収納して容器本体１の外部に露出する筒形ケース２２と、フィルタ保持具４６を収納して筒形ケース２２に容器本体１内から着脱自在に螺嵌される保持ケース２９とを備え、これら筒形ケース２２と保持ケース２９とが視覚的な認識を容易にする観点から相互に異なる形に構成されており、容器本体１の貫通孔４にその内外方向からスペーサリング３５と緩み防止リング３７とを介して嵌着される。

【００４０】

筒形ケース２２は、基本的には円筒形に形成されてその下端部側が半径外方向に略漏斗形に拡開形成され、この下端部側の直線的に傾斜した内面が内圧調整弁体３９に密接してシールするガイド傾斜面２３とされる。

【００４１】

筒形ケース２２の内周面は、上端部側周方向に保持ケース２９と螺合する螺子２４が螺刻形成され、この上端部側と下端部側との境界付近には、半径内方向に突出する平面リング形の支持部２５が形成されるとともに、この支持部２５の平坦な上面には平面リング形の保持突起２６が形成されており、この保持突起２６に内圧調整弁体３９がコイルバネ２７の下端部を介して位置決め保持される。また、筒形ケース２２の上端面には、緩み防止リング３７と係合接触する複数の微小突起２８が間隔をおいて配列形成される。

【００４２】

Entegris, EX1002, p. 469

保持ケース２９は、基本的には円筒形に形成されてその外周面下部には筒形ケース２２の螺子２４と螺合する螺子溝３０が周方向に螺刻形成され、開口した通気性の上端部には、フィルタ４８に接触する格子形の仕切りリブ３１が架設されており、容器本体１の貫通孔４内に気密用のＯリング３２を介し着脱自在に密嵌される。この保持ケース２９の内周面周方向には、フィルタ保持具４６用の複数の係止穴３３が間隔をおいて配列形成される。

【００４３】

スペーサリング３５は、保持ケース２９に嵌合するリングに形成され、容器本体１の貫通孔４にパージバルブ２０が嵌着される際、貫通孔４の周縁部と保持ケース２９のフランジ３４付きの上端部との間に容器本体１内から選択的に介在配備され、成形された容器本体１が金型から脱型されるときの脱型用抜きテーパに伴う寸法誤差を補正するよう機能する。このスペーサリング３５の上面には、低い円柱形の位置決め部３６が突出形成され、この位置決め部３６が保持ケース２９を位置決めするよう機能する。

【００４４】

緩み防止リング３７は、保持ケース２９に嵌合するリングに形成され、容器本体１の貫通孔４にパージバルブ２０が嵌着される際、貫通孔４の周縁部とバルブケース２１の筒形ケース２２との間に容器本体１外から選択的に介在配備される。この緩み防止リング３７は、下面に複数の凹凸３８が形成され、この複数の凹凸３８が対向する筒形ケース２２の微小突起２８と相互に係合接触することにより、湿度や衝撃等の作用で筒形ケース２２が緩んで脱落するのを防止するよう機能する。

【００４５】

内圧調整弁体３９は、図１、図６～図８に示すように、基本的には保持ケース２９よりも縮径の円筒形に形成されてその下端部側の周面には切り欠きが周方向に凹み形成され、この切り欠きに筒形ケース２２のガイド傾斜面２３に弾接する気密用のＯリング４０が嵌着されており、バルブケース２１の内面との間にガス用の流路を形成する。内圧調整弁体３９の上端部側は、半径外方向に略漏斗形に拡開形成されて保持ケース２９の内面に僅かな隙間をおいて近接するとともに、コイルバネ２７の上端部に係止し、内面が外圧調整弁体４４とそのコイルバネ４１用のガイド支持斜面４２とされる。

【００４６】

内圧調整弁体３９の内面の上端部側と下端部との境界付近には、コイルバネ４１の上端部に干渉する段差部４３が半径内方向に向けて突出形成される。また、コイルバネ２７は、内圧調整弁体３９に外側から嵌合されて筒形ケース２２の支持部２５に支持され、内圧調整弁体３９を上方に弾圧付勢する。

【００４７】

外圧調整弁体４４は、同図に示すように、基本的には内圧調整弁体３９よりもやや背の低い略円柱形に形成されてその下端部にはフランジが半径外方向に突出形成され、このフランジにコイルバネ４１の下端部が支持されており、内圧調整弁体３９の内面との間にガス用の流路を形成する。この外圧調整弁体４４の上端部側の周面には切り欠きが周方向に凹み形成され、この切り欠きに内圧調整弁体３９のガイド支持斜面４２に弾接する気密用のＯリング４５が嵌着される。また、コイルバネ４１は、内圧調整弁体３９に内側から嵌合されてその段差部４３と外圧調整弁体４４のフランジとの間に介在され、外圧調整弁体４４を下方に弾圧付勢する。

【００４８】

フィルタ保持具４６は、同図に示すように、背の低い通気性の円筒形あるいはリングに形成されてその開口部内には格子形の仕切りリブ４７が架設され、この仕切りリブ４７上にフィルタ４８を支持しており、保持ケース２９内に着脱自在に嵌合されてその仕切りリブ３１との間にフィルタ４８を挟持するよう機能する。このフィルタ保持具４６の外周面には、複数の係止爪４９が周方向に間隔をおいて配列形成され、各係止爪４９が保持ケース２９の係止穴３３に係止してフィルタ保持具４６を位置決め固定するよう機能する。

【００４９】

フィルタ４８は、例えば高純度アルミナやポリテトラフルオロエチレン等の材料を使用して薄い円板に形成され、フィルタ保持具４６中を流通するガス中のパーティクルを除去し、半導体ウェーハW等の汚染を防止する。

【００５０】

上記構成において、容器本体１の貫通孔４にパージバルブ２０を嵌着する場合には、先ず、バルブケース２１の筒形ケース２２に内圧調整弁体３９と外圧調整弁体４４とをコイルバネ２７・４１を介してそれぞれ収納し、バルブケース２１の保持ケース２９にフィルタ４８を備えたフィルタ保持具４６を収納して位置決め固定し、保持ケース２９にスペーサリング３５を嵌合する。

【００５１】

こうして保持ケース２９にスペーサリング３５を嵌合したら、容器本体１の貫通孔４に保持ケース２９をスペーサリング３５と共に容器本体１内からＯリング３２を介し下向きに嵌入し、保持ケース２９を位置決めし、その後、貫通孔４から露出した保持ケース２９の下端部にバルブケース２１の筒形ケース２２を緩み防止リング３７と共に嵌合して螺嵌し、筒形ケース２２と緩み防止リング３７とを相互に圧接して筒形ケース２２の緩みを未然に防止するようにすれば、容器本体１の貫通孔４にパージバルブ２０を強固に嵌着することができる。

【００５２】

なお、内圧調整弁体３９と外圧調整弁体４４については、内圧調整弁体３９と外圧調整弁体４４の上下を１８０°反転させ、外圧調整弁体４４の内部に内圧調整弁体３９を位置させ、この状態でバルブケース２１に収納することもできる。この場合、保持ケース２９の内部に、外圧調整弁体４４との間をシールするガイド傾斜面２３を形成すると良い。また、筒形ケース２２内のコイルバネ２７に外圧調整弁体４４を支持させ、保持ケース２９に嵌合したフィルタ保持具４６に内圧調整弁体３９を支持させると良い。

【００５３】

次に、双方向性のパージバルブ２０を用いて容器本体１内の空気を不活性ガス等に置換する場合について説明するが、置換前のパージバルブ２０は、筒形ケース２２のガイド傾斜面２３に内圧調整弁体３９のＯリング４０が密接してシールし、内圧調整弁体３９のガイド支持斜面４２に外圧調整弁体４４のＯリング４５が密接してシールするので、容器本体１の内外にガスが過誤により漏洩することがない（図６参照）。

【００５４】

次いで、容器本体１内に不活性ガスが外部から給気される場合には、不活性ガスの給気圧力により、外圧調整弁体４４がコイルバネ４１を圧縮しつつ上昇してそのＯリング４５を内圧調整弁体３９のガイド支持斜面４２から離隔させ、内圧調整弁体３９と外圧調整弁体４４との間の流路が開放される。この流路の開放により、不活性ガスは、外部からパージバルブ２０の流路を経由して容器本体１内に給気される（図７参照）。

【００５５】

不活性ガスの給気が停止すると、外圧調整弁体４４がコイルバネ４１の復元作用により下降してそのＯリング４５を内圧調整弁体３９のガイド支持斜面４２に密接させるが、この際、外圧調整弁体４４のＯリング４５は、テーパ形のガイド支持斜面４２に案内されつつ適切に密接し、良好なシール状態を確保する。

【００５６】

次いで、不活性ガスの給気に伴い、容器本体１内の圧力が高まり、容器本体１内の空気が外部に排気される場合には、空気の圧力により、内圧調整弁体３９がコイルバネ２７を圧縮しつつ下降してそのＯリング４０を筒形ケース２２のガイド傾斜面２３から離隔させ、バルブケース２１と内圧調整弁体３９との間の流路が開放される。この流路の開放により、空気は、容器本体１内からパージバルブ２０の流路を経由して容器本体１の外部に排気される（図８参照）。

【００５７】

容器本体１内の圧力が低下すると、内圧調整弁体３９がコイルバネ２７の復元作用によ

Entegris, EX1002, p. 471

り上昇してそのＯリング４０を筒形ケース２２のガイド傾斜面２３に密接させるが、この際、内圧調整弁体３９のＯリング４０は、テーパ形のガイド傾斜面２３に案内されつつ適切に密接し、良好なシール状態を確保する。

【００５８】

上記構成によれば、ガス給気用としても、ガス排気用としても使用可能な双方向性のパージバルブ２０を用いるので、ガス給気用の逆止弁とガス排気用の逆止弁の双方を個別に要したり、パージバルブ２０の取付位置に留意する必要が全くない。したがって、容器本体１に複数のパージバルブ２０を取り付ける作業がきわめて容易になり、作業の簡素化や迅速化を図ることができる。

【００５９】

また、ガス給気用とガス排気用の仕様が異なることがなく、専用品のバルブを省略することができるので、ガス供給ポートの数を迅速に増やすことができる。さらに、バルブケース２１の筒形ケース２２と保持ケース２９との外観が相互に異なる形なので、視覚的に容易に把握することができ、筒形ケース２２を保持ケース２９と誤って取り付けること等がなく、取付ミスの防止や部品管理の容易化が大いに期待できる。

【００６０】

次に、図９～図１６は本発明の第２の実施形態を示すもので、この場合には、ガス給気用として使用される複数のパージバルブ２０の保持ケース２９をそれぞれ仕切りリブ３１を有しない中空に形成してその上面には容器本体１内の下方から上方に伸びる細長いノズルタワー５１を一体形成し、各ノズルタワー５１を中空に形成してその周壁には容器本体１の前方に不活性ガスを噴射する噴出孔５２を複数配列するようにしている。

【００６１】

各保持ケース２９は、その外周面中央付近に嵌合溝５０が周方向に切り欠かれ、この嵌合溝５０に気密用のＯリング３２が嵌合される。また、各ノズルタワー５１は、やや先細りの中空円錐台形に形成され、周壁の上下方向には、複数枚の半導体ウェーハＷやその間に不活性ガスを噴射する噴出孔５２が一定間隔で複数配列されており、不活性ガスを下方から上方に導くよう機能する。

【００６２】

各噴出孔５２は、不活性ガスの広範囲に亘る拡散噴射を図る観点から、ノズルタワー５１の内部から外部に向かうにしたがい徐々に広がるよう断面略漏斗形に拡開形成され、半導体ウェーハＷの表裏両面に不活性ガスを効率的に噴射する。

なお、フィルタ保持具４６は、リングに形成されてその開口部内にフィルタ４８を直接的に支持したり、仕切りリブ４７を介して間接的に支持しており、保持ケース２９内に着脱自在に嵌合される。その他の部分については、上記実施形態と略同様であるので説明を省略する。

【００６３】

本実施形態においても上記実施形態と同様の作用効果が期待でき、しかも、容器本体１内に不活性ガスを単に供給するのではなく、容器本体１内に収納された半導体ウェーハＷの表裏両面等に向けて不活性ガスを直接噴射するので、半導体ウェーハＷの表面酸化の防止が大いに期待できるのは明らかである。

【００６４】

次に、図１７～図１９は本発明の第３の実施形態を示すもので、この場合には、容器本体１の内部後方の両側部に、容器本体１の背面壁７内面との間にガス隔離用のチャンバ領域５３をシール状態に区画形成する区画遮蔽板５４をそれぞれ配設し、各区画遮蔽板５４には、半導体ウェーハＷにガスを噴出する噴出口５５を必要数穿孔し、チャンバ領域５３に給気用のパージバルブ２０を連通させるようにしている。

【００６５】

区画遮蔽板５４は、容器本体１の上下方向に伸びる断面略皿形に形成され、容器本体１の背面壁７内面に熱溶着や超音波溶着等の方法で直接固定されたり、あるいは容器本体１の背面壁７内面にシール部材、係合穴、係合爪等を介して着脱自在に装着される。この区

画遮蔽板５４の半導体ウェーハＷに対向する対向壁には、横長の噴出口５５が上下方向に並べて穿孔されたり、あるいは複数枚の半導体ウェーハＷの高さに相当する縦長の噴出口５５が穿孔される。

【００６６】

区画遮蔽板５４の内面には、区画遮蔽板５４の内部と噴出口５５とを隔離するポリプロピレン等からなるブリージングフィルタ５６が選択的に貼着され、このブリージングフィルタ５６が一定の圧力に蓄積されたガスを区画遮蔽板５４の内部から噴出口５５を介して外部に均一に噴出するよう機能する。噴出口５５は、必要に応じ、区画遮蔽板５４の内部から外部に向かうにしたがい徐々に広がるよう断面略漏斗形に拡開形成され、半導体ウェーハＷの表裏両面に不活性ガスを効率的に噴射する。その他の部分については、上記実施形態と略同様であるので説明を省略する。

【００６７】

本実施形態においても上記実施形態と同様の作用効果が期待でき、容器本体１内に収納された複数枚の半導体ウェーハＷの間や半導体ウェーハＷの表裏両面に向けて不活性ガスを直接噴射することができるので、半導体ウェーハＷの表面酸化の防止が大いに期待できる。

【００６８】

次に、図２０は本発明の第４の実施形態を示すもので、この場合には、筒形ケース２２の下端部に、断面略Ｕ字形の接触キャップ５７を交換可能に取り付け、この接触キャップ５７の平坦部中央には、ガス供給ポートあるいはガス排気ポートに圧接して連通する流通口５８を丸く穿孔するようにしている。

【００６９】

接触キャップ５７は、筒形ケース２２よりも弾力性に富む熱可塑性エラストマーにより弾性の平面リング形に形成され、ポートのノズル形状に応じて外形や流通口５８が形成される。このような接触キャップ５７は、筒形ケース２２の下端部外周面に高さ調整可能に着脱自在に螺嵌されたり、摩擦係合を利用して圧入されることにより、ガス供給ポートあるいはガス排気ポートと筒形ケース２２とを連通する。その他の部分については、上記実施形態と略同様であるので説明を省略する。

【００７０】

本実施形態においても上記実施形態と同様の作用効果が期待でき、ポートのノズル形状に対応する接触キャップ５７のみを筒形ケース２２の下端部に装着すれば良いので、ポートのノズル形状に応じてパージバルブ２０自体を交換する必要が全くない。また、接触キャップ５７の高さを容易に調整することができるので、ポートのノズルとの接触性を向上させることができる。さらに、接触キャップ５７が損傷した場合にも、接触キャップ５７のみを交換すれば良いので、部品点数の削減が期待できる。

【００７１】

なお、上記実施形態では容器本体１の底板３の四隅部付近に貫通孔４をそれぞれ穿孔して各貫通孔４にパージバルブ２０を嵌合したが、容器本体１の底板３の一隅部付近に貫通孔４を穿孔して貫通孔４にパージバルブ２０を嵌合しても良いし、容器本体１の天板、背面壁７、側壁に貫通孔４を穿孔し、この貫通孔４にパージバルブ２０を嵌合しても良い。また、筒形ケース２２の外周面に螺子２４を螺刻形成し、保持ケース２９の内周面に、筒形ケース２２の螺子２４と螺合する螺子溝３０を螺刻形成しても良い。

【００７２】

また、バルブケース２１の筒形ケース２２と保持ケース２９とを螺子結合ではなく、係止フックと係止ホックとの係止、あるいは摩擦抵抗等により結合しても良い。また、上記実施形態ではスペーサリング３５の上面に円柱形の位置決め部３６を突出形成したが、スペーサリング３５に位置決め部３６を凹み形成しても良い。また、ガス排気用として使用されるパージバルブの保持ケース２９上面に細長いノズルタワー５１を形成することもできる。

【００７３】

Entegris, EX1002, p. 473

また、ノズルタワー５１を中空の円柱形や円錐形に形成したり、ノズルタワー５１の一部を曲げることもできる。さらに、ノズルタワー５１の噴出孔５２は、長孔、楕円孔、ノズルタワー５１の長軸方向に必要数形成されるスリット孔でも良いし、焼結合金や多孔質材料からなる無数の微小孔等とすることもできる。

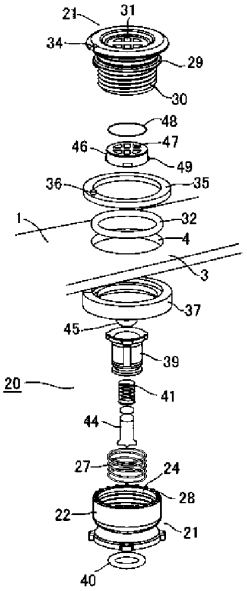
【符号の説明】

【００７４】

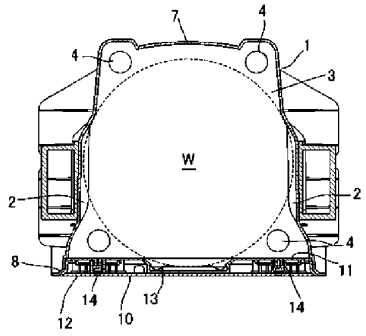
1	容器本体
3	底板
4	貫通孔
7	背面壁
１０	蓋体
２０	パージバルブ
２１	バルブケース
２２	筒形ケース
２３	ガイド傾斜面
２５	支持部
２７	コイルバネ
２９	保持ケース
２７	コイルバネ
３２	Ｏリング
３５	スペーサリング
３７	緩み防止リング
３９	内圧調整弁体
４０	Ｏリング（シール部材）
４１	コイルバネ
４２	ガイド支持斜面
４４	外圧調整弁体
４５	Ｏリング（シール部材）
４６	フィルタ保持具
４８	フィルタ
５１	ノズルタワー
５２	噴出孔
５３	チャンバ領域
５４	区画遮蔽板
５５	噴出口
５７	接触キャップ
５８	流通口
W	半導体ウェーハ（基板）

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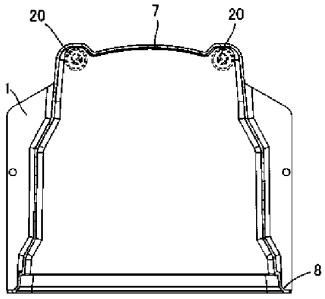
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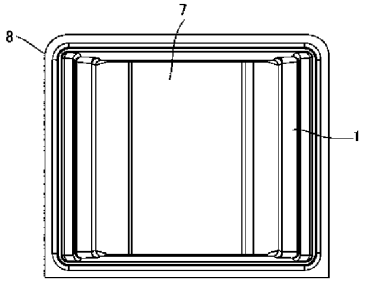
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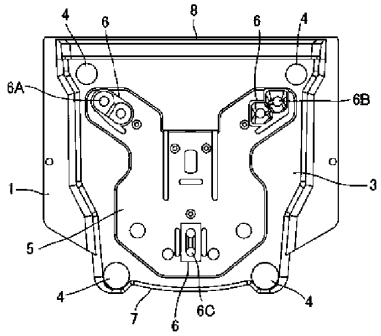
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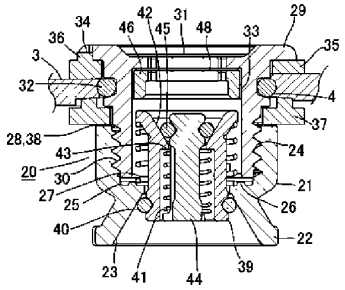
【図４】



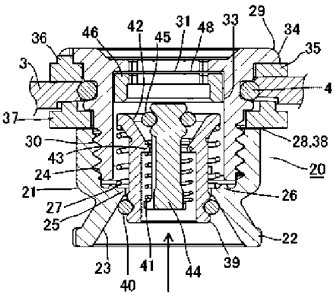
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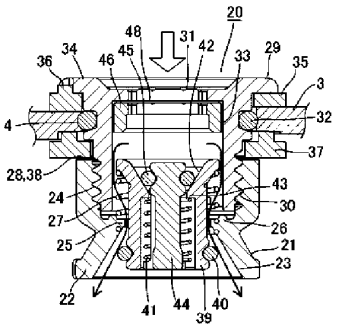
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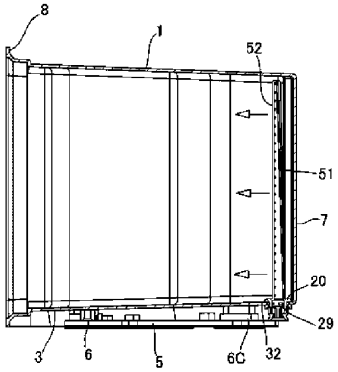
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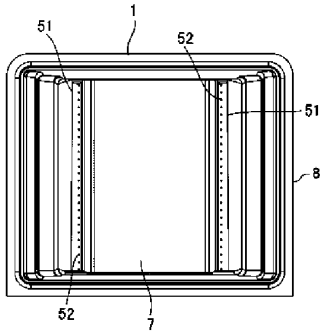
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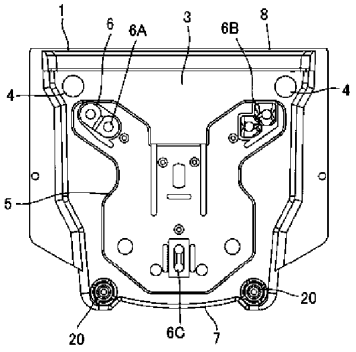
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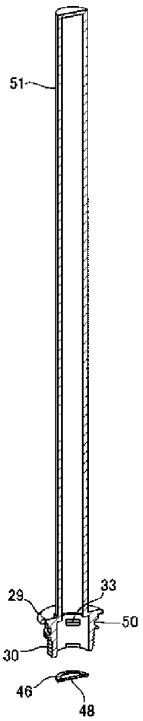
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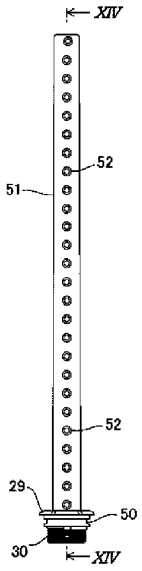
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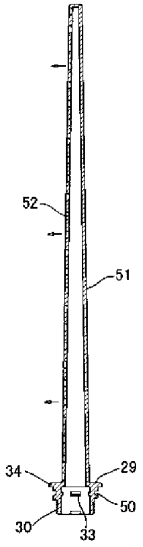
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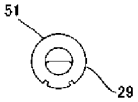
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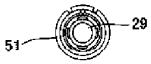
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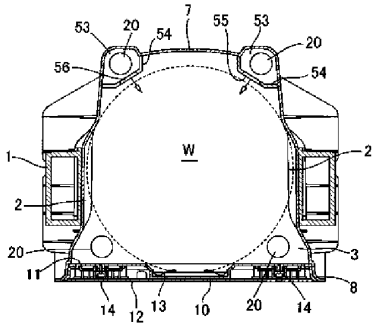
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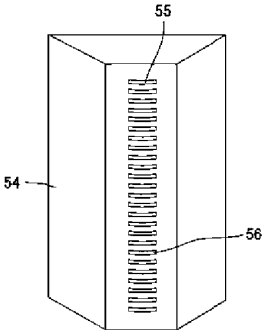
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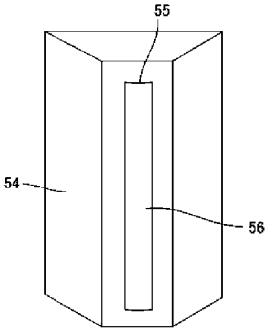
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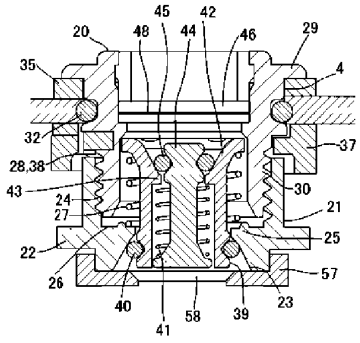
【図１８】



【図１９】



【図２０】



フロントページの続き

(56)参考文献 実開平０１－１２４４４０（ＪＰ，Ｕ）
特開２００４－１４６６７６（ＪＰ，Ａ）
特開２００３－２４０１４３（ＪＰ，Ａ）
特開２００８－１８９３３８（ＪＰ，Ａ）
実開昭５３－１３２０２９（ＪＰ，Ｕ）
特開２００５－２５６９８３（ＪＰ，Ａ）
実公昭４８－０２９２１９（ＪＰ，Ｙ１）
実開昭５０－０２００５５（ＪＰ，Ｕ）
実開昭５２－０３７１３９（ＪＰ，Ｕ）
特開２００４－０２２６７４（ＪＰ，Ａ）
特開２０１０－２６７７６１（ＪＰ，Ａ）
特表２００２－５２１１８９（ＪＰ，Ａ）
特開２００５－１６７１６８（ＪＰ，Ａ）
特開２００４－０２２８１６（ＪＰ，Ａ）

(58)調査した分野(Int.Cl.，ＤＢ名)
Ｆ１６Ｋ １５／００－１５／２０，
Ｆ１６Ｋ ２１／００－２４／０６，
Ｆ１６Ｋ １／００－１／５４，
Ｆ１６Ｋ １７／００－１７／１６８，
Ｆ１６Ｋ １７／１６－１７／３４，
Ｈ０１Ｌ ２１／６８，
Ｂ６５Ｄ ８５／８６

Espacenet

Bibliographic data: JP2002170876 (A) — 2002-06-14

SUBSTRATE TRANSPORT CONTAINER

Inventor(s): TANAKA AKIRA; KISHI TAKASHI ± (TANAKA AKIRA, ; KISHI TAKASHI)

Applicant(s): EBARA CORP ± (EBARA CORP)

Classification: **- international:** ***B65D81/24; B65D85/86; G03F7/20; H01L21/673;*** (IPC1-7): B65D81/24; B65D85/86; H01L21/68

- cooperative: G03F1/66 (EP); G03F7/70741 (EP)

Application number: JP20000403875 20001204

Priority number(s): JP20000403875 20001204

Abstract of JP2002170876 (A)

PROBLEM TO BE SOLVED: To provide a substrate transport container which efficiently prevents a pollution to the contained substrates to be stored or transported from outer atmosphere, also which is made possible the atmosphere to be efficiently substituted in a short time by introducing a dry air or the like into the container. SOLUTION: A substrate transport container 10 comprises a container main body 12 in which substrates to be stored or transported are contained, and a door 14 which can tightly close the main body 12. A suction port 30 and air outlet 32 for communication or substitution of the air inside of the substrate transport container 10 with clean air, a duct 38 joined to the suction port 32 and extended into the container 10, and a straightening vane 40 disposed to a face directed inward of the container 10 of the duct 38 are provided for the substrate transport container 10.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
特開2002－170876
（P2002－170876A）
(43)公開日　平成14年６月14日(2002.6.14)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード（参考）
Ｈ０１Ｌ　21/68		Ｈ０１Ｌ　21/68	Ｔ	３Ｅ０６７
Ｂ６５Ｄ　81/24		Ｂ６５Ｄ　81/24	Ｃ	３Ｅ０９６
			Ｄ	５Ｆ０３１
85/86		85/38	Ｄ	

審査請求　未請求　請求項の数４　書面　（全　９　頁）

(21)出願番号　特願2000－403875(P2000－403875)

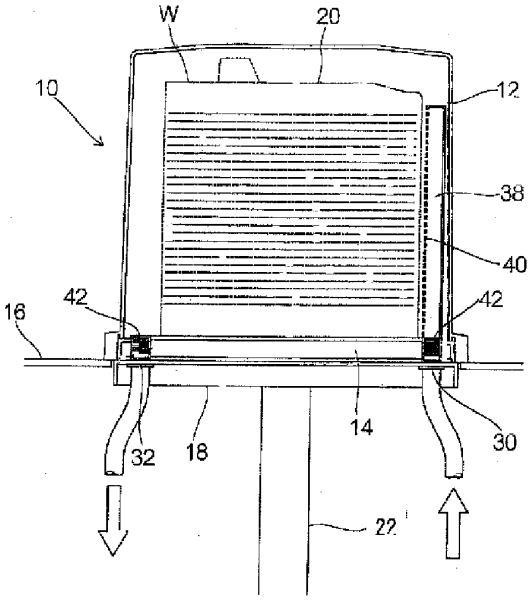
(22)出願日　平成12年12月４日(2000.12.4)

(71)出願人　000000239
株式会社荏原製作所
東京都大田区羽田旭町11番１号
(72)発明者　田中　亮
東京都大田区羽田旭町11番１号　株式会社荏原製作所内
(72)発明者　岸　貴士
東京都大田区羽田旭町11番１号　株式会社荏原製作所内
(74)代理人　100091498
弁理士　渡邉　勇　（外１名）

最終頁に続く

(54)【発明の名称】　基板搬送容器

(57)【要約】
【目的】　収容した保管又は搬送対象基板への外部雰囲気からの汚染を効率よく防止すると共に、乾燥気体等を容器内に導入してその雰囲気を短時間で効率的に置換できるようにした基板搬送容器を提供する。
【構成】　内部に保管又は搬送の対象とする基板を収納する容器本体１２と、容器本体１２に対して密閉可能なドア１４とで構成される基板搬送容器１０において、基板搬送容器１０内を清浄な気体で流通又は置換するための給気口３０及び排気口３２と、給気口３２に接続し容器１０内に延びるダクト３８と、ダクト３８の容器１０内方に向けた面に配置した整流板４０とを備えた。



Entegris, EX1002, p. 480

【特許請求の範囲】
【請求項１】　内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記基板搬送容器内を清浄な気体で流通または置換するための給気口及び排気口と、前記給気口に接続し前記容器内に延びるダクトと、該ダクトの容器内方に向けた面に配置した整流板とを備えたことを特徴とする基板搬送容器。
【請求項２】　前記給気口近傍に粒子除去用フィルタ及びガス状不純物除去用フィルタとを備えたことを特徴とする請求項１に記載の基板搬送容器。
【請求項３】　前記給気口と排気口に逆流防止機構を備えたことを特徴とする請求項１に記載の基板搬送容器。
【請求項４】　内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記容器本体を構成する主要材料を吸水率０．１％以下の高分子材料または不透湿材料で構成したことを特徴とする基板搬送容器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、半導体ウエハ、フォトマスクまたはハードディスク等の被処理物を、極めて清浄度の高い雰囲気下で保管または運搬するのに使用して好適な基板搬送容器に関する。
【０００２】
【従来の技術】例えば、半導体工場において製造工程中の半導体ウエハやフォトマスク等の基板を搬送・保管する時に、雰囲気空気中に存在する微量の粉塵やガス状不純物が半導体ウエハ等の対象物へ付着すると製品歩留まりの低下につながり、この傾向は、集積度の増加に伴って益々顕著になる。また、磁気ディスクにおいても、磁気抵抗ヘッドの登場により、記録の高密度化が一段と加速しており、粉塵だけでなくガス状不純物に対しての高い清浄度が求められつつある。さらに、半導体ウエハのコロージョン低減の観点から、基板を収納する雰囲気の湿度を低く維持する簡便な手段も求められている。
【０００３】このような搬送・保管の場合に基板を収容する清浄空間を作るため、モータファンと、ＨＥＰＡ（ｈｉｇｈ　ｅｆｆｉｃｉｅｎｃｙ　ｐａｒｔｉｃｌｅ　ａｉｒ）フィルタやＵＬＰＡ（ｕｌｔｒａ　ｌｏｗ　ｐｅｎｅｔｒａｔｉｏｎ　ａｉｒ）フィルタを搭載した基板搬送容器等が開発されている。また、例えば、半導体ウエハ周辺を局所的に清浄化する方法として、半導体ウエハを収納した基板搬送容器内を高純度の窒素で置換し、清浄度維持と自然酸化膜の成長を抑えるようにしたものがある。
【０００４】しかしながら、前記ＨＥＰＡフィルタやＵＬＰＡフィルタを使用したものでは、粒子状汚染物質は除去できるものの、微量の有機または無機ガスは除去できない。また、循環する空気が被処理物の清浄化に直接寄与しない部分に大量に流れたり、基板搬送容器内で滞留部があると、基板搬送容器内の換気効率の向上が望めず、清浄化された空気による被処理物の汚染防止効果が薄れてしまう。また、窒素に置換する方法では、例えばレジスト等を塗布した半導体ウエハ自身から発生する不純物を除去できない等の問題がある。
【０００５】即ち、例えば半導体ウエハの保管に当たっては、半導体素子の微細化により分子状汚染物質が問題になっている。例えば、レジスト等を塗布した半導体ウエハ自体からレジスト等の有機物成分が基板容器内壁に付着すると、その部分が汚染源となり不均一な自然酸化膜の成長や、化学増幅型レジストによるパターン不良が顕在化するという問題がある。また、化学気相成長による成膜や配線材料の多様化によって、多種多様な材料がこれらに用いられ、これらが容器内壁に付着すると、同様に清浄環境に維持すべき半導体ウエハの汚染源となる。
【０００６】一方で、半導体素子のうち、ＤＲＡＭは少品種大量生産品であるが、今後システムＬＳＩの占める割合が増大するという傾向が予測され、半導体生産も多品種少量生産に移行する傾向がある。これらの半導体ウエハの処理ロットは、工程間の高速搬送が要求されると共に、次処理までの保管時間がランダムとなる傾向がある。このようなわけで、これらの半導体ウエハを搬送・保管する基板搬送容器としては、上述した多様な汚染物質が発生する半導体製造工程、及び工程間処理待ち時間の多様化に対応して、常に清浄な環境下に半導体ウエハを維持することが要請されている。
【０００７】
【発明が解決しようとする課題】本発明は上記の課題に鑑み、収容した保管または搬送対象基板への外部雰囲気からの汚染を効率よく防止すると共に、乾燥気体等を容器内に導入してその雰囲気を短時間で効率的に置換できるようにした基板搬送容器を提供することを目的とする。
【０００８】
【課題を解決するための手段】請求項１記載の発明は、内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記基板搬送容器内を清浄な気体で流通または置換するための給気口及び排気口と、前記給気口に接続し前記容器内に延びるダクトと、該ダクトの容器内方に向けた面に配置した整流板とを備えたことを特徴とする基板搬送容器である。
【０００９】これにより、整流板の開口率を容器内の気体流れが均一となるように調整することで、給気口から整流板を備えたダクトを介して容器内に収容された多数の半導体ウエハ等の被処理基板間に均一に清浄な気体を供給することが出来る。従って、清浄ガスによる容器内

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の置換効率が改善され、短時間で清浄な気体の置換が行える。また、清浄な気体を流通しつつ例えば複数の半導体ウエハを保管する場合には、多数の半導体ウエハの間に清浄な気体が均一に流れ、これにより半導体ウエハ表面を効率的に清浄な気体に接触させつつ保管を行うことが出来る。

【００１０】請求項２記載の発明は、前記給気口近傍に粒子除去用フィルタ及びガス状不純物除去用フィルタとを備えたことを特徴とする請求項１に記載の基板搬送容器である。これにより、容器内に流入する清浄な気体中に含まれる粒子状汚染物質のみならずガス状汚染物質も除去することができる。従って、保管・搬送対象の基板に外部から導入されるガス中に含まれる物質による汚染を防止することが出来る。

【００１１】請求項３記載の発明は、前記給気口と排気口に逆流防止機構を備えたことを特徴とする請求項１に記載の基板搬送容器である。これにより、供給口のガス配管側のガス圧力が容器内部のガス圧力よりも高くなった時のみ、清浄な気体が容器内に供給され、容器内部のガス圧力が排気口外側のガス圧力よりも高くなった時に清浄な気体が容器内から排出される。従って、置換または流通する清浄な気体の逆流が防止される。

【００１２】請求項４記載の発明は、内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記容器本体を構成する主要材料を吸水率０．１％以下の高分子材料または不透湿材料で構成したことを特徴とする基板搬送容器である。これにより、清浄な気体の容器内の置換を停止した時に、容器内壁面から容器内部に拡散する湿気の量が低減し、容器内の湿度を低く保つことができる。従って、処理対象基板の湿気による汚染に基づく不良等を防止することが出来る。

【００１３】

【発明の実施の形態】以下、本発明の実施の形態について図１乃至図８を参照しながら説明する。

【００１４】図１及び図２は、本発明の実施の形態の基板搬送容器を示す。この基板搬送容器は、例えば直径が２００ｍｍ程度の半導体ウエハ（被処理基板）Ｗをカセットに収納した状態で容器内に収容し、搬送・保管等を行うものである。この基板搬送容器１０は、底面にカセットに収納した被処理基板を出し入れする開口部を有した角筒状の容器本体１２と、その開口部を閉塞するドア１４とから構成されている。ドア１４は装置１６側に設けられた基板搬出入ドア自動開閉装置１８に連結されて、容器本体１０の底面の開口部を開閉可能としている。

【００１５】ドア１４上にはカセット２０が搭載され、これに多数の半導体ウエハＷが収納されている。ドア１４にはラッチ機構を備え、基板搬出入ドア自動開閉装置１８によりドア１４に設けられたラッチを外して昇降機構２２を下げることにより、ドア１４と共にカセット２０を容器本体１２から取り出し、更にカセット２０に搭載した半導体ウエハＷをカセット２０から取り出すことができる。そして、半導体ウエハを容器１２内に収容する場合には、半導体ウエハＷを搭載したカセット２０をドア１４に載せて、昇降機構１８を上昇させてカセット２０を容器本体１２内に挿入し、基板搬出入ドア自動開閉装置１８によりドア１４に設けられたラッチ機構をロックすることによりドア１４が容器本体１２に固定される。ドア１４と容器本体１２との接触部にはガスケット等が配置され、容器１０内を気密に保つことができる。

【００１６】処理済み半導体ウエハを収容した容器１０を装置１６のロードポートから切り離して搬送する場合等には、切り離す直前に容器１０内部の清浄な気体による置換が行われる。この清浄な気体は、不活性ガス、乾燥空気、または湿り空気が用いられる。このような場合に、清浄な気体による容器内部の置換時間を削減するためには、高流量で且つ置換効率を上げることが重要である。このため、この容器１０においては清浄な気体の吹き出し口の面積を増加させ、且つ容器内を均一に清浄な気体が流れるような構成を有している。

【００１７】清浄ガス置換は通常、半導体製造装置に取り付けられたドア自動開閉装置上において、ウエハを装置に搬入する前、又は処理の終わったウエハを容器内に収納した後に実施する。その他の時期としては、例えばＡＧＶ（ＡｕｔｏｍａｔｅｄＧｕｉｄｅｄ　Ｖｅｈｉｃｌｅ）等の基板搬送装置や、保管庫、保管棚といった搬送・保管している時期に実施することもある。ドア自動開閉装置上においてガス置換する場合は、大流量、例えば１０～４０Ｌ／ｍｉｎで容器内を短時間で、高速置換することが重要である。このため、この容器１０においては清浄な気体の吹き出し口の面積を増加させ、且つ容器内を均一に清浄な気体が流れるような構成を有している。一方、保管庫で保管する場合には、例えば０．５～５Ｌ／ｍｉｎ程度の低流量でゆっくり置換すれば良い。この清浄な気体は、高純度な窒素ガス、不活性ガス、乾燥空気が用いられるが、用途によっては湿度４０％ＲＨ程度の高純度な湿り空気を用いても構わない。ガスの置換の方法は、例えば、給気ポートにガスを連続的に注入しながら排気ポートから連続的に排気したり、給気ポートから一定流量のガスを注入後一旦止めて、排気ポートから一定流量排気する操作を繰り返したり、或いは給気ポートはガスを流し続けて、排気ポートから間欠的に排気する方法等がある。置換は、容器内にもともと閉じ込められていた空気と、注入する清浄気体が効率良く混合・置換できる方法が良い。従って、単に清浄ガスを連続的に流し、連続的に排気するよりも、給気・排気を断続的に繰り返したり、給気は連続にして、排気を断続的に実施したり、給気は断続的にして、排気を連続的に実施するような方法が良い。

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【００１８】図３（ａ）（ｂ）（ｃ）（ｄ）はドアの構造の詳細を示す。（ａ）はドア１４の下面を示し、容器１０内を清浄な気体で流通または置換するための給気口３０及び排気口３２が配置されている。更にドア１４の下面には基板搬出入ドア自動開閉装置１８と係合する位置決め穴３４が設けられ、基板搬出入ドア自動開閉装置１８に立設したピンと係合することにより、ドア１４を基板搬出入ドア自動開閉装置１８に対して固定する。ドアラッチ３６は、これを回転することにより、ドア１４内に設けられたラッチ機構をロックすることでドア１４を容器本体１２に固定い、またアンロックすることでドア１４を容器本体１２から開放可能とする。給排気口３０，３２、位置決め穴３４、ドアラッチ３６等の寸法及び配置は、Ｓｅｍｉ規格等により統一されている。

【００１９】ドア１４には容器１０内の半導体ウエハWが配置される一番上の高さ近傍迄延在するダクト３８が配置されている。このダクト３８は、その先端３８ａが閉塞されていて、容器１０の内方に向かう面に図４に示す多数の開口を有する整流板４０が配置されている。この整流板４０には、図示するように多数の開口を有し、この開口率は給気口側が大きく、ダクト３８の先端部に向かうに従い小さくなるように構成されている。このダクト３８及び整流板４０によりドア１４の底面に設けられた給気口３０から供給される清浄な気体はダクト３８内を上昇し、先端部が閉塞されているので、気体の流れは９０° 向きを変えて整流板から吹き出させることができる（図１及び図２参照）。仮に整流板４０の開口率を均一にしておくと、ダクト３８の上端部が閉塞されているため、ダクトの上部程供給圧力が高くなり、吹き出し量が増える。従って、ダクト３８の下部において開口率を高くし、ダクトの上部に行くに従い開口率を低くすることで、ダクトの高さ方向に沿って均一な吹き出し量が得られる。

【００２０】このようなダクト３８と整流板４０を設けることにより、清浄な気体の吹き出し面積を拡大することができ、これにより通過面風速を低下させ、高流量で且つ容器内ガスの置換効率を上げることができる。これにより清浄な気体の容器１０内部の置換時間を低減することができる。

【００２１】図５は、本発明の基板搬送容器の乾燥ガスによる置換特性を示した図である。即ち、乾燥ガスによる置換に際して、相対湿度の変化を示したグラフであり、図中の黒い△印は通常のポリカーボネート容器を用いた場合であり、流量が５Ｌ／ｍｉｎであり、図中の×印は、流量が１０Ｌ／ｍｉｎの場合である。図示するように、下限湿度までの到達時間は約１５分程度かかり、流量による差は殆どない。これに対して、白い○印は本発明の吸水率０．１％以下の高分子材料を用いた容器であり、同様に乾燥ガスの流量が１０Ｌ／ｍｉｎである場合を示し、約５分程度で下限湿度まで到達する。このことは、乾燥ガスの置換効率が高いことを示しており、乾燥ガスをダクト３８から整流板４０を介して均一な流れを形成するように容器内に供給することで、置換効率が改善されることを示している。

【００２２】尚、この実施の形態では整流板として多数の円形の開口を有するパンチングプレートを用いた例について示したが、異なる通気抵抗を持った不織布を張り付け、ダクトに沿って均一な吹き出し量が得られるように通気抵抗を調整するようにしてもよい。また、この実施の形態では整流板を備えたダクトをドアに設けた例について示したが、容器本体に固定するようにしてもよい。

【００２３】次に、給気口に備えた逆止弁について図５を参照して説明する。逆止弁４２は、スプリング４４により固定部４６に固定されている。固定部４６と逆止弁４２の接触部にはＯリングシール４８が備えられている。従って、逆止弁４２の下流側Ａの圧力が上流側Ｂの圧力よりも高い時には、（ａ）に示すようにスプリング４４が伸張して逆止弁４２が閉止状態となる。また、逆止弁４２の下流側Ａの圧力が上流側Ｂの圧力よりも低い時には、（ｂ）に示すようにスプリング４４が収縮して逆止弁４２が開放状態となる。

【００２４】次に、図６を参照して、給気口とダクトとの接続について説明する。給気口３２には上述した逆止弁４２を備えている。フィルタ５０は、ＵＬＰＡ沪材等の粒子状汚染物質捕捉フィルタと、ガス状不純物捕捉フィルタ５４とを備えている。粒子状汚染物質捕捉フィルタ５２は、種々のフィルタが知られているが、疎水性で且つ不純物放出がないフッ素形樹脂を用いたＵＬＰＡフィルタが好適である。ガス状不純物捕捉フィルタ５４は、活性炭、添着活性炭、活性炭素繊維、ゼオライト、シリカゲル、イオン交換不織布または繊維の内これらを単独または組み合わせて用いることができる。この実施形態においては、活性炭５４ａとこれをサンドイッチ状に挟み込むイオン交換不織布５４ｂが用いられている。これらのガス状不純物を捕捉するフィルタは、粒子状汚染物質捕捉フィルタの負荷を軽減するために発塵しない材料を用いることが好ましい。いずれのフィルタも、その平均面風速を０．１ｍ／ｓ以下、好ましくは０．０５ｍ／ｓにして、接続するガス配管やパージ配管から流入した外気中に含まれる汚染物質を確実に捕捉することができることが必要である。

【００２５】半導体ウエハの容器内への保管時で、最も困難なのは湿度の問題である。この実施の形態の基板搬送容器１０においては、その容器本体１２とドア１４との材料を吸水率０．１％以下の高分子材料または不透湿材料で構成している。これらの材料はＡＳＴＭ（Ａｍｅｒｉｃａｎ Ｓｏｃｉｅｔｙ ｆｏｒ Ｔｅｓｔｉｎｇ ａｎｄ Ｍａｔｅｒｉａｌｓ）Ｄ５７０規格により定められている。半導体ウエハ等の搬送・保管容器に使用

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される一般的な材料の吸水率を述べると、ＰＣ（ポリカーボネート）０．２%、ＰＢＴ（ポリブチレンテレフタレート）０．０８%、ＰＥＥＫ（ポリエーテルエーテルケトン）０．１４%、ＰＥＩ（ポリエーテルイミド）０．２５%、ＰＰ（ポリプロピレン）０．０３%である。

【００２６】この容器１０の構成材料として好ましいのは、吸水率０．１%以下であり、これに該当するものとしてＰＥ（ポリエーテルイミド）＜０．０１%、ＰＰ（ポリプロピレン）０．０３%、ＰＢＴ（ポリブチレンテレフタレート）０．０６～０．０８%、ＰＰＳ（ポリフェニレンスルフィド）０．０２%、ＰＴＦＥ＜０．０１%、ＰＣ（カーボン２０%添加ポリカーボネート）０．１%、ＰＢＴ（カーボン２０%添加ポリブチレンテレフタレート）０．０５%などがある。特にこの容器材料として好ましいものは、吸水率が低く、耐薬品性が良好であり、高温での安定性が高く、且つ成型収縮率が低い材料が好ましく、ＰＰＳ（ポリフェニレンスルフィド）、カーボン添加ポリブチレンテレフタレート（ＰＢＴ）、カーボン添加ポリカーボネートが特に好ましい。

【００２７】また、低湿度にすると、ウエハが帯電しやすくなるので、少なくともウエハに接するウエハ支持部材とウエハ支持部材から容器下部に接地するドアは、カーボン等を添加した導電性材料が特に好ましい。更に、ガス状不純物捕捉素子として用いるイオン交換不織布や活性炭は、製造直後の状態で水を吸着しているので、予め脱水処理をして使用するのが好ましい。

【００２８】容器内を乾燥ガス、即ち乾燥空気または水分を含まない不活性ガスと置換すると、置換直後は湿度は略０%の限界湿度まで低下する。しかしながら、この状態で乾燥ガスの供給を停止して放置しておくと、容器内壁面の高分子材料が保持している水分が湿度勾配によって容器内部に拡散する。従って、乾燥ガスにより置換した容器内部の湿度は、時間の経過と共に増大する。図８は、この一例を示し、乾燥ガスによる置換後に略０%の相対湿度が従来の市販ＰＣ（ポリカーボネート）容器を使用した場合には、数時間後には３０%以上に上昇することを示している。本発明の実施形態の吸水率０．０２%のポリフェニレンスルフィド（ＰＰＳ）を使用することで、乾燥ガスにより置換直後の略０%の相対湿度は数時間以上経過しても略１２%程度に留まり、顕著な湿度上昇抑制効果が確認された。これにより保管搬送時の容器内湿度が上昇することが防止できることは明らかである。尚、自然酸化膜の成長は暗所で保管することにより抑制効果があることが知られている。このため、容器本体を構成する材料は、光透過性材料よりも光遮断性材料を用いることが好ましい。

【００２９】図５は、本発明の基板搬送容器の乾燥ガスによる置換特性を示した図である。即ち、乾燥ガスによる置換に際して、相対湿度の変化を示したグラフであり、図中の黒い△印は通常のポリカーボネート容器を用いた場合であり、流量が５Ｌ／ｍｉｎであり、図中の×印は、流量が１０Ｌ／ｍｉｎの場合である。図示するように、下限湿度までの到達時間は約１５分程度かかり、流量による差は殆どない。これに対して、白い○印は本発明の吸水率０．１%以下の高分子材料を用いた容器であり、同様に乾燥ガスの流量が１０Ｌ／ｍｉｎである場合を示し、約５分程度で下限湿度まで到達する。このことは、乾燥ガスの置換効率が高いことを示しており、乾燥ガスをダクト３８から整流板４０を介して均一な流れを形成するように容器内に供給することで、置換効率が改善されることを示している。

【００３０】尚、上述した実施の形態においては、容器の材料としてポリフェニレンスルフィドを用い、乾燥ガスをダクトを介して開口率を調整した整流板から均一に流す例について説明したが、本発明の趣旨を逸脱することなく種々の変形実施例が可能なことは勿論である。

【００３１】次に、本発明の第二の実施の形態を図９乃至図１４を参照しながら説明する。本発明の実施の形態は、３００mmウエハ用ＦＯＵＰ（Ｆｒｏｎｔ　Ｏｐｅｎｉｎｇ　Ｕｎｉｆｉｅｄ　Ｐｏｄ）に適用した例である。本基板搬送容器は、容器本体１２と容器前面に配置されたドア１４と、位置決めピンを受けるキネマティックカップリング等を持つ底板５８と、容器本体内部に配置されて、複数枚の半導体ウエハWを支えるウエハ支持部材５６と、容器本体１２に取り付けられた給気ポート３０と排気ポート３２及び給気ポート３２の下流側に配置されてガス吹き出し口に多孔板４０を持ったダクト３８から構成される。ＦＯＵＰはＳＥＭＩ規格により、ポッド底部に位置決めピンや各種識別用穴などが配置されるため、給気・排気ポートはそれらに干渉しないようドアから見て左右の下部に配置している。本発明の第一の実施の形態と同様に、給気・排気ポートには逆流防止弁４２とフィルタ５２が内蔵されている。容器内のガスは、ガス置換装置、ドアオープナ、搬送装置、保管庫などの所定の位置に着座した後、給気ポートから不活性ガスなどが給気されると、フィルタ５４で不純物が除去され、ダクト３８を通り、多孔板４０からドアに向かう流れが形成される。半導体ウエハW通過後のガスは排気ポート３２から排気され、容器内を効率良くガス置換できる。

【００３２】

【発明の効果】以上説明したように本発明によれば、基板搬送容器内を清浄な気体で流通または置換する際に、清浄な気体をダクトを介して整流板から均一に容器内に流すことで、容器内のガスの滞留を生じることなく効率的な置換が行える。これにより、清浄な気体による置換時間を短縮することができ、半導体工場等における生産の効率化が図れる。また、清浄な気体が容器内を均一に流れることで、容器内に保管する多数の半導体ウエハ等

に均一に新鮮な清浄ガスを供給してこれらを清浄に保つことができる。また、ガス状不純物捕捉素子を備えたフィルタを設けると共に逆流防止弁を備えることで、容器内に保管する半導体ウエハ等の汚染を防止することができる。更にまた、容器を構成する主要材料を、吸水率が０．１%以下の高分子材料または不透湿材料を用いることで、容器内壁面からの湿気の拡散による相対湿度の上昇を防止できる。

【００３３】総じて本発明によれば、ガス状汚染物質を除去しつつ、短時間で乾燥ガス等の置換が行え、且つ容器内湿度が上昇しないようにした基板搬送容器が提供される。従って、多品種少量生産等の半導体デバイス等の製造方式に用いて有用である。

【図面の簡単な説明】

【図１】本発明の実施の形態の基板搬送容器の立面図である。

【図２】図１に示す基板搬送容器の平面図である。

【図３】図１に示す基板搬送容器のドアの構造を示す、（ａ）下面の平面図、（ｂ）X矢視図、（ｃ）上面の平面図、（ｄ）Y矢視図である。

【図４】整流板の構造令を示した図である。

【図５】本発明の容器と従来例の容器とを対比した乾燥ガスの供給停止後の容器内の相対湿度の上昇を示すグラフである。

【図６】逆流防止弁の構造を模式的に示した図であり、（ａ）は閉止状態を示し、（ｂ）は開放状態を示す。

【図７】給気口とダクトとの接続構造例を示した図である。

【図８】本発明の容器と従来例の容器とを対比した乾燥ガスによる容器内部の置換特性を示すグラフである。

【図９】本発明の第２の実施の形態の基板搬送容器の側面図である。

【図１０】本発明の第２の実施の形態の基板搬送容器の下面図である。

【図１１】図９のＡ－Ａ断面図である。

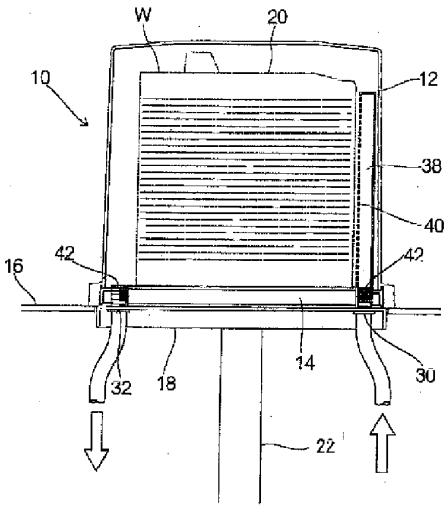
【図１２】図１１のＢ－Ｂ断面図である。

【図１３】図１１のＣ－Ｃ断面図である。

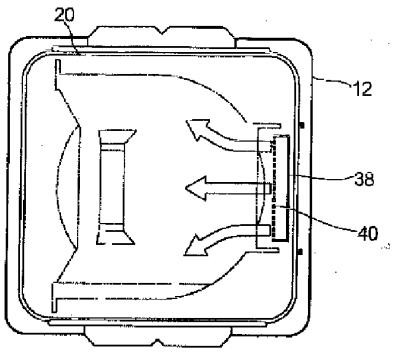
【符号の説明】

１０　基板搬送容器
１２　容器本体
１４　ドア
２０　カセット
３８　ダクト
４０　整流板
４２　逆流防止弁
５２　フィルタ

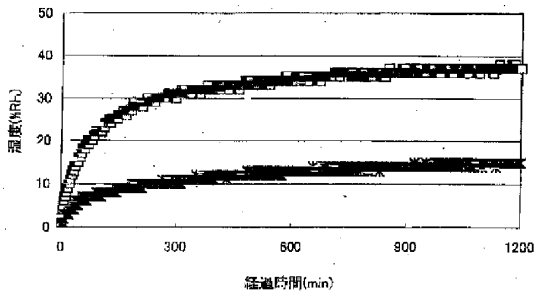
【図１】



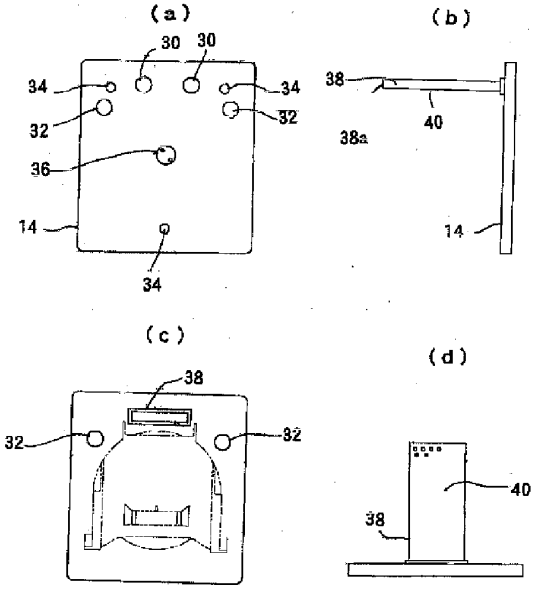
【図２】



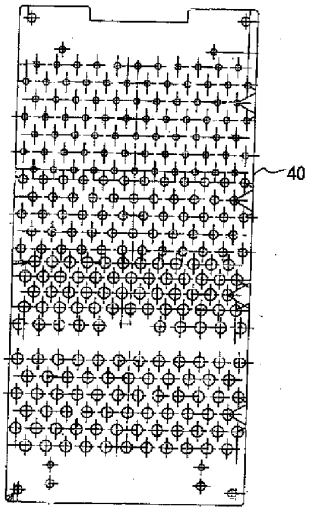
【図８】



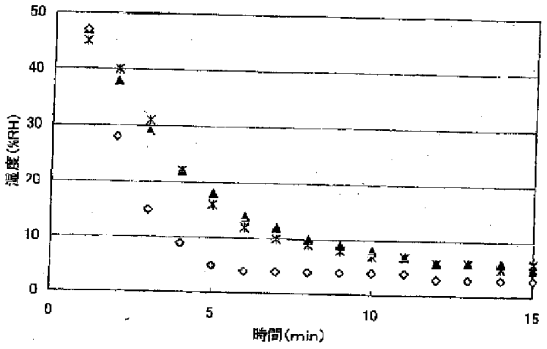
【図3】


(a)
30
30
34
34
32
32
36
14
34
(b)
38
40
38a
14
(c)
38
32
32
(d)
40
38

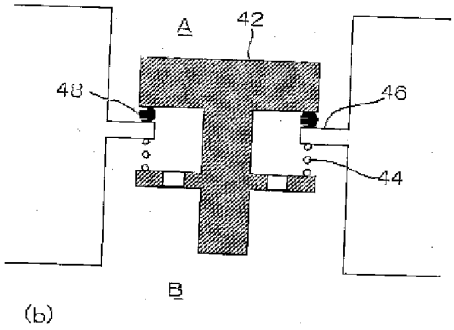
【図4】


40

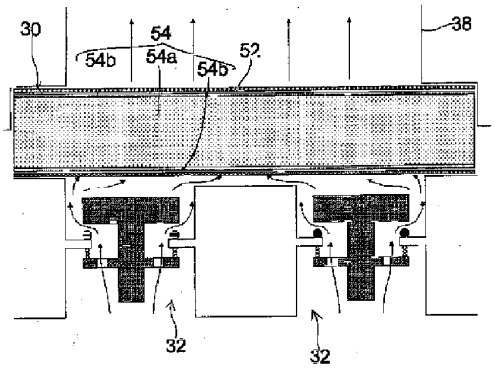
【図5】

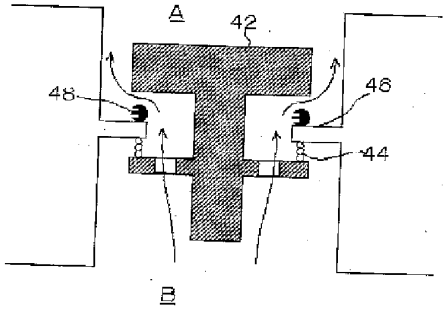

50
40
30
20
10
0
湿度(%RH)
0
5
10
15
時間(min)

【図6】

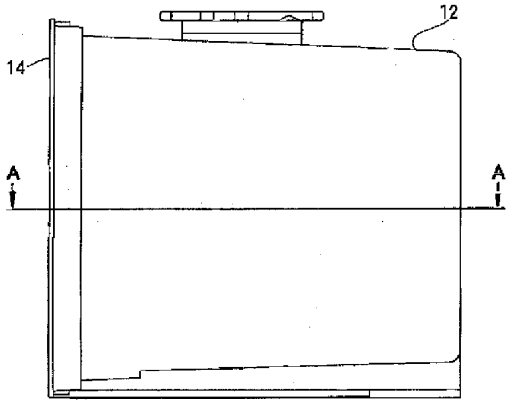

(a)
A
42
48
46
44
B
(b)

【図7】

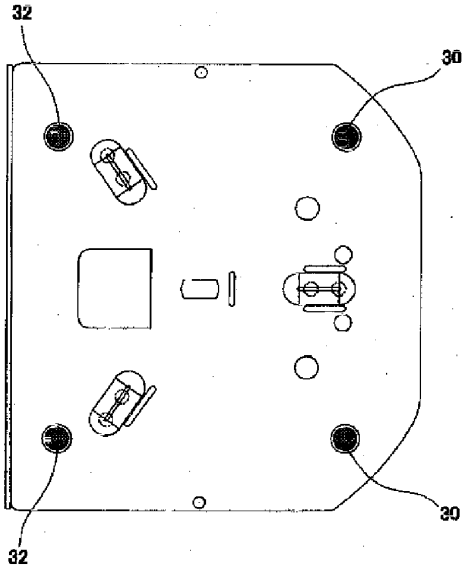

30
54
54b
54a
54b
52
38
32
32


A
42
48
46
44
B

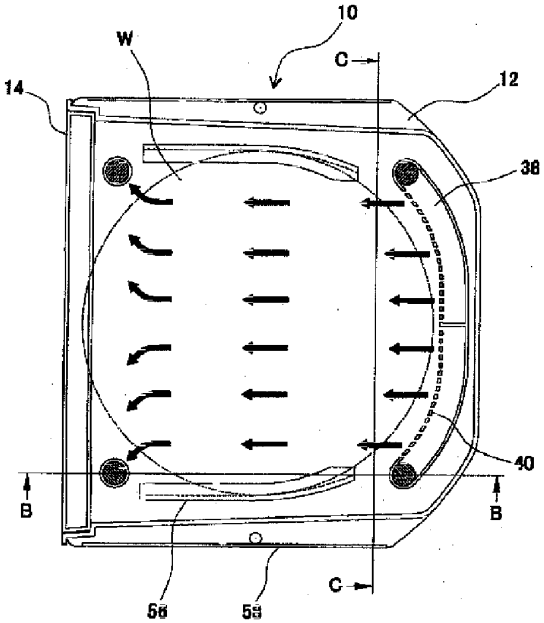
【図9】



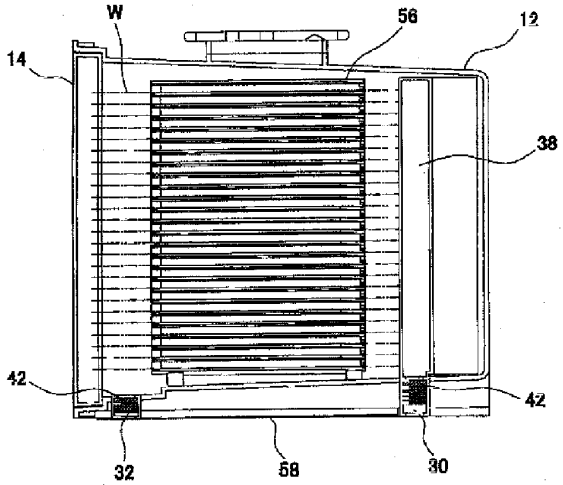
【図10】



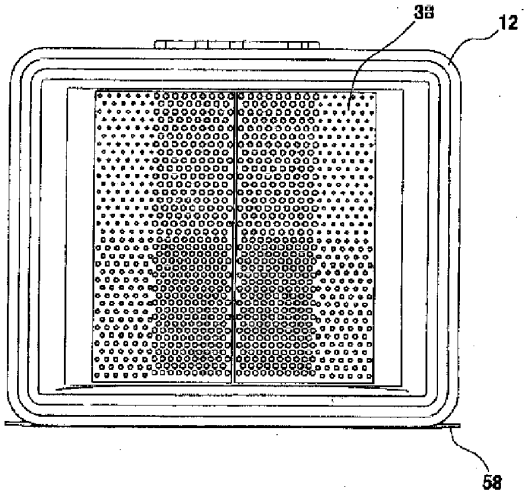
【図11】



【図12】



【図13】



フロントページの続き

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BB14A BC06A CA04 CA05
FA01 FC01 GA19
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FA03 FA22 GA03
5F031 CA02 CA05 CA07 DA09 EA02
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Espacenet

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GAS DIFFUSING DEVICE AND SUBSTRATE CARRIER THEREOF

Inventor(s): HU SHI ZHENG; LIN DI ± (胡 石政, ; 林 廸)

Applicant(s): UNIV NAT TAIPEI TECH ± (國立臺北科技大學)

Classification: **- international:** ***B65D81/18; B65D85/86; H01L21/673***
- cooperative:

Application number: JP20190115487 20190621 Global Dossier

Priority number(s): TW20190108541 20190313

Abstract of JP2020150245 (A)

To provide a gas diffusing device and a substrate carrier thereof.SOLUTION: A gas diffusing device according to the present invention directly attaches a gas diffusing device and does not affect an elements inside a carrier by utilizing a structure of a substrate carrier and an opening thereof. The gas diffusing device is provided with a tubular portion that has an acute-angled side and an obtuse-angled side, and whose material is a sintered polymer with multiple holes, an inlet portion connected to one end of the tubular portion and having a first base and an intake port, and a stopper portion connected to the other end of the tubular portion and provided with a second base.SELECTED DRAWING: Figure 1

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B65D 85/86	(2006.01)	B65D	85/86	400	3E096
B65D 81/18	(2006.01)	B65D	81/18	Z	5F131

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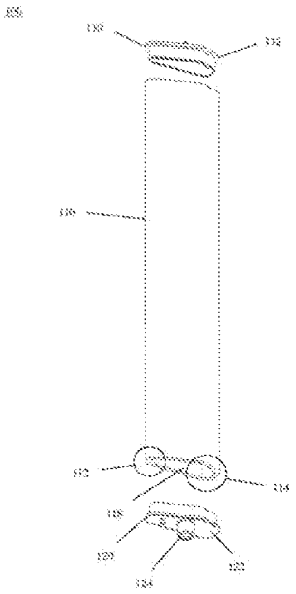
(71)出願人　513197703
國立臺北科技大學
台灣台北市大安區忠孝東路三段１號
(74)代理人　110002262
ＴＲＹ国際特許業務法人
(72)発明者　胡　石政
台灣台北市大安區忠孝東路三段１號
(72)発明者　林　廸
台灣台北市大安區忠孝東路三段１號

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最終頁に続く

(54)【発明の名称】気体拡散装置及びその基板キャリア

【要約】
【課題】　気体拡散装置及びその基板キャリアを提供することを課題とする。
【解決手段】　本発明は、基板キャリア及びその開孔の構造を利用して、直接気体拡散装置を取り付け、かつキャリア内部の素子に影響を及ぼすことがない気体拡散装置を提供する。気体拡散装置は、鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、前記管状部の一端と接続され、第１基台と吸気口とを備えた入口部と、前記管状部の他端と接続され、第２基台を備えたストッパー部と、を含む。
【選択図】　図１



Entegris, EX1002, p. 490

【特許請求の範囲】
【請求項１】
鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、
前記管状部の一端と接続され、第１基台と吸気口とを備え、かつ前記吸気口が前記管状部と同一軸線上に配置される入口部と、
前記管状部の他端と接続され、第２基台を備えたストッパー部と、
を含むことを特徴とする、気体拡散装置。
【請求項２】
前記第１基台及び前記第２基台と前記管状部との嵌合部位に気密リングを更に有することを特徴とする、請求項１に記載の気体拡散装置。
【請求項３】
前記気密リングの寸法は、前記管状部の両端管口の寸法と同一であることを特徴とする、請求項２に記載の気体拡散装置。
【請求項４】
前記複数孔の孔径サイズは１μｍ～４５μｍであることを特徴とする、請求項１に記載の気体拡散装置。
【請求項５】
前記焼結されたポリマーは、高密度ポリエチレン（ＨＤＰＥ）或いは超高分子量ポリエチレン（ＵＰＥ）であることを特徴とする、請求項１に記載の気体拡散装置。
【請求項６】
開口部を備えた容器と、
前記開口部と閉成する扉と、
前記容器内に設けられた少なくとも１個の請求項１に記載の気体拡散装置と、
を含む基板キャリアにおいて、
前記容器は、底板を更に含み、かつ前記底板が少なくとも１個の開孔を備え、
前記吸気口が前記少なくとも１個の開孔上に設けられる、
ことを特徴とする、基板キャリア。
【請求項７】
前記第１基台及び前記第２基台と前記管状部との嵌合部位に気密リングを更に有することを特徴とする、請求項６に記載の基板キャリア。
【請求項８】
前記気密リングの寸法は、前記管状部の両端管口の寸法と同一であることを特徴とする、請求項６に記載の基板キャリア。
【請求項９】
前記複数孔の孔径サイズは、１μｍ～４５μｍであることを特徴とする、請求項６に記載の基板キャリア。
【請求項１０】
前記焼結されたポリマーは、高密度ポリエチレン（ＨＤＰＥ）或いは超高分子量ポリエチレン（ＵＰＥ）であることを特徴とする、請求項６に記載の基板キャリア。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、基板キャリアに用いることのできる気体拡散装置に関し、特に、入口部を偏位配置する必要なく、キャリア内部素子を避けることができる気体拡散装置及びその基板キャリアに関する。
【背景技術】
【０００２】
ウエハケース又はレチクルケースは、半導体製造工程間の搬送及びウエハ或いはレチクルの保管に運用される装置であり、素子が製造工程内で汚染されることを防止するため、

ウエハケース又はレチクルケースの底部に気体充填孔を設け、ウエハケース又はレチクルケースの内部に気体を充填する方式により、ケース内環境の清浄度を維持する。ケース内の清浄を保持するため、通常ウエハケース又はレチクルケースの底部に気体充填孔が開設されている。しかしながら、気体充填孔を通じて吸気する気体充填方式は、往々にしてウエハケース又はレチクルケース内の気流分布が不均一となり、気流の死角が生じることで、湿度の不均一或いは局所の清浄度が要求を満たさない問題が生じていた。

【０００３】

前記問題点に鑑み、業者は、ケース内に整流装置を追加で取り付け、気体充填孔から入り込んだ気体を先に整流装置内に貯めてから均一にウエハケース又はレチクルケースの内部に向けて拡散させ、気流の死角という問題を減少させることができる。気体拡散装置がケース内においてウエハ或いはレチクルに接触しないように、整流装置の入口ジョイントに通常オフセット部（例えば特許文献１）が設けられ、或いは拡散器の整流孔口とウエハケースの気体充填孔を平行にオフセットするよう設計させることで、ウエハケース内のウエハ保管位置（特許文献２）を避ける。

【０００４】

しかしながら、この挙動は、容器の気体充填口と整流装置の吸気口のオフセットにより、整流装置内部に充填する気体の圧力抵抗が増加し、気体を整流装置内に容易に貯めることができなくなり、容器内部に拡散する気体流量が過小になるため、容器の遠い場所まで吹き込むことができなかった。

【先行技術文献】

【特許文献】

【０００５】

【特許文献１】台湾特許番号第Ｉ６０６５３４号

【特許文献２】台湾実用新案番号第Ｍ５４８５９８号

【発明の概要】

【発明が解決しようとする課題】

【０００６】

本発明は、上記の様々な欠陥を解決するため、既存の基板キャリア及びその開孔の構造を利用して、直接気体拡散装置を取り付け、かつキャリア内部の素子に影響を及ぼすことがない気体拡散装置を提供する。

【課題を解決するための手段】

【０００７】

気体拡散装置は、鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、前記管状部の一端と接続され、第１基台と吸気口とを備え、かつ前記吸気口が前記管状部と同一軸線上に配置される入口部と、前記管状部の他端と接続され、第２基台を備えたストッパー部と、を含む。

【０００８】

さらに言えば、前記第１基台及び前記第２基台と前記管状部との嚙合部位に各々気密リングを更に有することで、気体填充過程中において、管状部と入口部及びストッパー部の接続部位の隙間から漏れることを効果的に防止することができる。

【０００９】

また、本発明は、気体拡散装置を備えた基板キャリアを更に提出する。前記基板キャリアは、開口部を備えた容器と、前記開口部と閉成する扉と、鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、前記管状部の一端と接続され、第１基台と吸気口とを備え、かつ前記吸気口が前記管状部と同一軸線上に配置される入口部と、前記管状部の他端と接続され、第２基台を備えたストッパー部とを含み、前記容器内に設けられた少なくとも１個の気体拡散装置と、を含む。前記容器は、底板を更に含み、かつ前記底板が少なくとも１個の開孔を備え、前記吸気口が前記少なくとも１個の開孔に設けられる。

【００１０】

以上の本発明に対する略述は、本発明の幾つか態様及び技術的特徴に対し基本的な説明を行うことを目的とする。発明の略述は、本発明に対する詳細な記述ではないため、その目的は特別に本発明のキーとなる或いは重要要素を挙げることなく、本発明の範囲を画定するために用いられることはなく、簡明な方式でのみ本発明の数種概念を開示する。

【図面の簡単な説明】

【００１１】

【図１】本発明の好ましい実施例に係る気体拡散装置を示す模式図である。

【図２】本発明の好ましい実施例に係る管状部を示す模式図である。

【図３】本発明の好ましい実施例に係る入口部を示す模式図である。

【図４】本発明の好ましい実施例に係るストッパー部を示す模式図である。

【図５】本発明の好ましい実施例に係る基板キャリアを示す模式図である。

【発明を実施するための形態】

【００１２】

本発明の技術的特徴及び実用効果を理解し、明細書の内容に基づいて実施できるため、更に図面に示す好ましい実施例で次の通り詳細に説明する。

【００１３】

本発明に係る基板（例えば半導体ウェハ或いはレチクル等）キャリアに運用される気体拡散装置は、清浄気体を基板キャリアの容器内に均一に吹き込むことで、容器内部の例えば酸素、水蒸気或いは他の気体分子による汚染物質を除去できる。本発明の気体拡散装置に関しては、まず図１を参照すると、本発明の好ましい実施例に係る気体拡散装置１００を示す模式図であり、図１に示すように、本実施例の気体拡散装置１００は、管状部１１０と入口部１２０とストッパー部１３０とを含む。

【００１４】

具体的に言えば、前記管状部１１０（図２を参照しながら）は、五角形の管体構造を呈し、かつ五角形の管体構造が同時に鈍角側１１４と鋭角側１１２とを備える。前記構造設計は、管体構造上下両端の鈍角側１１４及び鋭角側１１２で画成された内方に凹む平面が気体拡散装置１００を基板キャリアに取り付けた時、管状部１１０がキャリア内部に搬送された半導体ウェハ或いはレチクルに接触することを効果的に防止できることを目的とする。よって、前記内方に凹む平面は、基板の待避面とも呼ぶこともでき、気体拡散装置１００が基板キャリア内部に簡単に取り付けられて容器環境を清浄することができる。

【００１５】

他に、前記管状部１１０の材料は、複数孔のある焼結されたポリマーを選択でき、清浄気体を管状部１１０の内部から前記複数孔を経由して流出させると共に基板キャリア内部に均一に吹き込むことで清浄の目的を達成できる。本実施例において、焼結されたポリマーの材料は、高密度ポリエチレン（Ｈｉｇｈ－Ｄｅｎｓｉｔｙ　Ｐｏｌｙｅｔｈｙｌｅｎｅ、ＨＤＰＥ）又は超高分子量ポリエチレン（Ｕｌｔｒａ－Ｈｉｇｈ　Ｍｏｌｅｃｕｌａｒ　Ｗｅｉｇｈｔ　ｐｏｌｙｅｔｈｙｌｅｎｅ、ＵＰＥ）から選択でき、吸水率が０．１～５％を下回り、かつ疎水性を持つ超高分子量ポリエチレンが好適である。超高分子量ポリエチレンは、高度な靭性及び耐衝撃性を持ち、同時に耐食性、耐薬品性及び極めて低い摩擦係数を持ち、その表面が疎水性を有し、水の通気プレート表面における接触角が１００°～１３０°の範囲（例えば１１３°）にあり、かつ滑り角が存在しない（３６０°内において水玉を回転しても動かない）。

【００１６】

管状部１１０内の圧力の大きさは、管状部１１０上の複数孔の大きさ及び個数によって決まり、清浄気体が基板キャリアの隅隅に吹き込むことができることを基準とする。本実施例において、管状部に備えられた各孔の孔径サイズが０．０１μｍ～１３０μｍで、好ましい孔径サイズが１μｍ～４５μｍであり、孔が大きすぎると、圧力不足が生じて気体をキャリア内部の遠い場所に吹き込むことができなくなり、孔が小さすぎると、内部圧力抵抗が過大となって清浄気体が流出できなくなる。

【００１７】

次に、同時に図３を参照すると、本発明の好ましい実施例に係る入口部を示す模式図である。図１及び図３に示すように、入口部１２０は、前記管状部１１０の一端と接続して設けられ、かつ前記入口部１２０が第１基台１２２と、前記第１基台１２２の表面に配置された吸気口１２４とを含む。管状部１１０が鈍角側１１４及び鋭角側１１２で画成された基板待避面を備えるため、入口部１２０に設けられた吸気口１２４の軸心線は、管状部１１０の一端にある管口１１８の軸心線とつながって同一直線になることができる点に留意されたい。言い換えると、前記吸気口１２４は前記管状部１１０の一端にある管口１１８と同一軸線上に配置される。こうして、気体拡散装置１００は、基板キャリア内部に設けられた開孔（気体充填孔）上に直接接続でき、同時にキャリア内部の半導体ウェハ或いはレチクル等の基板保管位置を避けることができる。

【００１８】

オフセット部（ｕｎｉｔａｒｙ　ｏｆｆｓｅｔ　ｐｏｒｔｉｏｎ）を備えた入口ジョイントを使用し、又は拡散器の整流孔口とウエハケースの気体充填孔を平行オフセット設計に採用することで、ウエハケース内のウェハ保管位置を避けるという従来技術に対比すると、本発明は、管状部１１０がウエハ待避面を備える特殊な構造設計を通じて気体拡散装置１００を基板キャリア内部の開孔（すなわち、気体拡散装置１００の吸気口１２４と基板キャリア内部の開孔の軸心が同一線上にある）に直接取り付けさせることができ、オフセット部或いは平行オフセット設計で入口部に形成される比較的大きな圧力抵抗を効果的に低下させる。これにより、清浄気体充填過程中において、気体を基板キャリア内部の開孔から気体拡散装置１００に直接入らせると共に、簡単に清浄気体を基板キャリアの内部に吹き込んで、キャリア内部の清浄効果を維持できる。

【００１９】

最後に、同時に図４を参照すると、本発明の好ましい実施例に係るストッパー部を示す模式図である。図１及び図３に示すように、ストッパー部１３０は、前記管状部１１０の入口部１２０に対向する他端に接続され、かつ前記ストッパー部１３０が第２基台１３２を含む。ストッパー部１３０の役目は、管状部１１０内に充填される清浄気体が外部に漏えいするのを防止するためであり、管状部１１０内の気体圧力が時間の経過に伴い徐々に飽和に達して最大静圧（Ｓｔａｔｉｃ　Ｐｒｅｓｓｕｒｅ）になると、清浄気体が管状部１１０上にある複数孔から基板キャリアの内部までに拡散されてキャリア内部の隅隅まで吹き込まれることで、内部の酸素、水蒸気或いは他の気中分子状汚染物質を除去する。

【００２０】

さらに言えば、前記第１基台１２２及び前記第２基台１３２の一側と前記管状部１１０との嚙合部位に気密リング１２６、１３６を更に有し、かつ清浄気体が入口部１２０と管状部１１０との接合部の隙間或いはストッパー部１３０と管状部１１０との接合部の隙間から漏れないように、前記気密リング１２６、１３６の寸法は、前記管状部１１０の両端管口１１８の寸法と同一で、気密性を高めることができる。

【００２１】

また、本発明の別の実施例において、前記気体拡散装置を備えた基板キャリアを更に提出する。図１及び図５を参照すると、本発明の好ましい実施例に係る基板キャリアを示す模式図である。図５に示すように、前記基板キャリア２００は、開口部２１２を備えた容器２１０と、前記開口部２１２と閉成する扉２２０と、鋭角側１１２と鈍角側１１４とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部１１０と、前記管状部１１０の一端と接続され、第１基台１２２と吸気口１２４とを備え、かつ前記吸気口１２４が前記管状部１１０と同一軸線上に配置される入口部と、前記管状部１１０の他端と接続され、第２基台１３２を備えたストッパー部とを含み、前記容器２１０内に設けられた少なくとも１個の気体拡散装置１００と、を含む。

【００２２】

さらに言えば、前記容器２１０は、底板２３０を更に含み、かつ前記底板２３０が少なくとも１個の開孔２３２を備え、前記開孔２３２が清浄気体を前記開孔２３２内部に充填するための外部清浄気体填充装置（図示せず）に接続できる。前記管状部１１０の一端に

ある吸気口１２４は、前記少なくとも１個の開孔２３２に配置され、吸気口１２４を通じて前記開孔２３２と接続することで、清浄気体填充装置で填充された清浄気体を前記開孔２３２と接続された吸気口１２４を経由して管状部１１０内に導入し、管状部１１０内の気体が一定圧力に達した後、複数孔を経由して外方へ拡散し、一定の方向に開口部２１２に向かって清浄気体の気流を誘導することで、容器２１０内部の環境を吹き払う。

【００２３】

填充された清浄気体は、窒素（N_2）等の不活性ガス或いは乾燥圧縮空気（ＣＤＡするることができる。

【００２４】

具体的に言えば、前記基板キャリア２００は、レチクルを搬送したレチクルケ半導体ウェハを搬送したウエハケースとすることができ、本実施例においてフー ont Opening Unified Pod、FOUP）を用いる

【００２５】

本実施例において、気体拡散装置１００の台数が２台で、かつ両気体拡散装置１００は容器２１０内部の開口部２１２に対向する端に配置され、気体拡散装置１００の設置は清浄気体が容器内において空気と十分混合させることができ、気流の死角が生じないため、気中分子状汚染物質を除去できる。その他の可能な実施例において、基板キャ内に１台の気体拡散装置１００のみが配置された時、気体拡散装置による汚染物質除去の効果を最大化にさせるため、容器の開口部２１２及び気体拡散装置１００を気体拡散装置１００の一つの対角線両端の相対位置に設けることができ、気体拡散装置１００と開口部２１２との間の相対位置が対角線両端にある方式は、清浄気体を基板キャリア２００移動させた時、比較的長い経路を持たせ、清浄気体と空気の混合時間も長くなり、死角発生確率も下がるため、容易に気中分子状汚染物質を除去できる。しかしながら板キャリア２００内における少なくとも１台の気体拡散装置１００の台数及び配置位置は、利用用者の需要に応じて調整できるため、本発明ではこれを制限しない。

【産業上の利用可能性】

【００２６】

本発明は、気体拡散装置がウェハ待避面を備えた特殊な構造設計を通じて、気体拡置を基板キャリア内部の開孔（すなわち、気体拡散装置の吸気口と基板キャリア内部の孔の軸心が同一線上にある）に直接取り付けさせることで、オフセット部或いは平セット設計で生じる大きな圧力抵抗を効果的に低下させ、従って清浄気体の充填過程おいて、気体を基板キャリア内部の開孔から気体拡散装置に直接入らせることができ、また容易に清浄気体を基板キャリアの内部に吹き込まれることで、キャリア内部の清浄の効果を維持できる。

【００２７】

以上に説明するものは、本発明の好ましい実施例であって、本発明の実施範囲はような実施例に限定されるものではなく、本発明の特許請求の範囲及び明細書の内づいて均等の範囲内で各種の変更や修飾を加えるものは、本発明にカバーされる属する。

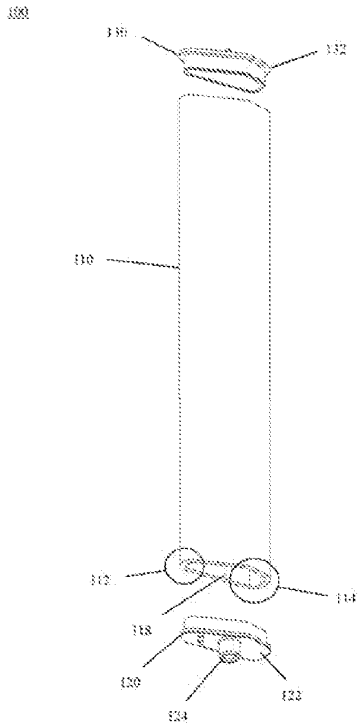
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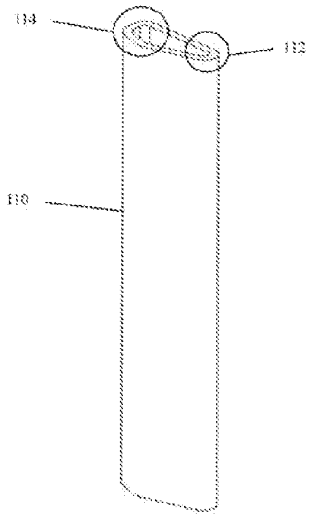
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１２０… 入口部
１２２… 第１基台
１２４… 吸気口
１２６ … 気密リング

１３０…ストッパー部
１３２…第２基台
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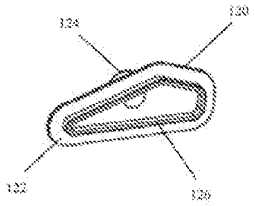
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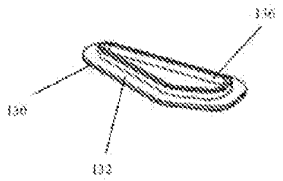
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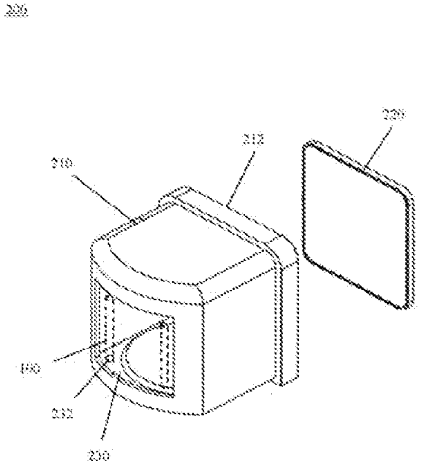
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【図４】



【図５】



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(71) Applicant *(for all designated States except US)*: **ENTEGRIS, INC.** [US/US]; 3500 Lyman Boulevard, Chaska, MN 55318 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **WATSON, James, A.** [US/US]; 6499 Mistral Lane, Eden Prairie, MN 55346 (US). **BURNS, John** [US/US]; 6046 Bow River Drive, Colorado Springs, CO 80918 (US). **FORBES, Martin, L.** [US/US]; 993 Ridge Road, Divide, CO 80814 (US). **FULLER, Matthew, A.** [US/US]; 1731 North Nevada Avenue, Colorado Springs, CO 80907 (US). **SMITH, Mark, V.** [US/US]; 4110 Bobbie Kay Place, Colorado Springs, CO 80908 (US).

(74) Agents: **CHRISTENSEN, Douglas, J.** et al.; Patterson, Thuente, Skaar & Christensen, P.A., 4800 IDS Center, 80 South Eighth Street, Minneapolis, MN 55402-2100 (US).

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(54) Title: WAFER CONTAINER WITH TUBULAR ENVIRONMENTAL CONTROL COMPONENTS

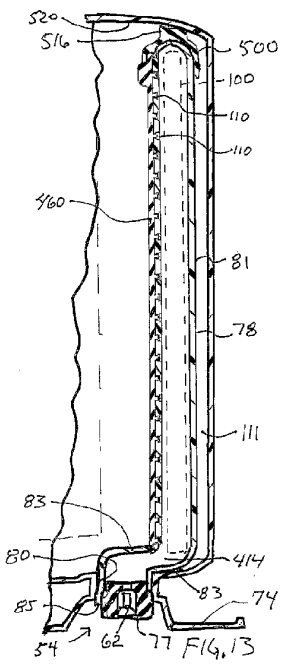


FIG. 13

(57) Abstract: A wafer container utilizes a rigid polymer tubular tower with slots and a "getter" therein for absorbing and filtering moisture and vapors within the wafer container. The tower preferably utilizes a purge grommet at the base of the container and may have a check valve therein to control the flow direction of gas (including air) into and out of the container and with respect to the tower. The tower is sealingly connected with the grommet. The tower may have a getter media piece rolled in an elongate circular fashion forming or shaped as a tube and disposed within the tower and may have axially extending. The media can provide active and/or passive filtration as well as having capabilities to be recharged. Front opening wafer containers for 300mm sized wafers generally have a pair of recesses on each of the left and right side in the inside rear of the container portions. These recesses are preferably utilized for elongate towers, such towers extending substantially from a bottom wafer position to a top wafer position. In alternative embodiment, a tubular shape of getter material is exposed within the front opening container without containment of the getter other than at the ends. The tubular getter form is preferably supported at discrete locations to maximize exposure to the internal container environment. A blocker member can selectively close the apertures. An elastomeric cap can facilitate securement of the tubular component in the container portion.

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WAFER CONTAINER WITH TUBULAR ENVIRONMENTAL CONTROL COMPONENTS

RELATED APPLICATION

The present application claims the benefit of U.S. Provisional Application No. 61/036,353 filed March 13, 2008, which is incorporated herein in its entirety by reference.

BACKGROUND OF THE INVENTION

Wafer containers and reticle pods generally are sealed containers known as FOUPs (front opening unified pods), FOSBs (front opening shpping boxes), or SMIF (standard mechanical interface) pods. These containers provide a microenvironment to isolate and control the environment surrounding a wafers and substrates used in manufacturing integrated circuits, during storage, transport and processing of the materials. Processing of such materials traditionally has been carried out in a particulate free environment generally known as a "clean room". However, maintenance of such "clean rooms" in a contaminant free state can require a great deal of care and effort, particularly during processing of the materials.

The internal atmosphere of such microenvironments can be more readily controlled and maintained. Often, such containers are purgible with inert gas or clean dry air (CDA) or extra CDA. It has been observed that contamination of reticles in such containers can be caused not only by discrete particles but also by hazing occurring on wafers or reticles. See Publication WO 2007/149513 A2, owned by the owner of the instant application, which is incorporated herein by reference and included in the Appendix to this application. Such hazing can also occur on wafers in wafer containers and be detrimental thereto, see U.S. Patent No. 5,346,518 which is incorporated herein by reference. Also relevant, U.S. Patent No. 6,042,651, owned by the owner of the instant application, discloses using nozzled towers in bottom opening SMIF pods and a front opening wafer container that uses wafer shelf assemblies as purge outlets. Problems associated with such structures and optimal use of such structures has not been adequately addressed.

For example, the use of desiccants and vapor getters in substrate containers typically require removal or disassembly of same before washing and such substrate containers as the fluids utilized can destroy the media for filtering and/or vapor absorption. Moreover, purge

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port plumbing within substrate containers is, aside from the media issues, difficult to clean and dry due to the enclosed areas used for transferring purge gases. A means for facilitating cleaning of such substrate containers without disassembly and removal of media and purge components would be very advantageous. Particularly, problematic in cleaning are free standing towers such as disclosed in U.S. Pat. No. 6,042,651. Moreover, such towers are subject to movement and potential dislocation due to their conventional positioning where they may be inadvertently contacted and their connection only at the base of the substrate container. Better positioning and attachment methods and structures would be advantageous, particularly methods that do not rely on holes or fasteners that extend through walls or other barriers separating the enclosed interior of the container from the exterior.

The use of discrete towers in a front opening pod, the use of more than one discharge tower, and the optimal placement and securement of discharge towers or tubular environmental control components has not heretofore been adequately considered and optimized to satisfactorily address reliability, haze, contamination and particulate control, and cleaning issues in front opening large diameter wafer containers. As a transition is made from 300mm wafers to 450mm wafers, improvements in these areas will be even more important.

SUMMARY OF THE INVENTION

In an embodiment of the invention, a wafer container includes a tubular environmental control component that is configured with an open interior and slots communicating with the interior of the wafer container. One or two of the tubular component may be strategically placed in back corners or compartments of the wafer container and may be connected to purge inlets on the bottom of the wafer container. Certain embodiments may have a filter in addition to or alternatively to the absorbent material. In certain embodiment an additional purge inlet port may be utilized for a total of three purge inlets. The tubular components or the purge ports may have a check valve therein to control the flow direction of gas (including air) into and out of the container and with respect to the tower. The purge port may utilize an elastomeric grommet and the tubular component sealingly connected thereto. The tubular component may have a getter media piece rolled in an elongate circular fashion forming or shaped as a tube and disposed within the tower. The media can provide active and/or passive filtration as well as having capabilities to be recharged.

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One configuration of front opening wafer containers for 300mm sized wafers have a pair of compartments on each of the left and right side in the inside rear of the container portions. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. A feature and advantage of certain embodiments is utilizing these compartments for containing, completely or partially, elongate tubular environmental control components that extend substantially from a bottom wafer position to a top wafer position or from the bottom of the container portion to the top. In one embodiment, a tubular shape of getter material is exposed within the front opening container in one or both compartments with minimal containment of the getter and without being part of an active purge system. In another embodiment, a tubular environmental control component configured as a purge tower may be placed in one or both compartments. The tower may be configured as a containment portion that may contain media. The media can be filter and/or absorbent media.

In particular embodiments, the tubular environmental control component has apertures either for exuding purge gas into the open interior of the container portion or for allowing absorbant media in the component to absorb vapors, including humidity from the interior of the container portion. A feature and advantage is that such apertures may be selectively obstructed to stop communication between the interior of the tubular component and the open interior of the wafer container. This is highly advantageous for washing the container so that filters, getters, or other contents of the tubular component can be protected from the washing fluids without removing the components. The obstruction may be by an elastomeric strip that seals the apertures as by a rigid slidably attached member that can cover and uncover the apertures. Moreover such selective blocking can be adjustable to change the size of the openings between the interior of the container portion and the interior of the tubular component.

A feature and advantage of certain embodiments is that the tubular component with apertures may be horizontally offset form the purge inlet connected thereto. This provides clearance with respect to the wafers. Moreover, positioning the discharge aperture in the tubular component back in the recess or compartment is believed to provide better fluid flow characteristics for the purge gas. Positioning the tubular components in the back recess

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provides the advantage of protection of the purge component from bumping or inadvertent contact.

A feature and advantage of certain embodiments is the methods of attachment of environmental control components in the rear compartments. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. These internal compartments have walls that generally converge rearwardly. In a particular embodiment, a flexible elastomeric attachment member is secured intermediate the top of a tubular environmental control component and the polymer wall of the container portion. Such elastomeric attachment member secures the tower in place without apertures through the walls and optimally utilizes the high coefficient of friction between the polycarbonate container portion wall and the elastomeric material. The member may be shaped as a cap further providing the advantageous function of securing together elongate components that comprising the containment portion of tubular environmental control components. A tubular component may have such a member on both ends to utilize the high coeffidient of friction and the compression of the elastomeric members to retain said tubular environmental control component within, totally or partially, the rearward compartment. In another embodiment a rigid bracket formed from metal or a rigid polymer may have spring teeth to wedge the bracket between opposing walls of the compartment wherein the teeth dig into the surface of the container portion wall. A feature and advantage of these attachment methods and structures is that the attachment utilizes the opposing walls for engagement of the attachment components without separate structure or fasteners that extend through walls of the wafer container. Therefore, wafer containers may be readily retrofitted with no modifications or reduced modifications to the product.

A feature and advantage of embodiments utilizing the tubular getter media is that a relatively high area of media is effectively exposed in a confined area in the wafer container. Moreover, the rear compartments work well for the tubular components that have no media and are utilized for pure purging.

A further feature and advantage of certain embodiments is that where purge gas is exhausted through the tower, the tubular getter media may be effectively recharged for periods when the environment therein is static.

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A further feature and advantage of embodiments herein is that accommodation of the invention in existing configurations of 300 wafer containers requires minimal changes in such containers. A further feature and advantage is that aspects of the invention are highly suitable for larger wafer containers.

DESCRIPTION OF THE FIGURES

Figure 1 is a perspective view of a front opening wafer container according to an embodiment of the invention;

Figure 2 is a bottom view of the wafer container of Figure 1;

Figure 3 is a front perspective view into the open front of a different embodiment of a container portion;

Figure 4 is a detail top view cross-sectional of the embodiment of Figure 3 showing the location of tubular components and purge ports with respect to the walls of the container portion and wafers therein;

Figure 5 is an elevational view of a tubular component;

Figure 6 is a detail view of attachment features suitable for securing the tower component to the bottom wall of a container portion of a front opening wafer container;

Figure 7 is a front elevation view of a container portion with a pair of tubular environmental control components configured as filter cartridges mounted therein with brackets;

Figure 8 is a perspective view of tubular environmental control components configured as an absorbent filter cartridge according to an embodiment of the present invention;

Figure 9 is a bracket suitable for attaching a tubular environmental control component to the back region of a wafer container such as is shown in Figures 4 and 5;

Figure 10 is a top cross sectional view illustrating an attachment means for a tubular environmental control component of a wafer container;

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Figure 11 is a perspective view of a filter cartridge in a bracket;

Figure 12 is a perspective view of the bracket of Figure 11;

Figure 13 is a cross sectional view taken at line 13-13 of Figure 4;

Figure 14 is an exploded view of a tubular environmental control component according to an embodiment of the invention;

Figure 15 is an exploded view of a tubular environmental control component of the tubular environmental control component of Figure 14;

Figure 16 is a front side perspective view of a tubular environmental control component;

Figure 17 is a rear side view of the tubular environmental control component of Figure 16;

Figure 18 is a front perspective view of the tubular environmental control component of Figures 16 and 17 with a blocking member engaged therewith;

Figure 19 is a front side perspective view of a tubular environmental control component according to an embodiment of the invention;

Figure 20 is a detail view of the tubular environmental control component of Figure 19 opened revealing a living hinge;

Figure 21 is a container portion according to an embodiment of the invention; and

Figure 22 is a perspective view of an alternative embodiment of a blocking member 800 according to the present invention.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figures 1 and 2, a front opening wafer container 20 is depicted and generally includes door 24 and container portion 26. Container portion 26 has front opening 30 leading into open interior 32 where a plurality of wafers W are retained on wafer shelves 35. Door 24 has key access holes 36 with latch mechanism 38 partially illustrated in the interior of the door enclosure with latch tips 41 that engage recesses 39 in the container portion door frame 40. The wafer container has purge capabilities with a pair of forward purge ports 48 with purge grommets 50 which are secured into grommet receiving structure 51 on the bottom 52 of the container portion and rearward purge ports 54. Check valves 56 may be inserted into the grommets to control the direction of purging gas fluid flow. Tubular environmental control components configured as purge towers 60 are illustrated which also may utilize grommets 62 and check valves 64. An exemplary location of purge ports is illustrated in Figure 2 with reference to the wafers W.

Referring to Figures 3, 4, and 13, further details of a wafer container with a different configuration portion 64 embodying the inventions are illustrated with appropriate component placement. The container portion 64 has a shell 65 and closed top 66, a closed bottom 66.1, a closed left side 66.2, a closed right side 66.3, an open front 67, and a closed back 67.1. The interior of the container has a plurality of shelves 70 which may be secured to the container portion at the top and bottom of same. A kinematic coupling plate 74 (not shown in Figure 4) is positioned at the bottom of the container portion and has appropriate openings for receiving the front side grommets and rear side grommet 77 at rear ports 54. The openings will extend through the shell 65. The container portion has two rearward apertures 80 which extend from the interior 32 of the wafer container to the exterior.

The tubular environmental control component 78 configured as a tower component as depicted in Figures 3 and 13 is inserted into the container portion 64 from the interior into the aperture 80. The tubular component has a containment portion 81, an offset portion 83, and port portion 85. Elastomeric grommet 77 may be sealingly placed in the lower portion 94 of the tubular component and a check valve 62 may be placed therein. A cylindrical shaped filter and/or getter media material 100 may be included in the containment portion and is configured to conform to the interior of the tubular component. Said tubular component has a plurality of axially-extending apertures 110 configured as horizontal slots disclosed therein. In a preferred embodiment, there may be a slit for each wafer with the slit position to

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discharge purge gas over the surface of the respective wafer. The media material, if in the containment portion, is thus exposed to the interior of the wafer container by way of said axially-extending openings. Of particular note of this container portion 64 is the rearward compartments 111 that are defined by rearward protrusions 112 at the back 67.1. The wall 113 is configured to provide two feet 114 when the container is tipped rearward 90 degrees whereby the front with door 24 is upward, such as for shipping. Each compartment 111 has a pair of sidewall portions 115, a back wall portion 116 and a compartment opening 117.

Referring to Figures 5 and 6, the tubular component 119 in this embodiment has vertical slits and has a plurality of fingers 122 that extend downwardly into the apertures 80 through the shell and kinematic coupling plate 74. Said fingers resiliently flex radially inward and allow a secure fit in the aperture in the bottom of the container portion. A flange 113 may facilitate proper seating of the component.

Referring to Figures 7-11, additional embodiments are depicted with a pair of tubular environmental control components configured as filter cartridges 200 mounted in approximately the same position, in rearward 3-sided compartments 202, and configured as getters without the associated active purge capability of the containers illustrated in Figures 1-4. Such cartridges may have an outer housing 210 formed of a polymer or other suitable material with media 211 positioned therein. In a preferred embodiment the cartridge and media will be tubular shaped. Bosses 212 on the cartridge of Figure 8 can be utilized to attach the cartridge directly to the container portion wall by way of screws extending through the exterior wall. Alternatively the bracket 220 as illustrated in Figure 9 and Figure 7 may be attached to the back wall of the container portion with the cartridge clamped therein.

Referring in particular to Figures 10, 11 and 12 a further embodiment of a filter cartridge 300 is illustrated and again has media 304 closed within a housing 308. The cartridge 300 is clamped within the clamp 320 which has resilient catch legs 330 with tabs 322 which can bite into the walls of the container simply by insertion therein with no further attachment mechanisms. Spring arms 335 secure the cartridge in the bracket.

Specific getter media which may be utilized in the cartridges and the towers illustrated herein is disclosed in international publication no. WO 2007/149513 A2 which is incorporated herein by reference. Similarly the methodology and system for recharging a getter that is part of a purge system within the wafer container as illustrated herein in Figures

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2, 3 and 4 are described in detail with reference primarily to a reticle pod in said publication. Said systems and methodologies and equipment are also applicable herein and said references incorporated for the disclosure relating directly thereto.

Referring to Figures 14-18, details of a tubular environmental control component 400 in accord with the inventions herein is illustrated. The component has a pair of elongate portions 402, 406 that assemble together to form a containment portion 410 with a containment interior 414. The containment portion has an axis 418 and connects to an offset portion 422 that connects to a purge port portion 428. An elastomeric grommet 432 may fit in a grommet receiver 440. The two elongate portions are configured as elongate clam shell portions. A rearward portion 406 has edge portions 444 with latch portions 448 configured as loops. The forward portion 402 also has edge portions 448 with latch portions 452 configured as tabs to engage the loops. The latch portion operates to secure the elongate portion together while allowing disassembly for cleaning or media placement or replacement. The forward portion 402 has an aperture portion 451 with a plurality of apertures 453 that provide communication between the containment interior 414 and the open interior of the container portion.

Referring in particular to Figures 13-18, an elastomeric elongate blocking member 460 is configured as a strip to engage the aperture portion by having tabs 464 fit into and seal the aperture 453. Figures 13 and 18 illustrate the member 460 in a blocking position. Thus, the blocking member can selectively block or expose the interior of the containment portion to the interior of the container portion.

Referring still to Figures 13-18, an elastomeric retainer, configured as an elastomeric cap 500, resiliently expands and fits over the upper end portion 506 of the tubular component 400. The cap 500 has a dome shape and has an extension portion 516 that is configured to engage the interior surface 520 of the container portion at the top. The cap functions to secure the elongate portions together and further to engage resiliently the container portion whereby the vibration of tubular component and plastic to plastic contact, the plastic component portion and the shell, is minimized. The tubular component is inserted putting the cap under compression and the high friction between the elastomeric material of the cap and the hard plastic of the shell, typically polycarbonate, holds the tubular component in place.

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Referring to Figures 19 and 20, another embodiment of the tubular environmental control component 600 is shown. The component has two clam shell portions 604, 606 that are hinged together by a living hinge 610 or the like. The two shell portions may be latched with latch portions. Apertures 630 provide communication between the interior 634 of the capsule portion or containment portion 644 and the open interior of the wafer container. The containment portion also may connect to an offset portion 650 and then to a purge port portion 654.

Referring to Figure 21, an embodiment of a wafer container 692 with a tubular environmental control component 700 is placed in recesses 710 on the backside wall 714 of the container portion 718. The recesses may have apertures positioned and spaced from the top 720 to the bottom 722. Offset portion 726 may provide communication between the containment portion 730 and the purge port portion (not shown) positioned in the interior. This arrangement allows the tubular environmental control components to be changed without disturbing the interior of the container portion to the same level as some of the other embodiments.

Referring to figure 22, an alternative embodiment of a blocking member 800 is illustrated. This rigid plastic, for example polycarbonate, piece clamps around a tubular environmental control component, such as the configuration of Figure 19. Gripping fingers 810 may secure the member to the tubular member by locking on to the rear corner 670 with wedge shape teeth 812. In a further embodiment the blocking member may have apertures 820 that correspond with the apertures 630 on the tubular component. This component can then sidably engage with the tubular environmental control component by sliding vertically, can open, close or adjust the communication between the interior of the tubular component and the interior of the container portion. Similarly shaped rigid blocking components can have arcuate fingers that partially wrap around the tubular components with cylindrical or oval cross-sectional shapes.

The present invention may be embodied in other specific forms without departing from the spirit of the essential attributes thereof; therefore, the illustrated embodiments should be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

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CLAIMS

1. A front opening wafer container for wafers 300 mm and larger, the container comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a inwardly extending recess extending from the top of the container portion to the bottom of the container portion, at both lateral sides of the recess a protruding portion of the shell defines a pair of upright feet for seating the wafer container when the wafer container is rotated backwardly with the open front facing upwardly, the feet defining interior compartments,

each compartment having a pair of opposing side wall portions, a back wall portion, two interior vertical corners, a top wall portion and a bottom wall portion;

a door to fit in the open front and latchable to the door frame;

at least one elongate tubular environmental control component, secured within one of said compartments and being spaced from the pair of side wall portions and the back wall portion, the elongate tubular environmental control component having a length and the length extending substantially a distance between the top wall portion and the bottom wall portion.

2. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprised of two elongate portions, each elongate portion connected by a plurality of latches for securing the elongate portions together, the two portions defining a containment region.

3. The front opening wafer container of claim 2 wherein the two elongate portions are hinged together defining a containment portion and the containment portion contains at least one of a filtration material or a vapor absorbent material.

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4. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component has a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein the elongate tubular environmental control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port that is offset from the axis of the tubular environmental control component.

5. The front opening wafer container of claim 4 further comprising an elongate blocking member that is positionable on the tubular environmental control component to selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

6. The front opening wafer container of claim 5 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

7. The front opening wafer container of claim 5 wherein the elongate blocking member is slidably engagable with the containment portion and is slidingly shiftable on between a blocking position and an aperture open position.

8. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprised of two elongate portions defining a containment portion, and wherein the elongate tubular control component further comprises an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion.

9. The front opening wafer container of claim 1 further comprising an additional elongate tubular environmental control component located in an interior compartment and wherein the two elongate tubular environmental control components are both connected to a purge inlets on the bottom of the wafer container, and wherein the wafer container has a further purge inlet positioned on the bottom of the wafer container proximate to the door

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frame, and further comprises a purge outlet on the bottom of the wafer container proximate the door frame.

10. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprises an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion and wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

11. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprised of a vapor absorbent material and the wafer container further comprises a bracket with spring arms to secure the bracket intermediate the pair of side wall portions of one of the compartments, the elongate tubular environmental control component removably attachable to the bracket.

12. A front opening wafer container for wafers 300 mm and larger, comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

a door to fit in the open front and latchable to the door frame;

a pair of elongate tubular environmental control components positioned in the corner regions, each elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein each of the elongate tubular environmental control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port that is offset from the axis of the tubular environmental control component.

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13. The front opening wafer container of claim 12 wherein the pair of elongate tubular environmental control components are both outwardly exposed on the backside.

14. The front opening wafer container of claim 12 the pair of elongate tubular environmental control are spaced from the wall portions and the back side and the elongate tubular environmental control component has a length and the length extends substantially a distance between the top wall portion and the bottom wall portion.

15. The front opening wafer container of claim 12 wherein each elongate tubular environmental control component is comprised of two elongate portions, each elongate portion connected to the other by at least one of a plurality of latches and hinges, the two portions defining a containment portion.

16. The front opening wafer container of claim 15 further comprising an elongate blocking member that is positionable on at least one of the tubular environmental control component to selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

17. The front opening wafer container of claim 16 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

18. The front opening wafer container of claim 16 wherein the elongate blocking member is slidably engagable with one of the containment portions and is slidingly shiftable on said containment portion between a blocking position and an aperture open position.

19. The front opening wafer container of claim 12 wherein the elongate tubular environmental control components are each comprised of two elongate portions defining a containment portion, and wherein the elongate tubular control component further comprises an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion.

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20. The front opening wafer container of claim 8 wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

21. The front opening wafer container of claim 12 wherein each of the containment portions has therein at least one of a filter material and an absorbent material.

22. A front opening wafer container for wafers 300 mm and larger, the wafer container comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

a door to fit in the open front and latchable to the door frame;

an elongate tubular environmental control component positioned in one of the corner regions, said elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein said elongate tubular environmental control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port that is offset from the axis of the tubular environmental control component, and wherein the elongate tubular environmental control component is comprised of two elongate portions, each elongate portion connected to the other by at least one of a plurality of latches and hinges, the two portions defining a containment portion.

23. The front opening wafer container of claim 22 wherein the containment portion has therein at least one of a filter material and an absorbent material.

24. The front opening wafer container of claim 22 further comprising an elongate blocking member that is positionable on the tubular environmental control component to

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selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

25. The front opening wafer container of claim 24 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

26. The front opening wafer container of claim 22 wherein the elongate blocking member is slidably engagable with one of the containment portions and is slidingly shiftable on said containment portion between at least a blocking position and an aperture open position.

27. The front opening wafer container of claim 22 wherein the elongate tubular environmental control component is further comprised an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion.

28. The front opening wafer container of claim 27 wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

29. The front opening wafer container of claim 1 wherein each of the containment portions has therein at least one of a filter material and an absorbent material.

30. A front opening wafer container comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

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a door to fit in the open front and latchable to the door frame;

an elongate tubular environmental control component positioned in the container portion and extending subantially from the bottom of the container portion to the top of the container portion, said elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein said elongate tubular environmental control component has an axis that is upright and is connected to the bottom of the container portion at a purge port and wherein the elongate tubular environmental control component is further comprised of an elongate blocking member that is positionable on the tubular environmental control component to selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

31. The front opening wafer container of claim 30 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

32. The front opening wafer container of claim 30 wherein the elongate blocking member is formed of a rigid polymer and is slidably engagable with one of the containment portions and is slidingly shiftable on said containment portion between at least a blocking position and an aperture open position.

33. The front opening wafer container of claim 30 wherein the elongate tubular environmental control component is further comprised a cap formed of elastomeric material that resiliently expands to adheringly cover the top of the containment portion.

34. The front opening wafer container of claim 33 wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

35. A front opening wafer container comprising:

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a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

a door to fit in the open front and latchable to the door frame;

a pair of elongate tubular environmental control component positioned in the container portion, one at each of the corner regions and extending substantially from the bottom of the container portion to the top of the container portion, each of said elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein said elongate tubular environmental control component is connected to the bottom of the container portion at a purge port inlet, and wherein the container portion has an additional purge port inlet, and the container portion further has a purge port outlet.

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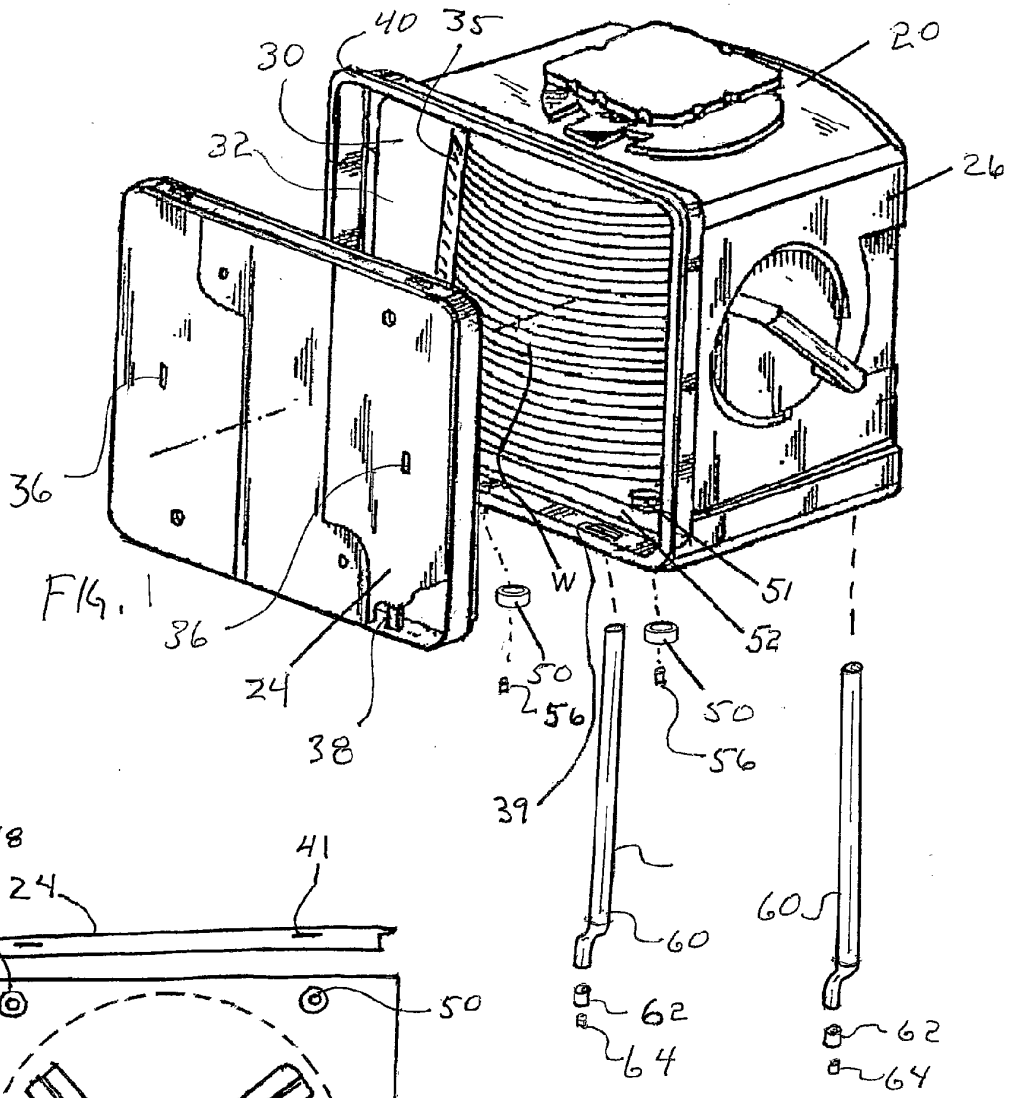

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Fig. 1

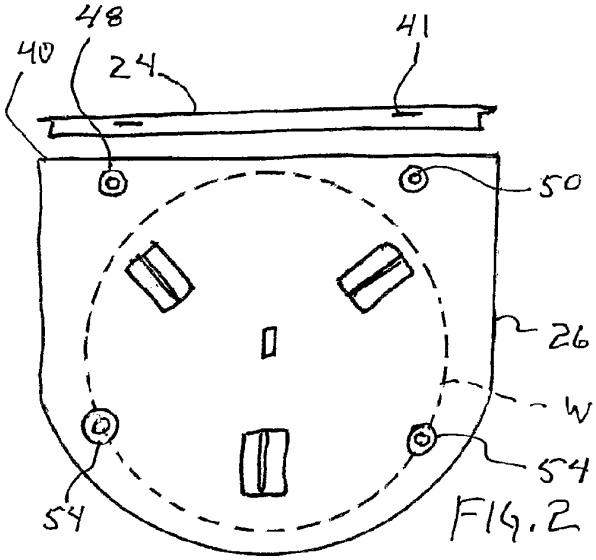

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Fig. 2

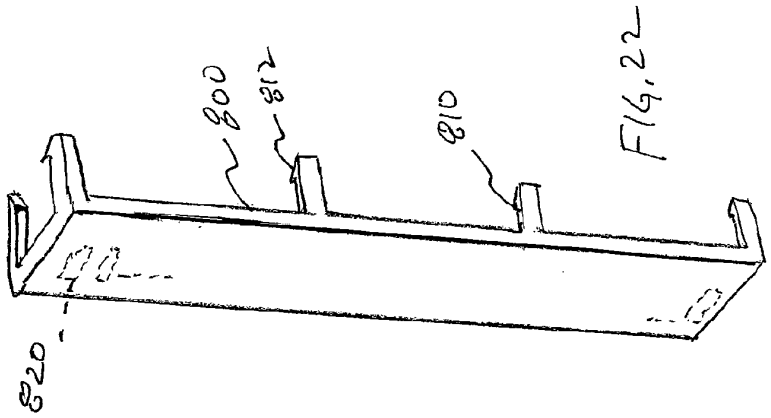


Fig. 22

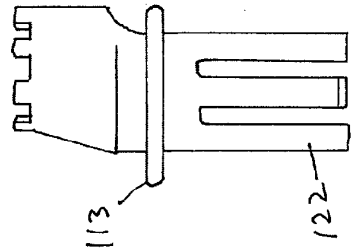


Fig. 6.

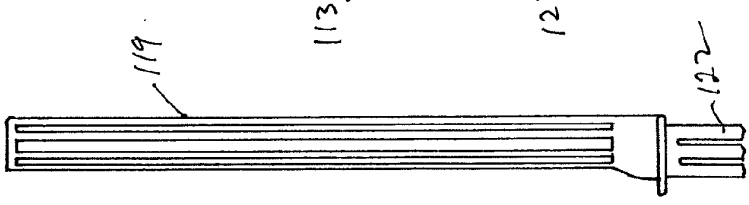


Fig. 5.

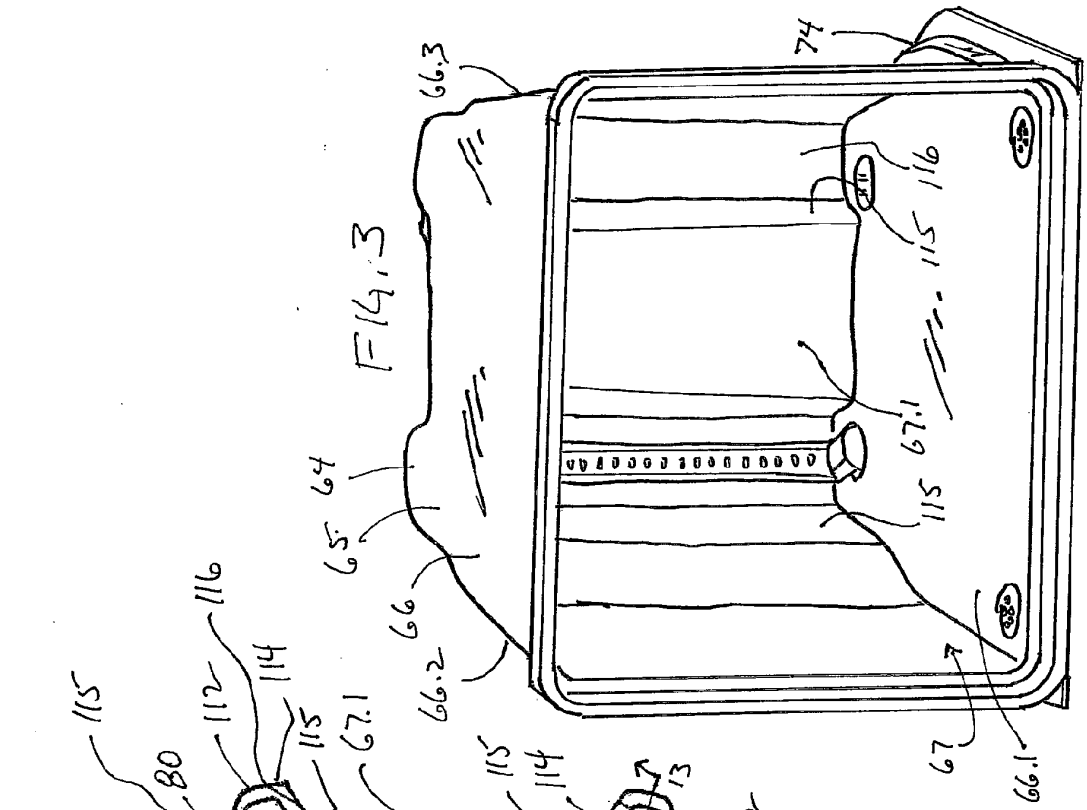

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FIG. 3

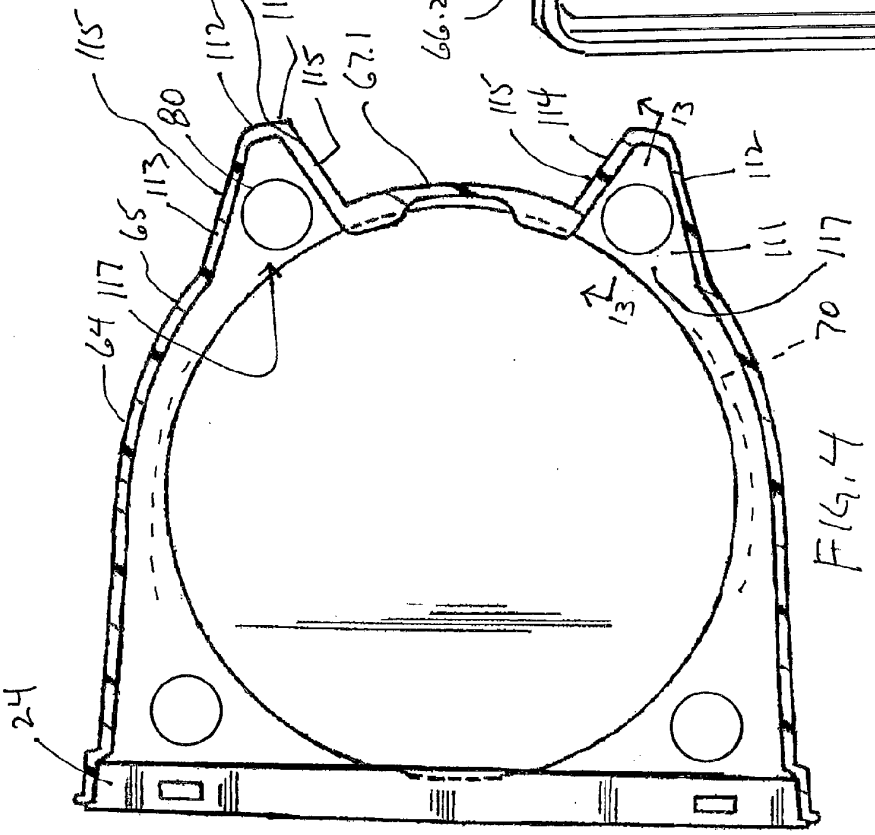

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FIG. 4

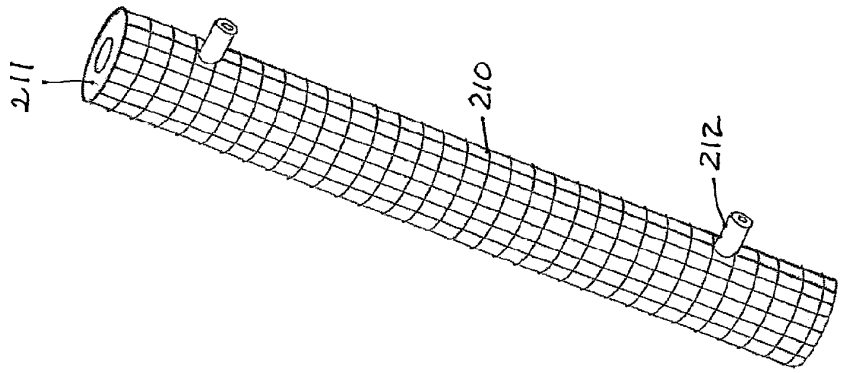


Fig.8.

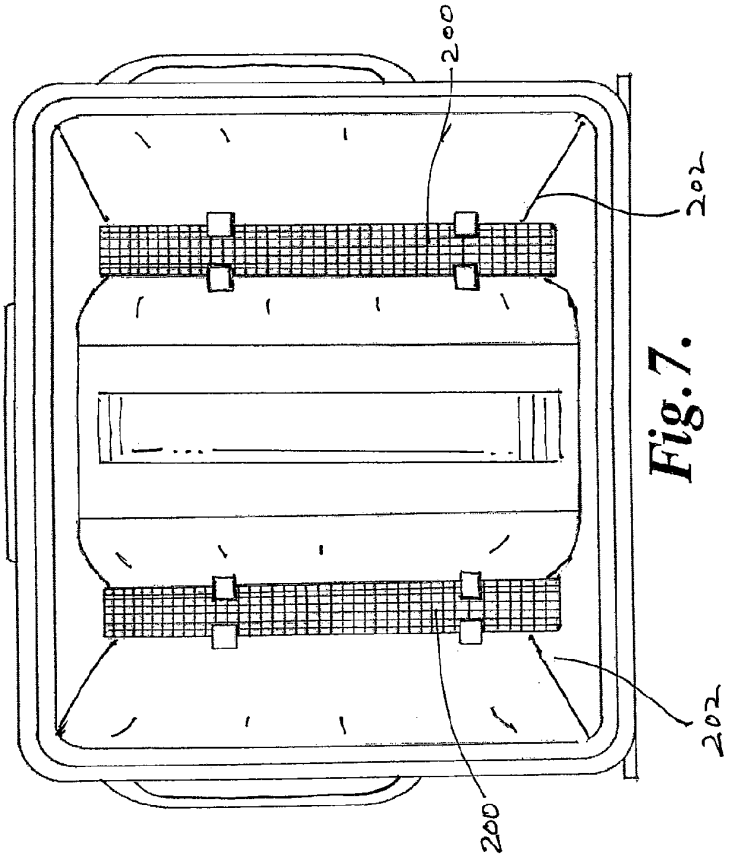


Fig.7.

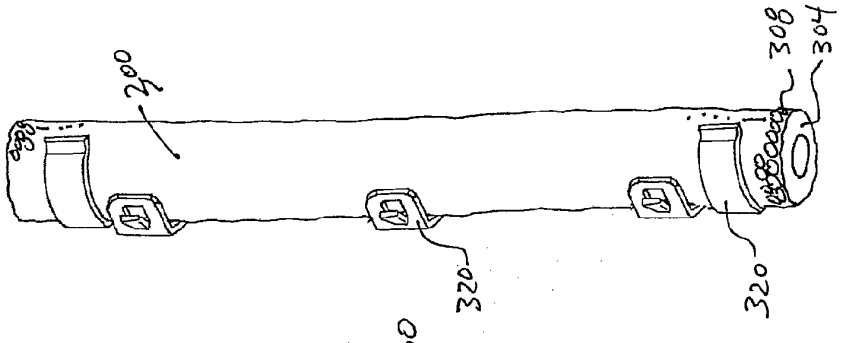


Fig. 11.

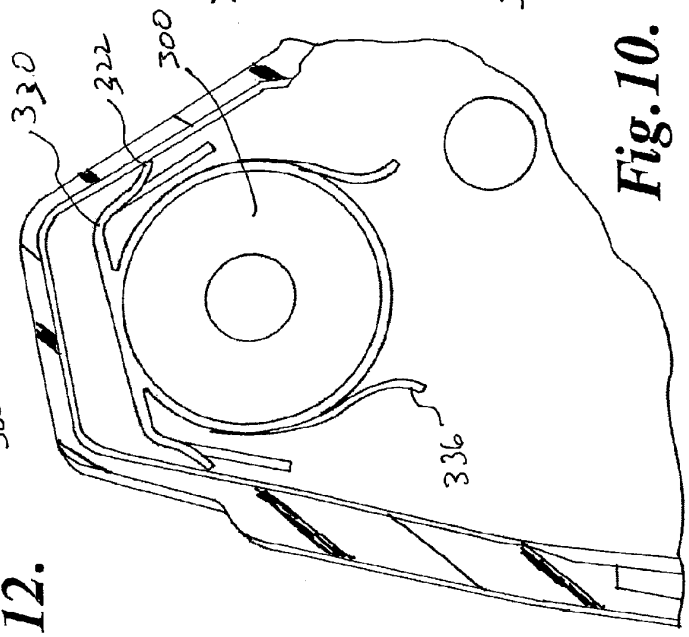


Fig. 10.

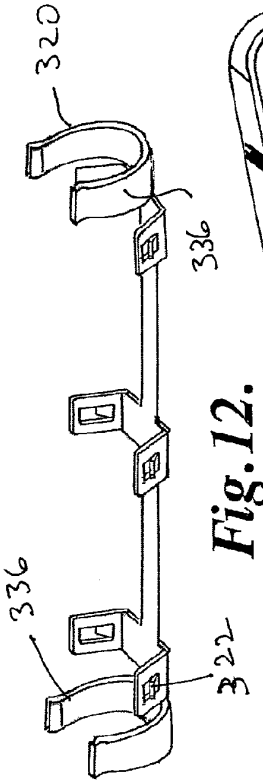


Fig. 12.

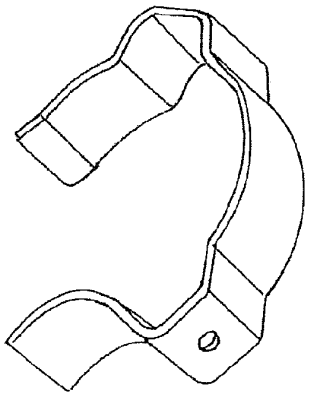
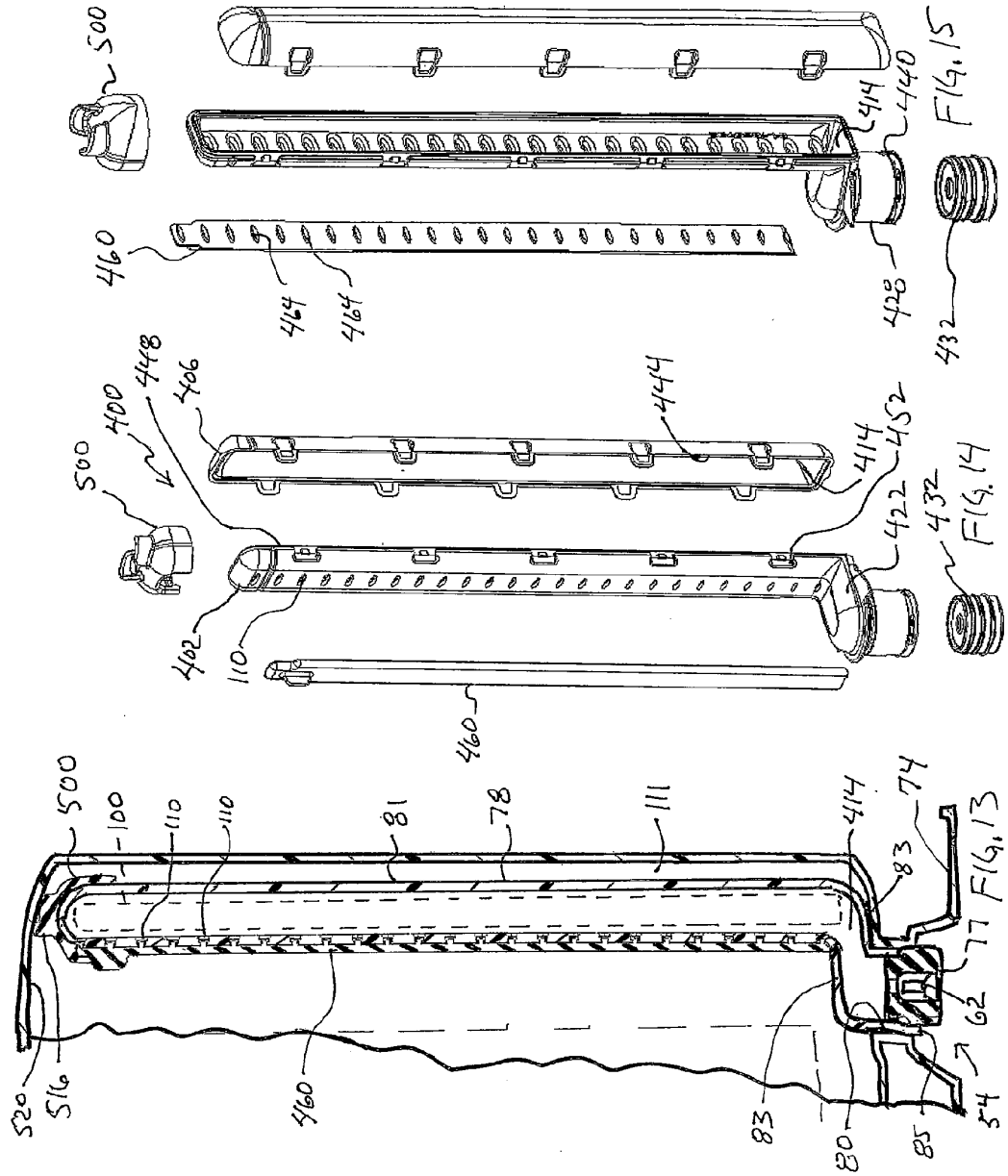
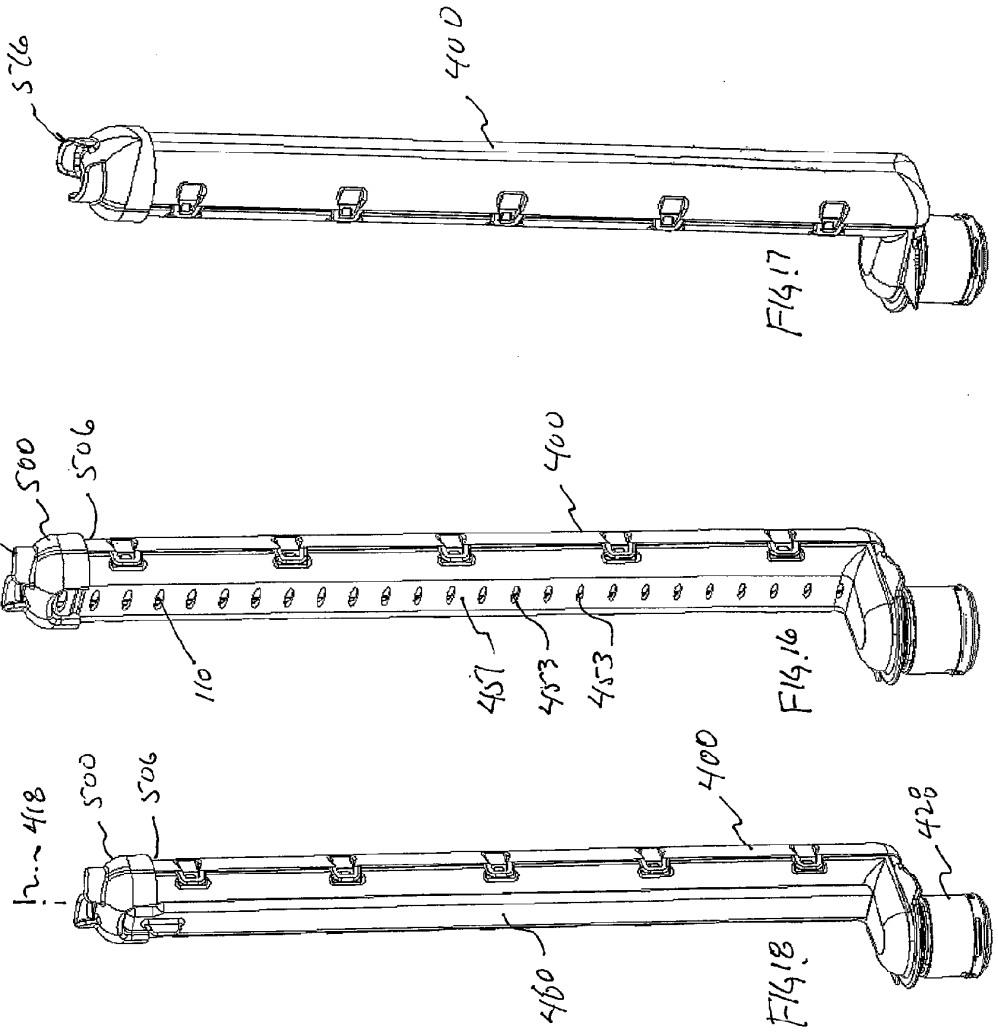


Fig. 9.

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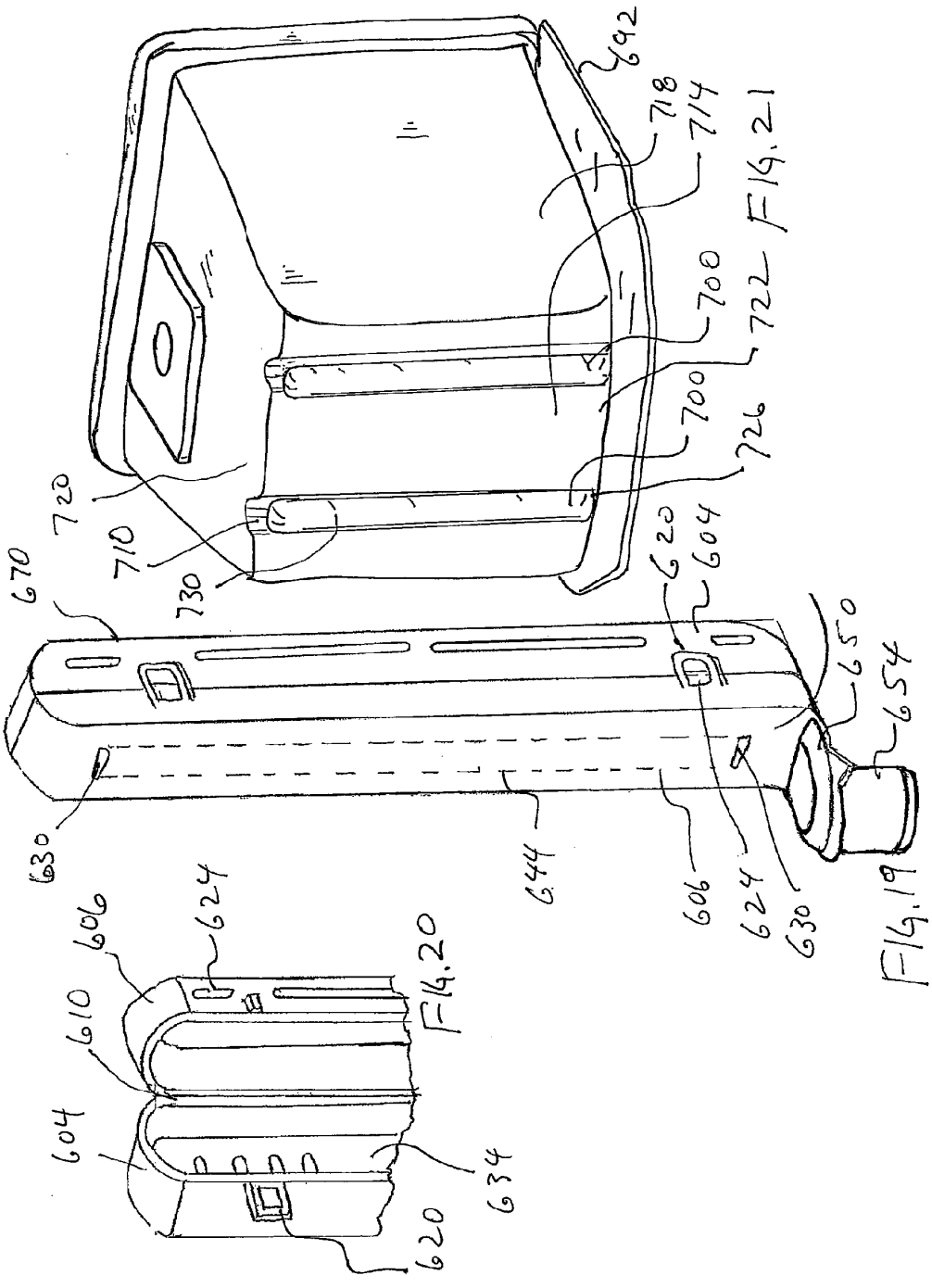


FIG. 21

FIG. 19

FIG. 20

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(71) Applicant *(for all designated States except US)*: **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billerica, MA 01821 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BURNS, John** [US/US]; 6046 Bow River Drive, Colorado Springs, CO 80918 (US). **SMITH, Mark** [US/US]; 4110 Bobbie Kay Place, Colorado Springs, CO 80908 (US). **FULLER, Matthew** [US/US]; 1731 North Nevada Avenue, Colorado Springs, CO 80907 (US).

(74) Agents: **CHRISTENSEN, Douglas, J.** et al.; Patterson Thuente Christensen Pedersen, P.A., 4800 IDS Center, 80 South Eighth Street, Minneapolis, MN 55402-2100 (US).

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(54) Title: POROUS BARRIER FOR EVENLY DISTRIBUTED PURGE GAS IN A MICROENVIRONMENT

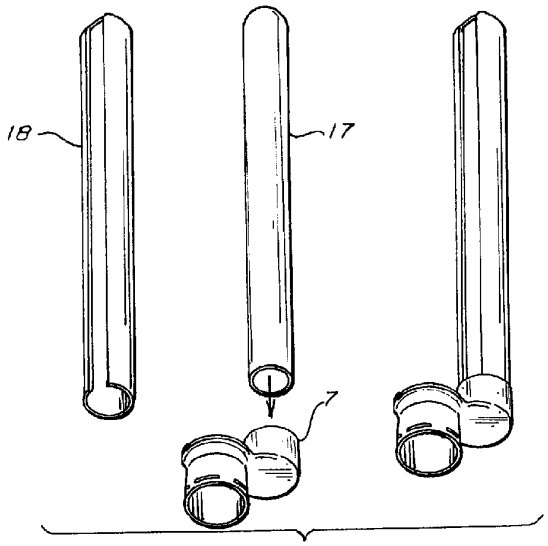


Fig.5

(57) Abstract: An improved system and method for purging a microenvironment to desired levels of relative humidity, oxygen, or particulates through the implementation of a purge gas delivery apparatus and method that provides even distribution of the purging gas within the microenvironment. A substrate container has a tower therein with a fluid flow passageway extending the length of the tower. Apertures with porous media between the aperture and fluid flow passageway regulate the volume and pressure of air discharging at each aperture. Alternatively, the tower may be formed of a porous tubular polymeric material. A sleeve may direct the discharge purge gas in the interior.

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POROUS BARRIER FOR EVENLY DISTRIBUTED PURGE GAS IN A MICROENVIRONMENT

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 61/285,218, filed December 10, 2009, which is incorporated herein in its entirety by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention relates to transportable substrate containers suitable for use in storing or transporting objects such as semiconductor wafers in an extremely clean environment and more particularly to systems and methods for purging the environment within said container to desired levels of relative humidity, oxygen, and airborne particulates.

BACKGROUND OF THE INVENTION

During transport or storage of substrates, if traces of dust or gaseous impurities present in the surrounding air adhere to the semiconductor wafers or other objects, the subsequent product yield from the affected wafer is lowered. This tendency becomes increasingly noticeable as the degree of integration increases. Accordingly, there is an increased demand for the environment within these transport containers to achieve a high level of cleanliness regarding not only dust but also gaseous impurities.

Currently to produce a clean space for accommodating substrates when transported or stored, microenvironments are purged using an inert gas which is injected into the interior of the container through an inlet port causing the air within the container to exit through an outlet port. These purge gas inlet and outlet ports are generally located on the bottom surface of the container shell and extend from the interior through the shell bottom surface where they interface with the purge gas delivery system. This method uses a check valve and circular PTFE particulate filter located in the purge inlet port to control and filter the incoming purge gas. The inert purge gas then replaces the air and

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contaminants within the container and the contaminated air is forced out of the container through the purge outlet port or the door opening if the door is removed.

Other methods of delivering purge gas into the container have been designed to provide the improved environment within the container, these prior art attempts have significant drawbacks which precipitate the need for the present invention. For example, U.S. patent number 6,221,163 to Roberson et al. discloses a system and method for molecular contamination control permitting purging a container to desired levels of relative humidity, oxygen, or particulates. The container includes an inlet port and an outlet port, each including a check valve and filter assembly for supplying a clean, dry gaseous working fluid to maintain low levels of moisture, oxygen, or particulates. The inlet port is connected with a gaseous working fluid source and the outlet port is connected to an evacuation system. The integral directional flow check valves operate at very low pressure differentials (such as less than 10 millibar). In one embodiment, flow of purge gas inside the container can be directed towards the substrates with one or more nozzle towers to encourage laminar flow inside the pod. One or more outlet towers, having a similar function to that of the inlet tower may also be provided to encourage laminar flow inside the container. This method has a particulate filter located in the check valve/filter assembly located in the bottom of the tower. The disadvantage of this method is that as the purge gas flows through the orifices of the tower, the distribution of gas decreases from the tower top orifice to the tower bottom orifice. This results in an extended time to evacuate the water and oxygen from the microenvironment.

One goal of purging is to decrease humidity and oxygen levels in the internal volume of the microenvironment. A challenge of purging is to evenly distribute the purge gas fast and effectively over the substrates within the container. Current purging methods, using inlet and outlet ports at the bottom of the container do not meet either requirement of purging fast or effectively because the path of least resistance for the purge gas flow is directly from the inlet to the outlet. Little of the gas flows between the wafers, and the volume between the wafers is a dead zone that is not immediately affected by the purge gas. This results in non-uniform humidity and oxygen levels within the microenvironment. Utilizing the purge tower improves the speed and effectiveness of the purge, but the orifices in the tower still do not evenly distribute the purge gas between the wafers even with the implementation of graduated orifices. In effect, as the purge gas

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flows through the orifices of the tower, the distribution of gas decreases from the top orifice to the bottom orifice. This results in ineffective evacuation of water and oxygen from the microenvironment.

Another goal of purging is to remove airborne contaminants from the environment within the container. These contaminants are primarily trapped in the filtering mechanism in the purge ports and are effectively removed when the container is purged. However, the containers are reusable and prior to reuse must be cleaned. As a part of the cleaning process, a human operator must remove the purge tower and the purge port/filter mechanisms to keep water from accumulating in these devices. Contaminants are introduced into the microenvironment from the human operator during the process of removing/reinstalling the purge towers and purge ports/filters.

A need therefore exists for an improved purging method which solves the problems of evacuating the wafer container in a fast and efficient manner. In particular, a need exists for a purging method and apparatus that can allow the purge gas to accumulate in the tower so that as the gas accumulates and the pressure inside of the tower increases therefore the gas flows through the tower into the microenvironment and is evenly distributed between the wafers. Another need is to minimize or eliminate human operators from reaching inside the container. Currently, operators must reach inside the container to remove and reinstall the purge towers and purge ports/filters when the container is cleaned and returned to service.

SUMMARY OF THE INVENTION

In view of the above mentioned problems, the present invention provides for an improved system and method for purging a microenvironment to desired levels of relative humidity, oxygen, or particulates through the implementation of a purge gas delivery apparatus and method that provides even distribution of the purging gas within the microenvironment.

An additional advantage of the present invention is that the purge tower porous barrier may be composed of a hydrophobic material that prevents water from entering the purge tower during the cleaning process which consequently eliminates the need to remove the purge gas delivery apparatus during the cleaning process which avoids

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introducing particles into the microenvironment from the removal and reinstallation process of the purge gas delivery apparatus after cleaning.

Further advantages of the invention are that the porous barrier may be formed into shapes that match the non-flat geometry of the purge tower and by resisting the flow of gas, the porous barrier allows for the purge gas to accumulate in the tower. As the gas accumulates, the pressure inside the tower increases and when the pressure is sufficient to overcome the barrier material, the gas flows through the barrier material into the wafer container and is evenly distributed among the installed wafers in the container.

A further advantage of the invention is that the purge tower significantly reduces the relative humidity level within the microenvironment in instances where the wafer access door has been removed.

A further advantage of the invention si that the purge tower porous barrier improved purging efficiency from top to bottom of the microenvironment.

In one preferred embodiment, the microenvironment includes an inlet port and an outlet port, each including a check valve assembly and a purge tower connected to the inlet port and the outlet port for a clean, dry gaseous working fluid that is used to provide controlled low levels of moisture, oxygen, and particulate content around the materials contained in the microenvironment. The microenvironment container inlet port is connected with a gaseous working fluid source, and the outlet port is connected with an evacuation system. In operation, according to one embodiment, the tower includes a sealing grommet in the tower base portion that maintains a seal against the container shell to prevent undesired chemicals or particulates from entering into the interior of the wafer container. Thus, any flow between the interior and exterior of the wafer container is limited to passing through the passageway defined by the grommet. Types of fluid flows include the introduction of purging gases such as nitrogen into the interior of the wafer container. The fluid flow can be further limited by the porous barrier element. The porous barrier provides filtering to the purge gas to remove particulates as well as oxygen and humidity from the purge gas prior to the gas being introduced into the interior of the wafer container. The integral directional flow check valves operate at very low pressure differentials. In this embodiment, a porous membrane barrier is placed in the inlet tower directly behind the tower orifices. The membrane barrier improves the performance of the

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tower in two ways. For the first improvement, the membrane barrier allows for the purge gas to evenly pressurize within the tower. The pressurized gas then evenly flows through the membrane and the tower orifices and into the container interior. The orifices in the tower can be of any shape including a continuous vertical opening from top to bottom of the tower such that the tower has a "C" shape as viewed from the top down. This results in evenly distributed purge gas between the substrates in the microenvironment and the tower resulting in an improved reduction in relative humidity and oxygen from the microenvironment. For the second improvement, the barrier can be manufactured from a material with hydrophobic characteristics that act as a water barrier during the cleaning of the microenvironment. This hydrophobic water barrier keeps water out of the purge tower and consequently the purge port during the cleaning process. The porous membrane barrier also functions as a particle filter which removes particles from the gas flow which eliminates the need for a particle filter in the purge port at the base of the tower.

In an additional embodiment, the membrane barrier is manufactured out of a porous polymer that is formable into geometry that matches the geometry of the tower. A benefit of the formed barrier is that it can also be used to seal the mating surfaces of the rear and slotted front portions that make up the purge tower. Additionally, the barrier can be formed into a flat woven shape and used to cover the orifices in the front portion of the tower.

An additional embodiment, the purge tower itself can be fabricated from the same porous polymer material as is used for the membrane barrier avoiding the need for orifices, radial slots, or separate tower portions to form the tower. This tower may be manufactured as a capped porous tube that attaches directly to the inlet/outlet ports on the bottom surface of the container. This tower can be made as a "C" shaped sleeve that can be situated such that flow is directed towards the substrates or towards the container wall, or any other direction desired simply by how the sleeve is positioned in the microenvironment.

An additional embodiment is that the porous membrane filter can be made as a bladder that is installed within the tower. In this embodiment, the porous material not only covers the purge tower nozzles but also the reveal between the front and back portions of the purge tower. This allows for any leakage through the reveal to be filtered as well as any water to be blocked from coming into the tower through the reveal. The purge gas is

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injected into the filter bladder at the base of the tower and subsequently is dispersed through the bladder walls, through the tower slots and into the container interior. The bladder can be manufactured either as a complete tube that is installed between the front and back portions of the tower, or as a complete tube that is installed between the front and back portions of the tower.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1A is a front opening wafer container.

FIG. 1B shows a front opening wafer container with one purge tower installed.

FIG. 2 is a front view of the tower showing the gas dispersal slots

FIG. 3.is an exploded view of the back portion of the tower, the porous membrane barrier and the slotted front portion of the tower

FIG. 4 shows the purge gas flow into the tower and subsequently out through the barrier membrane and the tower slots into the container interior.

FIG. 5 is an exploded view of the purge tower made of porous polymer material which is then press-fit into the molded base portion.

FIG. 6 is an exploded view of the tower and porous membrane bladder.

FIG. 7 is a cross section view of the complete tube shape bladder showing the gas inlets and the different wall section thickness which enables the purge gas flow toward the disperse slots in the front portion of the tower.

FIG. 8 shows the respective flow data for porous polyethylene and porous polypropylene in the presence of air pressure and water pressure.

FIG. 9 shows the reduction in relative humidity measured at wafer slot #1, wafer slot #13 and wafer slot #25 with the door removed before and after purge with the present invention.

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DETAILED DESCRIPTION OF THE INVENTION

FIG. 1A illustrates a configuration of a substrate container configured as a wafer container assembly **1** known as a FOUP or FOSB comprising an open front **2**, a front door **3**, and an enclosure portion **4**. Wafers W are inserted and removed horizontally through the open front. Slots formed in the interior sides hold the substrates, in this case semiconductor wafers. Front door **3** with seal sealingly engages with enclosure portions **4** to form an interior space that is isolated from the ambient atmosphere. Receiving structure **5** for the purge towers **6** may be in the bottom wall of the enclosure portion.

Referring to **FIG. 1B**, a purge tower **6** is shown that is part of the preferred embodiment enabling gaseous working fluid or purge gas inside a substrate container to be directed toward and away from substrates housed in the container using one or more uniquely configured towers **6** connected by a base portion **7** to the inlet port or the outlet port. Orifices are provided in each tower, preferable in the form of a series of spaced apart nozzles **8.** The gaseous purge fluid will sweep the container and its contents picking up residual moisture, oxygen and AMC's and encouraging movement of particulates toward the outlet port or door opening. U.S. Patent No. 6,221,163, owned by the owner of the instant invention, and International Publication No. WO2009/114798 A2, also owned by the owner of the instant application disclose certain structural configurations, assembly details, materials which may be applicable to embodiments of the inventions disclosed herein, said patent and publication are incorporated by reference herein

In an alternate embodiment, shown in **FIG. 5** the tower configuration can be in the form of a tower **17** made from the porous polymer material which is friction fitted onto the base unit **7**. One or more vent towers are also preferable connected to the outlet port or ports, having a structure and function similar to that of the inlet towers, to direct flow to the outlet valve for exhausting to the instrument suite.

FIGS. 3 and **4** show the interior of the tower with the porous material filter installed. **FIG. 3** is an exploded view of the entire tower. This view shows the tower rear portion **9** which is a molded separate part that is connected to the tower front portion **11** with a series of tabs **12** located on the tower rear portion **9** that fit into recesses **13** on the tower front portion **11. FIG. 3** is a cut away view of the interior of the tower **6** near the base portion **7** showing the tower grommet **16**, the purge gas inlet **14**, and the purge gas

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flow path through the grommet and into the tower flow conduit or fluid flow passageway **15** and out of the nozzle orifices **8**. Purge gas enters the tower **6** through the purge gas inlet **14,** passes through the gas conduit and the presence of the barrier filter configured as a strip of porous material **10** allows the gas pressure to build inside the tower until the pressure is sufficient to overcome the filter membrane and then is dispersed through the nozzle orifices **8** into the interior of the container at a uniform pressure and distribution from top to bottom. In other words, a pressure drop across the filter material allows a uniform pressure along the entire length of the tower that is greater that the pressure outside the tower in the interior of the container. The higher pressure along the length of the tower provides uniform air flow out each orifice or each outlet region or equal air discharge along the length of an outlet slot. The pressurization allows the purge gas to clean the interior volume through laminar flow across all of the substrates installed within the container. Ideally the diameter of the tower is .75 inches to 2.0 inches and the tower wall thickness is 1/16 inch to 3/8 inches. Ideally the length of the tower is 70% to 100% of the interior height of the container portion where the tower is located. And ideally the length of the tower portion is at least the distance between the lowermost substrate slot and the uppermost substrate slot.

The system and method of the invention are planned for use while the container is waiting for the next production station or step in the fabrication process. These periods have been estimated to be about six minutes to more than one hour long. Ideally, the container is completely purged to desired levels of relative humidity, oxygen, or particulates in a period of about 6 minutes or less. Relative humidity levels of about 0.1% or less have been achieved in about 5 minutes. Flow of the gaseous working fluid or purge gas is typically provided in the container at up to 20 SCFH, and at a pressure of from about zero to about 5 psi. Pressurized nitrogen gas and other inert gases are typically available at pressures from about 65 to about 125 psi, and the pressure of the working gas within the system is typically controlled using a point-of-use regulator, limiting feed pressure to the inlet of the container to a maximum of about 10 psi. Working pressures within the container are typically about 1 psi. The gaseous working fluid or purge gas is filtered to remove particulates as small as 0.10 – 2.0 microns at an efficiency of about 99.999%

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FIG. 5 shows the alternate embodiment of the tower configured as a tubular structure formed entirely of, or substantially entirely of, porous material so that the tower portions are no longer needed. Tower portion tubular structure **17** is molded from the porous barrier material and formed into the shape of the tower portion without the nozzle slots in the front portion. The molded purge tower is then friction fit attached to the base portion **7**. The purge gas behaves the same as in the preferred embodiment in that the gas in held within the tower until the pressure increases to a level sufficient to permeate the barrier material and proceed to the interior of the container. An alternate embodiment of the molded barrier is one in which the tower in made from the barrier material, however sleeve **18** is added that is "C" shaped in a horizontal cross section. This allows the purge gas to pass through the tower material and onto the substrates through the open slot running the entire length of the sleeve from top to bottom. This tower configuration allows improved directionality of the purge gas through the relatively large single purge slot that is adjustable by rotating the sleeve on the tower. The sleeve may provide a cap or end plug on the top of a tubular porous form that is otherwise open at the top.

FIG. 6 shows the bladder **19** which is molded out of the porous barrier polymer material so that it fits into the tower **6** and provides the purge gas filtering and pressurization by not only covering the orifice nozzles **8**, but also sealing the reveal **20** where the two separately molded tower halves **9** and **11** are mated. The bladder shown in the illustration is molded without a back side to facilitate the molding process. Therefore the bladder **19** must be inserted into the tower with the opening away from the orifices **8** in order to work properly. Each of the bladders has an interior fluid flow passageway 23 that extends the length of the bladder and the length or substantially the length of the tower. The bladders may be formed of a flexible woven polymeric porous material.

FIG. 7 shows an alternative construction for bladder **19**. This view, which is a cut away view of the bladder shows the different thicknesses of the walls of the bladder. The front bladder wall **22** is thinner that the rear bladder wall **21.** This different thickness facilitates the purge gas delivery since the gas will permeate faster and easier through the thinner wall **22** which is facing the tower orifices than through the thick rear wall **21.** This difference in wall thickness requires that the bladder is correctly installed. The porous material is preferably porous polymers such as polyethylene, polypropylene, PTFE (polytetrafluoroethylene), or PFA (perfluoroalkoxy). The porosity in the porous material

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may be, for example, be in the form of a foamed material, a fibrous material or a sintered material. The fibrous material can be woven or randomly packed or intertwined. The particular shapes herein can be formed by thermal molding or, in some cases, by machining rigid blocks or preforms of the porous material. Suitable porous polymers are available from GenPore, 1136 Morgantown Rd, Reading PA.

Appropriate porous materials used in the purge tower to improve the flow of the purge gas of the tower into the container by by making it uniform along the length of the tower by providing sufficient pressurization of the gas to build pressure within the tower prior to permeating through the barrier membrane filter material which provides for a uniform pressure and dispersion within the container and across all of the substrates. Simultaneously this material has hydrophobic characteristics such that it prohibits or minimizes water from entering the purge tower during the wash cycles of the recycling procedure. Keeping water out of the purge tower and the purge inlet and purge outlet minimizes the time required for the cleaning process and keeps the container cleaner.

Referring to **FIG. 8,** in an embodiment, the purge tower may be formed of a tubing portion **36** formed of porous material closable at the top end **38**, with a cap **40**, suitably formed of nonporous polymer that can be sealing fit over the top of the tubing. To direct the discharge on one side of the tower, non porous polymer blocking sleeve **44** configured as a tubing segment with a slit extending axially and formed of a non porous polymer, my be fitted around the porous tubing portion. The bottom may be secured to a nonporous polymer fitting **48** and connected at the bottom end to a purge port. The purge port is connectable to a purge gas source exterior of the container by conventional means. The purge tower may be pressurized such that flow velocities and flow volumes near the top of the tower are equal or substantially equal to such flow velocities and volumes near the bottom of the tower. Ideally the diameter of the tubing portion is .75 inches to 2.0 inches and the tubing portion wall thickness is 1/8 inch to 3/8 inches. Ideally the wall thickness of the tubing portion is 10% to 25% of the diameter. Ideally the length of the tubing portion is 70% to 100% of the interior height of the container portion where the tubing portion is located. And ideally the length of the tubing portion is at least the distance between the lowermost substrate slot and the uppermost substrate slot.

FIG. 9 shows the levels of relative humidity within the microenvironment before and after purging with the present invention installed and with the door removed.

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Measurements of relative humidity made before purging at wafer slot #13 indicates a relative humidity level **23** of between 40% and 45%. Another measurement made prior to purging at wafer slot #1 indicates a relative humidity level **24** of between 35% and 40%. After purging, relative humidity measurements at wafer slot #25 indicate a relative humidity level **26** of between 20% and 25%. Another measurement made after purging at wafer slot #13 also indicates a relative humidity level **25** of between 20% and 25%.

While the present invention has been described herein in conjunction with a preferred embodiment, a person with ordinary skill in the art, .after reading the foregoing, can effect changes, substitutions of equivalents and other types of alterations to those set forth herein. Each embodiment described above can also have included or incorporated therewith such variations as disclosed in regard to any or all of the other embodiments. Thus, it is intended that protection granted by Letters Patent hereon be limited in breadth and scope only by definitions contained in the appended claims and any equivalents thereof.

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CLAIMS

What is claimed is:

1. A system for transporting substrates comprising:

a substrate container having a container portion with an opening for loading/unloading substrates, a door adapted to sealably cover the opening;

a substrate carrying section disposed in the transport container;

an apparatus comprising an inlet tower adapted to be mounted to substrate container portion for admitting a gaseous working fluid to the interior of the container for purging the substrate container body with the gaseous working fluid;

the inlet tower having a length and one or more outlet regions arranged along the length of the tower, and an interior flow passageway extending the length of the tower,

filter media positioned at each outlet region intermediate the one or more outlet regions and the interior flow passageway whereby the gaseous working fluid being admitted to the substrate container may be filtered and the gaseous fluid.

2. The apparatus if claim 1, wherein the one or more outlet regions of said inlet tower comprises a plurality of orifices and the filter material comprises a strip of porous material that covers the orifices, the strip of porous material extending in the interior of the tower.

3. The apparatus of claim 1, wherein said inlet tower comprises a porous polymeric material that blocks water from the interior of the tower.

4. A system for transporting substrates comprising:

a substrate transport container having a container body with an opening and a wafer loading/unloading door adapted to sealably cover the opening;

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an apparatus for admitting a gaseous working fluid to the interior of the container comprising an inlet tower formed of porous barrier material and a filter in the tower formed of the same porous barrier material.

5. The apparatus of claim 4, wherein said inlet tower formed of the porous barrier material has in cross section, a "C" shape.

6. A system for transporting substrates comprising:

a substrate transport container having a container body with an opening and a wafer loading/unloading door adapted to sealably cover the opening; and

an apparatus for admitting a gaseous working fluid to the interior of the container comprising an inlet tower and a bladder portion made from the porous filter material, the bladder portion extending a length of the inlet tower.

7. The apparatus of claim 6, wherein said bladder has one side that is thinner than an opposite side.

8. The apparatus of claim 6, wherein said bladder has a length and is open on one side of said elongate bladder, said opening extending at least substantially the length of the elongate bladder.

9. A method of maintaining the environment within the wafer transport container to avoid damage to the substrates, the method comprising steps of:

placing a porous barrier material in the purge tower apparatus covering the orifices.

10. The method of claim 9 wherein, the porous barrier material is in the form of a bladder.

11. The method of claim 9 wherein, the porous barrier material is in the form of a bladder with the back side missing.

12. The method of claim 9 wherein, the porous barrier material is in the form of the purge tower.

13. The method of claim 9 wherein, the porous barrier is a strip of porous material.

14. The method of claim 9 wherein, the porous material comprising one of sintered material, fibrous material, or foamed material.

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15. A method of providing equalized purging flow of a gasous material along the length of a purge tower in a substrate container, the method comprising providing a purge tower with an interior connected to a purge gas source exterior of the container, the purge tower having a plurality of apertures, and providing porous material adjacent the apertures while leaving open a gaseous flow path the length of the tower that is not blocked by porous material.

16. A method of providing equalized purging flow of a gasous fluid along the length of a purge tower in a substrate container, the method comprising providing a purge tower of a tubing portion and formed of a porous polymer, the tubing portion closed at a top end and connected at the bottom end to a purge port; connecting the purge port to a purge gas source exterior of the container, providing a pressurization of the purge tower such that flow velocities and volumes near the top of the tower are equal or substantially equal to such flow velocities and volumes near the bottom of the tower.

17. The method of claim 16 wherein the method further provides adjusting the direction of the purge flow utilizing an elongate sleeve with a lengthwise slot, the sleeve conforming to and fitted to the tubing portion.

18. A substrate container comprising:

a substrate container having a container portion with an opening for loading/unloading substrates, a door adapted to sealably cover the opening; the substrate container having

a substrate carrying region in the transport container and further comprising an inlet tower mounted to container portion in the interior of the for admitting a gaseous working fluid to the interior of the container for purging the wafer container body with the gaseous working fluid;

the inlet tower having a length and one or more outlet regions arranged along the length of the tower, and an interior flow passageway extending the length of the tower, the tower comprising a filter media formed as a tubular structure extending the length of the tower, the tubular structure having an axial fluid flow passageway connecting to a purge

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port at the bottom of the container portion for allowing purge gas to flow up the tubular structure and to exit the tubular structure along the entire length of the tubular structure.

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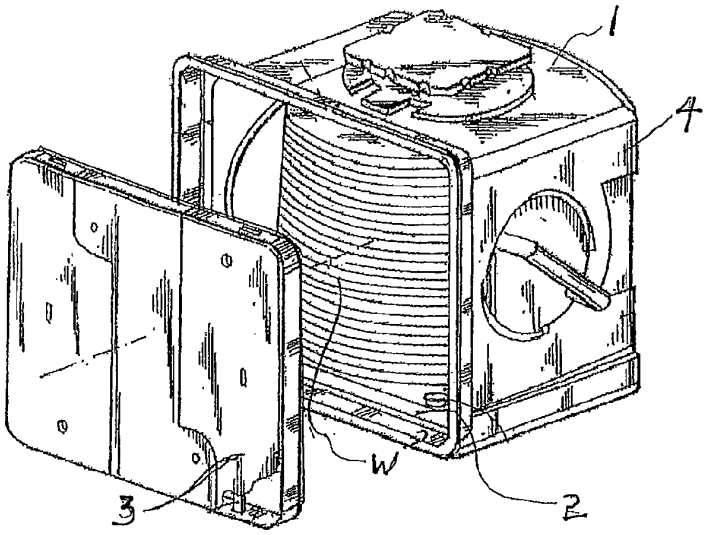


Fig. 1A

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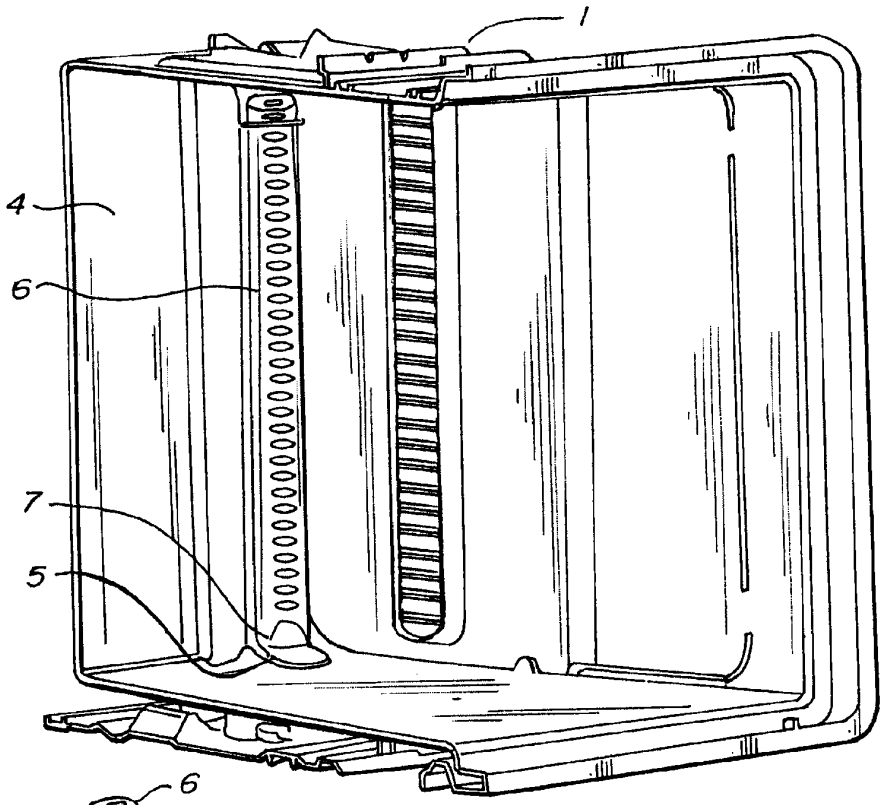


Fig.1B

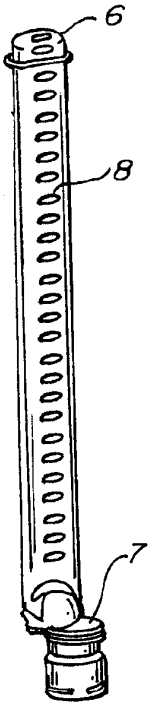


Fig.2

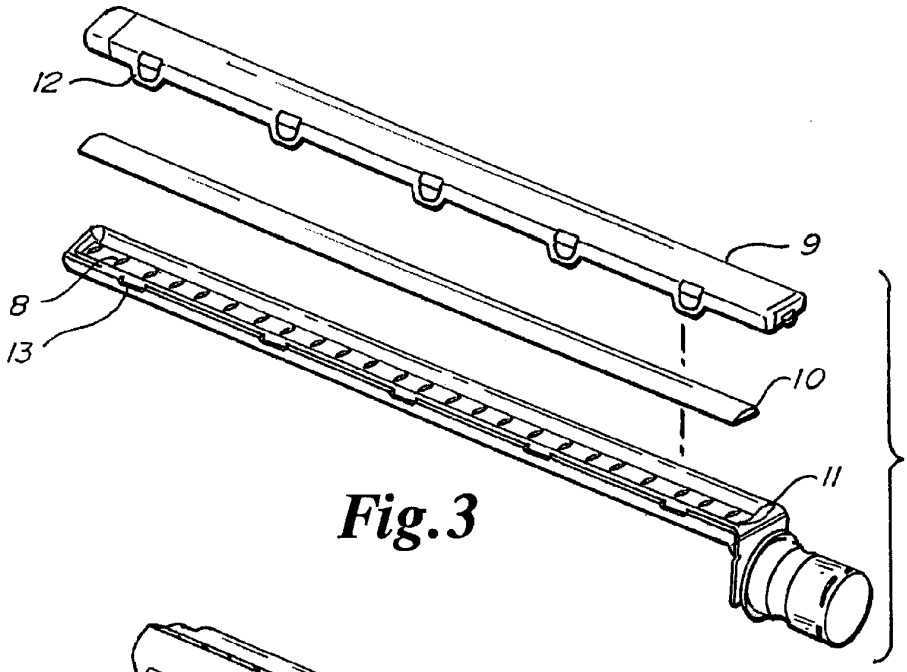


Fig.3

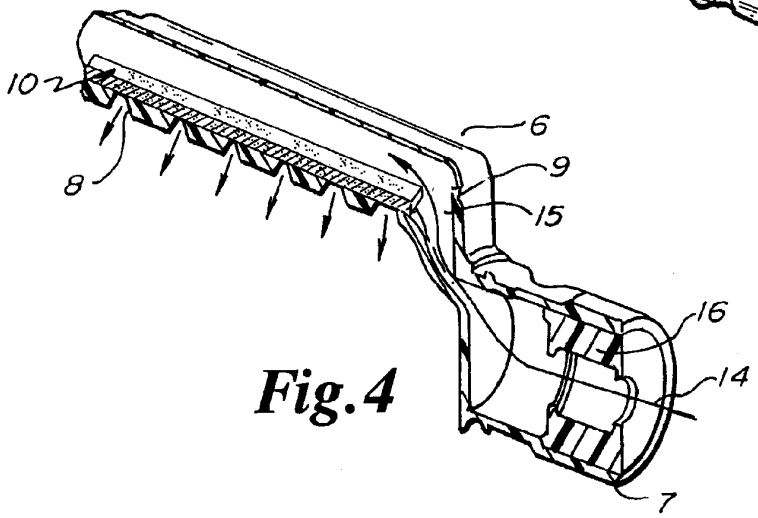


Fig.4

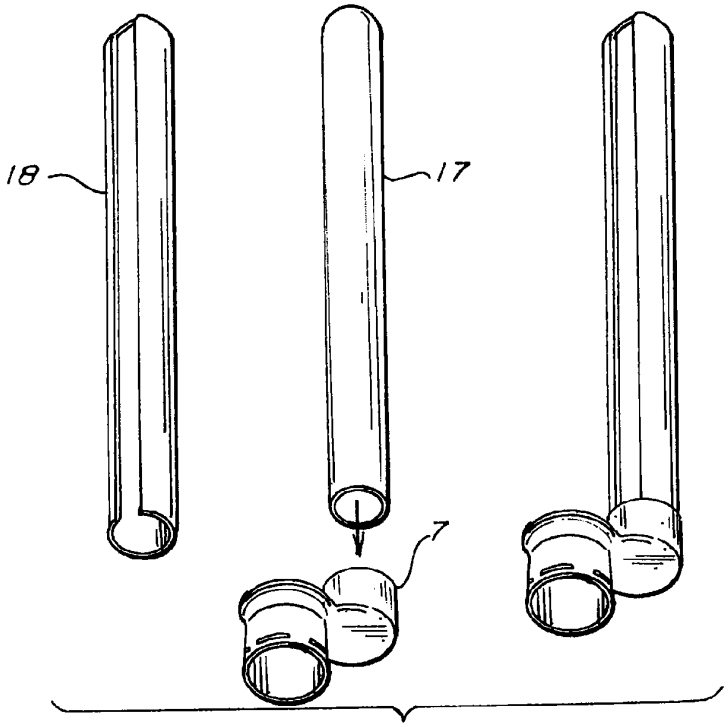


Fig.5

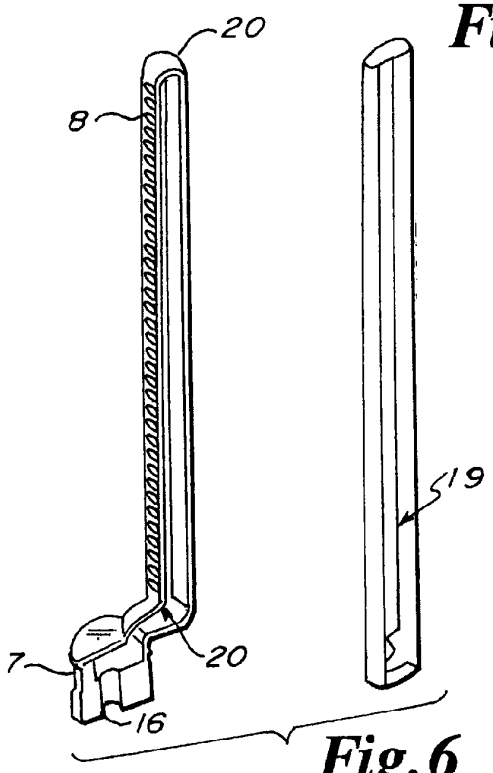


Fig.6

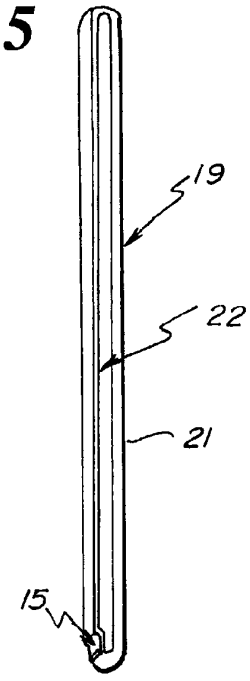


Fig.7

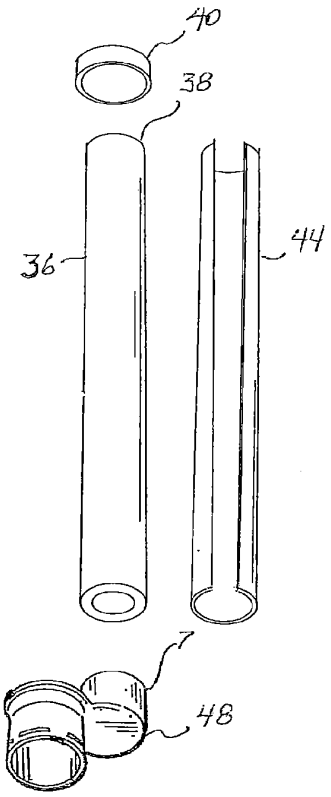


Fig.8

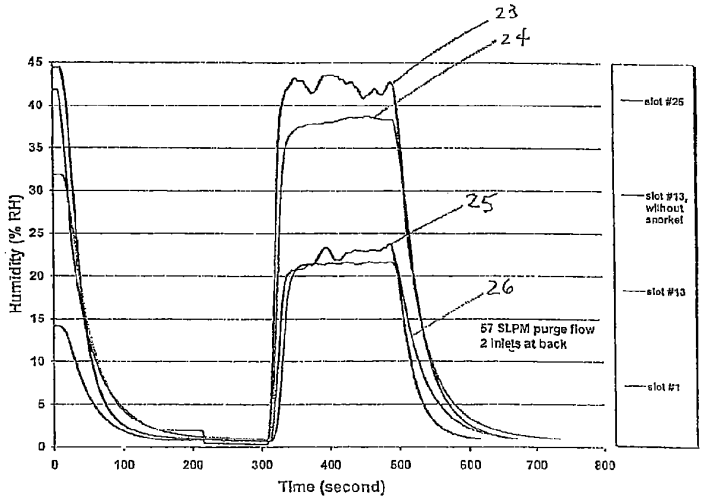


Fig.9

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(71) Applicant: **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billercia, MA 01821 (US).

(72) Inventors: **GLAVAN, Kyle**; 5764 Golden Field Land, Castle Rock, CO 80104 (US). **KING, Jeffery J.**; 5235 Iron Horse Triangle, Colorado Springs, CO 80917 (US). **FULLER, Matthew**; 1731 N. Nevada Avenue, Colorado Springs, CO 80907 (US).

(74) Agents: **STEINBERG, Donald R.** et al.; Wilmer Cutler Pickering Hale and Dorr LLP, 60 State Street, Boston, MA 02109 (US).

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(54) Title: INTERNAL PURGE DIFFUSER WITH OFFSET MANIFOLD

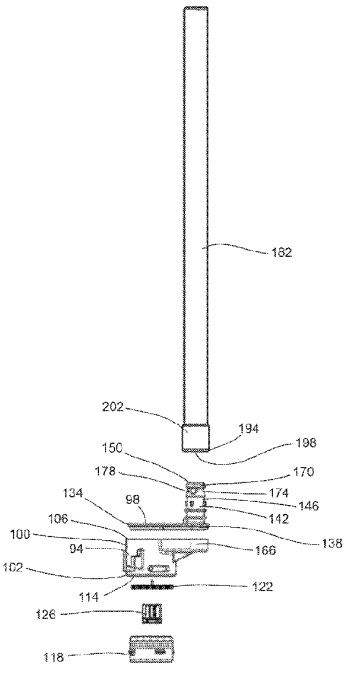


FIG. 4

(57) Abstract: A purge tower assembly for a substrate container. The assembly may include a purge interface body, including a base portion and a top portion, for mounting to a bottom plate of a substrate container. The base portion may include a substantially tubular base sidewall and the top portion may have a top sidewall positioned on the top edge of the base portion. The top portion may include an inlet nozzle for mounting through a rearward inlet in the bottom plate. The inlet nozzle may have a substantially tubular sidewall extending upwardly from the top sidewall and defining an interior of the inlet nozzle. The base portion and the top sidewall may define an offset conduit portion disposed connected to the base portion and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion.

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INTERNAL PURGE DIFFUSER WITH OFFSET MANIFOLD

FIELD OF THE DISCLOSURE

The disclosure is directed generally to purge systems for micro-environments, and more specifically to diffuser towers for substrate containers.

RELATED APPLICATIONS

The present application claims the benefit of the earlier filing date of U.S. Patent Application No. 62/214,464, filed on September 4, 2015 and U.S. Patent Application No. 62/263,194, filed on December 4, 2015, the contents of which are incorporated by reference herein in their entireties.

BACKGROUND

During insertion or removal of substrates from a substrate container, traces of dust, gaseous impurities, or increased humidity can be introduced into the substrate container, adversely affecting product yield of the resident wafers. Accordingly, there is an increased demand for controlling the environment within these containers during substrate handling to achieve or maintain a high level of cleanliness.

A microenvironment within a substrate container is, in some instances, purged using an inert gas that is injected into the interior of the container through an inlet port causing the air within the container to exit through an outlet port. Systems and methods of delivering purge gas into the container have been designed to provide an improved environment within the container.

As front opening unified pods (FOUPs) were developed, bottom purge ports were introduced by carrier manufacturers to enable the purging of the interior environment with clean dry air (CDA) or inert purge. These purge modules were introduced below the internal bottom surface of the FOUP shell.

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When purge diffusers were introduced, it became apparent that if the diffuser was assembled axially to the purge interface it would not only interfere with the wafer handling exclusion volume but also the wafers stored inside of the FOUP. Instead, without making any modifications to the existing shell design, the diffuser tube was designed to be internally offset axially.

U.S. Patent No. 9,054,144 to Burns et al. ("Burns") discloses a substrate container with a purge tower that includes a base portion and a diffuser tower portion connected by an offset conduit. The offset conduit enables the tower portion to be offset toward the back of the container, thereby enabling the interior space to be better utilized for substrate storage and handling and provided a more compact design. The disclosure of Burns is hereby incorporated by reference herein except for express definitions and patent claims contained therein.

SUMMARY

Conventional purge towers that utilize an offset conduit are configured so that the offset conduit is inside the substrate container and projected upward from the floor of the substrate container such that the offset conduit portion is not flush with the floor. While the conduit can be sized so that the lowermost wafer passes over the conduit, it has been found that the protruding conduit can still interfere with the operation of robotic end effectors during insertion or removal of the lowermost wafer. The interference can cause collisions between the end effector and the conduit, thereby generating particles and can also lead to wafer mishandling.

Another issue with conventional offset purge towers is that they must be mounted to the interior of the substrate container. For configurations where the overall length of the offset purge tower is greater than the floor-to-ceiling clearance of the substrate container, problems can arise when trying to upright the purge tower during assembly. The upper

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extremity of the diffuser portion may collide with the ceiling of the substrate container, which may damage one or both of the diffuser portion and the substrate container. In some instances, the desired length of the diffuser portion may need to be compromised.

Various embodiments of the present disclosure are directed to a purge diffuser assembly that frees up additional space within the wafer container for wafer storage and manipulation, while allowing for the flow of purge gas. Accordingly, various embodiments of the disclosure present a lower probability of contaminating the interior surfaces of the substrate container due to collisions between the end effector and the purge tower assembly. Furthermore, in various embodiments of the disclosure, the effective length of the diffuser portion of the purge tower assembly is increased such that purge gas outlets are located closer to the floor of the substrate container than with conventional purge tower assemblies. By locating purge outlets closer to the floor, the flow of purge gas beneath the lowermost wafer of the substrate container can be increased for improved purge performance.

Various embodiments of the disclosure provide an offset conduit that is external to the substrate container instead of being internal to the container, the conduit being routed underneath the floor of the substrate container. The additional space provided by locating the offset conduit external to the substrate container enables robotic end effectors to maneuver beneath a lowermost wafer stored therein without colliding with the offset conduit.

Also, some embodiments are configured so that the diffuser portion of the purge tower may be active at the floor level of the substrate container. That is, the effective length of the diffuser portion begins at a height on the diffuser portion that corresponds with the floor of the substrate container. This enables purge gas to enter the substrate container at floor level, so that purge flow beneath the lowermost substrate is increased relative to conventional purge towers. In one embodiment, the effective portion of the diffuser portion is lowered by as much as 4.5 mm relative to conventional diffusers.

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Some embodiments of the disclosure present an externally offset purge tower assembly that is assembled externally and can be mounted and dismounted from the exterior of the substrate container. Some embodiments of the disclosure include a diffuser portion that is detachable and re-attachable to a purge interface body of the externally offset purge tower assembly, so that the diffuser portion is affixed to the purge interface body after the purge interface body is mounted to the substrate container. Through both of these embodiments, the problem of excessive length of the purge tower assembly is eliminated.

Also contemplated are embodiments that reduce the profile of an internal conduit by providing a recess in the floor of the container through which the conduit is routed. The offset conduit and recess may be sized so that the uppermost extremity of the offset conduit is at or below the interior level of the floor of the substrate container. In such an embodiment, reduced profile of the offset conduit, though internal, provides the same effect as an external offset conduit with respect to end effector clearance and enhances purging of the lowermost substrate.

Various embodiments of the disclosure are directed to a purge tower assembly for a substrate container that includes a purge interface body for connection to a bottom plate of a substrate container. The purge interface body may include a base portion and a top portion. The base portion may have a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge. The bottom edge may define a first aperture, concentric about a first axis, for access to an interior of the base portion.

In one or more embodiments the top portion is connected to the top edge of the base portion. The top portion may have a top sidewall positioned on the top edge of the base portion for upwardly covering the bottom aperture. The top portion may include an inlet nozzle for mounting through an inlet in the bottom plate of the substrate container. The inlet nozzle may have a substantially tubular nozzle sidewall extending upwardly from the top

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sidewall to a nozzle edge. The nozzle edge may define a second aperture, concentric about a second axis, for access to an interior of the inlet nozzle. In certain embodiments, the second axis is substantially parallel to and positioned rearward of the first axis. In one or more embodiments, the purge interface body includes an offset conduit portion disposed between the base portion and the inlet nozzle. The base portion and the inlet nozzle may be in fluid communication via the offset conduit portion.

The purge tower assembly includes a diffuser portion. In one or more embodiments, the diffuser portion is a diffuser portion including a porous diffuser sidewall and defining a diffuser passageway that extends into the diffuser portion along a diffuser axis. The diffuser sidewall may define an opening at a bottom portion of the diffuser portion that may be operatively coupled to the inlet nozzle for fluid communication between the base portion, the inlet nozzle, and the diffuser portion. Additionally or alternatively, the diffuser portion may comprise an exterior shell with a plurality of through apertures formed therein.

The above summary is not intended to describe each illustrated embodiment or every implementation of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings included in the present application are incorporated into, and form part of, the specification. They illustrate embodiments of the present disclosure and, along with the description, serve to explain the principles of the disclosure. The drawings are only illustrative of certain embodiments and do not limit the disclosure.

FIG. 1 is a perspective view of a substrate container, according to an embodiment of the disclosure.

FIG. 2 is a front elevational view of a purge tower assembly, according to an embodiment of the disclosure.

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FIG. 3 is a cross-sectional view of the purge tower assembly of FIG. 2, according to an embodiment of the disclosure.

FIG. 4 is an exploded view of the purge tower assembly of FIG. 4, according to an embodiment of the disclosure.

FIG. 5 is an enlarged, partial perspective view of a purge tower assembly, according to an embodiment of the disclosure.

FIG. 6 is a front elevational view of purge tower assemblies mounted in a substrate container, according to an embodiment of the disclosure.

FIG. 7 is a cross-sectional view of the purge tower assembly and substrate container taken at line 7-7 of FIG. 6.

FIG. 8 is a cross-sectional view of a substrate container and an exploded view of a purge tower assembly, according to an embodiment of the disclosure.

FIG. 9 is a partial bottom perspective view of a substrate container including openings for a purge tower assembly, according to an embodiment of the disclosure.

FIG. 10 is a partial bottom perspective view of a substrate container including a conveyor plate, according to an embodiment of the disclosure.

FIG. 11 is a partial bottom perspective view of a substrate container including a conveyor plate mounted to a bottom plate, according to an embodiment of the disclosure.

FIG. 12 is a partial cross section view of a substrate container including a conveyor plate mounted to a bottom plate, according to an embodiment of the disclosure.

FIG. 13 is a partial bottom perspective view of a substrate container including an externally mounted purge assembly, according to an embodiment of the disclosure.

FIG. 14 is a partial perspective view of an interior of a substrate container including an externally mounted purge tower assembly, according to an embodiment of the disclosure.

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FIG. 15 is a partial perspective view of an interior of a substrate container including an externally mounted purge tower assembly, according to an embodiment of the disclosure.

FIG. 16 is a cross-sectional view of a substrate container including a recess with an internally mounted purge tower assembly, according to an embodiment of the disclosure.

FIG. 17 is a close up cross-sectional view of the purge tower assembly and substrate container taken at line 7-7 of FIG. 6

While embodiments of the disclosure are amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the disclosure to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

DETAILED DESCRIPTION

Referring to FIG. 1, a substrate container 30 for storing a plurality of substrates is depicted, according to an embodiment of the disclosure. As used herein, the plurality of substrates include substrates used in the manufacture of semiconductors, printed circuit boards, flat panel displays, and/or the like. For purposes of illustration, a single substrate 32a is presented. In certain embodiments, the substrate container 30 includes two opposing side portions 34, a top portion 36, a bottom plate 38 and a back portion 42. The bottom plate 38 defines an interior surface or floor 40 for the substrate container 30. A front portion 44 of the substrate container 30 includes a door frame 46 that defines a door opening 48 for insertion and removal of substrates 32. A door 52 is adapted to seal and cover the door opening 48. The door opening 48 of the substrate container 30 lies in a plane that is substantially parallel to a vertical direction 54. In various embodiments, the substrate container 30 is characterized as containing a microenvironment 64.

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In one or more embodiments, a pair of slotted sidewalls 66 are disposed within the substrate container 30, each being proximate a respective one of the side portions 34. The slotted sidewalls 66 are aligned so that the slots face each other to define a plurality of slot positions 68, and are spaced apart so that the substrate(s) 32 are supported therebetween. For purposes of this disclosure, a lowermost slot position 68a (i.e., the slot closest to the bottom plate 38) of the plurality of slot positions 68 is identified as the "first" slot, with the slot numbers increasing in the upward direction. For purposes of illustration, such as in FIGS. 6-8 and 15-16, described below, a substrate 32b is presented, and is depicted as occupying the lowermost slot 68a.

In various embodiments, the substrate container 30 further includes at least one purge tower assembly 70 disposed within the substrate container 30. In various embodiments, the purge tower assembly 70 may be operatively coupled to a gas source (not depicted) external to the substrate container 30 for introduction of a gaseous working fluid into the substrate container 30. In certain embodiments, one or more of the purge tower assemblies 70 are oriented to direct the gaseous working fluid toward the door opening 48 in order to purge the substrate container 30.

In certain embodiments, the substrate container 30 further includes a conveyor plate 71 positioned below the bottom plate 38. In various embodiments, the conveyor plate 71 is mounted to the bottom of the substrate container 30 for machine based positioning and alignment of the substrate container 30 during various substrate processing steps.

Referring to FIGS. 2-5, a purge tower assembly 70 is depicted, according to an embodiment of the disclosure. In the depicted embodiment, the purge tower assembly 70 includes a purge interface body 90 including a base portion 94 and a top portion 98. In one or more embodiments, the purge interface body 90 is appropriately sized and shaped for mounting externally on a substrate container 30. For example, the purge interface body may

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be mounted to a conveyor plate 71 of a substrate container 30. In some embodiments, the purge interface body may be mounted to the bottom plate 38. In some embodiments, the purge interface body 90 may be mounted between the bottom plate 38 and a conveyor plate 71.

In various embodiments, for example in FIG. 3, the base portion 94 has tubular shape defined by a sidewall 100 that extends from a bottom edge 102 to a top edge 106. The tubular shape of the sidewall 100 defines an interior portion 110 and, at the bottom edge 102, defines a bottom aperture 114 for access into the interior portion 110. In various embodiments, the base portion 94 includes components for coupling to an outside fluid source. For example, in some embodiments, the base portion includes a grommet 118, filter 122, and a valve 126 mounted in the bottom aperture 114 and in the interior portion 110 (FIG. 4). In certain embodiments, the bottom aperture 114 is concentric with an axis 130.

In one or more embodiments, for example in FIG. 5, the sidewall 100 defines a plurality of apertures 119 in the base portion 94. In certain embodiments, each of the apertures 119 are spaced circumferentially about the sidewall 100 and about the axis 130. In various embodiments, the apertures 119 are receptacles for lugs protruding from the side of the grommet 118 for fitting and placement of the grommet 118 within the interior 110 of the base portion 94. For example, in some embodiments, the grommet 118 is a flexible component and lugs may elastically compressing during insertion into the interior 110 of the base portion and then expand outwardly into apertures 119 to lock the grommet in place.

In some embodiments, the base portion 94 includes support portions 120. The support portions 120 may be outwardly extending portions of material integral with the sidewall 100. In certain embodiments, the support portions 120 function as handles or grips for manipulation of the purge interface body 90. In some embodiments, the support portions 120

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are flexible beams that snap fit into undercut features in the conveyor plate for installation of the body 90 to a substrate container, described further herein.

In one or more embodiments, the top portion 98 includes a top sidewall 134 that is substantially planar and connected to the base portion 94 along the top edge 106. In some embodiments, the top sidewall 134 is connected to the top of the base portion 94. The base portion 94 and the top portion 98 may be connected by techniques available to the artisan, for example, ultrasonic or heat welding, snap fits, adhesive bonding, or by other suitable techniques.

Additionally, for example in FIG. 3, the top sidewall 134 may include an offset portion 138 extending to one side from the base portion 94. The offset portion 138 may include an inlet nozzle 142 offset from the base portion 94. In one or more embodiments, the inlet nozzle 142 has a tubular shape defined by a nozzle sidewall 146 extending upwardly from the top sidewall 134 to a nozzle edge 150. In one or more embodiments, the nozzle sidewall 146 defines an interior portion 154 and a nozzle aperture 158 at the nozzle edge 150. In various embodiments, the nozzle aperture 158 provides access to the interior portion 154 of the inlet nozzle 142. In certain embodiments, the nozzle aperture 158 is concentric about a second axis 162. In various embodiments, the second axis 162 is substantially parallel to the first axis 130.

In one or more embodiments, an offset conduit portion 166 is disposed between the base portion 94 and the inlet nozzle 142 (FIGS. 2 and 5). In one or more embodiments, the offset conduit portion 166 cooperates with the offset portion 138 of the top sidewall 134 to provide a passage between the base portion 94 and the inlet nozzle 142 for fluid communication between the components of the purge interface body 90.

In operation, fluid enters the purge tower assembly 70 through the check valve 126 and the bottom aperture 114, passing through the interior portions 110, 154 and through the

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nozzle aperture 158. Functionally, the offset conduit 166 diverts flow from the first axis 130 to the second axis 162.

In some embodiments, as shown in FIG. 5, the inlet nozzle 142 is a barbed nozzle including a barbed portion 170 and a tapered portion 174 of the nozzle sidewall 146. In certain embodiments, the barbed portion 170 defines an outer diameter of the inlet nozzle 142 and the tapered portion 174 defines a reduced outer diameter adjacent the barbed portion 170. In certain embodiments, the nozzle sidewall 146 defines a lateral aperture 178 between the barbed portion 170 and the tapered portion 174. Described further, the lateral aperture 178 is a hole or aperture in the nozzle sidewall 146 for low diffusion of gas into the substrate container 30.

In one or more embodiments, the purge tower assembly 70 includes a diffuser portion 182 coupled to the inlet nozzle 142 of the purge interface body 90. In some embodiments, the diffuser portion 182 includes a porous or perforated (apertured) sidewall 186. In some embodiments, the sidewall 186 defines a substantially tubular shape with a diffuser passageway that extends from a top face 190 of the diffuser portion 182 to a bottom edge 194. In one or more embodiments, the bottom edge 194 of the diffuser portion 182 defines an aperture 198 at a bottom portion 202 of the diffuser portion 182. In various embodiments, the aperture 198 may be sized for insertion of the inlet nozzle 142 for operative coupling between the two for fluid communication between the base portion 94, the inlet nozzle 142, and the diffuser portion 182.

In certain embodiments, the nozzle sidewall 186 includes external threads formed on an external surface of the nozzle sidewall 146 (not depicted). The diffuser portion 182 may include internal threads formed on an internal surface of the diffuser portion (not depicted). The threads of the diffuser portion 182 and the nozzle sidewall 186, when implemented, are compatible for coupling therebetween.

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In various embodiments, the diffuser portion 182 includes a widened portion 206 at the bottom portion of the diffuser portion 182. In certain embodiments, the widened portion 206 is widened outwardly, having an increased inner diameter relative to the main body of the diffuser portion for insertion and coupling with the inlet nozzle 146.

Referring to FIGS. 6-8, the purge tower assembly 70 is depicted in assembly in the substrate container 30 according to an embodiment of the disclosure. In the depicted embodiment, the substrate container 30 and the purge tower assembly 70 are the same or substantially similar as described herein. Accordingly, like elements are identified with like-numbered reference numerals.

In assembly, for example in FIG. 8, the purge interface body 90 may be assembled to the substrate container 30 by inserting the purge interface body 90 upwardly in direction 210, placing inlet nozzle 142 through a rearward inlet 214 in the bottom plate 38 and attaching the purge interface body 90 to an exterior surface of the bottom plate 38 in a rearward mounting region 218. In various embodiments, the rearward mounting region 218 is between the conveyor plate 71 and the bottom plate 38. The purge interface body 90 can be designed to assemble to the substrate container 30 to various vertical heights 222 relative to a purge fixture of a load port. In various embodiments, the vertical height 222 substantially matches the vertical height of existing substrate container(s). In one or more embodiments, the inlet nozzle 142 is sized such that, when mounted to the conveyor plate 71 of the substrate container 30, the nozzle edge 150 of the inlet nozzle 142 extends upwardly to about the first slot 68a of the substrate container 30.

Once the purge interface body 90 is inserted through the inlet 214, the diffuser portion 182 may be assembled thereto by accessing the inlet nozzle 142 at the rear of the substrate container 30 via the door opening 48. The diffuser portion 182 is then affixed to the inlet nozzle 142.

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Referring to FIGS. 9-14, various stages of assembly of the purge tower assembly 70 within substrate container 30 are depicted according to an embodiment of the disclosure. The substrate container 30 and the purge tower assembly 70 may be the same or substantially similar as described herein. Accordingly, like elements are identified with like-numbered reference numerals. In reference to FIG. 9, a bottom perspective view of a substrate container 30 and bottom plate 38 are depicted. In one or more embodiments, the bottom plate 38 includes a rearward inlet 214 for insertion of an inlet nozzle 142 of a purge tower assembly 70 (FIG. 8). Additionally, in some embodiments, the bottom plate 38 includes a mounting inlet 250. In various embodiments, the mounting inlet 250 is an aperture in the bottom plate 38 for receiving mounting means for mounting the conveyor plate 71 to the bottom plate 38 of the substrate container 30.

For example, in FIG. 10 a conveyor plate 71 is placed against the bottom plate 38 of the substrate container 30. The conveyor plate 71 may including mounting inlet 251 which is aligned with mounting inlet 250. A mounting mechanism 254, as depicted in FIG. 11, is received in the mounting inlet 250 and secures the conveyor plate 71 to the bottom plate 38. In one or more embodiments, the mounting mechanism 254 is a portion of material positioned in the bottom plate 38 for securing the conveyor plate 71 to the bottom of the substrate container 30. Depicted in FIGS. 11 and 12, the mounting mechanism 254 is a partial ring having a downwardly extending sidewall 258 and including a plurality of generally L-shaped slots 262 arranged circumferentially in the sidewall 258. In one or more embodiments, the L-shaped slots 262 are ramped having a vertical portion 263 and a horizontal or detent portion 264.

In various embodiments, the conveyor plate 71 may include a plurality of outwardly extending members or cams 265 in mounting inlet 251. Each of the cams 265 may correspond with the L-shaped slots 262 such that the conveyor plate 71 may be secured to the

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bottom plate 38 by downward insertion of the mounting mechanism 254 into the mounting inlets 250 and 251, receiving cams 265 into the vertical portions 263, and twisting the mounting mechanism 254 to guide the cams 254 upwardly and into the detent portion 264, securing the conveyor plate 71 to the bottom plate 38.

In various embodiments, the sidewall 254 includes a rearward opening 266 corresponding to the offset conduit portion 166. As such, when secured to the bottom plate 38, the offset conduit portion 166 extends rearwardly from the mounting mechanism 254 to reach the inlet nozzle 214.

In certain embodiments, various types of mounting mechanisms 254 may be used to secure the conveyor plate 71 to the bottom plate 38. For example, the mounting mechanism may use ultrasonic or heat welding, snap fits, adhesive bonding, or other suitable techniques. In some embodiments, the mounting mechanism 254 is integral with the bottom plate 38, such that the bottom plate 38 and the mounting mechanism are one continuous piece.

Depicted in FIGS. 12-13, one or more embodiments, the conveyor plate 71 includes locking features for the purge interface body 90, including one or more lateral openings 267 in the mounting inlet 251 which expose access to a support shelf 268. In various embodiments, the support shelves 268 are defined by undercut portions 269 in the conveyor plate 71. In various embodiments, the purge interface body 90 is secured to substrate container 30 by upwardly inserting the purge interface body 94 into the mounting inlet 251 and the inlet nozzle 142 (FIG. 2-4) into the rearward inlet 214. As the purge interface body 94 is upwardly inserted, the support portions 120 may engage with the sloped or barbed undercut portion 269 and flex until the purge interface body 94 has been fully inserted into the mounting inlet 251. Once inserted, the support portions 120 may "snap" onto the support shelves 268 to lock the purge interface body in place.

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In FIG. 14, the interior of the substrate container 30 is depicted. In the interior, the rearward inlet 214 and mounting mechanism 254 are depicted in the floor 40 of the substrate container 30. The purge interface body 90 is mounted to the substrate container 30 and the inlet nozzle 142 is depicted inserted through the rearward inlet 214 and extended into the interior of the container 30. In FIG. 15, a diffuser tower 182 is depicted, fitted onto the inlet nozzle 142.

Referring to FIGS. 16 and 17, cross-sectional views of a portion of a substrate container 30 and purge tower assembly 70 are depicted according to embodiments of the disclosure. In FIG. 15, the purge interface body 90 is mounted externally on the bottom plate 38, as described above. The mounting mechanism 254 is positioned in the floor 40 and secures the purge interface body 90 to the container 30. The inlet nozzle 142 enters into the interior of the container 30 through the rearward inlet 214. A diffuser portion 182 for diffusion of purge gas entering the substrate container 30 through the purge interface body 90 is fitted onto the inlet nozzle 142 such that a portion of the inlet nozzle 142 extends into the interior of the diffuser portion 182. Substrate 32b, positioned in the lowermost slot 68a, extends rearwardly in the container 30 towards the purge tower assembly 70. Because the purge interface body 90 is mounted externally, a clearance 290 is maintained between the lowermost substrate 32b and the floor 40 and the mounting mechanism 254 of the container.

In some embodiments, such as depicted in FIG. 16, the substrate container 30 defines a rearward recess 300 in the floor 40. In such embodiments, the purge interface body 90 is mounted internally within in the container 30. For example, the purge interface body 90 may be positioned in the recess 300 with the base portion 94 extending through an aperture 304 for connection to an external fluid source. The recess 300 may be sized so that the uppermost extremity of the purge interface body 90 is at or below the level of the floor 40 of the substrate container 30.

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Functionally, the recess 300 of the FIG. 16 embodiment reduces the profile of the offset conduit 166. Because of the reduced profile, the offset conduit 166, though internal to the container 30, provides the same clearance 290 as the external offset conduit arrangement of FIG. 15, and the same operational benefits with respect to end effector manipulation and gas purging.

Also depicted in FIG. 15 and 16, in one or more embodiments, the inlet nozzle 142 includes a lateral aperture 178, as described above. In various embodiments, the inlet nozzle 142 and the lateral aperture 178 are configured so that the diffuser portion 182 of the purge tower assembly 70 may be active at or near the floor 40 of the substrate container. For example, in some embodiments, the lateral aperture 178 is positioned at a height on the on the inlet nozzle 142 that corresponds with the floor 40 of the substrate container 30.

In operation, for both the embodiments of FIGS. 15 and 16, the clearance 290 provides maneuvering space beneath the substrate 32b for robotic end effectors (not depicted), with little or no interference from the components of the purge interface body 90. Also, having the base of the diffuser portion 182 at floor level, in combination with the clearance 290 provided by the external or the reduced profile offset conduit 166, enables purge gas to enter the substrate container 30 at floor level so that purge flow 308 is directed beneath the lowermost substrate 32b.

Each of the additional figures and methods disclosed herein can be used separately, or in conjunction with other features and methods, to provide improved devices and methods for making and using the same. Therefore, combinations of features and methods disclosed herein may not be necessary to practice the disclosure in its broadest sense and are instead disclosed merely to particularly describe representative and preferred embodiments.

Various modifications to the embodiments may be apparent to one of skill in the art upon reading this disclosure. For example, persons of ordinary skill in the relevant art will

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recognize that the various features described for the different embodiments can be suitably combined, un-combined, and re-combined with other features, alone, or in different combinations. Likewise, the various features described above should all be regarded as example embodiments, rather than limitations to the scope or spirit of the disclosure.

Persons of ordinary skill in the relevant arts will recognize that various embodiments can comprise fewer features than illustrated in any individual embodiment described above. The embodiments described herein are not meant to be an exhaustive presentation of the ways in which the various features may be combined. Accordingly, the embodiments are not mutually exclusive combinations of features; rather, the claims can comprise a combination of different individual features selected from different individual embodiments, as understood by persons of ordinary skill in the art.

Any incorporation by reference of documents above is limited such that no subject matter is incorporated that is contrary to the explicit disclosure herein. Any incorporation by reference of documents above is further limited such that no claims included in the documents are incorporated by reference herein. Any incorporation by reference of documents above is yet further limited such that any definitions provided in the documents are not incorporated by reference herein unless expressly included herein.

References to "embodiment(s)", "disclosure", "present disclosure", "embodiment(s) of the disclosure", "disclosed embodiment(s)", and the like contained herein refer to the specification (text, including the claims, and figures) of this patent application that are not admitted prior art.

For purposes of interpreting the claims, it is expressly intended that the provisions of 35 U.S.C. 112(f) are not to be invoked unless the specific terms "means for" or "step for" are recited in the respective claim.

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CLAIMS

What is claimed is:

1. A purge tower assembly for a substrate container, the purge tower assembly comprising:

a purge interface body for mounting to a bottom plate of a substrate container, the purge interface body including:

a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture for access to an interior of the base portion, the first aperture being concentric about a first axis; and

a top portion connected to the base portion, the top portion including a top sidewall positioned on the top edge of the base portion, the top portion including an inlet nozzle configured for mounting through an inlet in the bottom plate of the substrate container, the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the top sidewall to a nozzle edge, the nozzle edge defining a second aperture for access to an interior of the inlet nozzle, the second aperture concentric about a second axis substantially parallel to and positioned rearward of the first axis, wherein the top sidewall cooperates with the base portion to define an offset conduit portion disposed between the first aperture and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion.

2. The purge tower assembly of claim 1, further comprising:

a diffuser portion defining a diffuser passageway that extends into the diffuser portion along a diffuser axis, the diffuser passageway defining an opening at a bottom portion of the

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diffuser portion operatively coupled to the inlet nozzle for fluid communication between the base portion, the inlet nozzle, and the diffuser portion.

3. The purge tower assembly of claim 2, wherein the nozzle sidewall includes external threads formed on an external surface of the nozzle sidewall.

4. The purge tower assembly of claim 3, wherein the diffuser portion includes internal threads formed on an internal surface of the diffuser portion, the internal threads compatible with the external threads of the inlet nozzle for operative coupling between the diffuser portion and the inlet nozzle.

5. The purge tower assembly of claim 2, wherein the diffuser portion includes a widened portion at the bottom portion.

6. The purge tower assembly of claim 2, wherein the diffuser portion includes a porous diffuser sidewall.

7. The purge tower assembly of claim 1, wherein the base portion includes a grommet and a valve mounted in the first aperture for fluid communication with an external fluid source.

8. The purge tower assembly of claim 1, wherein the inlet nozzle is a barbed nozzle including a barbed portion and a tapered portion, the barbed portion defining an outer diameter of the barbed nozzle, the tapered portion defining a reduced outer diameter adjacent the barbed portion.

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9. The purge tower assembly of claim 8, wherein the nozzle sidewall defines a lateral aperture between the barbed portion and the tapered portion.

10. The purge tower assembly of claim 1, wherein the inlet nozzle is sized such that, when mounted to the bottom plate of the substrate container, the inlet nozzle extends upwardly to about a position of a first wafer contained within the substrate container.

11. The purge tower assembly of claim 1, wherein the top sidewall is substantially planar.

12. A substrate container for containing substrates, the substrate container comprising:

a container portion including two opposing sidewalls, a back sidewall, a top sidewall, and a bottom plate, the container portion defining an opening in a front portion of the substrate container for insertion and removal of substrates, the container portion mounted on a conveyor plate;

a door configured for covering and sealing the opening defined by the container portion; and

a purge interface body connected to the bottom plate, the purge interface body including:

a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture for access to an interior of the base portion, the first aperture concentric about a first axis;

a top portion connected to the base portion, the top portion having a substantially planar top sidewall positioned on the top edge of the base portion for upwardly covering the bottom aperture, the top portion including an inlet nozzle for

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mounting through an inlet in the bottom plate of the substrate container, the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the top sidewall to a nozzle edge, the nozzle edge defining a second aperture for access to an interior of the inlet nozzle, the second aperture concentric about a second axis substantially parallel to and positioned rearward of the first axis; and

an offset conduit portion disposed between the base portion and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion.

13. The substrate container of claim 12, further comprising a diffuser portion having a diffuser passageway that extends into the diffuser portion along a diffuser axis, the diffuser passageway defining an opening at a bottom portion of the diffuser portion operatively coupled to the inlet nozzle for fluid communication between the base portion, the inlet nozzle, and the diffuser portion.

14. The substrate container of claim 13, wherein the nozzle sidewall includes external threads formed on an external surface of the nozzle sidewall.

15. The substrate container of claim 14, wherein the diffuser portion includes internal threads formed on an internal surface of the diffuser portion, the internal threads compatible with the external threads of the inlet nozzle for operative coupling between the inlet nozzle and the diffuser portion.

16. The substrate container of claim 13, wherein the diffuser portion includes a widened portion at the bottom portion of the diffuser portion.

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17. The substrate container of claim 12, wherein the base portion includes a grommet and a valve mounted in the first aperture for fluid communication with an external fluid source

18. The substrate container of claim 12, wherein the inlet nozzle is a barbed nozzle including a barbed portion and a tapered portion of the tubular nozzle sidewall, the barbed portion defining an outer diameter of the barbed nozzle, the tapered portion defining a reduced outer diameter adjacent the barbed portion.

19. The substrate container of claim 18, wherein the nozzle sidewall defines a lateral aperture between the barbed portion and the tapered portion.

20. The substrate container of claim 12, wherein the inlet nozzle is sized such that, when connected to the bottom plate and the conveyor plate of the substrate container, the inlet nozzle extends upwardly to about a position of a first wafer contained within the substrate container.

21. A method of assembling a purge tower assembly to a substrate container, the method comprising:

upwardly inserting an inlet nozzle of a purge interface body into a rearward inlet in a bottom plate of a substrate container, the purge interface body including a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture concentric about a first axis, the purge interface body including a top positioned on the top edge of the base portion and including the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the

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top sidewall to a nozzle edge, the nozzle edge defining a second aperture concentric about a second axis that is substantially parallel to and positioned rearward of the first axis, the top sidewall and the base portion defining an offset conduit portion between the first aperture and the inlet nozzle for fluid communication; and

securing the purge interface body to the bottom plate of the substrate container when the inlet nozzle is inserted into the rearward inlet.

22. A substrate container, the substrate container comprising:

a container portion including two opposing sidewalls, a back sidewall, a top sidewall, and a bottom plate, the container portion defining an interior for insertion and removal of substrates, the interior having a floor including a rearward recess in the floor; and

a door configured for covering and sealing the opening defined by the container portion; and

a purge interface body mounted in the recess, the purge interface body including:

a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture for access to an interior of the base portion, the first aperture concentric about a first axis;

a top portion connected to the base portion, the top portion having a substantially planar top sidewall positioned on the top edge of the base portion for upwardly covering the bottom aperture, the top portion including an inlet nozzle for mounting through an inlet in the bottom plate of the substrate container, the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the top sidewall to a nozzle edge, the nozzle edge defining a second aperture for access to an interior of the inlet nozzle, the second aperture concentric about a second axis substantially parallel to and positioned rearward of the first axis; and

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an offset conduit portion disposed between the base portion and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion;

wherein the top sidewall is substantially flush with the floor.

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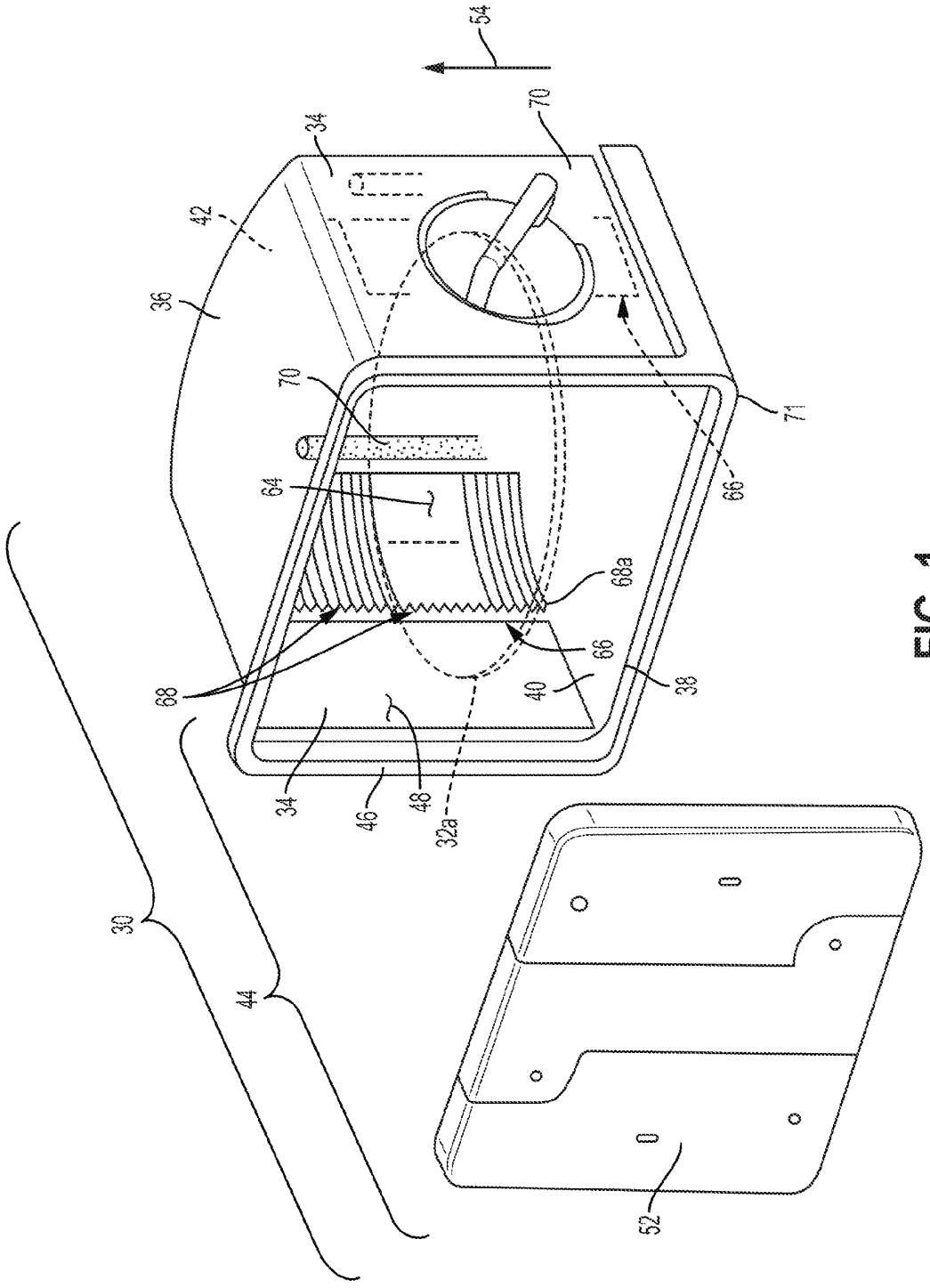


FIG. 1

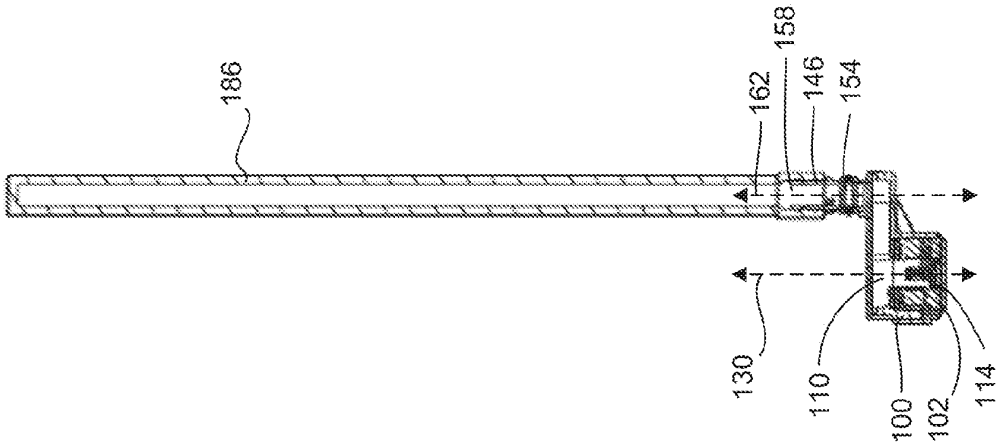

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FIG. 3

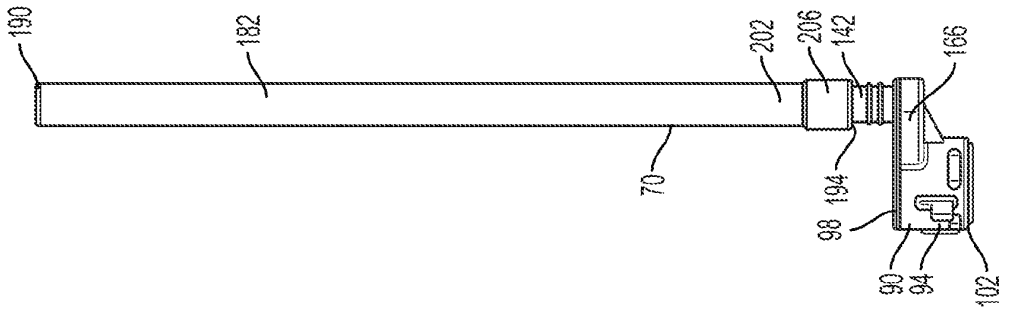

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FIG. 2

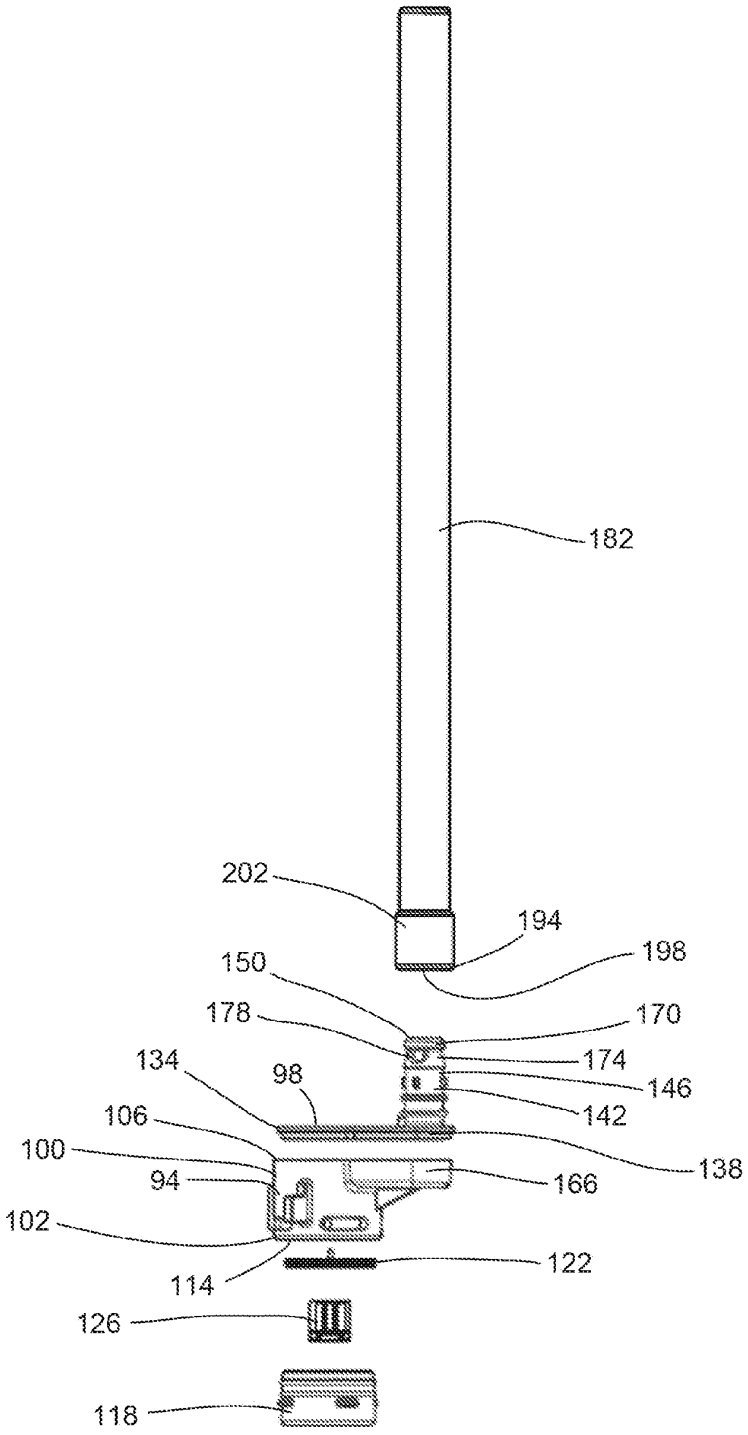

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FIG. 4

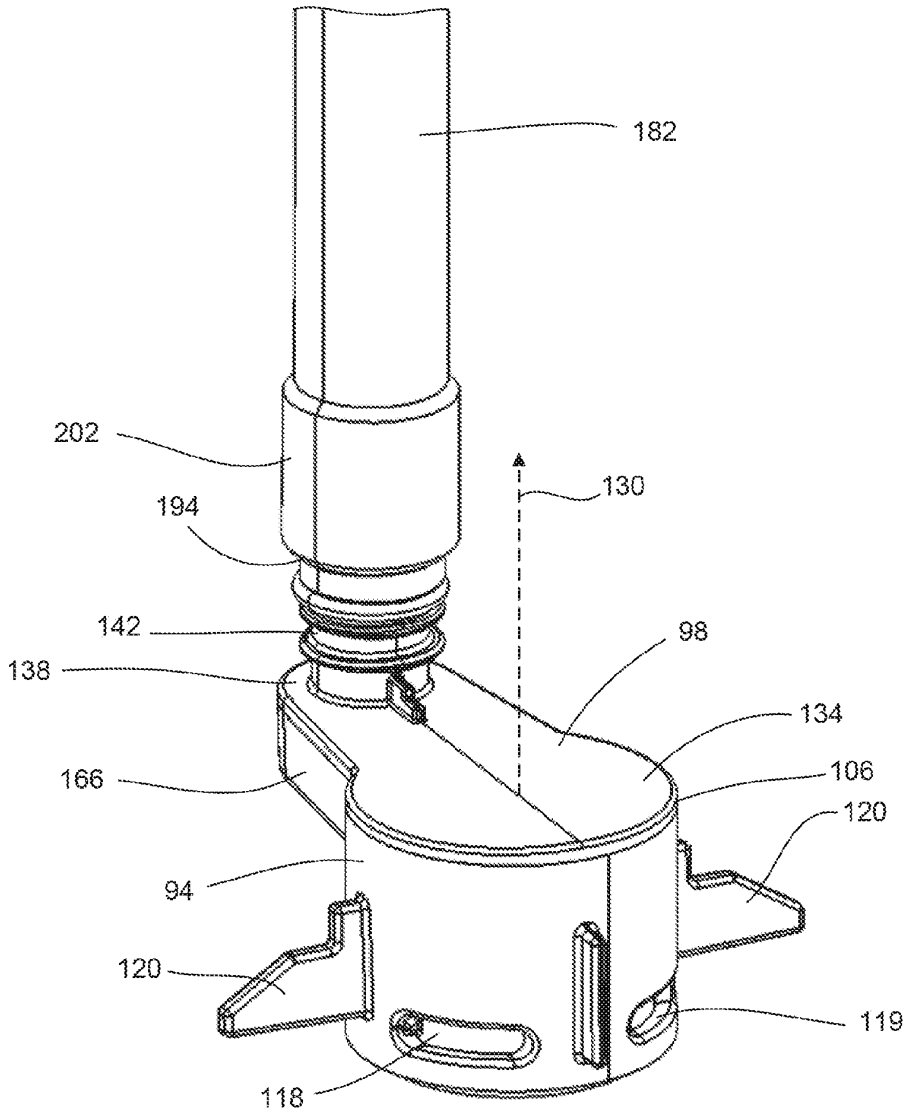


FIG. 5

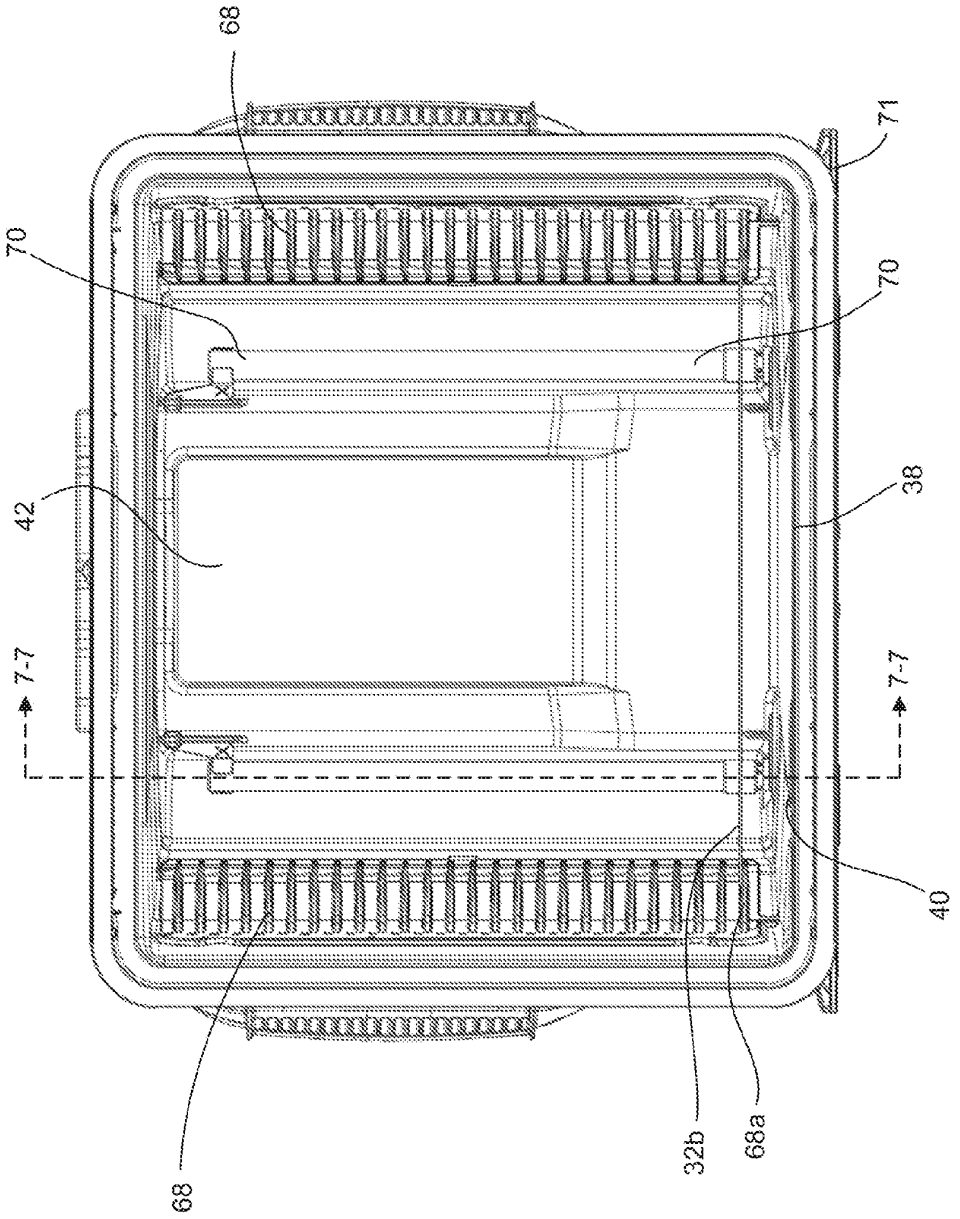


FIG. 6

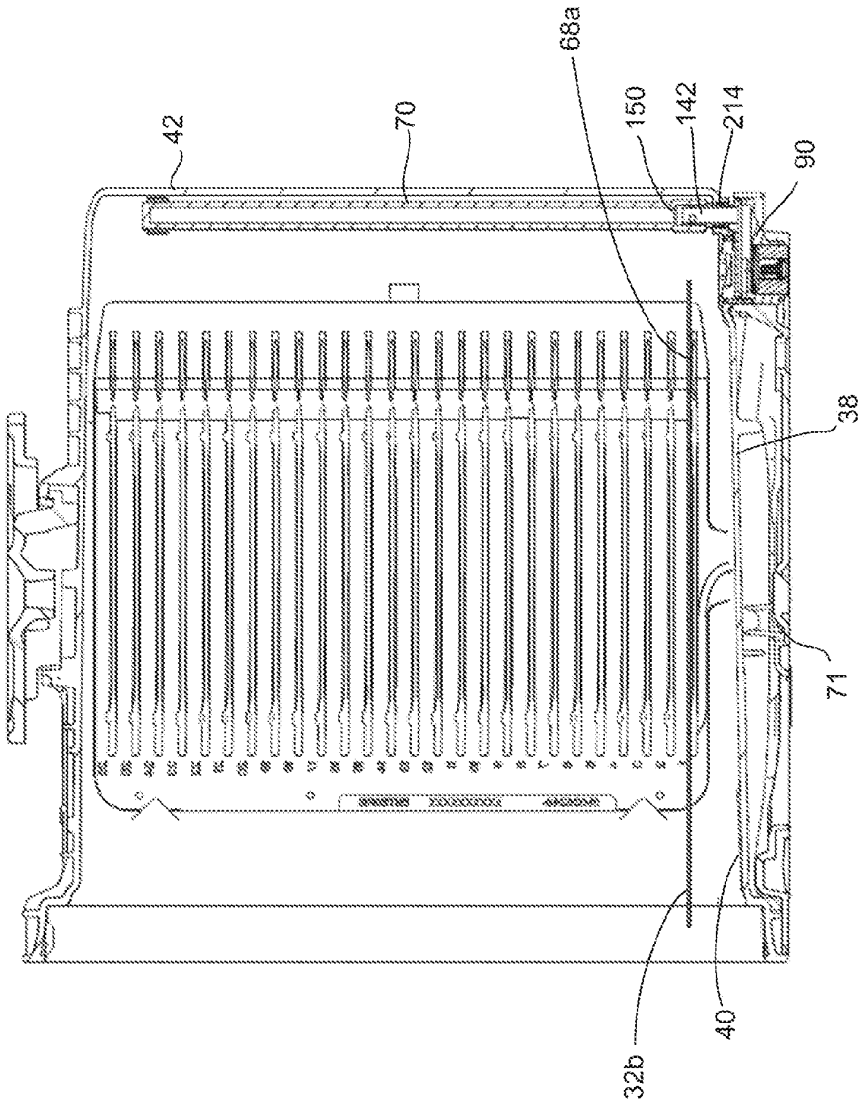


FIG. 7

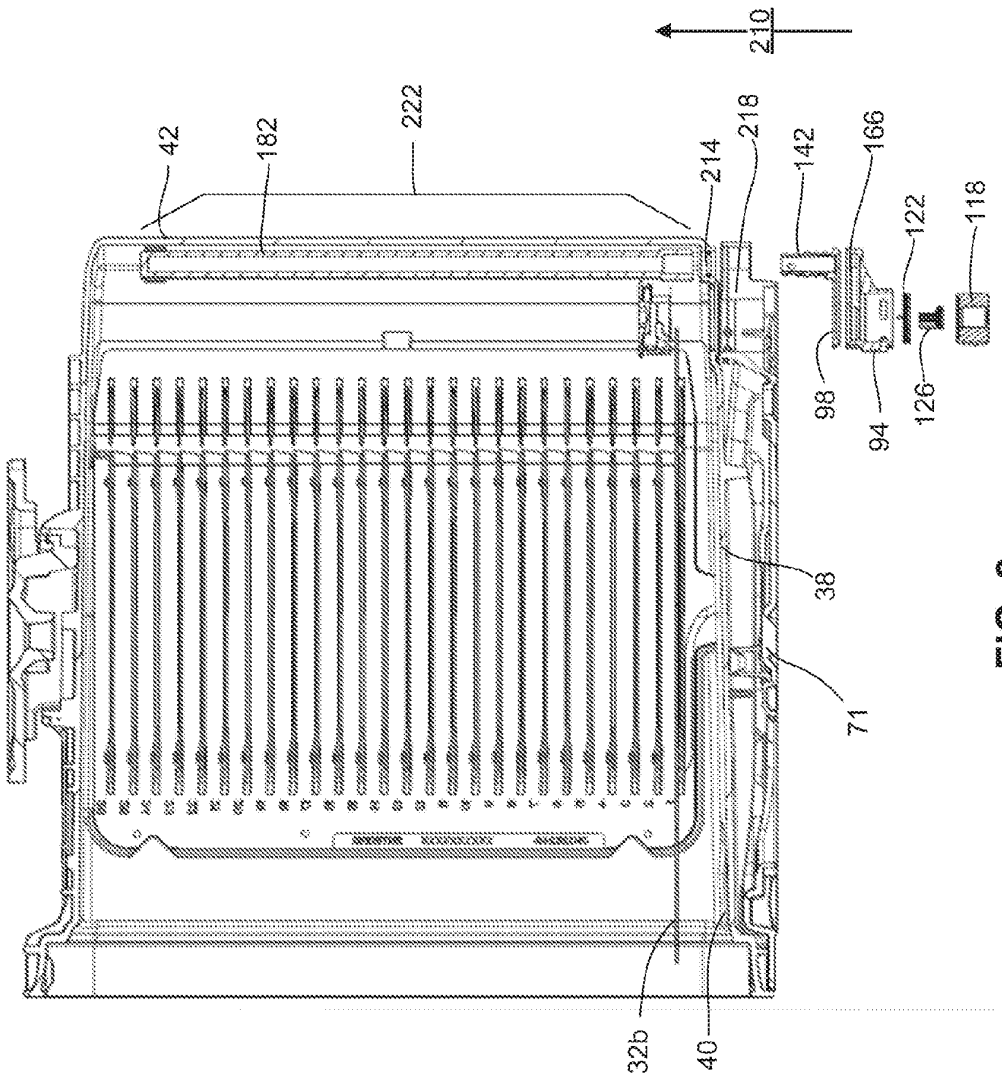


FIG. 8

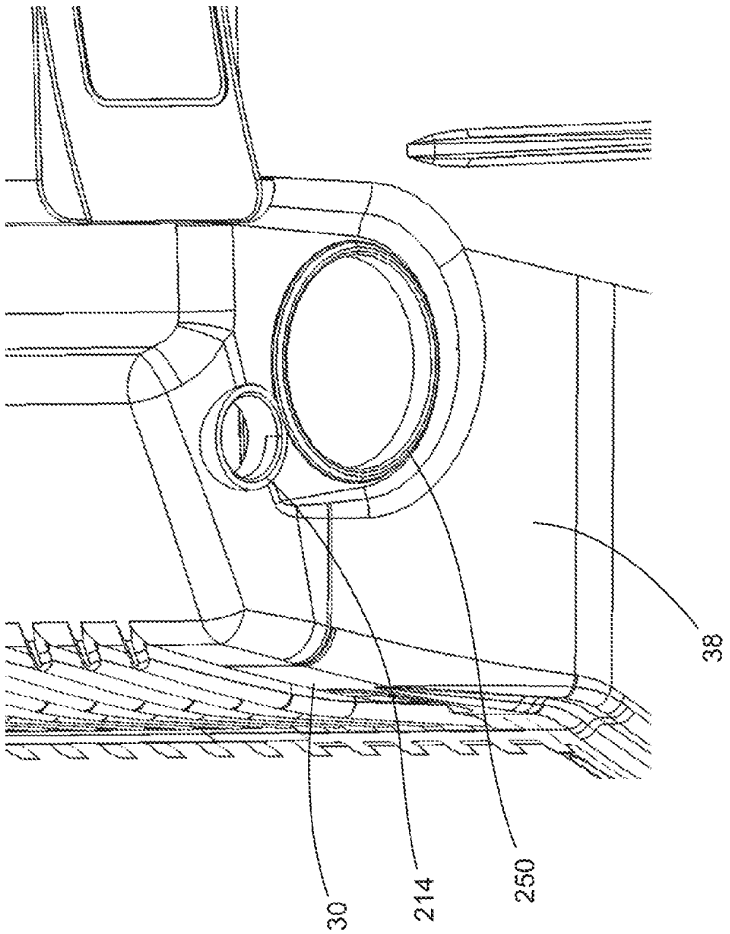


FIG. 9

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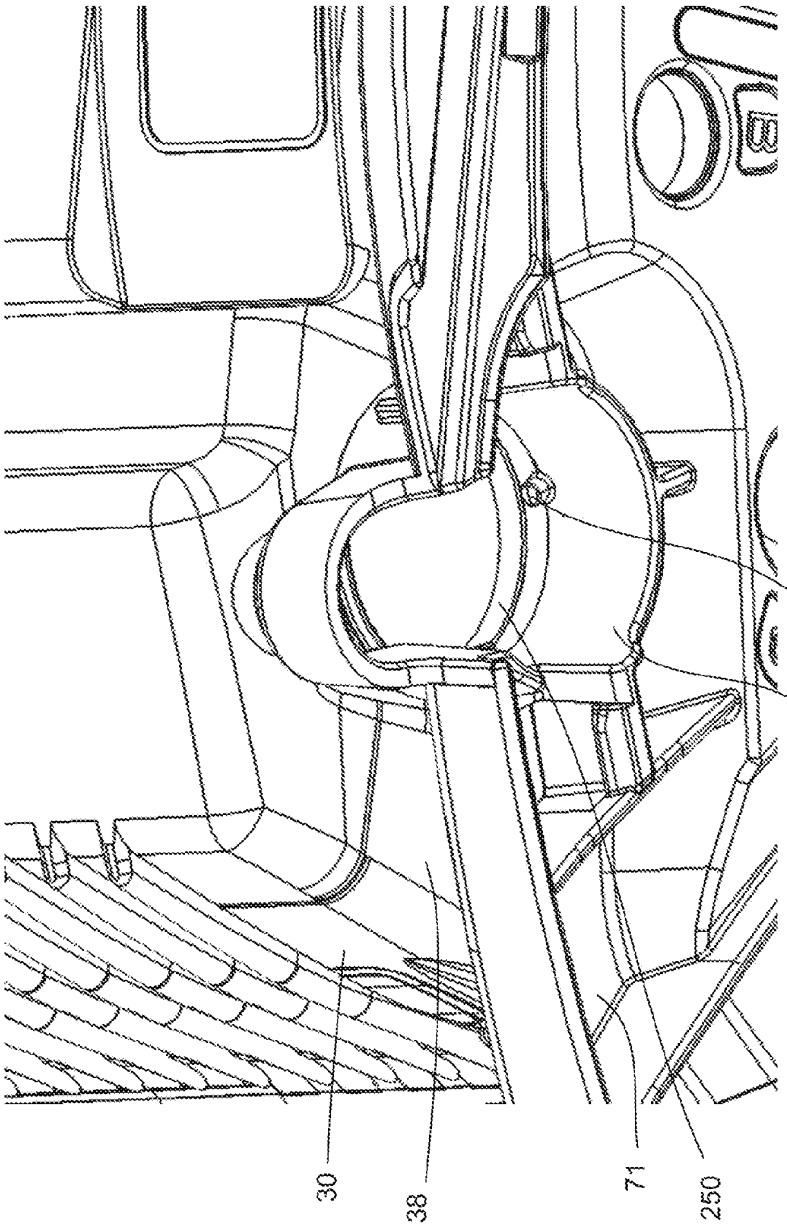


FIG. 10

Entegris, EX1002, p. 583

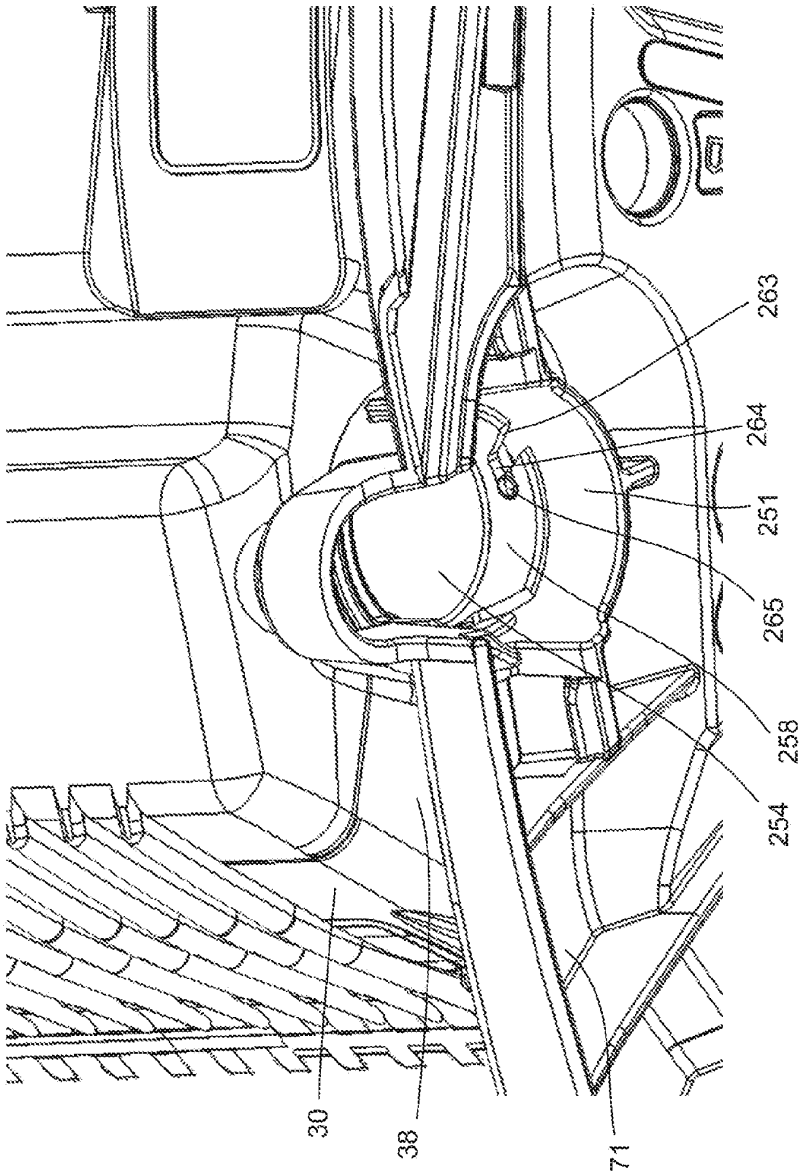


FIG. 11

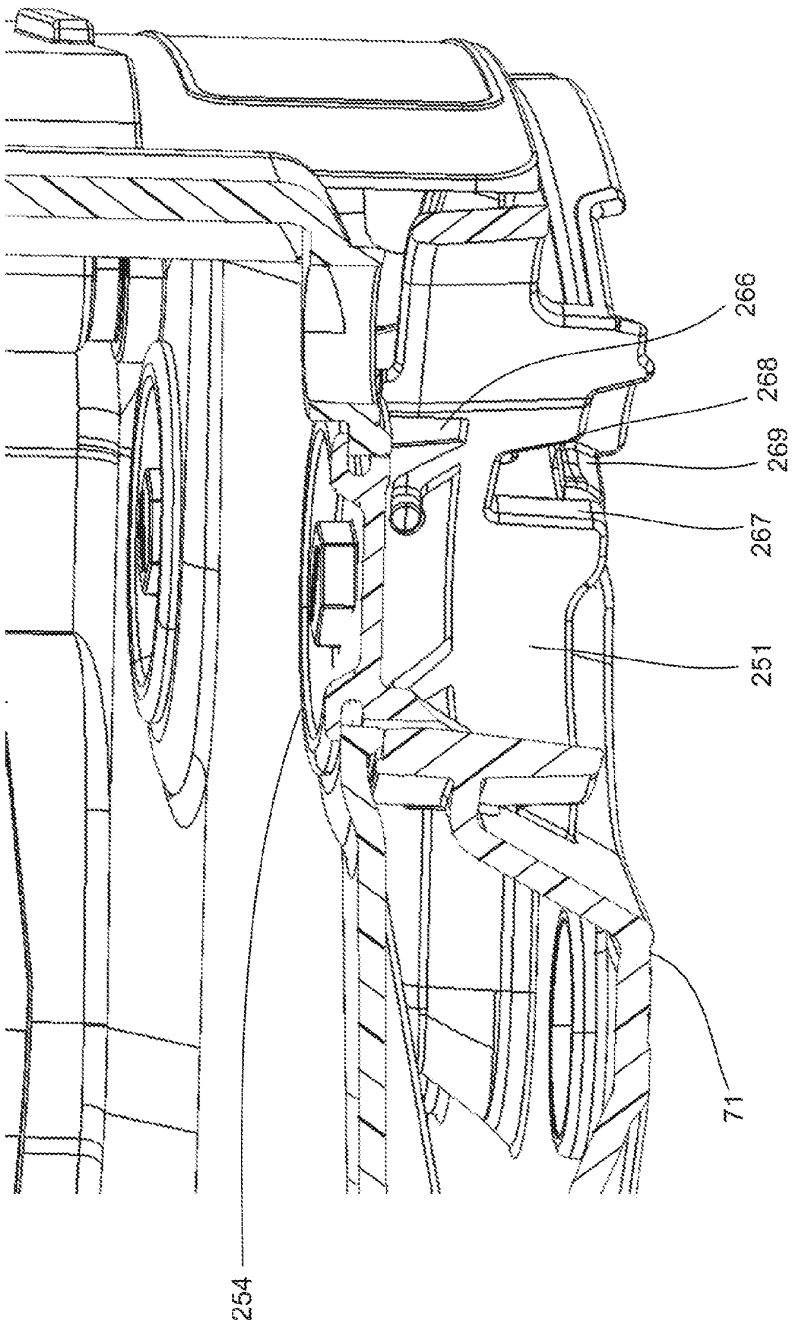


FIG. 12

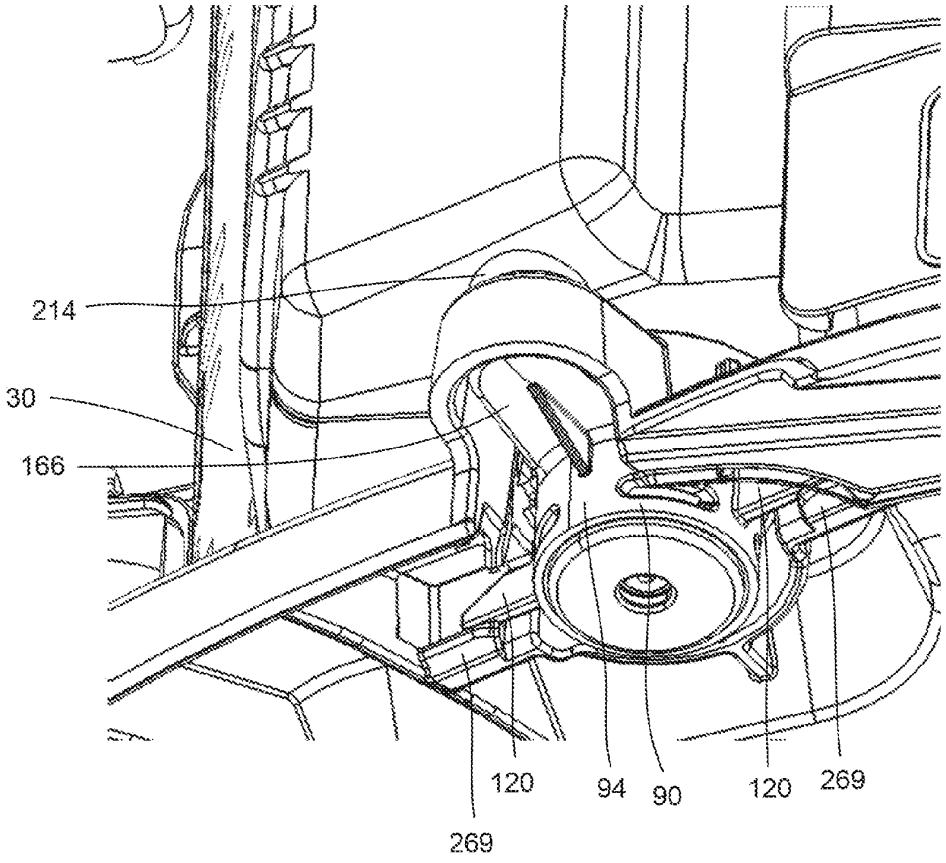


FIG. 13

Entegris, EX1002, p. 586

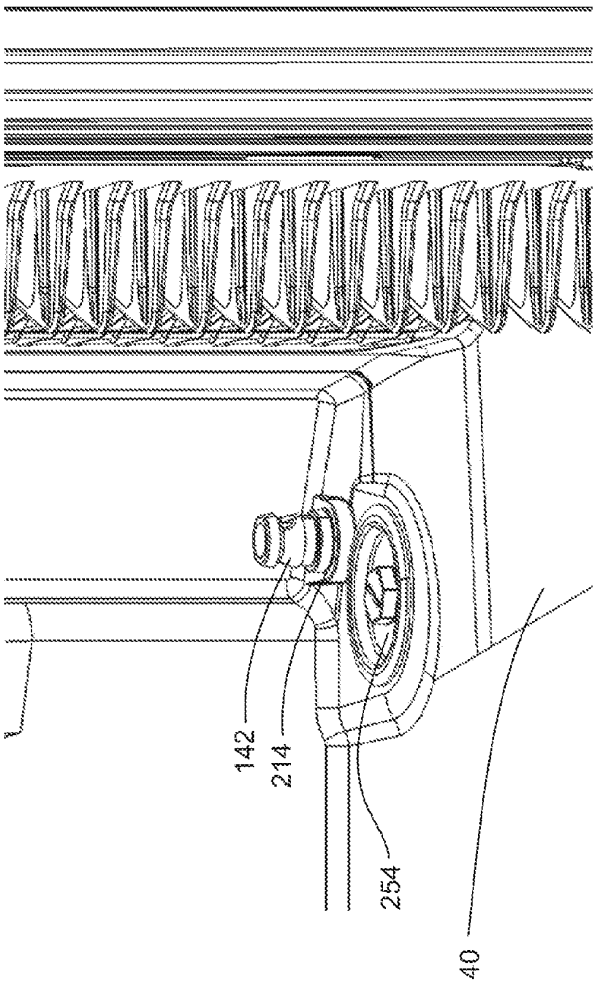


FIG. 14

Entegris, EX1002, p. 587

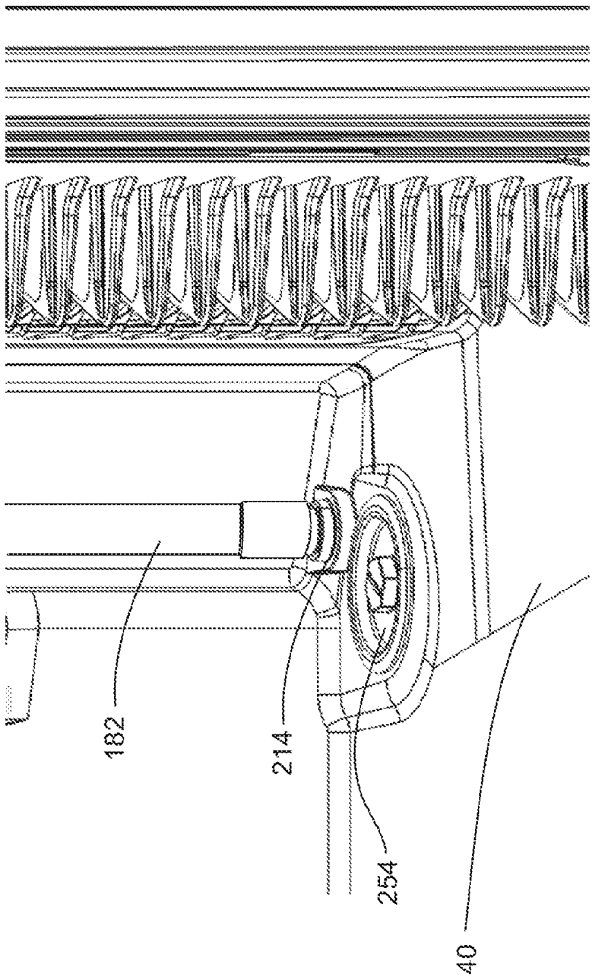


FIG. 15

Entegris, EX1002, p. 588

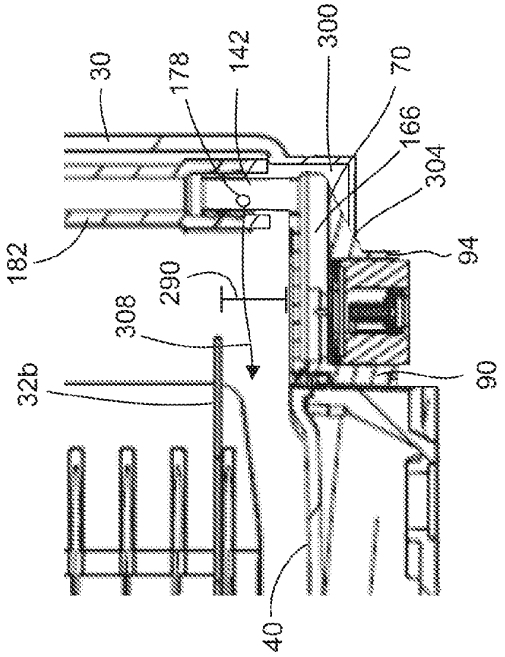

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FIG. 17

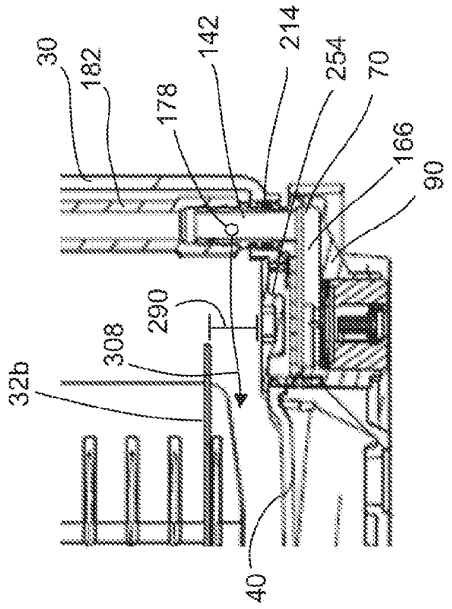

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FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/50085

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H01L 21/673, 21/02, 21/677; B65D 51/16 (2016.01)
CPC - H01L 21/67393, 21/02041, 21/677; B65D 51/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8): H01L 21/00, 21/02, 21/67, 21/673, 21/677; B65D 51/00, 51/16 (2016.01)
CPC: H01L 21/02, 21/02041, 21/02087, 21/0209, 21/02093, 21/67, 21/673, 21/6735, 21/67389, 21/67393, 21/677; B65D 51/00, 51/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH); Google Patent, Google Scholar, IEEE, Total Patent, EBSCO
Keywords: purge, clean, tower, substrate, wafer, container, box, pod, wall, door, opening, aperture, nozzle, valve, conduit, tube, diffuser

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	WO 2015/057739 A1 (ENTEGRIS, INC) April 23, 2015; page 8, lines 4-10, 18-22, page 21, line 3 to page 22, line 13, lines 20-28, page 23, lines 15-17, claims 19, 39, 56, figures 1, 16a-16c, 17a, 18b	1-11 & 22 --- 12-21
Y	US 2005/0115866 A1 (BURNS, J et al.) June 2, 2005; figures 2-4, paragraphs [0025], [0026]	12-20
Y	US RE39,241 E (FOSNIGHT, W) August 22, 2006; title, figures 3, 6c, 7, column 5, lines 9-37, 43-46, column 6, lines 1-15, 61-66, column 7, line 45 to column 8, line 21	21

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 October 2016 (18.10.2016)	25 OCT 2016
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

(12) 特許協力条約に基づいて公開された国際出願

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2018年10月4日(04.10.2018)

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(10) 国際公開番号
WO 2018/179964 A1

(51) 国際特許分類:
H01L 21/673 (2006.01) *B65D 85/30* (2006.01)

(21) 国際出願番号: PCT/JP2018/005296

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(30) 優先権データ:
特願 2017-061813 2017年3月27日(27.03.2017) JP

(71) 出願人: 信越ポリマー株式会社 (**SHIN-ETSU POLYMER CO.,LTD.**) [JP/JP]; 〒1010041 東京都千代田区神田須田町一丁目9番地 Tokyo (JP).

(72) 発明者: 小川 統 (**OGAWA Osamu**); 〒3310811 埼玉県さいたま市北区吉野町1丁目406番地1 信越ポリマー株式会社内 Saitama (JP). 冨永 公徳 (**TOMINAGA Kiminori**); 〒9410007 新潟県糸魚川市大字大和川715番地 信越ポリマー株式会社内 Niigata (JP).

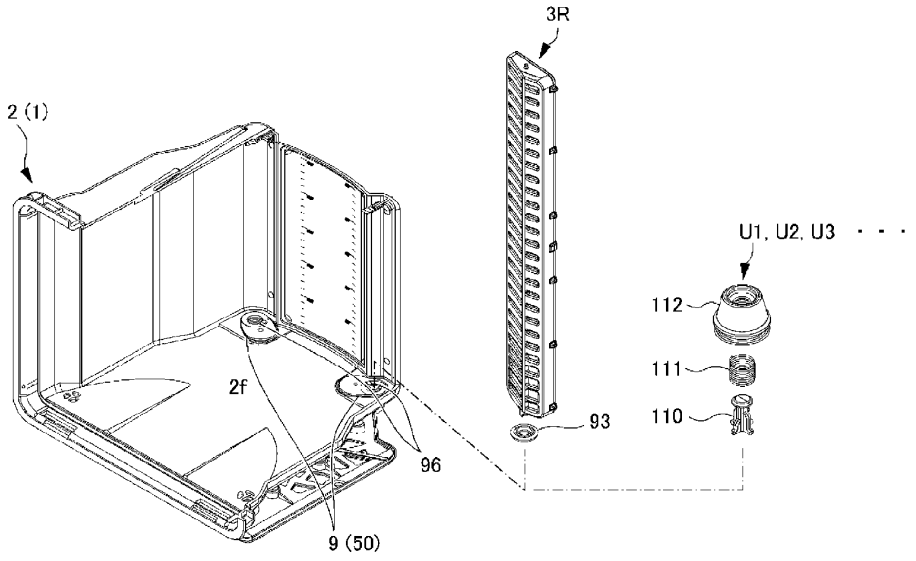
(74) 代理人: 坂本 智弘 (**SAKAMOTO Tomohiro**); 〒1600004 東京都新宿区四谷2－13 Tokyo (JP).

(81) 指定国(表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH,

WO 2018/179964 A1

(54) **Title:** SUBSTRATE STORAGE CONTAINER

(54) 発明の名称: 基板収納容器



(57) **Abstract:** The present invention provides a substrate storage container (1) provided with: a container body (2) that can house a substrate (W); and a gas supply member (50) that can supply a gas (G) from the outside of the container body (2) to an internal space, wherein the container body (2) is formed into a front-open box, and the gas supply member (50) is attached to a bottom surface (2f). The gas supply member (50) is configured such that function units (U; 3R, 3L, U1, U2, U3, U4) for changing the environment of the internal space to a different state are connected so as to be replaceable

[続葉有]

KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) 指定国(表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, RU, TJ, TM), ヨーロッパ (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

添付公開書類:

— 国際調査報告(条約第21条(3))

by being fitted. Thus, a substrate storage container that enables easy replacement of the function units for changing the environment of the internal space can be provided.

(57) 要約:本発明は、基板(W)を収納可能な容器本体(2)と、容器本体(2)の外部から内部空間に気体(G)を供給可能な給気部材(50)と、を備え、容器本体(2)をフロントオープンボックスに形成し、底面(2f)に給気部材(50)を取付けた基板収納容器(1)であって、給気部材(50)は、内部空間の環境を異なる状態に変更する機能ユニット(U;3R, 3L, U1, U2, U3, U4)が、嵌合によって交換可能に接続されているものである。これにより、内部空間の環境を変化させる機能ユニットを、簡単に交換することができる基板収納容器を提供することができる。

明　細　書

発明の名称 ： 基板収納容器

技術分野

[0001] 本発明は、複数枚の基板を収納する基板収納容器に関する。

背景技術

[0002] 基板収納容器は、半導体ウエハなどの基板を内部空間に収納し、倉庫での保管、半導体加工装置間での搬送、工場間での輸送などに使用されている。基板収納容器は、内部空間に収納した基板が酸化や汚染されないように、内部空間が窒素ガスなどの不活性ガスやドライエアで置換されることがある。

[0003] このような基板収納容器として、複数枚の基板を収納する容器本体と、容器本体の開口に着脱自在に嵌合される蓋体とを備え、容器本体の底板に、容器本体の外部から内部空間に気体を供給する給気部材がそれぞれ嵌着され、給気部材に連通する中空の吹出しノズル（機能ユニット；気体置換ユニット）を縦にして設け、吹出しノズルの周壁に、基板に向けて気体を吹出す吹出孔を設けたものが知られている（特許文献１及び２参照）。

先行技術文献

特許文献

[0004] 特許文献1：特開２０１６－００４９４９号公報

特許文献2：特開２０１６－０１５４２１号公報

発明の概要

発明が解決しようとする課題

[0005] しかしながら、特許文献１及び２にみられる基板収納容器では、機能ユニットと螺合部材とで容器本体を挟むようにして、機能ユニットを螺合により取付けているため、機能ユニットを交換する際、容器本体の内側及び外側の両側で、取付け又は取外し作業を行う必要があり、作業性が悪かった。

[0006] そこで、本発明は以上の課題に鑑みてなされたものであり、内部空間の環境を変化させる機能ユニットを、簡単に交換することができる基板収納容器

を提供することを目的とする。

課題を解決するための手段

[0007] （１）本発明に係る１つの態様は、複数枚の基板を収納可能な容器本体と、前記容器本体の外部から内部空間に気体を供給可能な給気部材と、を備え、前記容器本体をフロントオープンボックスに形成し、底面に前記給気部材を取付けた基板収納容器であって、前記給気部材は、前記内部空間の環境を異なる状態に変更する機能ユニットが、嵌合によって交換可能に接続されているものである。

（２）上記（１）の態様において、前記給気部材は、前記気体を濾過する濾過部材を有してもよい。

（３）上記（１）又は（２）の態様において前記機能ユニットは、前記給気部材から供給された前記気体を貯留するハウジング部材と、前記ハウジング部材の開口を覆うカバー部材と、前記ハウジング部材及び前記カバー部材の少なくとも一方に形成された前記気体を吹出す吹出孔と、を含む気体置換ユニットであってもよい。

（４）上記（１）又は（２）の態様において、前記機能ユニットは、前記内部空間への前記気体の流通を可能にするチェックバルブを含むバルブユニットであってもよい。

（５）上記（１）又は（２）の態様において、前記機能ユニットは、前記内部空間への前記気体の流通を不能にする閉塞ユニットであってもよい。

（６）上記（１）又は（２）の態様において、前記機能ユニットは、前記内部空間に供給される前記気体を浄化するフィルタ部材を含むフィルタユニットであってもよい。

（７）上記（１）から（６）までのいずれか１つの態様において、前記気体は、窒素ガス又はドライエアであってもよい。

発明の効果

[0008] 本発明によれば、内部空間の環境を変化させる機能ユニットを、簡単に交換することができる基板収納容器を提供することができる。

図面の簡単な説明

[0009] [図1]本発明の実施形態に係る基板収納容器の分解斜視図である。

[図2]容器本体の正面図である。

[図3]容器本体の底面図である。

[図4]容器本体の断面平面図である。

[図5]気体置換ユニットの斜視図である。

[図6]気体置換ユニットの分解斜視図である。

[図7]気体置換ユニットの（ａ）正面図、（ｂ）平面図、（ｃ）底面図、（ｄ）背面図である。

[図8]気体置換ユニットの図７（ａ）におけるＡ－Ａ断面図である。

[図9]容器本体の（ａ）正面概略図、（ｂ）気体置換ユニットの上部取付部の拡大斜視図、（ｃ）気体置換ユニットの下部取付部の拡大斜視図である。

[図10]気体置換ユニットの上部取付部の拡大斜視図である。

[図11]気体置換ユニットの（ａ）下部取付部の拡大図、（ｂ）断面斜視図である。

[図12]給気部材から流入した気体の流れを示す断面斜視図である。

[図13]交換可能な各種の機能ユニットを説明する概略図である。

[図14]バルブユニットを接続した状態における下部取付部の断面斜視図である。

[図15]閉塞ユニットを接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

[図16]小径フィルタユニットを接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

[図17]大径フィルタユニットを接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

発明を実施するための形態

[0010] 以下、本発明の実施形態について、図面を参照して詳細に説明する。なお、本明細書の実施形態においては、全体を通じて、同一の部材には同一の符

号を付している。また、図面中に、正面Ｆの方向及び後方（背面壁）Ｂの方向を、実線矢印で示している。また、左右は、正面Ｆから見た状態を指すものとする。

[0011] 基板収納容器１について説明する。図１は、本発明の実施形態に係る基板収納容器１の分解斜視図である。図２は、容器本体２の正面図であり、図３は、容器本体２の底面図であり、図４は、容器本体２の断面平面図である。

図１に示される基板収納容器１は、複数枚の基板Ｗを収納する容器本体２と、この容器本体２の開口に着脱自在に装着される蓋体４と、を備えている。基板収納容器１に収納される基板Ｗとしては、直径が３００ｍｍや４５０ｍｍの半導体ウエハ、マスクガラスなどが挙げられる。

[0012] 容器本体２は、正面開口枠２ａと、背面壁２ｂと、右側壁２ｃと、左側壁２ｄと、天面２ｅと、底面２ｆとで形成される、いわゆるフロントオープンボックスタイプのものである。

[0013] 蓋体４は、容器本体２の正面開口枠２ａの開口に装着されるもので、図示しないシールガスケットが容器本体２の正面開口枠２ａに対向するように取付けられている。この蓋体４を容器本体２に装着した際、シールガスケットは容器本体２と蓋体４との間の周縁部に密着し、基板収納容器１の内部空間の気密性を維持するように構成されている。

[0014] 容器本体２の背面壁２ｂには、更に後方Ｂに突出する突出部が左右両側に形成されている（図４参照）。この突出部は、容器本体２の正面Ｆの開口を上向きにして載置される際に、脚部として機能する。また、容器本体２の背面壁２ｂの中央外側には、収納された基板Ｗの枚数の補助となる目盛りなどが表示される（図１参照）。

[0015] 容器本体２の右側壁２ｃ及び左側壁２ｄの外側の中央付近には、握持操作用に機能するグリップ２３がそれぞれ取付けられている。

[0016] また、容器本体２の右側壁２ｃ及び左側壁２ｄの内側には、収納される基板Ｗを水平に支持する左右一対の支持片２１がそれぞれ複数設けられ、右側壁２ｃ及び左側壁２ｄの内側の後方Ｂ側には、基板Ｗを後方Ｂに向けて挿入

した際に、基板Ｗの挿入位置を規制する位置規制部２２がそれぞれ設けられている。

[0017] この左右一対の支持片２１は、上下方向に所定のピッチで配列され、各支持片２１が基板Ｗの周縁を支持する細長い板状に形成されている。実施形態では、２５枚の基板Ｗが支持できるように支持片２１が設けられているが、基板Ｗの最大収納枚数は２５枚に限らない。

[0018] このとき、基板Ｗは、容器本体２に必要に応じて満載状態で収納されたり、満載状態より少ない数が収納されたり、収納位置が変えられたりするため、容器本体２への収納枚数及び収納状態は、基板収納容器１の使用態様によって種々異なる。例えば、複数枚の基板Ｗが、上方又は下方に偏って収納されたり、１つ置きに収納されたりすることもある。

[0019] 容器本体２の天面２ｅの外側には、ロボティックフランジなどのトップフランジ２５が取付けられている。このトップフランジ２５は、例えば、半導体製造工場の天井搬送車に把持され、工程間を搬送されたり、半導体加工装置などの蓋体開閉装置に位置決めに利用されたりする。

[0020] 容器本体２の底面２ｆの外側には、容器本体２を位置決め、載置するためのボトムプレート２６が取付けられている。

[0021] 容器本体２や蓋体４、また、グリップ２３、トップフランジ２５、ボトムプレート２６などの付属品は、所要の樹脂を含有する成形材料により射出成形されたり、射出成形された複数の部品の組み合わせにより構成されたりする。成形材料に含まれる樹脂としては、例えばポリカーボネート、シクロオレフィンポリマー、ポリエーテルイミド、ポリエーテルケトン、ポリエーテルエーテルケトン、ポリブチレンテレフタレート、ポリアセタール、液晶ポリマーといった熱可塑性樹脂やこれらのアロイなどが挙げられる。

[0022] また、これらの樹脂には、カーボン繊維、カーボンパウダー、カーボンナノチューブ、導電性ポリマーなどからなる導電性物質やアニオン、カチオン、非イオン系などの各種帯電防止剤が必要に応じて添加される。さらに、紫外線吸収剤や、剛性を向上させる強化繊維なども必要に応じて添加される。

なお、容器本体２、蓋体４、グリップ２３、トップフランジ２５及びボトムプレート２６などは、透明、不透明、半透明のいずれでもよいが、容器本体２及び蓋体４は、透明が好ましい。

[0023] ここで、容器本体２の底面２ｆには、図３に示すように、３つの給気部材５０と１つの排気部材６０とが設けられている。これらの給気部材５０及び排気部材６０は、基板収納容器１の外部から内部空間に又は内部空間から外部に気体Ｇを流通させることにより、収納した基板Ｗの表面の変質を抑制したり、基板収納容器１の内部空間と外部との圧力差を解消したりするように機能する。

[0024] このうち、２つの給気部材５０が、底面２ｆの後方Ｂの左右両側に設けられており、また、１つの給気部材５０と１つの排気部材６０とが、底面２ｆの正面Ｆ付近の左又は右側に設けられている。そして、これらの給気部材５０に、後述する各種の機能ユニットＵが接続されている（図１３参照）。なお、正面Ｆ付近の給気部材５０は、排気部材６０として使用される場合もある。

[0025] 給気部材５０は、容器本体２の底面２ｆに形成された凹部に装着されるグロメット５０ａと、グロメット５０ａの端部に取付けられた、通気性を有する濾過部材５１と、逆止弁５２とを有している。グロメット５０ａは、エラストマーなどの弾性樹脂部材で形成されている。濾過部材５１は、供給される気体Ｇを濾過し、塵埃を除去するもので、不織布フィルタなどが用いられる。

[0026] 逆止弁５２は、弁を閉止する方向にコイルバネ５３により付勢されて、バルブハウジング５４に収容されている。なお、本実施形態では、給気部材５０は、逆止弁５２を有するものとしたが、後述する機能ユニットＵの種類によっては、逆止弁５２を有さないものであってもよい。

[0027] 一方、排気部材６０は、逆止弁（図示なし）を有するとともに、例えば、湿度（又は濃度）センサを取付けることで、基板収納容器１の内部空間を気体Ｇで置換した後、基板収納容器１の内部空間の湿度（又は濃度）を測定す

ることができ、基板収納容器１の内部空間への気体Ｇの置換が正常に行われているかの管理を行うことができる。

[0028] つづいて、基板収納容器１の内部空間の環境を変化させる各種の機能ユニットＵの構成について順に説明する。図１３は、交換可能な各種の機能ユニットＵを説明する概略図である。

機能ユニットＵとしては、気体置換ユニット３Ｒ，３Ｌ、バルブユニットＵ１、閉塞ユニットＵ２、小径フィルタユニットＵ３、大径フィルタユニットＵ４などが挙げられる。

[0029]（気体置換ユニット３Ｒ，３Ｌ）

まず、基板収納容器１の内部空間を気体置換ユニット３Ｒ，３Ｌにより気体Ｇに置換する構成について説明する。図５は、気体置換ユニット３Ｒ，３Ｌの斜視図であり、図６は、気体置換ユニット３Ｒ，３Ｌの分解斜視図である。図７は、気体置換ユニット３Ｒ，３Ｌの（ａ）正面図、（ｂ）平面図、（ｃ）底面図、（ｄ）背面図である。図８は、気体置換ユニット３Ｒ，３Ｌの図７におけるＡ－Ａ断面図である。なお、図５から図８は、正面Ｆから見て右側の気体置換ユニット３Ｒについて示す。

[0030] 気体置換ユニット３Ｒ，３Ｌは、容器本体２の内部空間を気体Ｇで置換するもので、基板Ｗが挿入された状態でも基板Ｗと干渉しないように、容器本体２の後方Ｂ（背面壁２ｂ又は突出部付近）の左右両側に、長手方向を縦にして備えられている（図１及び２参照）。

[0031] この気体置換ユニット３Ｒ，３Ｌは、容器本体２の内部空間に気体Ｇを吹出すものである。吹出す気体Ｇとしては、不活性ガスやドライエアが挙げられる。さらに、不活性ガスとしては、窒素ガス、アルゴンガスなどが挙げられるが、コスト面から窒素ガスが好ましい。

[0032] 気体置換ユニット３Ｒ，３Ｌについて更に詳細に説明する。ただし、気体置換ユニット３Ｌは、図２に示されるように、気体置換ユニット３Ｒと左右対称なものである点を除いて、同じ形状・構造であるから、説明を省略する。

[0033] 図５に示される気体置換ユニット３Ｒは、ハウジング部材３１と、カバー部材３２とを含み、略５角形柱状に形成されているが、形状はこれに限られない。また、気体置換ユニット３Ｒは、容器本体２などと同様の樹脂で形成されても、異なる樹脂で形成されてもよい。

[0034] ハウジング部材３１は、気体Ｇを貯留するように、一方が開口した面となる箱状に形成されており、この開口した面を覆うように、カバー部材３２が、爪などの係止手段（係合手段）によって取付けられている。これらのハウジング部材３１とカバー部材３２とで、気体Ｇを貯留する空間が形成されている。

[0035] ここで、ハウジング部材３１は、所定の角度で交差し、大きさの異なる２つの面部３１Ａ，３１Ｂを有している。面部３１Ａと面部３１Ｂとの交差角度は、内角で１２０°から１７０°の範囲である。また、面部３１Ａの面積は、面部３１Ｂの面積より大きく形成されている。

[0036] ハウジング部材３１の下面には、給気部材５０からの気体Ｇが流れ込む円筒状の接続具３１１が突出して設けられている。接続具３１１の近傍には、気体置換ユニット３Ｒの左右方向の回転を止め、回転方向の位置決めをする回止め突起３１２が形成されている（図７参照）。一方、ハウジング部材３１の上面には、容器本体２に位置決め固定するための円柱状の位置決め突起３１３が形成されている。

[0037] ハウジング部材３１の面部３１Ａには、図７（ａ）に示すように、横長の略矩形状の吹出孔が、縦方向（長手方向）に上から順に、第１吹出孔３１ａ，３１ｂ，３１ｃ・・・３１ｘ，３１ｙ，３１ｚ（以下、必要に応じて「第１吹出孔群３１ａ－ｚ」という。）が２６か所に形成されている。

[0038] ハウジング部材３１の面部３１Ｂには、同じく横長の略矩形状の吹出孔が、縦方向（長手方向）に上から順に、第３吹出孔３３ａ，３３ｂ，３３ｃ・・・３３ｘ，３３ｙ，３３ｚ（以下、必要に応じて「第３吹出孔群３３ａ－ｚ」という。）として２６か所に形成されている。

[0039] 第１吹出孔群３１ａ－ｚと、第３吹出孔群３３ａ－ｚとを、所定の角度で

交差する面部３１Ａ，３１Ｂにそれぞれ形成することにより、気体Ｇの吹出方向を異ならせることができ、気体Ｇが基板収納容器１の内部空間に拡散し易くなる。

[0040] 最上段の第１吹出孔３１ａの開口高さは、２段目の第１吹出孔３１ｂの開口高さよりも、少し大きく、すなわち、第１吹出孔３１ａの開口面積は、第１吹出孔３１ｂの開口面積よりも、少し大きい。また、第１吹出孔３１ｂから第１吹出孔３１ｕまでの開口面積は、すべて等しく、第１吹出孔３１ｖから第１吹出孔３１ｙまでの開口面積は、第１吹出孔３１ｕの開口面積よりも徐々に大きくなり、第１吹出孔３１ｚの開口面積は、第１吹出孔３１ｙの開口面積よりも小さい。また、第３吹出孔群３３ａ－ｚについても同様である。

[0041] そして、最下段の第１吹出孔３１ｚ及び第３吹出孔３３ｚは、容器本体２の最下段の支持片２１に支持された基板Ｗよりも下方に位置している。ただし、最下段の基板Ｗよりも下方に位置する第１吹出孔３１ｚ及び第３吹出孔３３ｚは、１つに限らず複数であってもよい。

[0042] このように、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚは、下方側の開口面積を大きくしているため、下方から供給される気体Ｇの直進性が高くても、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚの下方から上方にわたって、気体Ｇが均一に吹出される。また、最下段の基板Ｗの下にも第１吹出孔３１ｚ及び第３吹出孔３３ｚが形成されているので、最下段の基板Ｗと底面２ｆとの間にも、気体Ｇが吹出されるから、クリーンルーム内のダウンフローのエアが容器本体２の正面Ｆの開口から内部に侵入しても、底面２ｆの上面を正面Ｆに向かって吹出す気体Ｇによって、必要以上に流れ込むことがない。

[0043] 一方、カバー部材３２には、図７（ｄ）に示すように、略矩形又は正方形状の吹出孔が、縦方向（長手方向）に上から順に、第２吹出孔３２ａ，３２ｂ・・３２ｅ，３２ｆ（以下、必要に応じて「第２吹出孔群３２ａ－ｆ」という。）として６か所に形成されている。最上段の第２吹出孔３２ａの高さ

位置は、第１吹出孔３１ｃの高さ位置と略同じで、以下、第２吹出孔３２ｂと第１吹出孔３１ｈとが、第２吹出孔３２ｃと第１吹出孔３１ｍとが、第２吹出孔３２ｄと第１吹出孔３１ｓとが、第２吹出孔３２ｅと第１吹出孔３１ｗとが、第２吹出孔３２ｆと第１吹出孔３１ｙとが、略同じ高さでそれぞれ一致している。

[0044] ここで、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚのそれぞれの合計開口面積Ｓ１，Ｓ２，Ｓ３の比率は、容器本体２に収納された複数の基板W間での湿度のバラツキがより小さくなるように調節できる。開口面積の調節は、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚの各吹出孔が異なるハウジング部材３１及びカバー部材３２を準備することや、適宜の吹出孔を閉止することで実施できる。

[0045] 図４に戻って、気体置換ユニット３Ｒ，３Ｌは、上述したように容器本体２の後方Ｂ（背面壁２ｂ又は突出部付近）の左右両側に備えられているため、吹出した気体Ｇを基板収納容器１の内部空間に均一に拡散させるためには、基本的に第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚから正面Ｆ側に向かって吹出し、空気を気体Ｇで置換することになる。このとき、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚが設けられた位置よりも後方Ｂ側の、背面壁２ｂから右側壁２ｃ又は左側壁２ｄ付近にも空気が存在するため、後方Ｂに向かって第２吹出孔群３２ａ－ｆからも気体Ｇを吹出す方がよい。

[0046] そして、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚが設けられた位置よりも正面Ｆ側の空間は、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚが設けられた位置よりも後方Ｂ側の空間と比較するとかなり大きいため、正面Ｆ側を向く第１吹出孔群３１ａ－ｚの合計開口面積Ｓ１及び第３吹出孔群３３ａ－ｚの合計開口面積Ｓ３は、後方Ｂ側を向く第２吹出孔群３２ａ－ｆの合計開口面積Ｓ２よりも、大きくする方がよい。

[0047] また、気体置換ユニット３Ｒ，３Ｌは、前述したように基本的に正面Ｆ側

に向かって気体Ｇを吹出すが、右側壁２ｃ又は左側壁２ｄ付近に備えられるため、右側壁２ｃ又は左側壁２ｄに沿って正面Ｆに向かう気体Ｇは、少なくてもよいが、逆に、容器本体２の中央に向かう気体Ｇは、多い方がよい。そのため、第１吹出孔群３１ａ－ｚの合計開口面積Ｓ１は、第３吹出孔群３３ａ－ｚの合計開口面積Ｓ３よりも、大きくする方がよい。

[0048] これらを踏まえると、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚのそれぞれの合計開口面積Ｓ１，Ｓ２，Ｓ３は、Ｓ１：Ｓ２：Ｓ３＝３：１：２などとしてもよい。

[0049] 図６に戻って、ハウジング部材３１の内側には、通気性を有するフィルタ部材３４が設けられており、同じくカバー部材３２の内側には、通気性を有するフィルタ部材３５が設けられている。フィルタ部材３４，３５としては、例えば、不織布フィルタなどが挙げられる。

[0050] そして、円筒状の接続具３１１から導入された気体Ｇは、ハウジング部材３１とカバー部材３２とで形成される空間に導入され、貯留される。貯留された気体Ｇは、フィルタ部材３４，３５を介して、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚから容器本体２の内部空間に吹出される。

[0051] 気体置換ユニット３Ｒの容器本体２への取付方法について説明する。図９は、容器本体２の（ａ）正面概略図、（ｂ）気体置換ユニット３Ｒの上部取付部の拡大斜視図、（ｃ）気体置換ユニット３Ｒの下部取付部の拡大斜視図である。図１０は、気体置換ユニット３Ｒの上部取付部の拡大斜視図である。図１１は、気体置換ユニット３Ｒの（ａ）下部取付部の拡大図、（ｂ）断面斜視図である。

[0052] 気体置換ユニット３Ｒは、位置決め固定部材８及びオフセット部材９により容器本体２に取付けられている。具体的には、気体置換ユニット３Ｒの上部が、位置決め固定部材８に取付けられ、気体置換ユニット３Ｒの下部が、オフセット部材９に取付けられる。

[0053] そこで、容器本体２の背面壁２ｂの左右両側には、位置決め固定部材８を

固定するために、円形の貫通孔２７が形成されており、また、貫通孔２７の上部には、ストッパ２８が形成されている。一方、容器本体２の底面２ｆの左右両側には、オフセット部材９を固定するために、取付孔２９が形成されている。この取付孔２９は、円形でなく大きな円と小さな円を繋いだ略楕円形状で形成されている。

[0054] 図１０に示される位置決め固定部材８は、細長い形状で、一端側が略板状で、他端側が矩形の軸で形成されている。この軸の周囲には、３つの円盤状のフランジ８１，８２，８３が他端側に向かって形成されている。軸端のフランジ８３と中間のフランジ８２は、背面壁２ｂの貫通孔２７の径より小さく形成され、貫通孔２７に挿入される。中間のフランジ８２には、小径の段部が形成され、Ｏリング８４Ａが嵌め込まれている。内側のフランジ８１にも、小径の段部が形成され、Ｏリング８４Ｂが嵌め込まれている。内側のフランジ８１及びＯリング８４Ｂは、貫通孔２７の径より大きく形成されており、位置決め固定部材８の他端側を貫通孔２７に挿入した際、容器本体２とフランジ８１の間にＯリング８４Ｂが挟まるため、気体Ｇが漏れることがない。

[0055] 位置決め固定部材８を貫通孔２７に挿入後、軸端のフランジ８３と容器本体２の間に位置する矩形の軸に、内側が矩形状に形成され、外径が貫通孔２７より大きいＣリング８５を挟むことにより、位置決め固定部材８が貫通孔２７を介して容器本体２に固定される。具体的には、軸端のフランジ８３を外側に引っ張りながら、Ｏリング８４Ｂをフランジ８１と容器本体２との間で潰しながら、Ｃリング８５を差し込むことで密封性が高まる。

[0056] また、位置決め固定部材８の一端側は、上方に屈曲した板形状で、細長いスリット８６が形成されている。このスリット８６には、ハウジング部材３１の位置決め突起３１３とストッパ２８が嵌り込む。端部８７は、更に上部に湾曲し、その更に先端にはＵ字型の切欠き８８が形成されている。

[0057] 図１１に示されるオフセット部材９は、底面２ｆの内側に位置するオフセットプレート押さえ９０と、底面２ｆの外側に位置するオフセットプレート

９５との間に、気体Ｇが流通する隙間が形成されるように、Ｏリング９４を介して組立てられている。

[0058] オフセットプレート押さえ９０には、ハウジング部材３１の回止め突起３１２が嵌り込む凹部９２が形成されており、回止め突起３１２が凹部９２に嵌り込むことで、回転する気体置換ユニット３Ｒの方向及び位置が決まる。また、オフセットプレート押さえ９０には、気体置換ユニット３Ｒの接続具３１１を差し込む差込孔９６が形成されており、接続具３１１は、パッキン９３を介して差込孔９６に差し込まれる。取付孔２９には、このオフセットプレート押さえ９０がＯリング９１を介して嵌め込まれる。

[0059] オフセットプレート９５は、平面視で、パッキン９３の中心位置からズレた位置に、給気部材５０の中心が位置するように、給気部材５０を嵌め込む凹部が形成されている。

[0060] このような構成により、気体置換ユニット３Ｒは、まず下部の接続具３１１がオフセット部材９に取付けられ、その後、上部の位置決め突起３１３が位置決め固定部材８に取付けられて、容器本体２に取付けられる。

[0061] 具体的には、気体置換ユニット３Ｒの下部の接続具３１１をパッキン９３に差し込んで傾いた状態から、気体置換ユニット３Ｒの上部の位置決め突起３１３を、端部８７側からスリット８６に向かって押し込むことで、位置決め固定部材８が湾曲して、位置決め突起３１３が、スリット８６に嵌り込む。と同時に、位置決め突起３１３は、ストッパ２８にも当接することで、スリット８６内での位置が決められ、気体置換ユニット３Ｒの上部が位置決め固定される。

[0062] 気体Ｇの流れについて説明する。図１２は、給気部材５０から流入した気体Ｇの流れを示す断面斜視図である。なお、気体Ｇの流れは、矢印で示す。

図１２において、給気部材５０から高圧で導入された気体Ｇは、濾過部材５１を通過し、オフセットプレート押さえ９０とオフセットプレート９５との隙間を流れ、後方Ｂのオフセットプレート押さえ９０と気体置換ユニット３Ｒの下部の接続具３１１との接続部に向かう。

[0063] その後、気体Ｇは気体置換ユニット３Ｒの貯留空間を進みながら（図８参照）、第１吹出孔群３１ａ－ｚ、第３吹出孔群３３ａ－ｚ及び第２吹出孔群３２ａ－ｆから吹出される。このとき、気体Ｇは、正面Ｆ側の中央付近及び右側壁２ｃに向かう方向と、後方Ｂ側の背面壁２ｂに向かう方向との、異なる３方向に吹出される（図４参照）。

[0064] ここで、第１吹出孔群３１ａ－ｚから容器本体２の正面Ｆ側の中央付近に向かって吹き出される気体Ｇの方向及び第３吹出孔群３３ａ－ｚから容器本体２の右側壁２ｃ又は左側壁２ｄに向かって吹出される気体Ｇの方向について具体的に説明する。

[0065] 第１吹出孔群３１ａ－ｚ又は第３吹出孔群３３ａ－ｚの吹出開口の延長方向、つまり、第１吹出孔群３１ａ－ｚ又は第３吹出孔群３３ａ－ｚが形成された面部３１Ａ又は面部３１Ｂの中央を通る法線が、右側壁２ｃ又は左側壁２ｄに交差することなく、容器本体２の正面開口枠２ａの開口に到達する範囲であることが好ましい。更に好ましくは、気体置換ユニット３Ｒの場合、面部３１Ａの法線が、容器本体２の正面開口枠２ａの開口からの法線ＮＬ（垂線）に対して１０°から４０°の範囲であり、面部３１Ｂの法線が、容器本体２の正面開口枠２ａの開口からの法線ＮＬ（垂線）を挟んで、中央側５°から右側壁２ｃ側１０°の範囲である。なお、気体置換ユニット３Ｌの場合は、気体置換ユニット３Ｒと対称となる。

[0066] このような範囲となるように、面部３１Ａ及び面部３１Ｂ（あるいは、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚ）を形成し、気体置換ユニット３Ｒ，３Ｌを容器本体２の内部に備えることで、各吹出孔から吹出された気体Ｇは、容器本体２の右側壁２ｃ又は左側壁２ｄに、衝突して反射することがない。そのため、気体Ｇの気流に乱れが起きることがないから、容器本体２の内部空間を気体Ｇで素早く確実に置換することができる。

[0067] 蓋体４が容器本体２に装着されている場合には、容器本体２に気体Ｇが高圧で供給され、内部空間に充満すると、気体Ｇは、図３に示した排気部材６０から容器本体２の外部に流出する。この空気の流出により、基板収納容器

１の内部空間がパージガスである気体Ｇに置換される。

[0068] 一方、蓋体４が装着されていない場合には、図示しないクリーンルームなど外部装置からのダウンフローのエアが、容器本体２の正面Ｆから流れ込むが、このエアに抗しながら、基板収納容器１の内部空間がパージガスである気体Ｇに置換される。

[0069] （バルブユニットＵ１）

図１４は、バルブユニットＵ１を接続した状態における下部取付部の断面斜視図である。

バルブユニットＵ１は、給気部材５０から基板収納容器１の内部空間への気体Ｇの流通を可能にするが、内部空間の気体Ｇが給気部材５０に逆流しない、チェックバルブ１１０を含むものである。

[0070] バルブユニットＵ１は、図１４に示すように、弁座１１３を有する略円筒状のバルブハウジング１１２と、コイルバネ１１１によって弁座１１３に付勢されるチェックバルブ１１０と、で構成されている。チェックバルブ１１０及びバルブハウジング１１２は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。

[0071] 上述した気体置換ユニット３Ｒ，３Ｌは、収納された基板W間に均一に気体Ｇを吹出すように構成されているのに対して、このバルブユニットＵ１は、給気部材５０から供給される気体Ｇの圧力が、コイルバネ１１１の付勢力に打ち勝って、チェックバルブ１１０を、弁座１１３から離間したときに、基板収納容器１の内部空間へ気体Ｇを流通させるようになっており、内部空間における気体Ｇの均一性が重要でない場合などに利用される。

[0072] バルブユニットＵ１を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、バルブハウジング１１２を差し込み、２つのフランジ１１４で嵌合係止すればよい。

[0073] （閉塞ユニットＵ２）

図１５は、閉塞ユニットＵ２を接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

閉塞ユニットＵ２は、給気部材５０から基板収納容器１の内部空間への気体Ｇの流通を不能にするものである。

[0074] 閉塞ユニットＵ２は、図１５に示すように、キノコ状のプラグ本体１２０と、プラグ本体１２０の棒状部が装着される装着孔１２２を有するとともに、差込孔９６に差し込まれ、嵌合係止されるパッキン１２１と、で構成されている。プラグ本体１２０は、プラスチック樹脂などで形成されており、パッキン１２１は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。

[0075] 閉塞ユニットＵ２を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、パッキン１２１を差し込み、嵌合係止し、プラグ本体１２０を装着孔１２２に挿入装着すればよい。

[0076] （小径フィルタユニットＵ３）

図１６は、小径フィルタユニットＵ３を接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

小径フィルタユニットＵ３は、給気部材５０から基板収納容器１の内部空間に供給される気体Ｇを浄化するフィルタ部材１３０を含むものである。

[0077] 小径フィルタユニットＵ３は、図１６に示すように、通気性を有するフィルタ部材１３０と、フィルタ部材１３０が接着又は保持固定される大径円筒部を有する二段円筒状のフィルタハウジング１３３と、フィルタハウジング１３３の小径円筒部が装着される装着孔１３２を有するとともに、差込孔９６に差し込まれ、嵌合係止されるパッキン１３１と、で構成されている。フィルタハウジング１３３は、プラスチック樹脂などで形成され、パッキン１３１は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。また、フィルタ部材１３０は、不織布フィルタなどで形成されている。

[0078] 小径フィルタユニットＵ３を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、パッキン１３１を差し込み、嵌合係止し、フィルタハウジング１３３を装着孔１３２に挿入装着すればよい。なお、小径フィル

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タユニットＵ３は、約１０Ｌ／ｍｉｎの気体Ｇを供給しても、通過圧損が小さいため、嵌合のみで接続されていても、嵌合が外れるようなことがない。

[0079] （大径フィルタユニットＵ４）

図１７は、大径フィルタユニットＵ４を接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

大径フィルタユニットＵ４は、小径フィルタユニットＵ３と同様に、給気部材５０から基板収納容器１の内部空間に供給される気体Ｇを浄化するフィルタ部材１４０を含むものである。

[0080] 大径フィルタユニットＵ４は、図１７に示すように、通気性を有するフィルタ部材１４０と、フィルタ部材１４０が接着又は保持固定される大径円筒部を有する二段円筒状のフィルタハウジング１４３と、フィルタハウジング１４３の小径円筒部が装着される装着孔１４２を有するとともに、差込孔９６に差し込まれ、嵌合係止されるパッキン１４１と、で構成されている。フィルタハウジング１４３は、プラスチック樹脂などで形成され、パッキン１４１は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。また、フィルタ部材１４０は、不織布フィルタなどで形成されている。

[0081] 大径フィルタユニットＵ４を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、パッキン１４１を差し込み、嵌合係止し、フィルタハウジング１４３を装着孔１４２に挿入装着すればよい。なお、大径フィルタユニットＵ４は、フィルタ部材１４０の面積が、小径フィルタユニットＵ３のフィルタ部材１３０の面積よりも約４倍大きいため、例えば、約３０Ｌ／ｍｉｎの大量の気体Ｇを供給する場合でも、通過圧損を小さくすることができる。

[0082] 上述した気体置換ユニット３Ｒ，３Ｌは、収納された基板W間に均一に気体Ｇを吹出すように構成されているのに対して、この小径フィルタユニットＵ３及び大径フィルタユニットＵ４は、基板収納容器１の内部空間における気体Ｇの均一性が重要でない場合などに利用される。なお、気体置換ユニッ

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ト３Ｒ，３Ｌは、フィルタ部材３４，３５を含むものであるから、フィルタユニット３Ｒ，３Ｌと言い換えることもできる。

[0083] 以上のとおり、本発明の実施形態に係る基板収納容器１は、複数枚の基板Ｗを収納可能な容器本体２と、容器本体２の外部から内部空間に気体Ｇを供給可能な給気部材５０と、を備え、容器本体２をフロントオープンボックスに形成し、底面２ｆに給気部材５０を取付けた基板収納容器１であって、給気部材５０は、内部空間の環境を異なる状態に変更する機能ユニットＵが、嵌合によって交換可能に接続されているものである。

[0084] これにより、給気部材５０に各種の機能ユニットＵを取付けることができるため、容器本体２から機能ユニットＵを簡単に取付け又は取外しをすることができる。容器本体２を洗浄する際も、機能ユニットＵを容易に取外すことができ、容器本体２内を隅々まで洗浄することができる。また、取外した機能ユニットＵも簡単に洗浄することができる。

[0085] 実施形態では、給気部材５０は、気体を濾過する濾過部材５１を有する。これにより、フィルタを有さない機能ユニットＵを接続する場合であっても、機能ユニットＵから、塵埃を含んだ気体Ｇが吹出されることを抑制できるし、また、フィルタユニットＵ２，Ｕ３などのフィルタを有する機能ユニットＵを接続する場合は、二重に塵埃を除去することができ、機能ユニットＵのフィルタ交換間隔を長くすることができる。さらに、容器本体２を洗浄する際に使用される洗浄液などの液体が、疎水性の濾過部材５１により、液体の侵入を防止することができる。

[0086] 実施形態では、機能ユニットＵは、給気部材５０から供給された気体Ｇを貯留するハウジング部材３１と、ハウジング部材３１の開口を覆うカバー部材３２と、ハウジング部材３１及びカバー部材３２の少なくとも一方に形成された気体を吹出す吹出孔と、を含む気体置換ユニット３Ｒ，３Ｌである。これにより、気体置換ユニット３Ｒ，３Ｌの吹出孔から吹出した気体Ｇは、容器本体２の中央付近、側壁２ｃ，２ｄ、背面壁２ｂに向かって流すことができる。

[0087] 実施形態では、機能ユニットＵは、内部空間への気体Ｇの流通を可能にするチェックバルブ１１０を含むバルブユニットＵ１である。これにより、基板収納容器１の内部空間における気体Ｇの均一性が重要でない場合などは、気体置換ユニット３Ｒ，３Ｌを利用する必要がない。

[0088] 実施形態では、機能ユニットＵは、内部空間への気体Ｇの流通を不能にする閉塞ユニットＵ２である。これにより、給気部材５０を介して、基板収納容器１の内部空間と外部の雰囲気との間で、気体Ｇ又は空気などが流通することを、より確実に防止することができる。

[0089] 実施形態では、機能ユニットＵは、内部空間に供給される気体Ｇを浄化するフィルタ部材を含むフィルタユニットＵ３，Ｕ４である。これにより、供給される気体Ｇに塵埃が含まれていても、フィルタ部材１３０，１４０で捕獲することができるため、容器本体２内に塵埃が吹出されることがなく、基板収納容器１の内部空間が汚染されることがない。

[0090] 実施形態では、気体Ｇは、窒素ガス又はドライエアである。これにより、基板収納容器１の内部空間に気体Ｇを供給した場合、内部空間が不活性又は低湿度に維持されるので、基板Ｗの表面は変質することがない。

[0091] （変形例）

実施形態の気体置換ユニット３Ｒ，３Ｌにおいて、第１吹出孔群３１ａ－ｚ、第３吹出孔群３３ａ－ｚ及び第２吹出孔群３２ａ－ｆの開口面積や数量や配置も実施形態に限らず、底面２ｆの上面に沿って吹き込むダウンフローエアなどの外部からエアに対向できるように、下方の吹出風量を増やすように構成してもよい。

[0092] また、第２吹出孔群３２ａ－ｆを選択的に塞いだり、追加で穿設したりすることで、正面Ｆ方向及び後方Ｂ方向への吹出風量の比率を調整してもよい。さらに、オフセット部材９の凹部９２の位置を変更することで、気体置換ユニット３Ｒ，３Ｌの方向を変更してもよい。あるいは、ハウジング部材３１の２つの面部３１Ａ，３１Ｂの交差角度を変更したり、面積を変更したりして、吹出方向及び／又は吹出風量の比率を調整してもよい。なお、これら

の変更は、成形金型に入れ子を用いることで対応することができる。

[0093] また、ハウジング部材３１は、上部でなく中央部で位置決め固定されてもよく、あるいは、上部及び中央部で位置決め固定されてもよい。このとき、背面壁２ｂに形成される貫通孔２７の位置は、適宜変更され、位置決め固定部材８の形状も適宜変更される。

[0094] 上記実施形態において、気体置換ユニット３Ｒ，３Ｌの他に、他の気体置換ユニットを複数備えてもよいし、逆に気体置換ユニット３Ｒ又は３Ｌのいずれか１つであってもよい。また、気体置換ユニット３Ｒ，３Ｌは、後方Ｂの左右の２か所に限らず、後方Ｂの中央部に基板Ｗと干渉しない領域があれば、その領域に配置してもよい。

[0095] 以上、本発明の好ましい実施形態について詳述したが、本発明は上述した実施形態に限定されるものではなく、特許請求の範囲に記載された本発明の要旨の範囲内において、種々の変形、変更が可能である。

符号の説明

[0096] １　基板収納容器

２　容器本体、２ａ　正面開口枠、２ｂ　背面壁、２ｃ　右側壁、２ｄ　左側壁、２ｅ　天面、２ｆ　底面、２１　支持片、２２　位置規制部、２３　グリップ、２５　トップフランジ、２６　ボトムプレート、２７　貫通孔、２８　ストッパ、２９　取付孔

３Ｒ，３Ｌ　気体置換ユニット、３１　ハウジング部材、３１Ａ，３１Ｂ　面部、３１１　接続具、３１２　回止め突起、３１３　位置決め突起、３２　カバー部材、３１ａ・・・３１ｚ　第１吹出孔、３２ａ・・・３２ｆ　第２吹出孔、３３ａ・・・３３ｚ　第３吹出孔、３４，３５　フィルタ部材

４　蓋体

５０　給気部材、５０ａ　グロメット、５１　濾過部材、５２　逆止弁、５３　コイルバネ、５４　バルブハウジング

６０　排気部材

８　位置決め固定部材、８１，８２，８３　フランジ、８４Ａ，８４Ｂ　Ｏリング、８５　Ｃリング、８６　スリット、８７　端部、８８　切欠き

９　オフセット部材、９０　オフセットプレート押さえ、９１　Ｏリング、９２　凹部、９３　パッキン、９４　Ｏリング、９５　オフセットプレート、９６　差込孔

Ｆ　正面、Ｂ　後方、Ｇ　気体、Ｗ　基板、ＮＬ　法線

Ｕ　機能ユニット

Ｕ１　バルブユニット、１１０　チェックバルブ、１１１　コイルバネ、１１２　バルブハウジング

Ｕ２　閉塞ユニット、１２０　プラグ本体、１２１　パッキン

Ｕ３　小径フィルタユニット、１３０　フィルタ部材、１３１　パッキン、１３３　フィルタハウジング

Ｕ４　大径フィルタユニット　１４０　フィルタ部材、１４１　パッキン、１４３　フィルタハウジング

請求の範囲

[請求項1] 複数枚の基板を収納可能な容器本体と、

前記容器本体の外部から内部空間に気体を供給可能な給気部材と、を備え、

前記容器本体をフロントオープンボックスに形成し、底面に前記給気部材を取付けた基板収納容器であって、

前記給気部材は、前記内部空間の環境を異なる状態に変更する機能ユニットが、嵌合によって交換可能に接続されている

ことを特徴とする基板収納容器。

[請求項2] 前記給気部材は、前記気体を濾過する濾過部材を有する

ことを特徴とする請求項１に記載の基板収納容器。

[請求項3] 前記機能ユニットは、

前記給気部材から供給された前記気体を貯留するハウジング部材と、

前記ハウジング部材の開口を覆うカバー部材と、

前記ハウジング部材及び前記カバー部材の少なくとも一方に形成された前記気体を吹出す吹出孔と、を含む気体置換ユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項4] 前記機能ユニットは、前記内部空間への前記気体の流通を可能にするチェックバルブを含むバルブユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項5] 前記機能ユニットは、前記内部空間への前記気体の流通を不能にする閉塞ユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項6] 前記機能ユニットは、前記内部空間に供給される前記気体を浄化するフィルタ部材を含むフィルタユニットである

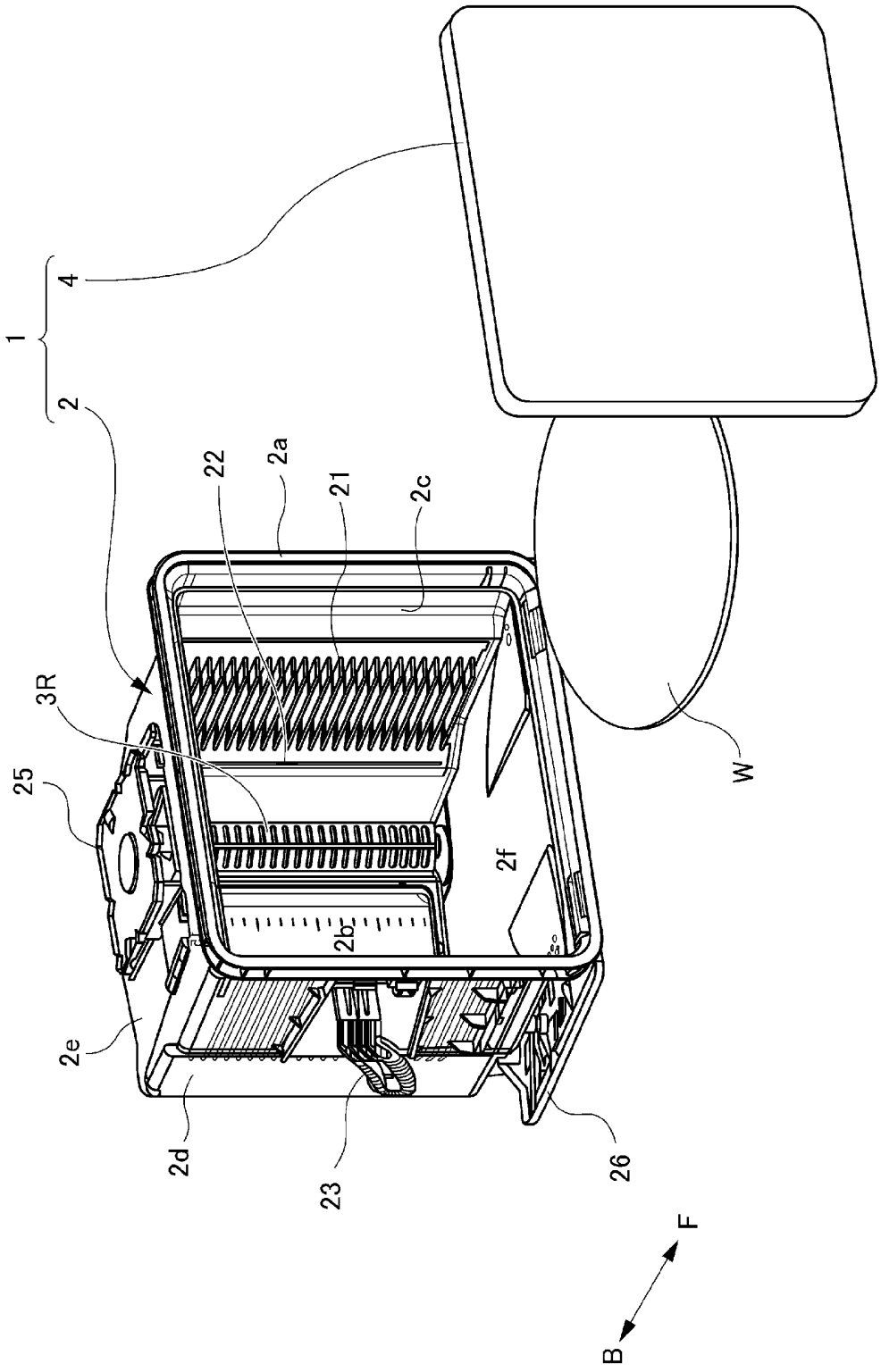
ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項7] 前記気体は、窒素ガス又はドライエアである

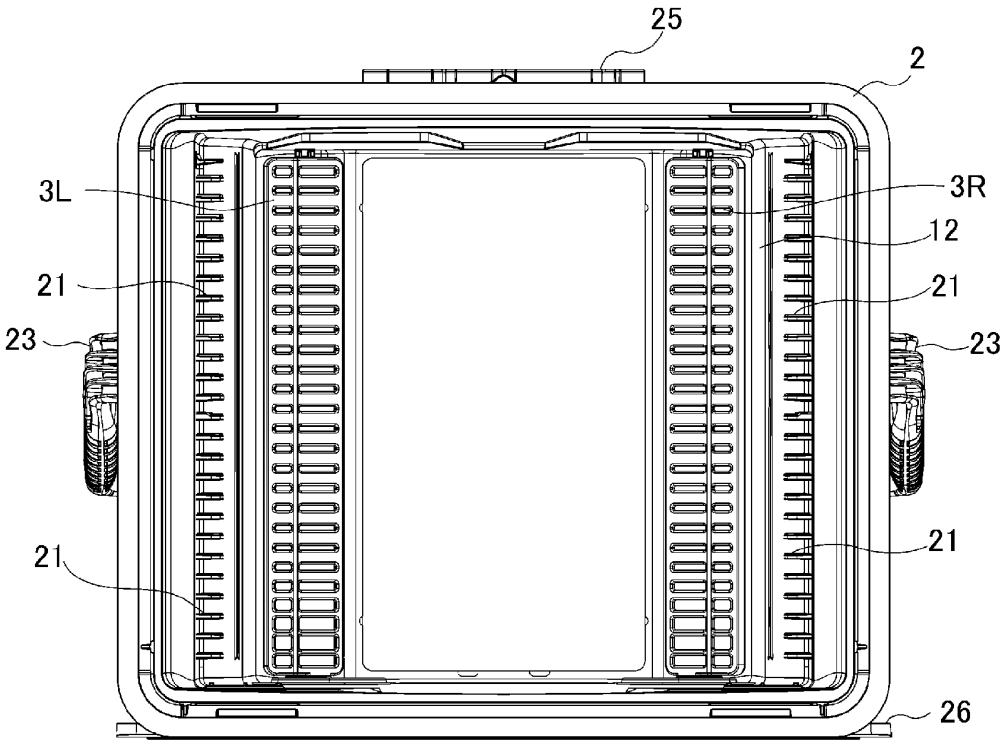
Entegris, EX1002, p. 614

ことを特徴とする請求項１から６までのいずれか１項に記載の基板収納容器。

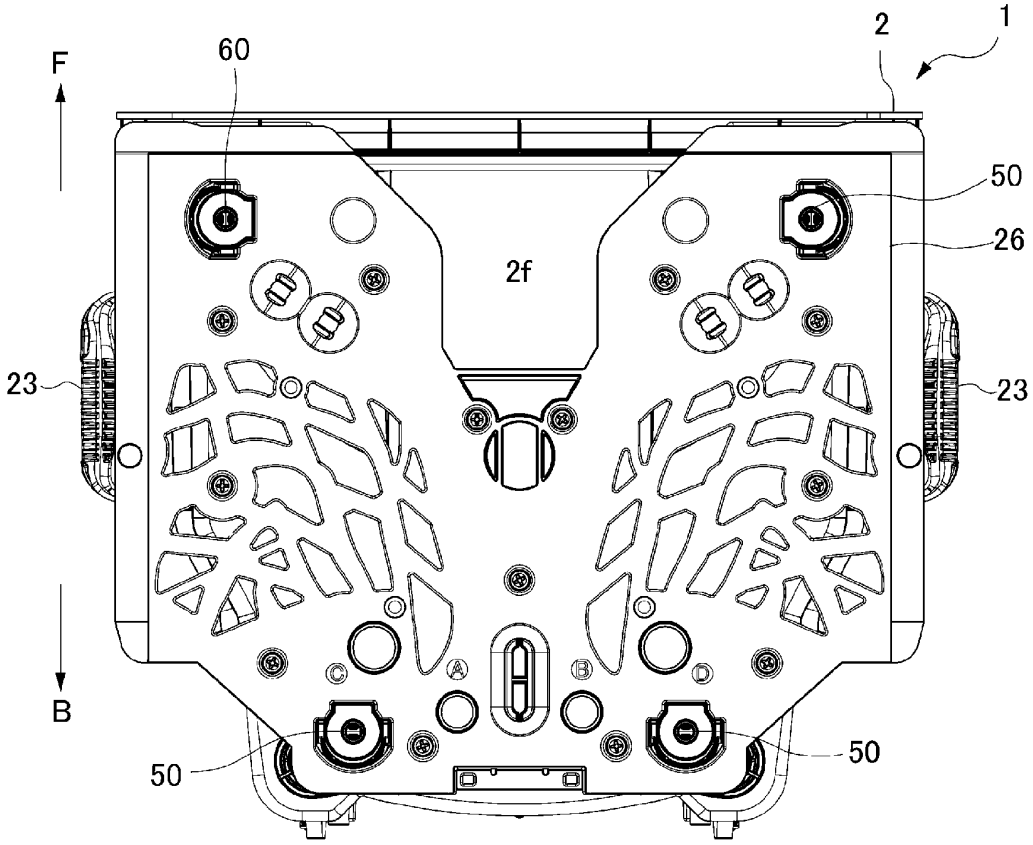
[図1]



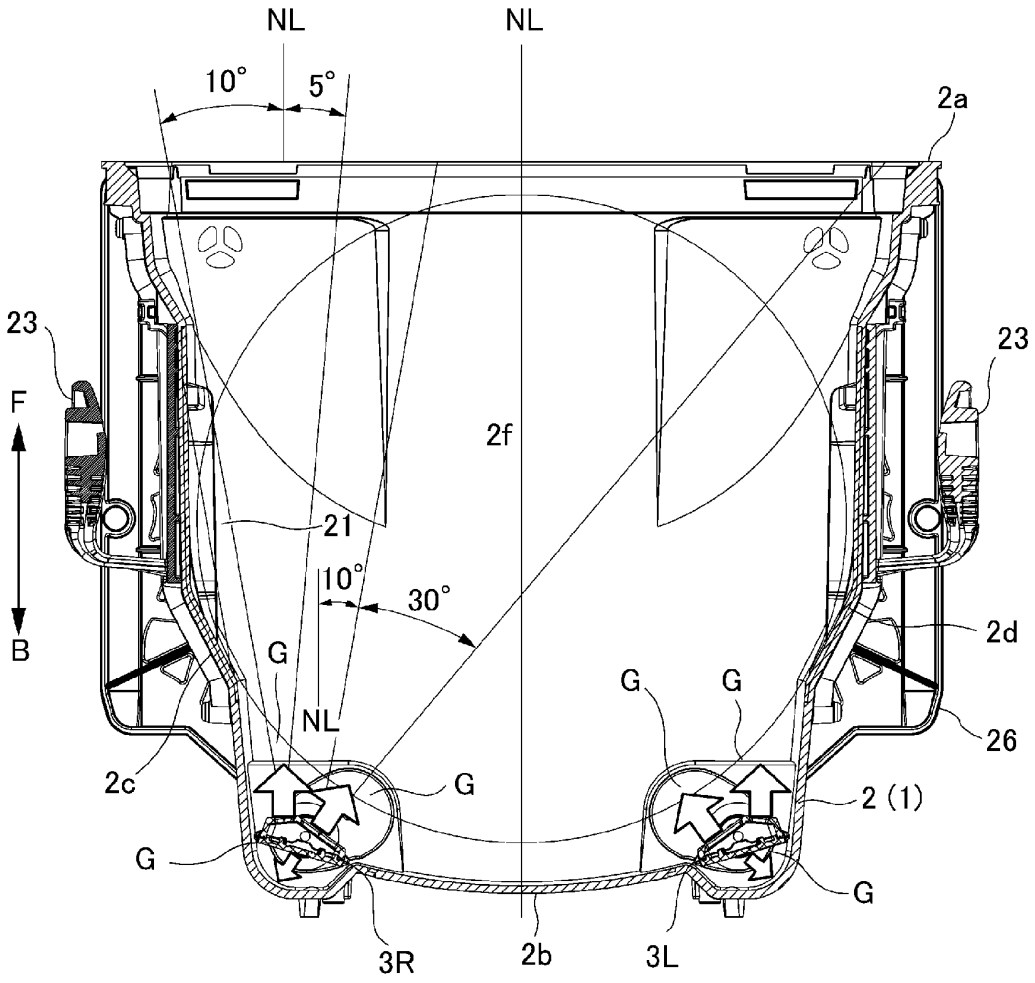
[図2]



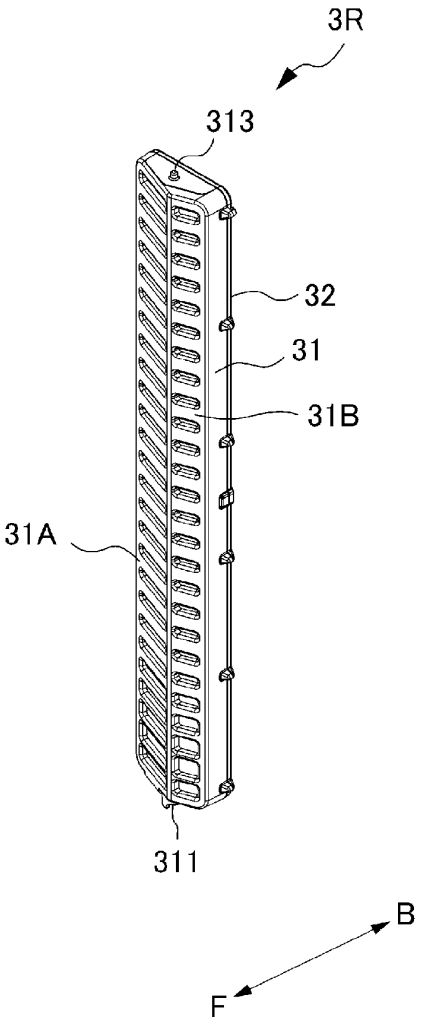
[図3]



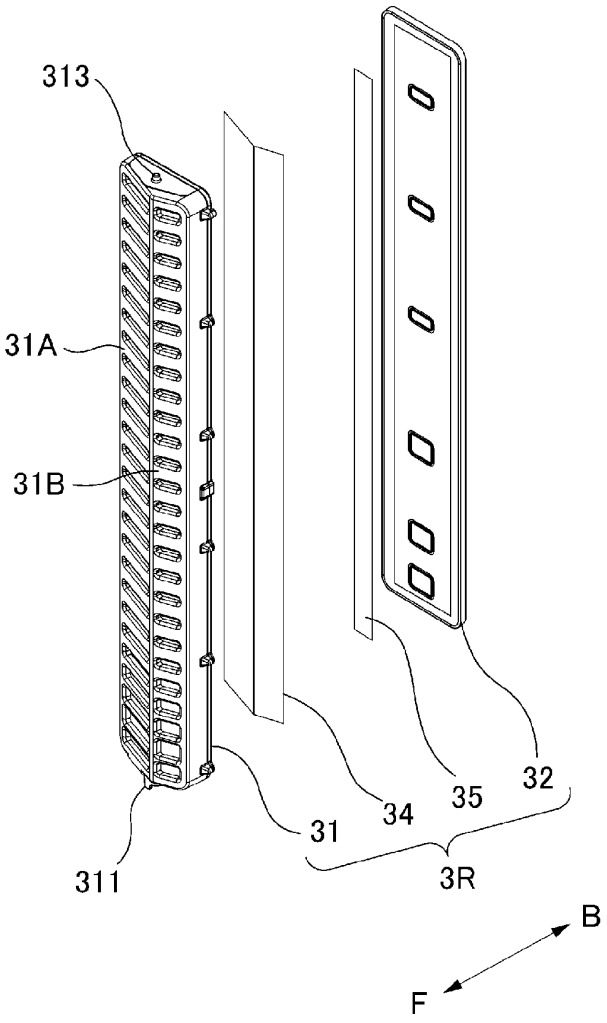
[図4]



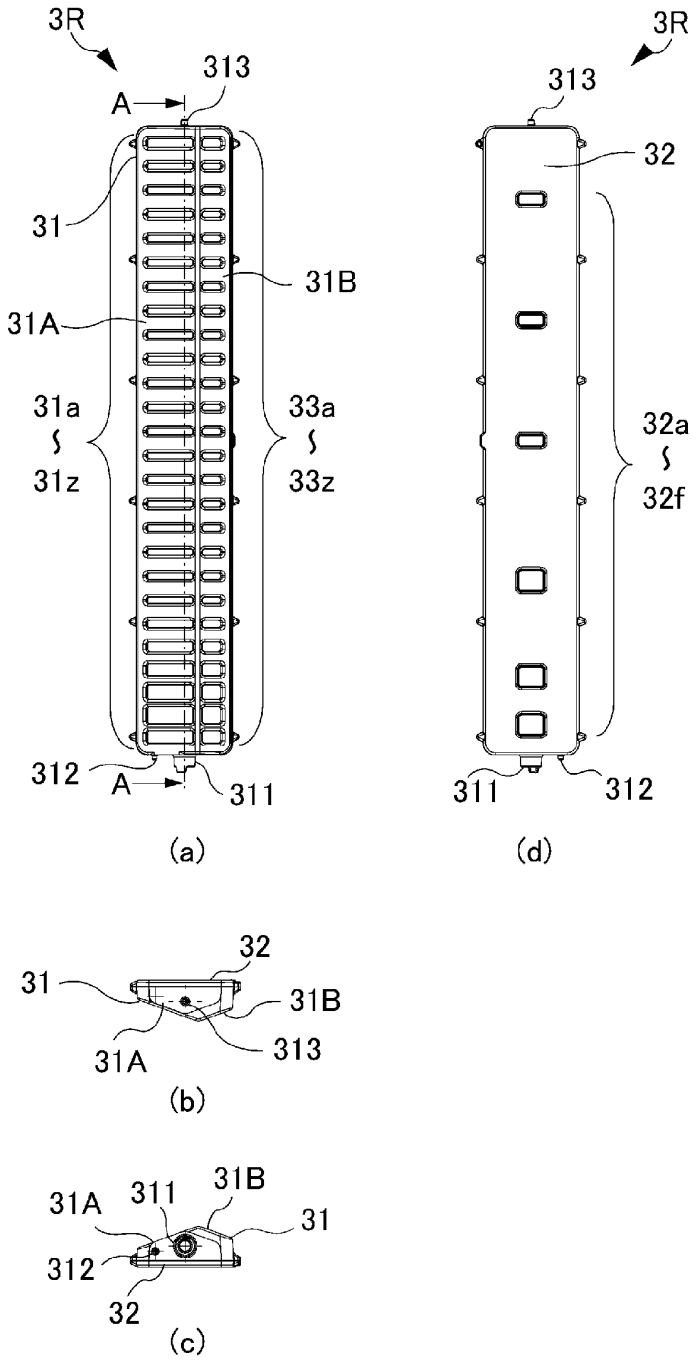
[図5]



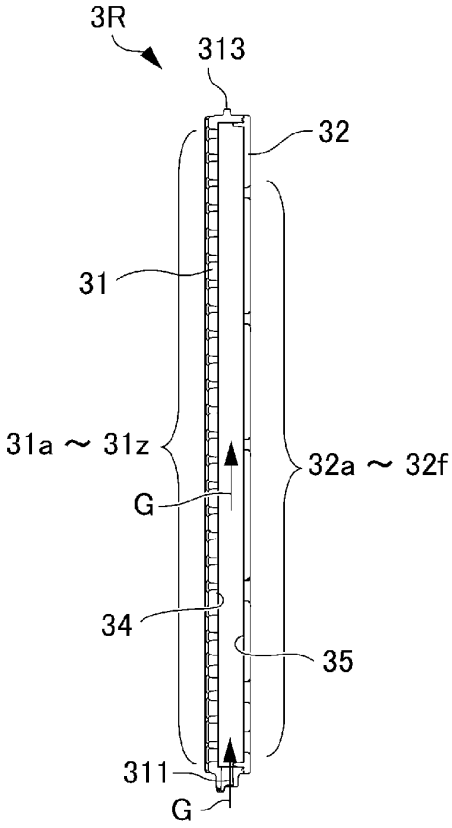
[図6]



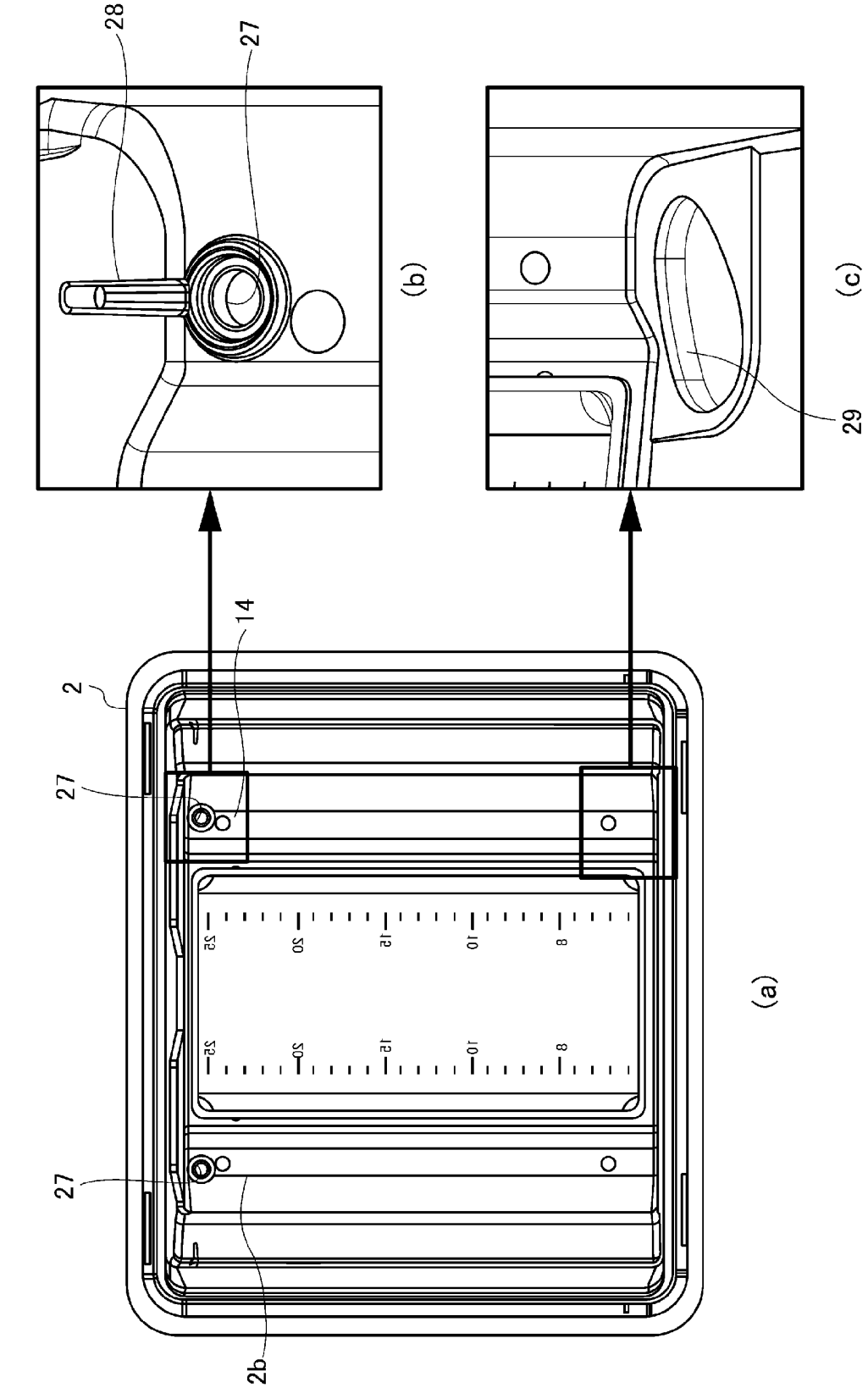
[図7]


3R
313
A
31
31B
31A
31a
31z
33a
33z
312
A
311
(a)
3R
313
32
32a
32f
311
312
(d)
32
31
31B
31A
313
(b)
31A
311
31B
31
312
32
(c)

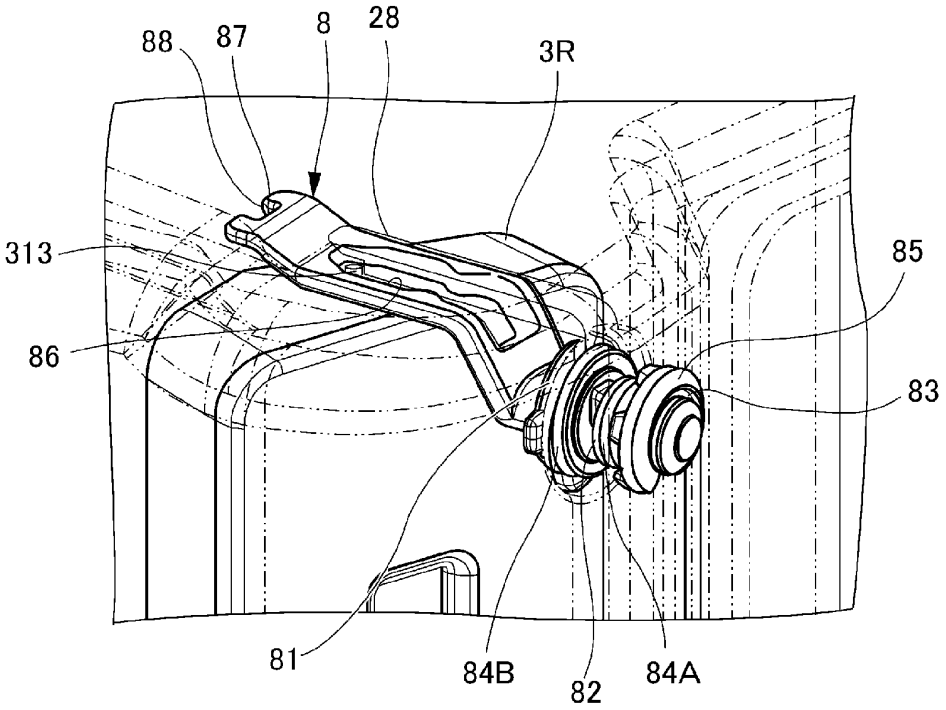
[図8]



[図9]

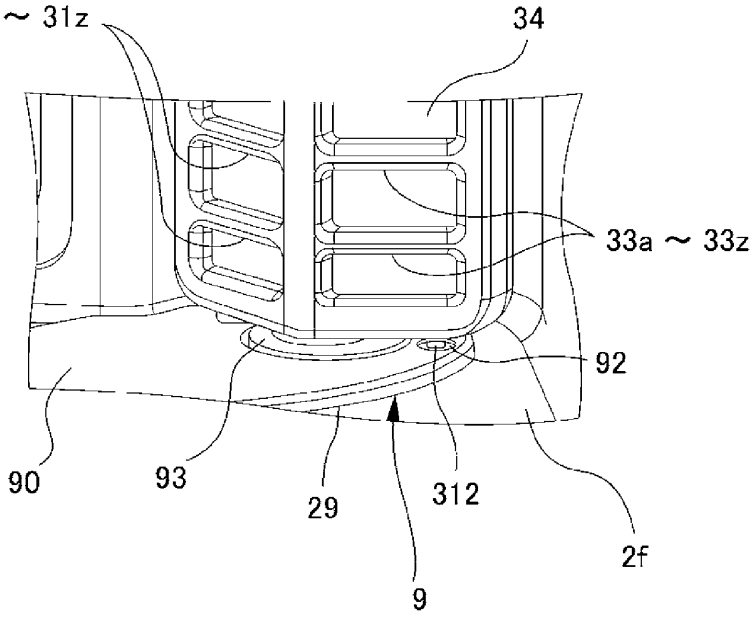


[図10]

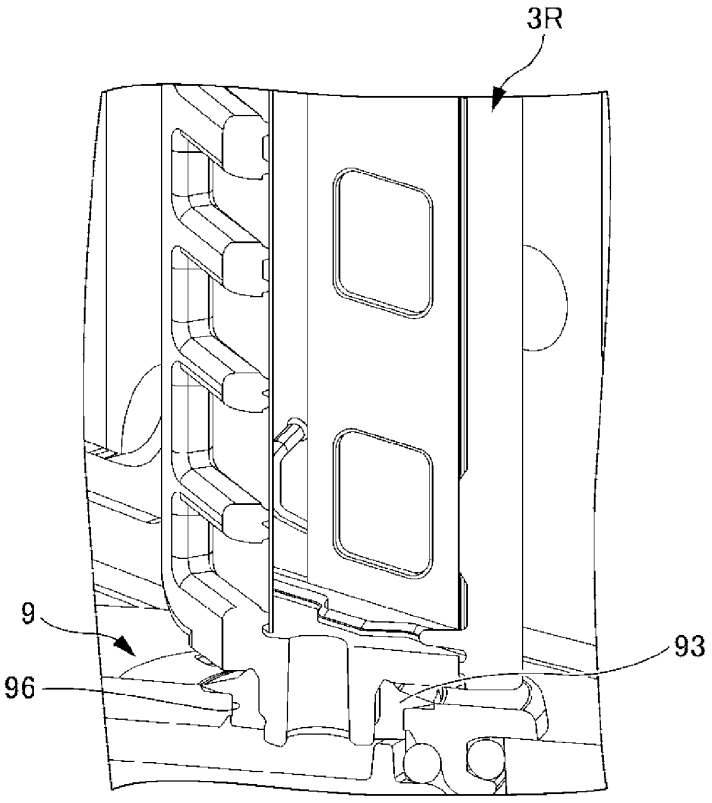


[図11]

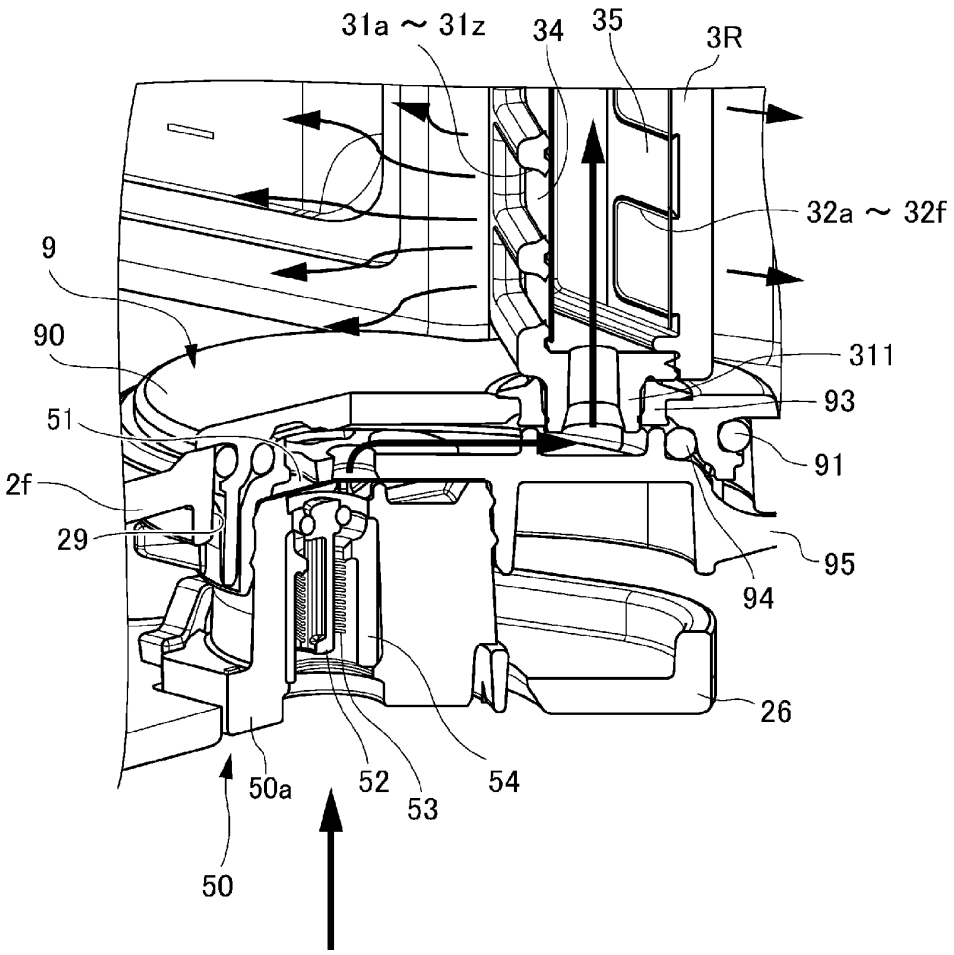
(a)



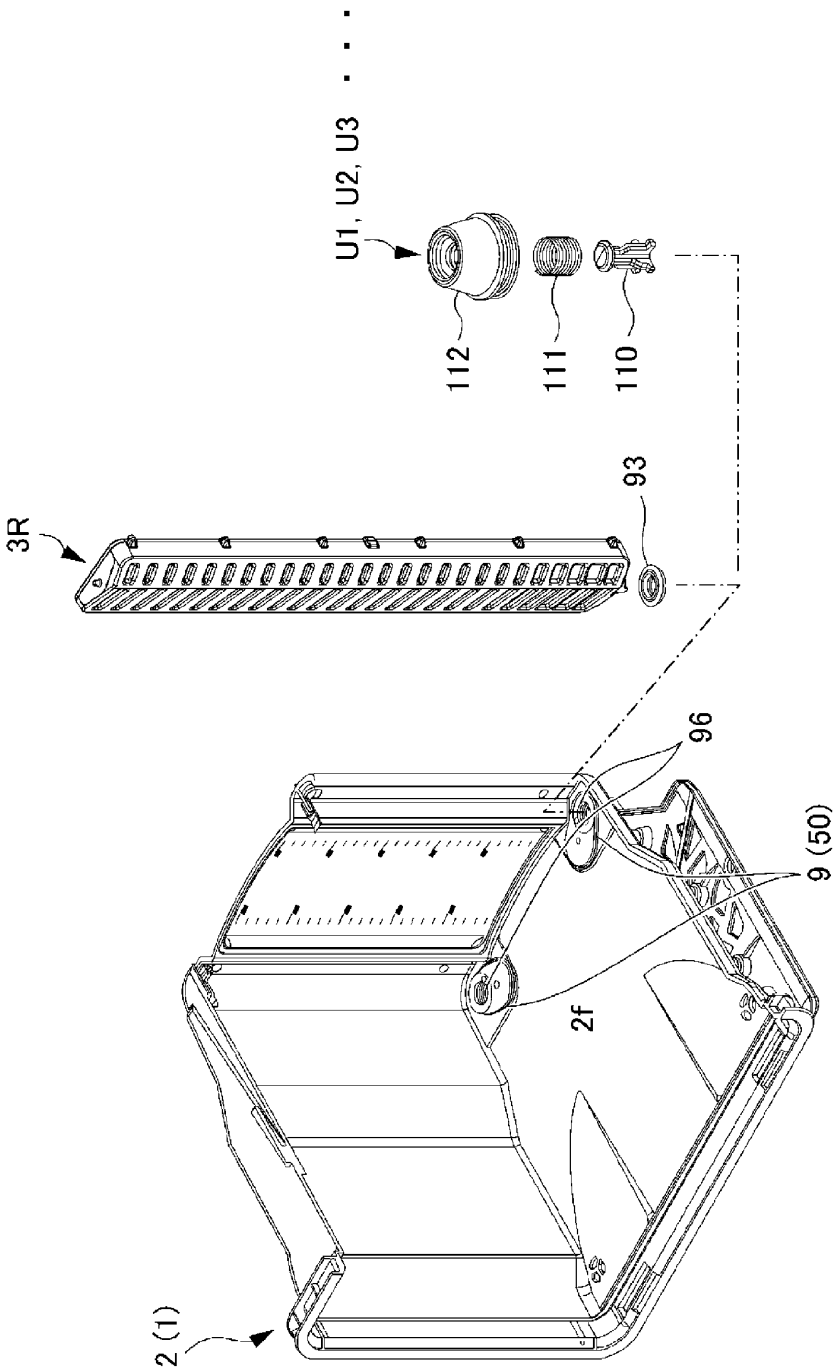
(b)



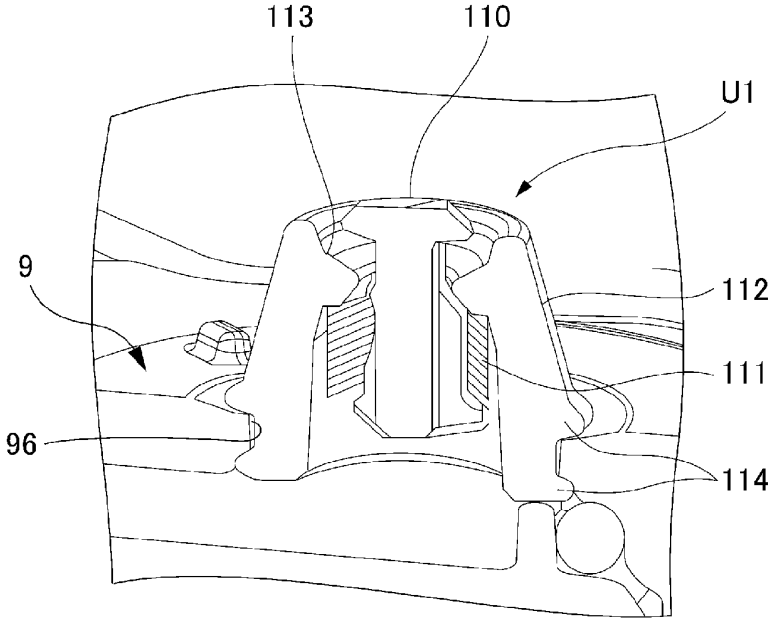
[図12]


31a ～ 31z
34
35
3R
32a ～ 32f
9
90
311
93
51
91
2f
29
95
94
26
50a
52
53
54
50

[図13]

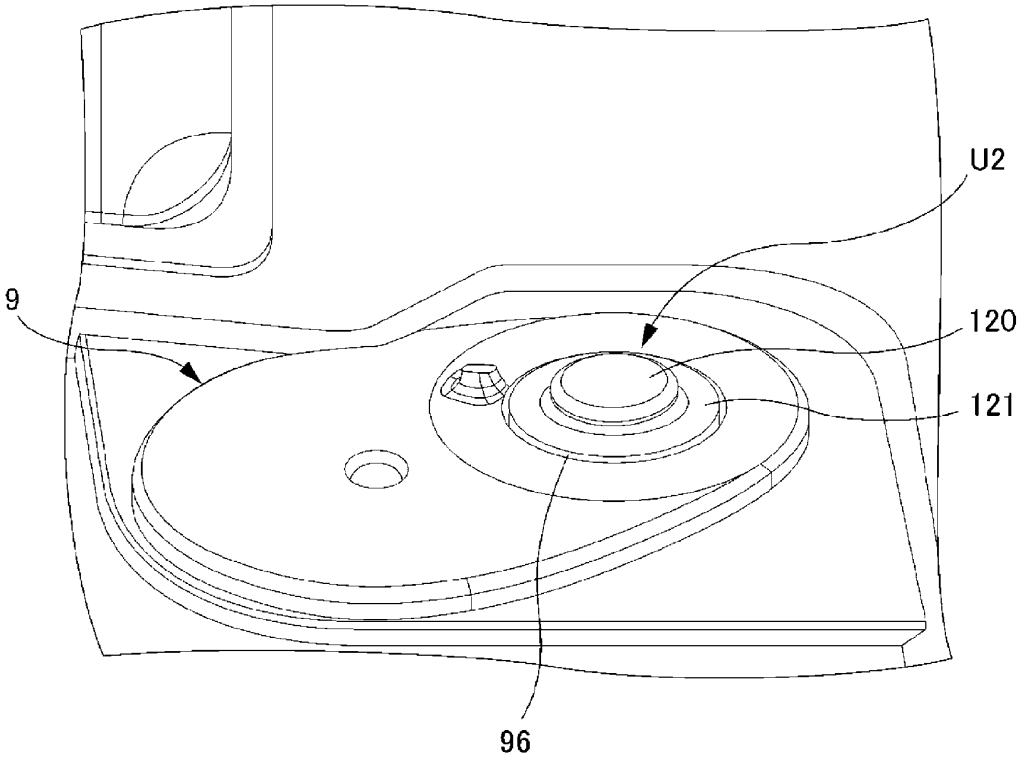


[図14]

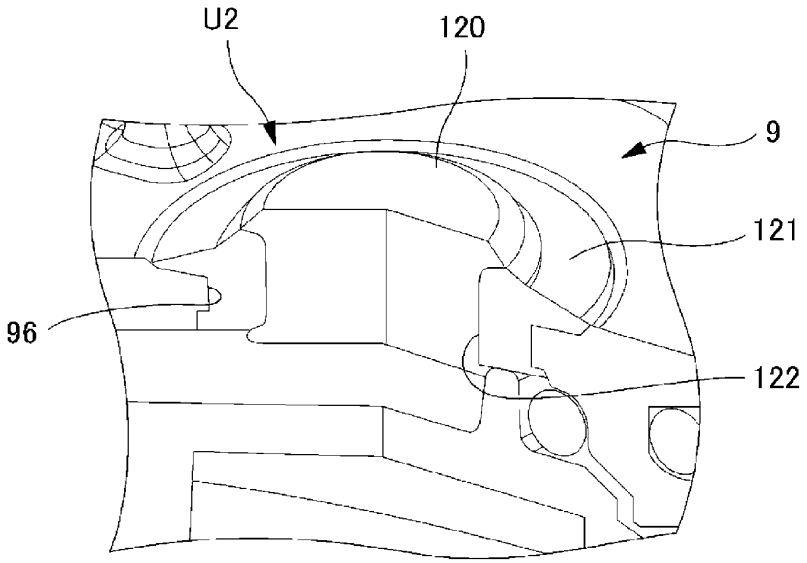


[図15]

(a)

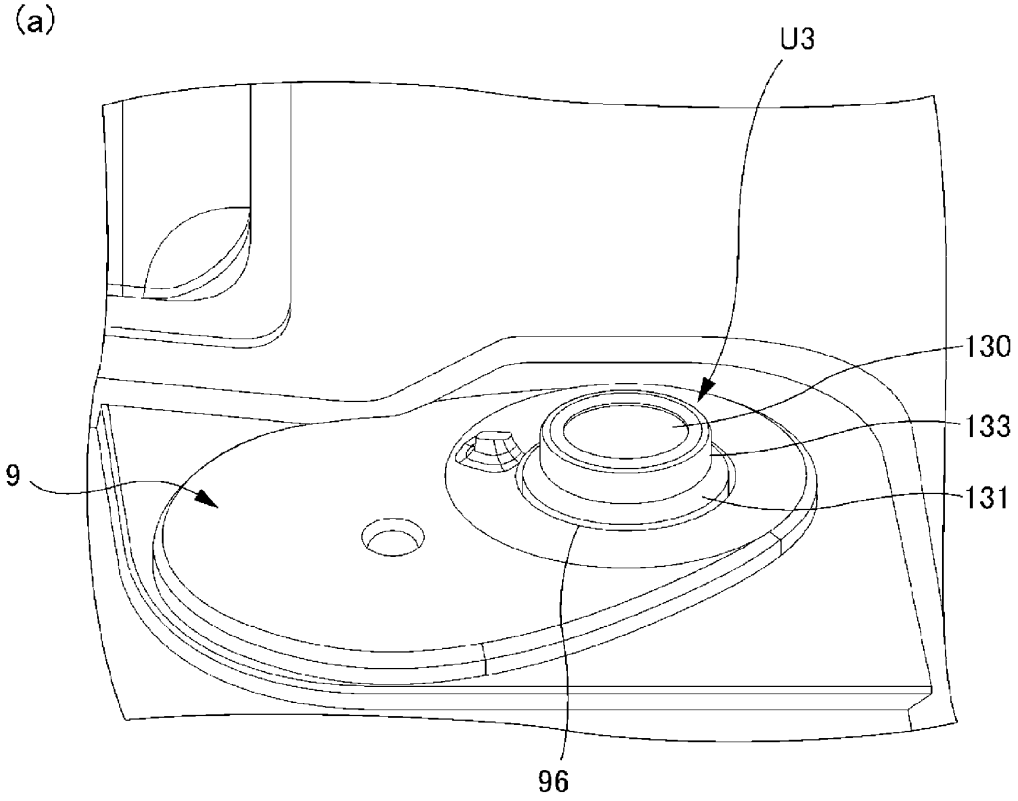


(b)

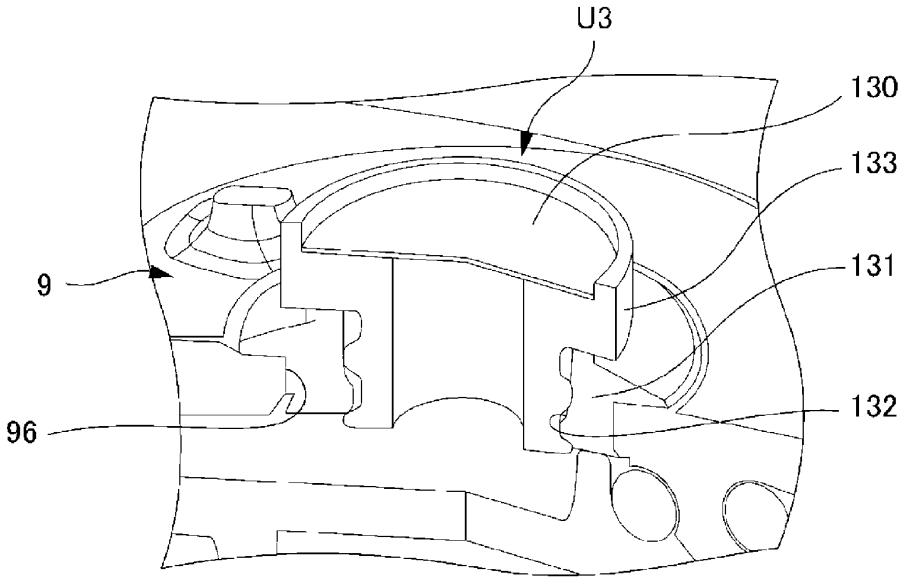


[図16]

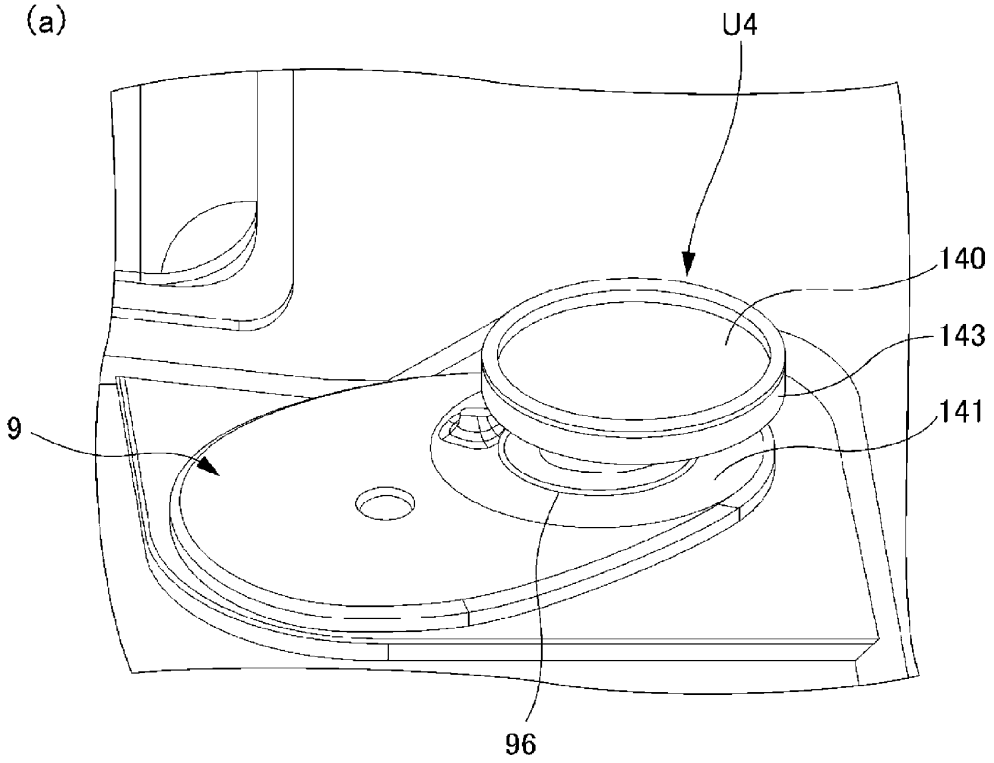
(a)

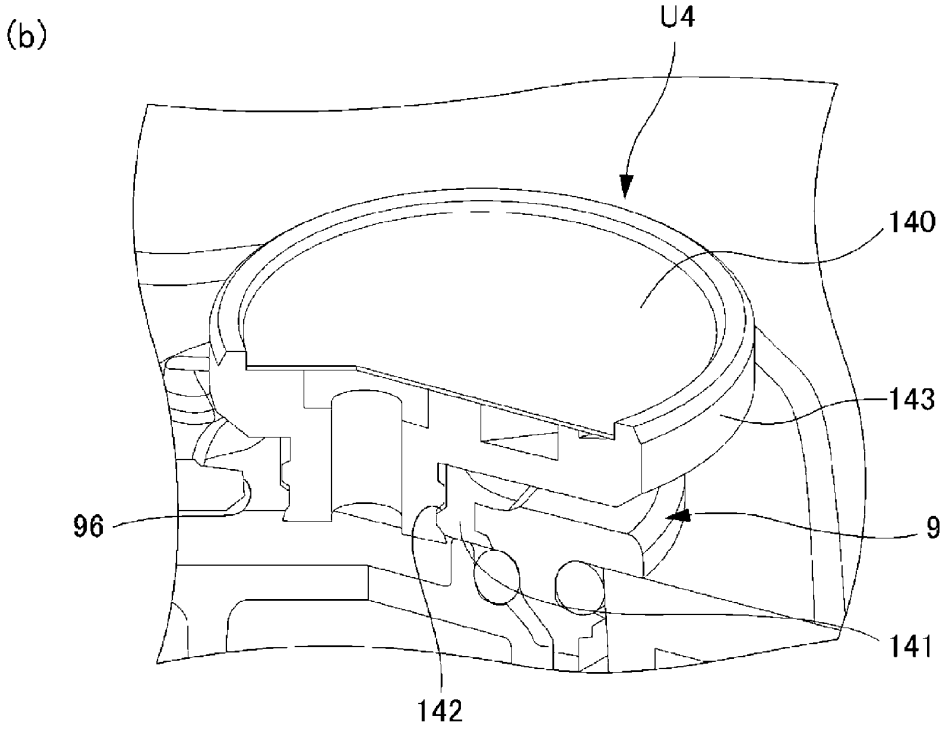


(b)



[図17]





INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/005296

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. H01L21/673(2006.01)i, B65D85/30(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. H01L21/673, B65D85/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2016/013536 A1 (SHIN-ETSU POLYMER CO., LTD.) 28 January 2016, paragraphs [0038]-[0092], fig. 3-13 & US 2017/0213752 A1, paragraphs [0075]-[0130], fig. 3-13 & DE 112015003423 T & CN 106537574 A & KR 10-2017-0038846 A & TW 201622047 A	1-4, 6-7 5
Y	JP 2011-181930 A (ENTEGRIS, INC.) 15 September 2011, claims, paragraphs [0017]-[0035], fig. 1-6 & US 2005/0252827 A1, claims, paragraphs [0023]-[0041], fig. 1-6 & WO 2005/102872 A2 & EP 1737763 A2 & KR 10-2007-0007936 A & CN 1968872 A & TW 200605372 A	5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23.03.2018	03.04.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/005296

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2016/135952 A1 (MIRAIAL CO., LTD.) 01 September 2016, paragraphs [0075]-[0094], fig. 11, 12 & TW 201630668 A	1-7
A	JP 2014-160783 A (SHIN-ETSU POLYMER CO., LTD.) 04 September 2014, paragraphs [0016]-[0047], fig. 1-17 (Family: none)	1-7
A	WO 2016/089912 A1 (ENTEGRIS, INC.) 09 June 2016, entire text, all drawings & US 2017/0271188 A1 & CN 107110389 A & KR 10-2017-0088411 A & TW 201633429 A & JP 2018-505546 A	1-7
A	JP 2016-538732 A (ENTEGRIS, INC.) 08 December 2016, entire text, all drawings & US 2016/0276190 A1 & WO 2015/057739 A1 & EP 3058585 A1 & TW 201530679 A & KR 10-2016-0068937 A & CN 105900217 A	1-7

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国際調査報告

国際出願番号　ＰＣＴ／ＪＰ２０１８／００５２９６

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Int.Cl.　H01L21/673(2006.01)i, B65D85/30(2006.01)i

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Int.Cl.　H01L21/673, B65D85/30

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２０１８年
日本国実用新案登録公報	１９９６－２０１８年
日本国登録実用新案公報	１９９４－２０１８年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
X Y	WO 2016/013536 A1 (信越ポリマー株式会社) 2016.01.28, 段落[0038]-[0092], 図 3-13 & US 2017/0213752 A1, 段落[0075]-[0130], 図 3-13 & DE 112015003423 T & CN 106537574 A & KR 10-2017-0038846 A & TW 201622047 A	1-4, 6-7 5

☑ Ｃ欄の続きにも文献が列挙されている。　　☐ パテントファミリーに関する別紙を参照。

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国際調査を完了した日	国際調査報告の発送日
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国際調査機関の名称及びあて先	特許庁審査官（権限のある職員）		
日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	宮久保　博幸	５Ｏ	３１３６
	電話番号　０３－３５８１－１１０１　内線　３５５９		

様式ＰＣＴ／ＩＳＡ／２１０（第2ページ）（２０１５年1月）

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Y	JP 2011-181930 A (インテグリス・インコーポレーテッド) 2011.09.15, 特許請求の範囲, 段落[0017]-[0035], 図 1-6 & US 2005/0252827 A1, 特許請求の範囲, 段落[0023]-[0041], 図 1-6 & WO 2005/102872 A2 & EP 1737763 A2 & KR 10-2007-0007936 A & CN 1968872 A & TW 200605372 A	5
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A	JP 2014-160783 A (信越ポリマー株式会社) 2014.09.04, 段落[0016]-[0047], 図 1-17 (ファミリーなし)	1-7
A	WO 2016/089912 A1 (ENTEGRIS, INC.) 2016.06.09, 全文, 全図 & US 2017/0271188 A1 & CN 107110389 A & KR 10-2017-0088411 A & TW 201633429 A & JP 2018-505546 A	1-7
A	JP 2016-538732 A (インテグリス・インコーポレーテッド) 2016.12.08, 全文, 全図 & US 2016/0276190 A1 & WO 2015/057739 A1 & EP 3058585 A1 & TW 201530679 A & KR 10-2016-0068937 A & CN 105900217 A	1-7

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(71) Applicant: **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billerica, Massachusetts 01821 (US).

(72) Inventors: **SMITH, Mark V.**; 4110 Bobbie Kay Place, Colorado Springs, Colorado 80908 (US). **THELEN, Nicholas**; 1713 Arbor Way, Colorado Springs, Colorado 80905 (US). **FULLER, Matthew A.**; 4910 Sunbird Cliffs Drive, Colorado Springs, Colorado 80919 (US). **ZABKA, Michael C.**; 24496 W. Cedar Lake Drive, New Prague, Minnesota 56071 (US). **MOON, Sung In**; 1979 Schoolmaster Drive, Chaska, Minnesota 55318 (US). **PUGLIA, John P.**; 64 Pierce Road, Townsend, Massachusetts 01469 (US).

(74) Agent: **GATES, Catherine D.** et al.; 129 Concord Road, Billerica, Massachusetts 01821 (US).

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(54) Title: MEMBRANE DIFFUSER FOR A SUBSTRATE CONTAINER

(57) Abstract: Purge diffusers for use in systems for transporting substrates include: i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface; ii) filter media secured to the outer surface of the purge diffuser core; and iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates. The purge diffuser core may be a unitary article, may be formed by injection molding, and may include diverters internal to the internal purge gas channel.

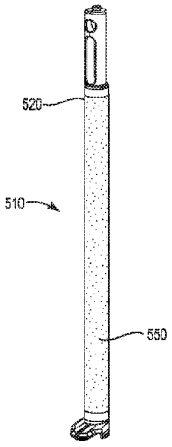


FIG. 7A

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[Continued on next page]

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MEMBRANE DIFFUSER FOR A SUBSTRATE CONTAINER

Cross-Reference to Related Applications

[0001] This application claims the benefit of: United States Provisional Application No. 62/723,979, filed August 28, 2018; United States Provisional Application No. 62/837,389, filed April 23, 2019; and United States Provisional Application No. 62/874,647, filed July 16, 2019, all of which are incorporated herein by reference in their entireties for all purposes.

Technical Field

[0002] This disclosure relates to systems for transporting or storing substrates which include a container and a system for purging the environment within the container to desired levels of relative humidity, oxygen, and airborne particulates.

Background of the Disclosure

[0003] In general, specialized carriers or containers are utilized for transporting and/or storing batches of silicon wafers or substrates before, during and after processing of the wafers or substrates. The term substrate as used herein can refer to one or more of semiconductor wafers, magnetic discs, flat panel substrates, and other such substrates.

[0004] Such containers are generally configured to axially arrange the substrates in slots, and to support the substrates in slots by or near their peripheral edges. The substrates are conventionally removable from the containers in a radial direction upwardly or laterally. Exemplary containers used to convey wafers or substrates can include front opening unified pods (FOUPs) or front opening shipping boxes (FOSBs). In certain configurations, the container portions of the substrate carriers have been provided with openings or passageways to facilitate the introduction and/or exhaustion of gases such as nitrogen or other purified gasses, into the internal environment of the carrier to displace ambient air that might contain contaminants.

[0005] During processing of semiconductor substrates or wafers, the presence of or generation of particulates can present significant contamination problems. Contamination is accepted as the single largest cause of yield loss in the semi-conductor industry. As the size of integrated circuitry has continued to be reduced, the size of particles which can contaminate an integrated circuit has also become smaller making minimization of contaminants all the more critical.

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[0006] Currently, to produce a clean space for accommodating substrates when transported or stored, the internal environment of the carrier is purged using an inert gas or clean dry air (CDA) which is injected into the interior of the container through an inlet port causing the air within the container to exit through an outlet port. These purge gas inlet and outlet ports are generally located on the bottom surface of the container body or shell and extend from the interior through the shell bottom surface where they interface with the purge gas delivery system. One goal of purging is to decrease humidity and oxygen levels in the internal volume of the microenvironment. A challenge of purging is to evenly distribute the purge gas fast and effectively over the substrates within the container. Another goal of purging is to remove airborne contaminants from the environment within the container. However, these contaminants may become trapped in filtering mechanisms of the purge system itself, leading to cross-contamination and requiring additional cleaning.

[0007] A need therefore exists for improved purging methods and equipment which solve the problems of evacuating the wafer container in a fast and efficient manner while at the same time controlling relative humidity and oxygen concentration internal environment of the wafer container. Additionally, a need exists for a purging method and apparatus that can allow high flow rates of purge gas at low pressure differentials while minimizing the propensity of the purge system itself to entrain contaminants.

Summary

[0008] Briefly, the present disclosure provides purge diffusers for use in systems for transporting substrates as well as systems comprising such purge diffusers. According to various embodiments as described herein, the present disclosure provides a purge diffuser that minimizes particulate contamination while at the same time controlling relative humidity and oxygen concentrations within an internal environment of a container containing such a purge diffuser. Additionally, the purge diffuser is capable of controlling back pressure in the system so as not to lose a static seal interface with a static purge source during high flow rates of an inert gas while achieving particle filtration efficiencies of greater than 99%.

[0009] Purge diffusers according to the present disclosure generally include: i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface; ii) filter media secured to the outer surface of the purge diffuser core; and iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates. These elements are arranged such that purge gas entering through the

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purge port connector enters the internal purge gas channel, exits the internal purge gas channel through the diffuser ports, and passes through the filter media into the interior of a substrate container. In some embodiments, the purge diffuser core is a unitary article of integral construction and, in some cases, is fabricated from an injection-moldable, melt processable polymer in a single molding. In various non-limiting embodiments, the filter media can be directly bound to the outer surface of the purge diffuser core, e.g., by weld bonds, secured to the outer surface of the purge diffuser core by an adhesive, or secured to the outer surface of the purge diffuser core by a filter media bracket, in which case the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core. Such a filter media bracket may be attached to the purge diffuser core by welding, friction fit, adhesive, fasteners, or other mechanisms. In certain embodiments, the filter media can include a mesh scrim disposed or wrapped over the outer surface of the filter media to protect the filter media.

[0010] According to various embodiments, the filter media is a porous hydrophobic film or membrane including a polyolefin, polyester, polysulfone, or fluoropolymer, and can have a thickness of between: 10 and 1300 micrometers; of between 10 and 1000 micrometers; of between 10 and 500 micrometers; or of between 40 and 150 micrometers. In some embodiments, the filter media is porous hydrophobic membrane, and in certain embodiments, the filter media is a hydrophobic ultra-high molecular weight polyethylene (UPE) membrane. In many cases, the membrane or film is preferably not pleated and is a non-pleated membrane or film. The film or membrane can be employed to enable sieving or non-sieving of contaminants, depending on the potential contaminants.

[0011] According to various embodiments, the purge diffuser core includes a plurality of diffuser ports. Purge gas exits the internal purge gas channel through diffuser ports and passes through the filter media disposed or wrapped over the purge diffuser core and into the interior of the substrate container.

[0012] In some embodiments, the purge diffuser core additionally includes one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel. In some embodiments, the diverters are staggered to enable injection-molding of the purge diffuser core as a unitary article in a single molding.

[0013] In other embodiments, the present disclosure provides systems including purge diffusers according to the present disclosure and a substrate container including a container portion with

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an opening, a door adapted to be received in the opening so as to seal the internal environment of the substrate container, and a purge port to admit purge gas to an interior of the substrate container. The purge diffuser is mounted by its purge port connector to the purge port. In some embodiments the substrate container is a Front Opening Unified Pod (FOUP).

[0014] In another embodiment, the present disclosure provides methods of making purge diffusers according to the present disclosure, comprising: a) molding the purge diffuser core as single unitary article; and b) securing filter media to the outer surface of the purge diffuser core. In some embodiments, molding the purge diffuser core as single unitary article is accomplished by injection molding. In some embodiments, securing filter media to the outer surface of the purge diffuser core is accomplished by welding methods such as impulse welding.

[0015] In still another embodiment, the present disclosure provides methods of purging a system for transporting substrates according to the present disclosure comprising passing a flow of purge gas through the purge port into the purge diffuser and thereby into the interior of the substrate container. In some embodiments, the purge gas is nitrogen and the purge diffuser provides a greater flow of purge gas to lower portions of the interior of the substrate container than to higher portions of the interior of the substrate container.

[0016] The preceding summary of the present disclosure is not intended to describe each embodiment of the present disclosure. The details of one or more embodiments of the disclosure are also set forth in the description below. Other features, objects, and advantages of the disclosure will be apparent from the description and from the claims.

Brief Description of the Drawing

[0017] The disclosure may be more completely understood in consideration of the following description of various illustrative embodiments in connection with the accompanying drawings

[0018] FIG.1 is a perspective view of one embodiment of a system for transporting substrates according to the present disclosure.

[0019] FIG. 2 is a perspective view of one embodiment of a purge diffuser core according to the present disclosure.

[0020] FIG. 3 is a cutaway view of the purge diffuser core of FIG. 2.

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[0021] FIG. 4 is a perspective view of one embodiment of a purge diffuser core according to the present disclosure.

[0022] FIG. 5 is a perspective view of one embodiment of a purge diffuser according to the present disclosure incorporating the purge diffuser core of FIG. 4.

[0023] FIGS. 6A and 6B are perspective views of a detail of one embodiment of a purge diffuser core of FIG. 4.

[0024] FIG. 7A is a perspective view of a purge diffuser according to an embodiment of the present disclosure.

[0025] FIG. 7B is an exploded view of the purge diffuser of FIG. 7B.

[0026] FIG. 8 is a graphic showing the open door relative humidity performance of a purge diffuser according to an embodiment of the present disclosure.

[0027] While the disclosure is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit aspects of the disclosure to the particular illustrative embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

Detailed Description

[0028] As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural referents unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

[0029] As used herein, "have", "having", "include", "including", "comprise", "comprising" or the like are used in their open ended sense, and generally mean "including, but not limited to." It will be understood that the terms "consisting of" and "consisting essentially of" are subsumed in the term "comprising," and the like.

[0030] The term "about" generally refers to a range of numbers that is considered equivalent to the recited value (e.g., having the same function or result). In many instances, the term "about" may include numbers that are rounded to the nearest significant figure.

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[0031] The term "directly bound" refers to two materials that are in direct contact with each other and bound together.

[0032] The term "integral" or "integral construction" refer to a construction that is a single piece, though it may include elements that can be separately named, that may be a unitary article, or that may be formed from multiple pieces where multiple pieces are permanently joined (such as by welding, permanent adhesive, permanent fasteners, or methods that cannot be reversed non-destructively) to form a single piece construction.

[0033] The term "unitary" or "unitary article" refer to an article that is a single piece, though it may include elements that can be separately named, that is formed from a single piece or aliquot of material without division of that piece or aliquot (such as by stamping, molding, forging, machining, sculpting, or the like), and that lacks seams or joints between elements.

[0034] Numerical ranges expressed using endpoints include all numbers subsumed within that range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4 and 5).

[0035] All scientific and technical terms used herein have meanings commonly used in the art unless otherwise specified.

[0036] The following detailed description should be read with reference to the drawings in which similar elements in different drawings are numbered the same. The detailed description and the drawings, which are not necessarily to scale, depict illustrative embodiments and are not intended to limit the scope of the invention. The illustrative embodiments depicted are intended only as exemplary. Selected features of any illustrative embodiment may be incorporated into an additional embodiment unless clearly stated to the contrary.

[0037] The present disclosure provides purge diffusers for use in systems for transporting substrates, and systems comprising such purge diffusers. Such systems typically include a substrate container comprising a container portion including a top wall, a bottom wall, a back wall and two side walls defining an opening, a door adapted to be received in the opening to seal the internal environment, and a purge port to admit purge gas to an interior of the substrate container. Some such substrate containers are typically known as a FOUPs or FOSBs. Substrates may be inserted and removed, typically horizontally through an open front. Slots formed in the interior sides hold the substrates, most typically semiconductor wafers. The door engages with the enclosure to form a sealed interior space that is isolated from the ambient atmosphere. Typically, the door and substrate container are adapted to be manipulated by

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automated or robotic mechanisms. Likewise, substrates may be placed in or removed from the substrate container by automated or robotic mechanisms. The purge port may be in the bottom wall (or floor) of the enclosure portion, and typically includes hardware to mount and form a seal with the purge port connector of a purge diffuser.

[0038] The purge diffuser, according to the various embodiments described herein, is adapted to distribute purge gas in the interior of the substrate container. Purge gas is directed through the purge port and purge port connector into the purge gas channel interior to the purge diffuser. The purge gas exits the internal purge gas channel through diffuser ports and passes through the filter media into the interior of a substrate container. By use of a purge diffuser, the distribution of purge gas within the interior of the substrate container may be controlled to avoid dead spots and achieve desired distribution. Any suitable purge gas may be used, which may include clean dry air (CDA) and inert gasses such as nitrogen. The design of the purge diffuser may be adapted to the selected purge gas. For example, where a lighter-than-air gas such as nitrogen is in use, greater flow to lower portions of the interior of the substrate container may result in a more even purging of the container and its contents from contaminants, particulates, and humidity. In some embodiments, the substrate container may additionally include a purge outlet port to allow purge gas to flow out of the container. In others, the container is purged with the door removed and purge gas exits through the open front of the container.

[0039] Purge diffusers according to the present disclosure include a purge diffuser core having an internal purge gas channel and one or more diffuser ports allowing exit of purge gas from the internal purge gas channel to the exterior of the purge diffuser core and into the interior of the substrate container. The purge diffuser core may include features for attachment to mounting apparatus, typically at the end of the purge diffuser core opposite the purge port connector. In some embodiments, the purge diffuser core is of an integral construction such that it is a unitary article. The purge diffuser core may be fabricated any suitable material, which may include injection-moldable materials, melt processable polymers, fluoropolymers, polyolefins, or fluorinated polyolefins. In some cases, the purge diffuser core can be fabricated from carbon-filled materials to facilitate the elimination of electro-static discharge. The material from which the purge diffuser core is fabricated should be selected to minimize outgassing.

[0040] In some cases, the purge diffuser can be sized so as to minimize the material mass of the purge diffuser within the internal environment of the substrate container. Material mass in a substrate container can absorb off-gassing (Airborne Molecular Contamination – AMC) from

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wafer processes such as boron, ammonia, chlorine or fluorene and then later desorb these contaminants back into the container environment potentially causing wafer yield loss. Reducing the amount of material in the internal environment environment can improve the propensity for AMC absorption and desorption. One method for reducing material mass within the internal environment of the wafer container is to reduce the overall length or height of the purge diffuser relative to the interior height of the substrate container and more particularly, relative to the interior height of the substrate as measured from a top wall of the container portion to the bottom wall of the container portion of the substrate container. In some embodiments, the length or height of the purge diffuser is not more than 85% of the height of the interior of the substrate container as measured from the top wall to the bottom wall of the container portion of the substrate container, in others not more than 75%, 65%, 60%, 55%, 50%, 45% or 40% of the height of the substrate container. In some such embodiments, the length or height of the purge diffuser is at least 20% of the interior height of the substrate container, in others at least 25%, 30%, or 35% of the interior height of the substrate container. In some cases, the purge diffuser can have a length ranging from: 100mm to 170 mm; 105mm to 160mm; or from 110mm to 150mm. In one particular embodiment, the purge diffuser has a length of 150mm. In another embodiment, the purge diffuser has a length of 110mm. The overall length of the purge diffuser as measured relative to the height of the substrate container can be selected or optimized based on the intended application. For example, the length of the purge diffuser can be optimized based on the type of purge gas, the flow rate of the purge gas, and/or the acceptable levels of relative humidity and oxygen in the environment of the container and/or the nature of the contaminants to be entrained by the purge diffuser, but not limited to these. In some embodiments, a purge diffuser having a reduced height or length relative to the height or of the substrate container can be used with in combination with other embodiments, as disclosed herein, used to reduce contaminants within the internal environment of the container and/or for controlling relative humidity and oxygen levels.

[0041] The internal purge gas channel may have a length equal to or less than the length of the purge diffuser core. In some embodiments, the length of the internal gas channel is not more than 85% of the interior height of the substrate container, in others not more than 75%, 65%, 60%, 55%, 50%, 45% or 40%. In some such embodiments, the length of the internal gas channel is at least 20% of the interior height of the substrate container, in others at least 25%, 30%, or 35%.

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[0042] The purge diffuser can include a plurality of diffuser ports distributed along the length of the purge diffuser core. Purge gas exits the internal purge gas channel through diffuser ports. In some cases, the purge gas exits the internal purge gas channel and passes through filter media disposed or wrapped over the purge diffuser core and into the interior of the substrate container. The diffuser ports can have any suitable shape, size, and position along the length of the purge diffuser core. The distribution and characteristics of diffuser ports may be selected to achieve a desired distribution of purge gas flow and be uniform or may vary. In some embodiments, rows of diffuser ports are offset from each other such that every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser. This design enables manufacture of the purge diffuser core as a unitary article with a continuous interior channel (the internal purge gas channel) by molding processes, such as an injection molding process using side pulls, cams, cam actions or slides.

[0043] In some embodiments, the purge diffuser core additionally includes diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core, i.e., an internal surface of the purge diffuser core bordering the internal purge gas channel. The diverters may be of any suitable shape, such as fins or pegs, or may bridge across the internal purge gas channel from a first location on the inner surface of the purge diffuser core to a second, separate, location on the inner surface of the purge diffuser core. The diverters may impede but typically do not block flow of purge gas to further portions of the internal purge gas channel. The distribution and characteristics of diverters may be selected to achieve a desired distribution of purge gas flow. The distribution and characteristics of diverters may be uniform along the length of the internal purge gas channel or may vary. In some embodiments, the diffuser core includes diverters in a first segment of the internal purge gas channel proximal to the purge port and does not include diverters in a second segment of the internal purge gas channel distal from the purge port.

[0044] The purge diffuser core can be fabricated by any suitable method. Typically, hot melt molding methods may be used, such as injection molding. In some cases, as described herein, the purge diffuser core is injection molded to produce an integrally formed, unitary article.

[0045] Purge diffusers according to the present disclosure include filter media disposed over and secured to the outer surface of the purge diffuser core. The filter media may be present in

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segments or, more typically, may be in the form of a single sheet wrapped around the circumference of the purge diffuser core. In some embodiments, the filter media is directly bound to the outer surface of the purge diffuser core, such as by weld bonds, including without limitation heat-weld bonds, impulse-weld bonds and ultrasonic-weld bonds. Welding or bonding the filter media to the purge diffuser core provides the desirable feature of leak-proof bonding the filter media to the purge diffuser core without the use of adhesives or fasteners.

[0046] In other embodiments, the filter media is secured to the outer surface of the purge diffuser core by an adhesive. In still other embodiments, the filter media is secured to the outer surface of the purge diffuser core by a filter media bracket, wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core. A filter media bracket may be attached to the purge diffuser core by welding, friction fit, adhesive, fasteners, or other suitable mechanisms. After attachment, filter media make be shrunk in place by application of heat to generate a tighter fit to the purge diffuser core. Typically, the filter media covers each diffuser port of the purge diffuser core. Typically, the filter media is attached such that purge gas exiting through diffuser ports cannot enter the interior of the substrate container without passing through the filter media. In some embodiments, the filter media can be provided with a mesh scrim disposed over the filter media to provide protection to the filter media and to permit safe handling of the filter media. The mesh scrim may be affixed to the filter media without adhesives or fasteners. In some cases, the mesh scrim can be wrapped about an outer surface of the filter media. Alternatively, the mesh scrim can be impulse welded to the filter media.

[0047] The filter media may be of any suitable material that is useful for controlling relative humidity and oxygen may additionally remove particulates from a gas stream passing through the filter media. In various embodiments, the filter media may include woven, non-woven, sieving, non-sieving, melt blown, core and sheath, film, or membrane materials and may include polyolefin (including polypropylene, polyethylene, high density polyethyelene, or ultra-high molecular weight polyethylene), polyester, polysulfone, fluoropolymer, polyamide or polyimide polymers. The filter media is preferably not pleated such that it is a non-pleated filter media. In some embodiments, the filter media is a porous hydrophobic film. In other embodiments, the filter media is a porous hydrophobic membrane. In one embodiment, the filter media is a porous hydrophobic ultra-high molecular weight polyethylene membrane. Filter media may be laser-ablated to modify porosity. In some embodiments the filter media has a thickness of between;

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10 and 1300 micrometers; of between 10 and 1000 micrometers; of between 10 and 500 micrometers; or of between 40 and 150 micrometers.

[0048] In one aspect, filter media can be characterized with regard to a property known as "bubble point," which is an understood property of a porous filter membrane. Bubble point corresponds to pore size, which may correspond to filtering performance, e.g., as measured by retention. A smaller pore size can correlate to a higher bubble point and often to higher filtering performance (higher retention). Preferred membranes for the filter media exhibit a combination of a relatively higher bubble point and a useful level of flow (flow rate). Examples of useful mean bubble points of membrane filter media can be in a range from 2 to 400 psi, e.g., in a range from 5 to 15 psi. To measure the mean bubble point, a sample of filter media is placed in a holder. Air is pressurized through the holder and the flow rate measured as a function of pressure. A low surface tension fluid, HFE-7200 (3M) is then introduced to the membrane to wet the membrane. Air is pressurized through the holder at the interior of the filter media, and the air flow is measured as a function of pressure. The mean bubble point is the pressure at which the ratio of the air flow of the wet membrane to the air flow of the dry membrane is 0.5. The test is performed at a temperature in a range of between 20 and 25 degrees Celsius.

[0049] In some embodiments, exemplary membrane filter media may have pores of a size (average pore size) to be considered either a microporous filtration membrane or an ultrafiltration membrane. A microporous membrane can have an average pore size in a range on from about 0.05 micrometers to about 10 micrometers. An ultrafiltration membrane can have an average pore size in a range from 0.001 micrometers to about 0.05 micrometers. Pore size is often reported as average pore size of a porous material, which can be measured by known techniques such as by Mercury Porosimetry (MP), Scanning Electron Microscopy (SEM), Liquid Displacement (LLDP), or Atomic Force Microscopy (AFM).

[0050] Purge diffusers according to the present disclosure typically include a purge port connector for mounting the purge diffuser to a purge port of a substrate container. In some embodiments, the purge port connector is an integral construction with the purge diffuser core such that the purge core and the purge port connector form a unitary article. In other embodiments, the purge port connector is part separate from but attachable to the purge diffuser core. The purge port connector and purge diffuser core are typically connected in a sealable manner, such that purge gas does not escape the purge diffuser between the purge port connector

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and purge diffuser core. The purge port connector may be made of any suitable material, including those recited above for the purge diffuser core.

[0051] With reference to FIG. 1, a system for transporting substrates according to one embodiment of the present disclosure includes substrate container 190. Front edge 192 of substrate container 190 surrounds a front opening and is adapted to accept a door (not shown) adapted to seal the opening defined by front edge 192. Typically, the door (not shown) and substrate container 190 are adapted to be manipulated by automated or robotic mechanisms. Purge diffuser 110 is depicted without filter media secured to the outer surface, revealing purge diffuser core 120. Purge diffuser core 120 includes diffuser ports 130, 132 arranged in lengthwise rows, according to an embodiment. In the embodiment depicted in FIG. 1, a first row of diffuser ports 130 is offset from a second row of diffuser ports 132, with the centers of diffuser ports 130 generally aligned with the boundaries between diffuser ports 132 and vice versa. Purge diffuser core 120 also includes an internal purge gas channel (not visible). Purge port connector 140 is attached to the bottom end of purge diffuser core 120. Purge port connector 140 is mounted to a purge port (not visible, as it is occupied and covered by purge port connector 140). The purge port passes through substrate container 190. During purge of substrate container 190, purge gas enters through the purge port into purge port connector 140 and thereby into the internal purge gas channel of purge diffuser core 120. The purge gas then exits the internal purge gas channel through diffuser ports 130, 132. When filter media is installed on the outer surface of purge diffuser core 120, purge gas exiting the internal purge gas channel through diffuser ports 130, 132. passes through the filter media, and into interior 194 of substrate container 190. Substrate container 190 is also equipped with substrate supports 196 which define slots for storage of substrates (not shown) by or near their peripheral edges. Optional mounting hardware 180 can provide additional attachment of purge diffuser 110 to substrate container 190, as necessary or desired.

[0052] With reference to FIGS. 2 and 3, these figures are a perspective view and a cutaway view (respectively) of one embodiment of a purge diffuser core according to the present disclosure. Purge diffuser core 220 is connected at its bottom end to purge port connector 240. Purge port connector 240 is adapted to connect to a purge port of a substrate container. Purge diffuser core 220 includes internal purge gas channel 260, which provides passage of purge gas entering through the purge port through purge port connector 240 to all diffuser ports 230, 232, 234. Purge diffuser core 220 includes diffuser ports 230, 232, 234 arranged in lengthwise rows. In some embodiments, as depicted in FIGS. 2 and 3, the row of diffuser ports 230 is offset from the

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rows of diffuser ports 232, 234, with the centers of diffuser ports 230 generally aligned with the boundaries between diffuser ports 232, 234 and vice versa. When diffuser ports 230, 232, 234 are staggered in this manner, every portion of internal purge gas channel 260 between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser. This design enables manufacture of purge diffuser core 220 as a unitary article with a continuous interior channel (internal purge gas channel 260) by molding processes, such as an injection molding process using side pulls, cams, cam actions or slides. Purge diffuser core 220 is adapted to engage with mounting hardware component 280.

[0053] Purge diffuser core 220 optionally may additionally include diverters 265 which project into internal purge gas channel 260 from inner surfaces of purge diffuser core 220 which border internal purge gas channel 260. Diverters 265 slow and/or direct the flow of purge gas, but do not fully block flow of purge gas to further points along internal purge gas channel 260. In this embodiment, diverters 265 bridge across internal purge gas channel 260 from a first location on the inner surface of purge diffuser core 220 to a second and separate location on the inner surface of purge diffuser core 220. In this embodiment, purge diffuser core 220 includes diverters 265 in first segment 266 of internal purge gas channel 260, proximal to purge port connector 240, and does not include diverters in second segment 267 of internal purge gas channel 260 distal to purge port connector 240.

[0054] With reference to FIGS. 4 and 5, FIG. 4 is a perspective view of one embodiment of a purge diffuser core according to the present disclosure. FIG. 5 is a perspective view of one embodiment of a purge diffuser according to the present disclosure incorporating the purge diffuser core of FIG. 4. Purge diffuser 410 includes purge diffuser core 420. Purge diffuser core 420 is connected at its bottom end to purge port connector 440. Purge port connector 440 is adapted to connect to a purge port of a substrate container. Purge diffuser core 420 includes an internal purge gas channel (not visible), which provides passage of purge gas entering through the purge port through purge port connector 440 to all diffuser ports 430, 432. Purge diffuser core 420 includes diffuser ports 430, 432 arranged in lengthwise rows. The row of diffuser ports 430 is offset from the rows of diffuser ports 432, with the centers of diffuser ports 430 generally aligned with the boundaries between diffuser ports 432 and vice versa. As noted above, when diffuser ports 430, 432 are staggered in this manner, every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line

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perpendicular to the length of the purge diffuser. This design enables manufacture of purge diffuser core 420 as a unitary article with a continuous interior channel (the internal purge gas channel) by molding processes, such as an injection molding process using side pulls, cams, cam actions or slides.

[0055] With reference to FIGS. 6A and 6B, these figures are perspective views of a detail of the purge diffuser core of FIG. 4 and its assembly. Purge diffuser core 420 is connected at its bottom end to purge port connector 440. Engaging tabs 442 securely attach purge port connector 440 to purge diffuser core 420. Seal 444 prevents escape of purge gas at the interface between purge port connector 440 and purge diffuser core 420. Diffuser ports 430, 432 are shown.

[0056] Referring again to FIG. 5, filter media 450 is secured to the outer surface of purge diffuser core 420 such that purge gas from the purge port entering purge diffuser 410 through purge port connector 440 enters the internal purge gas channel, exits the internal purge gas channel through diffuser ports 430, 432, and passes through filter media 450 into the interior of the substrate container.

[0057] FIG. 7A is a perspective view and FIG. 7B is an exploded view of a purge diffuser 510 according to yet another embodiment. Purge diffuser 510 includes a porous membrane disposed over purge diffuser core 520. Similar to those embodiments discussed above with reference to FIGS. 4 and 5, Purge diffuser core 520 is connected at its bottom end to purge port connector 540. Purge port connector 540 is adapted to connect to a purge port of a substrate container. Purge diffuser core 520 includes an internal purge gas channel (not visible), which provides passage of purge gas entering through the purge port through purge port connector 540 to all diffuser ports 530, 532. Purge diffuser core 520 includes diffuser ports 530, 532 arranged in lengthwise rows. The row of diffuser ports 530 is offset from the rows of diffuser ports 532, with the centers of diffuser ports 530 generally aligned with the boundaries between diffuser ports 532 and vice versa. As noted above, when diffuser ports 530, 532 are staggered in this manner, every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser. Filter media 550 is secured to the outer surface of purge diffuser core 520 such that purge gas from the purge port entering purge diffuser 510 through purge port connector 540 enters the internal purge gas channel, exits the internal purge gas channel through diffuser ports 530, 532, and passes through filter media 550 into the interior of the substrate container.

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[0058] As shown in FIG. 7B, a mesh scrim 545 can be disposed over disposed over the filter media 550 to provide protection to the filter media 550 and to permit safe handling of the filter media 550. The mesh scrim may be affixed to the filter media without adhesives or fasteners. In some cases, the mesh scrim 545 can be wrapped about an outer surface of the filter media 550. Alternatively, the mesh scrim 545 can be impulse welded to the filter media 550.

[0059] As described herein filter media 450, 550 may be of any suitable material that is useful for controlling relative humidity and oxygen may additionally remove particulates from a gas stream passing through the filter media. In various embodiments, the filter media may include woven, non-woven, sieving, non-sieving, melt blown, core and sheath, film, or membrane materials and may include polyolefin (including polypropylene, polyethylene, high density polyethyelene, or ultra-high molecular weight polyethylene), polyester, polysulfone, fluoropolymer, polyamide or polyimide polymers. The filter media is preferably not pleated such that it is a non-pleated filter media. In some embodiments, the filter media is a porous hydrophobic film. In other embodiments, the filter media is a porous hydrophobic membrane. In a preffered embodiment, the filter media is a porous hydrophobic ultra-high molecular weight polyethylene (UPE) membrane. In some cases, the UPE membrane is selected such that it provides greater than 99% particle retention and less than 65 kPa of backpressure in the system.

[0060] FIG. 8 is a graphic showing the open door relative humidity (RH%) performance of a purge diffuser including a UPE membrane, in accordance with embodiments described herein. Relative humidity levels were measured using a sensor positioned at the front, left right and back of the substrate container. The initial relative humidity level in the environment was 50% RH. Purge gas was introduced into the substrate container with the door removed. The test was repeated for each of the twenty-five wafers contained within the substrate container. As shown in FIG. 8, the UPE membrane purge diffuser is effective at minimizing the relative humidity levels in the container environment at each wafer and at each position during the open door purge test.

Selected Embodiments

[0061] The following numbered embodiments are intended to further illustrate the present disclosure but should not be construed to unduly limit this disclosure.

Embodiment 1. A system for transporting substrates comprising:

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a) a substrate container comprising a container portion with an opening, a door adapted to seal the opening, and a purge port to admit purge gas to an interior of the substrate container; and

b) a purge diffuser mounted to the purge port, the purge diffuser comprising:

i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface; and

ii) filter media secured to the outer surface of the purge diffuser core;

arranged such that there is a continuous path for purge gas entering through the purge port to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media into the interior of the substrate container.

Embodiment 2. The system according to embodiment 1 wherein the purge diffuser core is a unitary article.

Embodiment 3. The system according to embodiment 1 wherein the purge diffuser core is a unitary article comprising an injection-moldable material and made in a single molding.

Embodiment 4. The system according to embodiment 3 wherein the injection-moldable material is a melt processable polymer.

Embodiment 5. The system according to any of embodiments 1-4 wherein the filter media is directly bound to the outer surface of the purge diffuser core.

Embodiment 6. The system according to embodiment 5 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds.

Embodiment 7. The system according to embodiment 5 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds selected from heat-weld bonds, impulse-weld bonds and ultrasonic-weld bonds.

Embodiment 8. The system according to any of embodiments 1-4 wherein the filter media is secured to the outer surface of the purge diffuser core by an adhesive.

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Embodiment 9. The system according to any of embodiments 1-4 wherein the filter media is secured to the outer surface of the purge diffuser core by a filter media bracket, wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core.

Embodiment 10. The system according to any of embodiments 1-9 wherein the filter media is a porous hydrophobic film comprising a polyolefin, polyester, polysulfone, or fluoropolymer.

Embodiment 11. The system according to any of embodiments 1-9 wherein the filter media is a hydrophobic ultra-high molecular weight polyethylene membrane.

Embodiment 12. The system according to any of embodiments 1-11 wherein the purge port is comprised in a first wall of the substrate container which faces an opposite wall of the substrate container across the interior of the substrate container; wherein the minimum distance between the purge port and the opposite wall is the height of the interior of the substrate container; wherein the purge diffuser has a purge diffuser length which is the distance that the purge diffuser extends toward the opposite wall when mounted to the purge port; and wherein the purge diffuser length is not more than 85% of the height of the interior of the substrate container.

Embodiment 13. The system according to embodiment 12 wherein the purge diffuser length is not more than 60% of the height of the interior of the substrate container.

Embodiment 14. The system according to embodiment 12 or 13 wherein the purge diffuser length is at least 20% of the height of the interior of the substrate container.

Embodiment 15. The system according to any of embodiments 1-14 wherein the purge port is comprised in a first wall of the substrate container which faces an opposite wall of the substrate container across the interior of the substrate container; wherein the minimum distance between the purge port and the opposite wall is the height of the interior of the substrate container; wherein the internal purge gas channel has an internal purge gas channel length which is the distance that the internal purge gas channel extends toward the opposite wall when the purge diffuser is mounted to the purge port; and wherein the internal purge gas channel length is not more than 85% of the height of the interior of the substrate container.

Embodiment 16. The system according to embodiment 14 wherein the internal purge gas channel length is not more than 60% of the height of the interior of the substrate container.

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Embodiment 17. The system according to embodiment 14 or 15 wherein the internal purge gas channel length is at least 20% of the height of the interior of the substrate container.

Embodiment 18. The system according to any of embodiments 1-17 wherein the purge diffuser core additionally comprises one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel.

Embodiment 19. The system according to embodiment 18 wherein one or more diverters bridge across the internal purge gas channel from a first location on the inner surface of the purge diffuser core to a second location on the inner surface of the purge diffuser core, the second location being separated from the first location.

Embodiment 20. The system according to embodiment 17 or 19 wherein the diffuser core comprises one or more diverters in a first segment of the internal purge gas channel proximal to the purge port and does not comprise diverters in a second segment of the internal purge gas channel distal to the purge port.

Embodiment 21. The system according to embodiment 20 wherein the first segment is smaller than the second segment.

Embodiment 22. The system according to any of embodiments 1-21 wherein the diffuser ports are staggered such that every portion of the internal purge gas channel between the diffuser ports closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser.

Embodiment 23. The system according to any of embodiments 1-22 wherein the substrate container is a Front Opening Unified Pod (FOUP).

Embodiment 24. The system according to any of embodiments 1-23 wherein the substrates are semiconductor wafers.

Embodiment 25. A purge diffuser for use in a system for transporting substrates comprising:

i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface;

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ii) filter media secured to the outer surface of the purge diffuser core; and

iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates;

arranged such that there is a continuous path for purge gas entering through the purge port connector to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media.

Embodiment 26. The purge diffuser according to embodiment 25 wherein the purge diffuser core is an integral construction.

Embodiment 27. The purge diffuser according to embodiment 25 wherein the purge diffuser core is a unitary article.

Embodiment 28. The purge diffuser according to any of embodiments 24-25 wherein the purge diffuser core is a unitary article comprising an injection-moldable material and made in a single molding.

Embodiment 29. The purge diffuser according to embodiment 28 wherein the injection-moldable material is a melt processable polymer.

Embodiment 30. The purge diffuser according to any of embodiments 25-29 wherein the filter media is directly bound to the outer surface of the purge diffuser core.

Embodiment 31. The purge diffuser according to any of embodiments 25-29 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds.

Embodiment 32. The purge diffuser according to embodiment 31 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds selected from heat-weld bonds, impulse-weld bonds and ultrasonic-weld bonds.

Embodiment 33. The purge diffuser according to any of embodiments 25-29 wherein the filter media is secured to the outer surface of the purge diffuser core by an adhesive.

Embodiment 34. The purge diffuser according to any of embodiments 25-29 wherein the filter media is secured to the outer surface of the purge diffuser core by a filter media bracket,

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wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core.

Embodiment 35. The purge diffuser according to any of embodiments 25-29 wherein the filter media is a porous hydrophobic film comprising a polyolefin, polyester, polysulfone, or fluoropolymer.

Embodiment 36. The purge diffuser according to any of embodiments 25-35 wherein the filter media has a thickness of between 10 and 1300 micrometers.

Embodiment 37. The purge diffuser according to any of embodiments 25-36 wherein the purge diffuser core additionally comprises one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel.

Embodiment 38. The purge diffuser according to embodiment 37 wherein one or more diverters bridge across the internal purge gas channel from a first location on the inner surface of the purge diffuser core to a second location on the inner surface of the purge diffuser core, the second location being separated from the first location.

Embodiment 39. The purge diffuser according to embodiment 37 or 38 wherein the diffuser core comprises one or more diverters in a first segment of the internal purge gas channel proximal to the purge port connector and does not comprise diverters in a second segment of the internal purge gas channel distal to the purge port connector.

Embodiment 40. The purge diffuser according to embodiment 39 wherein the first segment is smaller than the second segment.

Embodiment 41. The purge diffuser according to any of embodiments 25-40 wherein the diffuser ports are staggered such that every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser.

Embodiment 42. A method of making a purge diffuser according to any of embodiments 25-41 comprising:

a) molding the purge diffuser core as single unitary article; and

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b) securing filter media to the outer surface of the purge diffuser core.

Embodiment 43. The method according to embodiment 42 wherein step a) is accomplished by injection molding.

Embodiment 44. The method according to embodiment 42 or 43 wherein step b) is accomplished by welding.

Embodiment 45. The method according to embodiment 42 or 43 wherein step b) is accomplished by impulse welding.

Embodiment 46. The method according to embodiment 42 or 43 wherein step b) is accomplished by attaching a filter media bracket, wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core.

Embodiment 47. A method of purging a system for transporting substrates according to any of embodiments 1-24, comprising passing a flow of purge gas through the purge port into the purge diffuser and thereby into the interior of the substrate container.

Embodiment 48. The method according to embodiment 45 wherein the purge gas is nitrogen.

Embodiment 49. The method according to embodiment 45 wherein the purge gas is clean dry air (CDA).

Embodiment 50. The method according to embodiment 47 wherein the purge diffuser provides a greater flow of purge gas to lower portions of the interior of the substrate container than to higher portions of the interior of the substrate container.

[0062] Various modifications and alterations of this disclosure will become apparent to those skilled in the art without departing from the scope and principles of this disclosure, and it should be understood that this disclosure is not to be unduly limited to the illustrative embodiments set forth hereinabove.

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What is claimed is:

1. A purge diffuser for use in a system for transporting substrates comprising:

i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface;

ii) filter media secured to the outer surface of the purge diffuser core; and

iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates;

arranged such that there is a continuous path for purge gas entering through the purge port connector to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media.

2. The purge diffuser according to claim 1 wherein the purge diffuser core is a unitary article.

3. The purge diffuser according to claim 1 wherein the purge diffuser core is a unitary article comprising an injection-moldable, melt processable polymer.

4. The purge diffuser according to any of claims 1-3 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds.

5. The purge diffuser according to any of claims 1-3 wherein the filter media is secured to the outer surface of the purge diffuser core by an adhesive.

6. The purge diffuser according to any of claims 1-3, further comprising a scrim dispose over the filter media.

7. The purge diffuser according to any of claims 1-6 wherein the filter media is a porous hydrophobic film comprising a polyolefin, polyester, polysulfone, or fluoropolymer.

8. The purge diffuser according to any one of claims 1-6 wherein the filter media is a hydrophobic membrane comprising a polyolefin, polyester, polysulfone or fluoropolymer.

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9. The purge diffuser according to any of claims 1-8 wherein the filter media is a hydrophobic ultra-high molecular weight polyethylene membrane.

10. The purge diffuser according to any of claims 1-9 wherein the purge diffuser core additionally comprises one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel.

11. The purge diffuser according to any of claims 1-10 wherein the diffuser ports are staggered such that every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser.

12. A system for transporting substrates comprising:

a) a substrate container comprising a container portion with an opening, a door adapted to be received in the opening, and a purge port to admit purge gas to an interior of the container portion; and

b) a purge diffuser according to any of claims 1-11 mounted to the purge port by the purge port connector, arranged such that there is a continuous path for purge gas entering through the purge port to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media into the interior of the substrate container.

13. The system according to claim 12 wherein the purge port is defined in a first wall of the substrate container which faces an opposite wall of the substrate container across the interior of the substrate container; wherein a height of the substrate container is measured from a top wall to a bottom wall of the container portion and wherein a length of the purge diffuser is not more than 85% of the height the substrate container.

14. The system according to any of claims 12-13 wherein the substrate container is a front opening unified pod (FOUP).

15. A method of making a purge diffuser according to any of claims 1-11 comprising:

a) molding the purge diffuser core as single unitary article; and

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b) securing filter media to the outer surface of the purge diffuser core.

16. The method according to claim 15 wherein step a) is accomplished by injection molding.

17. The method according to claim 15 or 16 wherein step b) is accomplished by welding.

18. A method of purging a system for transporting substrates according to any of claims 12-14, comprising passing a flow of purge gas through the purge port into the purge diffuser and thereby into the interior of the substrate container.

19. The method according to claim 18 wherein the purge gas is nitrogen and the purge diffuser provides a greater flow of purge gas to lower portions of the interior of the substrate container than to higher portions of the interior of the substrate container.

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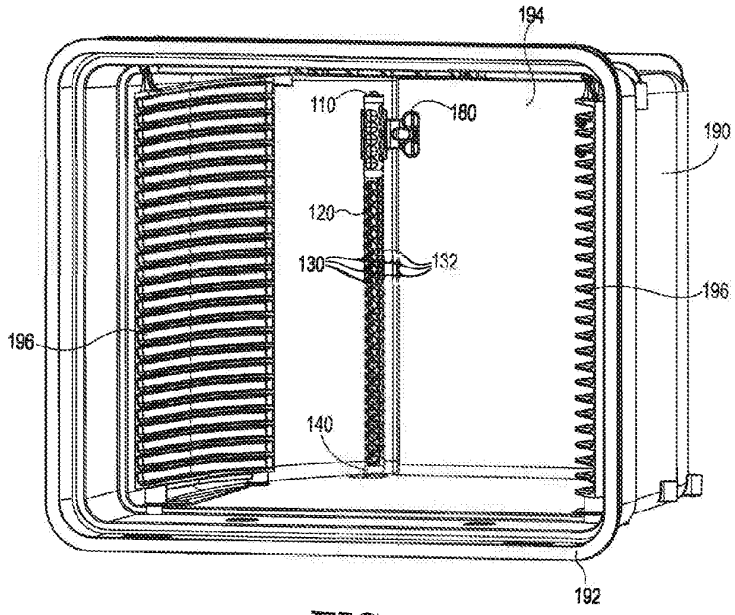


FIG. 1

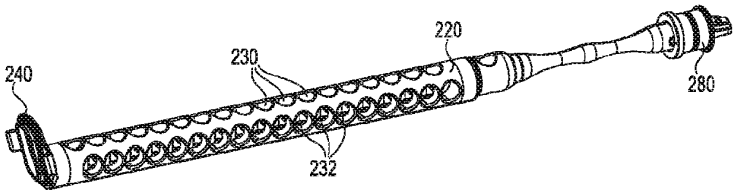


FIG. 2

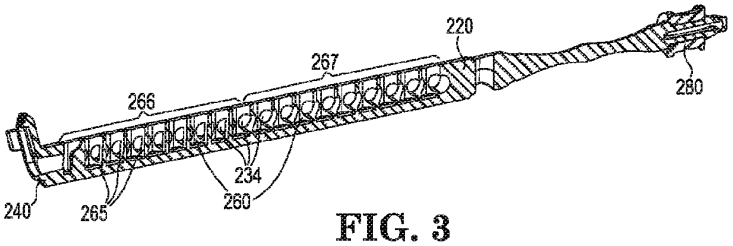


FIG. 3

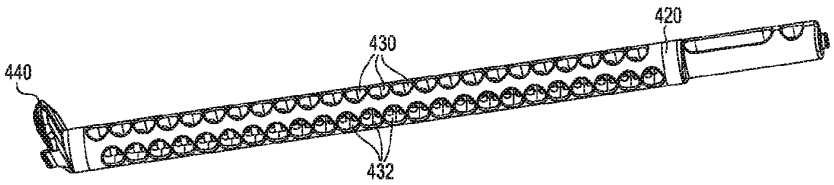


FIG. 4

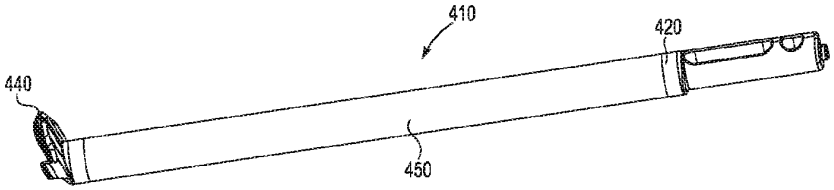


FIG. 5

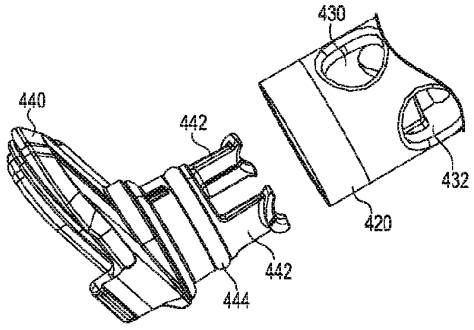


FIG. 6A

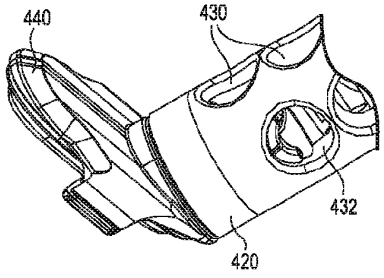


FIG. 6B

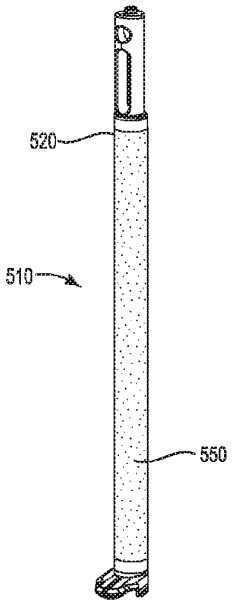


FIG. 7A

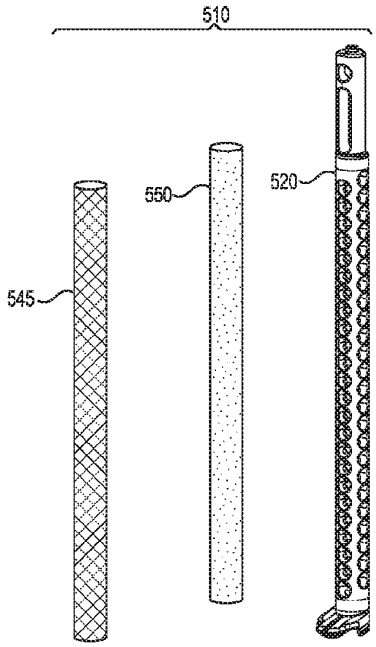


FIG. 7B

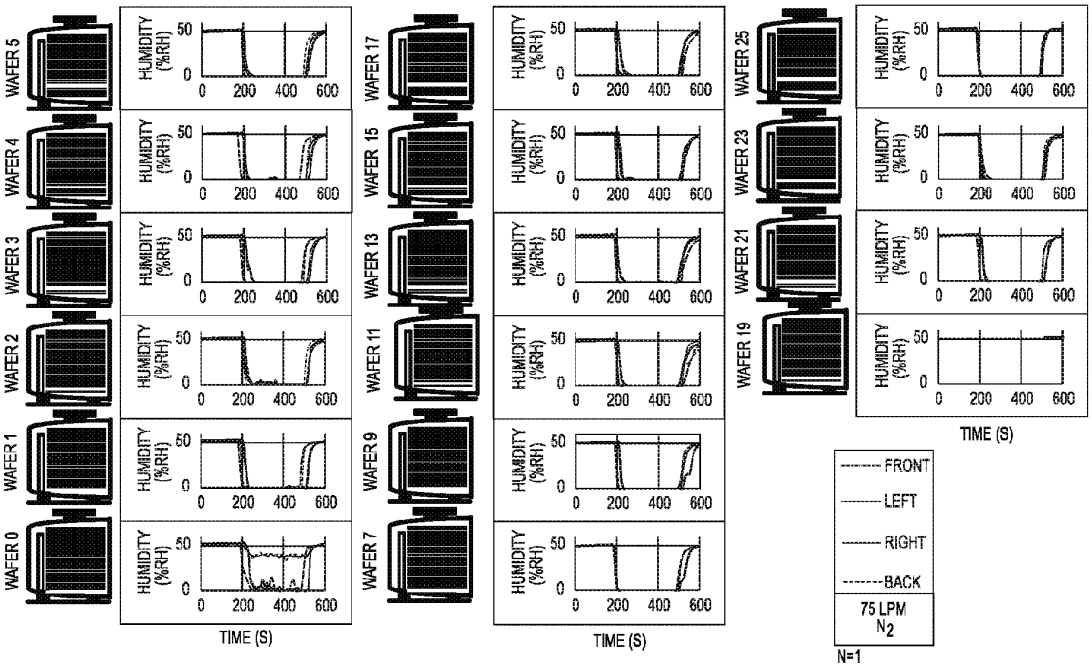

WAFER 5
WAFER 4
WAFER 3
WAFER 2
WAFER 1
WAFER 0
WAFER 17
WAFER 15
WAFER 13
WAFER 11
WAFER 9
WAFER 7
WAFER 25
WAFER 23
WAFER 21
WAFER 19
HUMIDITY (%RH)
50
0
0 200 400 600
TIME (S)
FRONT
LEFT
RIGHT
BACK
75 LPM N_2
N=1

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/048247

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 13,16,19
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 13, 16 and 19 are not clear, contrary to the requirement of PCT Article 6, because they each refer to a claim which does not comply with PCT Rule 6.4(a).

3. ☒ Claims Nos.: 7-12,14,15,17,18
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/048247

A. CLASSIFICATION OF SUBJECT MATTER

H01L 21/673(2006.01)i, H01L 21/677(2006.01)i, H01L 21/67(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L 21/673; B65D 85/86; H01L 21/02; H01L 21/324; H01L 21/67; H01L 21/677; H01L 21/68

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: FOUP, purge diffuser, channel, purge port, filter

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015-0348810 A1 (ENTEGRIS, INC.) 03 December 2015 See paragraphs [0016]-[0037] and figures 1B, 3, 6, 8.	1-6
Y	JP 2002-170874 A (EBARA CORP.) 14 June 2002 See paragraphs [0021]-[0027] and figures 1, 5, 6.	1,4,5
Y	KR 10-1748361 B1 (ZENSM CO., LTD.) 19 June 2017 See paragraphs [0057], [0059], [0070] and figure 1.	1,4,5
A	KR 10-1601600 B1 (CHO, CHANG HYEON) 09 March 2016 See paragraphs [0016]-[0018] and figure 3.	1-6
A	US 2018-0144965 A1 (LAM RESEARCH CORPORATION) 24 May 2018 See paragraphs [0086]-[0091] and figures 20-22.	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 December 2019 (13.12.2019)	**16 December 2019 (16.12.2019)**

Name and mailing address of the ISA/KR	Authorized officer
International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea	PARK, Hye Lyun
Facsimile No. +82-42-481-8578	Telephone No. 82-42-481-3463

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/048247

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 2013-513951 A	22/04/2013
		JP 6057716 B2	11/01/2017
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		WO 2011-072260 A2	16/06/2011
		WO 2011-072260 A3	03/11/2011
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KR 10-1748361 B1	19/06/2017	KR 10-2016-0128806 A	08/11/2016
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		KR 10-2015-0096351 A	24/08/2015
US 2018-0144965 A1	24/05/2018	JP 2016-086161 A	19/05/2016
		KR 10-2016-0048655 A	04/05/2016
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		US 10297480 B2	21/05/2019
		US 2016-0118282 A1	28/04/2016
		US 9881826 B2	30/01/2018

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(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2022年12月29日(29.12.2022)

WIPO | PCT

(10) 国際公開番号
WO 2022/269718 A1

(51) 国際特許分類:
H01L 21/673 (2006.01)

(21) 国際出願番号： PCT/JP2021/023474

(22) 国際出願日： 2021年6月21日(21.06.2021)

(25) 国際出願の言語： 日本語

(26) 国際公開の言語： 日本語

(71) 出願人: ミライアル株式会社 (**MIRAIAL CO., LTD.**) [JP/JP]; 〒1700013 東京都豊島区東池袋１丁目２４番１号 Tokyo (JP).

(72) 発明者: 松 鳥 千 明 (**MATSUTORI Chiaki**); 〒1700013 東京都豊島区東池袋１丁目２４番１号 ミライアル株式会社内 Tokyo (JP).

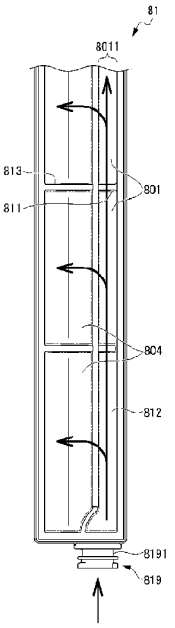
(74) 代理人: 正林 真之，外 (**SHOBAYASHI Masayuki** et al.); 〒1000005 東京都千代田区丸の内１－７－１２ サピアタワー Tokyo (JP).

(81) 指定国(表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

WO 2022/269718 A1

(54) **Title:** SUBSTRATE CONTAINER

(54) 発明の名称： 基板収納容器



(57) **Abstract:** A substrate container 1 includes: a container body 2; a lid 3; a gas passage 98, 99 that enables a substrate housing space 27 to communicate with a space outside of the container body 2; a gas ejection nozzle part 8 having multiple openings 841 for supplying a gas flowed into the gas passage 98, 99 to the substrate housing space 27; and a gas flow equalization part 801, 803, 804 that enables the gas to flow out from the multiple openings 841 at an equalized flow rate. The gas flow equalization part includes a gas retention chamber 801, a pre-outflow gas retention chamber 804, and an inter-chamber partition 812, 822 that prevents the gas retention chamber 801 and the pre-outflow gas retention chamber 804 from linearly communicating with each other and forms an inter-chamber flow path 806 through which the gas retention chamber 801 and the pre-outflow gas retention chamber 804 communicate with each other.

(57) 要約：容器本体２と、蓋体３と、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路９８、９９と、通気路９８、９９に流入した気体を基板収納空間２７に供給する複数の開口部８４１を有する気体噴出ノズル部８と、複数の開口部８４１から均一化された流量で気体を流出可能とする気体流量均一化部８０１、８０３、８０４と、を備え、気体流量均一化部は、気体滞留室８０１と、気体流出前保持室８０４と、気体滞留室８０１と気体流出前保持室８０４とを直線的に連通することを遮蔽して気体滞留室８０１と気体流出前保持室８０４とを連通する室間流路８０６を形成する室間間仕切り８１２、８２２と、を有する基板収納容器１である。

［続葉有］

(84) 指定国(表示のない限り、全ての種類の広域保護が可能)：ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, RU, TJ, TM), ヨーロッパ (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

添付公開書類：

— 国際調査報告（条約第21条(3)）

明 細 書

発明の名称 ： 基板収納容器

技術分野

[0001] 本発明は、半導体ウェーハ、レチクル、プリント基板などの基板を収納、保管、搬送、輸送等する際に使用される基板収納容器に関する。

背景技術

[0002] 各種基板を収納する基板収納容器としては、容器本体と蓋体とを備える構成のものが、従来より知られている。

[0003] 容器本体の一端部は、容器本体開口部を有する。容器本体の他端部は、閉塞された筒状の壁部を有する。容器本体内には基板収納空間が形成されている。基板収納空間は、壁部により取り囲まれて形成されており、基板を収納可能である。蓋体は、容器本体開口部に対して着脱可能であり、容器本体開口部を閉塞可能である。側方基板支持部は、基板収納空間内において対をなすように壁部に設けられている。側方基板支持部は、蓋体によって容器本体開口部が閉塞されていないときに、隣接する基板同士を所定の間隔で離間させて並列させた状態で、基板の縁部を支持可能である。

[0004] 蓋体の部分であって容器本体開口部を閉塞しているときに基板収納空間に対向する部分には、フロントリテーナ（蓋体側基板支持部）が設けられている。フロントリテーナは、蓋体によって容器本体開口部が閉塞されているときに、基板の縁部を支持可能である。また、フロントリテーナと対をなすようにして、奥側基板支持部が壁部に設けられている。奥側基板支持部は、基板の縁部を支持可能である。奥側基板支持部は、蓋体によって容器本体開口部が閉塞されているときに、フロントリテーナと協働して基板を支持することにより、隣接する基板同士を所定の間隔で離間させて並列させた状態で、基板を支持する。

先行技術文献

特許文献

[0005] 特許文献1：特表２０１６－５３８７３２号公報

特許文献2：特開２０１７－１７２６４公報

特許文献3：特開２０１６－００４９４９公報

発明の概要

発明が解決しようとする課題

[0006] 基板収納空間と、基板収納容器の外部とを連通する通気孔である掃気孔を有する基板収納容器においては、蓋体を取り外した状態でクリーンドライエア（ＣＤＡ）や、窒素（N_2）がパージガスとして用いられ、基板収納容器の外部のロードポートから供給される当該パージガスは、容器本体の下面（外面）より貫通孔を通じて、基板収納容器内面に設置された気体噴出ノズル部へ供給される。これによりガスパージが行われる。この際、ガスパージによるパージガスの置換を確実に行うために、気体噴出ノズル部の複数の開口部から、パージガスが均一に供給されることが要求される。

[0007] 本発明は、基板収納空間において気体を気体噴出ノズル部の複数の開口部から均一に供給可能な基板収納容器を提供することを目的とする。

課題を解決するための手段

[0008] 本発明は、一端部に容器本体開口部が形成された開口周縁部を有し、他端部が閉塞された筒状の壁部を備え、前記壁部の内面によって、基板を収納可能であり前記容器本体開口部に連通する基板収納空間が形成された容器本体と、前記容器本体開口部に対して着脱可能であり、前記容器本体開口部を閉塞可能な蓋体と、前記基板収納空間と前記容器本体の外部の空間とを連通可能な通気路と、前記通気路に流入した気体を前記基板収納空間に供給する複数の開口部を有する気体噴出ノズル部と、前記複数の開口部から均一化された流量で気体を流出可能とする気体流量均一化部と、を備え、前記気体流量均一化部は、気体滞留室と、気体流出前保持室と、前記気体滞留室と前記気体流出前保持室とを直線的に連通することを遮蔽して前記気体滞留室と前記気体流出前保持室とを連通する室間流路を形成する室間間仕切りと、を有する基板収納容器に関する。

[0009] また、前記気体流量均一化部は、前記気体流出前保持室を複数の気体流出前保持分室に区画する区画壁を有することが好ましい。また、前記複数の気体流出前保持分室は均一の容積を有することが好ましい。また、前記気体滞留室は、分室間間仕切りにより複数の気体滞留分室に仕切られていることが好ましい。また、全ての前記気体滞留分室に連通する気体供給流路が形成されていることが好ましい。

[0010] また、前記気体噴出ノズル部は、開口部に連通するノズル部室を有し、前記ノズル部室は、疎水性膜を介して前記気体流出前保持室に連通することが好ましい。また、前記ノズル部室は、全ての開口部及び全ての前記気体流出前保持分室に連通することが好ましい。また、前記気体噴出ノズル部は、前記開口部から気体を所定の方向へ向けて流出させる所定方向流出部を有することが好ましい。

[0011] また、前記開口部は、前記基板収納空間に収納される複数の前記基板のそれぞれに対応して形成されていることが好ましい。また、前記気体噴出ノズル部と前記気体流量均一化部とを有する柱状の突出部を備え、前記突出部の基部は、前記容器本体の前記壁部に形成され前記通気路を形成する穴であってシール部材が設けられた穴に挿入される共に、前記突出部の先端側の部分は、前記容器本体の前記壁部に対して固定されることにより、前記突出部は前記容器本体に固定されることが好ましい。

発明の効果

[0012] 本発明によれば、基板収納空間において気体を気体噴出ノズル部の複数の開口部から均一に供給可能な基板収納容器を提供することができる。

図面の簡単な説明

[0013] [図1]本発明の実施形態に係る基板収納容器１に複数の基板Ｗが収納された様子を示す分解斜視図である。

[図2]本発明の実施形態に係る基板収納容器１の容器本体２を示す上方斜視図である。

[図3]本発明の実施形態に係る基板収納容器１の容器本体２を示す下方斜視図

である。

[図4]図３のＡ－Ａ線で切断した容器本体２を示す側方断面図である。

[図5]基板収納容器１の突出部８を示す斜視図である。

[図6]基板収納容器１の突出部８を示す分解斜視図である。

[図7]基板収納容器１の突出部８を構成する突出部本体部８１の内部のパージガスの流れを示す分解斜視図である。

[図8]基板収納容器１の突出部８を示す後方斜視断面図である。

[図9]基板収納容器１の突出部８を示す前方斜視断面図である。

[図10]基板収納容器１の突出部８を構成するノズル部室形成部８４を示す側面図である。

発明を実施するための形態

[0014] 〔基板収納容器１の全体構成〕

以下、本実施形態による基板収納容器１について、図面を参照しながら説明する。

図１は、基板収納容器１に複数の基板Ｗが収納された様子を示す分解斜視図である。図２は、基板収納容器１の容器本体２を示す上方斜視図である。図３は、基板収納容器１の容器本体２を示す下方斜視図である。図４は、図３のＡ－Ａ線で切断した容器本体２を示す側方断面図である。

[0015] ここで、説明の便宜上、後述の容器本体２から蓋体３へ向かう方向（図１における右上から左下へ向かう方向）を前方向Ｄ１１と定義し、その反対の方向を後方向Ｄ１２と定義し、これらをあわせて前後方向Ｄ１と定義する。また、後述の下壁２４から上壁２３へと向かう方向（図１における上方向）を上方向Ｄ２１と定義し、その反対の方向を下方向Ｄ２２と定義し、これらをあわせて上下方向Ｄ２と定義する。また、後述する第２側壁２６から第１側壁２５へと向かう方向（図１における右下から左上へ向かう方向）を左方向Ｄ３１と定義し、その反対の方向を右方向Ｄ３２と定義し、これらをあわせて左右方向Ｄ３と定義する。主要な図面には、これらの方向を示す矢印を図示している。

[0016] また、基板収納容器１に収納される基板Ｗ（図１参照）は、円盤状のシリコンウェーハ、ガラスウェーハ、サファイアウェーハ等であり、産業に用いられる薄いものである。本実施形態における基板Ｗは、直径３００ｍｍのシリコンウェーハである。

[0017] 図１～図４に示すように、基板収納容器１は、上述のようなシリコンウェーハからなる基板Ｗを収納して、工場内の工程において搬送する工程内容器として用いられたり、陸運手段・空運手段・海運手段等の輸送手段により基板を輸送するための出荷容器として用いられたりするものであり、容器本体２と、蓋体３とから構成される。容器本体２は、側方基板支持部としての基板支持板状部５と、奥側基板支持部６とを備えている。蓋体３は、蓋体側基板支持部としての図示しないフロントリテーナを備えている。

[0018] 容器本体２は、一端部に容器本体開口部２１が形成され、他端部が閉塞された筒状の壁部２０を有する。容器本体２内には基板収納空間２７が形成されている。基板収納空間２７は、壁部２０により取り囲まれて形成されている。壁部２０の部分であって基板収納空間２７を形成している部分には、基板支持板状部５が配置されている。基板収納空間２７には、図１に示すように、複数の基板Ｗを収納可能である。

[0019] 基板支持板状部５は、基板収納空間２７内において対をなすように配置された内装部品であり、壁部２０に着脱可能に固定されて設けられている。基板支持板状部５は、複数の基板Ｗの縁部に当接することにより、隣接する基板Ｗ同士を所定の間隔で離間させて並列させた状態で、複数の基板Ｗの縁部を支持可能である。基板支持板状部５の奥側には、奥側基板支持部６が基板支持板状部５と一体成形されて設けられている。

[0020] 奥側基板支持部６は、基板収納空間２７内において後述する図示しないフロントリテーナと対をなすように壁部２０に設けられている。奥側基板支持部６は、複数の基板Ｗの縁部に当接することにより、複数の基板Ｗの縁部の後部を支持可能である。

[0021] 蓋体３は、容器本体開口部２１を形成する開口周縁部２８に対して着脱可

能であり、容器本体開口部２１を閉塞可能である。図示しないフロントリテーナは、蓋体３の部分であって蓋体３によって容器本体開口部２１が閉塞されているときに基板収納空間２７に対向する部分に設けられている。フロントリテーナは、基板収納空間２７の内部において奥側基板支持部６と対をなすように配置されている。

[0022] フロントリテーナは、蓋体３によって容器本体開口部２１が閉塞されているときに、複数の基板Wの縁部に当接することにより複数の基板Wの縁部の前部を支持可能である。フロントリテーナは、蓋体３によって容器本体開口部２１が閉塞されているときに、奥側基板支持部６と協働して複数の基板Wを支持することにより、隣接する基板W同士を所定の間隔で離間させて並列させた状態で保持する。

[0023] 基板収納容器１は、プラスチック材等の樹脂で構成されており、特に説明が無い場合には、その材料の樹脂としては、たとえば、ポリカーボネート、シクロオレフィンポリマー、ポリエーテルイミド、ポリエーテルケトン、ポリブチレンテレフタレート、ポリエーテルエーテルケトン、液晶ポリマーといった熱可塑性樹脂やこれらのアロイ等が上げられる。これらの成形材料の樹脂には、導電性を付与する場合には、カーボン繊維、カーボンパウダー、カーボンナノチューブ、導電性ポリマー等の導電性物質が選択的に添加される。また、剛性を上げるためにガラス繊維や炭素繊維等を添加することも可能である。

[0024]〔容器本体２〕

以下、各部について、詳細に説明する。図１～図４に示すように、容器本体２の壁部２０は、奥壁２２と上壁２３と下壁２４と第１側壁２５と第２側壁２６とを有する。奥壁２２、上壁２３、下壁２４、第１側壁２５、及び第２側壁２６は、上述した材料により構成されており、一体成形されて構成されている。

[0025] 第１側壁２５と第２側壁２６とは対向しており、上壁２３と下壁２４とは対向している。上壁２３の後端、下壁２４の後端、第１側壁２５の後端、及

び第２側壁２６の後端は、全て奥壁２２に接続されている。上壁２３の前端、下壁２４の前端、第１側壁２５の前端、及び第２側壁２６の前端は、略長方形状をした容器本体開口部２１を形成する開口周縁部２８を構成する。

[0026] 開口周縁部２８は、容器本体２の一端部に設けられており、奥壁２２は、容器本体２の他端部に位置している。壁部２０の外面により形成される容器本体２の外形は箱状である。壁部２０の内面、即ち、奥壁２２の内面、上壁２３の内面、下壁２４の内面、第１側壁２５の内面、及び第２側壁２６の内面は、これらによって取り囲まれた基板収納空間２７を形成している。開口周縁部２８に形成された容器本体開口部２１は、壁部２０により取り囲まれて容器本体２の内部に形成された基板収納空間２７に連通している。基板収納空間２７には、最大で２５枚の基板Ｗを収納可能である。

[0027] 上壁２３及び下壁２４の部分であって、開口周縁部２８の近傍の部分には、基板収納空間２７の外方へ向かって窪んだラッチ係合凹部２３１Ａ、２３１Ｂ、２４１Ａ、２４１Ｂが形成されている。ラッチ係合凹部２３１Ａ、２３１Ｂ、２４１Ａ、２４１Ｂは、上壁２３及び下壁２４の左右両端部近傍に１つずつ、計４つ形成されている。

[0028] 上壁２３の外面においては、リブ２３５が、上壁２３と一体成形されて設けられている。リブ２３５は、容器本体２の剛性を高める。また、上壁２３の中央部には、トップフランジ２３６が固定される。トップフランジ２３６は、ＡＭＨＳ（自動ウェーハ搬送システム）、ＰＧＶ（ウェーハ基板搬送台車）等において基板収納容器１を吊り下げる際に、基板収納容器１において掛けられて吊り下げられる部分となる部材である。

[0029] 下壁２４には、ボトムプレート２４４が固定されている。ボトムプレート２４４は、下壁２４の外面を構成する下面の略全面に対向して配置される略長方形状の板状を有しており、下壁２４に固定されている。

[0030] 下壁２４の四隅近傍には、２種類の貫通孔である給気孔２４２と排気孔２４３が形成されている。本実施形態においては、下壁２４の前部の２箇所の貫通孔は、容器本体２の内部の気体を排出するための排気孔２４３であり、

後部の２箇所の貫通孔は、容器本体２の内部に気体を給気するための給気孔２４２である。

[0031] 給気孔２４２としての貫通孔には、付加部品としての給気用フィルタ部９８が配置されており、排気孔２４３としての貫通孔には、排気用フィルタ部９９が配置されている。即ち、給気用フィルタ部９８及び排気用フィルタ部９９の内部の気体の流路は、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路の一部を構成する。また、給気用フィルタ部９８と排気用フィルタ部９９とは、壁部２０に配置されており、給気用フィルタ部９８と排気用フィルタ部９９とにおいては、容器本体２の外部の空間と基板収納空間２７との間でフィルタ（図示せず）を介して気体が通過可能である。給気用フィルタ部９８に供給されたパージガスは、基板収納空間２７へ供給されるように構成されている。排気用フィルタ部９９は、基板収納空間２７から容器本体２の外部の空間へ気体を通過可能に構成されている。

[0032]〔突出部８〕

奥壁２２は、気体噴出ノズル部としての突出部８（図５参照）を有している。突出部８は、図６に示すように、突出部本体部８１と、内部壁部８２と、疎水性膜８３と、ノズル部室形成部８４と、を有しており、これらはこの順で、図６に示すように、互いに固定されて突出部８を構成する。

[0033] 突出部８は、２つで対をなして設けられている。環状の溝８１９１が形成され溝８１９１に図示しないシール部材であるＯリングが嵌められた突出部本体部８１の基部８１９が、給気用フィルタ部９８の内部の通気路に気密に連通するように、２つの給気孔２４２の近傍の容器本体２の下壁２４の部分に形成された穴に、１つずつ計２つ差し込み構造により差し込まれることにより、容器本体２の下壁２４に固定されている。容器本体２の下壁２４に形成された当該穴にも、基部８１９に対してシールをする図示しないシール部材が設けられている。また、突出部８の先端側の部分である突出部８の上部は、スナップフィット、又は、溶着等により、壁部２０を構成する奥壁２２に固定されている。

Entegris, EX1002, p. 681

[0034] この構成により、一対の突出部８は、リブ状に容器本体開口部２１へ向って突出し、平行に奥壁２２の上端部から下端部に至るまで延びている。突出部８は中空の柱状を有している。

[0035] 突出部８は、基板収納空間２７と容器本体２の外部の空間とを連通可能な、給気用フィルタ部９８の内部の気体の流路である通気路に流入した気体を、基板収納空間２７に供給する複数の開口部８４１と、複数の開口部８４１から均一化された流量で気体を流出可能とする気体流量均一化部を有する。

[0036] 気体流量均一化部は、具体的には、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路（給気用フィルタ部９８の内部の気体の流路）と、開口部８４１と、の間に位置している。気体流量均一化部は、気体滞留室８０１と、気体流出前保持室８０４と、気体滞留室８０１と気体流出前保持室８０４とを直線的に連通することを遮蔽して気体滞留室８０１と気体流出前保持室８０４とを連通する室間流路８０６を形成する室間間仕切（本体側間仕切８１２、内壁側間仕切８２２）と、ノズル部室８０３と、を有している。

[0037] 図８、図９等に示すように、気体滞留室８０１は、突出部本体部８１と、内部壁部８２と、室間間仕切（本体側間仕切８１２、内壁側間仕切８２２）と、により囲まれる空間により構成されている。気体流出前保持室８０４は、突出部本体部８１と、内部壁部８２及び内部壁部８２に形成された貫通孔を塞ぐように設けられた疎水性膜８３と、室間間仕切（本体側間仕切８１２、内壁側間仕切８２２）と、により囲まれる空間により構成されている。ノズル部室８０３は、内部壁部８２及び内部壁部８２に形成された貫通孔を塞ぐように設けられた疎水性膜８３と、ノズル部室形成部８４と、により囲まれる空間により構成されている。

[0038] 気体滞留室８０１は、図６、図７に示すように、上下方向において所定の間隔で設けられた分室間間仕切り８１１により複数の気体滞留分室に仕切られている。分室間間仕切り８１１は、気体滞留室８０１を完全に区画してパージガスが複数の気体滞留分室の間を流通不能とするのではなく、内部壁部

８２との間にガス流通空間８０１１を形成している。このため、上下方向に隣接する気体滞留分室の間でパージガスの流通が可能である。

[0039] ガス流通空間８０１１は、上下方向において突出部８の最下部から最上部まで気体滞留室８０１が直線状に連通していない。具体的には、内部壁部８２から気体滞留室８０１の内方へ延びる分室間間仕切り８２３が、内部壁部８２に設けられている。従って、給気用フィルタ部９８の通気路から気体滞留室８０１へ流入したパージガスは、分室間間仕切り８１１と分室間間仕切り８２３とによりクランク形状の気体供給流路８０１１とされた、全ての気体滞留分室に連通する気体滞留室８０１の部分を通過して、気体滞留室８０１の最下端から最上端へ向かって流れるように構成されている。

[0040] 気体流出前保持室８０４は、図６、図７に示すように、上下方向において所定の間隔で設けられた区画壁８１３により、複数の気体流出前保持分室に区画されている。区画壁８１３は、気体流出前保持室８０４を完全に区画してパージガスが複数の気体流出前保持分室の間を流通不能とする。このため、各気体流出前保持分室に流入したパージガスは、疎水性膜８３を通して、ノズル部室８０３へ流入する。図６、図７に示すように、区画壁８１３により区画された複数の気体流出前保持分室は、均一の容積を有する。

[0041] 疎水性膜８３は、内部壁部８２に複数形成された貫通孔８２１の周囲であって内部壁部８２の前側に形成された凹部に嵌め込まれた状態で固定されている。疎水性膜８３は、基板収納容器１の容器本体２を洗浄する際に、濡れても流動抵抗が変化しない疎水性の膜により構成されている。疎水性膜８３としては、具体的には、通気性・疎水性能を持つ多孔質の膜、シート、又は疎水性能を持つコーティング品等が用いられ、本実施形態においては、ＰＴＦＥ膜が用いられる。

[0042] ノズル部室８０３の内部には、分室間間仕切りや区画壁は設けられていない。このため、下端部から上端部に至るまで連続して続く、１つの室として形成されている。図１０に示すように、ノズル部室８０３が形成されたノズル部室形成部８４の前側には、複数の開口部８４１が形成されている。開口

Entegris, EX1002, p. 683

部８４１は、基板収納空間２７に収納可能な基板Wの一枚毎に対応した個数、具体的には、２５個形成されている。ノズル部室８０３は、全ての開口部８４１に連通しており、また、疎水性膜８３を通して、区画壁８１３により複数に区画された全ての気体流出前保持分室に連通する。

[0043] 開口部８４１の上側には、図１０に示すように、それぞれ前方向Ｄ１１へ進むにつれて下方向Ｄ２２に傾斜する傾斜庇８４２が、開口部８４１の下側よりも前方向Ｄ１１へ突出して設けられている。傾斜庇８４２は、互いに平行に延びている。傾斜庇８４２は、容器本体２を洗浄する際に、開口部８４１からノズル部室８０３への洗浄液の流入を阻む。また、傾斜庇８４２は、開口部８４１から気体を下方向Ｄ２２へ向けて流出させる所定方向流出部を構成する。

[0044]〔蓋体３〕

図１に示すように、蓋体３は、容器本体２の開口周縁部２８の形状と略一致する略長方形状を有している。蓋体３は容器本体２の開口周縁部２８に対して着脱可能であり、開口周縁部２８に蓋体３が装着されることにより、蓋体３は、開口周縁部２８によって取り囲まれる位置関係で、容器本体開口部２１を閉塞可能である。

[0045] 蓋体３の内面（図１に示す蓋体３の裏側の面）であって、蓋体３が容器本体開口部２１を閉塞しているときの開口周縁部２８のすぐ後方向Ｄ１２の位置に形成された段差の部分の面（シール面２８１）に対向する面には、蓋体３の外周縁部を一周するように、環状のシール部材４が取り付けられている。シール部材４は、蓋体３を一周するように配置されている。シール部材４は、弾性変形可能なポリエステル系、ポリオレフィン系など各種熱可塑性エラストマー、フッ素ゴム製、シリコンゴム製等である。

[0046] 蓋体３が開口周縁部２８に装着されたときに、シール部材４は、容器本体２のシール面２８１と蓋体３の内面とにより挟まれて弾性変形する。即ち、蓋体３と容器本体２との間にシール部材４が介在することにより、蓋体３と開口周縁部２８とが互いに当接せずに離間した状態で、蓋体３は、容器本体

開口部２１を閉塞可能である。開口周縁部２８から蓋体３が取り外されることにより、容器本体２内の基板収納空間２７に対して、基板Wを出し入れ可能となる。

[0047] 蓋体３においては、ラッチ機構が設けられている。ラッチ機構は、蓋体３の左右両端部近傍に設けられており、図１に示すように、蓋体３の上辺から上方向Ｄ２１へ突出可能な２つの上側ラッチ部３２Ａ、３２Ａと、蓋体３の下辺から下方向Ｄ２２へ突出可能な２つの下側ラッチ部３２Ｂ、３２Ｂと、を備えている。２つの上側ラッチ部３２Ａ、３２Ａは、蓋体３の上辺の左右両端近傍に配置されており、２つの下側ラッチ部３２Ｂ、３２Ｂは、蓋体３の下辺の左右両端近傍に配置されている。

[0048] 蓋体３の外面においては操作部３３が設けられている。操作部３３を蓋体３の前側から操作することにより、上側ラッチ部３２Ａ、３２Ａ、下側ラッチ部３２Ｂ、３２Ｂを蓋体３の上辺、下辺から突出させることができ、又は、上辺、下辺から突出させない状態とすることができる。上側ラッチ部３２Ａ、３２Ａが蓋体３の上辺から上方向Ｄ２１へ突出して、容器本体２のラッチ係合凹部２３１Ａ、２３１Ｂに係合し、且つ、下側ラッチ部３２Ｂ、３２Ｂが蓋体３の下辺から下方向Ｄ２２へ突出して、容器本体２のラッチ係合凹部２４１Ａ、２４１Ｂに係合することにより、蓋体３は、容器本体２の容器本体開口部２１に固定される。

[0049] 蓋体３の内側（図１における蓋体３の後方向Ｄ１２の側）においては、基板収納空間２７の外方（前方向Ｄ１１）へ窪んだ凹部（図示せず）が形成されている。凹部には、フロントリテーナ（図示せず）が固定されて設けられている。

[0050] フロントリテーナ（図示せず）は、フロントリテーナ基板受け部（図示せず）を有している。フロントリテーナ基板受け部（図示せず）は、左右方向に所定の間隔で離間して対をなすようにして２つずつ配置されている。このように対をなすようにして２つずつ配置されたフロントリテーナ基板受け部は、上下方向に２５対並列した状態で設けられている。基板収納空間２７内

に基板Wが収納され、蓋体３が閉じられることにより、フロントリテーナ基板受け部は、基板Wの縁部の端縁を支持する。

[0051]〔実施形態の効果〕

上記構成の本実施形態に係る基板収納容器１によれば、以下のような効果を得ることができる。

本実施形態に係る基板収納容器１は、一端部に容器本体開口部２１が形成された開口周縁部２８を有し、他端部が閉塞された筒状の壁部２０を備え、壁部２０の内面によって、基板Wを収納可能であり容器本体開口部２１に連通する基板収納空間２７が形成された容器本体２と、容器本体開口部２１に対して着脱可能であり、容器本体開口部２１を閉塞可能な蓋体３と、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路（給気用フィルタ部９８及び排気用フィルタ部９９の内部の気体の流路）と、通気路に流入した気体を基板収納空間２７に供給する複数の開口部８４１を有する気体噴出ノズル部としての突出部８と、複数の開口部８４１から均一化された流量で気体を流出可能とする気体流量均一化部（気体滞留室８０１、気体流出前保持室８０４）と、を備え、気体流量均一化部は、気体滞留室８０１と、気体流出前保持室８０４と、気体滞留室８０１と気体流出前保持室８０４とを直線的に連通することを遮蔽して気体滞留室８０１と気体流出前保持室８０４とを連通する室間流路８０６を形成する室間間仕切り（本体側間仕切８１２、内壁側間仕切８２２）と、を有する。

[0052] この構成により、気体滞留室８０１に滞留されたパージガスが、室間流路８０６を通って気体流出前保持室８０４の複数の各気体流出前保持分室に流され、ノズル部室８０３へ流入して滞留され、ノズル部室形成部８４の複数の開口部８４１のそれぞれから均一に流出することが可能となる。この結果、基板収納空間２７に収納されている基板Wに対して、複数の開口部８４１から均一にパージガスを供給することが可能となる。

[0053] また、本実施形態に係る基板収納容器１によれば、気体流量均一化部は、気体流出前保持室８０４を複数の気体流出前保持分室に区画する区画壁８１

３を有する。この構成により、気体流出前保持室８０４に流入したパージガスは、複数の気体流出前保持分室に分けられて、一時的に滞留させることが可能となる。これにより、複数の気体流出前保持分室に流入したパージガスの量に差があった場合であっても、一時的に滞留させられるため、一時的に滞留させられて各気体流出前保持分室で均一化されたパージガスが、ノズル部室８０３へ流入する。このため、ノズル部室８０３へ流入したパージガスが、所定の開口部８４１から強く流出することを抑えることが可能となる。

[0054] また、本実施形態に係る基板収納容器１によれば、複数の気体流出前保持分室は均一の容積を有する。この構成により、所定の気体流出前保持分室から疎水性膜８３を通して、ノズル部室８０３へ流入するパージガスの量の差が生ずることを極力抑えることが可能となる。

[0055] また、本実施形態に係る基板収納容器１によれば、気体滞留室８０１は、分室間間仕切り８１１により複数の気体滞留分室に仕切られている。この構成により、気体滞留室８０１の下端部に流入したパージガスが、勢いよく気体滞留室８０１の上端部にまで至ることを抑えることができる。このため、気体滞留室８０１の上端部に多くのパージガスが流れることを抑えることが可能となる。

[0056] また、本実施形態に係る基板収納容器１によれば、全ての気体滞留分室に連通する気体供給流路としてのガス流通空間８０１１が形成されている。この構成により、気体滞留室８０１に流入したパージガスを、全ての気体滞留分室に連通させて、各気体滞留分室から、気体流出前保持室８０４を構成する各気体流出前保持分室へ流すことが可能となる。

[0057] また、本実施形態に係る基板収納容器１によれば、気体噴出ノズル部としての突出部８は、開口部８４１に連通するノズル部室８０３を有し、ノズル部室８０３は、疎水性膜８３を介して気体流出前保持室８０４に連通する。この構成により、基板収納容器１の容器本体２を洗浄する際に、疎水性膜８３は、流動抵抗が変化せず、且つ、気体流出前保持室８０４に洗浄液が流入することを防止することが可能となる。

[0058] また、本実施形態に係る基板収納容器１によれば、ノズル部室８０３は、全ての開口部８４１、及び、気体流出前保持室８０４を構成する全ての気体流出前保持分室に連通する。この構成により、気体流出前保持室８０４を構成する全ての気体流出前保持分室に流入したパージガスを、全ての開口部８４１に連通するノズル部室８０３に流入させることが可能となる。

[0059] また、本実施形態に係る基板収納容器１によれば、気体噴出ノズル部としての突出部８は、開口部８４１から気体を所定の方向へ向けて流出させる所定方向流出部としての傾斜庇８４２を有する。この構成により、容器本体２の洗浄の際に、開口部８４１からノズル部室８０３へ洗浄液が流入することを抑えることが可能となる。

[0060] また、本実施形態に係る基板収納容器１によれば、開口部８４１は、基板収納空間２７に収納される複数の基板Wのそれぞれに対応して形成されている。この構成により、1つの開口部８４１から流出するパージガスが１つの基板Wに割り当てられているため、基板Ｗ１枚ずつに確実にパージガスを流すことが可能となる。

[0061] また、本実施形態に係る基板収納容器１によれば、気体噴出ノズル部と気体流量均一化部とを有する柱状の突出部８を備え、突出部８の基部８１９は、容器本体２の壁部２０に形成され通気路を形成する穴であってシール部材が設けられた穴に挿入される共に、突出部８の先端側の部分は、容器本体２の壁部２０に対して固定されることにより、突出部８は容器本体２に固定される。この構成により、突出部８を容器本体２に対して、容易に且つ確実に固定することが可能となる。

[0062]〔変形例〕

本発明は、上述した実施形態に限定されることはなく、特許請求の範囲に記載された技術的範囲において変形が可能である。

[0063] 例えば、実施形態においては、突出部を構成する突出部本体部、内部壁部、疎水性膜、ノズル部室形成部等の構成は、突出部８を構成する突出部本体部８１、内部壁部８２、疎水性膜８３、ノズル部室形成部８４等の構成に限

定されない。

[0064] また、容器本体及び蓋体の形状、容器本体に収納可能な基板の枚数や寸法は、本実施形態における容器本体２及び蓋体３の形状、容器本体２に収納可能な基板Ｗの枚数や寸法に限定されない。

符号の説明

[0065] １　基板収納容器

２　容器本体

３　蓋体

５　側方基板支持部

６　奥側基板支持部

８　突出部

２０　壁部

２１　容器本体開口部

２５　第１側壁（側壁）

２６　第２側壁（側壁）

２７　基板収納空間

８３　疎水性膜

８０１　気体滞留室（気体流量均一化部）

８０３　ノズル部室

８０４　気体流出前保持室（気体流量均一化部）

８１１　分室間間仕切り

８１２　本体側間仕切（室間間仕切り）

８１３　区画壁

８１９　基部

８２２　内壁側間仕切（室間間仕切り）

８４１　開口部

８４２　傾斜庇（所定方向流出部）

８０１１　ガス流通空間

W　基板

請求の範囲

[請求項1] 一端部に容器本体開口部が形成された開口周縁部を有し、他端部が閉塞された筒状の壁部を備え、前記壁部の内面によって、基板を収納可能であり前記容器本体開口部に連通する基板収納空間が形成された容器本体と、

前記容器本体開口部に対して着脱可能であり、前記容器本体開口部を閉塞可能な蓋体と、

前記基板収納空間と前記容器本体の外部の空間とを連通可能な通気路と、

前記通気路に流入した気体を前記基板収納空間に供給する複数の開口部を有する気体噴出ノズル部と、

前記複数の開口部から均一化された流量で気体を流出可能とする気体流量均一化部と、を備え、

前記気体流量均一化部は、気体滞留室と、気体流出前保持室と、前記気体滞留室と前記気体流出前保持室とを直線的に連通することを遮蔽して前記気体滞留室と前記気体流出前保持室とを連通する室間流路を形成する室間間仕切りと、を有する基板収納容器。

[請求項2] 前記気体流量均一化部は、前記気体流出前保持室を複数の気体流出前保持分室に区画する区画壁を有する請求項１に記載の基板収納容器。

[請求項3] 前記複数の気体流出前保持分室は均一の容積を有する請求項２に記載の基板収納容器。

[請求項4] 前記気体滞留室は、分室間間仕切りにより複数の気体滞留分室に仕切られている請求項３又は請求項３に記載の基板収納容器。

[請求項5] 全ての前記気体滞留分室に連通する気体供給流路が形成されている請求項４に記載の基板収納容器。

[請求項6] 前記気体噴出ノズル部は、開口部に連通するノズル部室を有し、

前記ノズル部室は、疎水性膜を介して前記気体流出前保持室に連通

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する請求項２～請求項５のいずれかに記載の基板収納容器。

[請求項7] 前記ノズル部室は、全ての開口部及び全ての前記気体流出前保持分室に連通する請求項６に記載の基板収納容器。

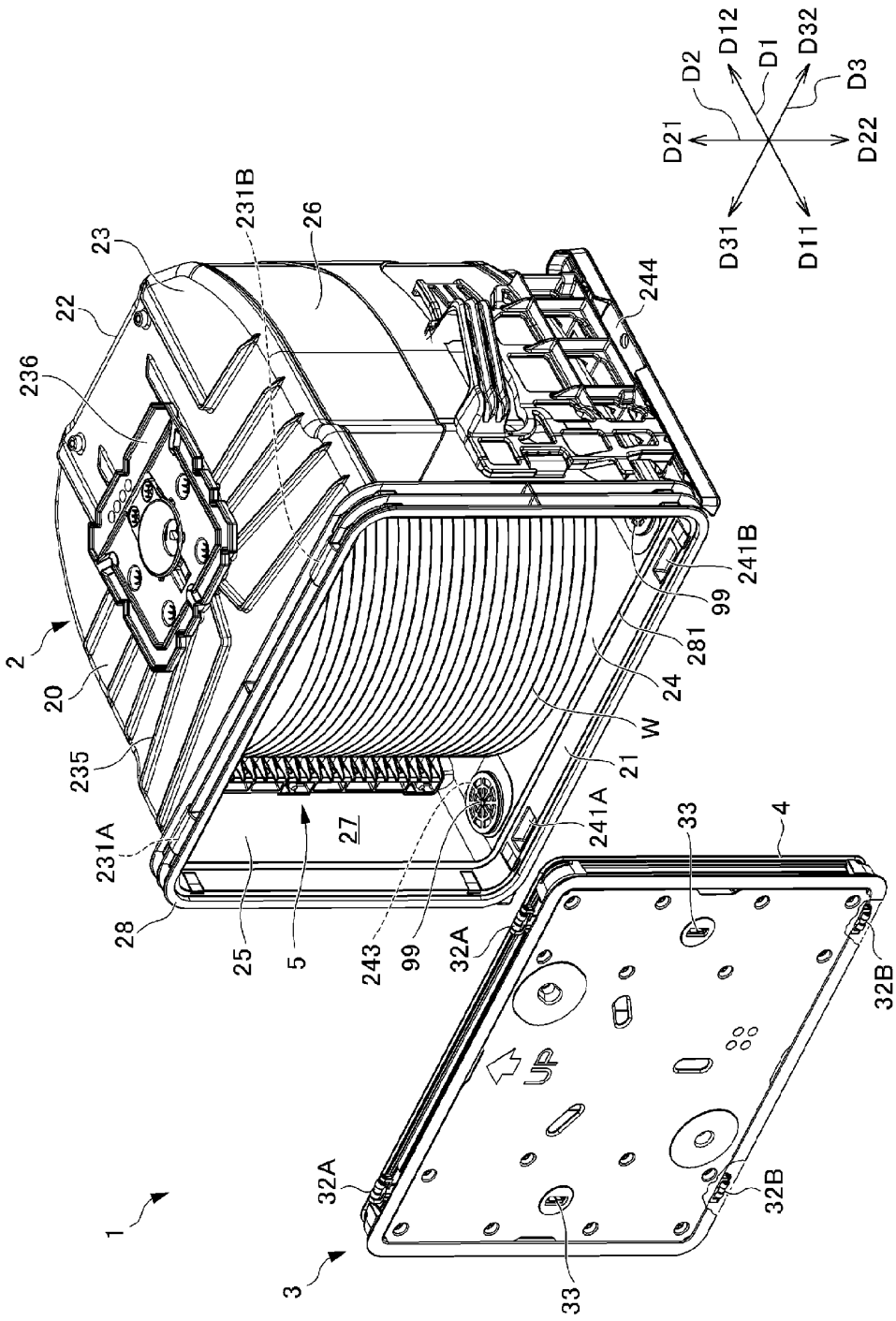
[請求項8] 前記気体噴出ノズル部は、前記開口部から気体を所定の方向へ向けて流出させる所定方向流出部を有する請求項１～請求項７のいずれかに記載の基板収納容器。

[請求項9] 前記開口部は、前記基板収納空間に収納される複数の前記基板のそれぞれに対応して形成されている請求項１～請求項８のいずれかに記載の基板収納容器。

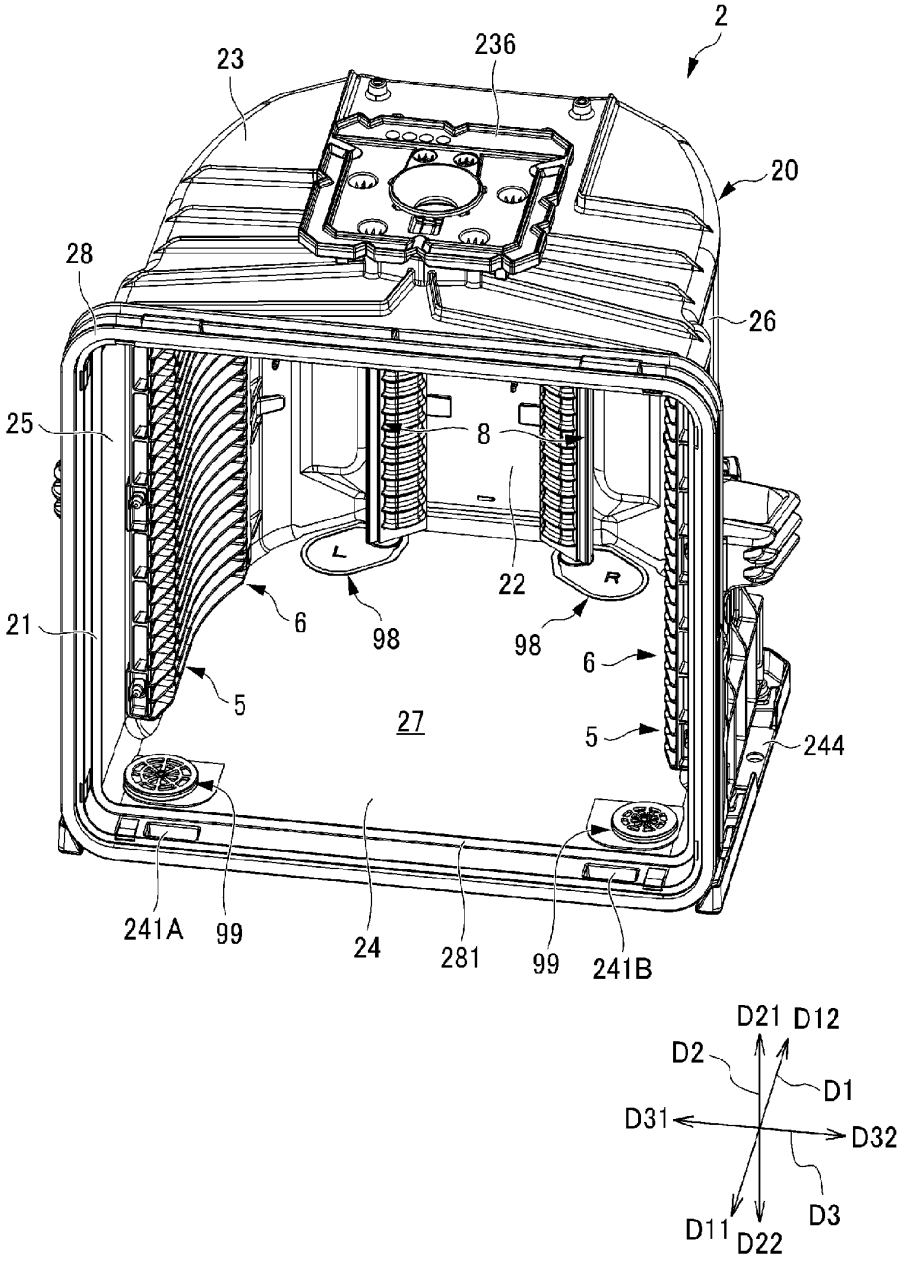
[請求項10] 前記気体噴出ノズル部と前記気体流量均一化部とを有する柱状の突出部を備え、

前記突出部の基部は、前記容器本体の前記壁部に形成され前記通気路を形成する穴であってシール部材が設けられた穴に挿入される共に、前記突出部の先端側の部分は、前記容器本体の前記壁部に対して固定されることにより、前記突出部は前記容器本体に固定される請求項１～請求項９のいずれかに記載の基板収納容器。

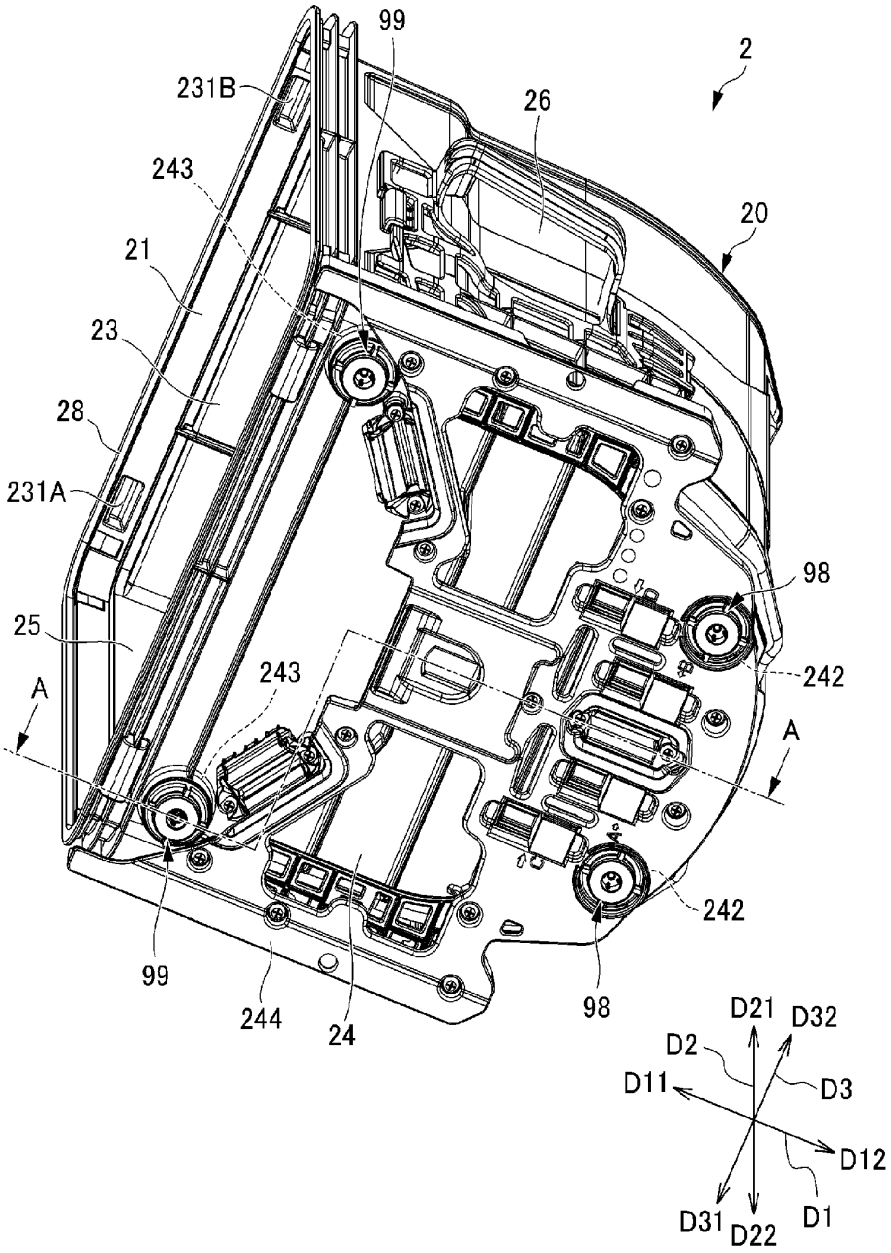
[図1]


D2
D12
D1
D32
D3
D21
D22
D31
D11
231B
26
23
244
22
236
241B
99
281
24
W
21
2
20
235
241A
33
4
231A
27
28
25
5
243
99
32A
32B
32A
32B
1
3
33

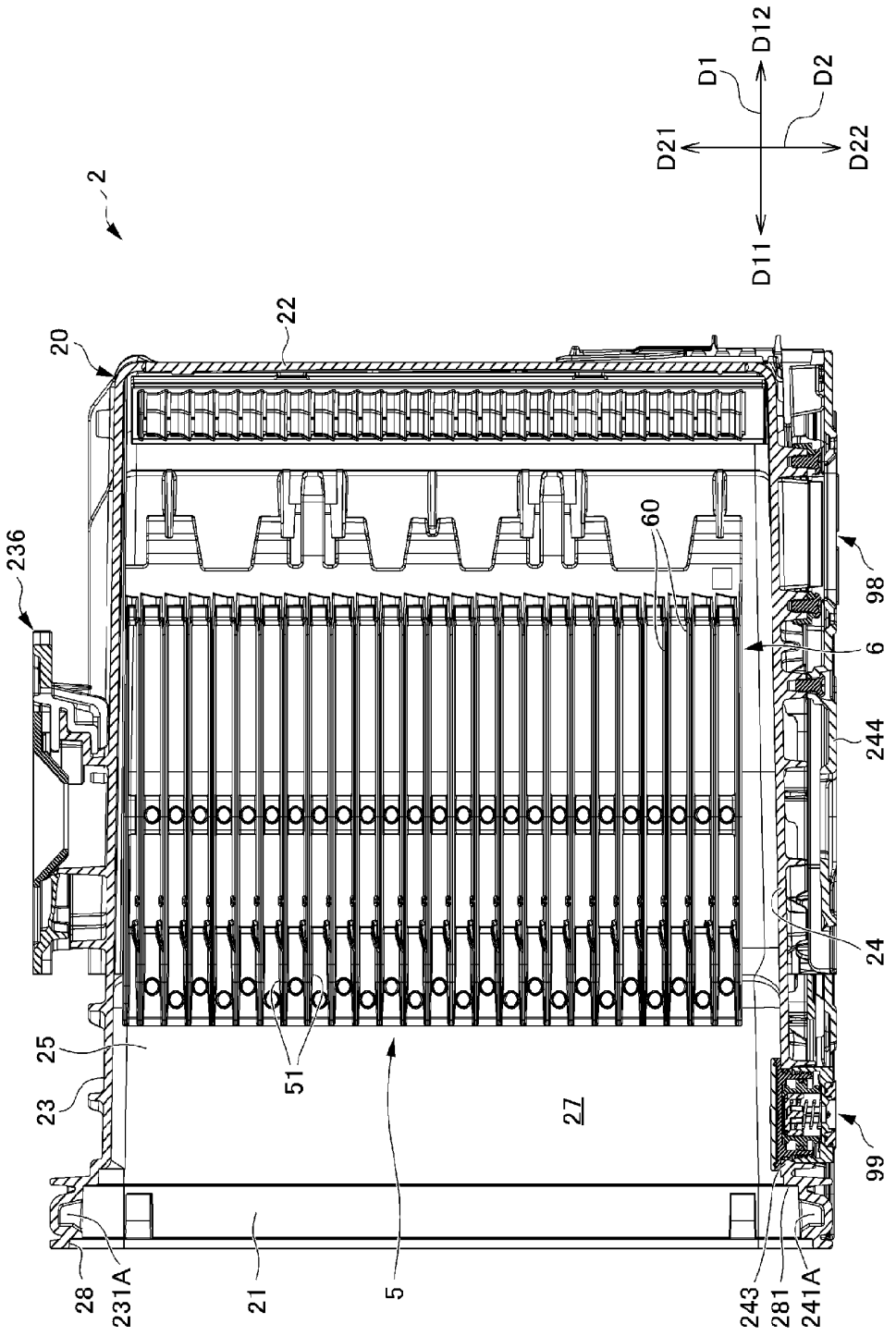
[図2]


2
23
236
20
28
26
25
8
L
R
22
21
6
98
98
6
5
27
5
244
241A
99
24
281
99
241B
D21
D12
D2
D1
D31
D32
D3
D11
D22

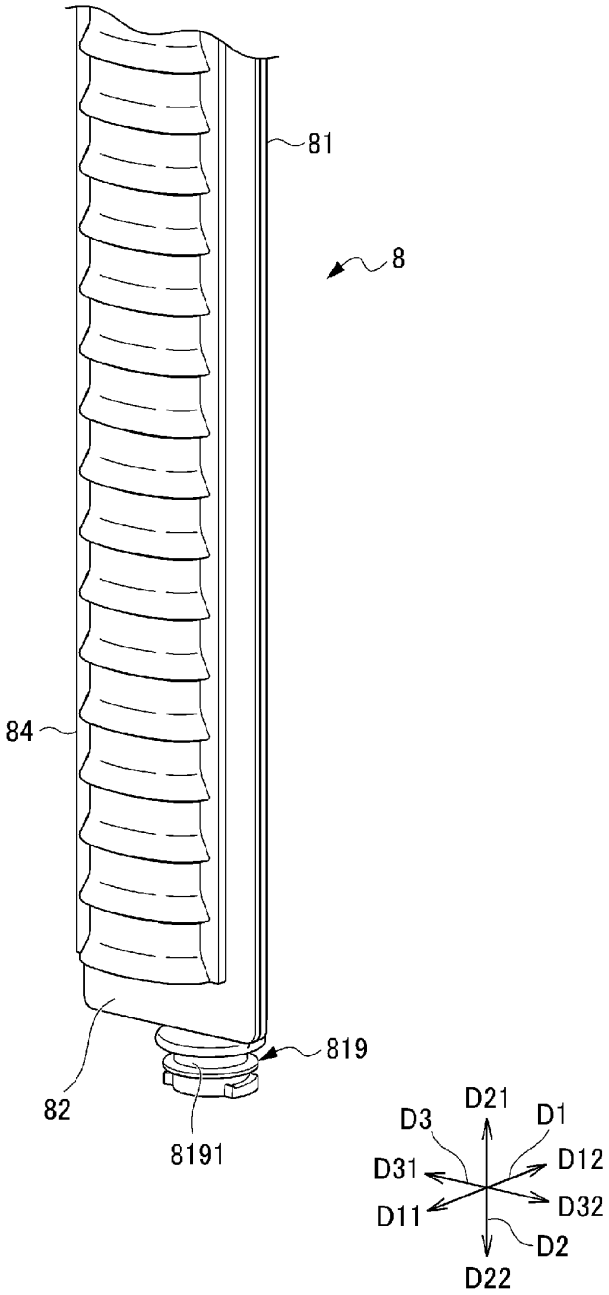
[図3]


99
2
231B
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243
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231A
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242
A
243
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244
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98
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D11
D3
D12
D31
D22
D1

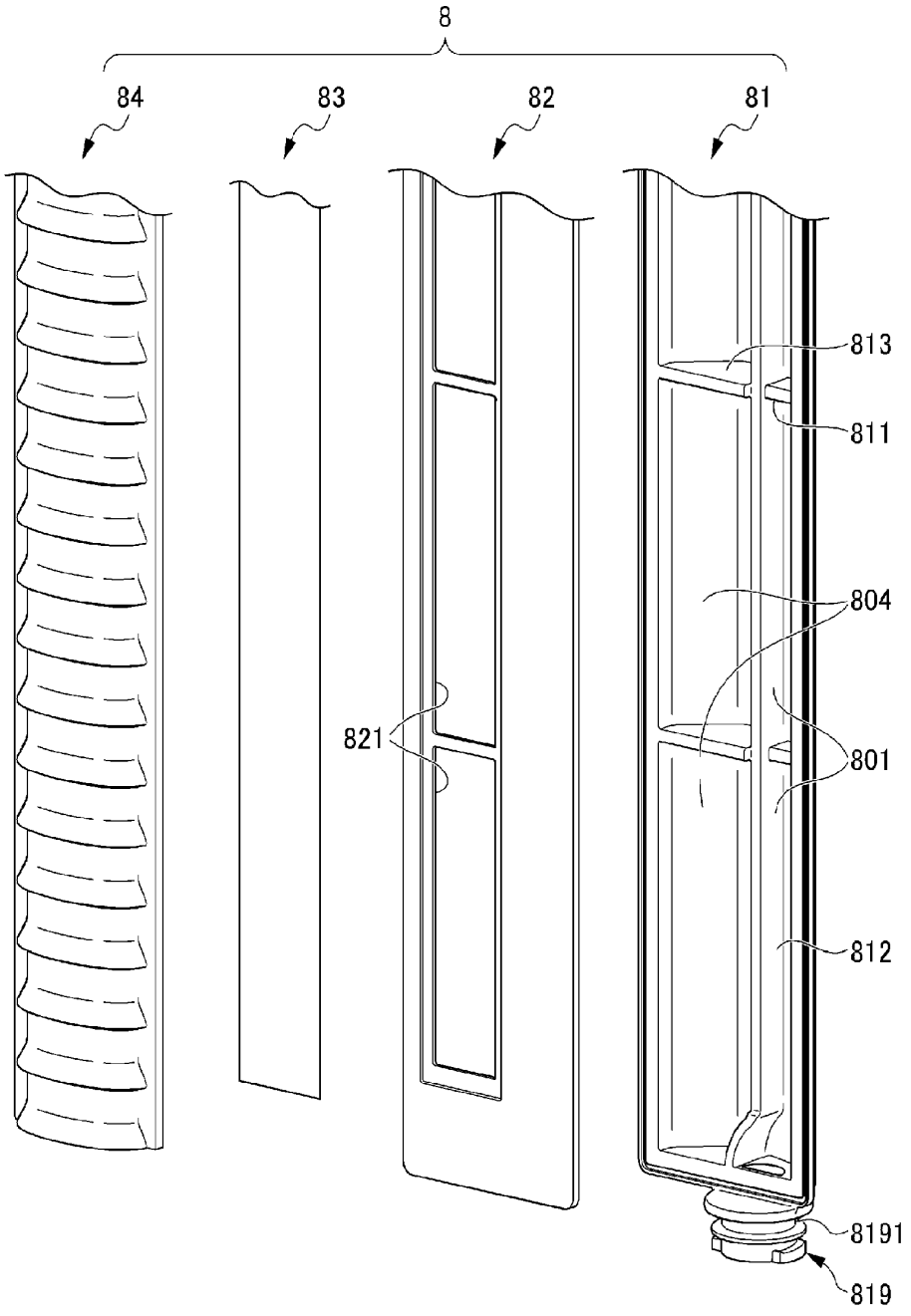
[図4]


D12
D1
D2
D21
D22
D11
2
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236
60
98
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244
24
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23
51
27
99
28
231A
21
5
243
281
241A

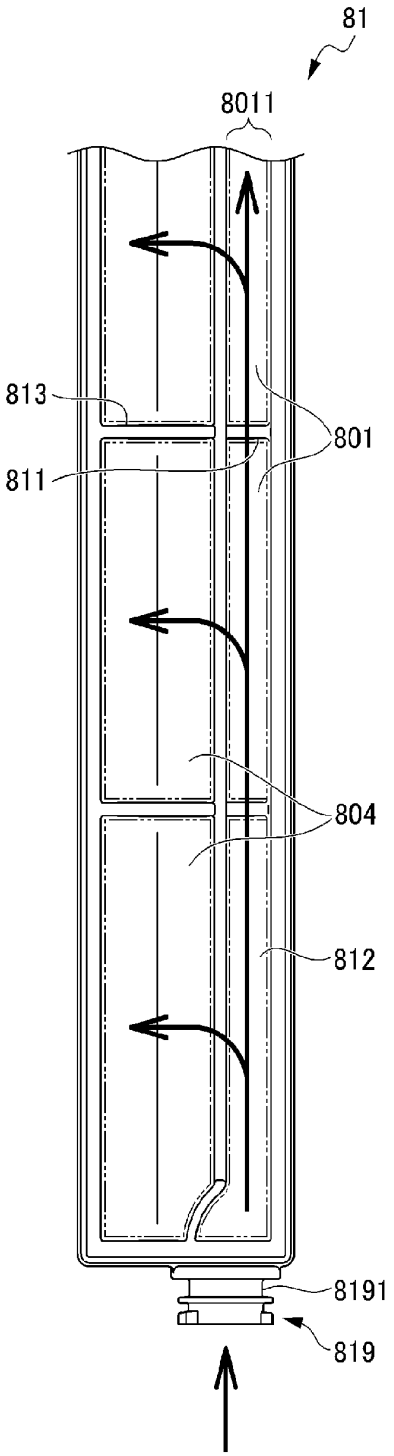
[図5]



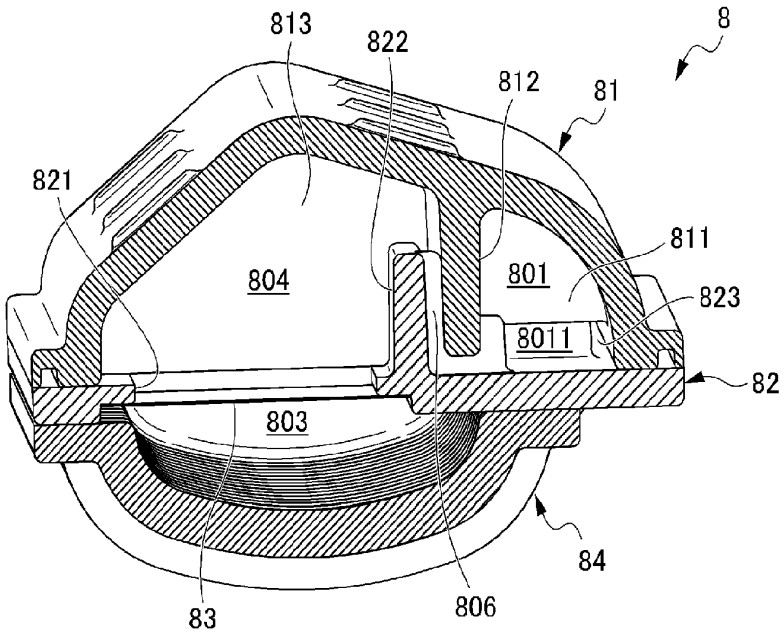
[図6]



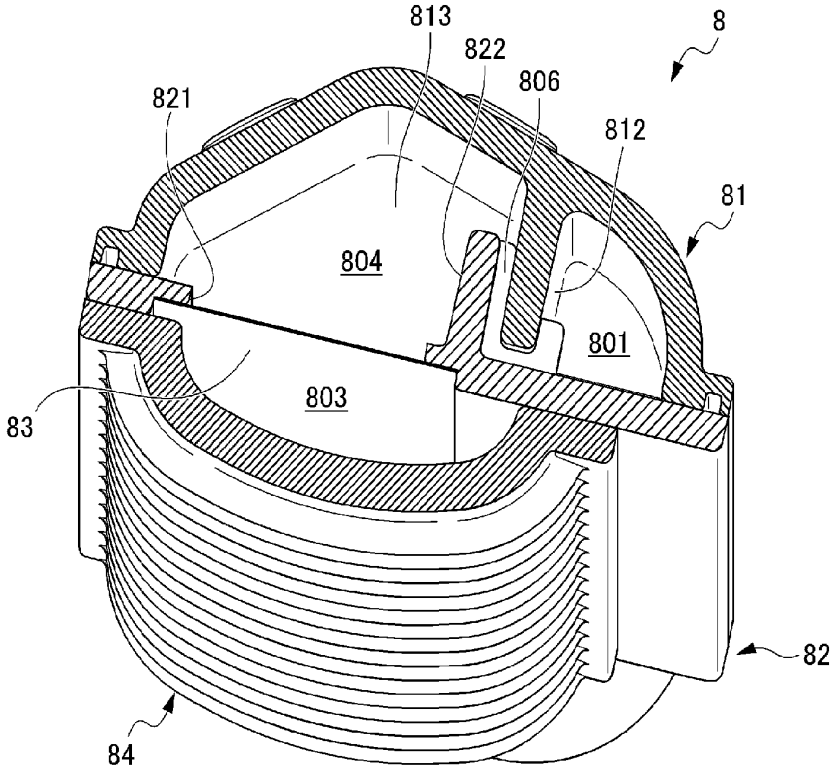
[図7]



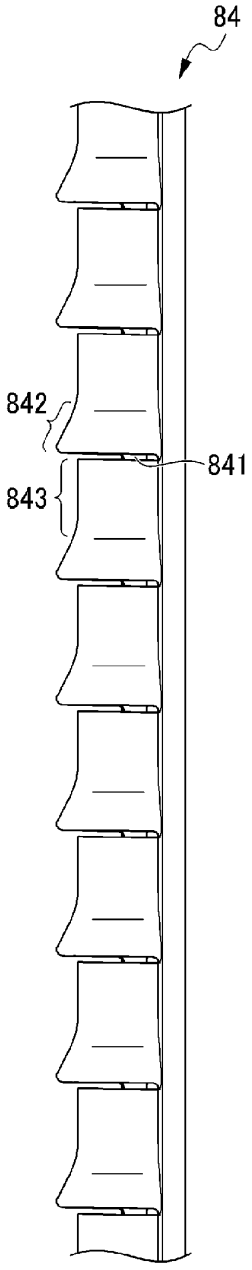
[図8]


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[図9]


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[図10]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/023474

A. CLASSIFICATION OF SUBJECT MATTER
H01L 21/673(2006.01)i
FI: H01L21/68 T

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L21/673

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2021/014653 A1 (MIRAIAL CO LTD) 28 January 2021 (2021-01-28) claim 1, paragraphs [0025]-[0065], fig. 1-6	1, 8-10
X	JP 3198841 U (GUDENG PRECISION INDUSTRIAL CO., LTD) 23 July 2015 (2015-07-23) paragraphs [0018]-[0024], fig. 1-3	1, 9, 10
A	KR 10-2020-0011290 A (SEMES CO., LTD.) 03 February 2020 (2020-02-03)	1-10
A	JP 2013-513951 A (ENTEGRIS, INC) 22 April 2013 (2013-04-22)	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 30 August 2021 (30.08.2021)	Date of mailing of the international search report 07 September 2021 (07.09.2021)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/023474

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2021/014653 A1	28 Jan. 2021	(Family: none)	
JP 3198841 U	23 Jul. 2015	US 2015/0357218 A1 paragraphs [0022]-[0031], fig. 1-3 CN 204558433 U KR 20-2015-0004506 U	
KR 10-2020-0011290 A	03 Feb. 2020	(Family: none)	
JP 2013-513951 A	22 Apr. 2013	US 2012/0297981 A1 CN 102812545 A KR 10-2012-0107987 A	

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国際調査報告

国際出願番号
PCT/JP2021/023474

A. 発明の属する分野の分類（国際特許分類（ＩＰＣ））

H01L 21/673(2006.01)i
FI: H01L21/68 T

B. 調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

H01L21/673

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２０２１年
日本国実用新案登録公報	１９９６－２０２１年
日本国登録実用新案公報	１９９４－２０２１年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

C. 関連すると認められる文献

引用文献のカテゴリー*	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
X	WO 2021/0.4653 A1（ミライアル株式会社）28.01.2021（2021-01-28） 請求項1,段落[0025]-[0065],図1-6	1,8-10
X	JP 3198842 U（家登精密工業股▲ふん▼有限公司）23.07.2015（2015-07-23） 段落[0018]-[0024],図1-3	1,9,10
A	KR 10-2020-0011290 A (SEMES CO., LTD.) 03.02.2020 (2020-02-03)	1-10
A	JP 2013-513951 A（インテグリス・インコーポレーテッド）22.04.2013（2013-04-22）	1-10

☐ C欄の続きにも文献が列挙されている。

☑ パテントファミリーに関する別紙を参照。

* 引用文献のカテゴリー
"A" 特に関連のある文献ではなく、一般的技術水準を示すもの
"E" 国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
"L" 優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
"O" 口頭による開示、使用、展示等に言及する文献
"P" 国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
"T" 国際出願日又は優先日後に公表された文献であって出願と抵触するものではなく、発明の原理又は理論の理解のために引用するもの
"X" 特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
"Y" 特に関連のある文献であって、当該文献と他の１以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
"&" 同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
30.08.2021	07.09.2021

名称及びあて先	権限のある職員（特許庁審査官）
日本国特許庁(ISA/JP) 〒100-8915 日本国 東京都千代田区霞が関三丁目４番３号	湯川　洋介　5Q 1788 電話番号 03-3581-1101 内線 3557

様式 PCT/ISA/210（第２ページ）（２０１５年１月）

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国際調査報告
パテントファミリーに関する情報

国際出願番号
PCT/JP2021/023474

引用文献	公表日	パテントファミリー文献	公表日
WO 2021/014653 A1	28.01.2021	（ファミリーなし）	
JP 3198841 U	23.07.2015	US 2015/0357218 A1 段落[0022]-[0031],図1-3 CN 204558433 U KR 20-2015-0004506 U	
KR 10-2020-0011290 A	03.02.2020	（ファミリーなし）	
JP 2013-513951 A	22.04.2013	US 2012/0297981 A1 CN 102812545 A KR 10-2012-0107987 A	

様式 PCT/ISA/210（パテントファミリー用別紙）（２０１５年１月）

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(51) Int Cl.[7]: **H01L 21/68**, B65G 49/06, B65G 49/07, B65D 85/86, B65G 1/00

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25.12.2000 JP 2000404696
17.01.2001 JP 2001047404

(71) Applicant: **Ebara Corporation**
Tokyo 144-8510 (JP)

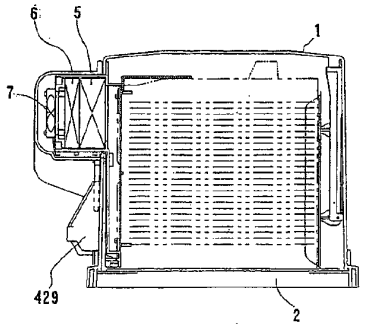
(72) Inventors:
- **SUZUKI, Yoko, Ebara Corporation**
Tokyo 144-8510 (JP)
- **TANAKA, Akira, Ebara Corporation**
Tokyo 144-8510 (JP)
- **KISHI, Takashi, Ebara Corporation**
Tokyo 144-8510 (JP)

(74) Representative: **Wagner, Karl H., Dipl.-Ing.**
Wagner & Geyer,
Patentanwälte,
Gewürzmühlstrasse 5
80538 München (DE)

(54) **DEVICE, CONTAINER, AND METHOD FOR TRANSFERRING SUBSTRATE**

(57) A method of using a substrate transport pod is provided, which is suitable for manufacturing semiconductor devices with copper wiring and low dielectric insulating film having dielectric constants of less than 3. The method is based on loading the substrates into a pod from an atmosphere of a first process, and circulating a gaseous atmosphere through interior of the pod in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, and to expose the substrates to a controlled atmosphere intermittently or continually while the substrates are held in the pod before unloaded from the pod and introduced into a second process. For a pod that is used to house the substrates for the purpose of retaining or transporting, the pod has a pod main body and a door that provides a hermetic sealing, and the pod is made primarily of a materiel that has moisture absorption factor of less than 0.1 %, and the pod can contact the substrates directly or indirectly and has a conductive area so as to enable static charges to be guided out of the pod.

FIG. 71B



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Description

Technical Field

[0001] The present invention relates to the structures, capabilities and methods of operating a substrate transport pod suitable for storing or transporting objects such as semiconductor wafers, photo-masks or hard-disks in a highly clean environment, and relates in particular to a method of managing the operation of the substrate transport pod to be used in semiconductor manufacturing processes.

Background Art

[0002] As semiconductor elements become more minute, it is anticipated that even higher degree of cleanliness would be required in the future. For example, it is anticipated that the target control size of the particles that can cause pattern defects and shorting of wiring would become smaller than 0.1 μm. Further, in addition to particulate contaminants, it becomes necessary to reduce gaseous contaminants. Various hydrocarbon molecules, by adsorbing onto the semiconductor wafers, cause deterioration in voltage resistance of gate oxide film or thickness variations in deposited films. Basic gases react with chemical enhancement type photo-resist to result in loss of resolution, and acidic gases can cause corrosion of wiring.

[0003] In addition, moisture (humidity) has been targeted for reduction in recent years. This is because finer device structure has led to the use of a variety of materials in forming wiring and films, and moisture in the environment can sometimes bind with the above-mentioned materials to cause problems. On the other hand, independent of the trend towards finer device structure, the size of the wafers is increasing and automation is also progressing in the field of processing technologies. Automation of semiconductor manufacturing line is prompted by the fact that it is necessary to segregate humans who acts as a contamination source and the fact that, as the diameter of wafers increases, the weight of the transport pod increases to about 10 kg such that manual handling becomes difficult.

[0004] In the past, with increasing circuit density and speed of semiconductor chips, aluminum has been used as the material for wiring to connect elements within the semiconductor chip. However, when the width of the wires becomes less than 0.13 μm, conventional aluminum wiring causes serious problems of heat generation and signal delay so that, in place of aluminum wiring, there is a trend towards the use of copper wiring.

[0005] Also, SiO_2 has been used as the insulation material for isolation of wiring. However, the dielectric constant of SiO_2 at about 4 is high so that replacement of aluminum wiring with copper wiring only results in about 20 % improvement in signal delay, so that there has been a need to use a substance of lower dielectric constant of less than 3 for the insulation material.

[0006] In readiness for such a development, examination of copper wiring and low dielectric materials for insulation has already identified a potential problem, arising from of the processing of chips with line-width at the level of 0.18 μm. Such low dielectric materials are based on organic materials or porous materials so that problems are encountered such as absorption of moisture from the environment, which leads to increasing dielectric constants, and therefore, these material must be handled differently from conventional insulation films and are presenting an extremely difficult challenge.

[0007] Also, copper used for wiring behaves differently from aluminum that has been used in the past because of its tendency to react with oxygen in the air to produce oxide films. Also, because the copper molecules have higher chemical activity compared with aluminum molecules such that, if particles containing copper or copper vapor itself is discharged into the clean-room, it contaminates the clean-room to lead to severe drop in the yield of semiconductor chips. Also, organic contaminants on silicon substrate surface has been known to cause a drop in reliability of gate oxide film, an increase in incubation time in the low pressure CVD processes and abnormal film growth. Therefore, even if a superior material is found in the future for use in making low dielectric insulation films, it is conceivable that it cannot be adopted because of its susceptibility to contamination from such impurities as organic substances and ions in the environment. Conversely, by controlling the processing environment, an opportunity may emerge of using those materials that have not been able to be used in the past. Also, if ammonia is present, the photo-resist material applied on the semiconductor wafer exhibits a so-called "T-top" phenomenon, which refers to a phenomenon that the top section of the developed photo-resist is wider than the bottom section.

Disclosure of Invention

[0008] The present invention is provided in view of the background information described above, and an object is to provide a substrate transport pod suitable for use in processes for manufacturing semiconductor chips comprised by a combination of copper wiring and low dielectric insulation films having dielectric constant less than 3, and methods for operating the pod. Also, as the line width becomes finer, problems of contamination resulting from minute quantities

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of ammonia and organic substances generated from workers and particle contaminants generated from the work uniform, become more serious. Furthermore, due to diversification of customer demands for semiconductor products, it is anticipated that the proportion of "large variety/small quantity" products such as system LSI (large scale integration) circuits will increase in relation to the proportion of "small variety and large quantity" products such as DRAM (dynamic random access memory) and MPU (micro-processor units). For these reasons, there will be a need for facilities that enable to vary combinations of semiconductor processing easily and quickly. The present invention provides a substrate transport pod suitable for use in an automated semiconductor processing plant for manufacturing semiconductor devices, including large variety and small quantity products, and methods for operating the pod.

[0009] To resolve the problems outlined above, the present invention provides a solution for resolving the problems encountered in semiconductor chip manufacturing processes that utilize copper wiring and insulation films of dielectric constant of less than 3. For example, silicon wafer substrates having low dielectric insulation film, photo-resist film or copper wiring may be housed in a substrate transport pod for transferring or storing the substrates between processes, so that the interior air of the pod is controlled in such a way that the level of at least the moisture is held below a certain value or ammonia concentration is held below a certain value; or if copper film is exposed to the interior air of the pod, the level of at least moisture or oxygen concentration is controlled, so that various problems associated with manufacturing semiconductor chips having copper wiring and insulation films of dielectric constant less than 3 can be resolved. In particular, a structure of the substrate transport pod is provided so as to enable to maintain at least one parameter of the interior air, such as particulate concentration, humidity, organic substance concentration, ionic gas concentration to a level below a specific value. Further, a method of operating a plurality of substrate transport pods in an automated semiconductor manufacturing plant is provided.

Brief Description of Drawings

[0010]

FIGS. 1A, 1B and 1C are diagrams of various air flows in the clean-room;
FIG 2 is a block diagram of the wiring process of semiconductor elements manufacturing suitable for application of the substrate transport pod;
FIG 3 is a cross sectional view of a first embodiment of the substrate transport pod;
FIG. 4 is a cross sectional view of another embodiment of the substrate transport pod;
FIG. 5 is a cross sectional view of another embodiment of the substrate transport pod;
FIG. 6 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 7 is a diagram of an embodiment of powering a substrate transport pod by mounting it on AGV;
FIG 8 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 9 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 10 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 11 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 12 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 13 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 14 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 15 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 16 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 17 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 18 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 19 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 20 is a cross sectional view of another embodiment of the substrate transport pod;
FIGS. 21A to 21F are diagrams of various types of air flow in the substrate transport pod;
FIG 22 is a cross sectional view of another embodiment of the substrate transport pod;
FIGS. 23A and 23B are spring connections of electrical contacts;
FIG 24 is a diagram of an example of non-contact method of powering the substrate transport pod;
FIG 25 is a cross sectional view of another embodiment of the substrate transport pod;
FIG 26 is a cross sectional view of another embodiment of the substrate transport pod;
FIGS. 27A and 27B are cross sectional views of a square- and a round-shaped substrate transport pod, respectively;
FIG 28 shows structures for powering and static charge discharging;
FIGS. 29A to 29F are diagrams of various methods of affixing the door to the pod main body;
FIG. 30 is a diagram of an example of latching mechanism;
FIGS. 31A and 31B are diagrams of wafer supports;

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FIGS. 32A, 32B and 32C are diagrams of connections of the pod main body to a powering apparatus;
FIGS. 33A and 33B are diagrams of seal structures between the pod main body and the lid;
FIGS. 34A and 34B are diagrams of an example of attaching computation unit to the pod;
FIGS. 35A, 35B and 35C are diagrams of filter structures based on folded filtering member;
FIGS. 36A, 36B and 36C are diagrams of filter structures based on wave-shaped separators;
FIG 37 is a diagram of a flat film structure filter;
FIG 38 is a diagram of a unit structure of filter;
FIG 39 is a diagram of a composite type filter unit;
FIGS. 40A, 40B and 40C are diagrams of examples of the structure of chemical filters;
FIG 41 is a diagram of a filter comprised by adsorbing agent held between two sheets of paper;
FIGS. 42A, 42B and 42C are diagrams of examples of the structure of chemical filters;
FIGS. 43A, 43B and 43C are diagrams of another examples of chemical filters;
FIGS. 44A, 44B and 44C are diagrams of still another examples of chemical filters;
FIGS. 45A and 45B are diagrams of still another examples of chemical filters;
FIGS. 46A, 46B and 46C are diagrams of examples of structures used for gaseous contaminants filters: FIG. 46A is a diagram showing direct attachment of the filter to the outer frame; FIG 46B is a diagram showing indirect attachment of the filter to the outer frame; and FIG 46C is a diagram showing attachment of the filter by way of a protrusion; and (A) is a view through A in FIG 46B, and (B) is a view through B in FIG 46B;
FIG. 47 is an illustration of the principle of dehumidification action by solid polymer electrolytic film;
FIG 48 is an exploded diagram of a dehumidifier based on solid polymer electrolytic film;
FIG. 49 is an exploded diagram of another dehumidifier based on solid polymer electrolytic film;
FIG 50 is an exploded diagram of still another dehumidifier based on solid polymer electrolytic film;
FIG. 51 is a cross sectional view of an example of the structure of a fan motor;
FIG 52 is an enlarged cross sectional view of regions near the rotation shaft shown in FIG 51;
FIG 53 is a diagram of air-flow inside the pod caused by thermal convection;
FIG 54 is a diagram of supplying dry gas into the interior of the pod;
FIG 55 is a top view of the substrate transport pod of the present invention;
FIG 56 is a side view of the pod shown in FIG 55;
FIGS. 57A and 57B are, respectively, a top view and a vertical cross sectional view of a substrate transport pod provided with an air cleaning apparatus;
FIGS. 58A and 58B are, respectively, a top view and a vertical cross sectional view of a substrate transport pod;
FIGS. 59A and 59B are, respectively, a top view of a power input apparatus and a bottom view of the substrate transport pod;
FIGS. 60A to 60H are diagrams of various methods of discharging the static electricity from semiconductor wafers disposed inside the substrate transport pod;
FIG 61 is a top view of a substrate transport pod;
FIG 62 is a cross sectional view of the substrate transport pod;
FIG 63 is a bottom view of the substrate transport pod;
FIG 64 is a top view of the substrate transport pod;
FIG 65 is a cross sectional view of a substrate transport pod;
FIG 66 is a bottom view of the substrate transport pod;
FIG 67 is a graph to compare the service life of a dehumidifier;
FIG 68 is a diagram to show the attachment of the substrate transport pod to a processing apparatus;
FIG 69 is a diagram to show transport of substrates from the substrate transport pod mounted on a processing apparatus;
FIGS. 70A and 70B are, receptively, a top view and a vertical cross sectional view of a substrate transport pod;
FIGS. 71A and 71B are, respectively, a top view and a vertical cross sectional view of a substrate transport pod;
FIG 72 is a diagram to show a substrate transport pod mounted on a processing apparatus;
FIG 73 is a diagram to show an example of operation of the pod shown in FIG 72;
FIG 74 is a graph showing dehumidifying performance and fan operations, and ○ refers to fan stopped, ∗ refers to fan operating intermittently, and ♦ refers to fan operating continually;
FIG 75 is a graph showing dehumidifying performance and fan operations, and ∗ refers to operation with two dehumidifying followed by one dehumidifying unit, and ♦ refers to operation with one dehumidifying unit only;
FIG 76 is a flowchart of first stage of semiconductor device production;
FIGS. 77A to 77D are diagrams of a substrate transport pod that allows detaching filter and moisture aversion parts;
FIGS. 78A and 78B are diagrams of a variation of the pod shown in FIG 77;
FIGS. 79A, 79B and 79C are diagrams of the structure of the power input section seen in a front view, a bottom view and a cross-sectional view;

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FIGS. 80A and 80B are diagrams of the structure of a power input apparatus seen in a vertical cross sectional view and a top view;
FIGS. 81A and 81B are diagram of the structure of another power input apparatus seen in a cross sectional view and a top view;
FIG 82 is a diagram of a substrate transport pod seated on a power input apparatus;
FIG 83 is a diagram of a substrate transport pod seated on another power input apparatus;
FIG. 84 is an exploded perspective view of a substrate transport pod;
FIG. 85 is a block diagram of the control section on the substrate transport pod side;
FIG. 86 is a block diagram of the control section on the powering apparatus side;
FIGS. 87A, 87B and 87C are diagrams showing transport state, seated state and door descended state of the substrate transport pod, respectively;
FIGS. 88A, 88B and 88C are diagrams of a variation of the example shown in FIG 87;
FIGS. 89A, 89B and 89C are diagrams of another variation of the example shown in FIG 87;
FIGS. 90A, 90B and 90C are diagrams of still another variation of the example shown in FIG 87;
FIG. 91 is a diagram of a substrate transport pod seated on a power input apparatus;
FIG 92 is a diagram to show a pod transported by OHT, and is being powered;
FIG. 93 is an enlarged view of the ceiling section of the pod shown in FIG. 92;
FIG 94 is a diagram of information management system for substrate transport pods;
FIG 95 is a diagram to explain information holding apparatus attached to the pod-side of the system shown in FIG 94;
FIG 96 is a diagram of a management system in managing washing events and filter exchange events;
FIG 97 is a cross sectional view of a substrate transport pod having a filter near the gas intake opening and the gas discharge opening;
FIG. 98 is a cross sectional view of a substrate transport pod having a cylindrical particle filter (5c) for producing a gaseous stream in the radial direction;
FIG 99 is an enlarged view of the cylindrical particle filter (5c) shown in FIG 98, and a cross sectional view through A-A and an enlarged view of B section;
FIG. 100 is a block diagram for a process of establishing a charging duration; and
FIG. 101 is a conceptual diagram of network management for the substrate transport pods.

Best Mode for Carrying Out the Invention

[0011] Preferred embodiments will be explained in the following with reference to the drawings attached.

[0012] First, the necessity for automation and clean-room will be explained. To prevent human errors by workers and contamination of substrates such as semiconductor wafers by organic substances and minute quantities of ammonia generated from the workers, it is effective to remove the workers from the space used for handling the substrates, and the introduction of process automation is required as a means for achieving such an end. Substrate transport pods for use in such automated facility include SMIF (standard mechanical interface) pod and FOUP (front opening unified pod), which are used in conjunction with door opener that positions the pod at a specific location and opens a door externally, and transport apparatus for automatic transport. SMIF pods and FOUPs are sealed containers that permit lesser degree of cleanliness in the exterior environment of the pod, that is, the cleanliness of the clean-room can be lesser degree. Accordingly, capital cost and operating cost of the clean-room can be reduced.

[0013] Clean-rooms are classified according to air flow pattern as: unidirectional flow clean-room, non-unidirectional flow clean-room and mixed flow type clean-room. FIG 1A shows the air-flow pattern in the unidirectional flow clean-room. In this type of clean-room, clean air that has been filtered through ULPA filter 635 and others is forced out from the ceiling or the front face of one wall and is exited from the floor opposite to the filter or the ceiling 631 to sweep the air from the clean-room through the circulation line 632 and an air blower 633. This method produces a highly clean environment in the entire room and permits reduction in the number of partitions required, but on the other hand, this method is the most expensive. FIG 1B shows the air flow pattern in the non-unidirectional flow clean-room. In this method, clean air that has been filtered through ULPA filter 635 and others is blown out from the ceiling or one portion of one wall and the room air is diluted with the clean air, which is exited from the discharge opening 634. This method is used to generate a degree of cleanliness that is less stringent than the class 6 (corresponds to Federal Standard 209D class 1000) defined by JIS B9920. Although the high degree of cleanliness cannot be produced, the method can reduce the number of partitions as well as capital and operating costs. The method provides advantages such as relative ease in switching the production lines because the number of partitions can be reduced. This method is most suitable for semiconductor plants based on mini-environment type production designed to store substrates primarily in containers. FIG. 1C shows the mixed-flow type clean-room that incorporates the features of both unidirectional flow and non-unidirectional flow clean-rooms described above. This method allows reduction in capital and operating costs

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by producing a high degree of cleanliness only in the production line containing the semiconductor production facilities and passages by the use of the unidirectional flow clean-room, while using the non-unidirectional flow clean-room in service areas and the like that can allow a lesser degree of cleanliness. Because the partition walls 636 are required, it has a disadvantage that regrouping of production line is more difficult. This method is suitable for open cassette type production plant that handles substrates mostly as they are.

[0014] FIG 2 shows an example of wiring formation process of a semiconductor chip based on copper wiring and low dielectric insulation film. As shown in FIG 2, CVD (chemical vapor deposition) apparatus or coater is used to deposit insulation film 62 comprising organic film or porous film, on top of the conductive wiring layer of the semiconductor substrate 61 having device elements fabricated thereon (step A). Next, after forming the plug film and others as necessary, a photo-resist material 63 is applied using a coater, then the coated substrate is dried (step B). Next, after exposing the coated substrate using the stepper (step C), the resist film is developed to form a resist pattern 64 on the insulation film 62 (step D). Next, contact holes and wiring grooves 65 are formed on the insulation film 62 by etching (step E), and after removing the resist film 63, a barrier layer comprising TaN and the like is formed thereon, and on top of this layer, a copper seed layer 66 is formed to serve as the power input layer for electrolytic plating (step F).

[0015] Then, by applying a copper layer 67 on the surface of the semiconductor substrate 61, contact holes and grooves of the device substrate are filled with copper when the copper layer 67 is formed on top of the insulation layer 62 (step G). Then, the device substrate is annealed (step H) and, using chemical and mechanical polishing (CMP), a portion of the copper layer is removed from the top of the insulation layer so as to roughly level the surfaces of the copper layer 67 filling the contact holes and wiring grooves with the surface of the insulation layer (step I). This process is repeated as many times as the number of layers of wiring required to produce a multi-layered wiring structure comprised by 6~8 layers.

[0016] When the low dielectric insulation layer is exposed to the air, it is preferable that the absolute humidity in the air be lower than $4x10^{-3}$ g/g (20 % relative humidity at 25 °C), and more preferably lower than $1x10^{-3}$ g/g (5 % relative humidity at 25 °C).

[0017] When the copper film is exposed to the air, it is preferable that the absolute humidity in the air be lower than $4x10^{-3}$ g/g (20 % relative humidity at 25 °C), or more preferably, lower than $1x10^{-3}$ g/g (5 % relative humidity at 25 °C). Further, the level of organic substances of boiling point higher than 80 °C should be lower than 1 $\mu g/m^3$, or more preferably, lower than 0.5 $\mu g/m^3$. The oxygen concentration should be lower than 10000 ppm, or more preferably lower than 1000 ppm.

[0018] When the resist film is exposed to the air, it is preferable that the basic gases should be lower than 1 $\mu g/m^3$ in concentration, or more preferably lower than 0.5 $\mu g/m^3$.

[0019] Also, when the humidity is low, static electricity is generated easily such that there is a danger of destroying elements such as FET and condensers so that it is preferable that each semiconductor wafer be grounded. The method of grounding include the use of conductive wafer carriers, grounding the wafers through metallic contacts provided on the wafer carrier or using an electrical conductor material to make the wafer carrier itself.

[0020] Next, an embodiment of the substrate transport pod of the present invention will be explained. First, general transport capabilities of the transport pod suitable for automation will be explained. For example, a substrate pod for transporting several semiconductor wafers is comprised at least by the following parts.

① a pod main body having an inverted square cup shape;
② a door that houses an internal mechanism for engaging with the pod main body to operate the door externally;
③ a holding means for holding the wafers separated at a given distance;
④ a retainer for preventing vibration of the wafers;
⑤ a holding means for handling the container.

[0021] The container main body is generally made of a transparent polymeric material or an opaque material having a transparent window so as to enable confirmation of the contents. The door is provided with a positioning hole for externally guiding a latching pin and the like for operating the door, and internally houses a mechanism for locking and unlocking the door that operates in conjunction with the door operating latching pin. This latching mechanism commercially available includes those operated by mechanical drive or by vacuum, compressed air as well as those having magnet-assisted fixation. The holding means is disposed on the ceiling or the side wall section of the pod, and some are shaped so that positioning notches are used to enable a robot to grip the pod or to enable to handle the pod manually. The base requirements of the pod suitable for automation purposes may include any of these methods so long as the required function is achieved.

[0022] FIG 3 shows a substrate transport pod of this embodiment for transporting semiconductor wafers. Further, a memory chip may be provided for the pod so as to track wafer ID, history and status for each wafer batch so as to manage the processing data. The pod is comprised by the box member 1 and a lid member 2, which are affixed by a stopper or latching mechanism and the like, for example, to guard the wafers from contamination by the external

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environment.

[0023] Silicon wafers W are stored in the wafer carrier 4, which is housed inside the substrate transport pod 1. In the interior of the substrate transport pod 1, a gaseous contaminants capture medium 6 and a dehumidifying agent 8 are disposed. The gaseous contaminant capture medium 6 may include non-woven ion exchange cloth, activated carbon fibers or zeolite to remove such gaseous contaminants as hydrocarbons and ammonia that may reside inside the pod. Dehumidifying agent 8 may include silica gel, for example, to remove moisture from the interior of the substrate transport pod. It is preferable that such substances have high surface area so as to increase the gaseous contaminant capture efficiency and dehumidifying effects. The filters may be formed preferably in a wavy shape or a folded shape. It is preferable that the area of the non-woven ion exchange cloth or activated carbon fibers be more than 10 % or more preferably more than 20 % of the surface area of the interior space of the substrate transport pod. It is preferable that the dehumidifying agent be those having a dehumidifying capacity of more than 0.1 g and less than 0.4 g, or more preferably more than 0.5 g and less than 3 g per L (liter) of the volume of the space to be dehumidified.

[0024] FIG 4 shows an example of the variation of the substrate transport pod. Because there is a danger of dust generation from the gaseous contaminant capture medium 6 and dehumidifying agent 8, in order to prevent particle contamination of semiconductor wafers, they are surrounded by a particle filter 5 such as HEPA filter and ULPA filter so as to prevent particulate matters from adhering to the semiconductor wafers W.

[0025] FIG. 5 shows a substrate transport pod 1 which is provided with a motor fan 7a for circulating the interior air by operating a motor 7b so as to force the air through the dehumidifying agent or dehumidifier 8, the gaseous contaminant capture medium 6, and the particle filter 5 to actively remove particulate contaminants. Here, when contamination is not a problem, the particle filer 5 may be omitted.

[0026] Electrical power may be supplied from an external source through a power input terminal 19 provided on the exterior of the substrate transport pod 1 to operate the fan motor and/or dehumidifier. It is preferable that the surface of the terminal be gold-plated to prevent contamination of the clean-room. Here, as shown in FIGS. 98 and 99, the particle filter 5 is a cylindrical filter and may eject air in the radial direction. This example relates to the particle filter but the chemical filter may also be constructed in a similar manner.

[0027] When supplying power externally, it is preferable that the power be turned on after confirming that the substrate transport pod is present and the power is needed to be supplied or that the external power input connector and the power input terminal of the substrate transport pod are connected. This is because the pod is used in a clean-room, and if sparks fly between the electrical terminals, minute metallic particles are generated and contaminate the clean-room.

[0028] Further, as shown in FIG 6, a battery 9 may be mounted on the substrate transport pod 1. Also, the substrate transport pod may be provided with a charging terminal so that the battery may be charged by supplying electrical power from an external source.

[0029] In the case of a container shown in FIG 5 or 6, as shown in FIG. 7, during the period of transport of the substrate transport pod 1 mounted on an unmanned vehicle 10 to travel between the processing apparatuses 11, the air inside the substrate transport pod is circulated by supplying power from the battery mounted on the unmanned vehicle 10 or from an external power source (not indicated) to the fan motor 7 located inside the substrate transport pod 1. Also, when the substrate transport pod 1 is in the standby mode by being placed on the processing apparatus 11, power may be supplied from the processing apparatus 11. For example, a battery provided for the processing apparatus or a part of electrical power supplied from an external source can be used for this purpose. Charging may be carried out in a similar manner.

[0030] Further in FIGS. 8 and 9, if dust generation from the fan motor is a problem when the fan motor 7 is stopped, the particle filter 5 may be placed upstream of the fan motor 7.

[0031] Also, in addition to dust generation from the fan motor 7, if the generation of gaseous contaminant is a problem, a chemical filter 6 may be placed in the upstream side of the fan motor 7. If moisture generation from the fan motor is a problem, dehumidifying agent 8 may be placed in the downstream side of the fan motor 7. These may be placed singly or in combination.

[0032] As shown in FIG 9, the substrate transport pod may be provided with a duct 12 that houses the filters 5, 6. Further, as shown in FIG. 10, there may be provided an air supply opening 21 and a discharge opening 22 for discharging the air from the interior of the substrate transport pod externally. Such a substrate transport pod 1 communicates, as shown in FIG 11, with the interior environment of the processing apparatus or an automatic guided vehicle (AGV). The air supply opening 21 and the discharge opening 22 have a reverse flow prevention device, and they assume a hermetic state excepting when the air is being supplied. The motor fan 7 may be provided on either the processing apparatus 11 or the AGV so that the air inside the substrate transport pod is circulated by flowing through the filter duct 12. The motor fan 7 uses power from the battery 9 provided on the processing apparatus 11 or the AGV 10 or a part of the power supplied from an external source. Further, as shown in FIG. 12, the substrate transport pod 1 may be provided only with the air supply opening 21 and the discharge opening 22, such that the fan motor, filter duct and others are provided on the processing apparatus 11 or the transport apparatus 10 or on a storage facility, as shown in FIG 13, for

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circulating the air.

[0033] Further, as shown in FIGS. 14 and 15, processing apparatus 11 or transport apparatus 10 or storage facility may be used to draw air from the clean-room, and the motor fan 7 is used to circulate the air to the substrate transport pod 1 by opening the discharge opening 22 of the substrate transport pod 1 to discharge the air to the clean-room or the discharge ducts in the processing apparatus. Here, the filters 5, 6 of the motor fan 7 in the upstream side of the motor fan and dehumidifying agent 8 may be omitted.

[0034] Also, as shown in FIGS. 16 and 17, by placing a filter unit on the outside of the substrate transport pod 1, the air inside the substrate transport pod may be circulated through the filters 5, 6 and the dehumidifying agent 8 by way of the air supply opening 21 and the discharge opening 22 communicating with the substrate transport pod 1. Because the filter units 5, 6, 7, 8 are placed outside the substrate transport pod, the interior space can be cleaned easily and filter exchanging can be carried out simply.

[0035] The interior of the substrate transport pod 1 may be provided with a flow regulation plate 23, as shown in FIG 18, so as to prevent the air from bypassing the wafers W by short-cutting from the air supply opening 21 to the discharge opening 22. The degree of opening of the flow regulation plate 23 increases as the air moves away from the air supply opening 21. Accordingly, the flow of air becomes uniform in the wafer stacking direction. In particular, for particles of smaller than 0.1 μm size, the Brownian movement is stronger than the gravitational movement. For example, in the case of 0.1 μm particles, the distance of movement due to Brownian motion is $3x10^{-3}$ cm per one second while the distance of movement due to gravitational settling is $9x10^{-5}$ cm per one second. It is preferable that the average speed of air moving between the wafers be at least 0.3 cm/s and lower than 30 cm/s, or preferably faster than 1 cm/s and lower than 10 cm/s.

[0036] Also, because the particles settle due to gravity, it is preferable to attach the air supply opening 21 to the upper section of the substrate transport pod 1 and attach the discharge opening 22 to the lower section of the substrate transport pod 1, as shown in FIG 19, or the air flow pattern should be formed so as to discharge the air in the lower section of the substrate transport pod 1, as shown in FIG 20.

[0037] FIG. 97 shows an example of disposing the particle filter 5 and the chemical filter 6 in the vicinity of the intake opening of the substrate transport pod 1. In this case, the filters 5, 6 are disposed in the upstream as well as downstream side of the pod 1. Here, the filters 5, 6 may be disposed either the upstream or downstream side.

[0038] FIG. 21A to 21F illustrate various practical situations of gaseous flow when the substrates are placed inside the substrate transport pod. The flow inside the pod 1 is formed by the gas flowing through the chemical filter (gaseous contaminants filter) 6 and the ULPA filter 5 by the action of the fan motor 7, so that the wafers W are swept by the cleanest gas. After flowing among the wafers, it again returns to the fan motor 7 by flowing along the inside wall surface of the pod 1. The interior wall surface of the pod 1 relates to at least one surface of the top/bottom and left/right surfaces of the pod. The opening section of the door may be provided anywhere. In automated transport systems, the opening section for the door is provided in the front or bottom surface of the pod.

[0039] FIG 21A shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and wafers W and returning to the motor fan 7 along the left and right interior walls of the pod 1. FIG 21B shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and wafers W and returning to the motor fan 7 along the top and bottom interior walls of the pod 1. FIG 21C shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and wafers W and returning to the motor fan 7 along all the interior walls of the pod 1. FIG 21D shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 along the left and right interior walls of the pod 1 and then flowing through the wafers W and returning to the motor fan 7. FIG 21E shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 along the top and bottom interior walls of the pod 1 and then flowing through the wafers W and returning to the motor fan 7. FIG 21F shows an example of flow pattern of a gas passing through the motor fan 7 to the filters 5, 6 and returning to the motor fan 7 along the interior walls of the pod 1. In this example, the gas need not flow directly to the wafers W. In all the cases of flow patterns, it is preferable that the gas be circulated at least once or preferably three times during the period between storing of the substrates in the substrate transport pod and removing the wafers again from the pod, such that the number of circulations can be adjusted, depending on the nature of the environment required by the stored substrates and the degree of contamination existing in the environments associated with the processes preceding and succeeding the current process. If there is no restriction on the power consumed by the fan, it is most preferable that the gas be circulated constantly. Here, it should be noted that "the nature of the environment required by the stored substrates" refers to the creation of an environment inside the pod during transit for individual processes so that all or any particular species of contaminants in the pod that may reduce the yield, such as particulate matters, ions, dopants, organic substances, moisture are kept below the target control level.

[0040] The substrate transport pod that performs such environmental control can be used for transporting the substrates within any manufacturing processes, for example, between the steps in a semiconductor manufacturing process, between the floors inside the plant, between plants, or, in addition to transporting them, it may also be used to store substrates.

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[0041] When the substrate transport pod itself has a battery, the fan may be operated intermittently so that the fan will be operating at some intervals. By so doing, the power consumption of the battery can be reduced. It is preferable that the power input terminal 19 be located at the bottom section of the substrate transport pod 1, as shown in FIG 22, so that the electrical resistance at the connection to the apparatus terminal can be kept low because of the weighting effect of the substrate transport pod. It is preferable that the power input terminal 19 be pressed down by a spring member s, as shown in FIG 23A, or by a metal terminal 19 itself providing a spring action as shown in FIG 23B.

[0042] Further, it is preferable that the surfaces of the power input terminals be gold plated, at the receiving end as well as the supply end. The power source may be a direct current source, but alternating current power may also be supplied so that inductive current generated by electromagnetic means, as shown in FIG. 24, can be supplied to the substrate transport pod 1 from AGV 10 or processing apparatus 11. In this case, metal surface is not exposed on the terminal surface so that metal to metal contact is avoided to minimize contamination of the clean-room by generation of metallic dust.

[0043] Also, as shown in FIG 25, it is preferable to provide a shutter or a one-way valve 24 to close the air supply opening 21 and the discharge opening 22, when the connection opening of the AGV 10 or processing apparatus 11 is not connected to the air supply opening 21 and discharge opening 22 of the substrate transport pod 1.

[0044] Also, as shown in FIG 26, it is preferable that, by locating the air supply opening 21 and the discharge opening 22 of the substrate transport pod 1 to face toward the bottom of the substrate transport pod 1, the air supply opening 21a and the discharge opening 22a of AGV 10 or processing apparatus 11 is hermetically connected by means of respective seals 25. The seal 25 may be associated with either the substrate transport pod, AGV or with the processing apparatus.

[0045] The air supply opening and the discharge opening may be provided on the door 2. The cross sectional shape of the substrate transport pod may be square as shown in FIG 27A or circular as shown in FIG 27B, but when it is square shaped, it is preferable that the comer radius R be greater than 10 mm or more preferably greater than 20 mm. Also, it is preferable that the supply opening and discharge opening be provided with a pre-filtering means such as membrane filter to prevent admission of particulate matters.

[0046] For storing semiconductor wafers inside the pod, the most difficult problem is humidity control.

[0047] In the substrate transport pod in this embodiment, the pod main body and the door are made of a polymeric or moisture impervious material having less than 0.1 % water absorption factor. The method of determining the water absorption factor is according to ASTM (American Society for Testing and Materials) D570. Some values of the water absorption factor of general materials used in transporting and storing of semiconductor wafers and the like are: PC (polycarbonate) 0.2 %; PBT (polybutylene terephthalate) 0.08 %; PEEK (polyether etherketone) 0.14 %; PEI (polyetherimide) 0.25 %; and PP (polypropylene) 0.03 %.

[0048] It is preferable that the water absorption factor of the pod 10 be at the most less than 0.3 % or more preferably less than 0.1 %. Polymeric materials of less than 0.1 % water absorption factor include: PE (polyethylene)<0.01 %; PP (polypropylene) 0.03 %; PBT (polybutylene terephthalate) 0.06~0.08 %; PPS (polyphenylene sulfide) 0.02 %; PTFE (polytetrafluoroethylene)<0.01 %; PC (polycarbonate with 20 % added carbon) 0.1 %; and PBT (polybutylene terephthalate with 20 % added carbon) 0.05 %. The material preferable for the pod should have water absorption factor of less than 0.1 %, resistant to chemicals, stable at elevated temperatures, and has a low mold shrinkage of less than 1 % or more preferably less than 0.5 %, and includes such materials as: PPS (polyphenylene sulfide); PPS with added carbon, PBT with added carbon; and PC with added carbon. The material for the pod may include alloy material of different polymers so long as the afore-mentioned characteristics are satisfied.

[0049] Also, it is preferable that at least the wafer support material that contacts the wafers and the door that grounds the wafer support to the pod bottom be made of some electrically conductive material having carbon or other electrical conductor added thereto. The polymeric materials in general are classified as follows: those having surface resistivity $1x10^3$~$1x10^8$ Ω are classified as static-charge conductive materials; those having $1x10^5$~$1x10^{12}$ Ω as static-charge dispersing materials; and those with values higher than $1x10^{12}$ Ω as insulating materials. Also, those material having volume resistivity $1x10^2$~ $1x10^5$ Ω·cm are classified as static-charge conductive material; those having $1x10^4$~ $1x10^{11}$ Ω·cm as static-charge dispersing material; and those with values higher than $1x10^{11}$ Ω·cm as insulating material. In the present invention, it is preferable that the surface resistivity be less than $1x10^{10}$ Ω; and volume resistivity be less than $1x10^9$ Ω·cm, or more preferably surface resistivity be less than $1x10^8$ Ω; and volume resistivity be less than $1x10^7$ Ω·cm. Also, because the non-woven ion exchange cloth and activated charcoal used for gaseous contaminant capture medium contain adsorbed moisture, immediately after their production, so that it is preferable to dry them before use.

[0050] When the atmosphere inside a hermetically sealed pod is replaced with a dry gas, i.e. dried air or an inert gas that does not contain moisture, the internal humidity immediately after replacement drops to the limiting humidity at nearly 0 %. However, if the pod is left in this condition by stopping the supply of dry gas, moisture contained in the polymeric material used in the interior walls diffuses into the pod due to moisture gradient. Therefore, the humidity inside the container that has been filled with dry gas gradually increases with passage of time. As one example, it has been shown that, when commercial PC (polycarbonate) is used for the pod, the relative humidity at 0 % inside the pod

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attained immediately after replacing with a dry gas, rises to a value higher than 30 % after several hours. When PPS (polyphenylene sulfide) that has water absorption factor of 0.02 % is used, the relative humidity at 0 % attained immediately after replacing with the dry gas remains at about 12 % even after more than several hours to demonstrate its superior suppression effect against humidity rise. It is clear from this that it is possible to prevent the rise in the humidity of interior of the pod space during storage/transport of wafers. Also, it is known that the growth of natural oxide film is prevented by storing the wafers in a dark environment. For this reason, it is preferable that the material for constructing the pod should be selected from optically opaque materials rather than from optically transparent materials.

[0051] The pod may be manufactured in one piece by press forming of sheet metal. The optically opaque material should block wavelengths shorter than 1500 nm (near infrared), or more preferably those shorter than 750 nm (visible light) to produce luminance of less than 10 lux or more preferably less than 1 lux. Further, the pod material may be made of a charge-retaining material so as to attract fine particles inside the pod, thereby preventing such fine particles from sticking to the wafers. For example, as shown in FIG 28, the pod may be externally charged or discharged so that the fine particles are adhered to the interior walls during the period of charging the pod and the fine particles adhered to the interior walls are removed during the period of discharging the pod. The pod 1 is charged only when it is placed on the powering/discharging apparatus 30. The pod is provided with a powering/discharging terminals 39 to couple with the powering/discharging apparatus 30.

[0052] Various mechanisms of latching the door 2 to the pod 1 are shown in FIGS. 29A and 29B that show a mechanical arrangement, FIG. 29C shows a magnetic device 30 to hold the door against a sealing surface and FIG 29D shows a vacuum chucking device 40 provided on the interface between the door and a sealing surface. The vacuum chuck is operated by the action of an evacuation means such as vacuum pump 32. Also, the door 2 may be attached to the pod 1 by evacuating the entire vessel to a negative pressure.

[0053] A preferred example of the method of FIG 29D is shown in FIGS. 29E and 29F. The pod 1 has a door 2 that can be opened or closed, and a seal member 54 is provided between the door 2 and the pod to maintain hermetic condition of the interior of the pod. The sealing member is formed in one piece along the external frame of the door. One or a number of sealing members may be provided. Also, the pod has an exhaust duct 53 for closing the door 2 and a port valve 52 for closing/opening one end of the exhaust duct. A groove is formed at the door side end section of the exhaust duct to extend along the flange. An interface 50 is provided on the transport apparatus side and a valve 51 to communicate with the interface is provided.

[0054] Next, the flow pattern in the vacuum chucking method will be explained. As shown in FIGS. 29E and 29F, a method of opening the door from the pod is to place the pod 1 on the interface 50 while the door 2 is closed against the pod 1. Valve 51 is opened to evacuate the interface. Then, valve 51 is closed to maintain the interface section under vacuum and the port valve 52 is opened. Valve 51 is opened to introduce atmosphere inside the interface and the door is opened. A method of closing the door against the pod is to evacuate the interface while holding the door against the pod somehow and opening the port valve 52. The door 2 is then closed tightly against the pod 1. Port valve 52 is closed and the valve 51 is opened to introduce atmospheric pressure inside the interface section, so the pod 1 becomes movable.

[0055] The drive source for the mechanical latching device shown in FIG. 29B may be based on an external mechanical latching device, or it may be based on the method shown in FIG 29B to operate the latch 26 in/out of the door 2 using compressed air through the duct 31. A more preferable method based on FIG 29B is shown in FIG. 30. The latch 26 is provided so as to slide horizontally inside the door so that the latch 26 is always pushed outwards by the pressing means 42 such as coil spring. The pressing means may utilize a metallic coil spring, for example. The latch can be positioned in the first fixed position or the second fixed position. In the first fixed position, the latch 26 is disposed outside of the door 2. This is so that the latch 26 protrudes beyond the door when gas is not evacuated through the duct 31. In the second fixed position, the latch is housed inside the door. This is so that the suction through the duct 31 pulls the latch inside the door. The pod 1 has a groove 45 for receiving the latch. The latch and groove may be provided in plurality. It is preferable that the door 2 be made of an electrically conductive polymeric material, such as carbon-containing polymer, because of protection for static electricity, which will be explained later.

[0056] Next, positioning of the pod will be explained. As shown in FIGS. 32A, 32B and 32C, a locating hole 556 is provided on the pod bottom section 553 so as to correspond with the locating pin 554 provided on the station side. Also, as shown in FIGS. 32A and 32B, the end section 553a of the pod bottom section 553 is beveled so as to facilitate entry into the pod mounting section 555 of the station side. As shown in FIG 32C, the end section 555a of the apparatus mounting section 555 may be machined at a slant angle. In this case, the end section 553a of the pod need not be beveled.

[0057] As shown in FIG. 33, in order to maintain a clean atmosphere inside the pod, sealing member is required between the box and the door. A method is to seal the interface by means of sealing member provided at the interface between the two. In the flange section of the pod main body to contact the sealing member provided on the door 2, guide ribs 559 may be provided inside the flange for mechanical strengthening. Also, a protrusion 560 may be provided on the contact section to the seal member so that hermetic sealing is achieved with a smaller contact pressure. For

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the sealing member 557, it is preferable to use a fluoride-based elastomer, a polyester-based elastomer, a polyurethane-based elastomer or a polyolefin-based elastomer. Further, heat treatment enhances prevention of degassing from the sealing member during processing. Also, it is known that a positive pressure inside the pod prevents entry of contaminants from external sources. Positive pressure environment can be generated constantly or periodically. Further, as shown in FIGS. 34A and 34B, a bar code 558 may be displayed on the outer surface of the pod 1 for content identification.

[0058] Next, the particle filter will be explained.

[0059] In general, air filters are used generally to remove particulate matters. According to the JIS standards, filters are classified into the following four categories according to their particle size and capture efficiently.

① coarse particle filter: an air filter used primarily for particles larger than 5 μm;
② medium performance air filter: an air filter having medium performance primarily for particles smaller than 5 μm;
③ HEPA filter: an air filter having a capture efficiency of greater than 99.97 % for particles of 0.3 μm at a specified wind velocity and generates a pressure drop of less than 245 Pa;
④ ULPA filter: an air filter having a capture efficiency of greater than 99.9995 % for particles of 0.1 μm at a specified wind velocity and generates a pressure drop of less than 245 Pa.

[0060] In the case of creating a clean environment as in the present substrate transport pod, either the HEPA filter or the ULPA filter should be used. The ULPA filter is generally constructed so that folded filter member is provided with spacers to secure flow passages. The pressure loss through the ULPA filter varies depending on the flow resistance of the filtering membrane and the manner of folding the membrane and uniformity of the passages. When the structure is such that the opening area of the filter is small, the length of the flow passage should be increased and it is preferable to use filters having low pressure drop by packing more filtering medium. Filtering media are available commercially in various materials such as glass fibers and fluoride-based resins, and any such filtering medium may be used, but it is preferable to use fluoride-based resins that offer superior chemical resistance, low gas emission and low flow resistance. When the opening area can be made large, it is preferable to decrease the length of flow so as to maximize the utilization of the limited space available.

[0061] A frame made of aluminum or a stainless steel (SUS) or a polymer is filled with folded HEPA or ULPA filter. As shown in FIGS. 35A and 35B, the folded filter member has partitions called ribbons 101 at the apexes. The ribbons serve to maintain a constant separation of the folds to secure passage of air through the filter member. The folded filtering medium 100 is affixed to the outer frame 102 using an adhesive 103. Instead of the ribbons, the filter member may be embossed to secure the flow passages or the ribbon may be eliminated. Also, when the outer frame is made of a polymer, attachment may be made by fusing instead of using adhesive.

[0062] Here, as shown in FIG 36, a filter member may be manufactured by inserting wave-shaped separators 104, instead of the ribbons.

[0063] Also, without folding the filter member, a flat film may be used as a filter member. For example, as shown in FIG 37, a circular filtering medium 100 may be inserted between a circular inner support member 105 and an outer support member 106, and mechanically affixed to produce a flat structured filter. Such a filter has a high flow resistance, and therefore, it is suitable for application to air moving devices such as pumps.

[0064] Filtering media for particle filtering include PTFE, glass fibers, non-woven cloths, recycled products. The structure of the filter may include folded structures (pleats, mini pleats), membranes (sheet type), corrugation and hollow fibers.

[0065] The particle filters are used in an assembled unit by surrounding the filtering medium 100 in an outer frame 102 as shown in FIGS. 38 and 39. To prevent the captured particles from being detached from the filter, it is necessary to seal between the filter members and the outer frame at the sealing sections 107. A general method of sealing is to use an adhesive 103. It is also possible to pressure-bond the filtering medium 100 and the outer frame 102. The adhesive includes urethane-based or epoxy-based resins. Furthermore, when the outer frame is made of a polymeric material, filter members may be fused to the frame. By constructing the particle filter 5 separately from the gaseous contaminants filter 6, as shown in FIG. 39, when the service life is ended, each filter can be replaced independently of the other to increase the respective efficiency of filter utilization. Also, a space S is created between the particle filter 5 and the gaseous contaminants filter 6 by way of the outer frame 102, moisture transmission and the pressure drop of filters themselves can be avoided.

[0066] Next, the chemical filter (gaseous contaminants filter) 6 will be explained.

[0067] Different gaseous contaminant removing means can be chosen depending on the nature of the target substance. Basic gases can be removed effectively by the use of strongly acidic or weakly acidic cation exchange non-woven cloth or fibers, or strongly acidic or weakly acidic cation exchange beads. They can also be removed by the use of activated charcoal or ceramics coated with an acidic chemical. Acidic gases, boron, and phosphorous may be removed effectively by the use of strongly basic or weakly basic anion exchange non-woven cloth or fibers, or strongly

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basic or weakly basic cation exchange beads. They can also be removed by the use of activated charcoal or ceramics coated with a basic chemical. Organic substances can be removed by activated charcoal, activated carbon fibers, zeolite, molecular sieve, silica gel and porous ceramics. Ozone can be removed by the use of a carrier medium made of manganese dioxide in the form of grains or sheet or by attaching them to a carrier, or activated charcoal coated with manganese dioxide. Also, ionized metals in a vapor form, for example, copper sulfide, can be removed by non-woven ion exchange cloth or ion exchange beads. The structure of adsorbing material can be chosen to suit the allowable size of the filter, shape and pressure drop.

[0068] FIG. 40 shows an example of the chemical filter made of a folded sheet type adsorbing material, comprised by an outer frame 102, a sheet shaped adsorbing agent 108, a separator 104 and a seal member 103. The outer frame 102 is made of Al or stainless steel (SUS) or a polymeric material. Sheet type adsorbing material includes: ① non-woven ion exchange cloth; ② activated carbon fibers; ③ non-woven cloth impregnated with activated charcoal in a particulate or powder form; ④ two melt-bonded non-woven cloths 109 laminated and the space filled with adsorbing material 110 comprised by activated charcoal powder or ion exchange resin, as shown in FIG 41; and ⑤ non-woven cloth or fibers for capturing debris falling from activated carbon fibers and others. The adsorbing material may be affixed to the outer frame by means of urethane adhesive or by pressing to a sponge type gasket member.

[0069] As shown in FIGS. 41 and 42, the chemical filter is comprised by an outer frame 102, an adsorbing material 108 or 110 and a support member 111. The structure is such that activated charcoal particles or zeolite or ceramic particles or single crystal particles or ion exchange resin 110, singly or in combination, is wrapped by non-woven ion exchange cloth or fibers or non-woven cloth or fibers108 having no adsorbing capability, and the structure is reinforced with a support member 111 so as not to expand the activated charcoal particles. Another method is shown in FIG 43, in which the spaces in a honeycomb structure 112 or corrugated core 113 are filled with activated charcoal particles or zeolite or ceramic particles or single crystal particles or ion exchange resin 110, singly or in combination, and the filled carrier is wrapped in a non-woven cloth 109 with a support member 111. The material for the honeycomb structure or corrugated core may or may not have adsorbing capability.

[0070] Another filter structure is shown in FIG 44, in which a unified adsorbing member 114 is wrapped with a non-woven ion exchange cloth or fibers 108 or with a non-woven cloth or fibers 109 having no adsorbing capability. Adsorbing agent may be made by bonding activated charcoal or activated charcoal coated with acidic or alkaline substance or ion exchange resin or zeolite to a three-dimensional web structure of foamed urethane, for example, or by making a unified structure by cementing activated charcoal particles using an adhesive and drying.

[0071] Another filter structure is shown in FIG. 45, in which the outer frame holds activated charcoal in fiber/paper form or a ceramic material made into a corrugated form 113 or in a lattice form 115, or activated charcoal powder formed into a honeycomb structure 112, which are wrapped with a non-woven ion exchange cloth or fibers, or with non-woven cloth or fibers having no adsorbing capability. It is also permissible to use the honeycomb structure 112 mentioned in ④ above.

[0072] The material for chemical filter (gaseous contaminants filter) includes: activated charcoal, activated carbon fibers, zeolite, silica gel, ceramic material, a non-woven ion exchange cloth or fibers, ion exchange resins, activated charcoal coated with acid or alkaline substance, activated charcoal on a manganese dioxide carrier, metallic catalyst and photo-sensitive catalyst.

[0073] The filter structure can be made of a single material or a plurality of materials. When a plurality of materials is to be used, activated charcoal particles and non-woven ion exchange cloth may be used, for example. In such a case, non-woven ion exchange cloth is used to contain the particles or powder of activated charcoal. Non-woven ion exchange cloth may be made into a sheet form or a folded form. They may be applied on a carrier body made of urethane, foam body, plastic, polymeric or metallic material. For example, activated charcoal particles on a urethane carrier and ion exchange resin on a urethane carrier; or activated charcoal particles on a urethane carrier and a urethane carrier impregnated with activated charcoal particles.

[0074] The shape of the chemical filter may include a plate type, rolled core type, w-type, cylindrical type, plate-fin type, bypass type, and a three-dimensional skeletal type.

[0075] As shown in FIGS. 46A, 46B and 46C, the structure of the gaseous contaminants filter is unitized by attaching the filter member 108 to an outer frame 102. The outer frame 102 may be made of metals such as stainless steel or aluminum, or plastic. FIG 46A illustrates a direct method and FIG. 46B illustrates an indirect method for attaching the filter 108 to the outer frame. In the direct method, the elastic force of the filter itself is used to press against the outer frame. For example, the filter 108 is folded, and the elastic force in the lamination direction presses the filter against the outer frame 102 (refer to FIG. 46A, see-through view A). Indirect mounting utilizes an elastic member 116a between the filter and the outer frame. For example, an elastic member 116b such as gasket (Teflon) and the like may be used (refer to FIG 46B, see-through view B). Also, as shown in FIG 46C, on the inside surface of the outer frame, a protrusion 117 is provided so as to act as a seal when the filter is pressed against the outer frame.

[0076] Also, a particle filter and a chemical filter may be mounted on one frame to produce a composite filter unit. Or, a particle filter and a sheet type chemical filter may be folded together to produce a unified filtering device.

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[0077] Next, dehumidifying agent and dehumidifier will be explained. To remove moisture contained in air, methods based on a dehumidifying agent containing primarily either silica gel, zeolite (including synthetic zeolite), calcium carbonate, calcium chloride or magnesium chloride is available. When using the dehumidifying agent, it is preferable to use an agent such as silica gel, which can be reused after regenerative heating and available in a cartridge form for easy replacement that can be carried out automatically. Another method that may be considered is to cool the pod or insert a cooled rod inside the pod for a given duration to collect the frozen moisture for removal. Also possible is a dehumidifier based on solid polymer electrolytic film. FIG 47 shows a mechanism of dehumidification. In this method, water molecules on the dehumidifier-side space 120 is decomposed into hydrogen and oxygen using a catalyst, and hydrogen is removed through a solid polymer electrolytic film 121 impressed with a voltage towards the outer side of the dehumidifier space 120, that is, hydrogen is discharged towards the moisture discharge side space 122.

[0078] An example of a minimum number of components required for dehumidifier based on a solid polymer electrolytic film will be explained with reference to FIG 48. The essential components are: a positive electrode 123, a negative electrode 124, a solid polymer electrolytic film 121 and a catalytic layer 125. Also, a feature of assembling the components is that the positive electrode 123 and negative electrode 124 have a catalytic layer 125 and a porous substrate base. The solid polymer electrolytic film 121, porous electrode 129 (123, 124) and the catalyst 125 are assembled into a single unit by having the substrate base coupled into the solid polymer electrolytic film 121 and forming the catalytic layer in the coupling space. It is possible to use ROSAHL made by Ryosai Technica Co. Ltd., for example (refer to FIG 49).

[0079] FIG 50 shows another example of the structure of a dehumidifier based on the solid polymer electrolytic film. This example relates to a unified structure produced by molding a fixation flange section 127 with the pod 1. The effective area of the dehumidifier may be made into a square, rectangular, circular, oval or polygonal shape and others, but it is preferable that the effective area (opening area that contacts the gas to be processed) relative to the electrode area be as large as possible, and specifically, the ratio of the opening area that contacts the gas to be processed to the electrode area be higher than 50 % and less than 99 %, or more preferably higher than 60 % and less than 90 %. If the ratios of the opening area that contacts the gas to be processed to the electrode area are the same, an oval shape is preferable than a circular shape and a rectangular shape is preferable than a square shape, and specifically, it is preferable to design so that the short axis and the long axis, or the short perimeter and the long perimeter are related in a range of not less than 10 % and not more than 99 %. The solid polymer electrolytic film should preferably transmit protons, but it may be served by Nafion (registered trade mark) -117 made by DuPont Co, which has a nominal film thickness of 170 μm. It is also possible to use Nafion-115, or XUS-13.204.10 made by Dow Chemical Co., for example. It is preferable to use platinum or platinum black as the catalyst because of its capability and durability, but platinum on carbon carrier or other platinum group metallic catalyst may be used. It is preferable to use aluminum or stainless steel for the current terminal 128 necessary for application of uniform voltage on the porous electrode 129. For packing material, PTFE is preferable because of its low emission of organic substance. Because the fixation flange contacts the process gas directly so that it is preferable to avoid using metals that are susceptible to corrosion by the process gas, so that resin materials such as polycarbonate is preferable, but if there is no danger of corrosion, stainless steel may be used. Also, it is preferable to provide a guard on the fixation flange and the pod main body so as to avoid contacting the electrode section directly from outside.

[0080] In any of these methods, the use of the fan to circulate air inside the pod can hasten the process of dehumidification. In practicing the present invention, it is acceptable to use any type of dehumidifier so long as the method chosen allows all machines to be arranged suitably. Also, by providing ports on the pod main body for introducing and discharging high purity nitrogen or inert gas into the interior of the pod so that replacement of the interior atmosphere is carried out along with dehumidification, it is possible to further reduce the time required for attaining low humidity in the interior of the pod.

[0081] Also, it is preferable to mount both the dehumidifier and moisture absorbing material (activated charcoal, ion exchange agent, silica gel and the like) to act as a dehumidifying unit for the purpose of removing moisture. This is to maintain the moisture absorbing material in the active initial stage, which exhibits fastest absorption speed, at all times by keeping the absorbing material in the dry state at all times using the dehumidifier. Further, the use of a pod having a means for forcing gas circulation achieves low humidity in the shortest possible time. Whether the means for creating a gas flow is a fan or gas purging, it is preferable to circulate the gas at least once or more, or more preferably more than three times during the duration between wafer storing and wafer removal, such that the number of circulation can be adjusted according to the degree of contamination existing in the outer environments before and after the current process in relation to the degree of cleanliness required by the stored wafers. If there is no restriction on the power consumed by the fan, it is most preferable that the gas be circulated constantly. Here, it should be noted that "the nature of the environment required by the stored substrates" refers to the creation of an environment within the pod during transit between the processes so that all or any particular species of contaminants in the pod that may reduce the yield, such as particulate matters, ions, dopants, organic substances, moisture are kept below the target control level. The substrate transport pod that performs such environmental control can be used for transporting the substrates

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within the any semiconductor manufacturing processes, for example, between the steps, between the floors inside the plant, between plants, or, in addition to transporting them, it may also be used to store substrates.

[0082] Here, when the object is to maintain low humidity, it is better to use a material that has low moisture absorption factor for the pod. This is because, in a typical environment of 25 °C and 50 % relative humidity (RH) generally adopted for clean-rooms, if the interior of the pod space only is reduced in humidity, ① moisture contained in the polymeric materials that comprise the pod migrates towards the low temperature side due to the temperature gradient, ② the moisture contained in the environment external to the pod migrates towards the interior of the pod due to humidity gradient between the interior of the pod and the external environment, and ③ air in the external environment leaks into the interior of the pod through the pod joints. These three reasons cause the moisture to migrate towards the interior of the pod which is maintained at a lower temperature. When the pod is highly hermetic, of the three reasons cited above, the factor that most affects the rise in humidity in the interior of the pod is the above-noted ① moisture contained in the polymeric materials that comprise the pod migrates towards the low temperature side.

[0083] The water absorption factor of polymeric materials is specified in ASTM (American Society for Testing and Materials) D570, and is reproduced in literature or polymer makers catalogue and the like. Polycarbonate (PC) is used often for making substrate transport pod, but the water absorption factor of PC is 0.2~0.3 % so that the pod main body and the door weighing 3 kg would contain 6~9 g of moisture. By using a material having water absorption factor of at least less than 0.1 %, it is possible to reduce the amount of moisture that can be migrated inside the pod, and contributes to improving the performance of the dehumidifier. Polymeric materials of less than 0.1 % water absorption factor include: PE (polyethylene)<0.01 %; PP (polypropylene) 0.03 %; PBT (polybutylene terephthalate) 0.06~0.08%; PPS (polyphenylene sulfide) 0.02 %; PTFE (polytetrafluoroethylene)<0.01 %; PC/carbon (polycarbonate with 20 % added carbon) 0.1 %; and PBT/carbon (polybutylene terephthalate with 20 % added carbon) 0.05 %. Of these substances, for constructing the substrate transport pod, it is preferable to use PPS (polyphenylene sulfide) or PBT (polybutylene terephthalate) or the above-mentioned materials with carbon addition that show characteristics of chemical resistance, superior high temperature properties and low mold shrinkage.

[0084] For the gas circulation apparatus, an axial flow fan, scirocco fan, and scroll fan may be used. A general construction of an axial flow fan is shown in FIG 51. A brushless fan motor is generally comprised by a casing 611, impeller 612, rotation shaft 613, magnet 614, winding 615, control board 616, and a bearing 617. Of the foregoing components, primary contamination sources are magnet 614, winding 615, control board 616, bearing 617 and adhesives used in various joints. First, if rubber is used in the magnet member or ferrite-based magnets bound with an adhesive, rubber and adhesives act as contamination sources, and emit base gases and organic substances. The winding 615 emits organic substances from lubricants used in manufacturing to promote copper wire drawing and insulation materials. The control board 616 emits organic substances from flux and solder resist that are applied for corrosion protection of copper foil. The bearing 617 emits organic substances from the mineral oil based grease used as sliding lubricant, and particulate contaminants are produced by rubbing of the rotor or retainer against the inner or outer ring.

[0085] For example, magnet 614, control board 616, and winding 615 can be coated by the use of the Parylene coating technology, which involves deposition of a polyparaxylene resin by chemical vapor deposition. In the Parylene coating technology, diparaxylene is heated and sublimed under low pressure, and when it is heated to about 600 °C, thermal decomposition takes place and some paraxylene radical gas is generated. By directing the vapor to the target object, a polyparaxylene coating of a molecular weight of about 500,000 can be produced. Parylene coating offers features such as ① processing temperature is about 35 °C and almost no thermal load is applied to the target object; ② because the process is CVD, it is possible to apply uniform coating on complex shapes and composite materials made of metal and plastic; ③ gas permeation is extremely low; ④ cost can be lowered by coating a large quantity of products at one time; and ⑤ there is no need to change the design because the coating can be applied directly to commercially available fan components. Therefore, this method appears to be suitable for reducing chemical contaminants. Coating thickness of more than 0.1 μm and less than 0.5 μm is suitable.

[0086] The bearing 617 is comprised by an outer ring, an inner ring, a rotor, and a retainer. In general, the outer ring, inner ring and rotor are made of high carbon chrome steel or stainless steel or ceramic, and the retainer is made of stainless steel or polyamide resin. Over the years, special-purpose bearings have been developed for vacuum use, low dust generation use, anti-corrosion use and non-magnetic uses, and commercial products have been available since about 1986. Impurities that can be produced from the bearing include particulate contaminants first. According to literature, it is known that particle contaminants from the bearing are often produced by the rotor contacting inner or outer ring. On the other hand, bearings using mineral oil based grease produce the highest amount of chemical contaminants, and contamination decreases in the order of fluoride-based grease and fluoride-based solid polymer lubricants. Particulate contaminants and chemical contaminants are reduced by combining a solid lubricant which emits least amount of gases and a retainer made from a polyamide-based resin or a fluoride-based resin that have self-lubricating properties.

[0087] Further, a method of preventing emission of contaminants from general-purpose bearings using grease that

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does not consider above problems is to use a magnetic fluid seal. Magnetic fluid is made by dispersing ultra-fine particles of magnetic powder in an oil base along with a surfactant agent, for example. Base oil may include paraffin, synthetic isoparaffin, alkyl naphthalene and para-fluoroether and the like. Magnetic particles may include iron, nickel, cobalt, ferrite and the like.

[0088] FIG. 52 shows an enlarged cross sectional view of the vicinity of a rotation shaft 613 of an axial flow brushless fan motor having a magnetic fluid seal. The parts that are required for the magnetic fluid seal are permanent magnet 619, a permanent magnet retainer 620 made of a magnetic material and a magnetic liquid 624, for example. Other necessary parts include a sleeve 622 and a spacer 623 and the like for separating the bearing from the permanent magnet retainer. In the magnetic fluid 624, a magnetic field is formed by the magnetic force generated by the permanent magnet 619 in the direction of permanent magnet ⇒ permanent magnet retainer ⇒ magnetic fluid ⇒ rotation shaft ⇒ permanent magnet retainer ⇒ permanent magnet to prevent segregation in the magnetic fluid due to rotational motion. The particulate and molecular contaminants generated from the bearing 617 are sealed by the magnetic fluid 624 and are prevented from being emitted. Additionally, other special items of note include: rotation shaft to be magnetic; permanent magnet retainer is to be a magnetic body or to be covered with a magnetic body; the housing that holds the permanent magnet retainer is to be a non-magnetic body or to be covered with a non-magnetic body; and another magnetic body is not to be placed near the magnetic fluid. If there is a magnetic body nearby, it is necessary to provide means for shielding the magnetic force field. In the example shown in FIG. 52, both ends of the two bearings are provided with a magnetic fluid seal, but depending on the necessity, it is permissible to have a seal on one end only.

[0089] A method of reducing the contaminants generated by the magnet 614 is to use a plastic magnet. Plastic magnet is used originally to prevent cracking that occurs in sintered ferrite magnets, to reduce the number of components required by unitizing the magnet and the impeller, for example, to reduce the number of steps in assembling the fan motor; or to improve the dimensional precision. In addition to the advantages of the present invention described above, reduction in chemical contamination is achieved by noting that magnetic body can be unified by means of thermoplastic resins. There are ferrite group materials and samarium-cobalt group materials and the like that can serve as the magnetic body, but the choice is made according to the necessary magnetic flux density.

[0090] FIG 53 shows a gas circulation method for circulating air inside the pod main body, other than those based on the gas circulation apparatus. Heat is generated from a heating source 530 external to the pod main body 1 and is absorbed by a heat absorbing section 531 provided on the pod main body. For example, by using thermal radiation such as infrared radiation, the gas inside the pod main body in the vicinity of the heat absorbing section is warmed and consequently, convective current is generated inside the pod main body 1. The gas flow generated inside the pod main body 1 comes into contact with the filters (particle filter 5, gaseous contaminants filter 6) and is cleaned. Further, a dehumidifying unit may be provided inside the pod main body. Further, a flow controller board 521 for forming a uniform pattern of gas flow in the wafer stacking direction may be provided.

[0091] FIG. 54 shows an apparatus for supplying a dry gas inside the pod 1. Air or nitrogen may be used as dry gas. A gas cylinder 38 filled with a dry gas is provided within the apparatus. Dry gas is introduced into the pod main body 1 through a pipe path having a pressure gauge 37 for detecting the pressure inside the interior of the pod, and, according to its reading, a mass flow controller 36 is operated to control the flow rate of the dry gas. Gas discharging is performed more effectively by evacuation. Mobility is increased if the AGV 10 has a gas cylinder 38. Also, if the gas supply source is provided by the nitrogen line from the plant, the processing apparatus 11 can also be served.

[0092] Also, wafer is susceptible to static charging at low humidity, it is preferable that an electrical conductor with added carbon be used to construct at least the wafer support section that contacts the wafers and the door that grounds to the pod bottom section through the wafer support section. Further, non-woven ion exchange cloth or activated charcoal used for gaseous contaminant capture medium contain adsorbed moisture immediately after their manufacture, it is preferable that they be used after being subjected to water removing treatment.

[0093] Next, a method of manufacturing a semiconductor device will be explained.

[0094] Semiconductor device manufacturing process is divided into a first stage in which the device elements such as transistors and condensers are formed within the chip area and the elements are interconnected with copper wiring, and a second stage in which each chip is cut away from the wafer and wiring connections are made to external terminals.

[0095] FIG 2 shows a flowchart of an example of the first state processing. In the first stage processing, after the elements are formed on the wafer, wiring steps are repeated as many times as the number of wiring layers in the multilayered structure. Silicon wafers having FET (field-effect-transistors) and condensers formed thereon are transported to a processing apparatus such as a coater or a CVD apparatus to form insulation layer above the surface. At this time, a low dielectric insulation film having a dielectric constant of less than 3 is formed.

[0096] The low dielectric insulation film may be made using an inorganic material such as SiO_x-based substances made in a porous or honeycomb shape, or PAE (poly arylene ether)-based or MSQ (methyl silses quioxane)-based organic material, and other organic substances in a porous form are useable.

[0097] Such low dielectric insulation films are susceptible to moisture absorption resulting that film is degraded by moisture absorption, or the dielectric constant of the insulation film is raised by the moisture absorbed. Further, it can

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be anticipated that the physical properties of the insulation film are altered by the effects of impurities such as organic matters, ions and metals contained in the environment. Because stable film growth may not be achieved under changing environment, it is essential to provide a stable, clean environment.

[0098] Therefore, at this stage, the wafers having low dielectric insulation film formed on the surface are stored in the substrate transport pod explained earlier, and are transported between the insulation forming apparatus such as coater or CVD apparatus and a photo-resist coating apparatus. The substrate transport pod in this case may be any one of the pods described above, but it is preferable that the interior of the pod is provided with a dehumidifier to provide dry air. Also, it is preferable that the air inside the substrate transport pod is circulated through a dehumidifier to dry the air. It is preferable that the air inside the substrate transport pod be less than 25 % humidity, or more preferably less than 10 % or even more preferably less than 5 %.

[0099] When there is a danger of damaging the elements due to static electricity generated by low humidity, it is preferable to discharge the wafer charges by using electrical conductor for constructing the wafer support member and removing the charges through such members. Electrically conductive materials that can be used include polymeric material with added carbon, surfactant agent or metals. For example, for a pod having a door at the bottom, the box door supports the wafer support member so that the box door is constructed of an electrical conductor. The box grounds the pod through the box door when the box is placed on the processing apparatus or station. It is permissible that the box door is entirely or only the surface layer is constructed of an electrical conductor, so that it can be grounded through a conductive object to the bottom section of the box. Or, only the portion that supports the wafers may be constructed of an electrically conductive polymer or a metallic material, for example.

[0100] Further, if chemical contamination is a problem, a chemical filter should be provided inside the substrate transport pod. It is preferable that the chemical filter be capable of removing non methane-based organic substances, and further, it may be combined with an ionic filter. If particular contamination is also a problem, particle filters such as HEPA and ULPA may be incorporated.

[0101] FIGS. 55 and 56 show an example of loading a substrate cassette 4 for storing substrates W having exposed copper surface, hermetically sealing the pod, and transporting the pod together with the cassette 4 in the hermetically sealed condition. In this case, the substrate transport pod 1 is constructed as a general SMIF pod. Here, degradation of the insulation film can be prevented by providing a dehumidifier inside the substrate transport pod 1 for 8-inch wafers to control the humidity in the interior of the substrate transport pod 1. It is preferable to control the inside humidity to less than 10 % or more preferably to less than 5 %. When the humidity is low, and there is a danger of damaging the insulation film due to generation of static charges, it is preferable to store/transport substrates while the copper surfaces on the wafers are grounded to discharge the static electrical charges.

[0102] By installing a particle filter and a fan motor in the interior of the substrate transport pod 1 so as to clean the inside air by circulating the internal atmosphere, it is possible to prevent cross contamination of the substrates. Also, by installing both a chemical filter and particle filter in the interior of the substrate transport pod 1, both particles and ions can be removed. It is obvious that only particle filter may be used or only an ion filter as the chemical filter may be used. Also, when the fan motor is provided inside the substrate transport pod 1, the fan may be operated without installing a battery inside the pod 1 so that the fan motor may be operated through a power outlet provided on a receiving platform member by placing the substrate transport pod 1 on the platform.

[0103] Also, although the interior space of the substrate transport pod 1 is normally filled with air, but by using an inert gas having limited concentration of oxygen, oxidation of copper can be prevented. The amount of oxygen should be lower than 10,000 ppm, or more preferably lower than 1,000 ppm.

[0104] FIGS. 57, 58 and 59 show another example of the substrate transport pod 1. This pod 1 is used for transport and storage of substrates by accommodating a plurality of 300 mm substrates W on a substrate support member 504 that is affixed to the inside of the pod main body 501. This substrate transport pod 1 is comprised by a pod main body 501; a substrate transport door 502 provided on the side surface of the pod main body 501 of a square tube shape whose opening section can be operated mechanically by being linked to an automatic substrate transport door controller; a lid member 503 disposed opposite to the opening section for covering an opening provided for changing filter and fan motor and the like; a substrate support member 504 for holding substrate wafers W, a ULPA filter 505, a chemical filter 506; and a fan motor 507.

[0105] The substrate transport door 502 is operated by a mechanical device, and on the bottom section of the pod main body 501, there is provided a V-groove 509 for coupling with a kinematic coupling pin 508 for positioning transport door accurately on the precision automatic door device. The substrate transport door 502 is provided with a positioning pin receiving section 510 and a latch receiving section 511 for inserting the latch key for door operation so as to enable to automatically open or close the door from the automatic door device side. Also, a robot holding means 512 is provided so as to enable to transport the pod using such transport apparatus as OHT (overhead hoist transport) or AGV (automatic guided vehicle). The material of construction may be PC, PEEK and PEI and the like. The designs for V-groove 509, positioning pin receiving section 510, latch receiving section 511 for inserting the latch key for door operation, robot holding means 512 and other items regarding automation interfaces are carried out according to SEMI standard

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E1.9, E47.1, E57, E62.

[0106] The interior of the pod main body 501 is divided into a center chamber 513a in the center and a pair of side chambers 513b by a partition plate 530 unified with a pair of spaced left/right substrate support member 504 between the substrate transport door 502 and the lid member 503. On the substrate transport door 502 side of the partition plate 530, a substrate support member 504 is integrally provided, which has a taper section that widens towards the door side so as to couple with the door. The movable wafer vibration prevention mechanism 515 presses the wafer in the vertical direction and holds the wafers in their fixed positions inside the pod and so as to prevent vibration of the wafers. The movable wafer vibration prevention mechanism 515 is provided on the inner side of the substrate loading/unloading door 502, for example.

[0107] On the lid 503 side of the center chamber 513a, a ULPA filter 505 that serves as the particle filter and a chemical filter 506 that serves as the gaseous contaminants filter are disposed so as to permit the air to flow from the lid 503 side to the substrate transport door 502 side. While, on the upstream side of the filter 506, a fan motor 507 is disposed so as to circulate the air towards the substrate transport door 502.

[0108] Both ends of the substrate transport door 502 are shaped so as to curve smoothly towards the interior, and in the center section, a triangular flow regulation plate 514 is provided, but this flow regulation plate 514 may be omitted. Also, the substrate transport door 502 is provided with a fixation jig 515 for substrate shifting prevention. Similarly, the internal surface of the lid member 503 is also curved towards the interior, and in the center, a triangular flow regulation plate 516 is provided. Also, flow regulation plates 517 are provided in two locations adjacent to the inside opening for outflow of clean air, for the purpose of supplying clean air uniformly to a plurality of substrates W. Further, a flow regulation plate 521 may be provided at the back of the filter section. The flow regulation plate 521 can be made of a porous plate or mesh. Because the porous plate or mesh or fixed flange contact the process gas directly so that it is preferable to avoid using metals that are susceptible to corrosion by the process gas, so that resin materials such as polybutylene terephthalate and polycarbonate are preferable, but if there is no danger of corrosion, stainless steel may be used.

[0109] Here, when twenty five substrates W are stored in the substrate transport pod 1, the separation distance between the interior surface of the substrate transport pod 1 and the No. 1 substrate and that between the same and No. 25 substrate are set wider than the separation distance between other substrates W. In this case, No. 1 substrate refers to the substrate near to the pod bottom side. The space associated with No. 1 substrate relates to the distance between No. 1 substrate and the inside surface of the pot bottom section, and the space associated with No. 25 substrate relates to the distance between No. 25 substrate and the inside surface of pod top section. It is preferable that the distances associated with No.1 and No. 25 substrates be more than 2 mm and less than 10 mm. By adopting such a wide separation distance, although uniform flow of air through the substrates W is adversely affected, a flow regulation plate 517 provided at the outflow opening of clean air is designed to carry out effective cleaning by creating a uniform flow of air at the clean air entry section between the substrate carrier main body and No. 1 and No. 25 substrates. Also, a porous plate or mesh member may be placed on the downstream side of the ULPA filter 505 for the purpose of equalizing the wind velocity and protecting the ULPA filter.

[0110] In the bottom section of the lid member 503 is disposed a power unit 518 having a secondary battery, which has a contact point to connect to the terminal 519 of the fan motor 507. Inside the power unit 518 is housed an operation control board for the fan motor 507, and the fan motor 507 is operated according to a control program prescribed in the board to control its operation start/stop timing and rotational speed. Also, at the bottom section of the power unit 518 is provided a charging terminal 520 so as to enable to charge a secondary battery automatically when it is mounted on the on the charging station or on the substrate transport door controller by connecting to the terminal on the apparatus side.

[0111] As described above, when various filters and secondary battery are installed on the substrate transport pod, the center of gravity of the pod shifts to the filter side. If it is attempted to transport the pod in the OHT or so on by grasping the robot holding means 512, for example, while its center of gravity is displaced towards one side, there is a danger of damaging the hoist and others on the OHT system. To avoid such a problem, it is desirable to reduce the weight of filter and secondary battery. Further, it is preferable to place a counter weight near the substrate transport door 502 and/or near the opening section of the pod main body 501 so that the center of gravity of a fully-loaded pod is within ± 100 mm, or more preferably within ± 60 mm of the substrate facial reference line. The substrate facial reference line refers to a plane that dissects the substrate in two parts and is parallel to the front surface of the substrate carrier through which the substrates are loaded/unloaded. Another method is to shift the center of gravity by making the latching mechanism housed inside the substrate transport door 502 with a metallic material, for example, to increase the weight of the substrate transport door 502. That is, it is preferable to adjust the center of gravity so that the center of gravity of the substrate transport pod in the horizontal direction is contained within a circle having a radius dimension that is 90 % of the substrate radius, or more preferably within 70 % of the substrate radius.

[0112] As shown in FIG 31, the semiconductor wafer W is supported on a carrier 4 by a protrusion 550 constructed of an electrically conductive material. FIGS. 60A to 60H show methods of discharging static electricity on the wafers

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stored inside the substrate transport pod. As shown in FIG 60A, wafer discharging from the FOUP structure is carried out by grounding to the apparatus side, through the substrate support member 504 that supports the wafers inside the pod (corresponds to the protrusion 550 shown in FIG 31). The substrate support member 504 is a unified body that includes the pod main body 501, so that the entire member including the substrate support member is made of an electrical conductor. Also, when the substrate support member 504 and the pod main body 501 are separate members, it is preferable that the substrate support member 504 and the pod main body 501 be made of some electrical conductor, and connecting them electrically using an electrical conductor 523, as shown in FIG 60B. Further, as shown in FIG. 60C, it is permissible to make only the bottom section 501a of the pod main body 501 using an electrical conductor. And, as shown in FIG 60D, it is permissible to make only the substrate transport section 501b that is in contact with the substrate support member 504 using an electrical conductor.

[0113] A second method of substrate discharging method for the FOUP structure pod is shown in FIG. 60E. In this method, the charges are grounded through the door to an apparatus that mounts the pod by making the fixation jig 515 (to prevent substrate shifting) and the door 502 using an electrical conductor. Also, as shown in FIG 60F, it is permissible to make only the fixation jig 515 with an electrical conductor and grounding to the grounding terminal 524 so as to connect the bottom section of the pod to an external ground. Here, the external ground refers to a processing apparatus or a transport apparatus.

[0114] A third method of discharging the substrates from the FOUP structure pod, as shown in FIG 60G, is through the robot holding means 512 for transporting the pod in the OHT system. The substrate support member 504 and the flange 512 are made into a unified member, and the charges on the wafers are grounded through the substrate support member 504 to the robot holding means 512 to the OHT system. Also, as shown in FIG 60H, it is permissible to make the robot holding means 512 separate from the substrate support member 504 and connecting them electrically by making a portion 501c of the pod main body 501 using an electrical conductor. Further, it is permissible to make only the portion 501c that contacts the robot holding means and substrate support member using an electrical conductor.

[0115] FIGS. 61, 62 and 63 show another variation of the automation-ready substrate transport pod designed for 300 mm wafers. A power unit 518 housed inside the bottom section of the pod 503 is provided with a contact point to connect to the terminal 519 of the motor fan 507. In the bottom section of the power unit 518 is provided a charging terminal 520 so that the secondary battery can be charged automatically when the pod is seated on a control apparatus for automated opening/closing of the wafer transport door or on a charging station by contacting the terminal on the apparatus side. Also, if the dry gas supply and dehumidification using solid polymer electrolytic film, the dry gas purging port 515 is housed in the bottom section of the pod main body 1. However, the position, size and number of the solid polymer electrolytic film 525 and the dry gas purging port 515 may be altered to suit the desired drying speed and target temperature, and are not limited to those shown in the diagrams.

[0116] FIGS. 64, 65 and 66 shows automation-ready substrate transport pods having a solid polymer electrolytic film in a different location than those shown in FIGS. 61, 62 and 63. In this case, because the solid polymer electrolytic film itself is housed inside the bottom section of the pod 1, direct current can be supplied from the power unit 518 housed inside the pod 503 linked to the main body 1 without going through the terminal 514.

[0117] Next, dehumidifying capacity of the substrate transport pod having the dehumidifying unit 525 based on the solid polymer electrolytic film after repeated use will be explained with reference to FIG. 67. In a clean-room having a relative humidity of 40 % at 22 °C, a wafer carrier 4 having twenty pieces of cleaned semiconductor wafers was placed inside the substrate transport pod, and the pod was sealed with the lid. After waiting for six hours, ultimate humidity inside the pod was measured. The results are shown by Δin the diagram. The horizontal axis relates to the number of operations and the vertical axis relates to eventual humidity generated inside the pod. For comparison, data on ultimate humidity achieved when dehumidifying agent was placed inside the box, and the data are shown by ○ in the same graph. In the substrate transport pod having the dehumidifying agent, the initial capability (i.e., reduction in relative humidify from 40 % to 5 %) was maintained up to fifteen repetitions, but the relative humidity gradually increased with continued use, and after fifty and more repetitions, the humidity did not drop below 20 %. On the other hand, the substrate transport pod containing the dehumidifying unit 10 having the solid polymer electrolytic film continued to maintain its initial capability (that is, reduction in relative humidify from 40% to 10 %).

[0118] In the substrate transport pod described above, the gaseous contaminants filter 506 is constructed, in this embodiment, by wrapping particulate activated charcoal for organic material removal with a non-woven ion exchange cloth for inorganic ion removal, but the filtering medium may include pulverized activated charcoal, activated carbon fibers, high purity silicon, zeolite, ceramics or activated charcoal with addition agents. Activated carbon fibers may be produced from a raw material of rayon, kynol, polyacrylonitryl or crude oil, or pitch, and carbon formed in fiber shape is reacted with steam and carbonic gas at over 800 °C to carry out the so-called activation reaction. Some activated carbon fibers are made with binder addition that does not affect its absorption quality to control strength and dust generation, but as a raw material, it is preferable that the addition should be less than 50 weight % and preferably less than 30 weight %.

[0119] Activated charcoal has numerous fine pores between the base crystals due to removal of unreacted carbon

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during the process of activation. Owing to such fine pores and large specific surface area, activated charcoal exhibits very high adsorption capability. Utilizing this property, activated charcoal filters filled with particulate activated carbon are available commercially. Also, filters using activated carbon fibers having finer pores than particulate activated carbon and higher specific surface area, or filters carrying activated carbon particles of about 0.5 mm on a urethane foam body of open-pore structure are also available commercially.

[0120] Also, it is permissible to use high purity silicon which is the same material as the semiconductor substrate for the absorbing agent. The conditions on the surface of high purity silicon are divided into hydrophilic and hydrophobic types, each of which differs in its absorbing characteristics. Hydrophobic surface produced by washing with diluted hydrofluoric acid is generally more sensitive to the environment, and exhibits a high adsorbing power for hydrocarbons. However, hydrophobic surface of silicon changes to hydrophilic surface when oxide film grows, so that the adsorbing characteristics change with time which is a disadvantage. Hydrophilic surface is excellent in adsorbing polarized organic substances, such as BHT (2, 6-Di-t-butyl-p-cresol) and DBP (dibutyl phthalate).

[0121] Also, because there is no material degradation when high purity silicon is used as the adsorbing agent, the filter can be reused after washing. Also, when there is a contaminant that cannot be removed by using chemical filter or ULPA filter, silicon performs a role of dummy filter. In any case, it is more effective to use silicon not by itself but in combination with activated charcoal.

[0122] On the other hand, non-woven ion exchange cloth and fibers can be obtained by introducing ion exchange sites through radiation graft polymerization. That is, a starting material, a polymer such as polyethylene and polypropylene or natural polymeric material such as cotton and wool is subjected to radiation using electron beam or gamma radiation to produce numerous activation sites. Such activation sites are called radicals which are highly reactive, and by combining such radicals with a monomer, it is possible to impart properties different from the starting material.

[0123] This technology is called graft polymerization because a monomer is grafted to the starting material. By using radiation graft polymerization, a monomer having the sulfone group, carboxyl group or amino group that acts as ion exchange agent, such as styrene sulfonic acid sodium salt, acrylic acid, allylamine, can be bound to a non-woven polyethylene cloth. It is then possible to obtain a non-woven ion exchange cloth that produces much higher ion exchange rate than ion exchange beads, which are normally referred to as ion exchange resin.

[0124] Similarly, an ion exchange medium of the starting material can be converted into an ion exchange medium in the original shape, by first radiation grafting a monomer capable of introducing an ion exchange group such as styrene, chloromethyl styrene, glycidyl methacrylate, acryronitrile, acrolein to a starting material, and then introducing an ion exchange group.

[0125] The filtering medium of ULPA filter or HEPA filter has been using glass fibers, but it has been discovered that glass fibers can form BF_3 by reacting with the vapor of hydrogen fluoride (HF) used in semiconductor processing, and has become a problem. In recent years, PTFE filters and HEPA filters that does no contain boron or metallic impurities and resistant to acids, alkalines and organic solvents are commercialized. In the present applications, glass fibers or PTFE may be selected as appropriate.

[0126] The operation of the substrate transport pod 1, having a plurality of substrates W stored therein, when it is transported inside a copper plating apparatus 34 will be explained with reference to FIG 68.

[0127] In this copper plating apparatus 34 is provided an automatic substrate transport door controller. Inside the copper plating apparatus 18, a fan-filter unit comprised by the fan motor 7, ULPA filter 5, chemical filter 6 and dehumidifier 8 is used to reduce particulate contaminants, gaseous contaminants and moisture. Chemical filter 6 and dehumidifier 8 are employed as needed. The dehumidifier 8 may be placed anywhere at the boundary between outside and inside of the enclosure, but if it is desired to dehumidify more actively, it is preferable to place it in a fast flowing region such as near the fan motor 7 or within the circulation path in the enclosure. When the substrate transport pod 1 is transported inside the copper plating apparatus 34 and is placed in a specific location and the clean-room is isolated by means of the gate valve and the like, the automatic substrate transport door controller opens the substrate transport door 602. After which, using the wafer mapping apparatus 603, wafer storage slots and the number of wafers are selected. After which, a substrate handling robot 621 inside the copper plating apparatus 34 removes the substrate W for processing, and after the processing is completed, the processed substrates W are returned to the substrate transport pod 1. Then, when the processing of all the substrates W is completed, the substrate transport door 602 is closed and sealed by the automatic substrate transport door controller, and from this point, the motor fan 7 is operated through the power input terminal 608 to clean the air inside the substrate transport pod.

[0128] As shown in FIG. 68, the substrate transport pod 1 may be operated such that when the wafers to be processed are removed, the substrate transport door 602 is closed and the wafer to be processed are stored in the pod 1. Also, when the substrate transport door is not opened or closed during the processing of one lot, it is preferable to provide a fan-filter unit having the chemical filter 6 and dehumidifying agent or dehumidifier 8 in the interface section in addition to the ULPA filter, so as to prevent contamination of the wafers yet to be processed by moisture and organic matters. Further, the fan filter unit may circulate the air inside the interface. Also, dehumidification may be performed using dry air or N_2.

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[0129] As shown in FIG. 69, comparing the degree of cleanliness of the interface interior with that of the pod interior, interior of the pod is cleaner because of its smaller volume. Therefore, when the pod 1 is placed in the interface entry, all the wafers in one lot inside the pod 1 are placed on the temporary cassette 604, and the pod is made to standby until all the wafers in one lot are processed while supplying the power to the pod through the power input terminal. By so doing, the interior of the pod can be kept at a desired degree of cleanliness while it is in the standby mode. In this case also, as in the system shown in FIG. 64, in addition to the ULPA filter, it is preferable to place a fan-filter unit that has a chemical filter, dehumidifying agent or dehumidifier in the interface section. Further, the fan-filter unit may be operated so that the air is circulated inside the interface. Also, dehumidification may be performed using dry air or N_2. When the substrate transport door 502 is closed, the pod 1 is transported to a next processing station or to a storing place by OHT or AGV, for example.

[0130] In the pod shown in FIG 57, for example, the fan motor 507 is operated according to a pre-determined program. Accordingly, a flow from the fan motor 507 is created through the gaseous contaminants filter (chemical filter) 506 and ULPA filter 505. The air entering the center chamber 513a is divided smoothly into two streams by the flow regulation plate 514 located in the substrate transport door 502, and air circulation path is created by each flow passing through the side chamber 513b and returning to the fan motor 507.

[0131] The fan motor may be provided with an optical or mechanical detector to detect the status of the door so that it is operated only when the door is closed. The purpose of this arrangement is that, if the fan motor is operated while the door is open, external air that contains various contaminants is introduced into the pod to shorten the life of the chemical filter, and this situation is prevented by adopting this arrangement. Another purpose is to prevent the internal surface of the pod from being contaminated by entry of the external air.

[0132] A method of supplying power to the fan motor and/or dehumidifier will be explained. The apparatus side that supplied power from an external power source comprises a positioning pin for positioning the pod in a specific location, a control board for controlling the supply voltage and current and a power input terminal.

[0133] The air is cleaned by passing through the gaseous contaminants filter 506 and ULPA filter 505, and is guided by the entry flow regulation plate 517 placed at the inner side of the opening section of the partition plate 530 unified with the pod main body to the spaces between the wafers W. By providing the entry flow regulation plate 517, air is prevented from flowing excessively through the space between the substrate W and the partition plate 530 unified with the substrate support member 504. The air that passed through the wafers W flows along the flow regulation plate 514 and the inner surface of the substrate transport door 502, and then inverts to return to the fan motor 507 through the side chamber 513b.

[0134] In this process, solid particulate matters adhered to various parts or gaseous substances emitted from such matters are carried by the circulation air and are cleaned in the two types of filters 505, 506 and flows over the substrates W. Therefore, not only external contaminants but also so-called self-generated contaminants emitted from the objects inside the substrate transport pod are prevented.

[0135] Whether the means for generating air flow is the fan or gas purging, it is preferable that the air is re-circulated at least once or preferably more than three times during the period between storing the substrate in the substrate transport pod and removing the substrates therefrom again, and the number of circulations can be adjusted depending on the environment required by the stored substrates and in relation to the degree of contamination associated with the preceding and succeeding environments to the current environment. Various patterns of operating the fan motor 507 may be considered depending on the operational requirements of the substrate transport pod 1. In general, during the initial stage of processing, continuous operation or fast flow operation to increase the number of circulation in unit time is desirable such that it is operated so as to produce at least more than one circulation in ten minutes, or more preferably, once or more and less than ten times in one minute. By adopting such an operational pattern, contaminants brought into the pod are actively removed. After cleaning is continued for some time, the flow rate may be decreased or intermittent operation may be carried out to reduce contamination that can be produced by the substrates W or construction materials of the interior of the substrate transport pod. By so doing, power consumption by the fan motor 507 is reduced, resulting that the frequency of charging the secondary battery can be reduced.

[0136] The total weight of the substrate transport pod 1 having a width of 389.5 mm, depth of 450 mm and height of 335 mm and containing twenty five pieces of substrates of 300 mm diameter is about 10 kg. In this embodiment, circulation conditions are such that the fan motor 507 is operated to produce a flow rate of 0.12 m^3/min through the substrates W at a wind velocity of 0.03 m/s in the center section of the space between the substrates W. The flow rate can be altered by varying the speed of the fan motor 507.

[0137] FIGS. 70A and 70B show an example of the substrate transport pod 1, and this pod 1 differs from the previous pod in that the size of the substrate W is 200 mm, the door 2 for the mechanical interface is housed in the bottom section of the substrate transport pod 1 and the substrates W are placed in a substrate cassette 4, which is then stored in the substrate transport pod 1. The method of cleaning the air in the substrate transport pod 1 is the same as that described above. Here, in this example, the secondary battery for operating the fan motor 7 and fan motor control circuit are housed inside the door 2.

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[0138] FIG 71 shows another example of the substrate transport pod. In this embodiment, an improvement is that an operational history managing apparatus (information processing apparatus) 429 is attached to the pod described above. In this embodiment also, the air circulated by the fan motor 7 passes through the gaseous contaminants filter 6 and ULPA filter 5, and the flow is made uniform by a punching plate 23 and is supplied to the wafers. The punching plate 23 is designed to have varying size of the openings. Specifically, openings are made larger in the upstream side which is located directly below the filter, and are made smaller in the downstream side. By adopting such a design, air flow in the piling direction of the wafers is made uniform. The air flows through the wafers and returns along the inner walls to the fan motor 7 to circulate and replace the air in the pod. This example illustrates a typical automation-ready substrate transport pod, and is not meant to specify the location of the operational history managing apparatus (information processing apparatus) 429.

[0139] The total weight of the substrate transport pod 1 having a width of 283 mm, depth of 342 mm and height of 254 mm and containing twenty five pieces of substrates of 200 mm diameter is about 6 kg including the cassette 4 and the wafers. In this example, circulation conditions are such that the fan motor 7 is operated to produce a flow rate of 0.05 m^3/min through the substrates W at a wind velocity of 0.03 m/s in the center section of the space between the substrates W.

[0140] The operation of the substrate transport pod for 200 mm substrates, when it is transported into a copper plating apparatus will be explained with reference to FIG 72. The combination of fan filter unit 35 inside the interface and other arrangements are the same as those for the substrate transport pod for 300 mm wafers. The substrate transport door 2 and the carrier 4 are separated from the substrate transport pod 1 by means of an elevator. After transferring the wafers W in the carrier 4 for each lot to the interface side, the elevator 20 is raised and the substrate transport door 2 is returned to the pod main body 1, and the pod may be kept waiting until processing for one lot is completed.

[0141] Also, as shown in FIG 73, during the processing of the one lot of wafers, if the pod main body 1 is left open while the substrate transport door 2 is in the standby mode with the carrier 4 and unprocessed wafers, it is preferable that the air flow from the fan-filter unit 35 be supplied not only to the door 2, carrier 4 and the wafers W but to the interior space of the pod main body 1.

[0142] The substrate transport pod storing silicon wafers having a coating of a low dielectric insulation film is gripped by a robot that engages with a robot holding means attached to the substrate transport pod, for example, and is placed on a transport apparatus such as AGV. It is preferable that the robot arm be provided with sensing means to detect whether the substrate transport pod has been gripped and a locking device to 'prevent the pod from slipping. The AGV detects that the pod has been mounted in the correct position, and whether or not the pod is a type that required power supply, and supplies a portion of the power from the battery on the AGV or a portion from an external source to the substrate transport pod 1, and operates the motor fan 7 provided within the substrate transport pod, so as to transport the wafers to the next processing apparatus such as a coating apparatus, etching apparatus or copper plating apparatus while circulating the air inside the substrate transport pod through the dehumidifying agent or an electrical dehumidifier and controlling the humidity and concentrations of chemicals in the interior of the pod below specified values.

[0143] Whether the means for generating air flow is a fan or gas purging, it is preferable that the air is re-circulated at least once or preferably more than three times during the period between storing the substrate in the substrate transport pod and removing the substrates therefrom again, and the number of circulations can be adjusted depending on the environment required by the stored substrates and in relation to the degree of contamination associated with the preceding and succeeding environments to the current environment. If there is no restriction on the power consumed by the fan, it is most preferable that the gas be circulated constantly. Here, it should be noted that "the nature of the environment required by the stored substrates" refers to the creation of an environment within the pod during transit between the processes so that all or any particular species of contaminants in the pod that may reduce the yield, such as particulate matters, ions, dopants, organic substances, moisture are kept below the target control level. The type of environment demanded by the substrates stored for each processing step will be explained specifically below.

[0144] The wafers coated with a photo-resist in a photo-resist coating apparatus are transported by a substrate transport pod, having an internal chemical filter that absorbs ammonia to create an environment containing a lesser amount of ammonia, from the coating apparatus to an exposure apparatus. This is because chemically-enhanced photo-resist materials having increased sensitivity are being used in recent years, and such materials absorb ammonia in air and react to result in the so-called T-top structure. The level of ammonia inside the substrate transport pod transporting silicon wafers is preferably less than 1 $\mu g/m^3$, or more preferably less than 0.5 $\mu g/m^3$, or most preferably less than 0.1 $\mu g/m^3$.

[0145] Also, another reason for reducing the ammonia level is that the resist-coated wafer surface is exposed to the environment not only inside the substrate transport pod but also inside the coating apparatus, exposure apparatus, developing apparatus and etching apparatus. The environment control may also be exercised in wafer transport section having transport robotic arm.

[0146] The resist layer after insulation film etching is removed by the asher so that the "T-top phenomenon" need

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not be considered. Therefore, only the humidity inside the substrate transport pod needs to be controlled during the transport of wafers from the etching apparatus to the ashing apparatus, transport from the ashing apparatus to the metal film forming apparatus by CVD, and for transporting to the plating apparatus. Further, if chemical contamination of the side surface of the insulation film groove after etching is a problem, wafers may be transported from the etching apparatus to the ashing apparatus and to the metal film forming apparatus, in a substrate transport pod equipped with a chemical filter, in addition to a dehumidifying agent or dehumidifier.

[0147] Further, for transporting inside the substrate transport pod, silicon wafers coated with copper film from a metal film forming apparatus such as CVD or plating apparatus by way of annealing apparatus to a CMP apparatus, and further to an insulation film forming apparatus such as coating and CVD apparatus, it is possible to prevent the growth of oxide film by controlling the humidity in the interior of the substrate transport pod 1 by providing dehumidifying means such as dehumidifier or dehumidifying agent inside the substrate transport pod 1. In this case, it is preferable to control the humidity to be less than 10 %, or more preferably less than 5 %. To prevent the slightest oxidation film growth, it is preferable to reduce the humidity to less than 10 % within ten minutes after opening the door 2 of the pod, or more preferably to 10 % within three minutes or most preferably to less than 5 % within three minutes. Also, from the viewpoint of shortening the operation of clean-rooms, it is desirable to reduce the humidity quickly. Here, when there is a danger of damaging the elements by static electricity due to low humidity, it is preferable to transport/store the wafers for removing the charges by grounding through the surface layer formed with the copper film.

[0148] Conversely, when the wafers are transported between processes that prioritize ion removal, such as the exposure processing that requires ammonia to be reduced, it is necessary to adjust the humidity to a level that enables the ion exchange agent to operate effectively so that, instead of reducing the humidity limitlessly, it is preferable to control the humidity to higher than 10 % and less than 50 %.

[0149] In any event, it is important to establish an environment that contains less than the managing target concentration suitable for each process, to control the environment in all the substrate transport pods that operates between the actual apparatuses (including the fore-shelf of the apparatus) in a plant, it is preferable to mount communication means that enable to communicate operating conditions for electrical drive sections such as fan and dehumidifying unit. Control method for operation of fan and dehumidifying unit to achieve a specific humidity environment will be explained with reference to FIGS. 74 and 75.

[0150] FIG. 74 shows an example of a method for humidity control by controlling the operational pattern of the fan. In all cases, the results were obtained under the same operating conditions that① two dehumidifying units are mounted on the pod, which were operated continually; and② ancillary dehumidifying agent is not used. It was found that when the fan is stopped (shown by ○ in the diagram), the humidity of about 30 % was reached in 20 minutes and about 20 % in 60 minutes, and these levels were maintained. Also, intermittent fan operation (on 30 seconds and off 150 seconds; shown by ∗ in the diagram), the humidity of about 20 % was reached in 25 minutes, and about 10 % in 90 minutes, and these levels were maintained. When the fan was operated continually (shown by ♦ in the diagram), the humidity of about 20 % was reached in 10 minutes, and less than 10 % in 20 minutes. From these results, it can be understood that, for processes that require removal of ions as priority, for example, to perform ion removal only, the dehumidifying unit may be stopped, but if gentle dehumidification is required along with ion removal, intermittent operation of the fan is effective.

[0151] Next, FIG. 75 shows a case of controlling the humidity by operational pattern of the fan, by mounting two dehumidifying units based on solid polymer electrolytic film on the substrate transport pod. In all cases, the results were obtained by varying the operating conditions of the dehumidifying units and using the same operating conditions that① the motor fan is operated continually and② ancillary dehumidifying agent is used. The results obtained when only one dehumidifying unit was used (shown by ♦ in the diagram) show that the humidity of about 20 % was reached in 20 minutes, about 15% in 40 minutes and these levels were maintained. When two units were operated during the first 30 minutes and switched to one unit operation (shown by ∗ in the diagram), the humidity of 10 % was attained in about 5 minutes, and an 8 % level was the maintained. When two units were operated continually (shown by ○ in the diagram), the humidity was also 10 % in about 5 minutes, but the ultimate humidity maintained was less than 5 %. Accordingly, the ultimate humidity reached in the pod is dependent on the film area of the dehumidifying unit, therefore, in the substrate transport pod having the dehumidifying unit based on the solid polymer electrolytic film, it is preferable that the film area be more than 0.3 cm^2/L and less than 10 cm^2/L, or more preferably more than 0.6 cm^2/L and less than 5 cm^2/L of the unit volume of the pod. In any case, it can be understood that, in a process requiring a rapid reduction in humidity, it is effective to use an operational pattern so that the fan is operated continually and is combined with a dehumidifying material. Here, for an absorbing agent that can be combined with the dehumidifying unit based on a solid polymer electrolytic film, a chemical filter (activated charcoal, ion exchange medium and the like) can perform adequately well. It is possible to use only one dehumidifying unit to lower the humidity relative quickly while aiming for the ultimate humidity range to enable removal of ionic species.

[0152] In practice, it is desirable to adjust the humidity level to suit each process by re-writing the operational pattern of the electrical drive section such as the fan and dehumidifying unit through the communication means described

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earlier. Further, the dehumidifying unit may be operated automatically by providing a humidity sensor inside the pod, and operate the dehumidifying unit according to its humidity data.

[0153] In the process described below, silicon wafers are transported inside a processing apparatus by following steps reverse to those related to transporting from the processing apparatus to AGV. Power supply to the substrate transport pod may be performed while the substrate transport pod is mounted on the processing apparatus in the standby mode.

[0154] Further, it is permissible that the substrate transport pod need not be directly mounted on the processing apparatus but it may be in the standby mode or in the waiting mode for the processing apparatus by placing the pod on a charging apparatus provided on the temporary fore-shelf of the processing apparatus while power is being charged to maintain clean environment, and then transport the pod to the processing apparatus when appropriate. Also, it is permissible that not only the substrate transport pod but also the loading/unloading section of the processing apparatus may be subjected to cleaning to reduce organic substances and ionic contaminants by using chemical filter and the like, and to control the level of humidity around the wafers by operating the dehumidifying means.

[0155] Also, the interior of the substrate transport pod 1 is normally filled with air, but by using an inert gas having a controlled oxygen level, oxidation of copper film can be prevented. It is preferable that oxygen be less than 10,000 ppm, or more preferably less than 1,000 ppm.

[0156] Further, by providing a particle filter 5 and a fan motor 7 inside the substrate transport pod 1 to prevent chemical and particulate contamination of metallic surfaces to circulate and clean the interior air, cross contamination of wafers can be prevented. Also, by providing both a chemical adsorption filter 6 and a particle filter 5 inside the substrate transport pod 1, particles and ions can be removed. Here, it is permissible to provide only the particle filter or only an ionic filter for the chemical filter. Also, when the fan motor 7 and others are provided inside the substrate transport pod 1, the fan motor 7 may be operated without providing a battery inside the substrate transport pod 1, by supplying the power to the fan motor 7 through the receptacle provided on the base member when the substrate transport pod 1 is mounted on the base member.

[0157] As described above, the internal wiring processes for semiconductor chip comprised by low dielectric insulation film and copper wiring demand different environments inside the substrate transport pod, depending on the characteristics of the films formed on the silicon wafer surface. Therefore, for each processing of wafer surface, it is preferable that the wafers be transported inside respective substrate transport pods having dehumidifying device and chemical filter and the like so as to meet the requirements of processing of surfaces comprised by a low dielectric insulation, processing of surfaces comprised by a photo-resist material, or processing of surfaces comprised by a metallic film such as copper film.

[0158] Further, one substrate transport pod having dehumidifying device, chemical filter and particle filter may be used through all the wiring processes of semiconductor wafers.

[0159] In any event, it is important to establish an environment that contains less than the target concentration suitable for each process, to control the environments in all the substrate transport pods that operate between the actual apparatuses (including the fore-shelf of the apparatus) in a plant, and it is preferable to mount communication means to enable to communicate operating conditions for electrical drive sections such as fan and dehumidifying unit.

[0160] Also, as shown in FIG. 76, when a substrate transport pod having data storing device of data related to various processes explained above, after completing wiring of all the layers, process data such as the apparatus identification numbers that the pod has passed through are given to the process managing computer, and at the same time, electrical properties of the chip wiring are measured. Then, the process managing computer performs data processing, such as statistical analysis of the data, using the data of the processing apparatuses that the wafers had passed through, and the results are sent as feedback data for the next lot of manufacturing.

[0161] The above process data will be explained in conjunction with the substrate management aspect of the operational history managing apparatus (information processing apparatus) 429 shown in FIG 71. In normal manufacturing plants, there are several processing apparatuses, and each apparatus performing the same process often has different recipes. For this reason, operational history management refers to managing the information related to processing of one lot of wafers through steps performed by different processing apparatuses, including time information as to when the process was carried out. The recipes refer to parameters in respective processing programs such as processing sequence of various apparatuses and control parameters (control target values of temperature, pressure, type and quantity of gas, and time and the like). The processing apparatus referred here relates to semiconductor manufacturing apparatus, and "between the apparatuses" relates to components in the exterior of the pod, including such items as load-ports, transport apparatus, transfer apparatus, fore-shelf and storage depot. The substrate transport pod is washed and dried, and the stored data are cleared so as to be ready for the next lot. Also, as shown in FIG 76, inspection of each wiring layer may be performed after completing wiring of all layers.

[0162] FIGS. 77A to 77D show another substrate transport pod of the present invention. This substrate transport pod is designed so that a filter block 311 having filters 305, 306 and the fan motor 307 is freely detachable from the pod main body 301. Then, a control board 309 and a secondary battery 310 are mounted on an electrical parts block

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312, which is hermetically sealed to be water proof. The flange section 312a of the electrical parts block 312 and the flange section 301a of the pod main body 301 are joined via a packing or an O-ring 315, and are affixed in a binder-like clamping manner by means of a flange guide 316. As shown in FIG 77D, the flange guide 316 is a ⊐-shaped part, and clamps the electrical parts block 312 to the pod main body 1 from three directions. Also, a clamp that binds the flange section 312a and the flange section 301a of the pod main body 301 may be used. The filter block 311 is freely detachably fixed by means of a hook 313 protruding into the interior of the pod.

[0163] To wash the substrate transport pod 301, the filter block 311 is detached from the pod main body 301 by disengaging the hook 313 to release the filter block 311. The electrical parts block 312 is water-proofed as mentioned above so that the pod main body 301 can be washed directly by detaching the filter block 311. Also, the electrical parts block 312 can also be freely detached by removing the flange guide 316. Therefore, by removing the electrical parts block 312 and replacing it with a plate and clamping the plate using the flange guide 316, the opening section can be sealed, so that the pod 301 may be washed in this condition. Filter exchange in the filter section 311 can be carried out readily by removing the filter block 311 from the pod main body 301.

[0164] FIG. 78 shows another substrate transport pod that enables easy washing. In this embodiment, filters 305, 306, a motor fan 307, a control board 309, a secondary battery 310 and the connectors for connecting these components are integrally fixed to a block 318, and are freely detachable as a whole from the pod main body 301. The block 318 is provided with a flange section 318a, and is joined and affixed by the flange guide 316. Between the flange section 301a of the pod main body and the flange section 318a of the casing 318 is provided a packing or an O-ring for hermetic sealing.

[0165] The pod is washed by removing the flange guide 316 to remove the filter block 318. Then, the plate 319 is attached. The washing plate 319 is attached against the flange section 301a of the pod main body with a packing or an O-ring by pressing and clamping with the flange guide 316. The flange guide 316 is ⊐-shaped as in the embodiment shown in FIG. 77. Here, to facilitate attachment, each flange section may contain a magnet in some locations so as to provide temporary fixation.

[0166] The substrate transport pods with air cleaning capability have components (moisture aversion parts) that are not suitable for washing, so that they cannot be immersed in water in a washing machine as can the conventional substrate transport pods. To wash the present pods, the moisture aversion parts may be made water-proof, but the filters need to be exchanged sometimes so that it is necessary to design the filters to be readily detachable. The present substrate transport pod has been made washable without having to remove the moisture aversion parts by separating the filter section from the moisture aversion parts such as electrical parts into self-contained units. The moisture aversion parts (secondary battery and control boards) are sealed to be water-proofing and affixed to the substrate transport pod, so as to facilitate washing the substrate transport pod without detaching the moisture aversion parts.

[0167] Such a structure is effective when using special washing machines designed for the present substrate transport pod, but normal substrate transport pods that do not have air cleaning capabilities cannot be washed in the same machine. This is because the dimensions of the present pod are different from the dimensions for normal pods because of the air cleaning apparatuses mounted on the pod. In this case, it is necessary to design so that the moisture aversion parts including filters, electrical parts are wholly detachable. When the air cleaning apparatuses are detached, the pod can be fitted to a normal washing machine. However, when the air cleaning apparatuses are detached from the pod main body, there will be vacant portions that create holes on the pod main body, so that if the pod is subjected washing as it is, it means that detergent enters into the interior of the pod is scattered outside thereof. Therefore, by setting the plate to the vacant portions, it has been enabled to use general purpose washing machines for washing the present substrate transport pods.

[0168] The joint sections between the block containing water aversion parts and the pod main body must be easily detachable while providing hermetic sealing to be water-proof. Therefore, it is necessary that the joint sections between parts, that are subjected to washing while being attached to the pod, be made in a flange shape, and a packing or an O-ring should be inserted into the interface as described above. To facilitate the pod and the flange to be attached temporarily, magnets may be mixed in respective parts. Method for drying may include dry gas purging, warm air drying, vacuum drying, and spin drying, and it is preferable that the cleaned and dried parts are assembled with the water aversion parts in clean environment.

[0169] FIG. 84 shows another structure of the substrate transport pod. The feature of this structure is that the area of the opening section other than the substrate transport door has been minimized. An expanded section 301a is integrally formed on the side wall section on the pod main body 301 for containing the filter block 311. The expanded section 301a is provided with a dehumidifying unit 324 of a circular or polygonal shape, and a dehumidifying unit cover member 326 is attached thereto. The electrical parts block 312 is isolated from the interior of the pod that needs to be clean, and is fixated from the exterior of the pod 301 by means of a one-touch-hook, for example. The electrical drive parts such as the fan motor and electrical dehumidifier are connected to the electrical parts block 312 from the exterior of the pod main body by way of wiring means 325. It is preferable that filter exchange be carried out by means of a unified filter block 311 that integrates the particle filter, gas contaminants filer, filter case and air circulation apparatus

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so as to maintain its performance capability. In the present structure, it is possible to exchange only the filter block without dismantling other components. When the pod is to be washed, the dehumidifier unit cover 326 is detached first. Next, the dehumidifying unit 324 is detached. Next, the filter block 311 is removed from the interior of the pod main body 301, and lastly, the electrical parts block 312 is removed. An opening generated by the removal of the dehumidifying unit 324 may be sealed with a stopper when the pod is to be washed.

[0170] Next, the substrate transport pod that can be powered through external source will be explained with reference to FIGS. 79A, 79B and 79C. This pod is used to hold a plurality of substrates W of 200 mm diameter, for example, in a substrate cassette, which is housed in a pod 410 to be transported or stored. This substrate transport pod 410 is comprised by: a pod main body 1 of a square shape having a side wall opening section; a substrate transport door 2 linked to a substrate transport door operating apparatus so as to operate the opening section provided on the bottom surface of the pod main body by mechanical means; a lid member 3 for covering the opening section for mounting or detaching filters and fan motor; a cassette 4 for holding wafers; a ULPA filter 5; a gaseous contaminants filter 6; a fan motor 7; a dehumidifying unit 8; a secondary battery for operating the fan motor 7 and the dehumidifying unit 8; and an operation control board 9. On the bottom surface of the substrate transport pod 410 are provided a latching device 411 for mechanically operating the substrate transport door 2, a positioning hole 412; and a secondary battery charging terminal 413.

[0171] In this embodiment, charging terminal 413 on the substrate transport pod-side is located on its bottom surface, but the terminal may be located on the side surface or upper surface as necessary. FIG 79 shows a managing information storage (information processing apparatus) 414 also for reference. Also, in this embodiment, the door of the substrate transport pod is located on the bottom section, but the pod is applicable to a structure in which the door is located on the side surface or upper surface. Also, in this embodiment, the substrate is stored in the horizontal position, but the pod is applicable if they are located in the vertical direction.

[0172] The power input apparatus for charging the secondary battery disposed on the substrate transport pod is an example of a charging setup to receive the substrate transport pod 410 in the vertical position and the charging terminals on the apparatus side and the pod-side contact each other to carry out charging and/or supplying power, as shown in FIGS. 80A and 80B. The power input apparatus comprises a charging system and a supply system for converting commercial voltage source to a specific voltage required and supplying power directly to the fan motor and dehumidifying unit. By obtaining the power from such commercial power source to the fan motor or dehumidifying unit, it is possible to operate continually over a long period. The power input apparatus is comprised by: a power supply main body 415; a guide member 416 for guiding the bottom four corners of the pod; a positioning pin 417 linked to the guide member for seating the pod in a specific location; detection means 418 disposed in the interior of the power supply main body 415 for detecting whether the pod is present and/or the necessity for supplying power; a terminal moving mechanism 420 also disposed in the inferior of the power supply main body 415 for raising or lowering of the powering connector 419 according to detected information from the detection switch 418; powering connector 419; and a pod fixation mechanism 421 for mechanically affixing the substrate transport pod. The power input apparatus referred to above relates not only to a simple charging device to supply or receive charges but relates all inclusively to the door operating apparatus having charging capability, temporary holding apparatus, semiconductor manufacturing apparatus, automated transport apparatus, and performance inspection apparatus. Of the constituting elements mentioned above, the guide member 417 and the pod fixation mechanism 421 may be omitted. Here, in this embodiment, although the secondary battery is disposed on the substrate transport pod, but the system is similarly applicable to a substrate transport pod that does not have a secondary battery, that is, a pod having air cleaning apparatus and dehumidifying device that operate only through an external power supply.

[0173] Another embodiment of the method for supplying power relates to a non-contacting manner of supplying the power. This method is based on a proven method of electromagnetic induction, being used for electric shaver, electric brush and electric car. Electromagnetic induction is realized by receiving or amplifying the magnetic flux generated by the current flowing in a wire or coil from an external AC source so as to supply necessary power, and is a type of transformer. The feature of electromagnetic induction type power supply is that no wear of terminals occurs because on non-contact, no generation of sparks, no danger of electrical shock, and no danger of shorting when used in wet environment. The outline is shown in FIGS. 81A and 81B. This power input apparatus is comprised by a charging system and a supply system that supplies power directly to the fan motor and dehumidifying unit after converting the commercial power to a specific voltage. By obtaining the power from such commercial power source to the fan motor or dehumidifying unit, it is possible to operate continually over a long period. The power input apparatus is comprised by: a power supply main body 415; a guide member 416 for guiding the bottom four corners of the pod; a positioning pin 417 linked to the guide member for seating the pod in a specific location; a detection device 418 disposed in the interior of the power supply main body 415 for detecting whether the pod is present and/or the necessity for supplying power; a control section 422 also disposed in the inferior of the power supply main body 415 for controlling supply voltage and current and the like; a powering connector 419 having a supply line or a coil; and a pod fixation mechanism 421 for mechanically affixing the substrate transport pod. The power input apparatus referred to above relates not only

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to a simple charging device to supply or receive charges but relates all inclusively to the door operating apparatus having charging capability, temporary holding apparatus, semiconductor manufacturing apparatus, automated transport apparatus, and performance inspection apparatus. Of the constituting elements mentioned above, the guide member 417 and pod fixation mechanism 421 may be omitted. Here, in this embodiment, although the secondary battery is disposed on the substrate transport pod, but the system is similarly applicable to a substrate transport pod that does not have a secondary battery, that is, a pod having air cleaning apparatus and dehumidifying device that operate only through an external power supply.

[0174] Next, of the actions of the various components carried out during charging, a contact system of charging will be explained with reference to FIGS. 80 and 82. When a pod is transported to a charging apparatus by various transport means (AGV or OHT and the like) to be charged, it is seated in a specific position by the guide member 416 and the positioning pin 417. In some cases, the pod is fixed to the apparatus by the pod fixation mechanism 421. This state is shown in FIG 82. When the pod 410 is seated, the detection switch 418 in the charging apparatus main body detects seating and/or determines whether charging is necessary, and if it is determined that charging is required, the terminal moving mechanism 420 is operated. The connector attached to the tip of the terminal moving mechanism contacts the charging terminal 411 on the pod-side, and begins charging. Before commencing charging, connection confirmation may be carried out to determine whether the terminals are in contact properly. When charging and/or power supply is completed or when the pod is to be transferred due to processing needs, the apparatus side first transmits clear-process information to the power supply control board, and stops supplying of power. Next, the power input terminal retreats to a position to not to interfere with the movement of the pod, and the pod fixation mechanism 415 is released so as to enable process clearing. In this embodiment, the power input connector on the power supply side is disposed on the top surface, but this is not meant to specify the location of the terminal, so that it may be located on the side surface or the top surface as needed. Also, the direction of movement of the power input terminal is not required to be vertical so that the horizontal or slant direction, or a suitable combination of vertical, horizontal, slant or rotation movement may be used.

[0175] Next, of the actions of the various components carried out during charging, a non-contact system of charging will be explained with reference to FIGS. 81 and 83. When a pod is transported to a charging apparatus by various transport means (AGV or OHT and the like) to be charged, it is seated in a specific position by the guide member 416 and the positioning pin 417. In some cases, the pod is fixed to the apparatus by the pod fixation mechanism 421. This state is shown in FIG 83. When the pod 410 is seated, the detection switch 418 in the charging apparatus main body detects seating, and it determines whether charging and/or powering is necessary, and if it is determined that the substrate transport pod requires charging, charging is commenced. Before commencing charging, connection confirmation may be carried out to determine whether the terminals are in contact properly. When charging and/or powering is completed or when the pod is to be transferred due to processing needs, the apparatus side first transmits clear-process information to the power supply control board 422, and stops supplying of power. Next, the pod fixation mechanism is released so as to enable the state of clear-process. In this embodiment, although the power input connector on the power supply side is disposed on the top surface, this is not meant to specify the location of the terminal so that it may be located on the side surface or the top surface as needed. Also, the power input terminal on the apparatus side may be a movable type as in the contact type. The direction of movement may be vertical or horizontal or slant direction, or a suitable combination of vertical, horizontal, slant or rotation movement may be used.

[0176] Seating detection mechanism of the substrate transport pod may include mechanical switch, proximity switch or photo-electric sensor. Mechanical switches are the most common means of detection, and include button type, rotary type, sliding type, joy stick, torque type, and miniature models are available in the marketplace. Proximity switches detect an approaching object by means of magnetic or electric field. They are non-contacting type detectors, and are effective when the detection object is metallic or non-metallic. Photo-electric sensors include scatter reflection type, mirror reflection type and transmission type. In the scatter reflection type, its operation is based on light emitting from the emission section illuminates an object and is scattered/reflected, and a portion of the reflected light returns to the receiver section. In the mirror reflection type light emitted from the emission section is reflected by the mirror to return to the receiver section, and operates when an object shields the light. In the transmission type, emission section and receiver section are placed in different locations, and an object is detected when it shields the light path between the emission and receiver sections. In the above embodiment, any of these methods may be used by considering the size, shape, price and reliability of each method.

[0177] For the connectors, there are coupling type, clip type or contact type. In the coupling type, a plug section is inserted into a socket section, and it is widely used for power and communication cables. For those applications that require little plugging and unplugging, this method is the most reliable. In the clip type, the conductive area is. clamped by the clip, and it is used often when making temporary connections so that it is not well suited to the present embodiment. In the contact type, a spring section and a plate section are in contact at a point. This method is useful when the space available for the connector is narrow. The contact type spring section includes plate spring and coil spring, and many commercial products are available. In this embodiment, the above connection devices, excepting the clip

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type, are useful but from the viewpoint of low space requirement, the contact type is the most preferable.

[0178] As described above, a drive power source is required when the cleaning and/or electric dehumidifier are to be mounted on the substrate transport pod. There are two methods of obtaining a drive power source: one method is to provide a power source such as secondary battery on the pod, and another method is to supply power from an external source.

[0179] First, the method based on mounting a secondary battery will be explained. The purpose of mounting a battery on the pod is to maintain low levels of contaminants and humidity, even when external power supply cannot be provided, by operating the air cleaning apparatus and/or electric dehumidifier. Batteries that may be considered for mounting may include: rechargeable secondary batteries, for example, lead storage battery, NiCd battery, nickel/metal hydride battery (Ni-MH), lithium ion battery (Li-ion), polymer battery. Polymer batteries use a solid or gel type polymeric electrolyte, and therefore, they are different from other type of batteries, so that there is no danger of liquid leaking and a metal container is not required leading to improved safety. Also, there is an advantage that it allows freedom in designing the shape. Other power sources include solar batteries. Two methods of using the solar battery are to use it to drive the fan motor and the like directly or to use it to charge secondary battery mounted on the pod. The substrate transport pod having the air cleaning apparatus and/or electric dehumidifier may utilize a secondary battery or a solar battery or a combination of secondary battery and solar battery.

[0180] The location for charging the battery may include, for example, door operating apparatus, transport apparatus, storage depot or specialized local charger. When a secondary battery is mounted, it is necessary that the charger be provided only where the pod stays for prolong period. The pod may stay for a long time on the door operating apparatus and in storage depot. Therefore, operation by secondary battery may be chosen only while transporting in the transporting apparatus, so that, even if the transport apparatus should experience problems and the pod is delayed, clean interior atmosphere can be maintained in the pod.

[0181] The quickest general method of charging the battery is to follow the procedure shown in FIG 84. First, preliminary charging is performed at 0.2~0.3 cmA, and the battery voltage is confirmed at this stage. If the battery voltage is higher than a specific voltage, the process is shifted to quick charging. Next, quick charging is performed at the maximum of 1 cmA. The end point of quick charging is reached when the battery temperature rise per unit time (dT/dt) reaches a pre-determined value. This is based on the method of judging the completion time of charging according to the amount of electrical energy injected into the battery manifesting in a given rate of temperature rise. When the quick charging is completed, the battery has been charged to 80~90 % of its full capacity. Then, trickle charging is performed at a low current of 1/20~1/30 cmA. When the trickle charging is completed, the battery is charged to the 100 % capacity.

[0182] General quick charging method follows the following sequence.

① Charging is performed at 0.2~0.3 cmA, and the battery voltage is confirmed. If the battery voltage is higher than a specific voltage, it changes to quick charging.

② Quick charging is performed at the maximum current of 1 cmA. The end of quick charging is reached when the temperature rise per unit time (dT/dt) reaches a specific value. At the completion of quick charging, 80~90 % of the full charge is attained.

③ Charging is continued at a low current of 1/20~1/30 cmA. When the trickle charging is completed, 100 % of the battery capacity is reached.

[0183] FIG 85 shows a control section on the pod-side for providing battery protection and showing accurate residual capacity. This apparatus has a control board on the pod-side having the information processing function shown in FIG 85, and a control board on the charger side having the information processing function shown in FIG. 86. The "measurement results input/output section" on the pod-side receives battery capacity, operation times and power consumption rate and others for the fan motor and/or electric dehumidifier, and next, necessary data are computed in the "control computation section" and the data are stored in the "memory" as information on the battery capacity, accumulated power consumption and the like. The "operational control signal input/output section" receives dedicated ID number of the pod, operation conditions such as operation patterns of the fan motor and/or electric dehumidifier and the like, which are stored in the "memory". Operational state of the pod, such as the battery residual capacity, is output from the "memory" according to the control computation actions stored in the "memory". The "interface section" has the capability to transmit information stored in the "memory" by wire or radio to the charger.

[0184] The "interface section" on the charger side receives information such as ID number of the pod and accumulated power consumption and others, and necessary data are computed in the "control computation section", and the data such as charging times are stored in the "memory". The "charging control circuit section" performs charging of the battery according to various information such as charging times stored in the "memory" and according to computed control actions including information on the voltage or current and the like output from the "measured results input section" through the "interface section".

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[0185] That is, because residual charge and operation times and accumulated power consumption are stored in the "memory" by the control board on the pod-side, this method enables to display more accurate information on the residual battery life. Also, because the battery capacity is computed constantly, performance degradation due to over-charging of secondary battery can be prevented. Also, the charging side is able to compute the shortest charging time based on the residual capacity of the secondary battery on the pod-side, and display the results.

[0186] Next, the structure of the electrical system will be explained. For example, if a charging system for charging the secondary battery is combined with a powering system for operating the air cleaning apparatus and/or electric dehumidifier, the power to operate the air cleaning apparatus and/or electric dehumidifier is consumed from the secondary battery. In this method, charging and discharging of the secondary battery is repeated to result in shortening the service life. When the pod is connected to the dedicated charger, it is preferable to separate the charging system from the powering system. By isolating the charging system from the powering system, when the pod is connected to the charger, the secondary battery is subjected only to charging process, and the service life can be increased. The longer the time of connection to the charger, this effect becomes more significant.

[0187] Next, the method of supplying power from external source will be explained. The purpose of supplying total power to operate the air cleaning apparatus and/or electric dehumidifier externally is to reduce the weight and cost of the pod by not mounting the battery on the pod. The power to the pod may be supplied when the pod is in the standby mode on the door operating apparatus, on the transport apparatus, in storage depot, or in the standby mode at a local charger. This method has a disadvantage such as the necessity for the power source to be located within the movement range of the pod, but the weight of the pod can be reduced and the cost lowered.

[0188] The substrate transport pod of the present invention having the air cleaning apparatus and/or electric dehumidifier may have a secondary battery or driven by external power source.

[0189] Examples of methods for powering the pod will be explained in the following with reference to the drawings.

[0190] FIGS. 87A, 87B and 87C will be used to explain the process of powering the substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a secondary battery 451; an operational control board 453; a power input terminal 454; a door 2 having reaction plate 455 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air circulation apparatus 7; a flow regulation plate 23; and a connection terminal 19. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving mechanism 467; a pod identifier sensor 468 and others. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the side surface of the pod, the reaction plate and reaction seal may be disposed on the pod bottom section.

[0191] FIGS. 88A, 88B and 88C will be used to explain the process of powering the substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a reaction plate or reaction seal 455 and a door open/close detection sensor 469 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 9; a flow regulation plate 23; a secondary battery 9; an operation control board 453; a power input terminal 454; and a door open/close sensor. The door open/close sensor 469 is provided for sensing the status of the door and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. Or, the power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving apparatus 467; a pod identifier sensor 468 and the like. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the side surface of the pod, the reaction plate and reaction seal may

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be disposed on the pod bottom section.

[0192] FIGS. 89A, 89B and 89C show, respectively, the pod in the transport state, seating state and door descended state. The diagrams explain the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a reaction plate or reaction seal 455, and a door open/close detection sensor 469 housed internally or attached; and an air cleaning unit having a particle filter 5, a gaseous contaminants filter 6, a dehumidifier 8, an air blower 7, a flow regulation plate 23, an operation control board 453, a power input terminal 454, and a door open/close sensor. The door open/close sensor is provided for sensing the status of the door and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving apparatus 467; a pod identifier sensor 468. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal 455 that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the pod-side, the reaction plate and reaction seal may be disposed on the pod bottom section.

[0193] FIGS. 90A, 90B and 90C show, respectively, the pod in the transport state, seating state and door descended state. The diagrams explain the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a reaction plate or reaction seal 455, a door open/close detection sensor 469, a gas intake opening 470, and a gas discharge opening 471 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 7; a flow regulation plate 23; an operation control board 453; a power input terminal 454; and a door open/close sensor 469. The door open/close sensor 469 is provided for sensing the status of the door and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. The gas intake opening 470 and the gas discharge opening 471 are provided with internal one-way valve and the particle filter, but it may be filled with the gaseous contaminants filter medium. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a port door moving apparatus 464; a pod fixation arm 465; a power input terminal 466; a power input terminal moving apparatus 467; a pod identifier sensor 468 and a gas intake pipe 472 and a gas discharge pipe 473 for gas replacement by linking with the gas intake opening 470 and the gas discharge opening 471. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465 and, at the same time, the pod identifier sensor 468 detects whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. It is permissible to confirm, during the initial stage of powering, that the terminal on the pod-side and terminal on the power side are correctly in contact for proper conduction. When transporting the wafers inside the pod or clear the process, the interior atmosphere may be replaced with nitrogen gas by utilizing the gas intake pipe 472, gas intake opening 470, gas discharge opening 471 and the gas discharge pipe 473. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted. In the case of the substrate transport pod having the door on the side surface of the pod, the reaction plate and reaction seal may be disposed on the pod bottom section. The gas intake opening and gas discharge opening may be disposed on the pod main body side.

[0194] FIG 91 shows the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a door 2 having a door open/close detection sensor 469 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 7; a flow regulation plate 23; a secondary battery 9; an operation control board 453; a power input terminal 454; a rectifier 474. The door open/close sensor 469 is provided for sensing the status of the door 2 and adjusting the operation of the fan motor and/or dehumidifier. When the door is in the open state, to prevent inflow of contaminated air in the outer environment of the pod, the operation may be stopped or the rotational speed of the fan is reduced, for example. Instead of detecting the door status, it is

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permissible to adjust the operation of the air cleaning apparatus by detecting whether or not the cassette and/or wafers are present inside the pod. The power input apparatus for powering the substrate transport pod is comprised by: a port door 463; a pod fixation arm 465; a power input terminal 466; a power control board 475 and the like. The apparatus having the powering capability includes, for example, door operating apparatus, storage depot, storage shelf, transport apparatus such as AGV, RGV, PGV, OHS and others; and inspection apparatus. When the substrate transport pod is seated on the power input apparatus, the pod is fixed in position by means of the pod fixation arm 465. It is permissible to supply power by adding a pod identifier sensor and a reaction plate, and detecting whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. This embodiment relates to a non-contact type powering system, and the power receiving terminal is wire, coil or core. The power input terminal is also wire, coil or core. The rectifier 474 is a device for converting the alternating current received from the power input terminal 454 to the direct current. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted.

[0195] FIG 92 shows the process of powering a substrate transport pod, having an air cleaning apparatus, comprised by: a pod main body 1; a robot holding means 476; a door 2 having a door open/close detection sensor 469 housed internally or attached; a particle filter 5, a gaseous contaminants filter 6; a dehumidifier 8; an air blower 7; a flow regulation plate 23; an operation control board 453; a power input terminal (coil) 454; and a rectifier 474. The power input apparatus for the substrate transport pod having the air cleaning apparatus is a ceiling-based transport apparatus such as OHT. As shown in FIG 93, OHT is comprised by a guide rail 477 affixed to the ceiling; a hoist 478, and a handling arm 479, and its forward thrust is generally provided by a linear motor. The guide rail has at least a magnetic body 480 and powering line 481. The moving body 482 has a primary coil 483, wheels 484 for supporting the vertical load; wheels 485 for supporting the horizontal load, and a moving-side powering coil 486. The handling arm 479 has a powering coil 487, and the current flows via the power input coil on the moving-side powering coil through the power input line 481, such that a portion of the input power is used for forward thrust power, and a portion is used for the hoist winding power, and the current flows from the powering coil 487 of the handling arm to the pod-side receiving coil 454, and the alternating current is rectified in the rectifier 474, and is further converted to a desired voltage to operate the fan motor and/or dehumidifier. It is permissible to supply power by adding a pod identifier sensor and a reaction plate, and detecting whether or not power input is necessary, and when it is determined by the dedicated reaction plate or by the reaction seal that power input is required, power is input. The combination of filter and dehumidifier to be mounted may be altered suitably. Also, the flow regulation plate 23 may be omitted.

[0196] Instead of the door open/close detection sensor, a sensor to detect the presence of a cassette may be attached. Attachment location of the sensor may be chosen anywhere, for example, bottom section, side surface, upper surface or front surface of the cassette. Methods for cassette detection include mechanical sensors, photo-electric sensors, magnetic sensors, and proximity sensors, but non-contact type sensors that do not touch the cassette are preferable.

[0197] Next, information management system of the substrate transport pod will be explained with reference to FIGS. 94 to 99.

[0198] In this embodiment, the substrate transport pod 1 is provided with data storage means 700 for storing information on contents housed inside the pod such as wafer and the like. Information on wafers stored inside refers to such data as the number of wafers, processing status, processing procedure and lot identification ID, but if the contents are masks, information relates to such objects.

[0199] FIG. 94 shows a system for use in the centralized management method. A communication antenna 701 is placed in a location for which information is required, and information arriving in the data storage means at this location is forwarded to the host computer 703 through a controller 702. The control section for the various on-site manufacturing apparatuses 704 and the stocker 705 for pod storage is also linked to the host computer, and the information on the wafers housed in the interior of the pod 1 is instantly confirmed, and the control section for a manufacturing apparatus instructs to perform processing exactly as the information stored inside the pod 1. When the processing is completed, such information is newly recorded in the data storage means 700, and the pod 1 is transported to the next apparatus by an automatic transport tool (for example, AGV and the like) instructed by the host computer.

[0200] FIG 95 shows a system for use in the on-site management method. The site is provided with interface module 707 for use in reading and writing information in information storage means 700 provided for the pod 1. Information storage means 700 is a data memory means for memorizing information on an object whose carrier, pod and other information are to be managed. Also, storage means 700a is able to read the information in the memory on-site. Accordingly, it is also possible to confirm or overwrite the information on the contents, such as wafers, stored inside the pod, on-site without the intervention of the host computer.

[0201] Next, with reference to FIG 96, a management system for managing information on filter service life and pod cleaning will be explained.

[0202] The substrate transport pod 1 is provided with data storage means 700 for accumulating the cumulative operation time γ of the driving section for managing the information on filter service life and pod cleaning frequency. This

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storage means 700 may be provided with computation means. It is obvious that a common storage medium should be used for the data storage means of the pod and for the data storage means for accumulating information on the contents stored inside the pod.

[0203] In the computation element, computed information is stored in the data storage means 700 so that the pod is washed when the cumulative operation time γ exceeds a certain value and the filter is exchanged when a certain value is exceeded. This information is sent from the host computer 703 to the AGV 706 and the pod washing machine 708 to enable the pod to be washed or filter 709 to be exchanged. For example:

γ = 480 hours for washing

γ = 7200 hours for filter exchange

[0204] It is obvious that, in the case of the on-site management system, the operator can be notified by displaying information regarding filter exchange and pod washing.

[0205] In another example of the management system, in order to increase the accuracy of filter service life management, the pod 1 is provided with data storage means 700 for accumulating the processed gas volume α per unit time and the cumulative operation time γ. This device may have computation means. It is preferable that a common storage medium should be used for the data storage means of the pod and for the data storage means for accumulating information on the contents stored inside the pod.

[0206] The computation means stores computation results so that the pod will be washed when the cumulative operation time γ exceeds a certain duration, and so that the filter will be changed when a product of the processed gas volume α per unit time and the cumulative operation time γ exceeds a certain value X, for example:

γ = 480 hours for washing

α (NH_3-mg/h) $\times$ γ (hours) = X(NH_3-mg) for filter change

[0207] In the case of central management system, this information is forwarded from the host computer 703 to AGV 706 and pod washing machine 708 to enable to confirm the need for pod cleaning and filter exchange. It is obvious that, in the case of on-site management system, the operator can be notified by displaying information regarding filter exchange and pod washing.

[0208] In still another management system, in order to improve the accuracy of filter service life management, the substrate transport pod is provided with a gas sensor, and has a data storage means for accumulating the processed gas volume β per unit time obtained from the results of sensor measurements and the cumulative operation time γ of the drive section, and a computation element may also be provided. It is obvious that a common storage medium should be used for the data storage means of the pod and for the data storage means for accumulating information on the contents stored inside the pod.

[0209] Gas sensor may include color indicating monitor, semiconductor sensor and quartz oscillator sensor, but it is not necessary to limit to these methods. In the computation element, computed results information is stored in the data storage means that indicates washing is needed when a pre-determined value of cumulative operation time γ of the drive section is exceeded. For example,

γ = 480 hours for washing,

β = monitored value (NH_3-mg)÷measuring duration in hours, and

$\beta \times \gamma$ = X (NH_3-mg) for filter change.

[0210] Processed gas volume β per unit time is computed using the indicated value of the gas sensor and the measuring duration, which is stored in the data storage means. For the centralized management system, various pieces of information are sent from the host computer to AGV and pod washing machine to enable pod washing and filter change. It is also possible, in the case of the on-site management system, to display information on filter change and pod washing on a display section to notify the operator.

[0211] Further, in order to operate the entire system smoothly, it is preferable that the computation element on the pod-side has a timing mechanism and data storage means for accumulating malfunction information of the drive parts. For example:

γ = 480 hours for washing, 2000/12/31/12:00,
2001/01/30/00:00,
2001/02/28/20:00,

α(NH_3-mg/h) $\times$ γ (hours) = X(NH_3-mg) for filter change,
2000/01/25/08:00,
2001/10/10/12:00, and

fan stop 2001/12/31/12:00.

[0212] By providing timing mechanism on the substrate transport pod 1 itself, it is possible to provide some estimate of the frequency of need for cleaning, change the filter and malfunction of drive parts, and such data are extremely effective for operational purposes. Also, even if malfunction of drive parts occurs during transport of substrates, search time for rejection lot is shortened because priority inspection can be provided for the processes that follows such breakdown.

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[0213] With reference to the flowchart for the wiring process in FIG 76, an example of operation of the information management system for substrate transport pod will be explained in the case of using a common medium for the data storage medium to store environment control information for the pod (pod data) and lot history (contents data).

[0214] When insulation film forming processing is completed, process completion information is newly entered in the data storage means. Also, receiving pre-stored or externally input information on environmental control during the period for the pod to reach its next processing, the electrical drive section is operated in such a way that moisture and organic control are prioritized for suppressing formation of oxidation film. For example, a plurality of dehumidifying units is operated and the fan is operated continually or intermittently. Also, transport to the target apparatus for resist coating (coater) is carried out by means of automated transport tool (for example, AGV) 706 that received instruction from the host computer. When the pod reaches the target coater, the matching of the coater recipe and processing requirements for the pod content is checked, and processing is carried out only when matching is confirmed.

[0215] When resist coating, exposure and development are continuously performed in the interface section, the pod is not used, and therefore, environmental control information may be blank during the period of transport between development to etching processes, but if an emergency situation arises relating to apparatus problems and the like, the memory contents need to be stored in the pod in such a way that instructions are externally entered into the data storage means to operate the electrical drive section to prioritize control of base substances in the environmental control so as to suppress the T-top formation. For example, the dehumidifying units are stopped or only one unit is operated and the fan is operated continually or intermittently. Procedures for lot history (contents information) manufacturing apparatus, and communication of transport apparatus are the same, and therefore, the following process describes only the environmental control aspects.

[0216] During transport between the developing apparatus and the etching apparatus, base substance control need not be prioritized to the extent required between the processes of photo-resist coating, exposure and development. When a metal film forming process is performed by etching, asher and CVD, environmental control is not necessary because the processes are carried out on whole substrates in a vacuum using a multi-chamber such as cluster tool and the like. However, when a metal film forming process involves etching, asher and electro-plating, or when processing cannot be carried out on whole substrates due to malfunction of multi-chambers and the like, or chemical contamination of the insulation film after etching on the side wall of the groove is a problem, transport from the etching apparatus to the metal film forming apparatus is carried out using a substrate transport pod having a chemical filter in addition to a dehumidifying agent or a dehumidifier. In such a case, priority controls are performed for all or some of moisture, acid and organic substances.

[0217] Further, when transporting copper-coated silicon wafers in the pod from the metal film forming apparatus such as CVD and electro-plating apparatus to the CMP apparatus, by way of the annealing apparatus, further to coater, and to the insulation film forming apparatus such as CVD apparatus, growth of oxidation film can be prevented by providing dehumidifying means such as the dehumidifier or dehumidifying agent inside the pod to control its humidity. In such a case, it is preferable to control to dehumidify inside the pod to less than 10 %, or more preferably to less than 5 %. To prevent the growth of even slightest oxide film, it is preferable to lower to dehumidify to a specific value within 10 minutes of opening the door 2, or more preferably, within 3 minutes. The electrical drive section is operated to control moisture and organic substances, in particular, priority should be given to controlling the humidity. For example, a plurality of dehumidifying units is operated and the fan is operated continually or intermittently.

[0218] Next, another example of the information management system for the substrate transport pod will be explained.

[0219] This substrate transport pod, as described above, is provided with computation element, memory element and computation processing unit 558 (refer to FIGS. 34A and 34B) having data input/output means. The computation processing unit stores information not only on cumulative operation time of electrical drive section parts such as fan motor or dehumidifying unit, malfunction information, and information on pod itself such as residual voltage of the secondary battery, but also stores information on externally-input information on the amount of processed gas per unit time, operational protocol for electrical drive parts, voltage target for charging and lot process history management. Of course, when the gas sensor is provided inside the pod, it is possible to compute and store actual measured value of the contaminated gas volume, not as pre-determined data. Here, as described in the following, the particle filter, gaseous contaminants filter 6, and fan motor may be used singly or in combination, and their attachment location and properties may be different depending on the process to be applied.

[0220] The substrate transport pod having contaminants removal means uses particle filter to remove particulate and metallic contaminants, and uses gaseous contaminants filter to remove ionic and organic contaminants. Also, moisture is removed by using dehumidifying means based on solid polymer electrolytic film for decomposing water or by using dehumidifying agent. There are various target substances to be removed from the interior of the substrate transport pod, as described above, but the target composition for removal is different in each process so that it is not necessary to mount all the means for removing contaminants in the pod. For example, for storage of exposed substrates inside the pod, it is sufficient if a pod has specialized capabilities for removing particulate contaminants and base

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substances. Also, after forming metallic film on semiconductor substrates, it is sufficient if a pod has specialized capabilities for removing particulate contaminants, organic contaminants and moisture. On the other hand, for storing exposed semiconductor substrates in the pod, the pod should have specialized capability for removing particle contaminants and chloride contaminants. Also, semiconductor substrates that have been processed with metal film, the pod should have specialized capability for removing particle contaminants, organic contaminants and moisture. On the other hand, for storing washed semiconductor substrates inside the pod, the target substances to be removed depend on the nature of the succeeding process. Further, it is anticipated that new materials will be adopted in the field of film forming, and it is said that adoption of such new materials is largely affected by whether environmental control for the new material is possible or not.

[0221] On the other hand, in some processes, filter service life is shortened by the release of large amounts of gases from the processed semiconductor substrates. Examples are found in degassing from organic solvents and the like brought into the pod during the exposure process. It can be anticipated that filter service life can be shortened when one pod is used for one process as in the conventional approach because of needless cleaning of the interior environment of the pod in some processes, so that the filter is no longer capable of performance in processes that require high degree of cleanliness. However, by adopting the present method of using the substrate transport pod, that is, by transporting the substrate in a pod having only those contaminants removal means customized for the processes being applied to the substrates, only those targeted contaminants relevant to the processes under consideration are removed effectively.

[0222] When the operation is based on a substrate lot being transported in a given substrate transport pod on a one-to-one basis as in the conventional method, types and concentrations of the contaminant gases brought into the interior of the pod and types and target levels of the gases to be removed are different in every process, and it is difficult to manage whether the cleaning functions are being sustained sufficiently. However, when the substrates are transported between each process in pods having contaminant removal means, the target gas types and the amount of gas generated are clearly known for each process. For this reason, it is preferable to pre-measure the amount of gas processed per unit time α during storage of the semiconductor wafers for each process, and to determine the need for changing the filter according to whether or not a threshold value, stored in the data storage means, has been reached, where the threshold value is given by a product of the measured value of processed gas volume α and the cumulative operation time γ of a drive part. Similarly, by pre-determining the frequency of washing the pod for each process, the need to wash a pod can be determined from the cumulative operation time γ of the drive part.

[0223] When the operation is based on a substrate lot being transported in a given substrate transport pod on a one-to-one basis as in the conventional method, types and concentrations of the contaminant gases brought into the interior of the pod and types and target levels of the gases to be removed are different in every process, and even if the gas level inside the pod is measured with a gas sensor, it is necessary to provide a sensor for each type of gas, so that this approach is not realistic. However, when a pod having suitable contaminant removal means is used for return transport of substrates between processes, the target gas types are known clearly for each process. For this reason, only sensors dedicated to the targeted gas species need to be mounted. Then, by determining the gas processed amount per unit time β by a filter according to measured results by the sensor, it is possible determine the need for washing the pod, according to whether or not a threshold value, stored in the data storage means, has been reached, where the threshold value is given by a product of the processed gas amount per unit time β and the cumulative operation time γ of a drive part. Similarly, by pre-determining the frequency of washing the pod for each process, the need to wash a pod can be determined from the cumulative operation time γ of the drive part.

[0224] Specific examples of selection of contaminants removal means and service life of the filters will be described in the following. For example, focusing on a case of the exposure process, the target contaminants for removal are particulate contaminants and base gases that can be found in the pod after processing, and it is not necessary to have removal capabilities for organic contaminants and moisture. Moreover, the exposure process uses a large quantity of organic substances such as photo-resist solvents, so that the filter service life is shortened if organic substance filter is used. Further, because the performance of base substance removal filter depends on humidity, so that if moisture removal is also used, service life of the base substance removal filter is shortened. When the pod is used as a dedicated transport apparatus having only the required filtering functions and unnecessary filtering functions are deleted, the filter is loaded only with particles entering from the clean-room environment when the substrate transport door is opened, and base gas substances. Therefore, the filter need not be changed until the guarantee periods are expired.

[0225] Similarly, taking an example of metal film forming process for Cu, the target contaminants for removal are primarily particulate contaminants, organic contaminants and moisture. There is no need for active removal of ionic contaminants. There is very little emission of target gases to be removed from the processed substrates, and therefore, in the dedicated pod operation, filter is loaded with particles entering from the clean-room environment when the substrate transport door is opened and organic contaminants.

[0226] Although the details regarding other processes will not be described here, in any operations according to the present method, when the pods having contaminants removal means are used to transport substrates back and forth

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between the processes, filters need not be changed until the guarantee periods are expired.

[0227] Table 1 shows an example of comparing the filter lives when used in the conventional one-to-one method and in the present process-specific pod method. In the method based on one-to-one correspondence of pod and substrate lot, service life of filter is shortened in some processes for which cleaning is superfluous, resulting that the degree of cleanliness required cannot be sustained for the process that requires it, so that the filter must be changed. However, by adopting the present method, that is, by transporting the substrates using substrate transport pods having contaminants removal means matched to the specific needs of each process, cleaning is carried out effectively to remove only those contaminants relevant to the processing of individual processes. The result is that the filter service life is extended while minimizing the contaminants that adhere to the substrates.

TABLE 1

Process Type	1:1 Lot-Pod		Process-Specific Pod
	Filter life	Short life cause	Filter life
Exposure	6 months	Loss of basic gas cleaning capability caused by NH_3 contaminations from wash process	Over 2 years*
Metal film (Cu)	6 months	Loss of organic gas cleaning capability caused by organic contaminations from organic. coating process	Over 2 years*
Metal wiring (Al)	3 months	Loss of acidic gas cleaning capability caused by acidic contaminations from RIE process	Over 2 years*
Washing (→film forming)	3 months	Loss of organic gas cleaning capability caused by organic contaminations from organic film coating process	Over 2 years*

* Guarantee period of gaseous contaminants filter

[0228] FIG 100 shows a flowchart for determining the charging times for a secondary battery. A substrate transport pod having the contaminants removal means described above has a fan motor and a drive section for operating the dehumidifying unit, so that it is necessary to carry out charging or powering (charging of secondary battery or powering the drive section). If full charge is maintained by connecting constantly to the powering station disposed in the loading port or fore-shelf of the processing apparatus, the process takes too long to match the cycle timing of the substrates returning from the processing apparatus. Therefore, it is necessary to stop charging when sufficient charges are given to enable to operate the longest interval between the preceding charging and the succeeding charging to meet the process cycle timing of the wafers returning from the apparatus. In this embodiment, the following procedure is used to shorten the charging time to meet the process cycle timing of the wafers returned from the processing apparatus. First, when the substrate transport pod 1 having the contaminants removal means is seated in the powering station 721, the residual voltage ε is measured and charging is started. At the same time, communication is started with the controller 702 of the processing apparatus A through the interface 701. Then, the time duration required by the pod to arrive at the next powering station is computed by obtaining a sum of the clean-room operation time (a sum of transport time, batch matching time, holding time for the operator and apparatus, and maintenance time) and the actual processing time (a sum of theoretical processing time, lot loading/unloading time, time for obtaining conditions for preceding wafers, time required for lot linking and quality control), and multiplying the sum by a factor of safety. That is,

Charge level = battery usage duration x power consumption - residual power

[0229] Battery usage duration = (actual processing time + clean-room operation time) x factor of safety.

[0230] Then, charging is carried out only to the extent of the charging to the voltage required ξ. Accordingly, it is possible to reduce the charging time.

[0231] The substrate transport pod 1 seated in the powering station 721a disposed in front of the apparatus 704a for process A must be charged sufficiently to enable to operate until it can be charged by the powering station 721b disposed in front of the apparatus 704b for process B. Battery driven operation should last for a period of time computed by obtaining a sum of the duration of actual processing for process A and the duration of clean-room operation (a sum of transport time, batch matching time, waiting time for the operator and apparatus, and maintenance time), and multiplying the sum by a factor of safety. Therefore, the amount of charge to be supplied by the powering station disposed in front of the apparatus for process A is computed by obtaining a product of the battery driving time and the power

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consumption (different depending on the process recipe for the drive parts) and subtracting the residual battery power. Here, the method of charging includes coupling through plus/minus terminal connections provided on the charging apparatus, non-contact method based on excitation of charging current in the coil of an object for power input, or charging double layer electrical condenser. Also, charging/powering may be carried out from the rail of the transport apparatus (AGV or OHT, for example).

[0232] Most of the conventional substrate transport pods having no air cleaning capabilities are almost always based on one-to-one correspondence of substrate lot and pod, and are used for transport of substrates through all the processes. It is thought that this method is chosen because the substrates are subjected to hundreds of processes starting from the bare stage to the product stage, so that it is considered necessary to leave processing history management information for each substrate lot as bar codes or memory information on the pod-side. Also, because the required processing duration is different for each process, there is a high probability that the pods tend to accumulate at particular processes. However, according to the present method based on using the pod specialized for transporting between particular processes only, conventional process management methodology cannot be used as it is. Therefore, by transferring the processing history management information for each lot stored or transported from a pod used in a preceding process to a pod used in a succeeding process, processing history management information for each lot can be carried out as smoothly as in the conventional method of using the substrate transport pods based on the one-to-one method.

[0233] FIG. 101 shows a conceptual diagram for network management of substrate transport pods. The substrate transport pod 1 provided with data storage means and computation means mounted on the charging station 721 and receives charge, and at the same time, exchanges information with the data collection server (controller) 725 and the server 703 by way of the hub 723. Information is exchanged with the washing machine 708 in addition to each processing apparatus. The substrate transport pod provided with individual contaminants removal means have identifier ID (for example, reference item 558 in FIGS. 34A and 34B), and it is necessary to manage the following information.

① identifier ID
② processed amount of gaseous contaminants per unit time α
③ amount of contaminant gas emitted per unit time β obtained by a sensor
④ cumulative operation time γ of a drive part
⑤ operating condition δ of a drive part
⑥ residual battery voltage ε
⑦ required charged voltage ξ
⑧ malfunction information η on a drive part and
⑨ processing history management information θ of a lot

[0234] A computation process unit containing memory element that stores at least the nine such parameters is mounted on the pod, and this information is transmitted when it is seated on a powering station. Also, when the pod is not seated on a powering station, information can be managed through the pods network by exchanging radio signals directly with a data collection PC. Here, because it is presumed that the substrate transport pods are used for transporting between processes, so that, for each process, a given value is normally assigned to parameters such as ② processed amount of gaseous contaminants per unit time α, ⑤ operating condition δ of a drive part ⑦ required charged voltage ξ. And, the parameters ③ amount of contaminant gas emitted per unit time β obtained by a sensor, ④ cumulative operation time γ of a drive part. ⑥ residual battery voltage ε and ⑧ malfunction information η on a drive part vary chronologically according to individual pods. By reading the contents of individual data stored in the memory elements of individual substrate transport pods from the data collection PC, the states of individual pods can be confirmed remotely by using a network such as the LAN shown in FIG 101.

[0235] That is, it is possible to manage the need for filter change (=value of an interval $\alpha \times \gamma$ to $\beta \times \gamma$), for washing (= value of γ), or if there is malfunction of pod (= value of η), to enable to prevent yield drop caused by storing a substrate lot in a pod that does not have sufficient cleaning abilities. Also, when it is necessary to alter the information due to malfunction in the processing apparatus side or changes in the operation condition of a drive part, changes in ② processed amount of gaseous contaminants per unit time α, ⑤ operating condition δ of a drive part or ⑦ required charged voltage ξ can be entered remotely in the data memory means of the pod. This entry of information is possible at on-site clean-room by exchanging data directly between the data collection controller 725 and the substrate transport pod 1, and such a procedure can also be used for entering trial parameters and the like for development work.

[0236] Also, it is possible to send the information on individual pods 1 to the washing machines 708 through the network to select those pods that require washing. Also, those pods that require filter change can also be selected at the same time as washing these pods.

[0237] On the other hand, the parameter ⑨ processing history management information of a lot θ can be used to understand the process history of a lot, even when the pods do not relate, one-to-one, to the lots, by having the information transferred from a pod used in the preceding process to a pod to be used in the succeeding process. The

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information can be transferred through the powering station directly, without resorting to the data collection controller 725, and it is normally carried out automatically.

[0238] It should be noted that, although the embodiment of the present invention related primarily to the substrate transport pods having a door on the bottom section, but various aspects of the present invention are applicable also to FOUPs (front opening unified pods).

[0239] Also, in the above embodiments, examples related to substrate transport pods used in wiring process of semiconductor manufacturing, but the present invention is not limited to wiring processes, and is applicable to all processes of semiconductor manufacturing that require various environments customized to processing conditions. According to the present invention, a structure of a substrate transport pod is provided for use in manufacturing of semiconductor chips comprised by copper wiring of less than 0.18 μm line width and low dielectric insulation film of less than 3.0 dielectric constant, in which the substrates are stored in the pod in an environment that maintains at least one parameter of air quality, including the level of particles, humidity, the level of organic substances, and the level of ionic gaseous substances, below a constant value. Further, a method is provided for using the pods in an automated semiconductor manufacturing plant in a logical and efficient manner.

[0240] It should be noted that, although various structures and methods of operating the substrate transport pods are described, these are meant to be illustrative and not restrictive of the essence of the invention. That is, it is obvious that various variations of basic invention are possible by combining the elements described in the above embodiments, thereby enabling various variations within the scope of the present invention.

[0241] As explained above, the present invention is applicable to manufacturing of semiconductor devices based on highly conductive wiring, such as copper wiring, and insulation films having a low dielectric constant. Therefore, it is suitable for use in storing or transporting an object to be subjected to processing, such as semiconductor wafers.

Industrial Applicability

[0242] The present invention relates to the structures, capabilities and methods of operating a substrate transport pod suitable for storing or transporting objects such as semiconductor wafers, photo-masks or hard-disks in a highly clean environment, and relates in particular to a method of managing the operation of the substrate transport pod to be used in semiconductor manufacturing processes. Therefore, it is applicable to manufacturing of semiconductor devices based on highly conductive wiring, such as copper wiring, and insulation films having a low dielectric constant.

Claims

1. A method for transporting substrates between a plurality of processes, comprising:

   loading the substrates into a pod from an atmosphere of a first process;
   circulating a gaseous atmosphere through interior of the pod intermittently or continually in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, to expose the substrates to a controlled atmosphere while the substrates are retained in the pod; and
   unloading the substrate from the pod to introduce into a second process.

2. A method according to claim 1, wherein an atmosphere in the first process is different than an atmosphere in the second process.

3. A method according to claim 1, wherein a gas circulated in the pod contains no particles of larger than 0.1 μm in excess of 10 particles/m^3, or organic substances in excess of 1 μg/m^3.

4. A method according to claim 1, wherein a gas in the pod is circulated and/or controlled in any selective pattern or atmosphere.

5. A method according to claim 4, wherein an interior environment of the gaseous atmosphere is controlled in any selective pattern by operating a circulation apparatus and/or dehumidifying apparatus.

6. A method according to claim 1, wherein an interior environment of the pod is controlled in any selective pattern according to information on an atmosphere used in the first process.

7. A method according to claim 1, wherein a pod having most suitable function is selected for use according to an information on an atmosphere of the first process.

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8. A substrate transport apparatus comprising a substrate transport pod that can be sealed hermetically for holding substrates therein, said substrate transport pod comprising:

at least one filter for purifying the gas, including a filter for removing particular substances, a filter for removing chemical substances or a dehumidifying apparatus for removing moisture;
a circulation apparatus for circulating a purified gas; and
a holding apparatus for holding the substrates so as to match the state of the substrates by exposing the substrates to the purified gas.

9. An apparatus according to claim 8, wherein the pod is provided with a gas sensor for detecting a processing gas.

10. An apparatus according to claim 9, wherein the circulation apparatus is controlled according to information provided by the gas sensor.

11. A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body, which is formed primarily of a material having moisture absorption coefficient of not more than 0.1 %, wherein the pod main body is in contact with the substrates directly or indirectly and has a conductive part so as to enable static charges to be drained from the pod main body.

12. A substrate transport pod according to claim 11, wherein a flow guiding structure is provided in interior of the pod main body for guiding a flow of a gas to the substrates.

13. A substrate transport pod according to claim 11, wherein a sensor is provided for detecting whether the door is opened or closed.

14. A substrate transport pod according to claim 11, wherein a sensor is provided for detecting presence of the substrates.

15. A substrate transport pod according to claim 13, wherein the gas circulation means for circulating a gas through the pod is provided, and stopped when the door is in the closed state.

16. A substrate transport pod according to claim 14, wherein the gas circulation means is provided, and operated only when it is detected that the door is closed and the pod contains the substrates.

17. A substrate transport pod according to claim 11, wherein the pod is provided with a gas circulation means in its interior space for circulating an internal gas.

18. A substrate transport pod according to claim 11, wherein the pod is provided with a humidifying means in its interior space for removing moisture from an internal gas.

19. A substrate transport pod according to claim 11, wherein the pod is provided with powering means for supplying electrical power.

20. A substrate transport pod according to claim 19, wherein the powering means comprises secondary batteries installed on the pod.

21. A substrate transport pod according to claim 20, wherein a powering means is further provided for charging the secondary batteries.

22. A substrate transport pod according to claim 19, wherein the powering means is constructed to be non-contacting and is operated electromagnetically.

23. A substrate transport pod according to claim 19, wherein the powering means is constructed to be contacting through point contacts.

24. A substrate transport pod according to claim 19, wherein the powering means is provided at least on a load port

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of a manufacturing apparatus, in a storage facility or on a transport apparatus.

25. A substrate transport pod according to claim 19, wherein powering is started as the pod is seated in the powering means.

26. A substrate transport pod according to claim 11, wherein the pod is provided with a circulation apparatus for circulating a gas inside the pod and at least one of a particle filter, a chemical filter and a dehumidifying apparatus.

27. A substrate transport pod according to claim 26, wherein a filter and a gas circulation means are formed as a unit in a form of a rod.

28. A substrate transport pod according to claim 26, wherein a filter is cylinder shaped and the gas flows in a radial direction of the cylindrical filter.

29. A substrate transport pod according to claim 26, wherein a filter is rod shaped and the gas flows in a longitudinal direction of the rod filter.

30. A substrate transport pod according to claim 26, wherein a ducting and/or a flow regulation apparatus is provided for guiding the gas.

31. A substrate transport pod according to claim 11, wherein the pod has a gas intake opening and a gas discharge opening for the gas circulated inside the pod.

32. A substrate transport pod according to claim 31, wherein a reverse flow prevention mechanism is provided at least on the gas intake opening or the gas discharge opening.

33. A substrate transport pod according to claim 31, wherein a ducting and/or a flow regulation apparatus is provided to connect to the gas intake opening.

34. A substrate transport pod according to claim 31, wherein a chemical filter, and a particle filter and/or a dehumidifying apparatus is provided in the vicinity of the gas intake opening and/or a gas discharge opening.

35. A substrate transport pod according to claim 11, wherein a center of gravity of the pod is adjusted in a horizontal direction within a circle having a radius of at least 90 % or preferably 70 % of a radius of substrates.

36. A substrate transport pod according to claim 11, wherein the pod is provided with an internal environment matching a processing atmosphere for substrates contained in the pod, and is used to transport the substrates between a plurality of processes.

37. A substrate transport apparatus comprising: a substrate transport pod that can be sealed hermetically for holding substrates therein, said substrate transport pod comprising:

at least one of a particle filter, a chemical filter, and a dehumidifying apparatus for removing, respectively, particulate substances, chemical substances, and moisture from a gas circulated inside the pod;
a gas circulation apparatus for circulating a purified gas;
a holding apparatus for holding the substrates so as to keep the state of the substrates by exposing the substrates to the purified gas; and
an identifier for distinguishing individual pods, whose historical data is managed by a computing apparatus.

38. An apparatus according to claim 37, wherein the pod is provided with a data storing apparatus.

39. An apparatus according to claim 37, wherein the pod has a means for receiving external signals, and controls internal environment in the pod according to the external signals.

40. An apparatus according to claim 37, wherein an internal environment is controlled by sending and receiving information between the pod and a processing apparatus.

41. An apparatus according to claim 37, wherein the pod is provided with processing history management information

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on substrates, and processing of the substrates is managed by transferring the processing history management information from one pod to other pod.

42. An apparatus according to claim 41, wherein the processing history management is carried out by way of a host computer network.

43. An apparatus according to claim 41, wherein a processing history is transferred from one pod to other pod by a controller provided on a processing apparatus.

44. An apparatus according to claim 37, wherein a washing interval for a pod is managed by information stored in memory means of the pod.

45. An apparatus according to claim 37, wherein a filter change interval of a pod is computed from a product of a processed gas volume and a duration of pod operation.

46. An apparatus according to claim 37, wherein a washing interval is estimated from a duration of pod operation.

47. An apparatus according to claim 37, wherein residual power of the secondary batteries provided for the pod is measured, and charging is carried out to a necessary level of the power.

48. An apparatus according to claim 37, wherein management of information on individual pods is carried out by sending and receiving information for individual pods by wire or radio transmission through a network.

49. An apparatus according to claim 37, wherein processing history management information for a lot is transferred from a pod used in a preceding step to a pod to be used in a succeeding step.

50. An apparatus according to claim 37, wherein information on a pod to be washed is sent to a pod washing machine so that the pod can be selected and subjected to washing.

51. An apparatus according to claim 8, wherein a level of ammonia in an interior atmosphere of a pod is maintained below a given level when the pod contains substrates whose surfaces are resist-coated.

52. An apparatus according to claim 51, wherein an ammonia level in interior of the pod is controlled by adsorbing ammonia gas by means of a chemical filter.

53. An apparatus according to claim 51, wherein a humidity level in interior of the pod is controlled by removing moisture using a dehumidifying apparatus provided for the pod.

54. An apparatus according to claim 8, wherein the pod is provided with a contaminant removal means and target components are selectively chosen for removing particulate contaminants, metallic contaminants, ionic contaminants, organic contaminants and moisture, and the pod is used for return transport for each process.

55. A method for manufacturing a semiconductor device by transporting substrates between a plurality of processes, comprising:

loading the substrates into a pod from an atmosphere of a first process;
circulating a gaseous atmosphere through interior of the pod in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, to expose the substrates to a controlled atmosphere intermittently or continually while the substrates are retained in the pod; and
unloading the substrates from the pod and introducing the substrates into a second process.

Amended claims under Art. 19.1 PCT

1. (Amended) A method for transporting substrates between a plurality of processes, comprising:

loading the substrates into a pod from an atmosphere of a first process;
removing selectively at least one contaminant including moisture, particulate substances or chemical sub-

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stances intermittently or continually, to expose the substrates to a controlled atmosphere that organic substances be lower than 1 $\mu g/m^3$ and/or moisture be lower than $4x10^{-3}$ g/g while the substrates are retained in the pod; and
unloading the substrate from the pod to introduce into a second process.

2. (Cancelled)

3. (Amended) A method according to claim 1, wherein a gas circulated in the pod contains particles of larger than 0.1 μm lower than 10 particles/m^3.

4. (Cancelled)

5. (Amended) A method according to claim 1, wherein an interior environment of the gaseous atmosphere is controlled by operating a circulation apparatus and/or dehumidifying apparatus.

6. (Amended) A method according to claim 1, wherein an interior environment of the pod is controlled according to information on an atmosphere used in the first process.

7. A method according to claim 1, wherein a pod having most suitable function is selected for use according to an information on an atmosphere of the first process.

8. (Amended) A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body, which is formed primarily of a material having moisture absorption coefficient of less than 0.1 %, wherein the pod main body is in contact with the substrates directly or indirectly and has a conductive part so as to enable static charges to be drained from the pod main body.

9. (Amended) A substrate transport pod according to claim 8, wherein the pod is provided with a sensor for detecting a gas or for detecting a moisture.

10. (Amended) A substrate transport pod according to claim 9, wherein a circulation apparatus and/or a dehumidifying apparatus is provided, which is controlled according to an information by the sensor.

11. (Amended) A substrate transport pod according to claim 8, wherein the pod is provided with at least one of a filter for removing particulate substance, a filter for removing chemical substance and a dehumidifying apparatus.

12. (Amended) A substrate transport pod according to claim 11, wherein a sensor is provided for detecting whether the door is opened or closed.

13. (Amended) A substrate transport pod according to claim 11, wherein a sensor is provided for detecting presence of the substrates in the pod.

14. (Amended) A substrate transport pod according to claim 12, wherein the gas circulation apparatus and/or the dehumidifying apparatus is controlled to operate by detecting that the door is closed or opened.

15. (Amended) A substrate transport pod according to claim 13, wherein the gas circulation apparatus and/or dehumidifying apparatus is controlled to operate in accordance with detection signal of the sensor for detecting a presence of said substrates.

16. (Amended) A substrate transport pod according to claim 11, wherein the pod is provided with a gas circulation apparatus in its interior space for circulating an internal gas.

17. (Amended) A substrate transport pod according to claim 11, wherein the pod is provided with a dehumidifying means in its interior space for removing moisture from an internal gas.

18. (Amended) A substrate transport pod according to claim 16 or 17, wherein the pod is provided with powering means for supplying electrical power to the gas circulation apparatus or the dehumidifying means.

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19. (Amended) A substrate transport pod according to claim 18, wherein the powering means comprises secondary batteries installed on the pod.

20. (Amended) A substrate transport pod according to claim 19, wherein the powering means is further provided for charging the secondary batteries.

21. (Amended) A substrate transport pod according to claim 18, wherein the powering means is constructed to be non-contacting and is operated electromagnetically.

22. (Amended) A substrate transport pod according to claim 18, wherein the powering means is constructed to be contacting through contacts.

23. (Amended) A substrate transport pod according to claim 18, wherein the powering means is provided at least on a load port of a manufacturing apparatus, in a storage facility or on a transport apparatus.

24. (Amended) A substrate transport pod according to claim 18, wherein powering is started as the pod is seated in the powering means.

25. (Amended) A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body;
a conductive part for contacting with the substrates directly or indirectly so as to enable static charges to be drained outside from the pod main body;
at least one of a particle filter, a chemical filter, and a dehumidifying apparatus for removing particulate substances, chemical substances, and moisture; and
a gas circulation apparatus for circulating an inner gas inside the pod.

26. (Amended) A substrate transport pod according to claim 25, wherein the filter and the gas circulation apparatus are formed as a unit in a form of a rod.

27. (Amended) A substrate transport pod according to claim 25, wherein a filter is cylinder shaped and the gas flows in a radial direction of the cylindrical filter.

28. (Amended) A substrate transport pod according to claim 25, wherein a filter is rod shaped and the gas flows in a longitudinal direction of the filter.

29. (Amended) A substrate transport pod according to any one of claims 26 through 28, wherein a ducting and/or a flow regulation apparatus is provided for guiding the gas, which is passed through the filter.

30. (Amended) A substance transport pod according to claim 16, wherein a flow regulation structure is provided for guiding the gas flow to the substrates.

31. (Amended) A substrate transport pod according to claim 8, wherein the pod has a gas intake opening and a gas discharge opening for the gas flowing inside the pod.

32. A substrate transport pod according to claim 31, wherein a reverse flow prevention mechanism is provided at least on the gas intake opening or the gas discharge opening.

33. A substrate transport pod according to claim 31, wherein a ducting and/or a flow regulation apparatus is provided to connect to the gas intake opening.

34. (Amended) A substrate transport pod according to claim 31, wherein at least one of a chemical filter, a particle filter and a dehumidifying apparatus is provided in a vicinity of the gas intake opening and/or a gas discharge opening.

35. A substrate transport pod according to claim 11, wherein a center of gravity of the pod is adjusted in a horizontal direction within a circle having a radius of at least 90 % or preferably 70 % of a radius of substrates.

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36. A substrate transport pod according to claim 11, wherein the pod is provided with an internal environment matching a processing atmosphere for substrates contained in the pod, and is used to transport the substrates between a plurality of processes.

37. (Amended) A substrate transport apparatus comprising:

a substrate transport pod that can be sealed hermetically for holding substrates therein, which are taken out from a processing apparatus;
at least one of a particle filter, a chemical filter, and a dehumidifying apparatus for removing, respectively, particulate substances, chemical substances, and moisture from a gas circulated inside the pod;
a gas circulation apparatus for circulating a purified gas or purge means;
a holding apparatus for holding the substrates;
data storing means for controlling an operation of the dehumidifying apparatus and the circulation apparatus; and
a power supply for driving the dehumidifying apparatus and/or the circulation apparatus and the data storing means.

38. (Amended) An apparatus according to claim 37, further comprising:

an identifier ID for distinguishing individual pods; and
means for sending and receiving control information with outside data storing means.

39. (Amended) An apparatus according to claim 38, wherein a change of control information for electrical driving portion is conducted by communication with outside data storing means by signal input/output portion.

40. (Amended) An apparatus according to claim 38, wherein a change of processing history management information is conducted by signal input/output portion by sending and receiving information with outside data storing means.

41. (Amended) An apparatus according to claim 38, wherein a change of lot history information is conducted by signal input/output portion by sending and receiving information with outside data storing means.

42. (Amended) An apparatus according to claim 37, wherein a washing interval for the pod is managed by information stored in memory means of the pod.

43. (Amended) An apparatus according to claim 38, wherein a washing interval, a filter change interval, or information of secondary battery is managed by signal input/output portion by sending and receiving information with outside data storing means.

44. (Amended) An apparatus according to claim 37, wherein a washing interval of the pod is managed by an information stored in data memory means of the pod.

45. (Amended) An apparatus according to claim 42, wherein a filter change interval of the pod is managed from a product of a processed gas volume and an operation time of the circulation apparatus or the dehumidifying apparatus.

46. (Amended) An apparatus according to claim 44, wherein a washing interval is estimated from an operation time of the circulation apparatus.

47. An apparatus according to claim 37, wherein residual power of the secondary batteries provided for the pod is measured, and charging is carried out to a necessary level of the power.

48. (Amended) An apparatus according to claim 38, wherein management of information on individual pods is carried out by sending and receiving information for individual pods by wire or radio transmission through a network.

49. (Amended) A substrate transport pod for containing, storing or transporting substrates, comprising:

a pod main body and a door for hermetic sealing of the pod main body; and

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a moisture aversion part including at least one of filter, dehumidifying apparatus, and circulation apparatus, being detachable for washing.

50. (Amended) An apparatus according to claim 38, wherein information on the pod to be washed is sent to a pod washing machine so that the pod can be selected and subjected to washing.

51. (Amended) A method according to claim 1, wherein a level of ammonia in an interior atmosphere of the pod is maintained below a given level when the pod contains substrates whose surfaces are resist-coated.

52. (Amended) A method according to claim 51, wherein an ammonia level in interior of the pod is controlled by adsorbing ammonia gas by means of a chemical filter.

53. (Amended) A substrate transport pod according to claim 49, wherein the pod is washable by a pod washing machine after detaching the moisture aversion part and attaching a plate.

54. (Amended) A method according to claim 1, wherein the pod is provided with a contaminant removal means and target components are selectively chosen for removing particulate contaminants, metallic contaminants, ionic contaminants, organic contaminants and moisture, and the pod is used for return transport for each process.

55. A method for manufacturing a semiconductor device by transporting substrates between a plurality of processes, comprising:

loading the substrates into a pod from an atmosphere of a first process;
circulating a gaseous atmosphere through interior of the pod in such a way to selectively remove at least one contaminant including moisture, particulate substances or chemical substances, to expose the substrates to a controlled atmosphere intermittently or continually while the substrates are retained in the pod; and
unloading the substrates from the pod and introducing the substrates into a second process.

56. (Added) A method according to claim 1, wherein the pod is used in wiring process in which copper wiring and low dielectric insulation film are used.

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FIG. 1A

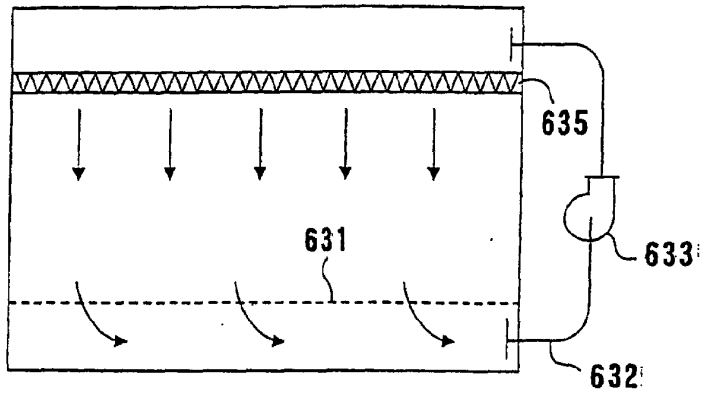


FIG. 1B

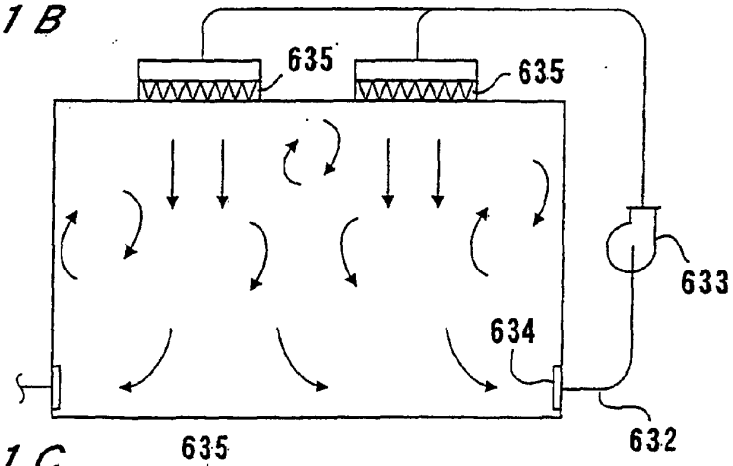
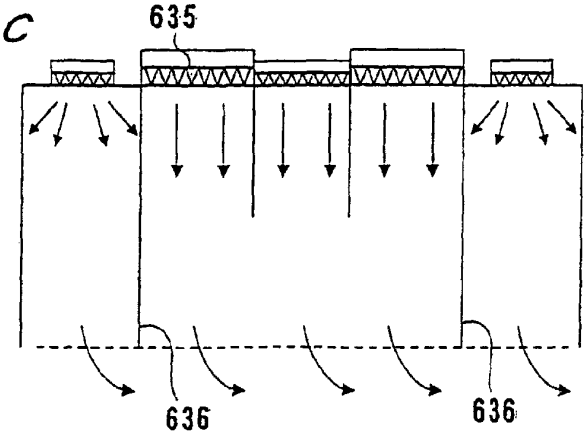
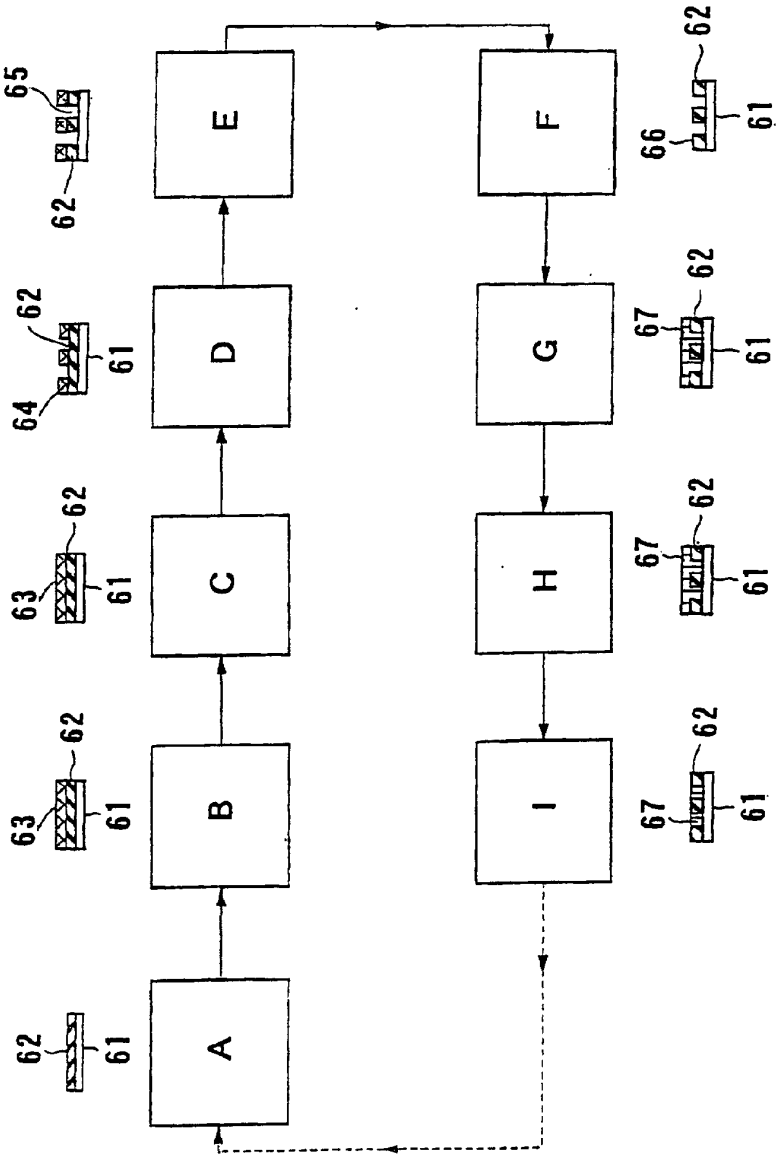


FIG. 1C



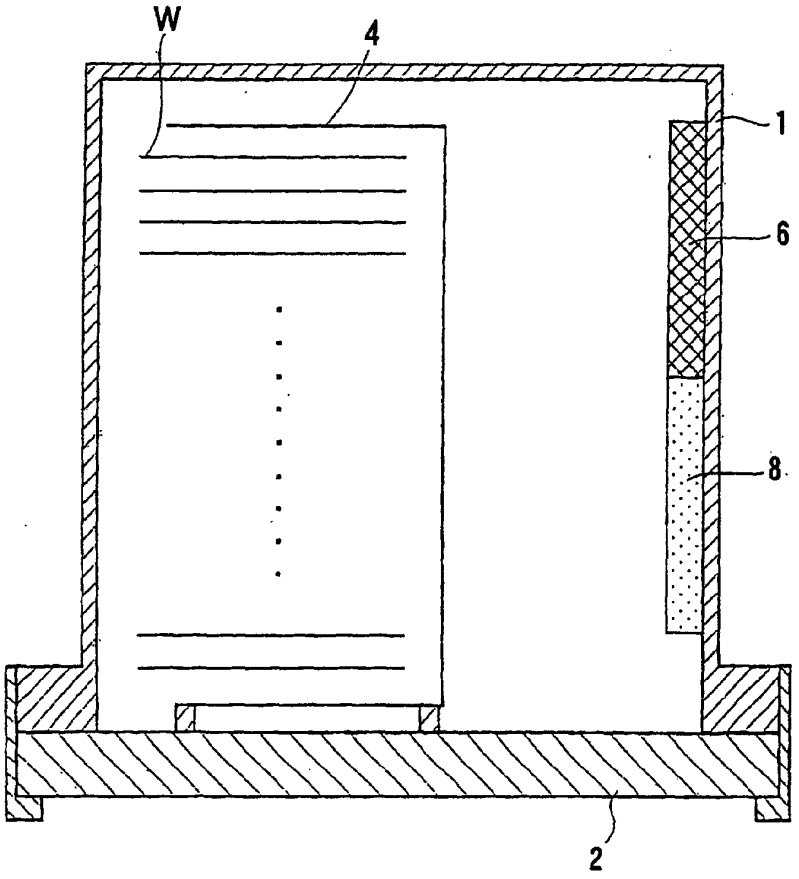
Entegris, EX1002, p. 749

FIG. 2



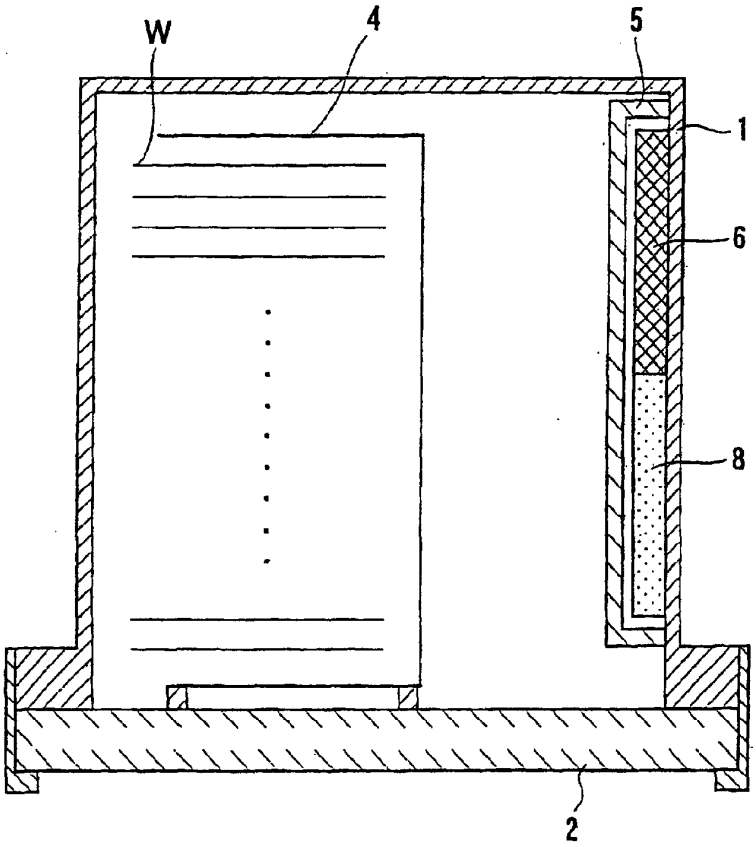
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FIG. 3



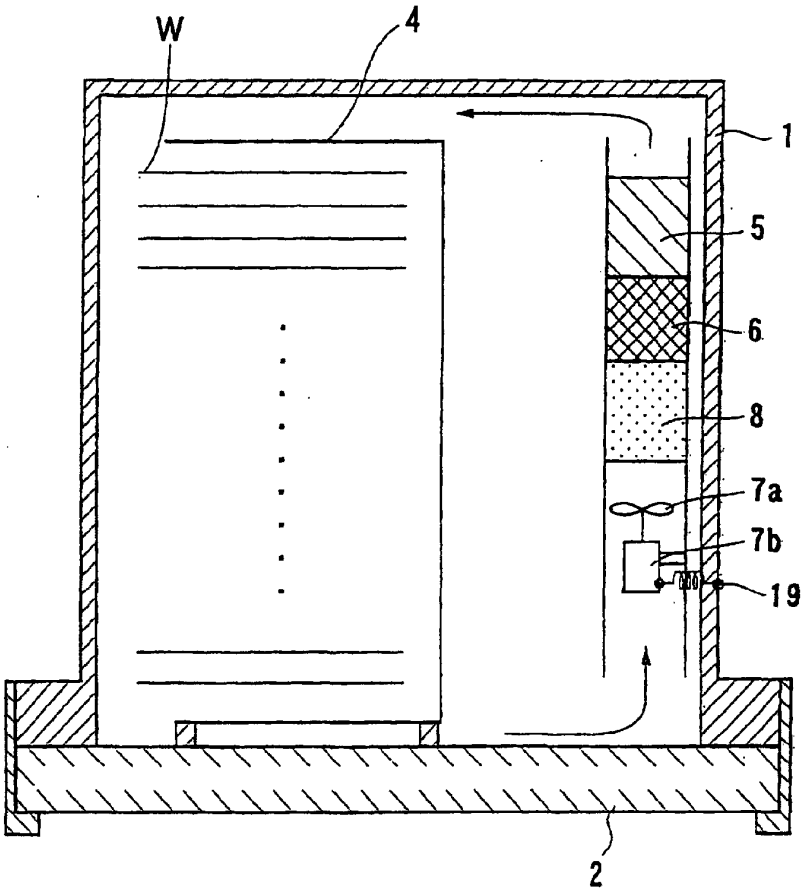
Entegris, EX1002, p. 751

FIG. 4



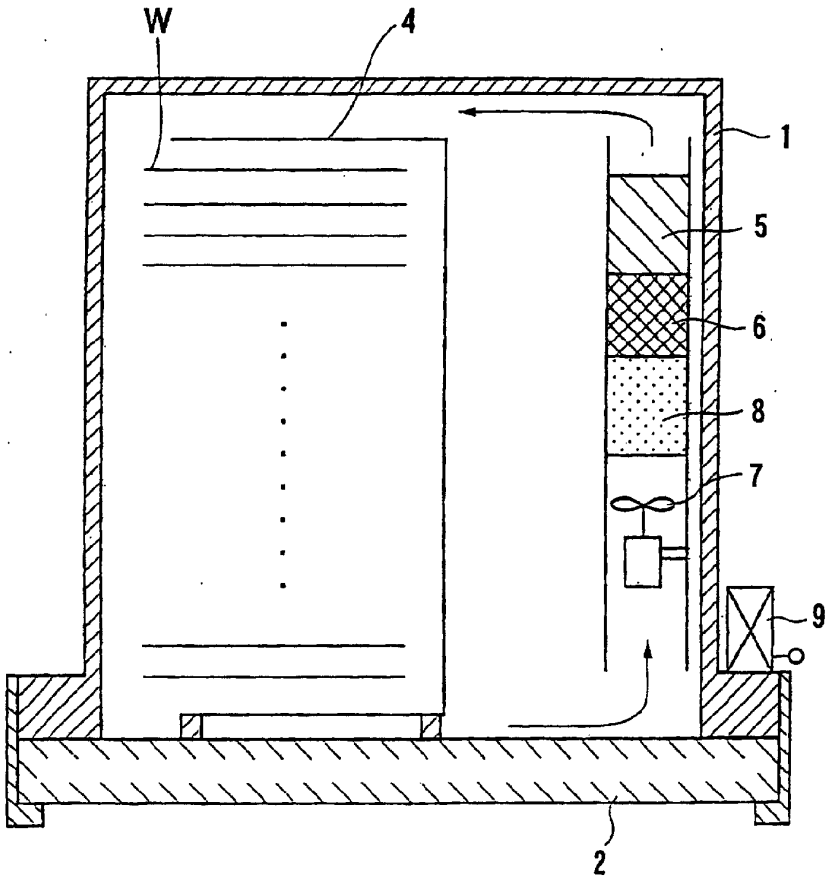
Entegris, EX1002, p. 752

FIG. 5



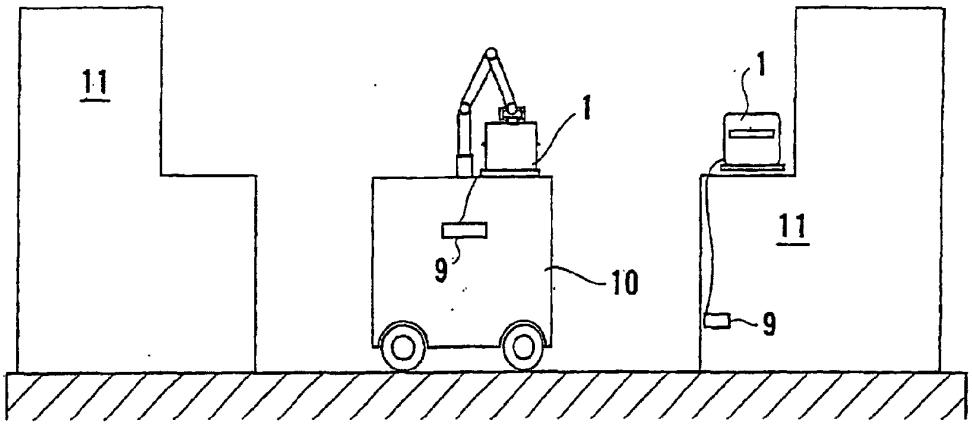
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FIG. 6



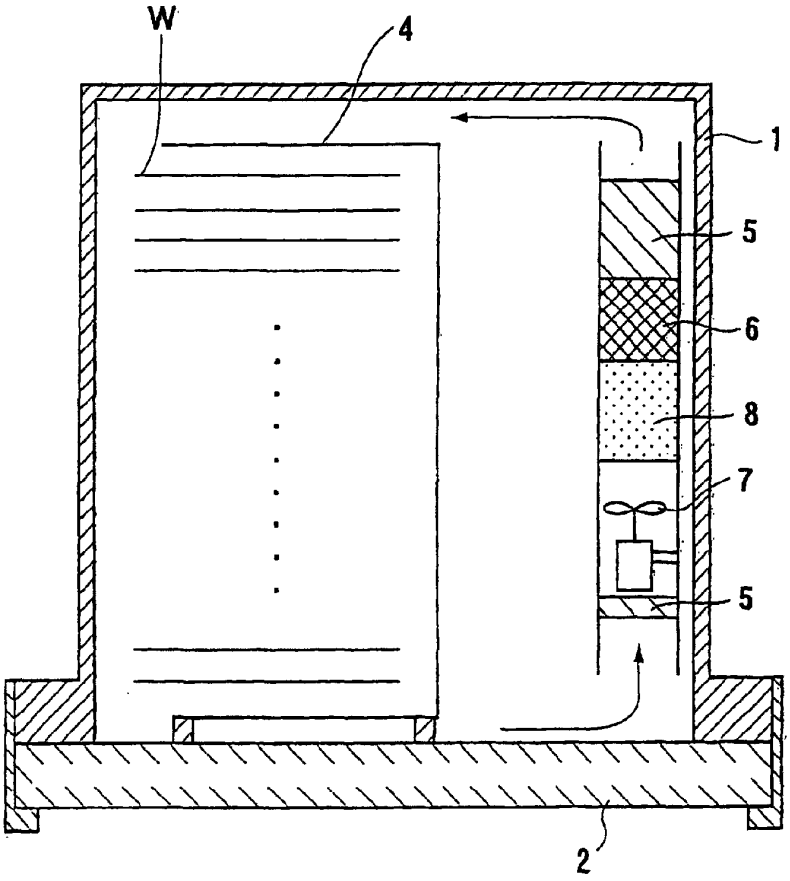
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FIG. 7



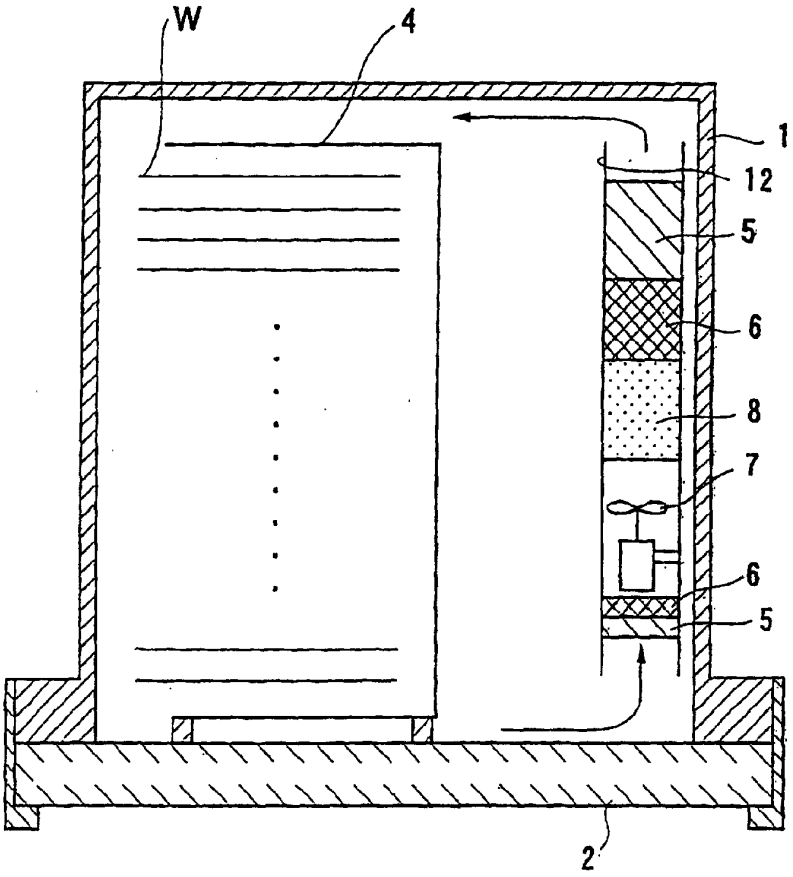
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FIG. 8



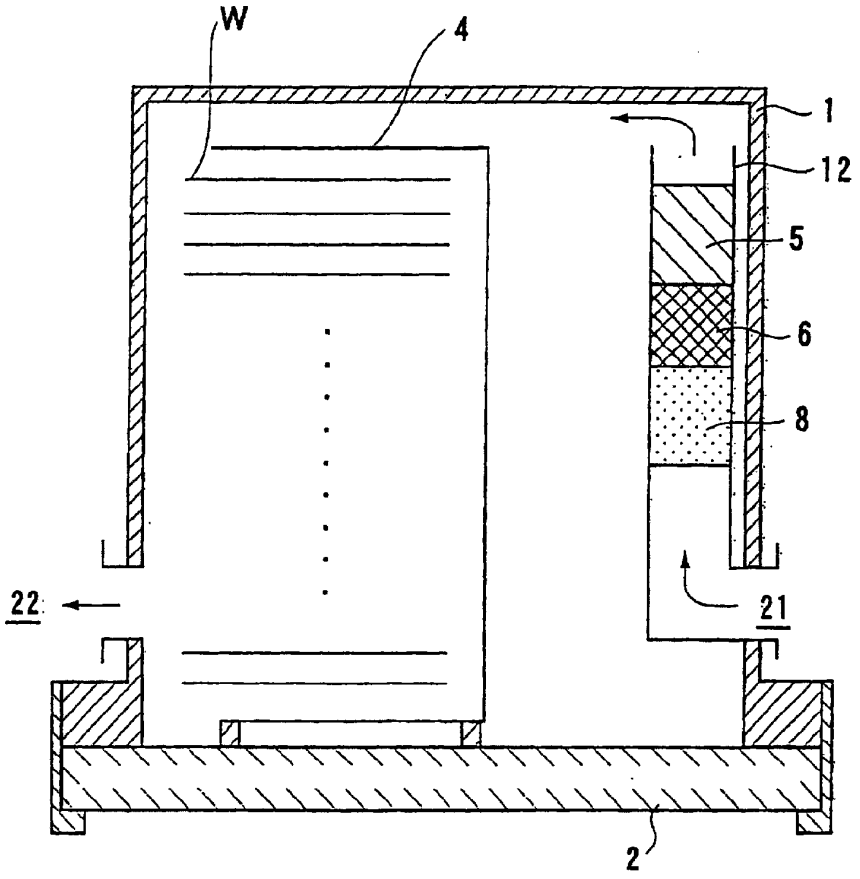
Entegris, EX1002, p. 756

FIG. 9



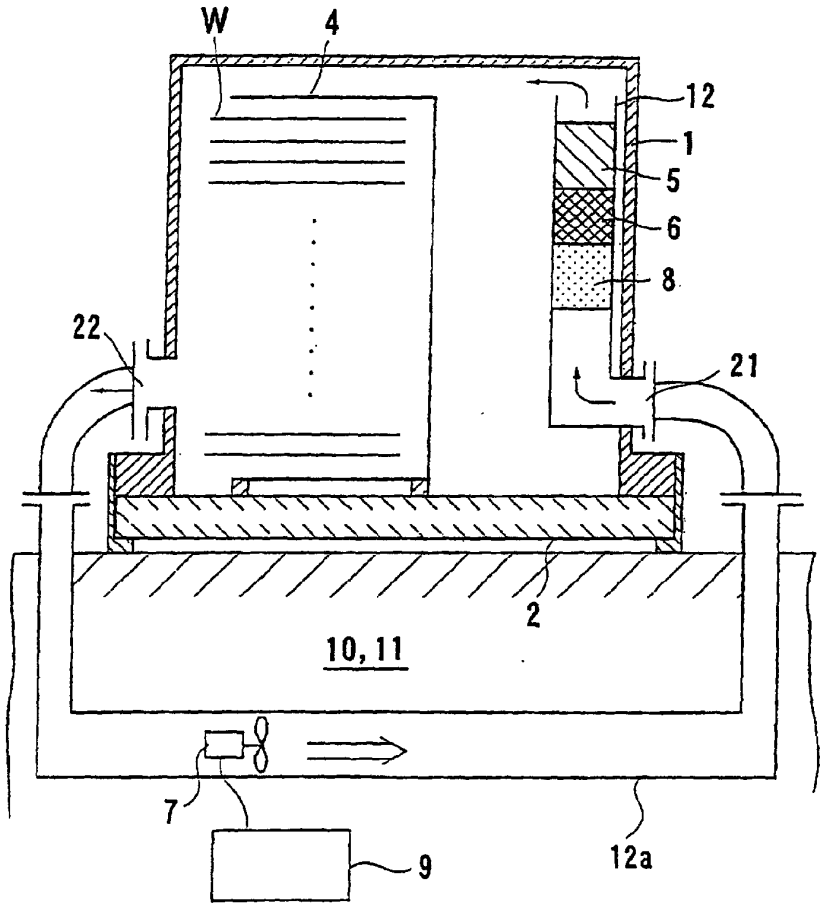
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FIG. 10



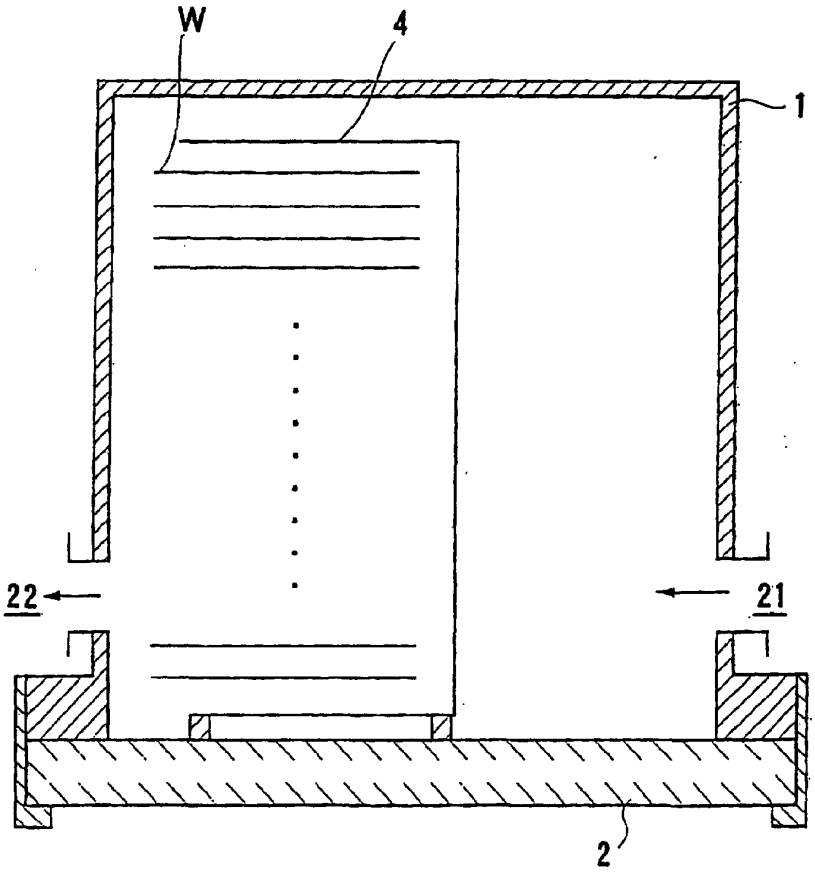
Entegris, EX1002, p. 758

FIG. 11



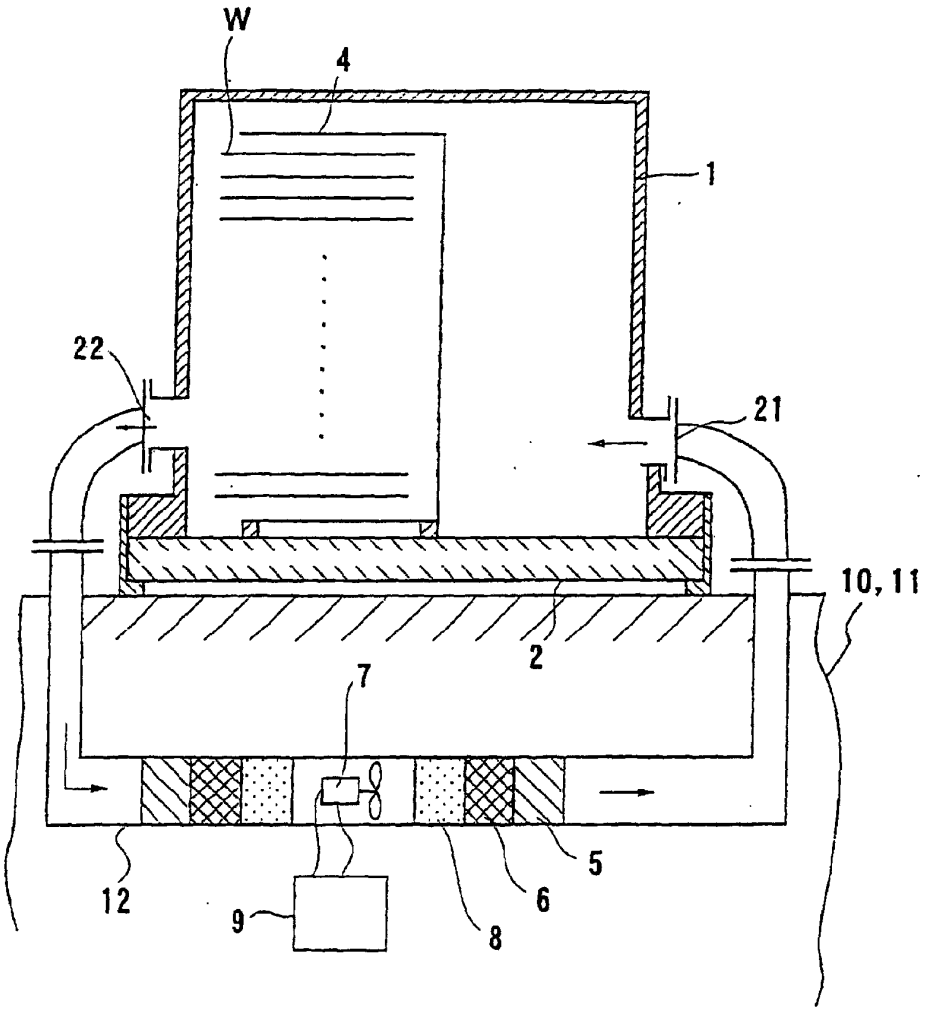
Entegris, EX1002, p. 759

FIG. 12



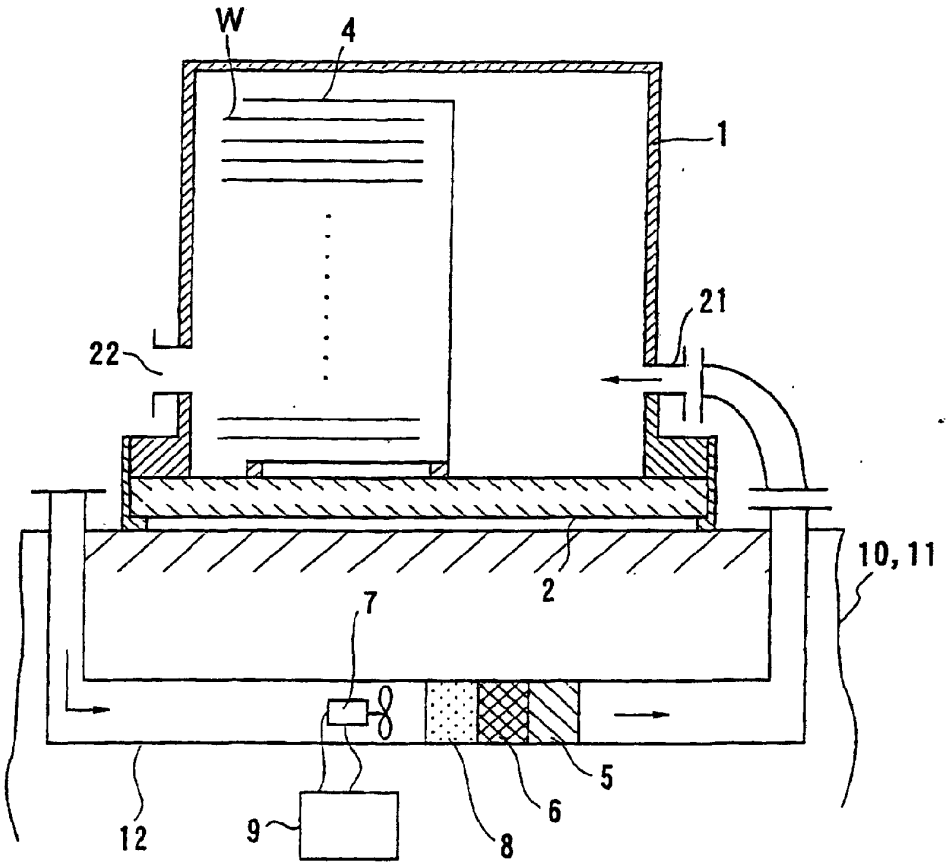
Entegris, EX1002, p. 760

FIG. 13



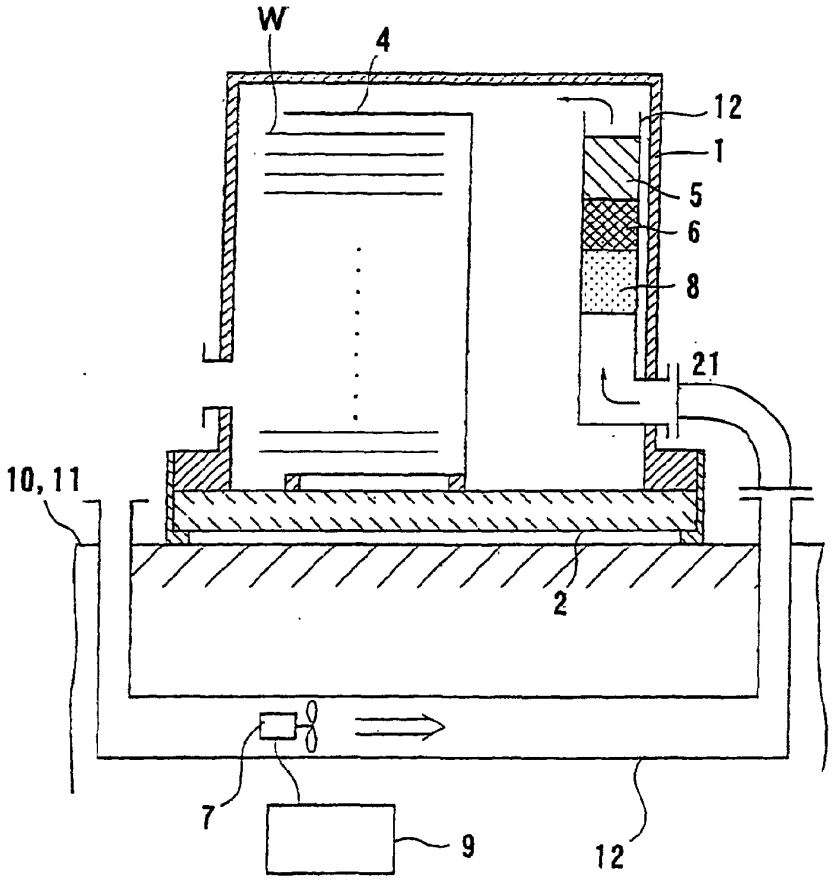
Entegris, EX1002, p. 761

FIG. 14



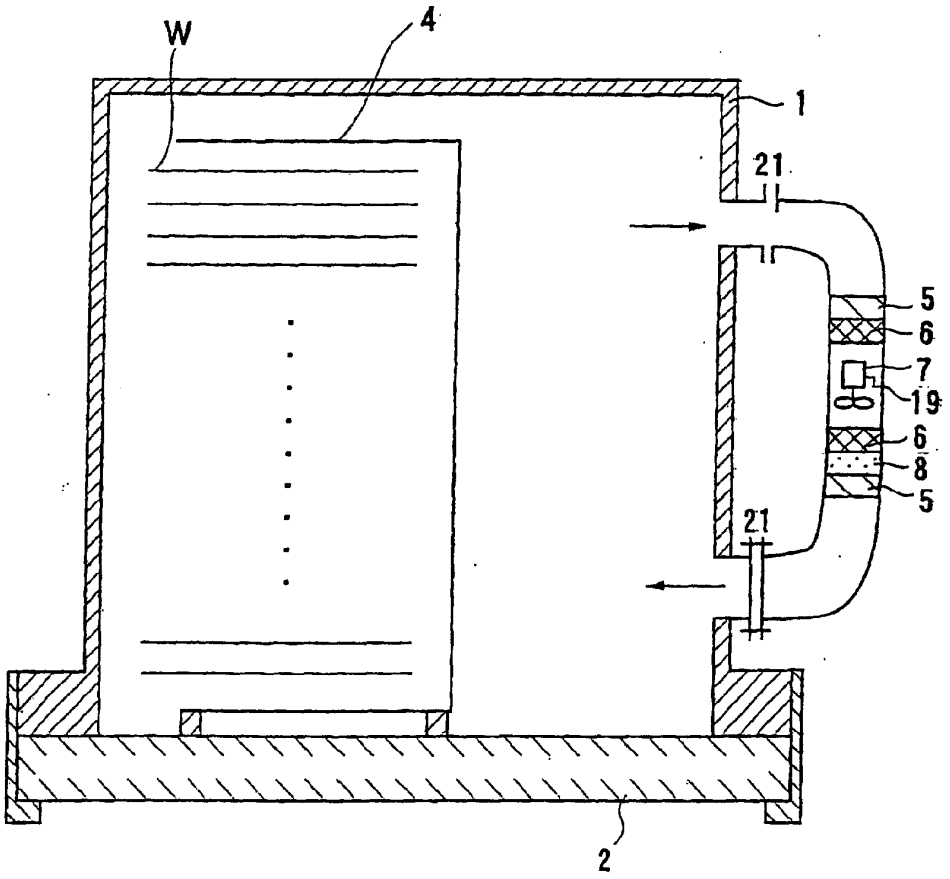
Entegris, EX1002, p. 762

FIG. 15



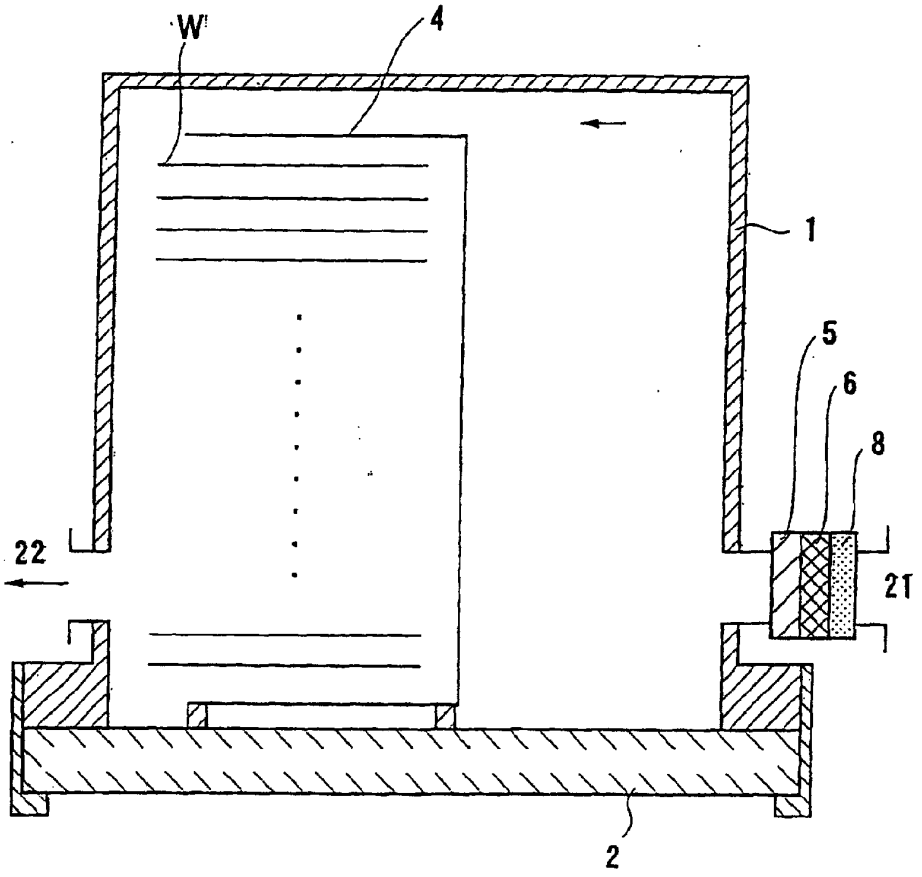
Entegris, EX1002, p. 763

FIG. 16



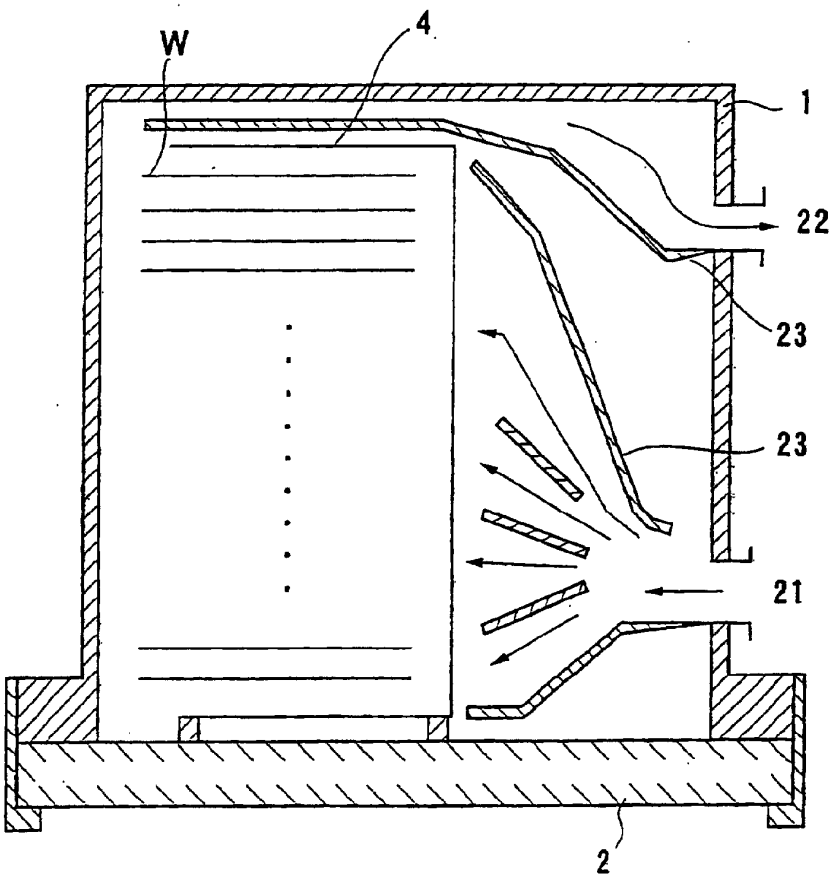
Entegris, EX1002, p. 764

FIG. 17



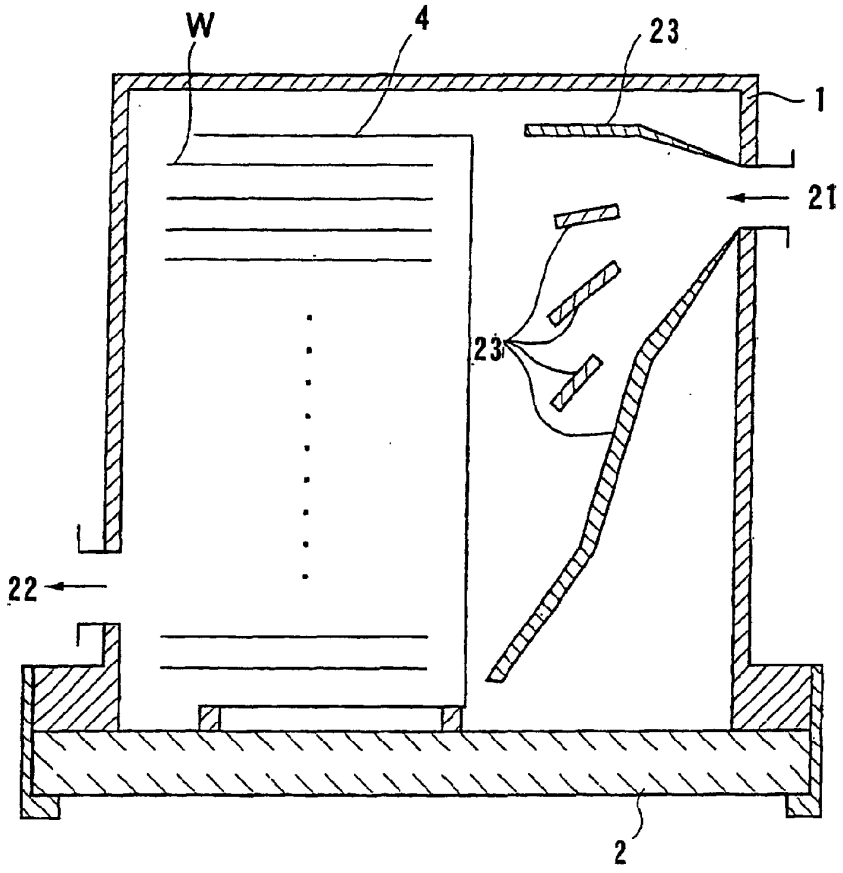
Entegris, EX1002, p. 765

FIG. 18



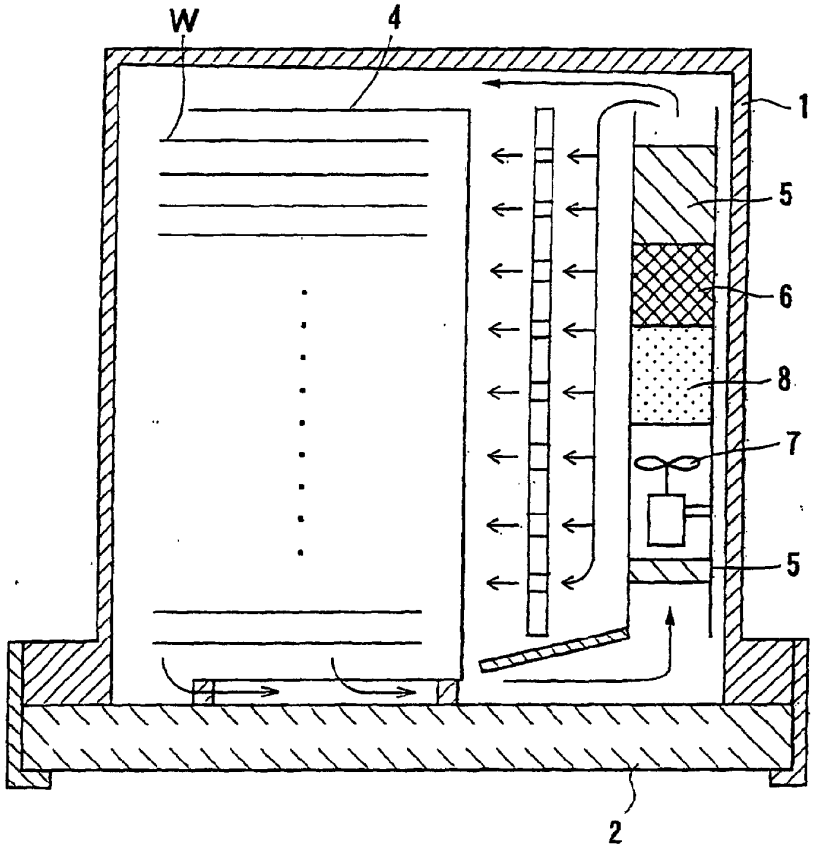
Entegris, EX1002, p. 766

FIG. 19



Entegris, EX1002, p. 767

FIG. 20



Entegris, EX1002, p. 768

FIG. 21A

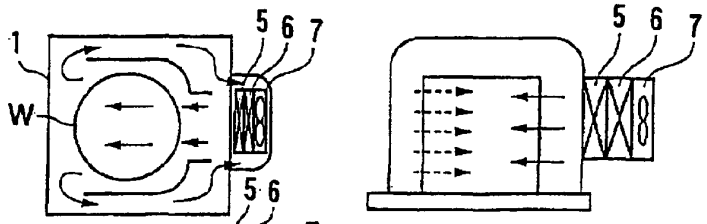


FIG. 21B

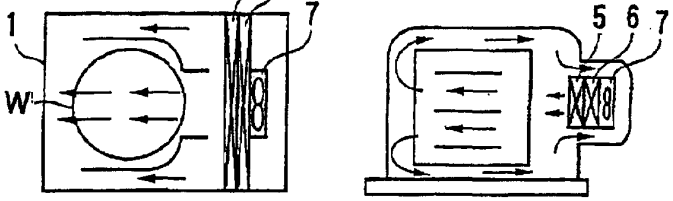


FIG. 21C

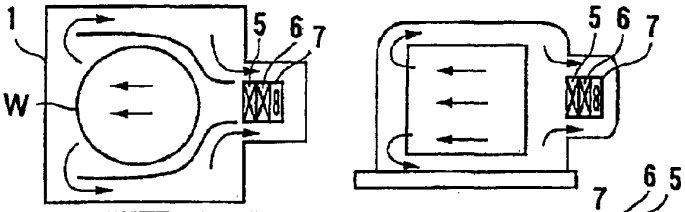


FIG. 21D

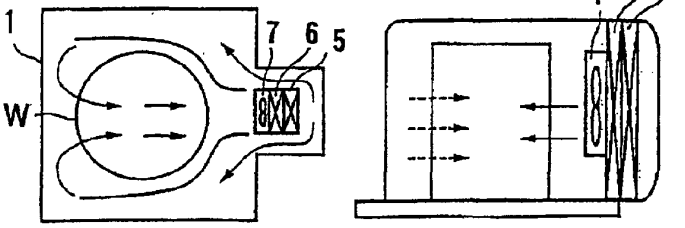


FIG. 21E

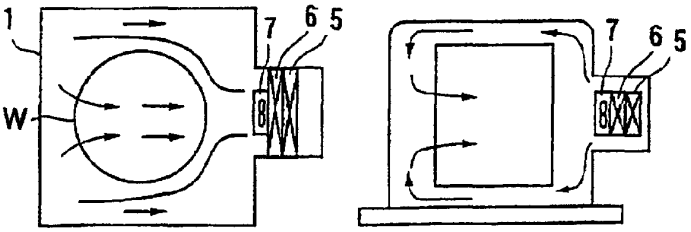
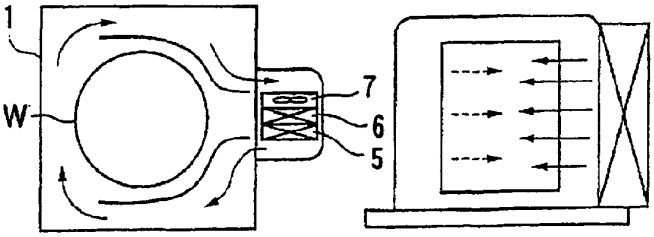
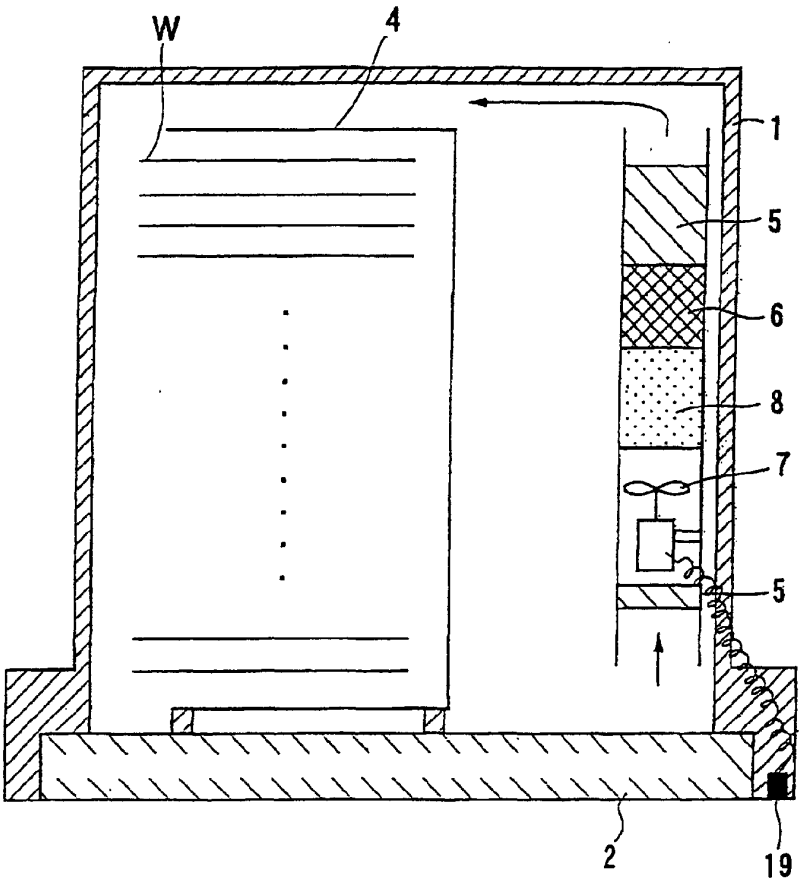


FIG. 21F



Entegris, EX1002, p. 769

FIG. 22



Entegris, EX1002, p. 770

FIG. 23A

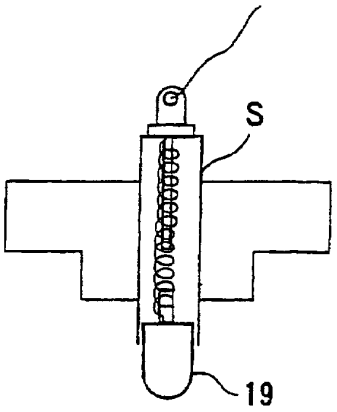
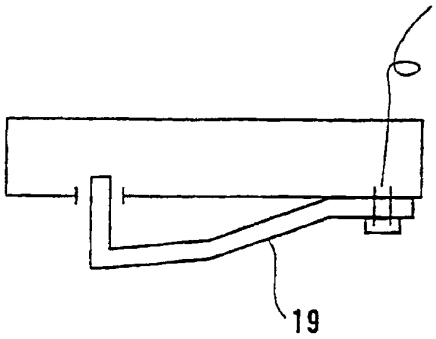
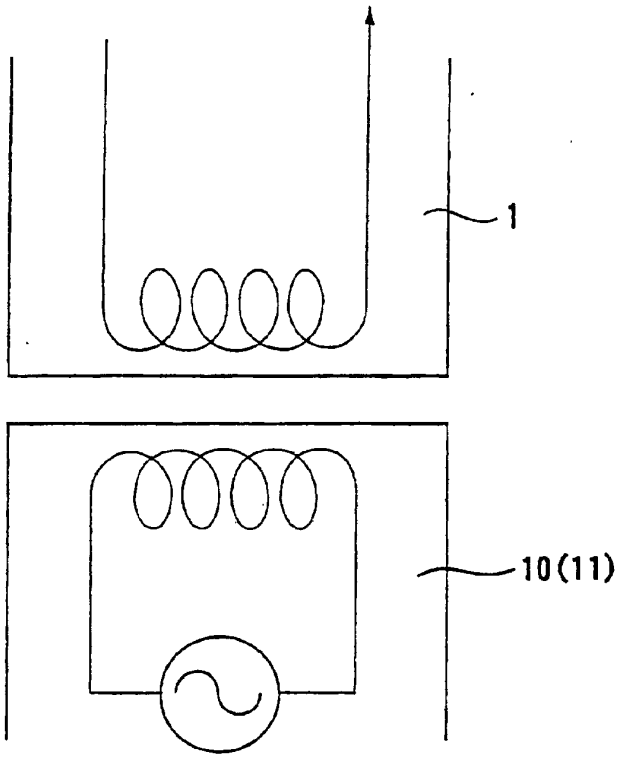


FIG. 23B



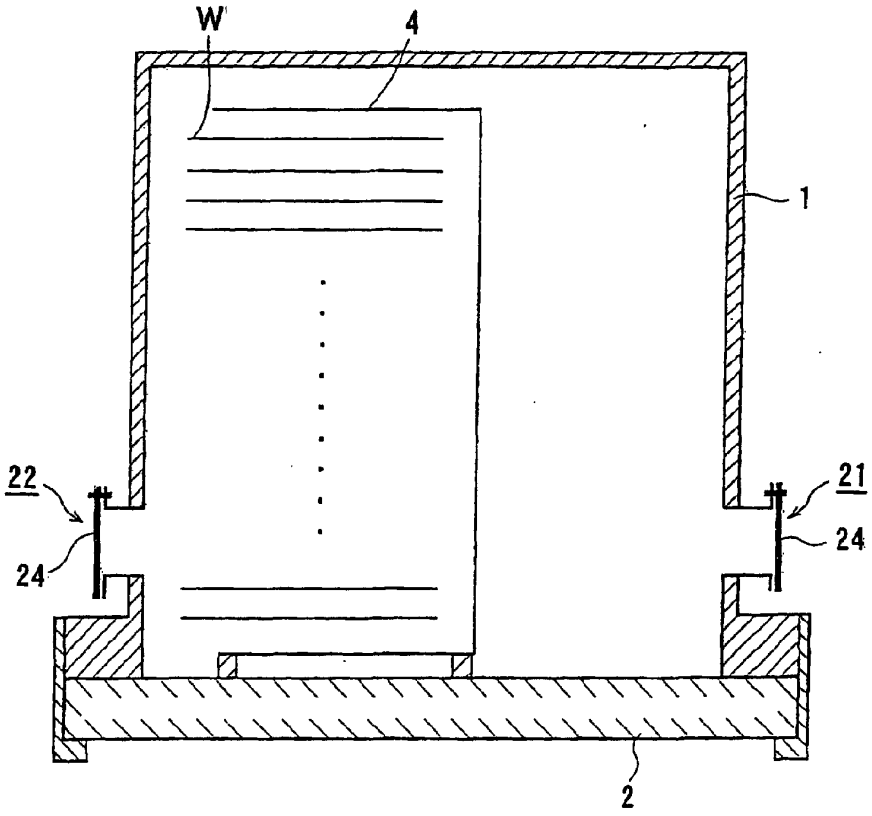
Entegris, EX1002, p. 771

FIG. 24



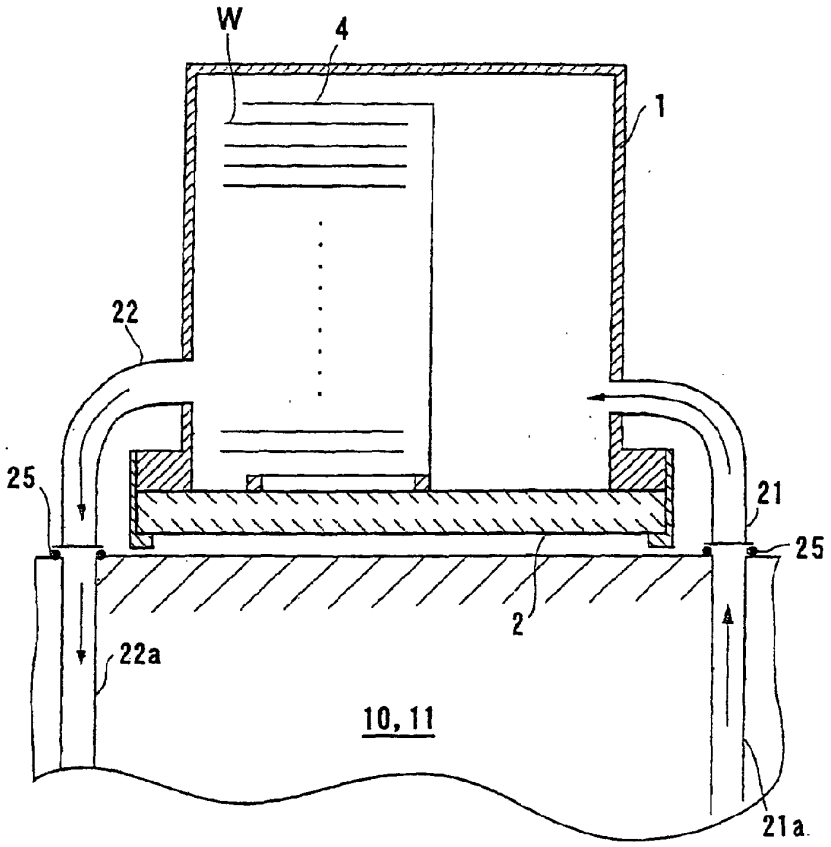
Entegris, EX1002, p. 772

FIG. 25



Entegris, EX1002, p. 773

FIG. 26



Entegris, EX1002, p. 774

FIG. 27A

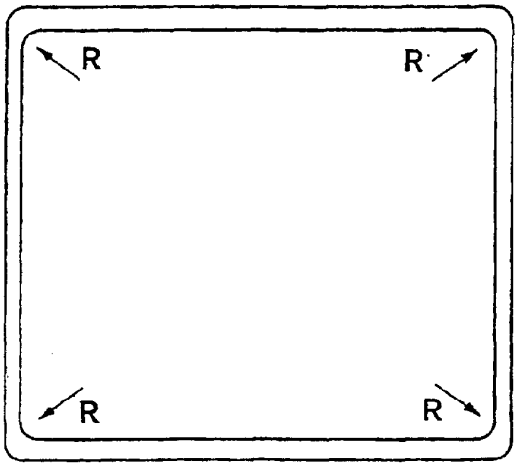
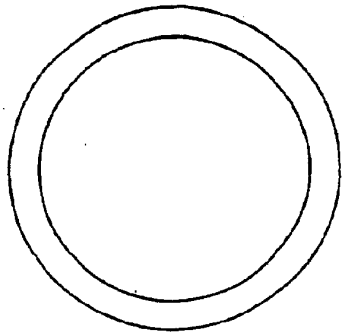
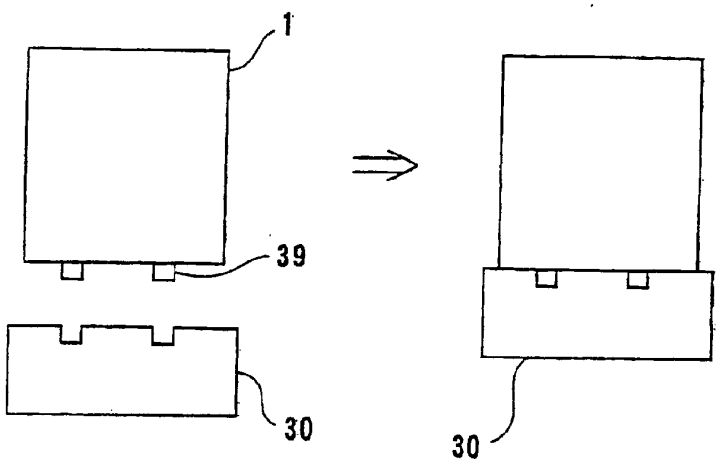


FIG. 27B



Entegris, EX1002, p. 775

FIG. 28



Entegris, EX1002, p. 776

FIG. 29A

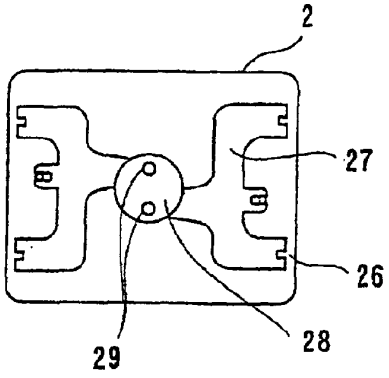


FIG. 29B

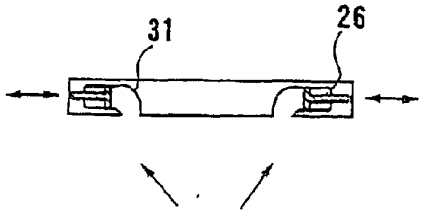


FIG. 29C

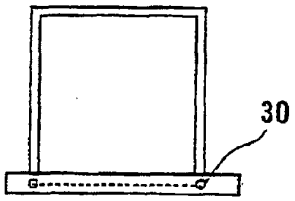


FIG. 29D

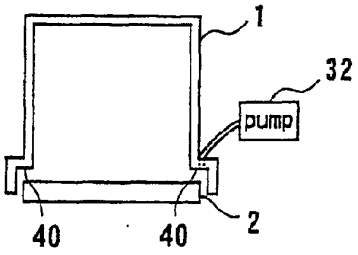


FIG. 29E

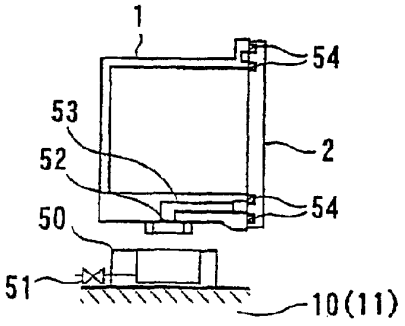
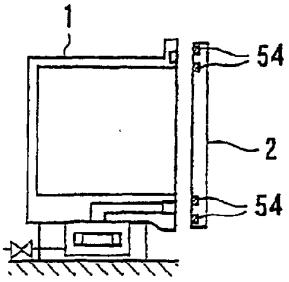
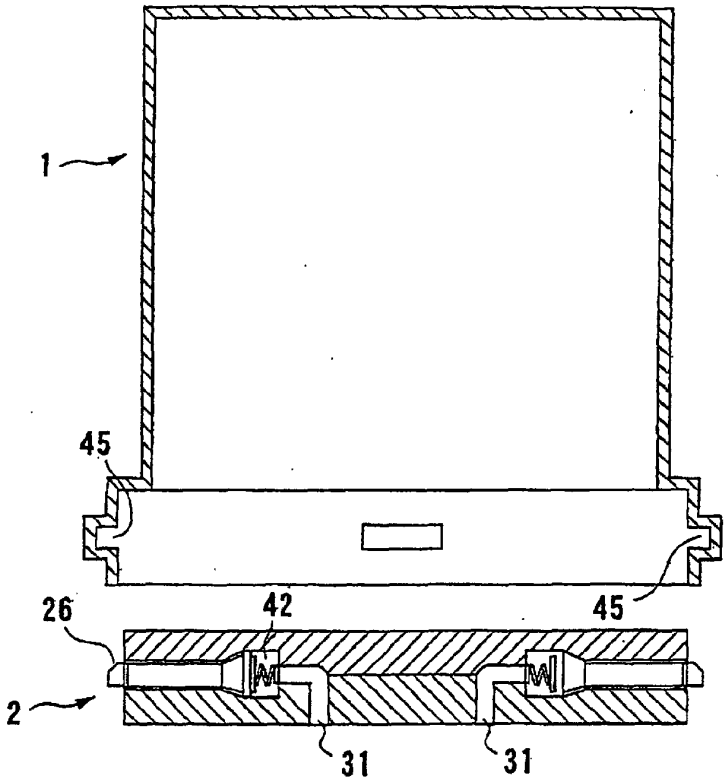


FIG. 29F



Entegris, EX1002, p. 777

FIG. 30



Entegris, EX1002, p. 778

FIG. 31A

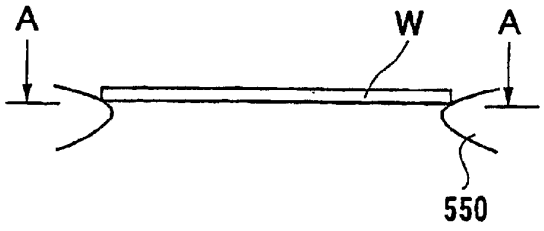
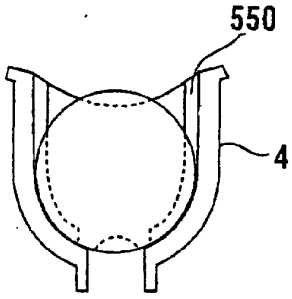


FIG. 31B



Entegris, EX1002, p. 779

FIG. 32A

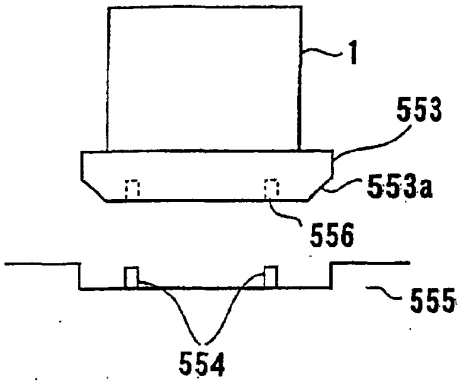


FIG. 32B

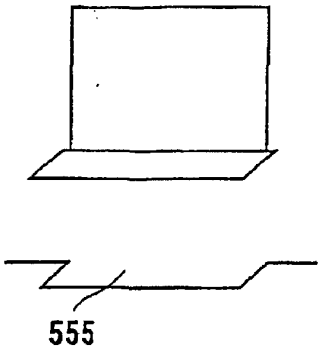
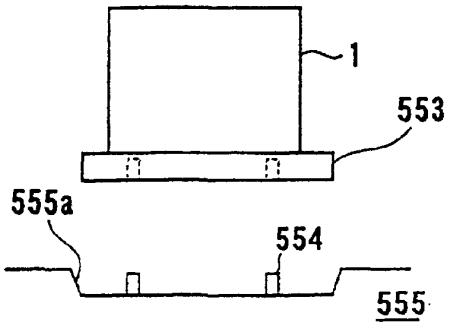


FIG. 32C



Entegris, EX1002, p. 780

FIG. 33A

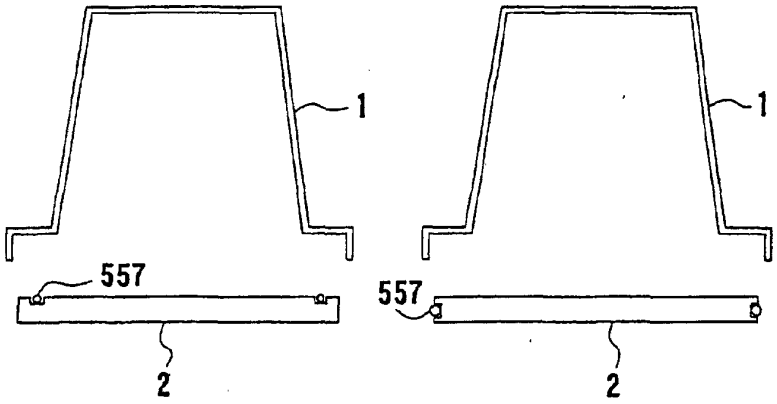
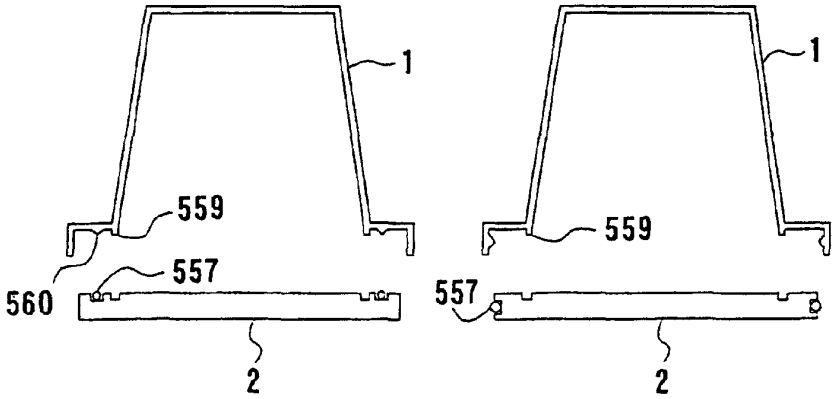


FIG. 33B



Entegris, EX1002, p. 781

FIG. 34A

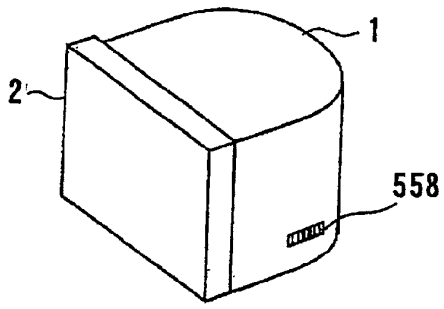
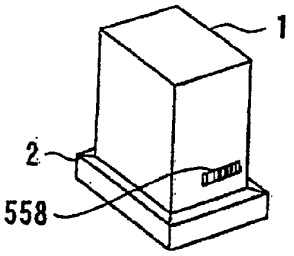


FIG. 34B



Entegris, EX1002, p. 782

FIG. 35A

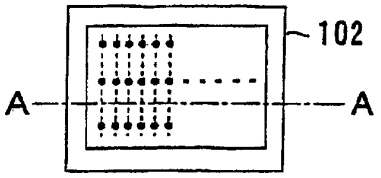


FIG. 35B

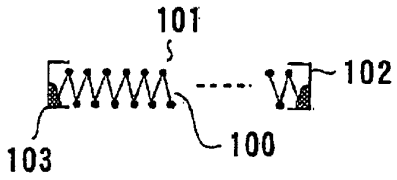


FIG. 35C



Entegris, EX1002, p. 783

FIG. 36A

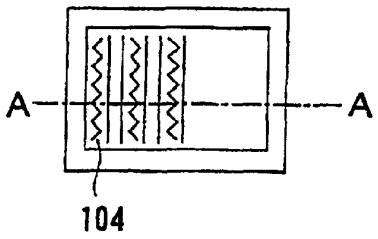


FIG. 36B

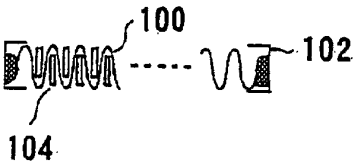
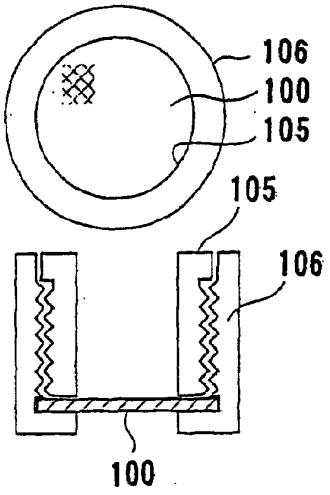


FIG. 36C



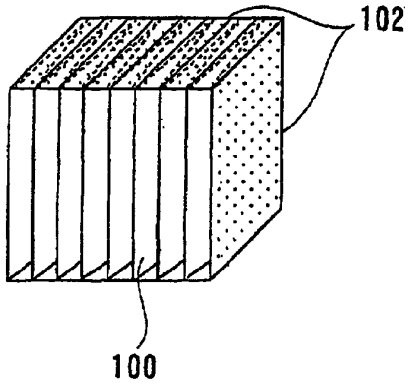
Entegris, EX1002, p. 784

FIG. 37



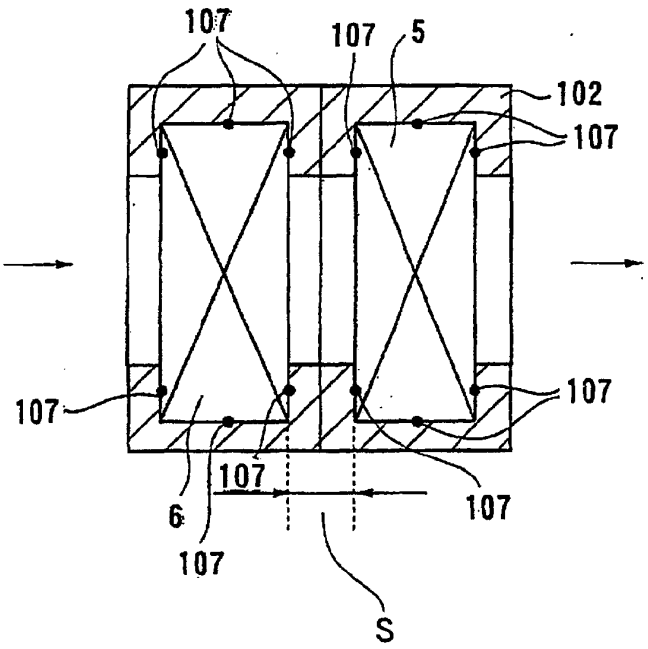
Entegris, EX1002, p. 785

FIG. 38



Entegris, EX1002, p. 786

FIG. 39



Entegris, EX1002, p. 787

FIG. 40A

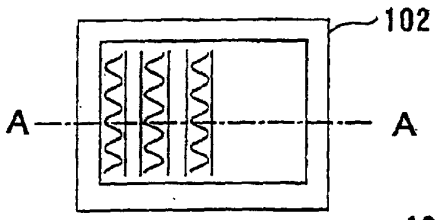


FIG. 40B

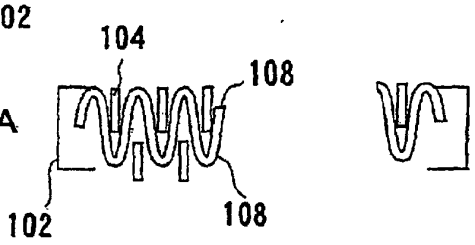
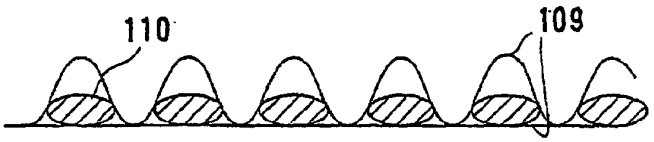


FIG. 40C



Entegris, EX1002, p. 788

FIG. 41



Entegris, EX1002, p. 789

FIG. 42A

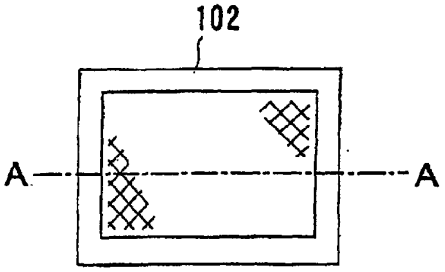


FIG. 42B

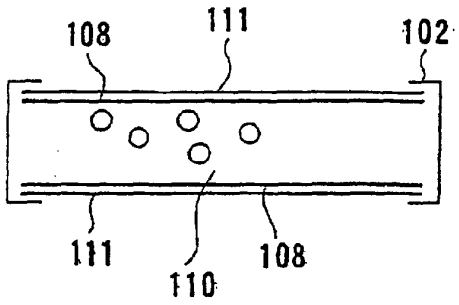


FIG. 42C



Entegris, EX1002, p. 790

FIG. 43A

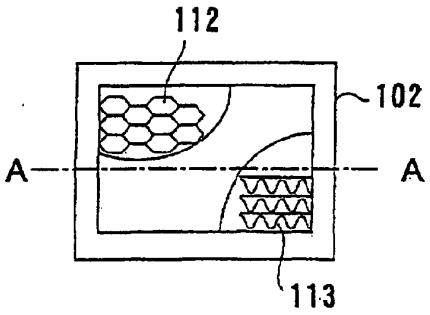


FIG. 43B

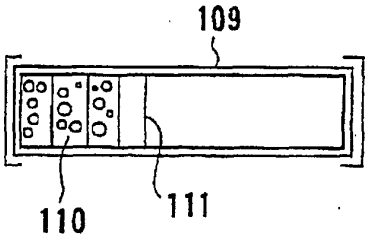


FIG. 43C



Entegris, EX1002, p. 791

FIG. 44A

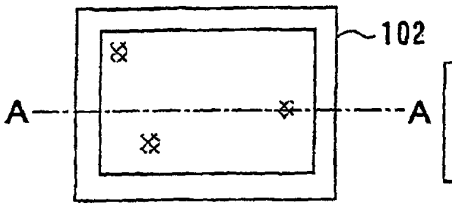


FIG. 44B

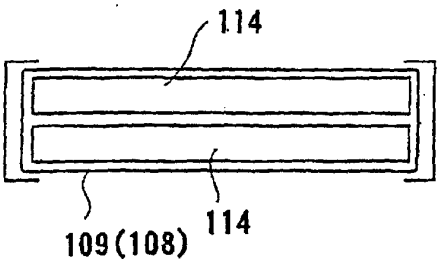


FIG. 44C



Entegris, EX1002, p. 792

FIG. 45A

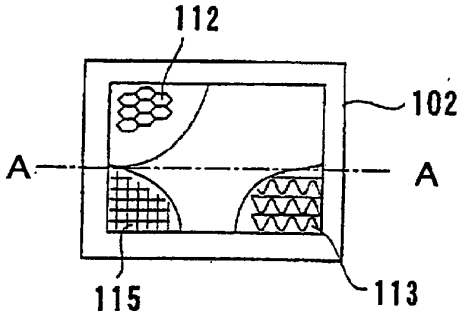
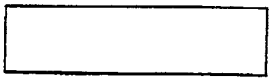


FIG. 45B



Entegris, EX1002, p. 793

FIG. 46A

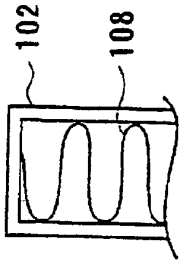


FIG. 46B

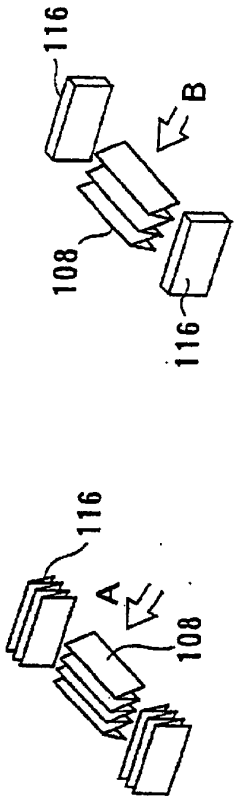
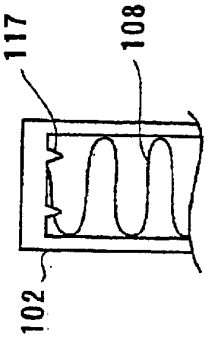
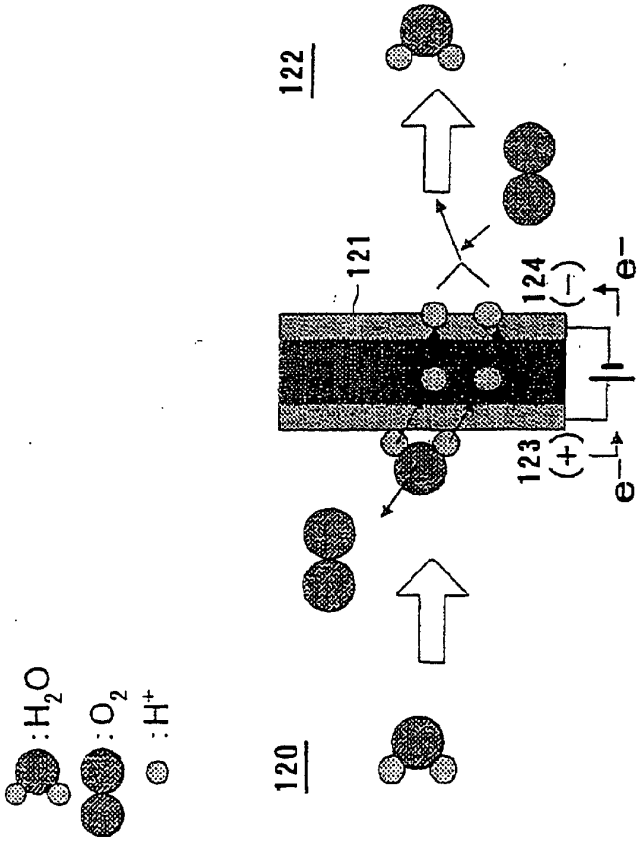


FIG. 46C



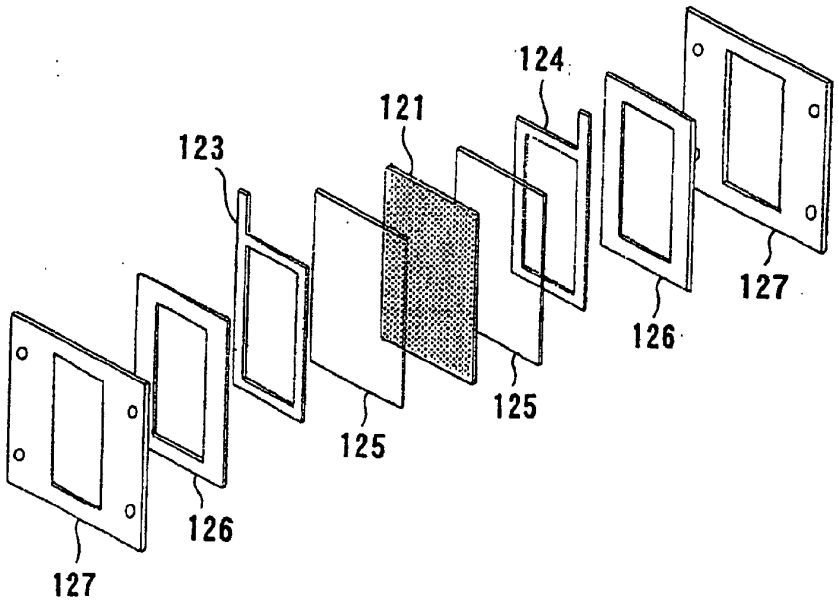
Entegris, EX1002, p. 794

FIG. 47



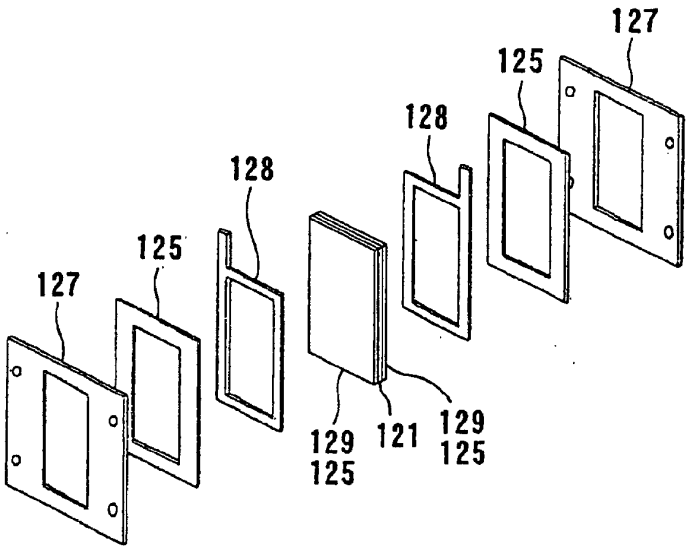
Entegris, EX1002, p. 795

FIG. 48



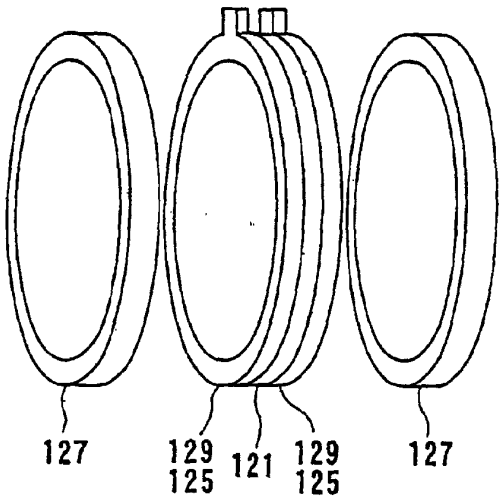
Entegris, EX1002, p. 796

FIG. 49



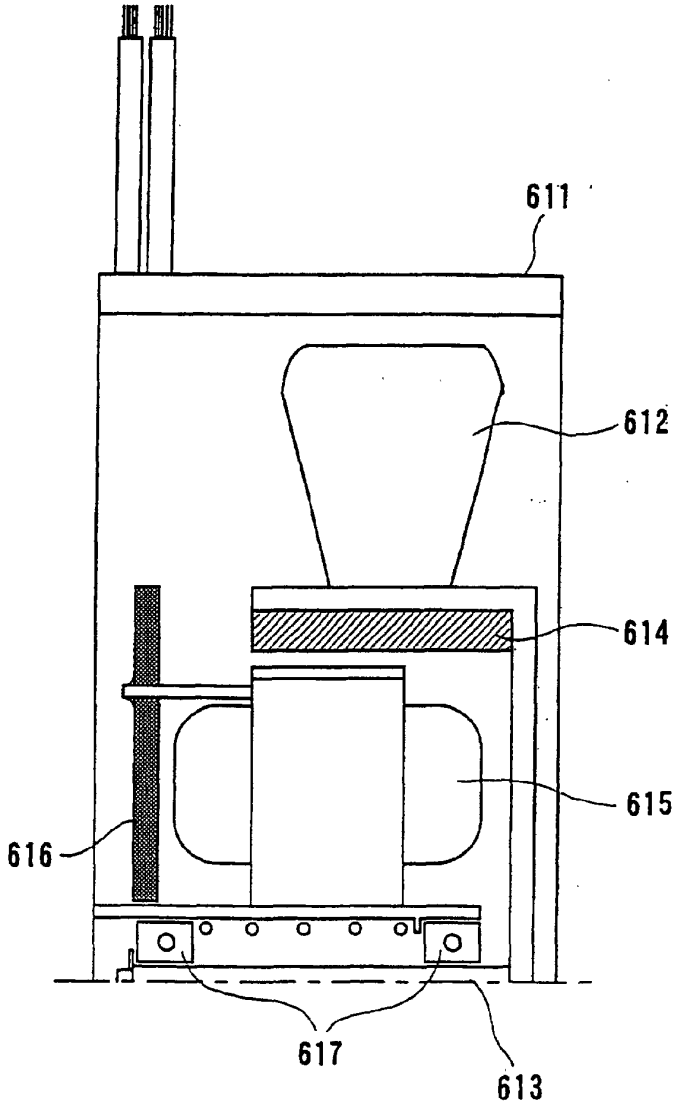
Entegris, EX1002, p. 797

FIG. 50



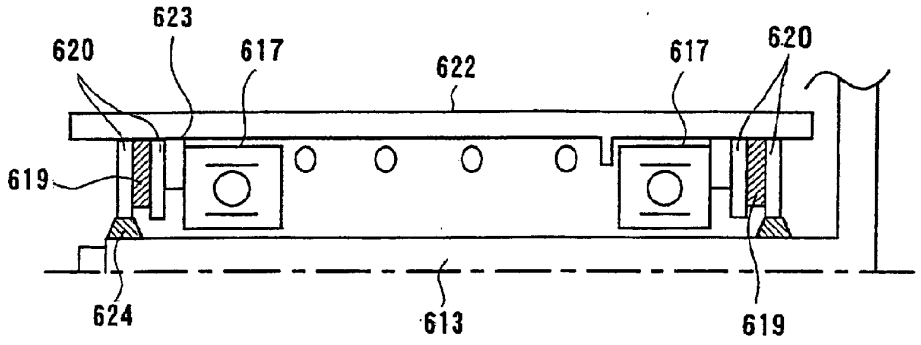
Entegris, EX1002, p. 798

FIG. 51



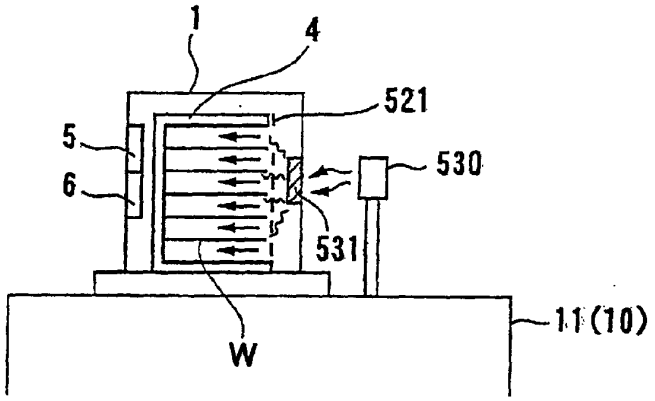
Entegris, EX1002, p. 799

FIG. 52



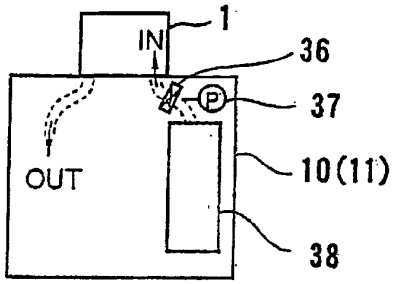
Entegris, EX1002, p. 800

FIG. 53



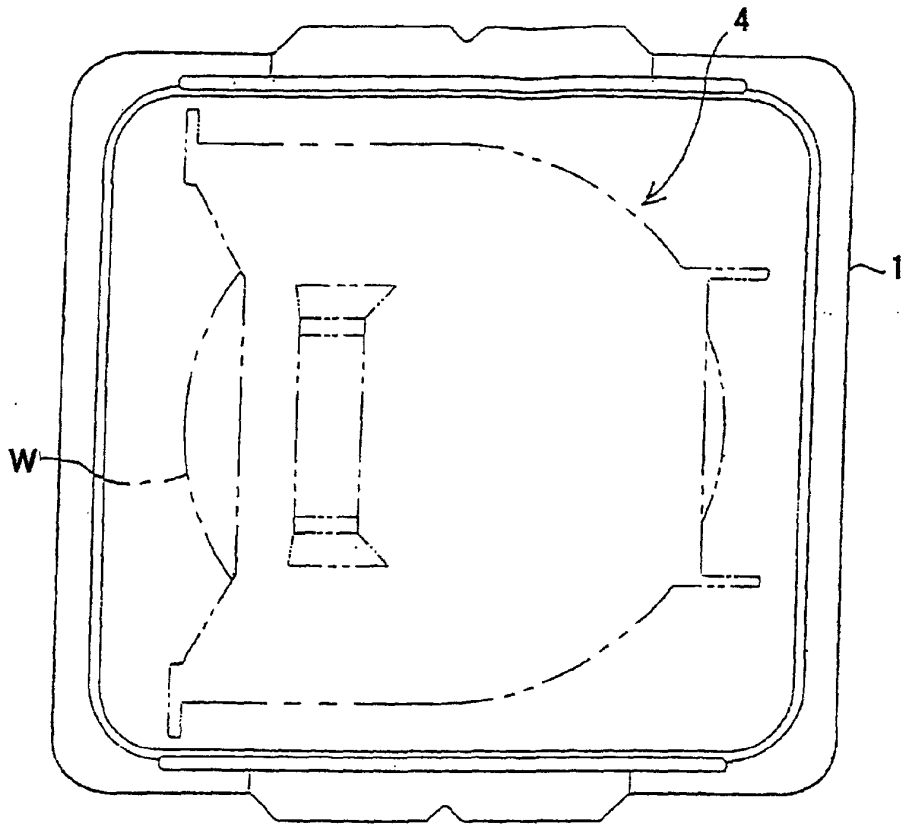
Entegris, EX1002, p. 801

FIG. 54



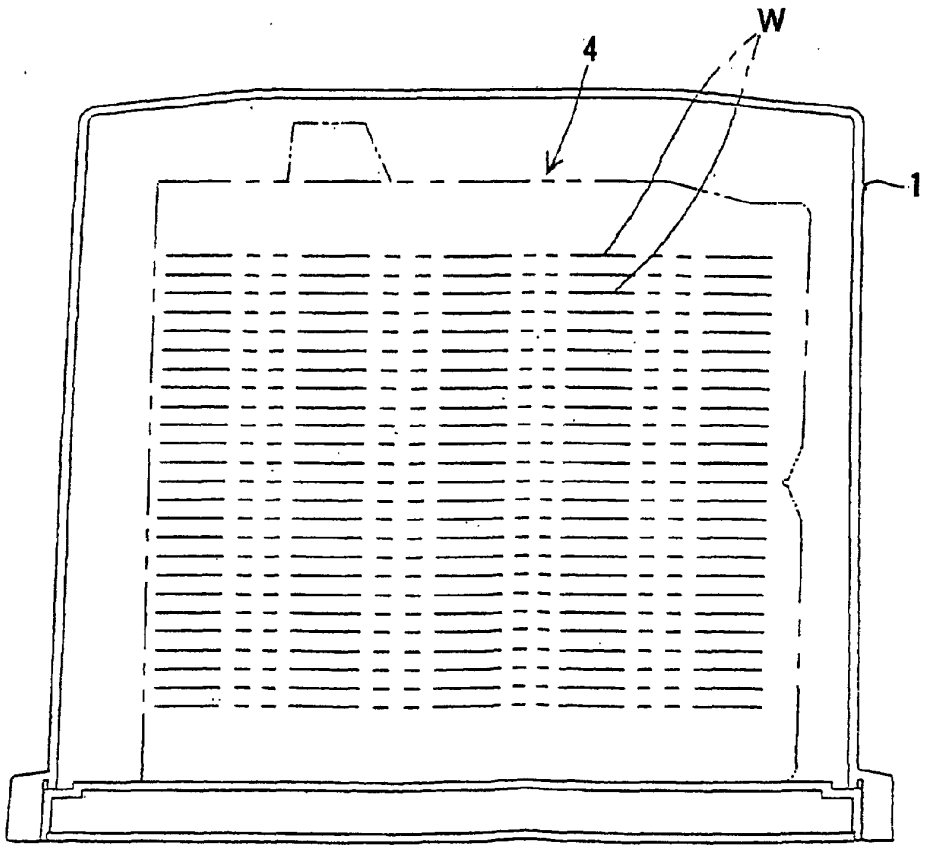
Entegris, EX1002, p. 802

FIG. 55



Entegris, EX1002, p. 803

FIG. 56



Entegris, EX1002, p. 804

FIG. 57A

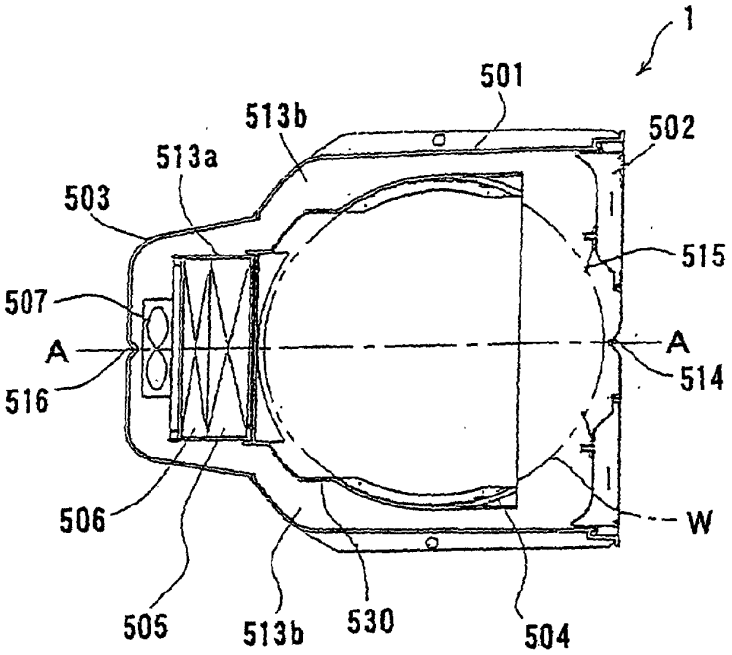
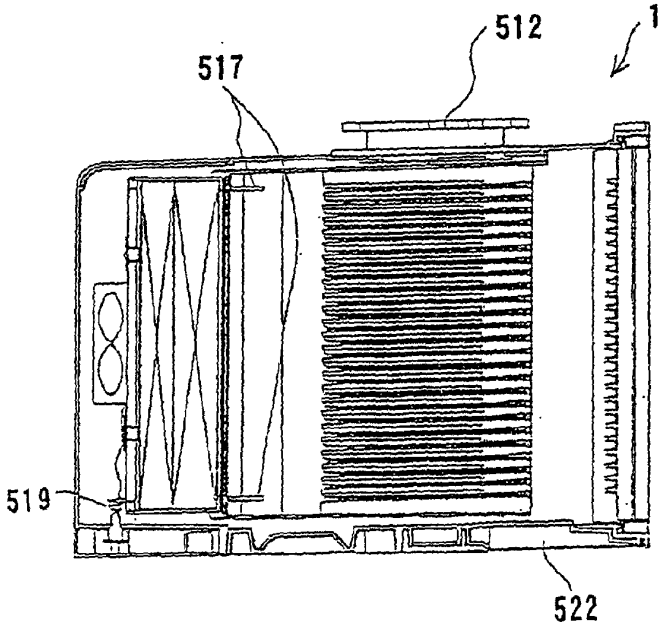


FIG. 57B



Entegris, EX1002, p. 805

FIG. 58A

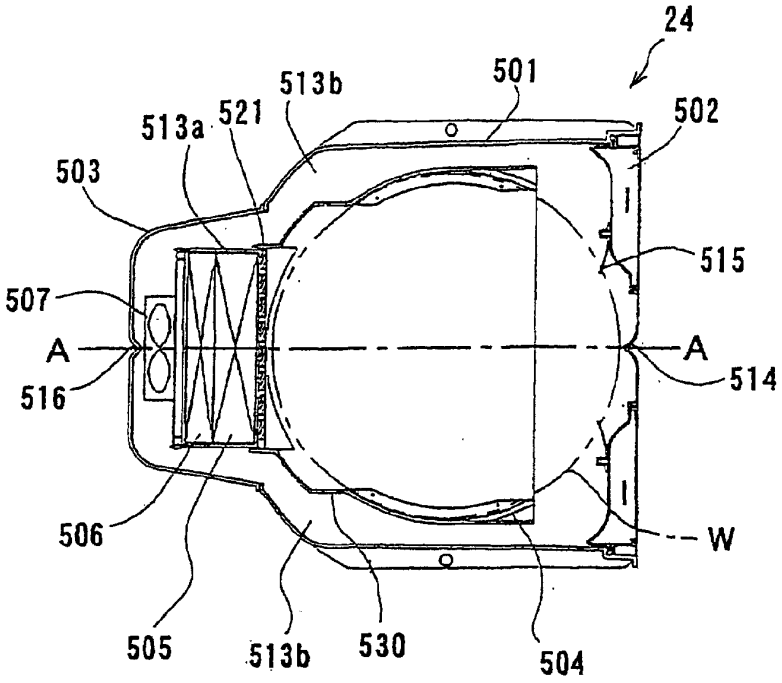
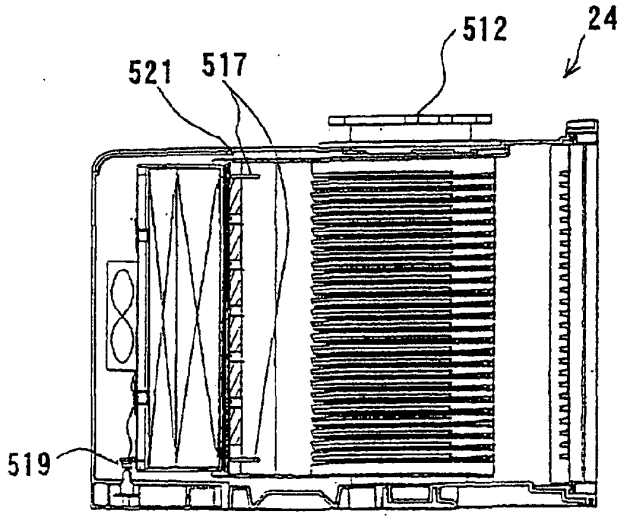


FIG. 58B



Entegris, EX1002, p. 806

FIG. 59A

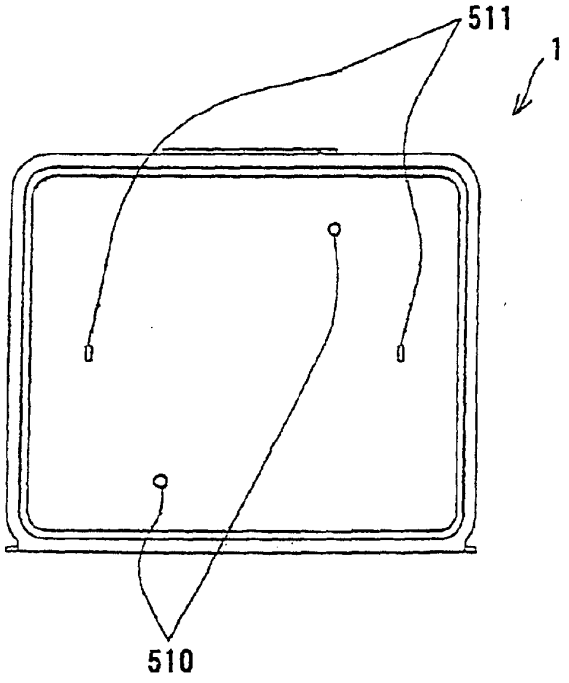
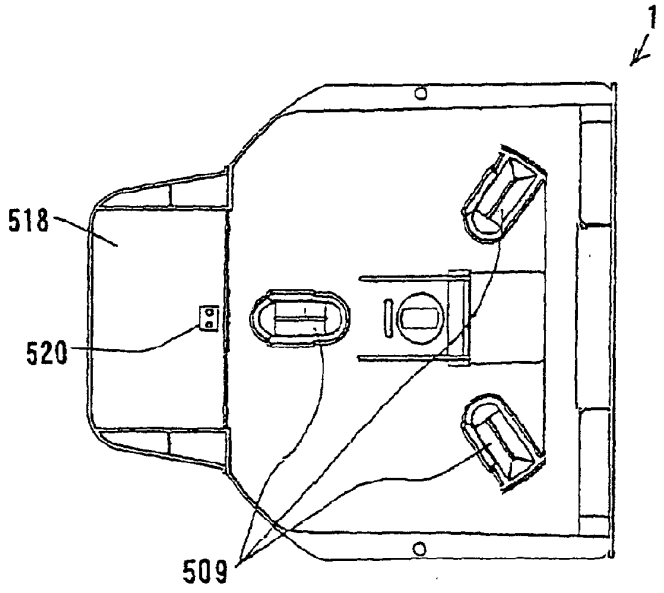


FIG. 59B



Entegris, EX1002, p. 807

FIG. 60A

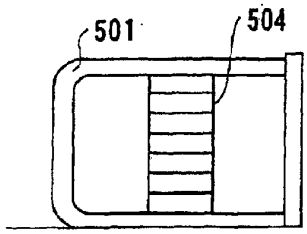


FIG. 60B

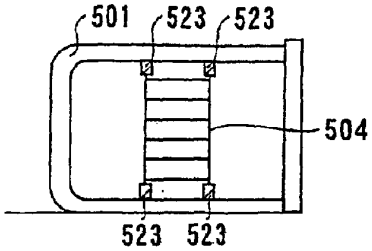


FIG. 60C

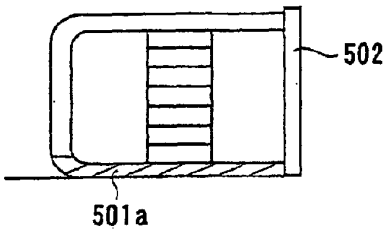


FIG. 60D

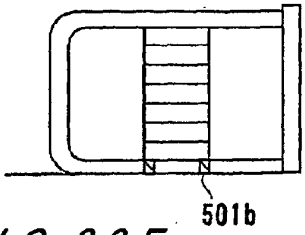


FIG. 60E

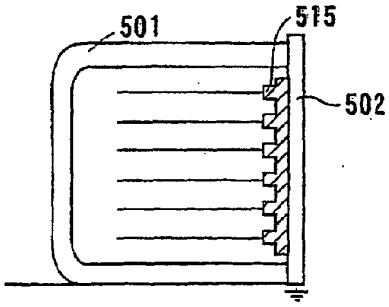


FIG. 60F

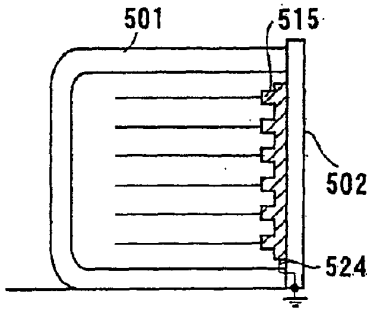


FIG. 60G

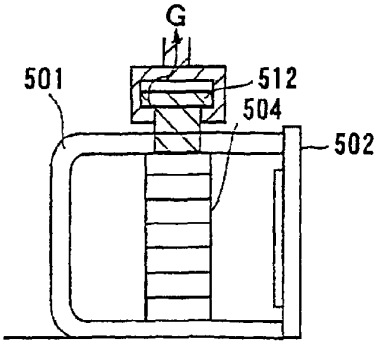
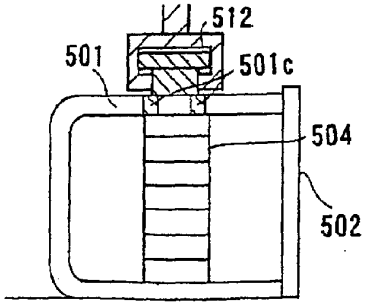
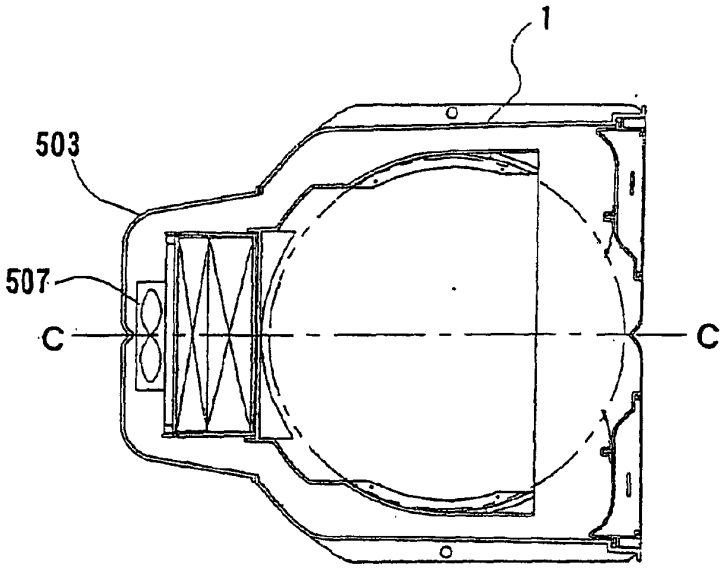


FIG. 60H



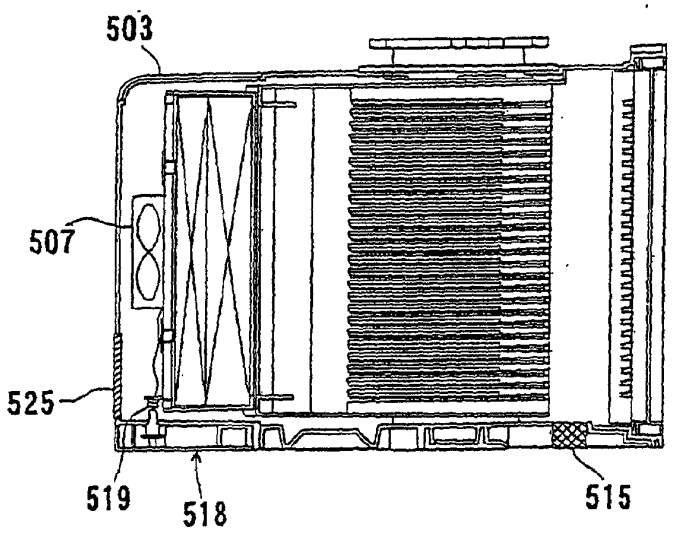
Entegris, EX1002, p. 808

FIG. 61



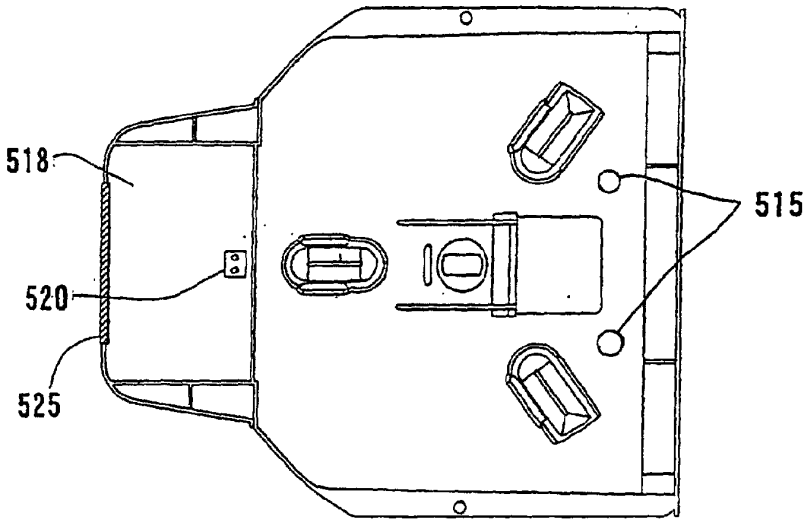
Entegris, EX1002, p. 809

FIG. 62



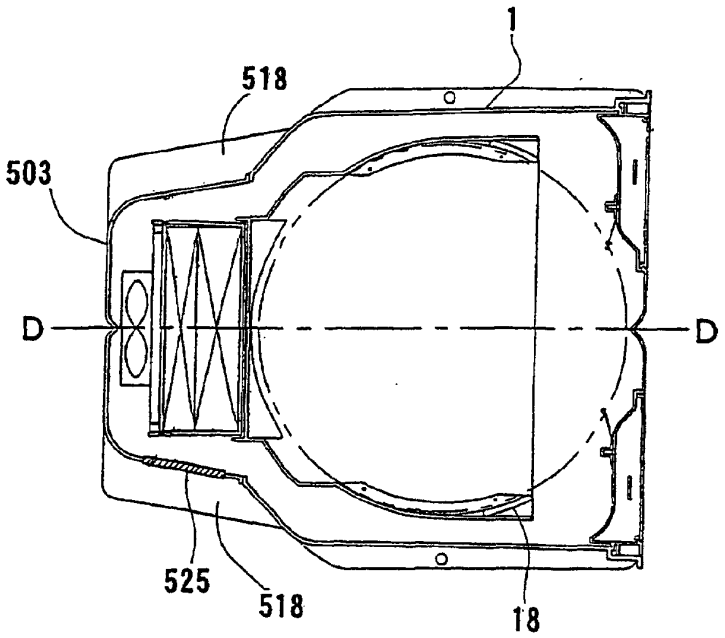
Entegris, EX1002, p. 810

FIG. 63



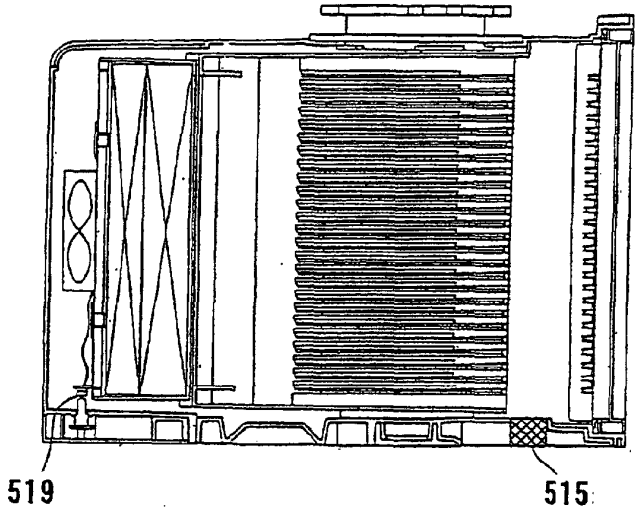
Entegris, EX1002, p. 811

FIG. 64



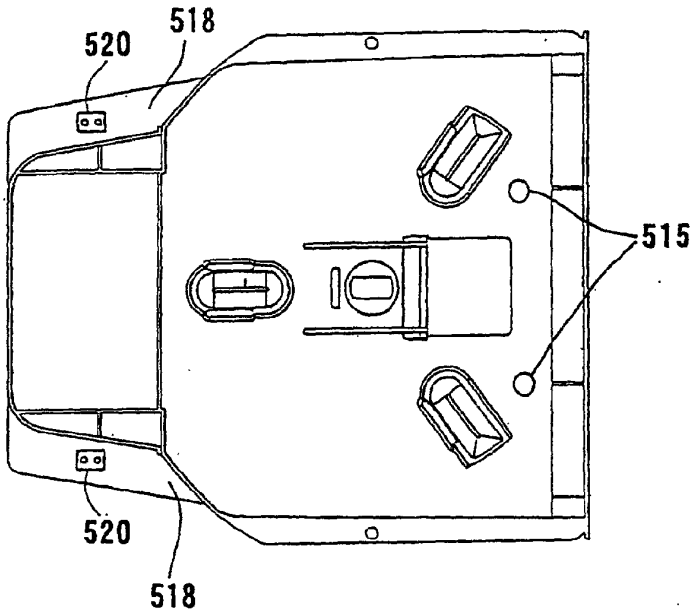
Entegris, EX1002, p. 812

FIG. 65



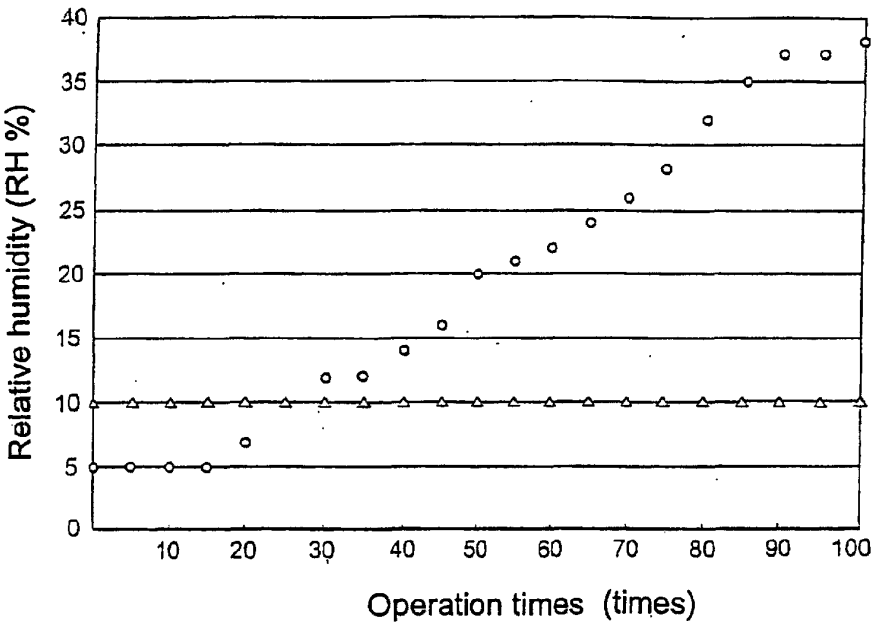
Entegris, EX1002, p. 813

FIG. 66



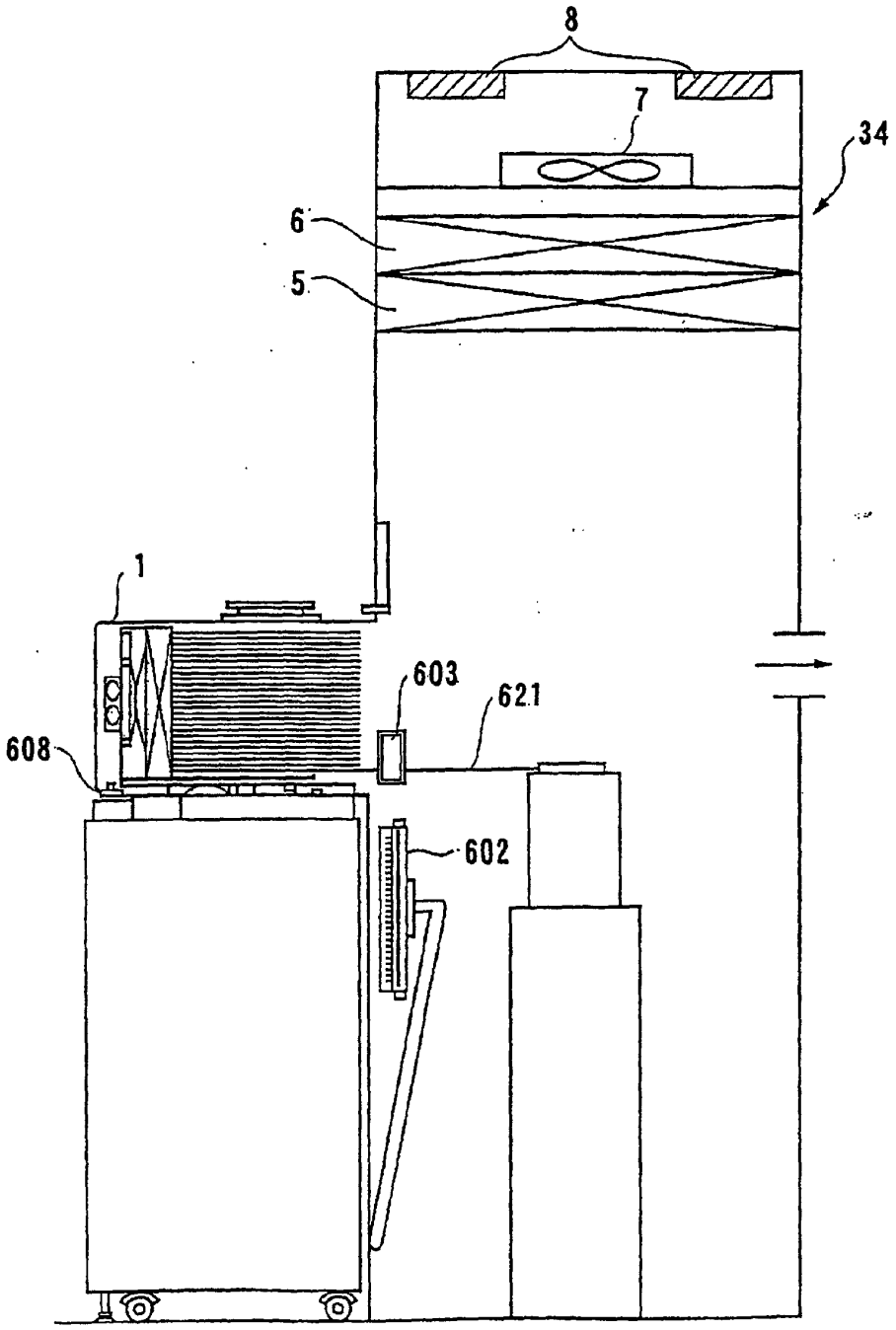
Entegris, EX1002, p. 814

FIG. 67



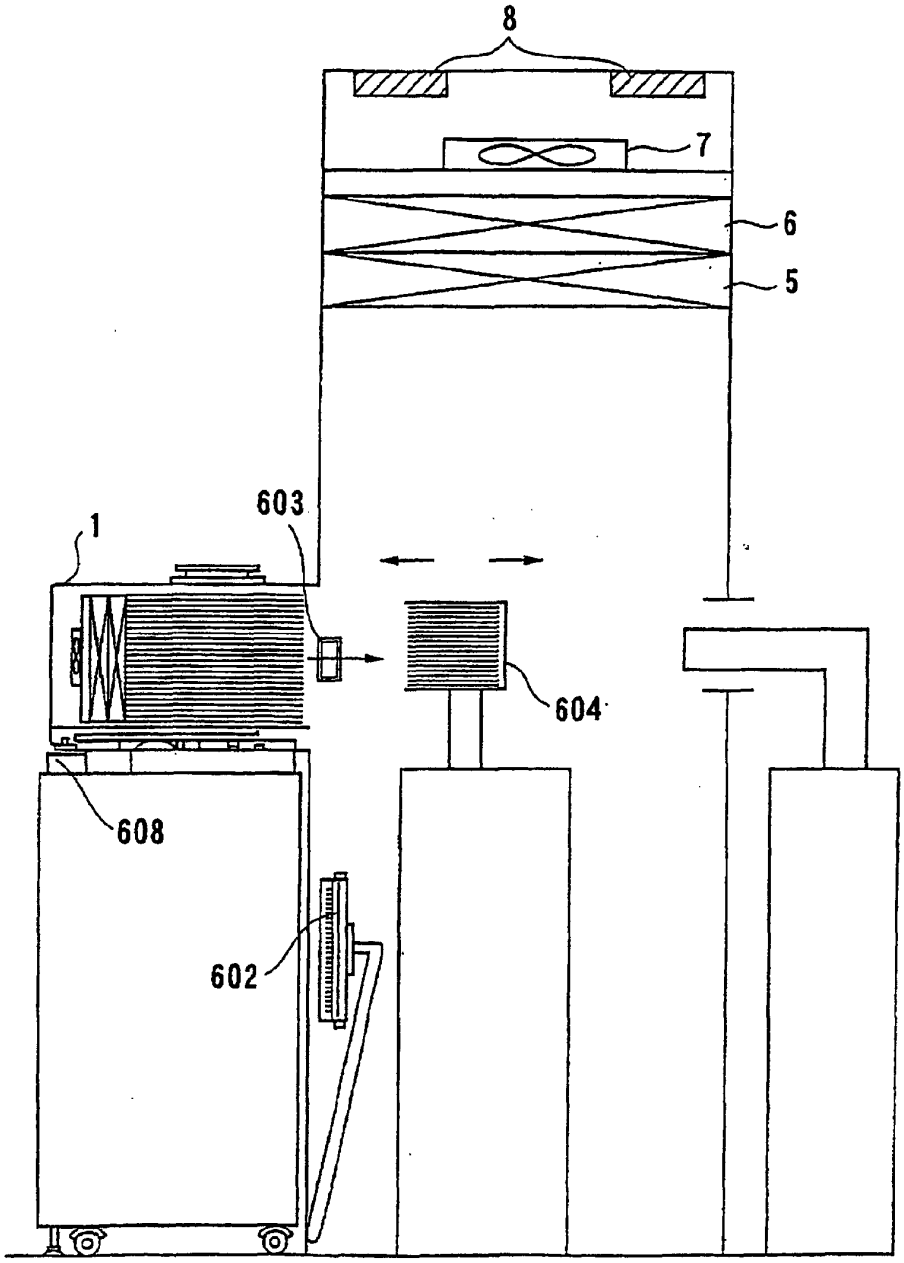
Entegris, EX1002, p. 815

FIG. 68



Entegris, EX1002, p. 816

FIG. 69



Entegris, EX1002, p. 817

FIG. 70A

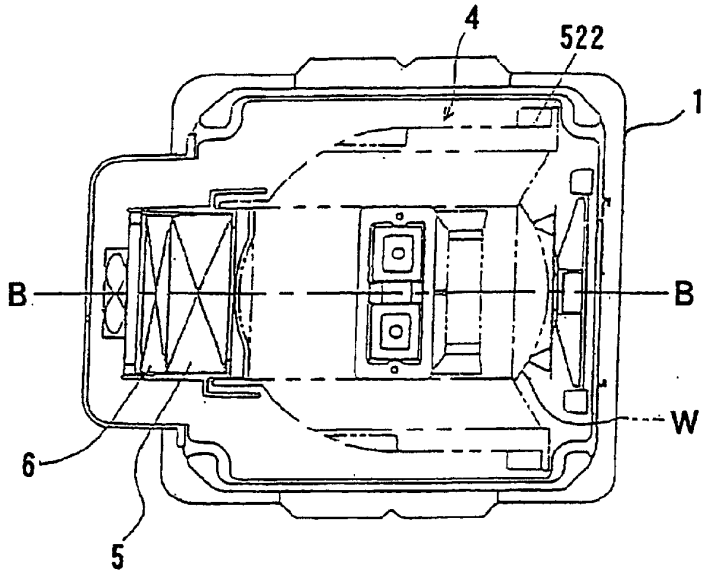
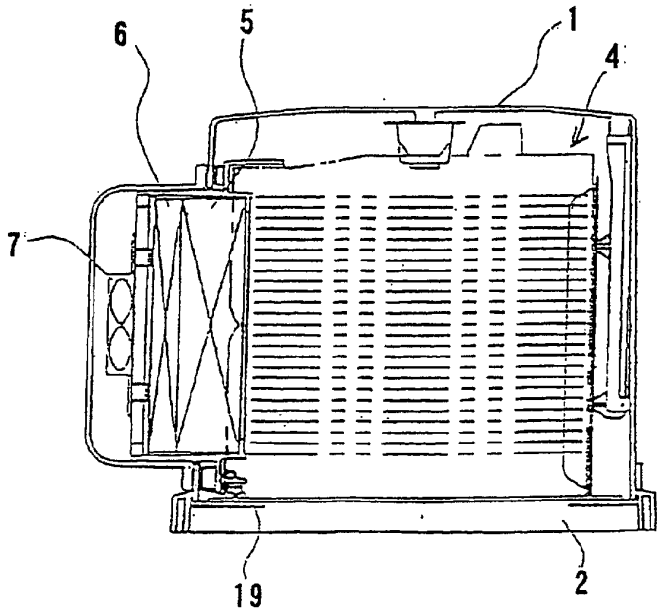


FIG. 70B



Entegris, EX1002, p. 818

FIG. 71A

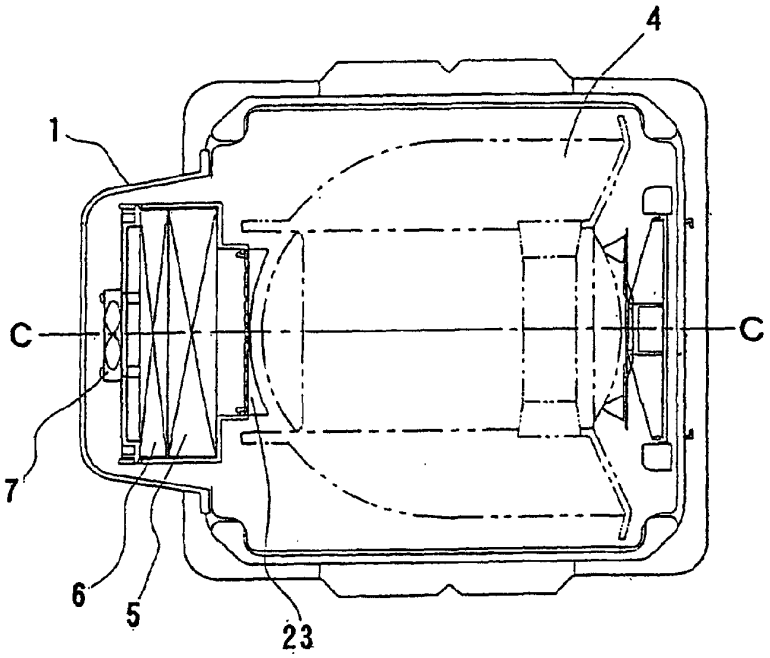
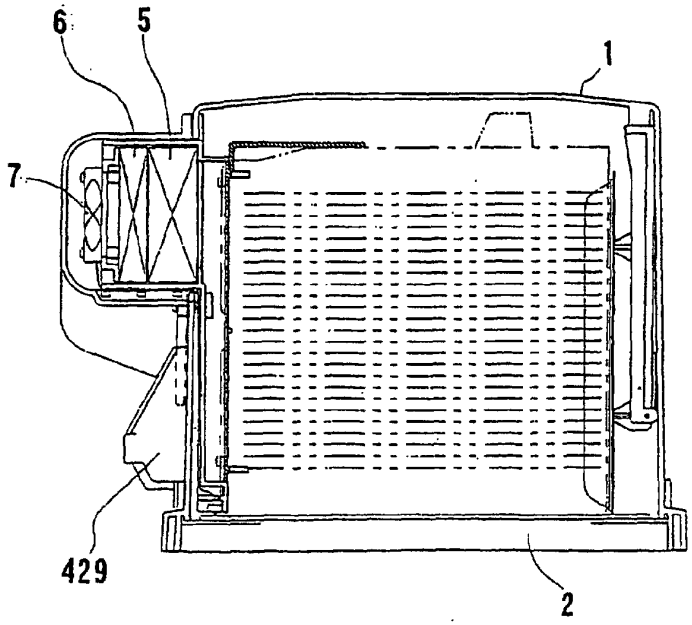
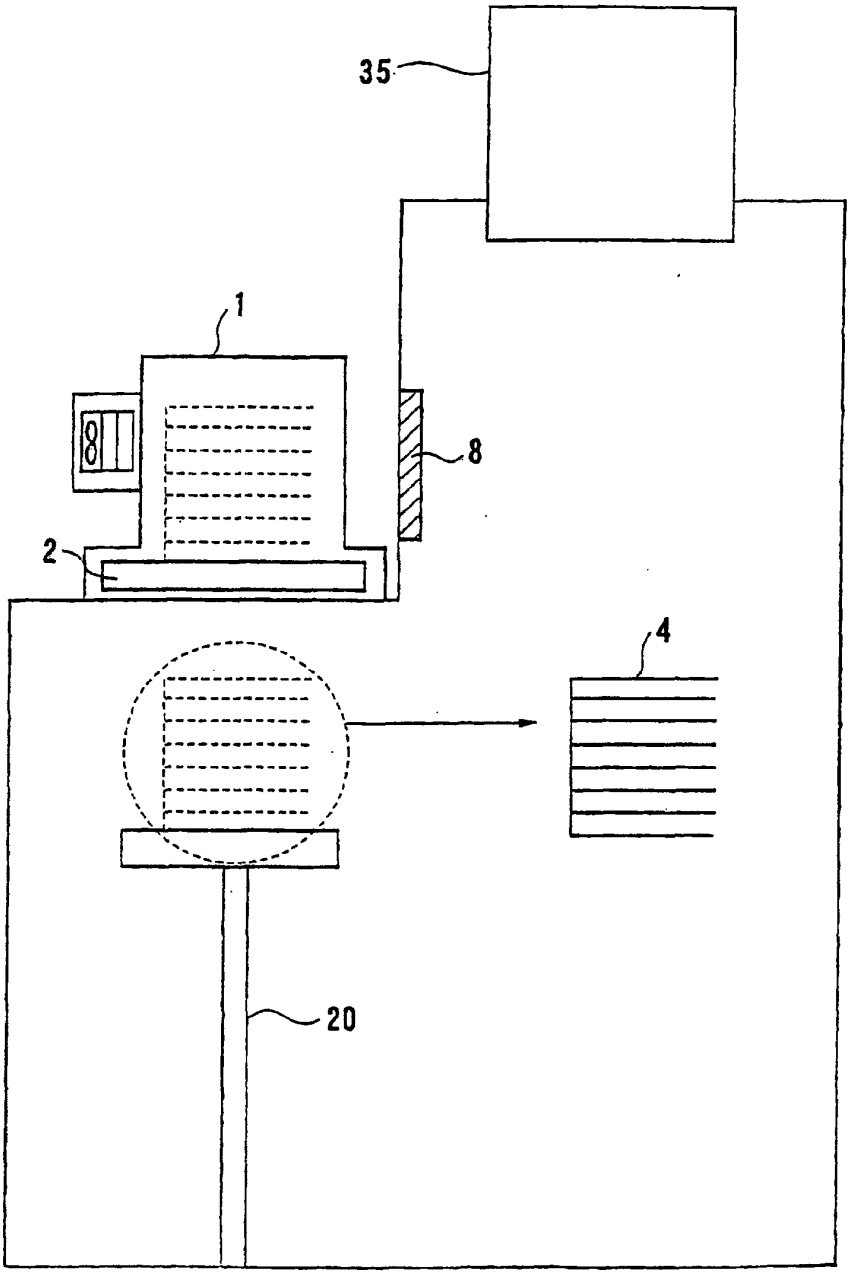


FIG. 71B



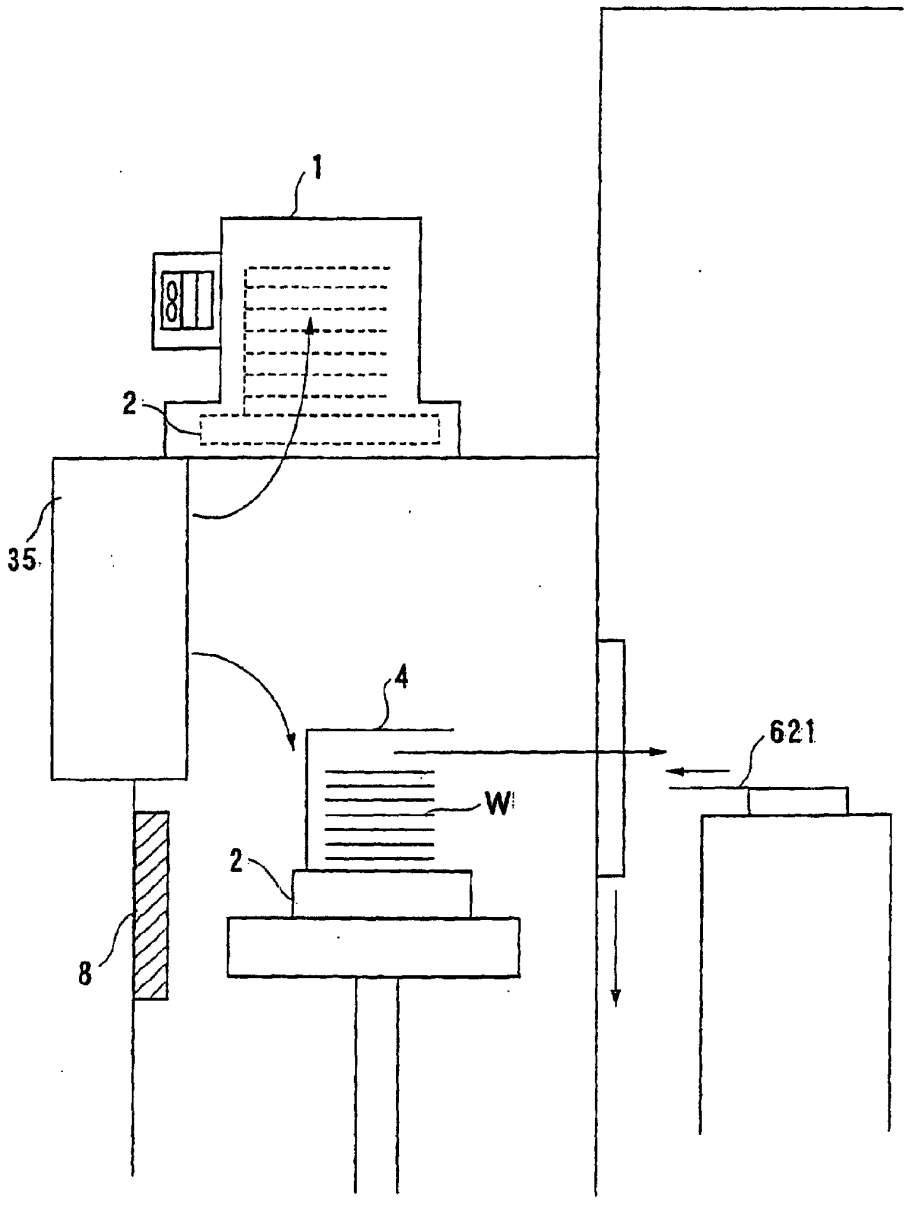
Entegris, EX1002, p. 819

FIG. 72



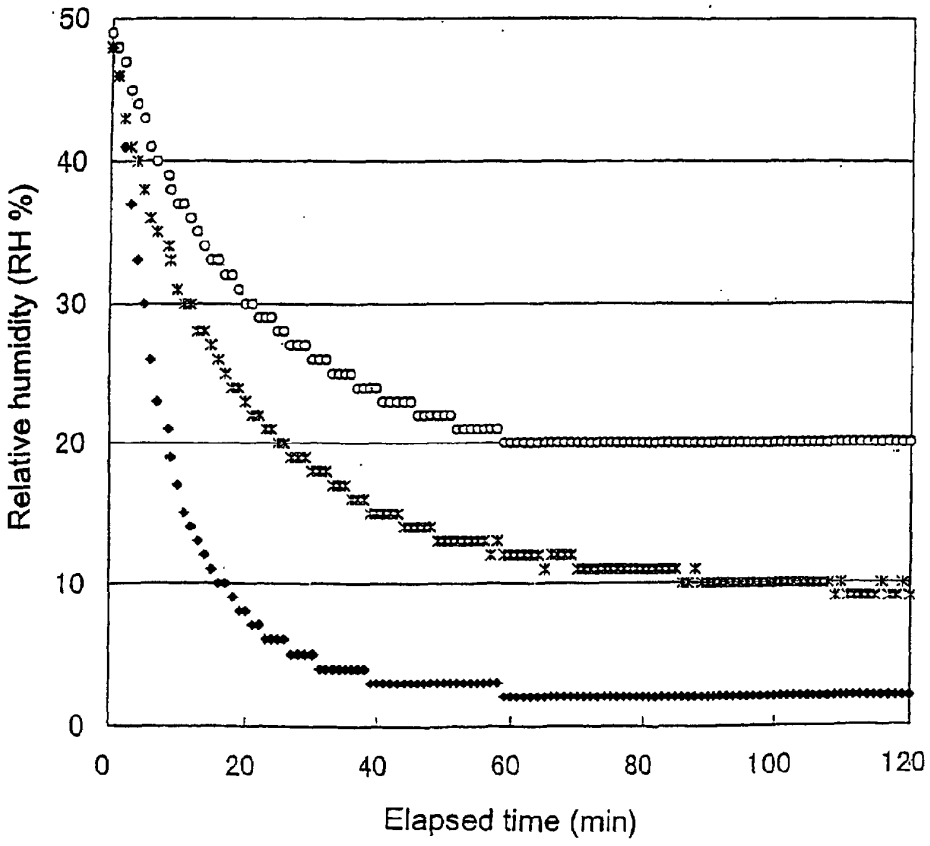
Entegris, EX1002, p. 820

FIG. 73



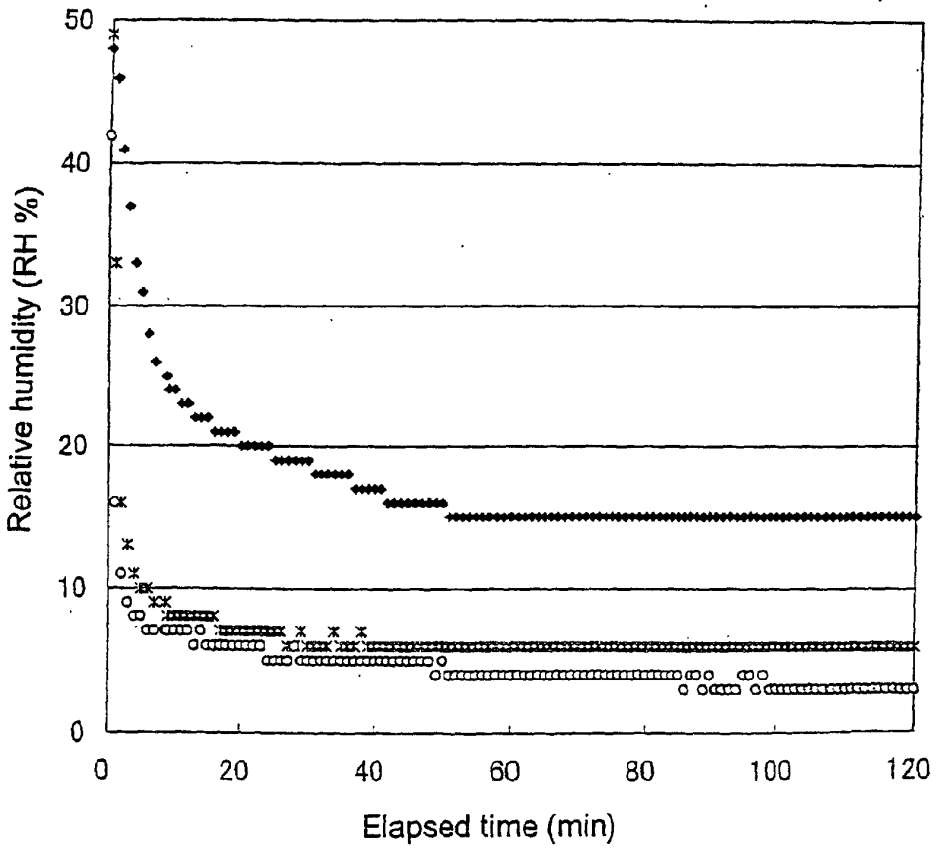
Entegris, EX1002, p. 821

FIG. 74



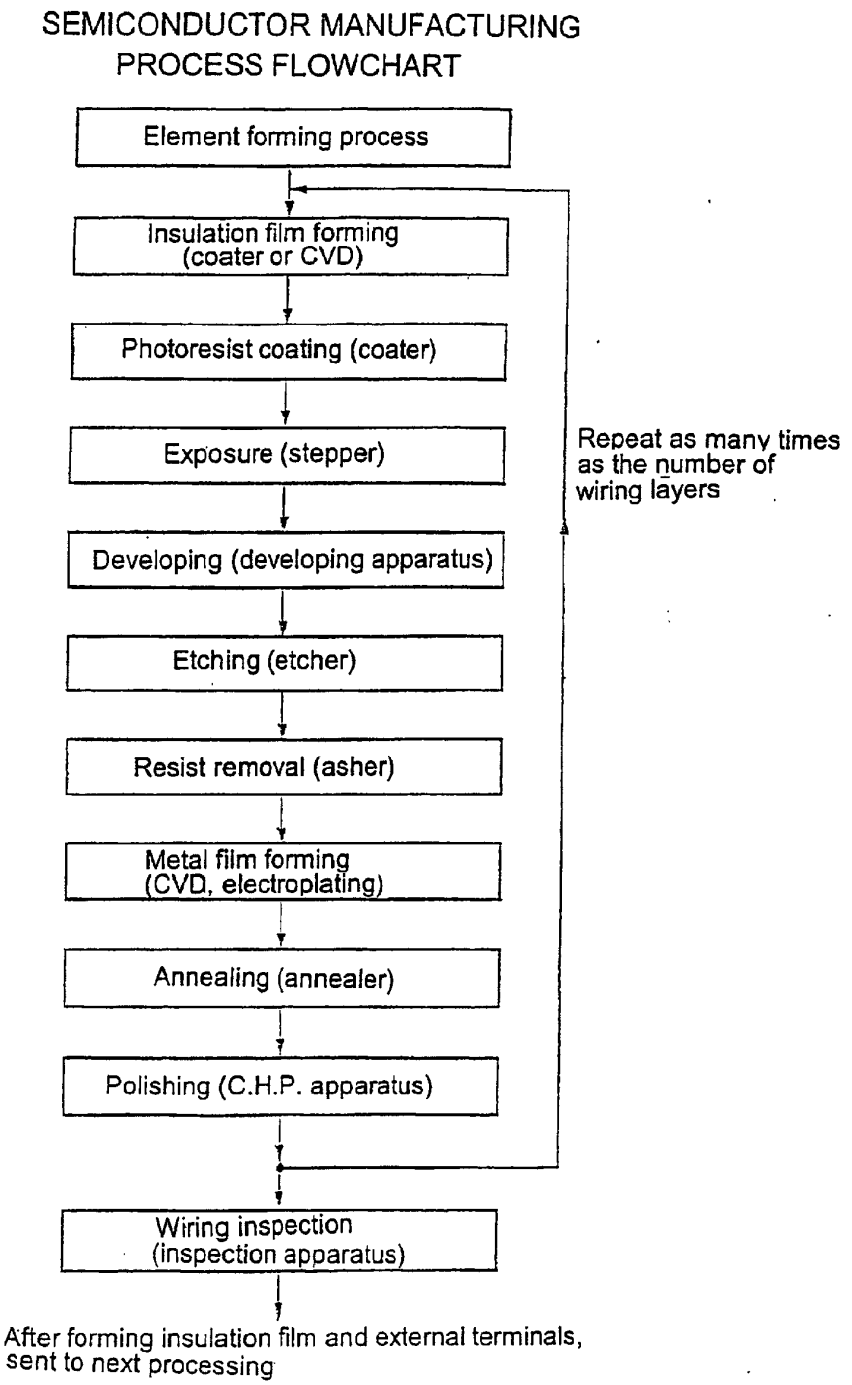
Entegris, EX1002, p. 822

FIG. 75



Entegris, EX1002, p. 823

FIG. 76



Entegris, EX1002, p. 824

FIG. 77A

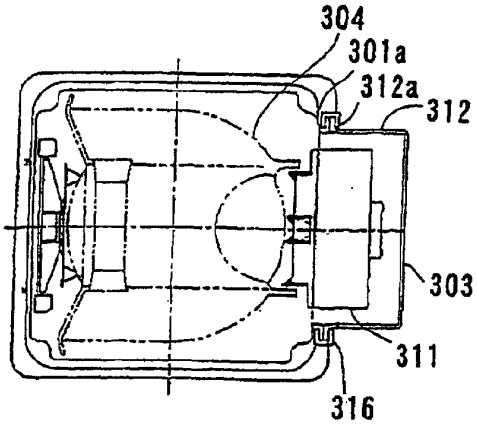


FIG. 77B

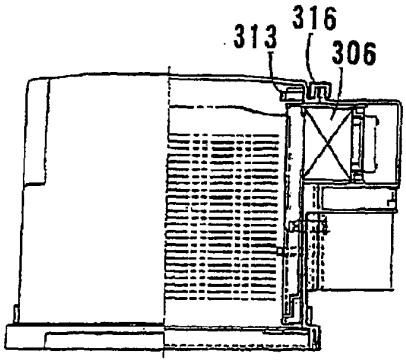


FIG. 77C

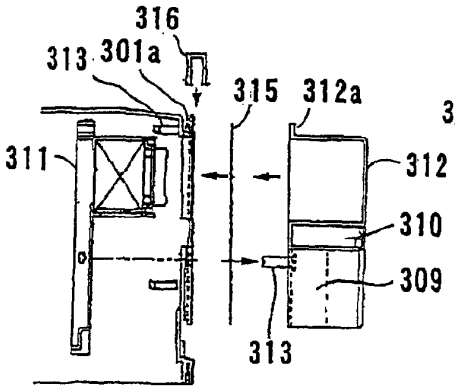
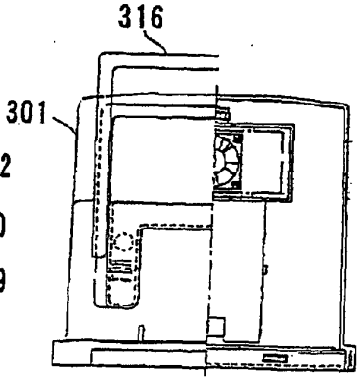


FIG. 77D



Entegris, EX1002, p. 825

FIG. 78A

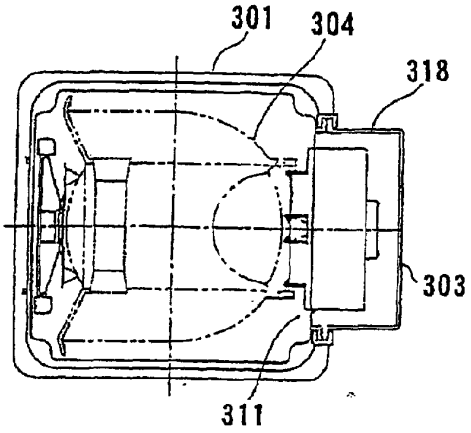


FIG. 78B

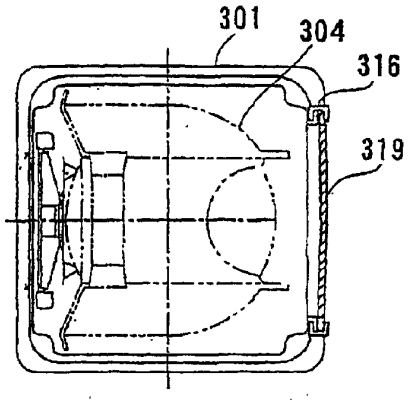


FIG. 78C

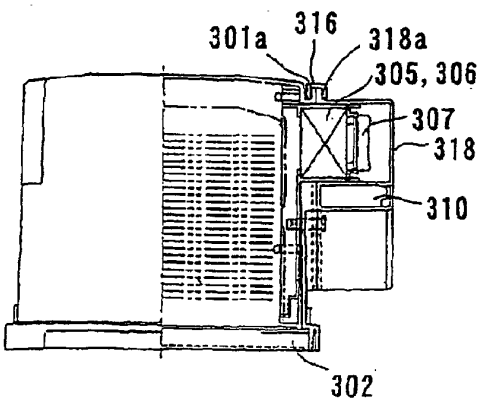
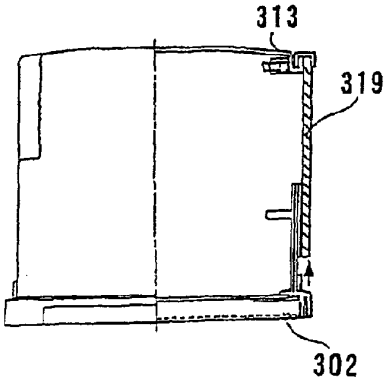


FIG. 78D



Entegris, EX1002, p. 826

FIG. 79A

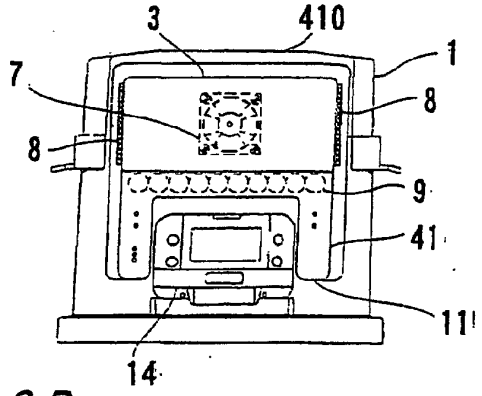


FIG. 79B

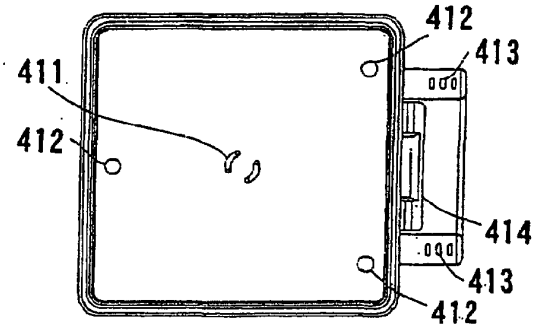
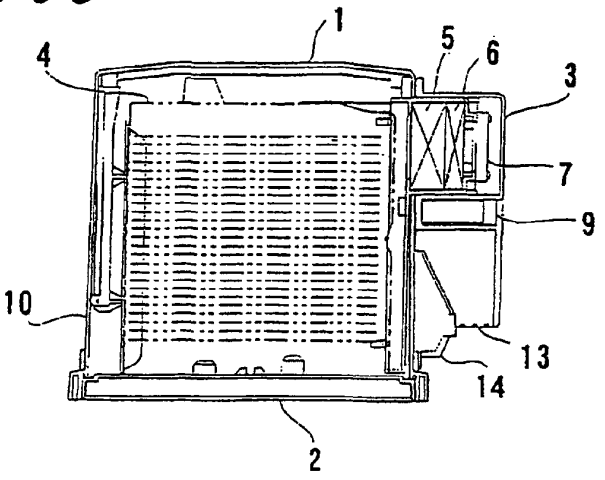


FIG. 79C



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FIG. 80A

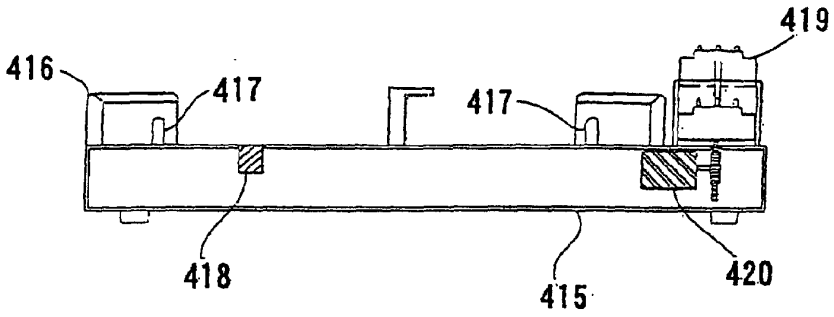
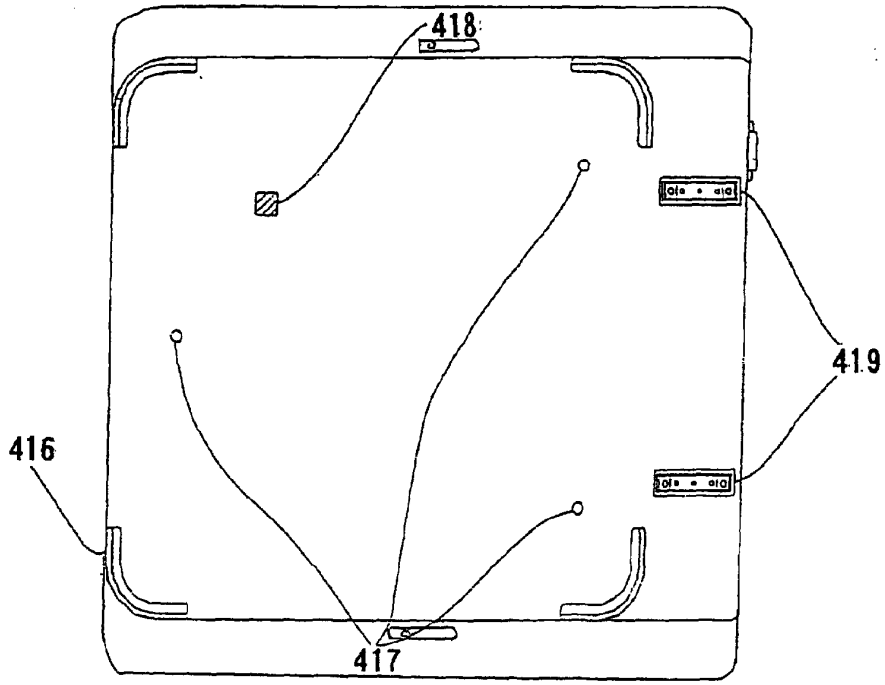


FIG. 80B



Entegris, EX1002, p. 828

FIG. 81A

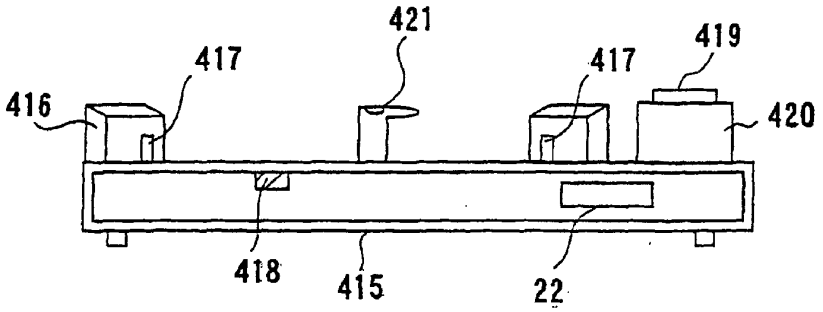
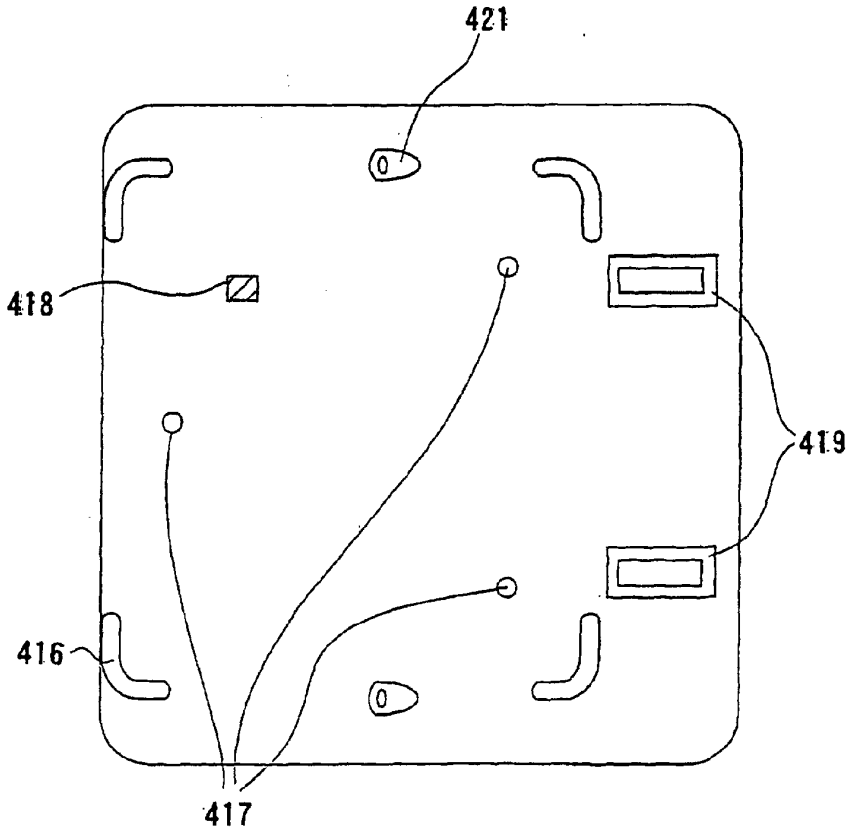
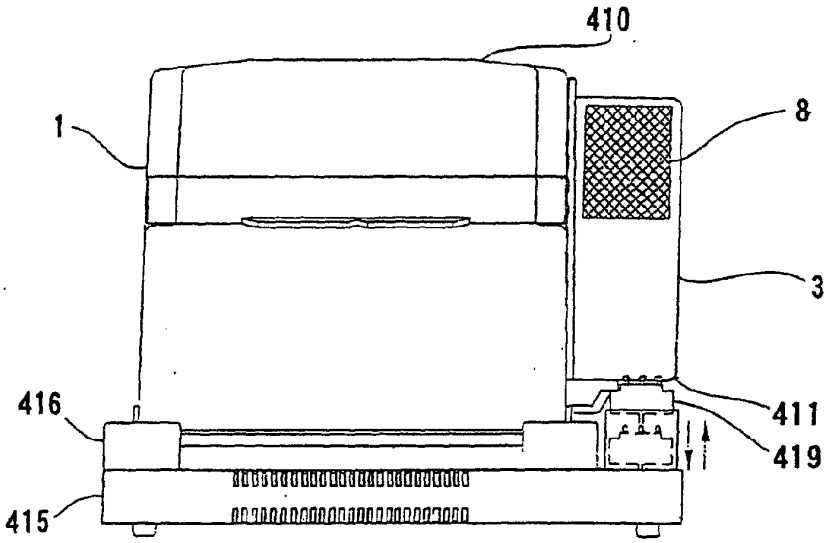


FIG. 81B



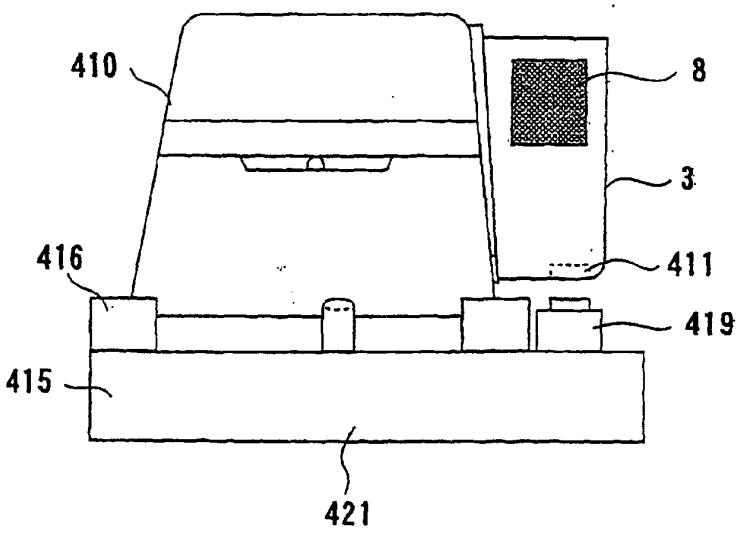
Entegris, EX1002, p. 829

FIG. 82



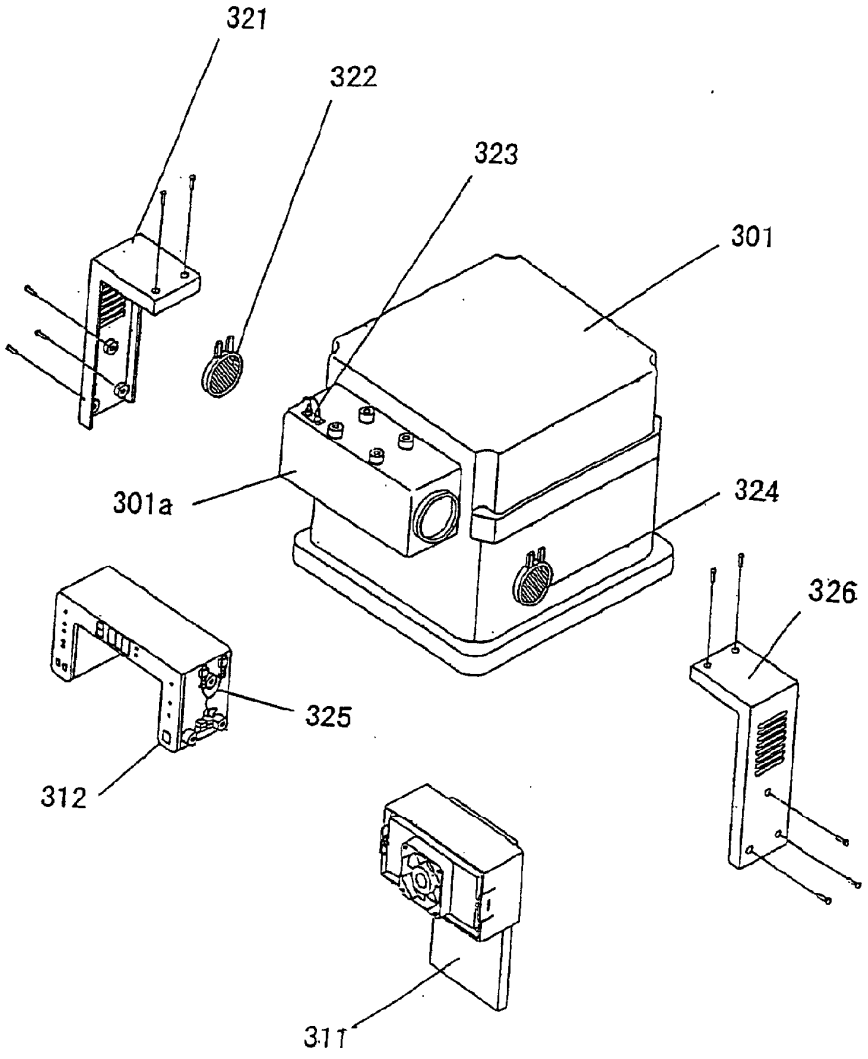
Entegris, EX1002, p. 830

FIG. 83



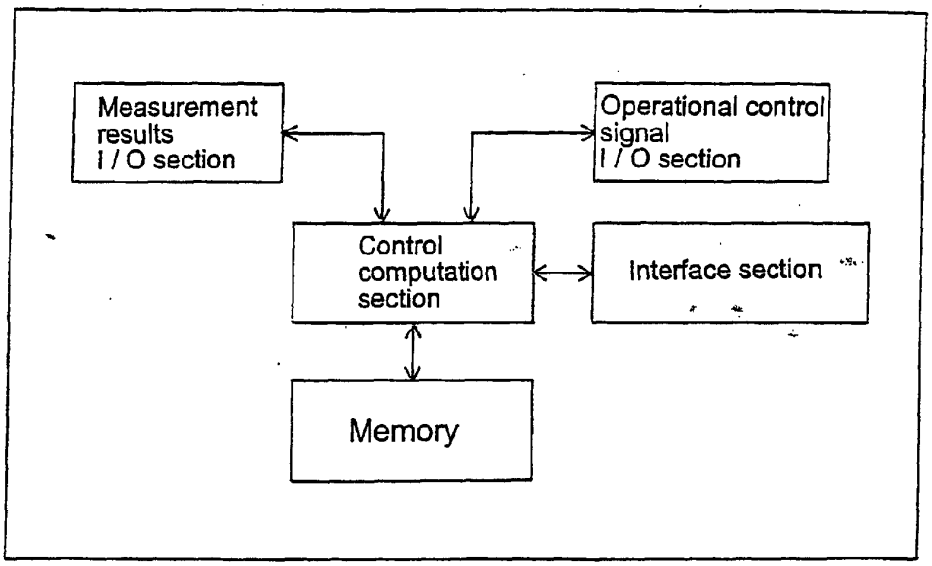
Entegris, EX1002, p. 831

FIG. 84



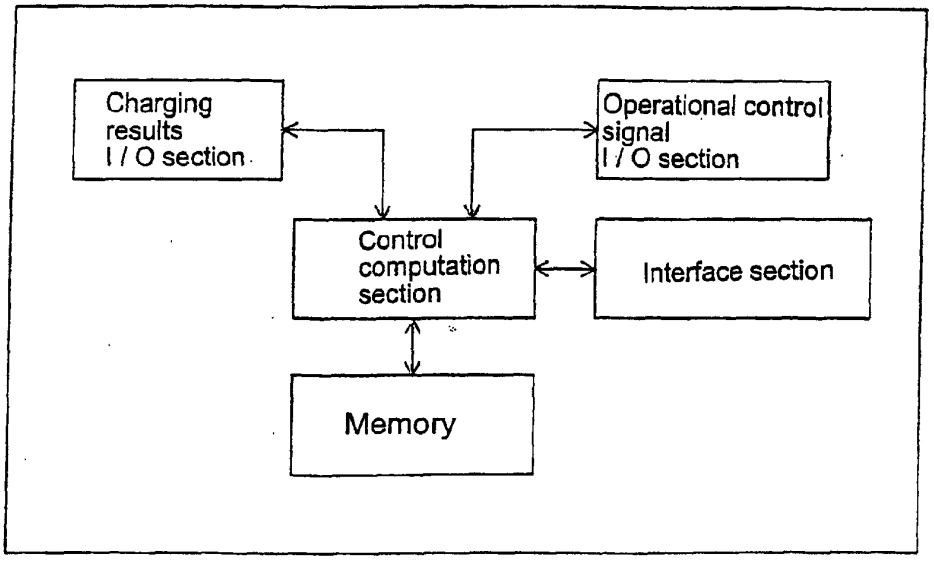
Entegris, EX1002, p. 832

FIG. 85



Entegris, EX1002, p. 833

FIG. 86



Entegris, EX1002, p. 834

FIG. 87A

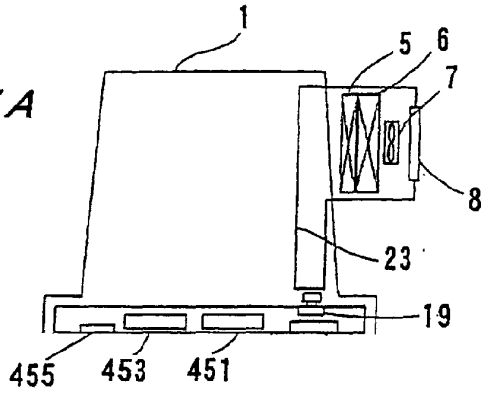


FIG. 87B

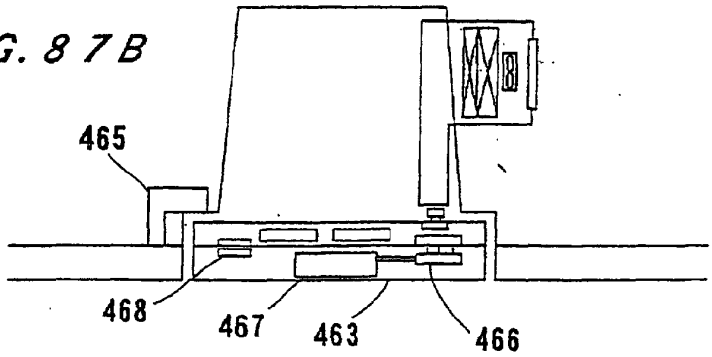
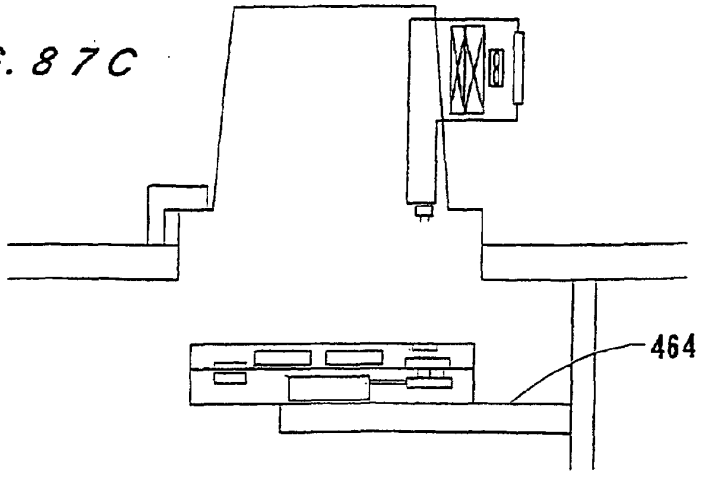


FIG. 87C



Entegris, EX1002, p. 835

FIG. 88A

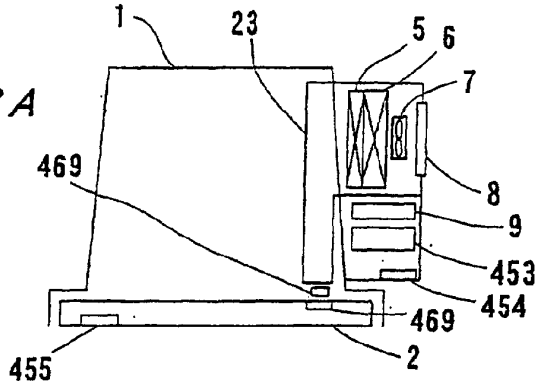


FIG. 88B

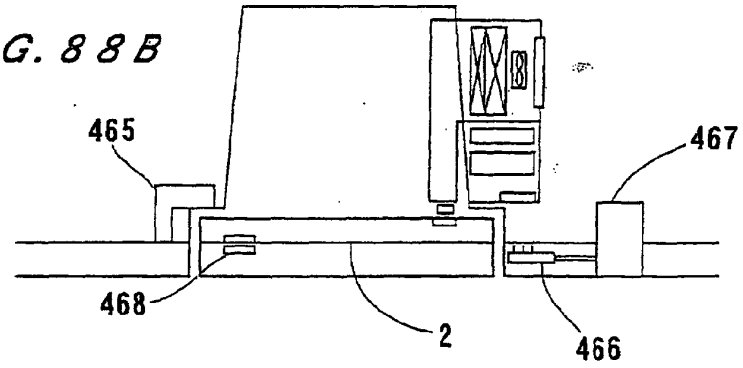
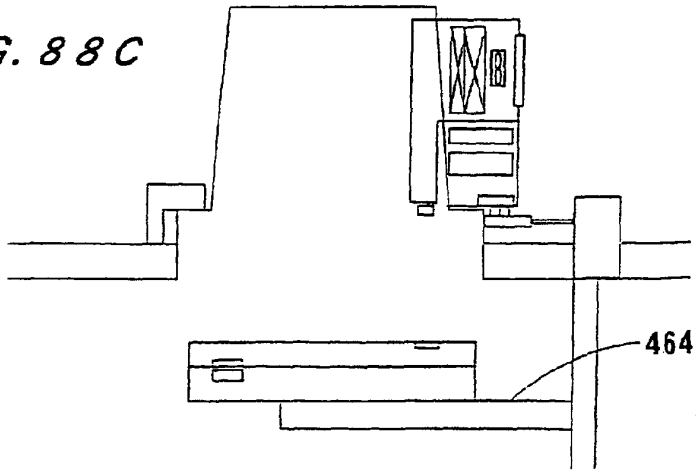


FIG. 88C



Entegris, EX1002, p. 836

FIG. 89A

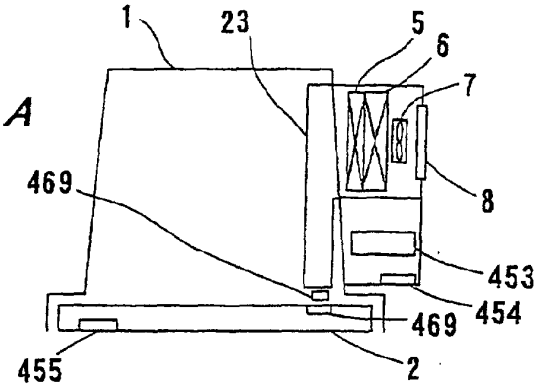


FIG. 89B

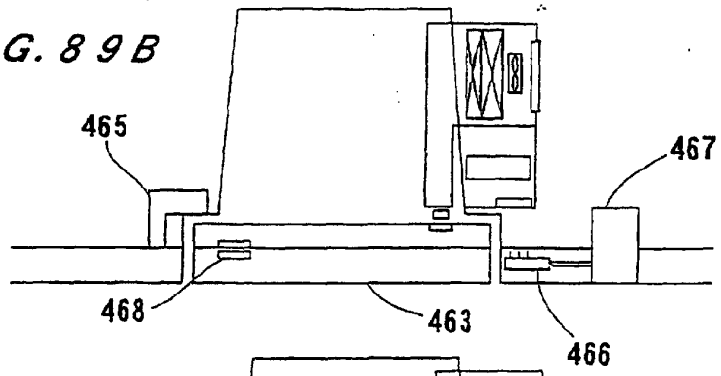
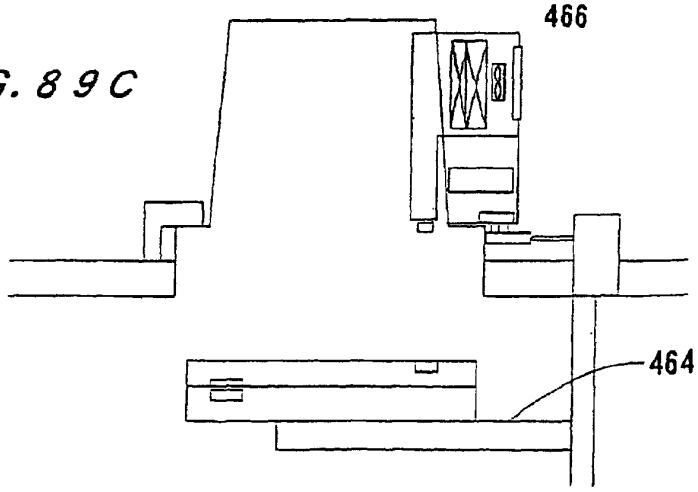


FIG. 89C



Entegris, EX1002, p. 837

FIG. 90A

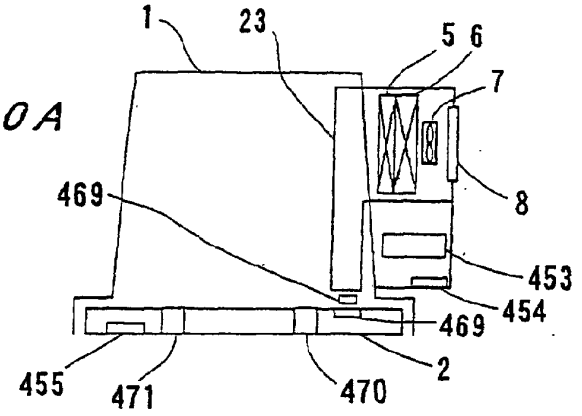


FIG. 90B

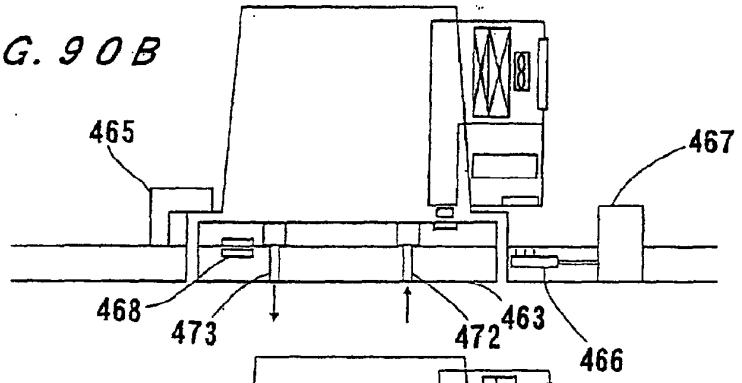
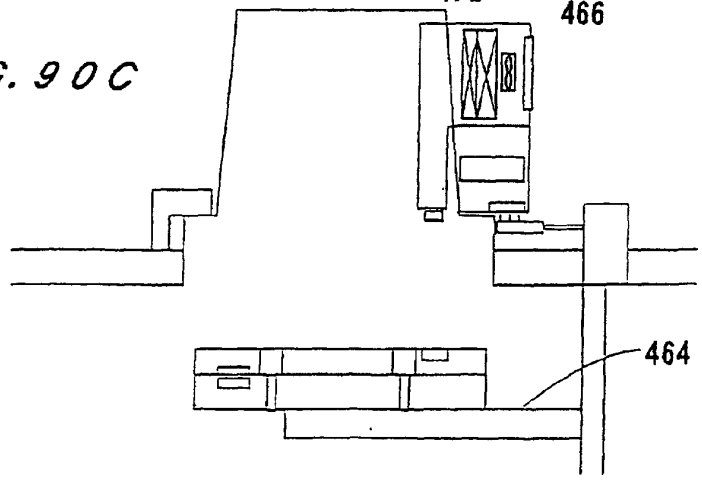
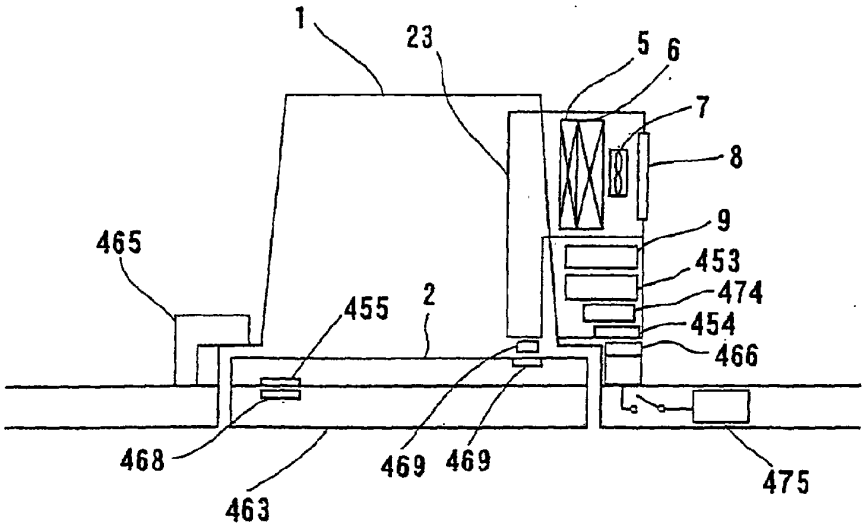


FIG. 90C



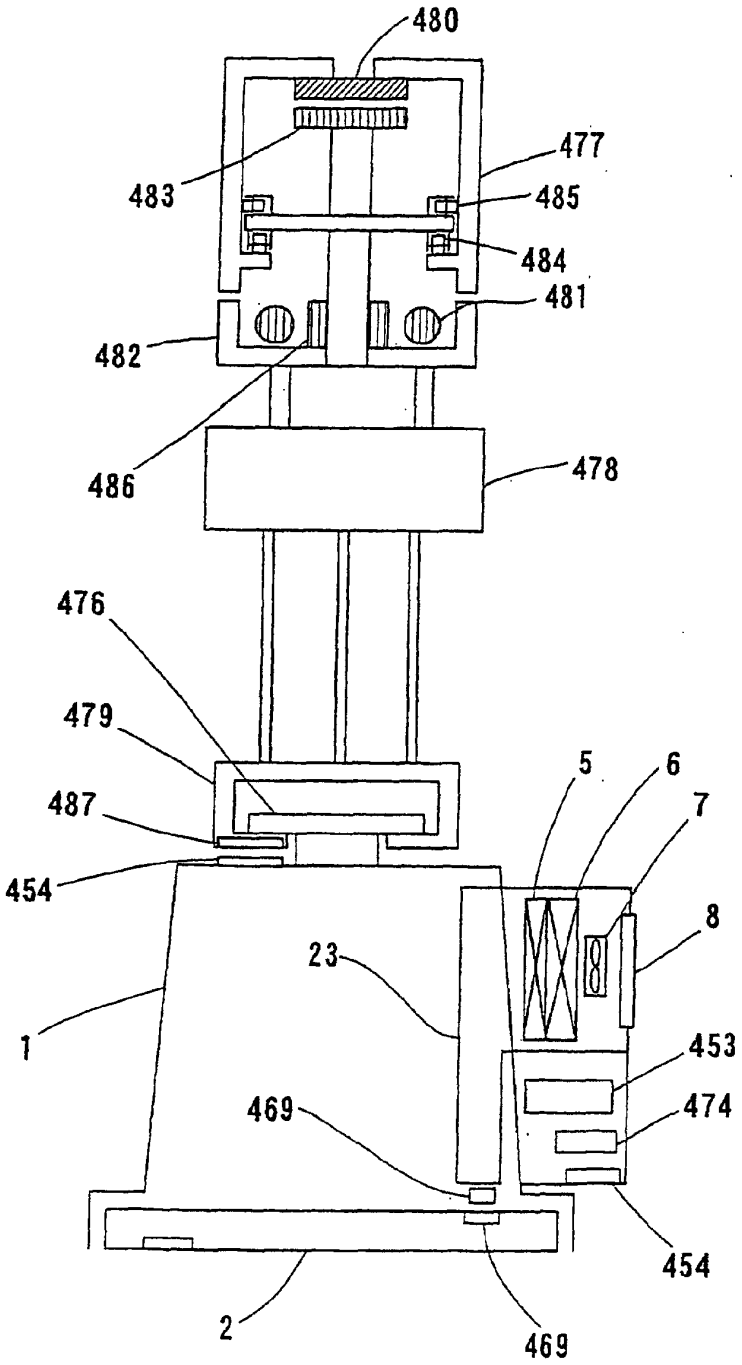
Entegris, EX1002, p. 838

FIG. 91



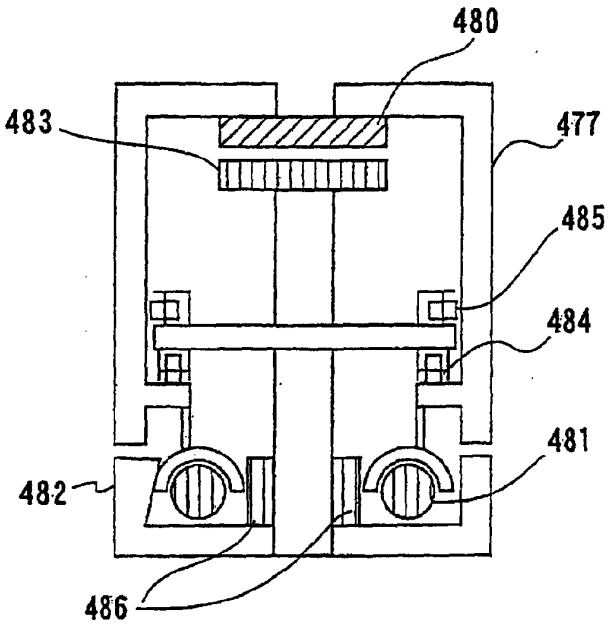
Entegris, EX1002, p. 839

FIG. 92



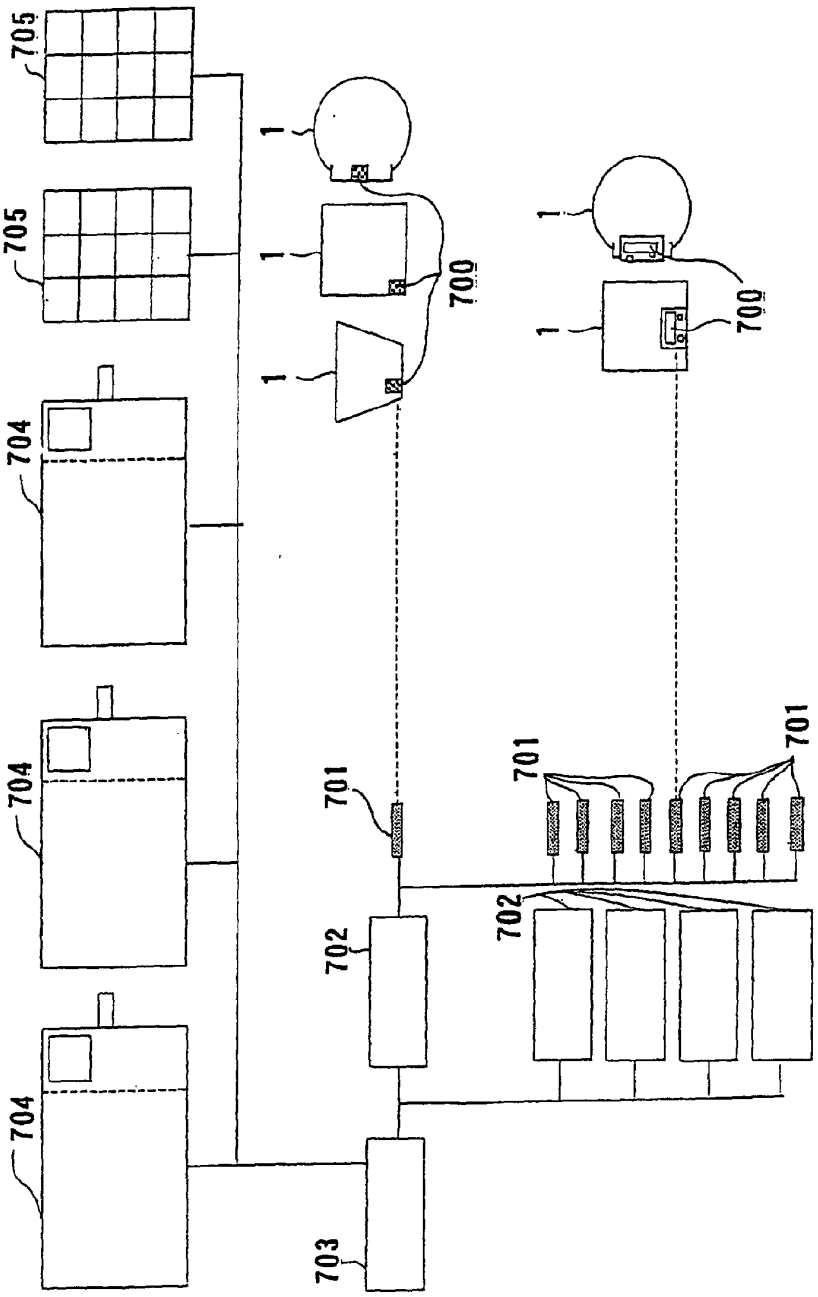
Entegris, EX1002, p. 840

FIG. 93



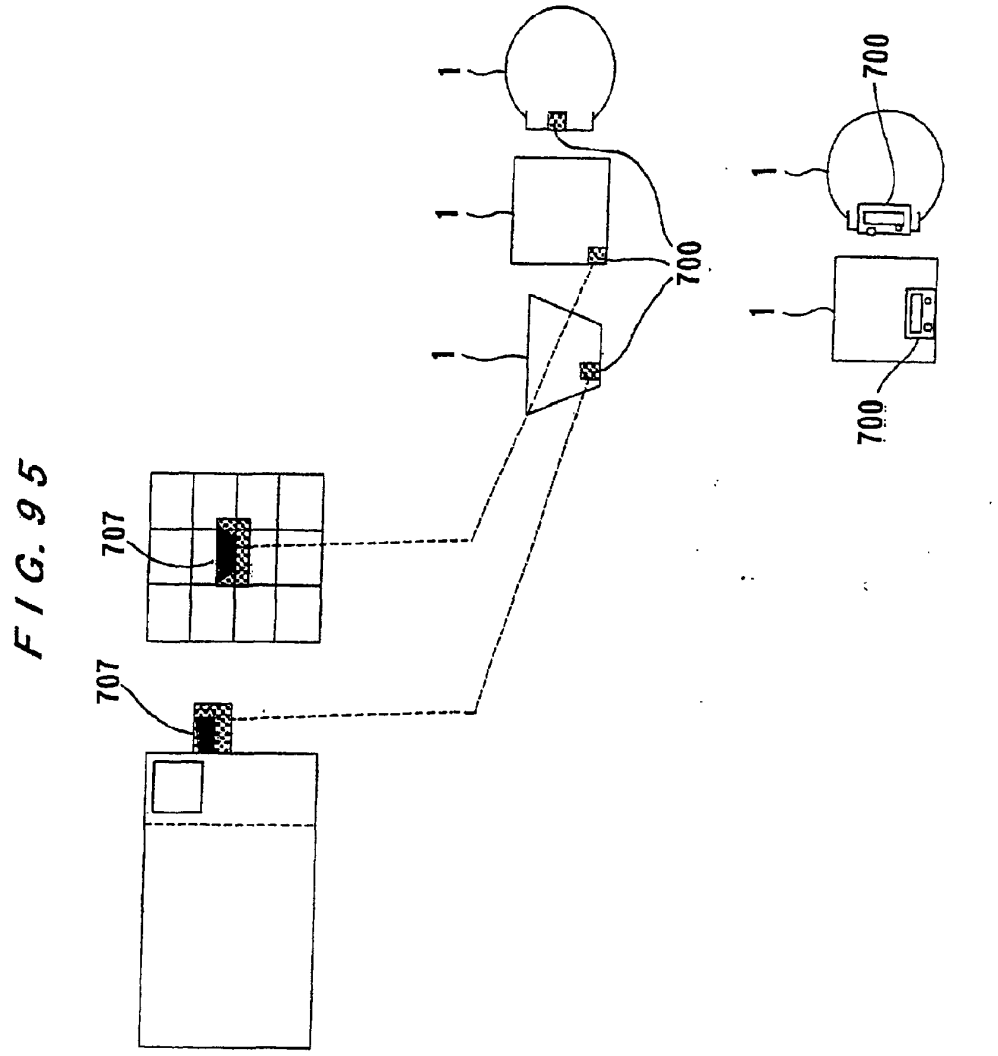
Entegris, EX1002, p. 841

FIG. 94



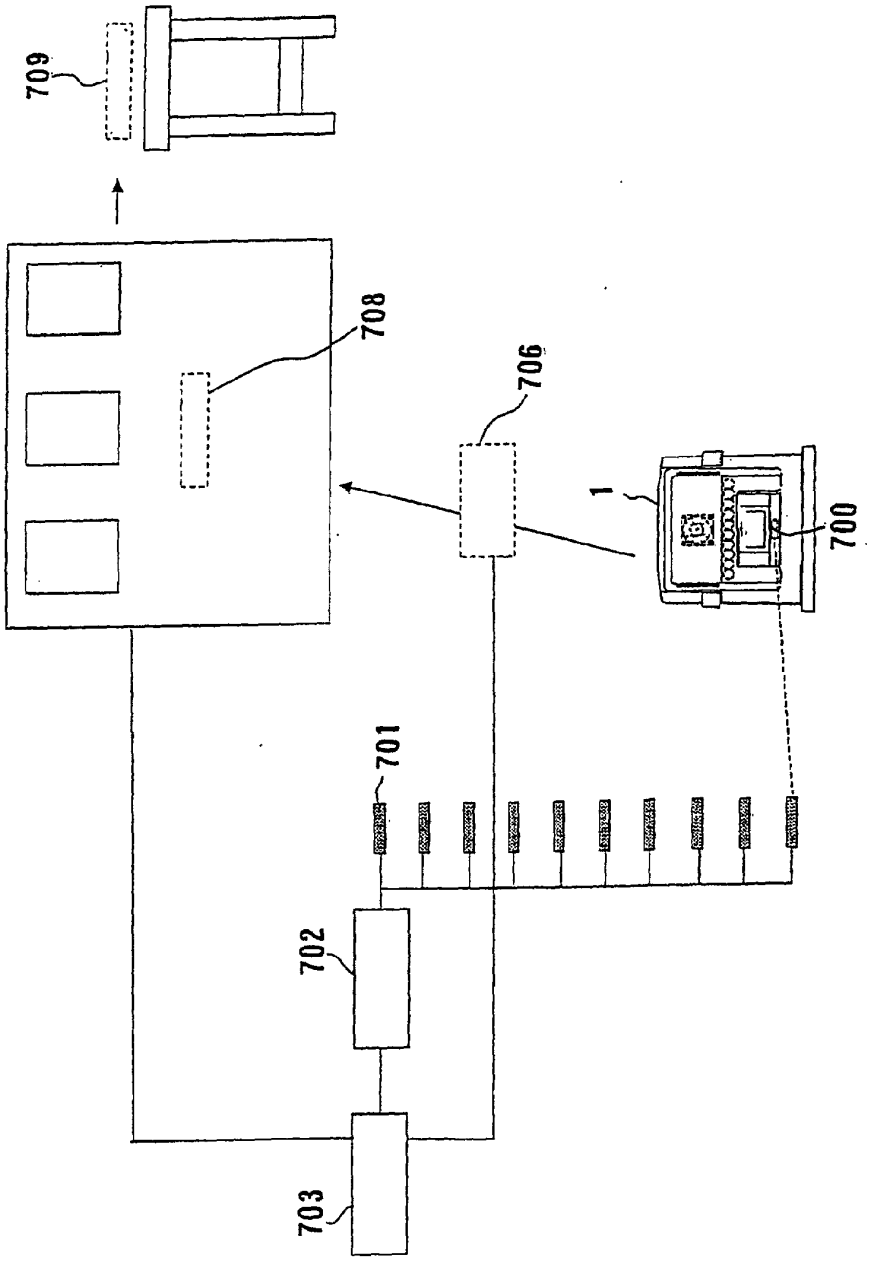
Entegris, EX1002, p. 842

FIG. 95



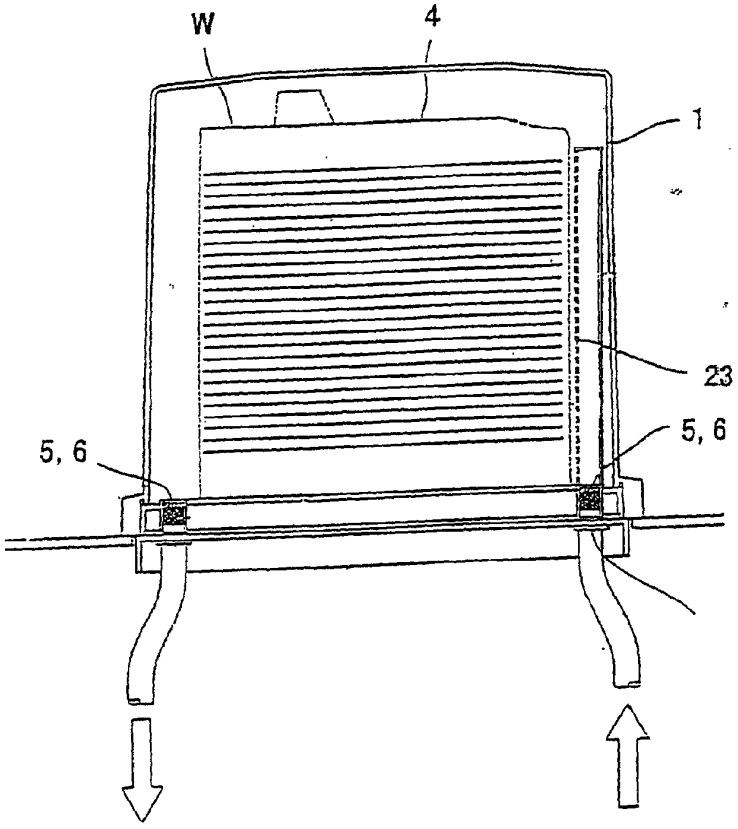
Entegris, EX1002, p. 843

FIG. 96



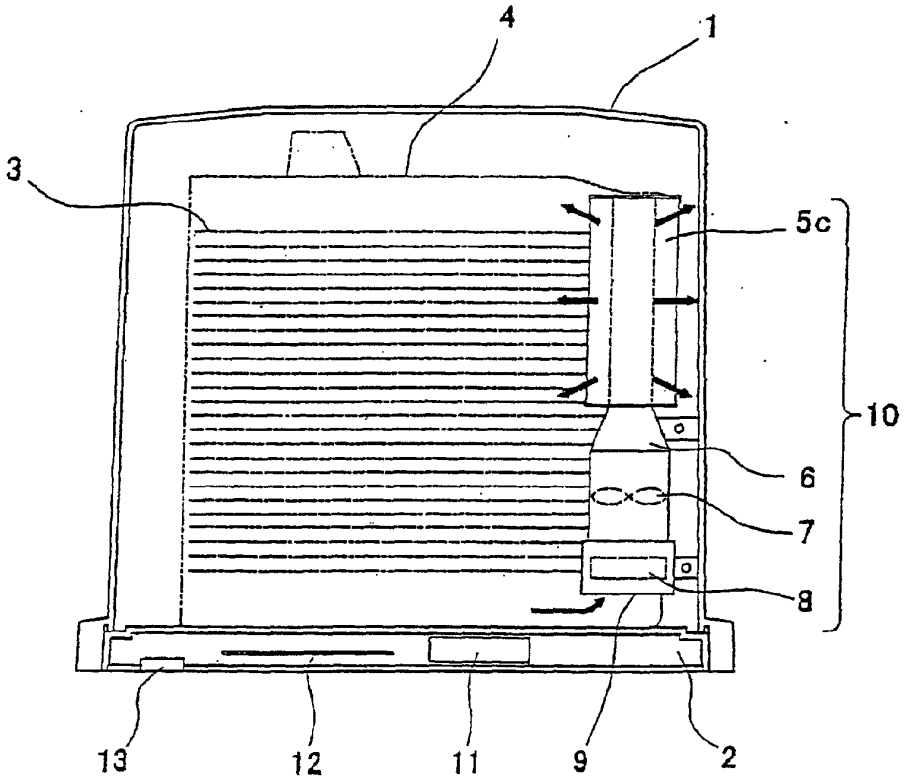
Entegris, EX1002, p. 844

FIG. 97



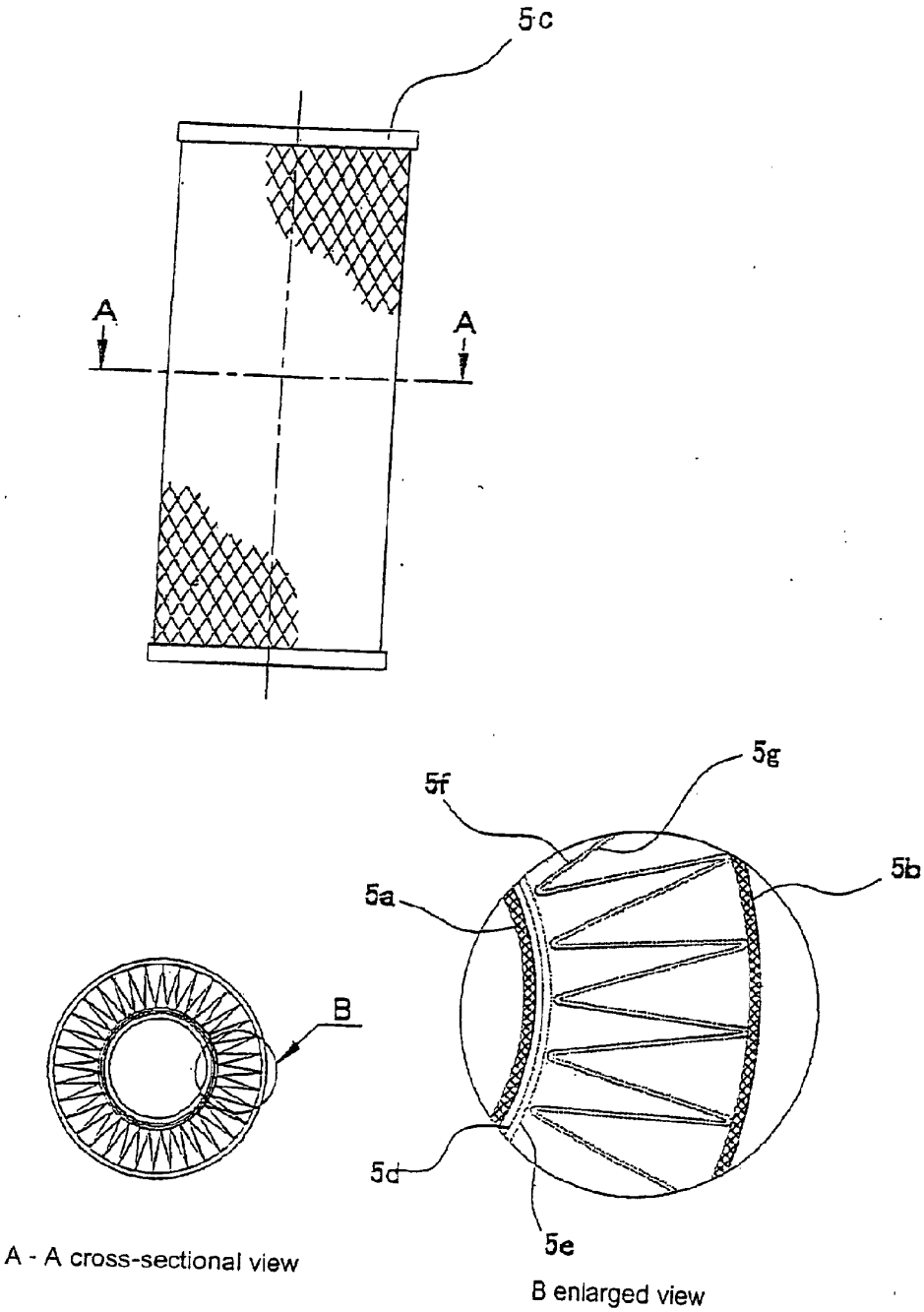
Entegris, EX1002, p. 845

FIG. 98



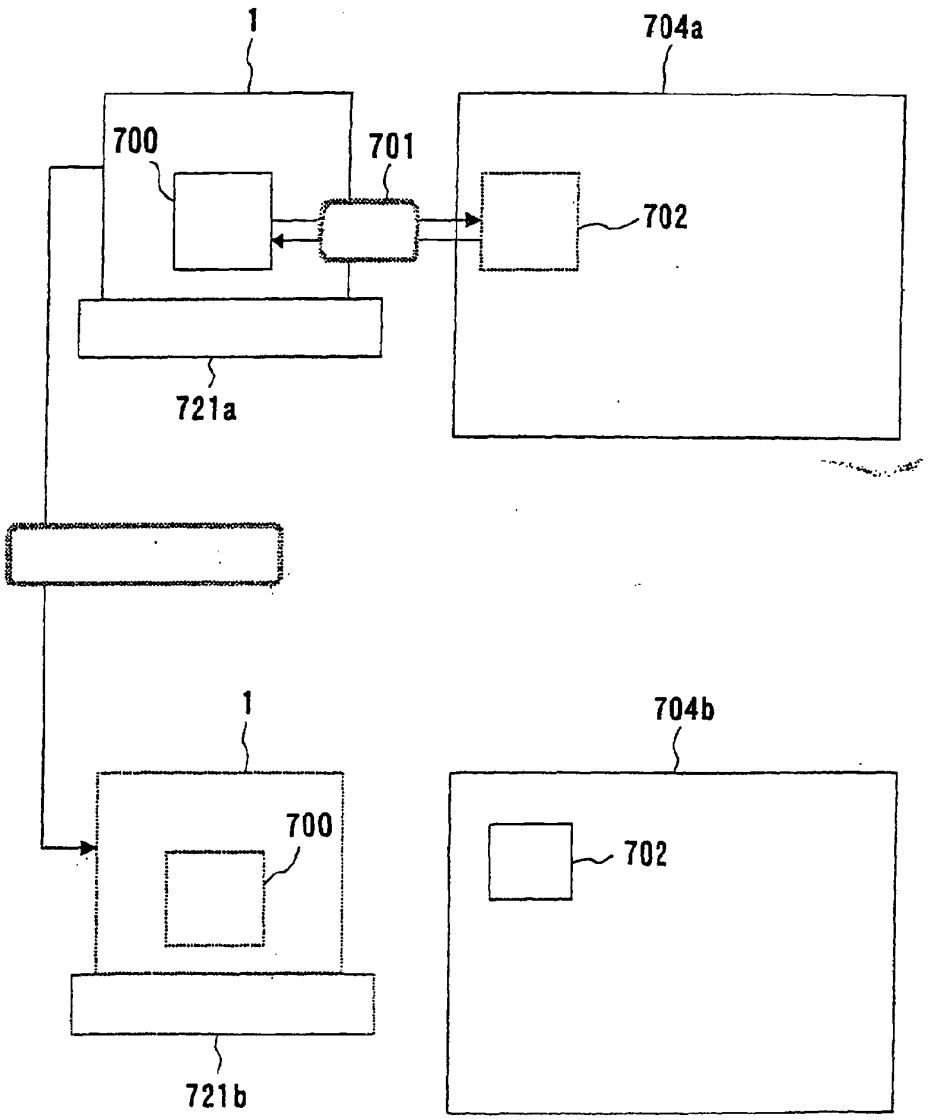
Entegris, EX1002, p. 846

FIG. 99



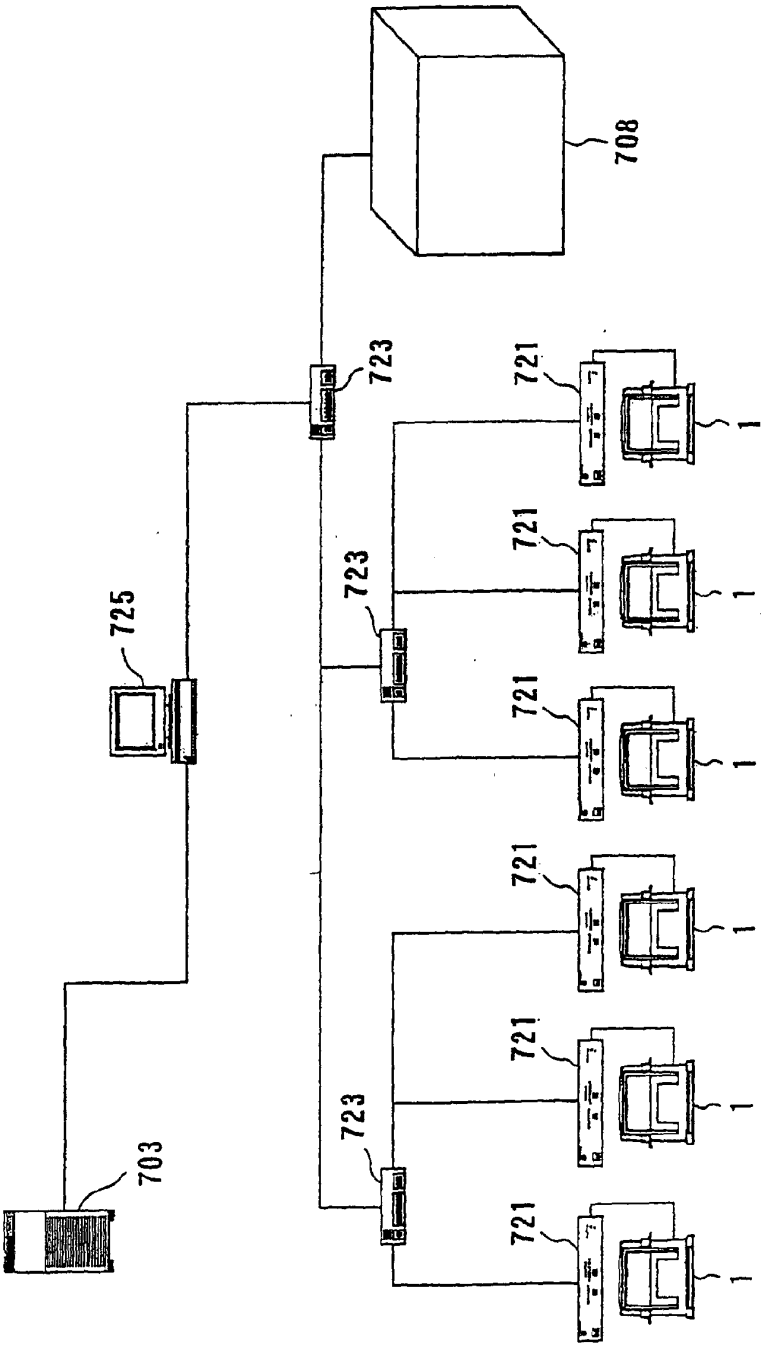
Entegris, EX1002, p. 847

FIG. 100



Entegris, EX1002, p. 848

FIG. 101



Entegris, EX1002, p. 849

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H01L21/68, B65G49/06-49/07, B65D85/86, B65G1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] H01L21/68, B65G49/06-49/07, B65D85/86, B65G1/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2002
Kokai Jitsuyo Shinan Koho 1971-2002 Jitsuyo Shinan Toroku Koho 1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP, 2000-174109, A (Toshiba Corp.), 23 June, 2000 (23.06.00), Full text; Figs. 1, 3, 4, 7 (Family: none)	1,2,4-10, 51-55 3,11-15, 17-38,41-50
A		16,39,40
Y	JP, 9-29020, A (Taisei Corp.), 04 February, 1997 (04.02.97), Par. No. [0058]; Table 5 (Family: none)	3
Y	JP, 6-291177, A (Sony Corp.), 18 October, 1994 (18.10.94), Claims; Fig. 2 (Family: none)	11-15,17-36

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 February, 2002 (26.02.02)	12 March, 2002 (12.03.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

Entegris, EX1002, p. 850

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, 5346518, A1 (International Business Machines Corp.), 13 September, 1994 (13.09.94), Column 16, lines 3 to 22; Fig. 11 & JP 7-94577 A Par. Nos. [0101] to [0102]; Fig. 12 & EP 617573 A & DE 69401023 C	12,30,33
Y	JP, 11-195699, A (Kokusai Electric Co., Ltd.), 21 July, 1999 (21.07.99),	13,15
A	Claims; Figs. 1 to 2 (Family: none)	16
Y	JP, 2000-223554, A (Shinko Electric Co., Ltd.), 11 August, 2000 (11.08.00),	14
A	Claims; Figs. 1 to 2, 5 (Family: none)	16
Y	JP, 11-314703, A (Ebara Corp.), 16 November, 1999 (16.11.99),	15
A	Par. Nos. [0065] to [0067]; Figs. 2 to 3, 29 (Family: none)	16
Y	US, 6040680, A1 (Sanyo Electric Co., Ltd.), 21 March, 2000 (21.03.00), Column 1, lines 10 to 37; Fig. 4 & JP 11-40207 A Par. Nos. [0001] to [0002]; Fig. 4 & TW 381356 B	19-25
Y	EP, 560379, A1 (Ebara Research Co., Ltd.), 15 September, 1993 (15.09.93), Page 7, lines 46 to 53; Fig. 7 & JP 6-29373 A Par. No. [0034]; Fig. 7 & US 5380503 A1 & DE 69304570 C	27
Y	JP, 2000-311936, A (Mitsubishi Materials Silicon Corp.), 07 November, 2000 (07.11.00), Par. No. [0030]; Figs. 1, 8 (Family: none)	31-34
Y	JP, 7-293956, A (Hitachi Plant Engineering & Construction Co., Ltd.), 10 November, 1995 (10.11.95), Column 4, lines 27 to 44; Fig. 1 (Family: none)	32
Y	JP, 7-125806, A (Hitachi, Ltd.), 16 May, 1995 (16.05.95),	37,38,41-50
A	Full text; Figs. 1 to 3 (Family: none)	39,40
Y	JP, 3-143518, A (Mitsubishi Electric Corp.), 19 June, 1991 (19.06.91), Page 2, lower right column, lines 9 to 17; page 3, lower right column, line 9 to page 4, upper right column, line 10; Fig. 6 (Family: none)	45

Form PCT/ISA/210 (continuation of second sheet) (July 1998)

Entegris, EX1002, p. 851

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

C (Continuation). *DOCUMENTS CONSIDERED TO BE RELEVANT*

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 11-274282, A (TDK Corp.), 08 October, 1999 (08.10.99), Par. No. [0011] (Family: none)	46,50
Y	JP, 2000-253596, A (Matsushita Electric Industrial Co., Ltd.), 14 September, 2000 (14.09.00), Claims; Fig. 1 (Family: none)	47

Form PCT/ISA/210 (continuation of second sheet) (July 1998)

Entegris, EX1002, p. 852

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/10546

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Claims 1, 8, 37, and 55 relate to a technological matter for removing moisture, particulate matter, and chemical substances from a container.
Claim 11 relates to a technological matter for removing static electricity from a substrate in a container.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 555 689 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
19.05.2010 Bulletin 2010/20

(21) Application number: **03748661.0**

(22) Date of filing: **01.10.2003**

(51) Int Cl.:
H01L 21/00 *(2006.01)* ***F16K 15/02*** *(2006.01)*
F16K 15/06 *(2006.01)*

(86) International application number:
PCT/JP2003/012612

(87) International publication number:
WO 2004/038789 (06.05.2004 Gazette 2004/19)

(54) **SUBSTRATE STORAGE CONTAINER**

SUBSTRATSPEICHERBEHÄLTER

RECIPIENT DE STOCKAGE DE SUBSTRAT

(84) Designated Contracting States:
DE FR IT

(30) Priority: **25.10.2002 JP 2002311275**
28.11.2002 JP 2002344954

(43) Date of publication of application:
20.07.2005 Bulletin 2005/29

(73) Proprietor: **SHIN-ETSU POLYMER CO., LTD.**
Tokyo 103-0023 (JP)

(72) Inventors:
- **SUMI, Atsusi**
  Itoigawa-shi, Niigata 941-0067 (JP)
- **TODA, Junya**
  Itoigawa-shi, Niigata 941-0067 (JP)
- **NAKAYAMA, Takayuki**
  Itoigawa-shi, Niigata 941-0062 (JP)

(74) Representative: **Oppermann, Frank**
Luderschmidt, Schüler & Partner
Patentanwälte
John-F-Kennedy-Strasse 4
65189 Wiesbaden (DE)

(56) References cited:

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JP-A- 9 280 399	**JP-A- 11 150 178**
JP-A- 2000 315 724	**JP-U- 5 034 371**
JP-U- 6 006 843	**JP-U- 62 193 537**
US-A- 4 909 276	**US-A- 5 879 458**
US-A- 6 044 874	**US-B1- 6 199 604**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

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EP 1 555 689 B1

Description

Technical Field

[0001] The present invention relates to a gas-purgeable, substrate storage container for storing substrates such as semiconductor wafers, photomask glass, and detailedly relates to a valve unit for gas purging, for controlling the gas flow, both into and from, the substrate storage container.

Background Art

[0002] In the recent semiconductor industry, as seen in the case of DRAM (Dynamic Random Access Memory) production, while there has been competition for acquisition of market-share due to cost reduction of semiconductor devices, revision of the production system, for cost reduction, as well as development of semiconductor wafers used for production of semiconductor devices into large sizes (300 mm or greater) have been in progress.

[0003] As to the revision of the production system, there is an example where the system in which the whole semiconductor manufacturing plant is kept as a highly clean environment (e.g., class 10 clean or above) to manufacture semiconductor devices is transferred to the system in which multiples processing steps of semiconductor wafers are divided into sections, each interior space being maintained to be highly clean while semiconductor wafers are conveyed by substrate storage containers between the processing steps.

[0004] According to such a new system, the installation cost for clean room construction as well as the running cost for its maintenance can be sharply cut down, and yet with increased production yield in the semiconductor device manufacturing.

[0005] The standards of the substrate storage containers used in the semiconductor production plant using this new system are specified by SEMI standards (E19, E47.1, E62, E63 and others), so that the container has a conveyance device for automated in-plant transportation and a door in compliance with FIMS, which can be attached and removed by automation. Further, the substrate storage container is demanded to have high hermetic sealing property for avoiding contamination of the semiconductor wafers and also, in order to keep the interior of the container body clean it should be formed using clean material that emits a lower amount of volatile gases.

[0006] The minimum conductor width of electronic circuits formed on semiconductor devices tends to be smaller and smaller (0.01 pm or below). In order to facilitate this, it is necessary to prevent the surfaces of the semiconductor wafers held in the substrate storage container from being formed with a natural oxide film and being contaminated with organic matter. As a countermeasure against this, there is a method called the gas purge (replacement) technique, which drives out the interior of the substrate storage container with an inert gas such as nitrogen or dry air with moisture removed (equal to or below 1%).

[0007] With regard to this, some techniques have been proposed: a filter is attached by providing a partial opening in the substrate storage container; or valves such as check valves, etc., are provided at the periphery of the opening so as to achieve gas purging (see Japanese Patent Application Laid-open Hei 11 No.191587 and Japanese Patent Application Disclosure 2002-510150).

[0008] The conventional substrate storage containers, which are constructed and gas purged as above, suffer from the following problems.

[0009] First, in the case where gas purge is performed with a valve attached to the substrate storage container, an engagement structure for valve attachment is needed. However, this engagement structure increases the complexity of the arrangement. An ordinary valve has a hollow portion with a narrow opening, and a shutoff valve that closes this opening is provided to come into contact with a tapered portion of the opening, creating a sealing structure. This shutoff valve is readily displaced by repeated usage, resultantly presenting a leakage problem due to imperfect seal. Further, since the ordinary valve incorporates more than a few metallic parts such as a spring for valve control and the like, there is a fear that a very small quantity of metal ions, discharged from the metal parts while the substrate storage container is put in storage or during its cleaning, infiltrates into the substrate storage container, contaminating semiconductor wafers.

[0010] On the other hand, in the case where a filter is merely attached to the substrate storage container, gas purge can be done with a simple configuration. In this case, however, there is a problem in that the purging gas charged through the filter, however, cannot be kept inside the substrate storage container. Therefore, the gas in the substrate storage container can easily leak out, so that the gas purge effect can be maintained in only a short period. There is also a problem in that it is impossible to effectively prevent a trace amount of organic matter in the clean room from flowing into the interior of the substrate storage container from exterior because there is a passage between inside and outside of the substrate storage container.

[0011] US 5,879,458 describes a system for molecular contamination control comprising a housing forming a chamber. A valve unit is inserted in a through-hole of the housing. The valve unit comprises a fixed sleeve fitted in the through-hole and a check valve fitted in the fixed sleeve. The check valve comprises an outer sleeve and a ball inserted into the outer sleeve so as to allow one-way flow of working fluid through the opening of the outer sleeve only.

[0012] US 6,199,604 discloses a substrate storage container comprising an inlet and outlet valve unit. The valve unit comprises a fixed sleeve fitted in a through-hole of the housing and a holding sleeve connected to the fixed sleeve. An elastic check-valve comprising an

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elastically deformable element is arranged between the holding sleeve and the fixed sleeve.

[0013] In view of the above, it is an object of the present invention to provide a substrate storage container according to claim 1 in which the engagement structure for valve attachment can be simplified, which can prevent displacement of the valve due to repeated usage and hence prevent incomplete sealing and which is free from the risk of traces of discharged metal ions contaminating the substrates. It is also another object to enable relatively long-term holding of purging gas and to efficiently prevent inflow of contaminant from the outside to the inside of the container.

[0014] Here, the container bodies within the range of the claims are mainly of a front-open box type. However, a top-open, bottom-open or side-open type may be used. Also, whether it is transparent or opaque is not particularly limited. This container body accommodates a single or a multiple number of substrates or the like such as semiconductor wafers, photomask glass, etc. The gas is usually inert gas or dry air, but is not particularly limited.

[0015] Also, the valve units maybe attached to the through-holes in both the container body and the door, or may be the through-holes in either the container body or the door. One or plural valve units may be used. The elastic check valve can be formed of a single part or made up of separate parts, i.e., a check valve and an elastically deformable element. A single or multiple sealing elements may be attached to the check valve, so that the sealing element(s) is placed into deforming contact with the fixed sleeve or the interior lid sleeve. The elastically deformable element may be built in the holding sleeve, leaving a clearance therebetween, but not necessary so. Further, the interior lid sleeve may be supported by the holding sleeve by an engaging means made up of concave and convex shapes.

Brief Description of Drawings

[0016]

Fig.1 is a perspective exploded view showing the embodiment of a substrate storage container according to the present invention.

Fig.2 is a bottom view showing a container body in the embodiment of a substrate storage container according to the present invention.

Fig.3 is a perspective exploded view showing a valve unit, cut along a chain line I-I in Fig.1, in the embodiment of a substrate storage container according to the present invention.

Fig.4 is a sectional illustrative view showing a gas inlet valve in the embodiment of a substrate storage container according to the present invention.

Fig.5 is a sectional illustrative view showing the gas inlet valve, shown in Fig.4, to which gas is supplied.

Fig.6 is a sectional illustrative view showing a gas discharge valve in the embodiment of a substrate storage container according to the present invention.

Fig.7 is a sectional illustrative view showing the gas discharge valve, shown in Fig. 6, from which gas is discharged.

Fig.8 is an illustrative plan view showing a jig for gas purge in the embodiment of a substrate storage container according to the present invention.

Fig.9 is a side view showing the jig for gas purge in Fig.8 in its usage state.

Fig.10 is a sectional illustrative view showing a gas inlet valve in the second embodiment of a substrate storage container according to the present invention.

Fig.11 is a sectional illustrative view showing a gas discharge valve in the second embodiment of a substrate storage container according to the present invention.

Fig.12 is a perspective exploded view showing the third embodiment of a substrate storage container according to the present invention.

Fig.13 is a bottom view showing a container body in the third embodiment of a substrate storage container according to the present invention.

Fig.14 is a perspective exploded view showing a valve unit, cut along a chain line II-II in Fig.12, in the third embodiment of a substrate storage container according to the present invention.

Fig.15 is a sectional illustrative view showing a gas inlet valve in the third embodiment of a substrate storage container according to the present invention.

Fig.16 is a sectional illustrative view showing the gas inlet valve, shown in Fig.15, to which gas is supplied.

Fig.17 is a sectional illustrative view showing a gas discharge valve in the third embodiment of a substrate storage container according to the present invention.

Fig.18 is a sectional illustrative view showing the gas discharge valve shown in Fig.17, from which gas flows out to the outside.

Fig.19 is a partial sectional illustrative view showing the fourth embodiment of a substrate storage container according to the present invention.

Fig.20 is a partial sectional illustrative view showing the fifth embodiment of a substrate storage container according to the present invention.

Fig.21 is a sectional illustrative view showing a gas inlet valve in the sixth embodiment of a substrate storage container according to the present invention.

Fig.22 is a sectional illustrative view showing a gas discharge valve in the sixth embodiment of a substrate storage container according to the present invention.

Fig.23 is a sectional illustrative view showing a gas discharge valve in the seventh embodiment of a substrate storage container according to the present invention.

Fig.24 is a sectional illustrative view showing a gas inlet valve in the seventh embodiment of a substrate storage container according to the present invention.

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Best Mode for Carrying Out the Invention

[0017] The preferred embodiment of the present invention will be described hereinbelow with reference to the drawings. The substrate storage container of the present embodiment is comprised of, as shown in Figs. 1 to 7, a container body 1 for accommodating and aligning a plurality of semiconductor wafers W in horizontal layers along the vertical direction, a door 10 which is removably attached to the front opening of the container body 1 to open and close it, and a pair of valve units 20 disposed in the bottom of container body 1 for controlling gas flow with respect to container body 1. Of the pair of valve units 20, one valve unit 20 is used as a gas inlet valve 20A, the other valve unit 20 as a gas discharge valve 20B.

[0018] As the semiconductor wafers W, 25 or 26 pieces of 300 mm silicon wafers, for example, may be accommodated therein.

[0019] As shown in Fig.1, container body 1 is formed as a front-open box type, having an opening on one side or on the front, using polycarbonate or the like, added with carbon fibers, conductive polymers or the like so as to present conductivity. Provided on both the interior sides are supporting structures (not shown) for supporting the rims of semiconductor wafers W at both sides by supporting pieces. As shown in Fig.2 an approximately Y-shaped, in plan view, bottom plate 2 having through-holes for detection and discrimination of the substrate storage container type is removably attached to the bottom of this container body 1. This bottom plate 2 has positioning members 3 having an approximately V-shaped section and arranged at both sides in front and one in the rear for positioning with respect to processing equipment. Other than these plurality of positioning members 3, bottom plate 2 has through-holes for attachment of an identification maker and clamp holes for fixture to the container body are bored, respectively.

[0020] Formed on both sides on the front part of the bottom of the container body, or in other words, in the area not overlapping the projected area of semiconductor wafers W, are round through-holes 4, respectively, as shown in Figs.1 to 3. At the periphery of each through-hole 4, a cylindrical rib 5 externally projected downwards is integrally formed. A handle 6 is removably attached to the top of container body 1. This handle 6 is held by an automaton called OHT (overhead hoisting transfer), whereby the substrate storage container is transferred from one step to another. A wide rim portion 7 for door fitting is integrally formed around the periphery of the front opening of container body 1. Formed in the interior of the rib portion 7 at both the top and bottom are hollow, door engagement slots 8. A pair of carrying handles 9 for manual handling are removably attached externally on both side of container body 1.

[0021] Door 10 is formed in a laterally long, approximately rectangular shape with four rounded corners, and incorporates an unillustrated interlocking mechanism. This interlocking mechanism includes a multiple number of retractable engagement prongs, which can project and retract from retraction holes 11 on the peripheral wall, and project and fit into engagement slots 8 of rim portion 7, so that the door 10 fitted to container body 1 will be tightly closed. A stepped portion that fits rim portion 7 of container body 1 is projectively formed on the rear side of door 10. Attached in a removable manner to this stepped portion is a front retainer 12 for supporting and aligning multiple semiconductor wafers W in their horizontal position with a predetermined pitch along the vertical direction. An endless gasket 13 for seal with container body 1 is fitted on the peripheral wall of door 10.

[0022] Here, container body 1, bottom plate 2, handle 6, carrier handles 9 and door 10 are formed of thermoplastic resin such as, for example, polycarbonate, polyetherimide, polyetheretherketone, cyclic olefine polymer (COP), or one of these added with conductivity.

[0023] As shown in Fig.3 and others, each valve unit 20 is constructed of a fixed sleeve 21 that is removably attached to rib 5 of through-hole 4 of container body 1 from below and forms the gas flow passage, a holding sleeve 25, removably attached to through-hole 4 of container body 1 from above with an O-ring 31 for seal interposed therebetween and screw fitted with fixed sleeve 21, a check valve 32 built in for defining a clearance 33 between the fixed sleeve 21 and holding sleeve 25, an elastically deformable element 36 for opening and closing this check valve 32, an interior lid sleeve 37 that opposes check valve 32 and holds elastically deformable element 36 and forms the gas flow passage, and a disk-shaped filter 42 interposed between holding sleeve 25 and interior lid sleeve 37. Check valve 32 and elastically deformable element 36 constitute an elastic check valve, which controls gas flow from fixed sleeve 21 to holding sleeve 25.

[0024] As shown in Figs.3 to 7, fixed sleeve 21 is basically a cylinder with a base, formed using polycarbonate, polyetherimide, polyetheretherketone, or the like, with a threaded groove 22 incised for fastening formed on the inner periphery thereof. This fixed sleeve 21 has a round vent port 23 formed at the bottom center for creating a gas flow passage. An annular flange 24 extending radially outwards is formed around the outer periphery at the bottom. This flange 24 abuts from below against the rim of the opening of rib 5.

[0025] As shown in Figs. 3 and 4, holding sleeve 25 is basically formed of the same resin as fixed sleeve 21, for example, in a cylindrical shape that is formed in a size smaller to snugly fit into fixed sleeve 21. In the opening top, sectioning ribs 27 for sectioning the opening into multiple vents 26 for gas flow passage are formed in a lattice-like or radial configuration. The underside of these sectioning ribs 27 serve as an abutment face 28 having a corresponding shape to a filter 42 and receiving it. This holding sleeve 25 has an annular flange 29 that extends radially outwards from the upper peripheral side. This flange 29 comes into contact from above with the rim of through hole 4. A thread 30 for fastening is formed on

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the outer periphery of holding sleeve 25 so that this thread 30 will mesh with threaded groove 22 of fixed sleeve 21.

[0026] O-ring 31 is disposed between through-hole 4 and the outer periphery of holding sleeve 25 to effectively prevent infiltration of gas into container body 1 and gas leakage from container body 1.

[0027] Check valve 32, as shown in Figs.3 to 7 and others, is formed in a disk-like configuration having an approximately plate-shaped section or an approximately hat-like section, using predetermined material based on the usage of valve unit 20, and is fitted and placed on the interior base of fixed sleeve 21 so as to cover the round vent port 23 and define clearance 33 as gas flow passage in cooperation with the inner periphery of holding sleeve 25. As the material for this check valve 32, polyethylene, polypropylene, polycarbonate, cyclic polyolefin polymer, thermoplastic polyester elastomer can be referred to, for example. A guided part 34 having an approximate concave-top section for preventing displacement is projectively formed from the center of the check valve 32 surface while an endless sealing element 35 is fitted along the periphery on the undersurface. This sealing element 35 provides the function of a sealing contact, by deformation, with the inner base of fixed sleeve 21.

[0028] Sealing element 35 is an O-ring, for example, or an elastic ring formed of fluoro rubber, NBR rubber, urethane rubber, EPDM rubber, silicone rubber or the like, coated with fluorine or silicone on the surface thereof, as appropriate. When formed with metal, the surface is coated with resin. When valve unit 20 is used as a gas discharge valve 20B instead of its usage as a gas inlet valve 20A as shown in Figs. 4 and 5, this sealing element 35 is fitted to the stepped periphery on the surface side of check valve 32 and pressed against the opening rim of interior lid sleeve 37, as shown in Figs. 6 and 7.

[0029] When valve unit 20 is used as a gas inlet valve 20A, the thus constructed check valve 32 covers vent port 23 of fixed sleeve 21 by the elastically repulsive action of elastically deformable element 36, as shown in Fig.4. On the other hand, when valve unit 20 is used as a gas discharge valve 20B, the check valve and elastically deformable element 36 are arranged upside down, and is placed on and supported by elastically deformable element 36 and pressed against the opening rim of interior lid sleeve 37 (see Figs.6 and 7).

[0030] Elastically deformable element 36 is comprised of a coil spring formed of SUS, synthetic resin or the like, and is disposed between guided part 34 of check valve 32 and interior lid sleeve 37 or between the inside of check valve 32 and fixed sleeve 21. This elastically deformable element 36, in most cases, employs a coil spring shown in the drawings, but is not limited to this. Elastic rubbers, elastomers, foamed materials, leaf springs and the like can also be used. Further, coil springs with their surface coated with a synthetic resin or elastomer can be used. In this case, discharge of a trivial amount of metal ions can be preferably prevented.

[0031] When valve unit 20 is used as a gas inlet valve 20A, the elastically deformable element 36 is fitted to the recessed surface side of check valve 32 as seen in Figs. 3 to 5. When valve unit 20 is used as a gas discharge valve 20B, the elastically deformable element is arranged upside down with respect to check valve 32 and placed at the periphery of vent port 23 of fixed sleeve 21 (see Figs.6 and 7).

[0032] Interior lid sleeve 37 is basically formed in a cylindrical shape, as shown in Figs.3 to 7, of the same material as fixed sleeve 21, with sectioning ribs 39 for sectioning its top opening into multiple vents 38 for gas flow passage in a lattice-like or radial configuration, and is held in holding sleeve 25 and placed in contact with elastically deformable element 36. This interior lid sleeve 37 is fitted and supported by means of a concavo-convex mating structure into holding sleeve 25 while an O-ring 40 for sealing is disposed between the interior lid sleeve and the upper interior part of holding sleeve 25. A guide element 41 having an approximate convex-top section for assembly convenience and limiting displacement is projectively formed from the center of the undersurface of sectioning ribs 39 of interior lid sleeve 37. This guide element 41 slidably mates into guided element 34. One example of the concavo-convex mating structure can be constructed such that a slot formed on the inner periphery of holding sleeve 25 or on the outer periphery of interior lid sleeve 37 may be engaged with a projection to fit into the slot, formed on the outer periphery of interior lid sleeve 37 or on the inner periphery of holding sleeve 25.

[0033] When valve unit 20 is used as a gas inlet valve 20A, this interior lid sleeve 37 is in contact with elastically deformable element 36, while, when valve unit 20 is used as a gas discharge valve 20B, this interior lid sleeve 37 is in contact with elastically deformable element 36, its open bottom is pressed against the peripheral part of check valve 32 with sealing element 35 in between (see Figs.6 and 7).

[0034] Filter 42 is composed of a molecular filter consisting of tetrafluoroethylene, polyester fiber, porous Teflon (registered trademark) film and glass fiber and/or a chemical filter in which chemical adsorbents are deposited on filter media such as activated carbon fiber and the like. A single or multiple number of filters are interposed and held between abutment face 28 of holding sleeve 25 and sectioning ribs 39 of interior lid sleeve 37 so as to cover the vents 38 of interior lid sleeve 37. A protective member made of polypropylene, polyethylene or the like is laminated as appropriate over the front and rear sides of filter 42.

[0035] When a multiple number of filters 42 are employed, the same type of filters may be used or different types of filters may be used. For example, if a molecular filter and a chemical filter are used in combination, organic gas contamination in addition to particle contamination of wafers W can be prevented.

[0036] Though assembly of valve unit 20 may be done by thread joint, another joint may be used alone or in combination with thread joint. For example, a recessed

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portion may be formed in one of fixed sleeve 21 and holding sleeve 25 while a projected portion may be formed in the other, so that these recess and projection can mate each other to complete fixture. It is also possible to form a recessed portion in one of holding sleeve 25 and interior lid sleeve 37 and a projected portion in the other, so that these recess and projection can be mated to each other to complete fixture.

[0037] Gas purge of the substrate storage container having the thus configured valve units 20 is carried out during being docked to the door opening/closing machine (load port or door opener), during storage at the stocker, during engagement in the process and/or during conveyance on the way to the stocker. For this purpose, if the machine side is equipped with a gas purge jig 60 and the substrate storage container is set to the gas purge jig 60, smooth, efficient and easy performance of gas purging can be expected.

[0038] Gas purge jig 60 may be configured of, as shown in Figs.5 and 7 to 9, for example, a housing body 62 having substrate storage container positioning pins 61 laid out in an approximate Y-arrangement, an air feed nozzle 63 disposed in the housing body 62 and connected to one valve unit 20, an air discharge nozzle 64 disposed in housing body 62 and connected to another valve unit 20, an air feed path built in housing 62 for connection between air feed nozzle 63 and a gas feed source and an air discharge path built in housing 62 for connection between air discharge nozzle 64 and a discharge device.

[0039] For air feed nozzle 63 and air discharge nozzle 64, seal forming means for prevention against gas leakage is formed appropriately around their projected portions. For example, air feed nozzle 63 is configured so that it projects from the contact surface of housing body 62 so as to be connected to valve unit 20 when it is used and it sinks in to housing body 62 so as to flatten the contact surface of housing body 62 when it is not used.

[0040] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, check valve 32 of gas inlet valve 20A is pressed against the interior bottom face of fixed sleeve 21 via sealing element 35 by the repulsive force of elastically deformable element 36 so as to close vent port 23, completing a sealed state (see Fig.4).

[0041] In contrast, when a gas such as an inert gas etc., is fed from air feed nozzle 63 of gas purge jig 60 to gas inlet valve 20A, the pressure of the gas ejected from air feed nozzle 63 urges check valve 32 of gas inlet valve 20A toward interior lid sleeve 37, compressing elastically deformable element 36 in the same direction, whereby check valve 32 forms a gap with respect to vent port 23 of fixed sleeve 21, releasing the sealed state (see Fig. 5). This cancellation of the sealed state causes gas to flow from the substrate storage container exterior, passing through the clearance 33 between vent port 23 of fixed sleeve 21 and check valve 32, the gap, interior lid sleeve 37 and filter 42, in the order mentioned, into the interior of the substrate storage container.

[0042] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, elastically deformable element 36 of gas discharge valve 20B presses check valve 32 over sealing element 35 and toward and against the opening rim of interior lid sleeve 37, forming a sealed state.

[0043] In contrast, when the substrate storage container interior is filled up with a gas, the pressure of the filling gas presses check valve 32 of gas discharge valve 20B toward fixed sleeve 21, expanding elastically deformable element 36 in the same direction, forming clearance 33 between check valve 32 and interior lid sleeve 37 to cancel the sealed state. This cancellation of the sealed state causes gas to flow out from the substrate storage container interior, passing through filter 42, interior lid sleeve 37, the clearance between check valve 32 and interior lid sleeve 37, the gap and vent port 23 of fixed sleeve 21, in the order mentioned, to the outside of the substrate storage container. In this case, gas purge can be efficiently done if air discharge nozzle 64 of gas purge jig 60 is connected to gas discharge valve 20B so as to reduce the pressure.

[0044] According to the above configuration, it is possible to create a firm engagement structure which is free of possible dislodgment by abutting flanges 24 and 29 of fixed sleeve 21 and holding sleeve 25 mating each other, against through-hole 4 and rib 5 of container body 1. Therefore, the configuration of the engagement structure can be made simple, and still the metallic mold for container body 1 can be simplified. Further, since guided part 34 and guide element 41 mate each other, providing the function of controlling positional displacement, check valve 32 can operate stably never causing positional displacement even with repeated use. Accordingly, it is possible to provide an efficient solution to the problem whereby leakage occurs due to imperfect sealing hence beneficial gas purge can be expected. Further, since valve unit 20 does not need to incorporate a number of metallic parts, it is possible to inhibit a trace amount of metal ions from being released from such a metal part when the substrate storage container is kept in storage or washed, and it is also possible to expect simplification and cost reduction of valve unit 20.

[0045] Moreover, fitting of a sealing element 35 to check valve 32 at the peripheral part of the front or rear surface, as appropriate so that it will be pressed in the perpendicular direction, makes it possible for valve unit 20 to be effectively used as a gas inlet valve 20A or as a gas discharge valve 20B. As a result, it is possible to lengthen the retention duration of the replaced gas in the interior of the substrate storage container, hence maintain the gas purge effect for a long period. Also, since the clearance 33 between holding sleeve 25 and the periphery of check valve 32 can be made wide open, efficient gas purge can be greatly expected. Further, since valve unit 20 incorporating filter 42 is attached to the sub-

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strate storage container, the filter 42 is not only effective in gas purging but also in retaining the purging gas in the substrate storage container interior. Accordingly, the gas will not readily flow outside from the substrate storage container, hence it is possible to maintain the gas purge effect for a prolonged period of time. Moreover, since provision of valve units 20 allow for indirect communication between the interior and exterior of the substrate storage container, it is possible to almost perfectly prevent the organic matter that trivially exists in the clean room from infiltrating into the inside from the outside of the substrate storage container.

[0046] Next, Figs.10 and 11 show the second embodiment of the present invention. In this case, a check valve 32A is constructed so as to be used both in a gas inlet valve 20A and in a gas discharge valve 20B.

[0047] Check valve 32A basically is a solid form having an approximately convex-top section, with a pair of round holes for guided parts 34, formed at the center thereof in both the front and rear sides. An annular sealing element 35 is fitted along the periphery of the underside. The check valve is formed marginally smaller than the inside diameter of an interior lid sleeve 37. A pair of guided parts 34, not being connected to each other, have a partition therebetween. When the valve is used as a gas inlet valve 20A, this check valve 32A is set with its projected portion up, as shown in Fig.10. When the valve is used as a gas discharge valve 20B, the check valve is set upside down as shown in Fig.11.

[0048] Interior lid sleeve 37 basically has a configuration similar to that of the above embodiment, however, an annular sealing element 35 that will be in contact with the periphery of check valve 32A or sealing element 35, is additionally bonded to the interior ceiling of the interior lid sleeve. Other components are the same as in the above embodiment so that description is omitted.

[0049] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. In addition, since common parts can be used, it is no longer necessary to provide plural types of check valves 32A depending on the usage of valve units 20. Accordingly, it is evidently expected that assembly work and management can be greatly made efficient.

[0050] Here, a grooved hole may be formed along the periphery on each of both the front and rear sides of check valve 32A so that a sealing element 35 is selectively fitted into these paired grooved holes.

[0051] Next, Figs.12 to 18 show the third embodiment of the present invention. In this case, each valve unit 20 is constructed of a fixed sleeve 21 that is removably attached to rib 5 of a through-hole 4 of a container body 1 from below and forms the gas flow passage, a holding sleeve 25, removably attached to through-hole 4 of container body 1 from above with an O-ring 31 for sealing interposed therebetween and screw fitted with fixed sleeve 21, an elastic check valve 32B built in for defining a clearance 33 between the fixed sleeve 21 and the holding sleeve 25, an elastically deformable element 36A having air permeability and continuous porosity, deforming the check valve 32B, an interior lid sleeve 37 that is in contact with elastically deformable element 36A and forms the gas flow passage and a disk-shaped filter 42 interposed between holding sleeve 25 and interior lid sleeve 37 while no guided part 34 and guide element 41 is provided. Each valve unit 20 is used for plural gas inlet valves 20A and gas discharge valves 20B.

[0052] Formed on both sides on the front and rear parts of the bottom of container body 1, or in other words, in the area not overlapping the projected area of semiconductor wafers W, are round through-holes 4, respectively, as shown in Fig.13. At the periphery of each through-hole 4, a cylindrical rib 5 externally projected downwards is integrally formed. Fixed sleeve 21, holding sleeve 25 and filter 42 in each valve unit 20 are the same as those in the above embodiment, so that description is omitted.

[0053] As shown in Fig.14, check valve 32B is formed of a predetermined elastomer, in an approximately disk-shape, in plan view, having an approximately H-shaped section and is fitted and mounted in the interior base of fixed sleeve 21 so as to cover a round vent port 23 and form a small clearance 33 for gas flow passage between itself and the inner peripheral surface of holding sleeve 25. For the material of this flexible check valve 32B, rubbers including melamine rubber, isoprene rubber, butyl rubber, silicone rubber and fluororubber, polyester thermoplastic elastomer and other thermoplastic elastomers can be used. The check valve 32B side that opposes fixed sleeve 21 is appropriately formed with a concavo-convex surface for sealing.

[0054] When the valve unit 20 is used as gas inlet valve 20A, the check valve 32B covers vent port 23 of fixed sleeve 21 by the repulsive force of elastically deformable element 36A as shown in Fig. 15. On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, the check valve 32B and elastically deformable element 36A are laid upside down so that the check valve rests on elastically deformable element 36A and comes into press contact with the opening periphery of interior lid sleeve 37 (see Figs.17 and 18).

[0055] As shown in Fig.14, elastically deformable element 36A is given in the form of a continuous porous ring made of a predetermined foaming material so as to enable communication between the interior and exterior of container body 1, and is fitted to the interior of holding sleeve 25 and rests on the outer periphery of check valve 32B while defining a small clearance 33 for gas flow passage in cooperation with the interior peripheral surface of holding sleeve 25. This endless elastically deformable element 36A is made from, for example, rubbers such as melamine rubber, isoprene rubber, butyl rubber, silicone rubber and fluororubber, polyethylenes, elastic and permeable unwoven cloth and the like. Because check valve 32B is compressed and deformed when operated, the degree of compressive strain is set to be low. The shape of elastically deformable element 36A is not limited to annular forms, but may be given in any other form, for

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example, in a cylindrical form, etc. , as long as it can provide the necessary air permeability.

[0056] When valve unit 20 is used as a gas inlet valve 20A, the thus constructed elastically deformable element 36A is set on the periphery of check valve 32B as shown in Fig.15. On the other hand, when valve unit 20 is used as a gas discharge valve 20B, the check valve 32B and elastically deformable element 36A are laid upside down so that the elastically deformable element is fitted and placed on the inner base surface of fixed sleeve 21 (see Figs.17 and 18). Other components are the same as in the above embodiment so that description is omitted.

[0057] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, check valve 32B of gas inlet valve 20A is pressed against the interior base face of fixed sleeve 21 via sealing element 35 by the repulsive force of elastically deformable element 36A so as to close vent port 23, completing a sealed state (see Fig.15).

[0058] In contrast, when a gas such as an inert gas etc., is fed from an air feed nozzle 63 of a gas purge jig 60 to gas inlet valve 20A as indicated by the arrows in Fig.16, the pressure of the gas ejected from air feed nozzle 63 urges check valve 32B of gas inlet valve 20A toward interior lid sleeve 37, compressing elastically deformable element 36A in the same direction, whereby the deformed check valve 32B forms clearance 33 with respect to vent port 23 of fixed sleeve 21, releasing the sealed state. This cancellation of the sealed state causes gas to flow from the substrate storage container exterior, passing through the clearance 33 between vent port 23 of fixed sleeve 21 and check valve 32B, the gap, interior lid sleeve 37 and filter 42, in the order mentioned, into the interior of the substrate storage container.

[0059] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, elastically deformable element 36A of gas discharge valve 20B presses check valve 32B over sealing element 35 against the opening rim of interior lid sleeve 37, forming a sealed state (see Fig.17).

[0060] In contrast, when the substrate storage container interior is filled up with a gas as indicated by the arrows in Fig. 18, the pressure of the filling gas presses check valve 32B of gas discharge valve 20B toward fixed sleeve 21, compressing elastically deformable element 36A in the same direction, forming clearance 33 between deformed check valve 32B and interior lid sleeve 37 to cancel the sealed state. This cancellation of the sealed state causes gas to flow out from the substrate storage container interior, passing through holding sleeve 25, filter 42, interior lid sleeve 37, the clearance 33 between check valve 32B and interior lid sleeve 37, the gap and vent port 23 of fixed sleeve 21, in the order mentioned, to the outside of the substrate storage container. In this case, gas purge can be efficiently done if air discharge nozzle 64 of gas purge jig 60 is connected to gas discharge valve 20B so as to reduce the pressure.

[0061] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since guided part 34 and guide element 41 are omitted, it is obvious that a further simplified configuration can be obtained. Further, since no metal part is used inside valve unit 20, it is possible to avoid any discharge of a trace amount of metal ions from metal parts when the substrate storage container is kept in storage or washed.

[0062] Next, Fig.19 shows the fourth embodiment of the present invention. In this case, a nozzle tower 43 that is connected to a valve unit 20 is made to stand at some or all of through-holes 4 in a container body 1.

[0063] Nozzle tower 43 is basically a hollow cylinder, formed of a predetermined resin such as, for example, polycarbonate, polyetherimide, polyetheretherketone, cycloolefin polymer or the like, and has a row of holes arranged vertically at intervals of a predetermined distance as gas ejection ports 44, on the peripheral wall thereof opposing the side of semiconductor wafers W, whereby gas is fed from these ejection ports 44 toward the semiconductor wafers W. Sectional size of these ejection ports 44 may be all equal in size or may be formed to be gradually greater from the bottom to the top. Other components are the same as that of the above embodiment so the description is omitted.

[0064] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since gas is moved from multiple ejection ports 44 towards semiconductor wafers W, it is obvious that stagnation inside the container body 1 can be cancelled during gas feeding, thus making it possible to sharply reduce the time of purging.

[0065] Next, Fig.20 shows the fifth embodiment of the present invention. In this case, a deflecting plate 45 is provided to stand near any of through-holes 4 in a container body 1, and an elongated part 46 of this deflecting plate 45 is made to oppose valve unit 20 with a gap therebetween.

[0066] Deflecting plate 45 is basically formed so as to have an approximately, inverted L-shaped section, using a predetermined resin such as, for example, polycarbonate, polyetherimide, polyetherketone, cycloolefin polymer and the like, and functions to guide gas flow from the valve unit 20 toward semiconductor wafers W or guide the gas in the substrate storage container to the valve unit 20. Other components are the same as that of the above embodiment so the description is omitted.

[0067] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since deflecting plate 45 regulates gas flow, obviously it is possible to effectively prevent gas from rushing onto the semiconductor wafer W held at the lower most stage and blowing particles over it, or flinging up particles.

[0068] Next, Figs.21 and 22 show the sixth embodiment of the present invention. In this case, the elastic

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check valve for each valve unit 20 is formed of an elastic check valve 32C having an approximately U-shaped section and fitted to a holding sleeve 25 at least leaving a clearance 33 as a flow passage, and an extensible bellows 47 fitted in the check valve 32C in the form of a cylinder with a base, for deforming check valve 32C, with elastically deformable element 36A omitted.

[0069] Bellows 47 is formed in a hollow cylindrical form having flexibility and elasticity, having a multiple number of vent holes 48 for ventilation formed at intervals of a predetermined distance on its peripheral wall. This bellows is laminated to check valve 32C which is located between a fixed sleeve 21 and the bottom of the peripheral wall of an interior lid sleeve 37. This bellows 47 is arranged at either the top or bottom with respect to check valve 32C, depending on whether the valve unit 20 is used as a gas inlet valve 20A or a gas discharge valve 20B. Other components are the same as in the above embodiment so that description is omitted.

[0070] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, bellows 47 of gas inlet valve 20A presses check valve 32C against the interior bottom face of fixed sleeve 21 so as to close a vent port 23, creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0071] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, bellows 47 presses check valve 32C located above, against the opening bottom of interior lid sleeve 37, thus creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0072] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since, instead of being formed of a multiple number of separate parts, the elastic check valve is formed of a check valve 32C for allowing gas to flow when deformed and a bellows 47 providing a spring function, it is expected to reduce the number of parts, hence it is possible to achieve a simple configuration with improved assembly performance and simplified product management.

[0073] Next, Figs. 23 and 24 show the seventh embodiment of the present invention. In this case, the elastic check valve for each valve unit 20 is formed of an elastic check valve 32D fitted to a holding sleeve 25, leaving a clearance 33 for the flow passage and an elastic skirt body 49 for check valve 32D, which is integrated with check valve 32D with a gap in between, with elastically deformable element 36A omitted.

[0074] For the material of check valve 32C and skirt body 49, rubbers including melamine rubber, isoprene rubber, butyl rubber, silicone rubber and fluororubber, polyester thermoplastic elastomer and other thermoplastic elastomers can be used. Formed in check valve 32D are a multiple number of passage holes 50 for ventilation at intervals of a predetermined distance.

[0075] The skirt body 49 is formed in a disk-like form or a cylindrical form having an approximate concave-top section. A thin elastic skirt piece 51 is flexibly extended from the rim of the skirt body, has a hollow, approximately frustoconical shape, and is fitted on the periphery of check valve 32D and integrated with it. This skirt body 49 is arranged at either the top or bottom with respect to check valve 32D, depending on whether the valve unit 20 is used as a gas inlet valve 20A or a gas discharge valve 20B. Other components are the same as in the above embodiment so that description is omitted.

[0076] In the above configuration, when the valve unit 20 is used as a gas inlet valve 20A and no gas such as an inert gas or the like is fed from the outside into the substrate storage container interior, skirt body 49 of gas inlet valve 20A, presses check valve 32D located below by skirt piece 51, against the interior bottom face of fixed sleeve 21 so as to close a vent port 23, creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0077] On the other hand, when the valve unit 20 is used as a gas discharge valve 20B, skirt body 49 located below presses check valve 32D located above, by skirt piece 51, against the opening bottom of an interior lid sleeve 37, thus creating a sealed state. Accordingly, it is possible to efficiently prevent gas from flowing into the substrate storage container from the outside thereof and from leaking outside from the interior of the substrate storage container.

[0078] Also in this embodiment, the same operation and effect as that in the above embodiment can be expected. Besides, since the elastic check valve is formed of a check valve 32D for allowing gas to flow when deformed and a skirt body 49 providing a spring function, it is expected to reduce the number of parts, hence it is possible to achieve a simple configuration with improved assembly performance and simplified product management.

[0079] In the above, though engagement slots 8 are formed on the interior peripheral surface of rim portion 7 of container body 1, these can be omitted. In this case, the interlocking mechanism for door 10 which operates by external control can be omitted. Further, with some modification of the shape of the check valve 32 shown in Figs.10 and 11, usage mode can be switched by changing the attachment position of elastically deformable element 36 without inverting the check valve 32 itself. It is also possible to provide some projections for valve opening and closing, suctioning hands and other components for the processing equipment for gas feed and discharge.

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[0080] Next, an example of a substrate storage container of the present invention will be explained with a comparative example.

[0081] Using a substrate storage container having the valve units shown in Figs.4 and 6, the oxygen concentration was measured when the interior of the substrate storage container was replaced by nitrogen gas while the retention time the low-oxygen state could be maintained was measured.

[0082] From the measurement results, the system of this example, using nitrogen gas at a flow rate of 20 L/min, could reach levels of 10 ppm oxygen concentration or lower in about 15 minutes. In the examination of the change of the oxygen concentration when the substrate storage container was left without any supply of nitrogen gas, it took about five hours until the oxygen concentration increased up to 1%.

[0083] Thereby, it was confirmed that the low-oxygen state can be maintained for a fixed period when the semiconductor wafers need to be temporarily stored in the course of processing, whereby it is possible to inhibit contamination and surface oxidation of semiconductor wafers.

[0084] In contrast to this, using a substrate storage container having the conventional valve units, the retention time the low-oxygen state could be maintained in the substrate storage container was measured.

[0085] Upon measurement, a pair of through-holes were formed in the bottom of the container body, and a piping route for measurement was prepared so as to connect these through-holes. An oximeter was interposed in this piping route so that the oxygen concentration was measured every one minute. The formed pair of through-holes were sealed at their periphery, and nitrogen gas was fed at a fixed rate into the substrate storage container via an inlet valve. The oximeter used was of a product of Toray Engineering Co., Ltd., having a measurement rage 0.1 ppm to 100 VOL%.

[0086] From the measurement result, change of the oxygen concentration after the substrate storage container was left without any supply of nitrogen gas was examined, and it was found that the oxygen concentration increased to 1% after only 70 minutes or thereabouts.

Industrial Applicability

[0087] The present invention is able to simplify the engagement structure for valve attachment, and provides a configuration that will not allow displacement of the valves even with repeated use. It is also possible to prevent sealing leakage, and hence inhibit the risk of a trace amount of discharged metal ions contaminating the substrates. Further, it is possible to maintain the purging gas for a relatively long period, and prevent contaminants from infiltrating into the container from outside.

Claims

1. A substrate storage container including:

   a container body (1);
   a door (10) for opening and closing the container body (1);
   a valve unit (20) attached to a through-hole (4) formed in, at least, one of the container body (1) and the door (10), for controlling the gas flow with respect to the container body as a gas inlet valve or a gas outlet valve, the valve unit (20) comprising:

   a fixed sleeve (21) for gas flow, fitted in the through-hole (4);
   a holding sleeve (25) for gas flow, threadably mated with the fixed sleeve (21);
   an elastic check valve (32) for controlling gas flow with respect to the container body (1), the check valve being built in between the fixed sleeve (21) and the holding sleeve (25);
   and
   an interior lid sleeve (37) for gas flow, the interior lid sleeve (37) opposing the elastic check valve (32);
   and one of the interior lid sleeve and the fixed sleeve (21) is adapted to be opened and closed by the elastic check valve (32), so that gas will pass through the check valve when the elastic check valve is open while gas will be prevented from passing into the substrate container when the elastic check valve is closed,
   wherein the valve unit is fitted to the through hole as a gas inlet valve or gas discharge valve,
   characterized in that a rib (5) is formed and extended outward from the periphery of the through-hole (4) and the fixed sleeve (21) is formed with a flange (24) that is in contact with the periphery of the rib (5) while the holding sleeve (25) is formed with a flange (29) that is in contact with the periphery of the through-hole (4).

2. The substrate storage container according to claim 1, wherein the through-hole (4) is formed in the bottom of the container body (1).

3. The substrate storage container according to claim 1, or 2, wherein a clearance (33) for gas flow is formed at least between the holding sleeve (25) and the periphery of the elastic check valve (32).

4. The substrate storage container according to any one of claims 1 through 3, wherein the interior lid

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sleeve (37) is fitted in the holding sleeve (25) with an air filter(42) interposed therebetween.

5. The substrate storage container according to any one of claims 1 through 4, wherein the elastic check valve (32) is at least made up of a check valve that is built in the fixed sleeve (21), leaving a clearance, and an elastically deformable element (36) interposed between the check valve (32) and the interior lid sleeve (37), and the opening of the fixed sleeve (21) is adapted to be opened and closed by the check valve, so that gas will pass through when the check valve is open while gas will be prevented from passing when the check valve is closed.

6. The substrate storage container according to any one of claims 1 through 4, wherein the elastic check valve (32) is at least made up of a check valve that is built in the fixed sleeve (21), leaving a clearance, and an elastically deformable element (36) interposed between the check valve (32) and the fixed sleeve (21), and the opening of the interior lid sleeve (37) is adapted to be opened and closed by the check valve, so that gas will pass through when the check valve is open while gas will be prevented from passing when the check valve is closed.

7. The substrate storage container according to any one of claims 1 through 4, wherein the elastic check valve (32) is at least made up of a check valve that is built in the fixed sleeve (2), leaving a clearance (33), and an elastically deformable element for the check valve, and either the check valve (32) or the elastically deformable element (36) is in contact with the interior lid sleeve (37), so that gas will pass through when the check valve is open while gas will be prevented from passing when the check valve is closed.

8. The substrate storage container according to any one of claims 5 through 7, wherein a guide element (34, 41) is provided for either the check valve of the elastic check valve (32) or the interior lid sleeve (37) while a guided part (41, 34) is provided for the other, so that the guide element and the guided part fit to each other in a slidably manner.

9. The substrate storage container according to claim 8, wherein the guide element (41) is formed in the interior lid sleeve (37) so as to have an approximately convex-top section while the guided part (34) is formed in the check valve of the elastic check valve (32) so as to have an approximately concave-top section.

10. The substrate storage container according to any one of claims 5 through 9, wherein a sealing element (35) is attached to the check valve of the elastic check valve (32), and the sealing element is placed into deforming contact with the opening of the fixed sleeve (21) or the interior lid sleeve (37) to seal.

11. The substrate storage container according to any one of claims 1 through 10, wherein the through-hole (4) is formed in the bottom of the container body (1), and a hollow nozzle tower (43) communicating with the valve unit (20) is made to stand, the peripheral wall thereof being formed with gas ejection holes.

12. The substrate storage container according to any one of claims 1 through 10, wherein the through-hole (4) is formed in the bottom of the container body (1), and a deflecting plate (45) is attached in the vicinity of the hole, the deflection plate being formed having an approximately L-shaped section with its longer part opposed to the valve unit (20) with a gap therebetween.

13. The substrate storage container according to any one of claims 1 through 4, 11 and 12, wherein the elastic check valve (32) is at least made up of a check valve (32C) that is build in the fixed sleeve (21), leaving a clearance (33) and an extensible bellows (47) fitted in the check valve, the peripheral wall of the bellows is formed with a passage opening, and the check valve (32C) is designed to be opened and closed by the extension and compression of the bellows.

14. The substrate storage container according to any one of claims 1 through 4, 11 and 12, wherein the elastic check valve (32) is at least made up of a check valve (32D) that is built in the fixed sleeve (21), leaving a clearance (33) and an elastic skirt body (49) integrated with the check valve (32D), a passage opening is formed in the check valve (32D), an approximately cylindrical skirt piece (51) is flexibly extended from the rim of the skirt body and is fitted on the periphery of the check valve, and the check valve is designed to be opened and closed by the deformation of the skirt body.

Patentansprüche

1. Substratspeicherbehälter, mit:

einem Behälterkörper (1);
einer Tür (10) zum Öffnen und Schließen des Behälterkörpers (1);
einer Ventileinheit (20), die an einem Durchgangsloch (4) befestigt ist, das in mindestens dem Behälterkörper (10) oder der Tür gebildet ist, zum Steuern der Gasströmung mit Bezug auf den Behälterkörper als ein Gaseinlassventil oder ein Gasauslassventil, wobei die Ventilein-

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heit (20) umfasst:

einer fest sitzenden Hülse (21) für eine Gasströmung, die in das Durchgangsloch (4) eingefügt ist;
einer Haltehülse (25) für eine Gasströmung, die gewindemäßig mit der fest sitzenden Hülse (21) gepaart ist;
einem elastischen Prüfventil (32) zum Steuern einer Gasströmung mit Bezug auf den Behälterkörper (1), wobei das Prüfventil zwischen der fest sitzenden Hülse (21) und der Haltehülse (25) eingebaut ist;
und
einer inneren Deckelhülse (37) für eine Gasströmung, wobei die innere Deckelhülse (37) dem elastischen Prüfventil (32) gegenüberliegt;
und die innere Deckelhülse oder die fest sitzende Hülse (21) angepasst ist, um durch das elastische Prüfventil (32) geöffnet und geschlossen zu werden, sodass Gas durch das elastische Prüfventil treten wird, wenn das elastische Prüfventil offen ist, während Gas am Durchtreten in den Substratbehälter gehindert wird, wenn das elastische Prüfventil geschlossen ist,
wobei die Ventileinheit an dem Durchgangsloch als ein Gaseinlassventil oder ein Gasauslassventil eingefügt ist,
dadurch gekennzeichnet, dass eine Rippe (5) gebildet wird und sich nach außen von dem Umfang des Durchgangslochs (4) erstreckt, und die fest sitzende Hülse (21) mit einem Flansch (24) gebildet wird, der in Kontakt mit dem Umfang der Rippe (5) ist, während die Haltehülse (25) mit einem Flansch (29) gebildet ist, der in Kontakt mit dem Umfang des Durchgangslochs (4) ist.

2. Substratspeicherbehälter gemäß Anspruch 1, bei dem das Durchgangsloch (4) in dem Boden des Behälterkörpers (1) gebildet ist.

3. Substratspeicherbehälter gemäß Anspruch 1 oder 2, bei dem ein Zwischenraum (33) für eine Gasströmung mindestens zwischen der Haltehülse (25) und dem Umfang des elastischen Prüfventils (32) gebildet ist.

4. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 3, bei dem die innere Deckelhülse (37) in der Haltehülse (25) mit einem dazwischen angeordneten Luftfilter (42) eingefügt ist.

5. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil, das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum (32) belassen wird, und einem elastisch verformbaren Element (36), das zwischen dem Prüfventil (32) und der inneren Deckelhülse (37) angeordnet ist, gebildet wird, und die Öffnung der fest sitzenden Hülse (21) angepasst ist, um durch das Prüfventil geöffnet und geschlossen zu werden, sodass Gas durchtreten wird, wenn das Prüfventil offen ist, während Gas am Durchtreten gehindert wird, wenn das Prüfventil geschlossen ist.

6. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil, das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum belassen wird, und einem elastisch verformbaren Element (36), das zwischen dem Prüfventil (32) und der fest sitzenden Hülse (21) angeordnet ist, gebildet wird, und die Öffnung der inneren Deckelhülse (37) angepasst ist, um durch das Prüfventil geöffnet und geschlossen zu werden, sodass Gas durchtreten wird, wenn das Prüfventil offen ist, während Gas am Durchtreten gehindert wird, wenn das Prüfventil geschlossen ist.

7. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil, das in der fest sitzenden Hülse (2) eingebaut ist, wobei ein Zwischenraum (33) belassen wird, und einem elastisch verformbaren Element für das Prüfventil gebildet wird, und entweder das Prüfventil (32) oder das elastisch verformbare Element (36) in Kontakt mit der inneren Deckelhülse (37) ist, sodass Gas durchtreten wird, wenn das Prüfventil offen ist, während Gas am Durchtreten gehindert wird, wenn das Prüfventil geschlossen ist.

8. Substratspeicherbehälter gemäß einem der Ansprüche 5 bis 7, bei dem ein Führungselement (34, 41) entweder für das Prüfventil des elastischen Prüfventils (32) oder die innere Deckelhülse (37) bereitgestellt wird, während ein geführtes Teil (41, 34) für das Andere der beiden bereitgestellt wird, sodass das Führungselement und das geführte Teil auf eine verschiebbare Art und Weise zueinander eingefügt sind.

9. Substratspeicherbehälter gemäß Anspruch 8, bei dem das Führungselement (41) in der inneren Dekkelhülse (37) gebildet ist, um einen näherungsweise konvexen oberen Abschnitt aufzuweisen, während das geführte Teil (34) in dem Prüfventil des elastischen Prüfventils (32) gebildet ist, um einen näherungsweise konkaven oberen Abschnitt aufzuweisen.

10. Substratspeicherbehälter gemäß einem der Ansprü-

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che 5 bis 9, bei dem ein Dichtungselement (35) an dem Prüfventil des elastischen Prüfventils (32) befestigt ist, und das Dichtungselement in verformenden Kontakt mit der Öffnung der fest sitzenden Hülse (21) oder der inneren Deckelhülse (37) platziert ist, um zu dichten.

11. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 10, bei dem das Durchgangsloch (4) in dem Boden des Behälterkörpers (1) gebildet ist, und ein hohler Düsenturm (43), der mit der Ventileinheit (20) kommuniziert, dazu gebracht wird, zu stehen, wobei die periphere Wand davon mit Gasausstoßlöchern gebildet wird.

12. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 10, bei dem das Durchgangsloch (4) in dem Boden des Behälterkörpers (1) gebildet ist, und eine Ablenkplatte (45) in der Nähe des Loches befestigt ist, wobei die Ablenkplatte mit einem näherungsweise L-förmigen Abschnitt gebildet wird, wobei sein längeres Teil der Ventileinheit (20) mit einem Spalt dazwischen gegenüberliegt.

13. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, 11 und 12, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil (32C), das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum (33) belassen wird, und einem in das Prüfventil eingefügten, ausdehnbaren Balg (47) gebildet wird, wobei die periphere Wand des Balgs mit einer Durchtrittsöffnung gebildet ist, und das Prüfventil (32C) ausgestaltet ist, um durch die Ausdehnung und Zusammendrückung des Balgs geöffnet und geschlossen zu werden.

14. Substratspeicherbehälter gemäß einem der Ansprüche 1 bis 4, 11 und 12, bei dem das elastische Prüfventil (32) mindestens aus einem Prüfventil (32D), das in der fest sitzenden Hülse (21) eingebaut ist, wobei ein Zwischenraum (33) belassen wird, und einem mit dem Prüfventil (32D) integrierten, elastischen Schürzenkörper (49) gebildet wird, wobei eine Durchtrittsöffnung in dem Prüfventil (32D) gebildet ist, ein näherungsweise zylindrisches Schürzenstück (51) vom Rand des Schürzenkörpers biegsam verlängert und am Umfang des Prüfventils angebracht ist, und das Prüfventil ausgestaltet ist, um durch die Verformung des Schürzenkörpers geöffnet und geschlossen zu werden.

Revendications

1. Contenant de stockage de substrat, comprenant :

un corps de contenant (1) ;
une porte (10) pour ouvrir et fermer le corps de contenant (1) ;
une unité de soupape (20) fixée à un orifice de passage (4) formé dans, au moins, un élément parmi le corps de contenant (1) et la porte (10), pour réguler l'écoulement de gaz par rapport au corps de contenant en tant que soupape d'entrée de gaz ou soupape de sortie de gaz, l'unité de soupape (20) comprenant :

un manchon fixe (21) pour l'écoulement de gaz, installé dans l'orifice de passage (4) ;
un manchon de support (25) pour l'écoulement de gaz, accouplé de façon filetée avec le manchon fixe (21) ;
une soupape de non-retour élastique (32) pour réguler l'écoulement de gaz par rapport au corps de contenant (1), la soupape de non-retour étant construite entre le manchon fixé (21) et le manchon de support (25) ;
et
un manchon de couvercle intérieur (37) pour l'écoulement de gaz, le manchon de couvercle intérieur (37) étant opposé à la soupape de non-retour élastique (32) ;
et un élément parmi le manchon de couvercle intérieur et le manchon fixe (21) est adapté pour être ouvert et fermé par la soupape de non-retour élastique (32), de sorte que le gaz passera à travers la soupape de non-retour lorsque la soupape de non-retour élastique est ouverte alors que le gaz sera empêché de passer dans le contenant de substrat lorsque la soupape de non-retour élastique est fermée,
dans lequel l'unité de soupape est installée sur l'orifice de passage en tant que soupape d'entrée de gaz ou soupape de décharge de gaz, **caractérisé en ce qu'**une nervure (5) est formée et étendue vers l'extérieur à partir de la périphérie de l'orifice de passage (4) et le manchon fixe (21) est formé avec une bride (24) qui est en contact avec la périphérie de la nervure (5) alors que le manchon de support (25) est formé avec une bride (29) qui est en contact avec la périphérie de l'orifice de passage (4).

2. Contenant de stockage de substrat selon la revendication 1, dans lequel l'orifice de passage (4) est formé dans le fond du corps de contenant (1).

3. Contenant de stockage de substrat selon la revendication 1 ou 2, dans lequel un espace libre (33) pour l'écoulement de gaz est formé au moins entre le manchon de support (25) et la périphérie de la soupape de non-retour élastique (32).

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4. Contenant de stockage de substrat selon une quelconque des revendications 1 à 3, dans lequel le manchon de couvercle intérieur (37) est installé dans le manchon de support (25) avec un filtre à air (42) interposé entre ceux-ci.

5. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour, qui est construite dans le manchon fixe (21), laissant un espace libre, et d'un élément déformable de façon élastique (36) interposé entre la soupape de non-retour (32) et le manchon de couvercle intérieur (37), et l'ouverture du manchon fixe (21) est adaptée pour être ouverte et fermée par la soupape de non-retour, de sorte que le gaz passera à travers lorsque la soupape de non-retour est ouverte alors que le gaz sera empêché de passer lorsque la soupape de non-retour est fermée.

6. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour qui est construite dans le manchon fixe (21), laissant un espace libre, et d'un élément déformable de façon élastique (36) interposé entre la soupape de non-retour (32) et le manchon fixe (21), et l'ouverture du manchon de couvercle intérieur (37) est adaptée pour être ouverte et fermée par la soupape de non-retour, de sorte que le gaz passera à travers lorsque la soupape de non-retour est ouverte alors que le gaz sera empêché de passer lorsque la soupape de non-retour est fermée.

7. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour qui est construite dans le manchon fixe (2), laissant un espace libre (33), et d'un élément déformable de façon élastique pour la soupape de non-retour, et la soupape de non-retour (32) ou l'élément déformable de façon élastique (36) est en contact avec le manchon de couvercle intérieur (37), de sorte que le gaz passera à travers lorsque la soupape de non-retour est ouverte alors que le gaz sera empêché de passer lorsque la soupape de non-retour est fermée.

8. Contenant de stockage de substrat selon une quelconque des revendications 5 à 7, dans lequel un élément de guidage (34, 41) est prévu pour la soupape de non-retour de la soupape de non-retour élastique (32) ou le manchon de couvercle intérieur (37) alors qu'une partie guidée (41, 34) est prévue pour l'autre, de sorte que l'élément de guidage et la partie guidée soient installés l'un sur l'autre de manière coulissante.

9. Contenant de stockage de substrat selon la revendication 8, dans lequel l'élément de guidage (41) est formé dans le manchon de couvercle intérieur (37) afin d'avoir une section supérieure approximativement convexe alors que la partie guidée (34) est formée dans la soupape de non-retour de la soupape de non-retour élastique (32) afin d'avoir une section supérieure approximativement concave.

10. Contenant de stockage de substrat selon une quelconque des revendications 5 à 9, dans lequel un élément d'étanchéité (35) est fixé à la soupape de non-retour de la soupape de non-retour élastique (32), et l'élément d'étanchéité est placé en contact de déformation avec l'ouverture du manchon fixe (21) ou le manchon de couvercle intérieur (37) pour réaliser une étanchéité.

11. Contenant de stockage de substrat selon une quelconque des revendications 1 à 10, dans lequel l'orifice de passage (4) est formé dans le fond du corps de contenant (1), et une tour d'éjection creuse (43) communiquant avec l'unité de soupape (20) est disposée verticalement, la paroi périphérique de celle-ci étant formée avec des orifices d'éjection de gaz.

12. Contenant de stockage de substrat selon une quelconque des revendications 1 à 10, dans lequel l'orifice de passage (4) est formé dans le fond du corps de contenant (1), et une plaque de déflexion (45) est fixée dans le voisinage de l'orifice, la plaque de déflexion étant formée pour avoir une section de forme approximativement en L avec sa partie plus longue opposée à l'unité de soupape (20) avec un écart entre celles-ci.

13. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, 11 et 12, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour (32C) qui est construite dans le manchon fixe (21), laissant un espace libre (33), et d'un soufflet extensible (47) installé dans la soupape de non-retour, la paroi périphérique du soufflet est formée avec une ouverture de passage, et la soupape de non-retour (32C) est conçue pour être ouverte et fermée par l'extension et la compression du soufflet.

14. Contenant de stockage de substrat selon une quelconque des revendications 1 à 4, 11 et 12, dans lequel la soupape de non-retour élastique (32) est au moins composée d'une soupape de non-retour (32D) qui est construite dans le manchon fixe (21), laissant un espace libre (33), et d'un corps de jupe élastique (49) intégré avec la soupape de non-retour (32D), une ouverture de passage est formée dans

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la soupape de non-retour (32D), une pièce de jupe approximativement cylindrique (51) est étendue de façon flexible à partir du rebord du corps de jupe et est installée sur la périphérie de la soupape de non-retour, et la soupape de non-retour est conçue pour être ouverte et fermée par la déformation du corps de jupe.

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FIG. 1

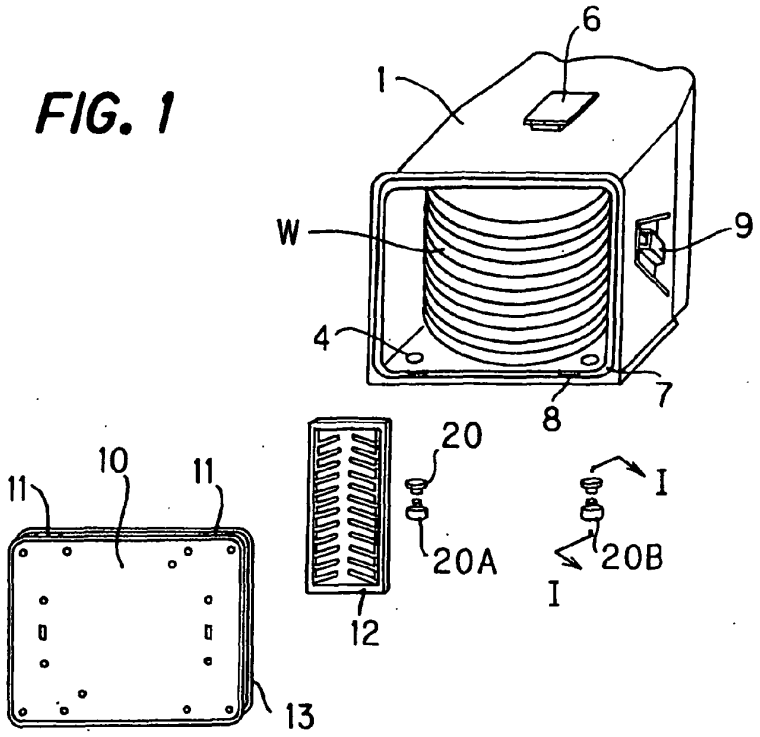
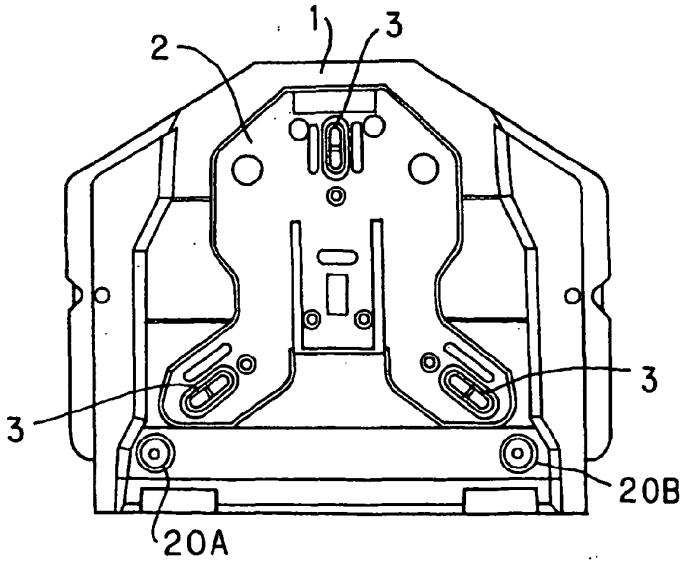


FIG. 2



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FIG. 3

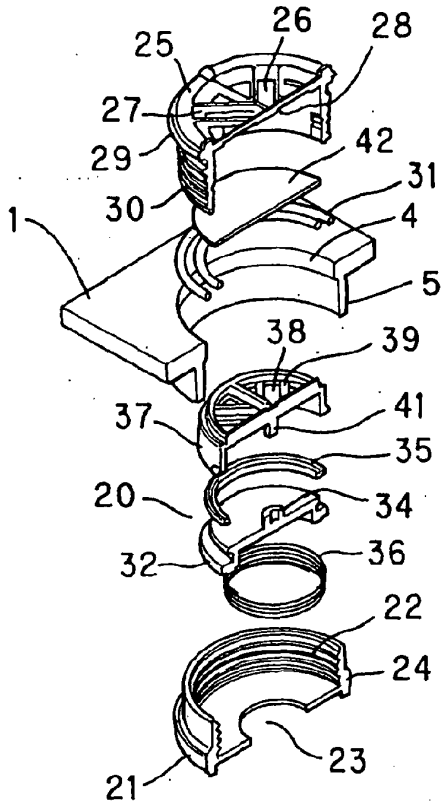
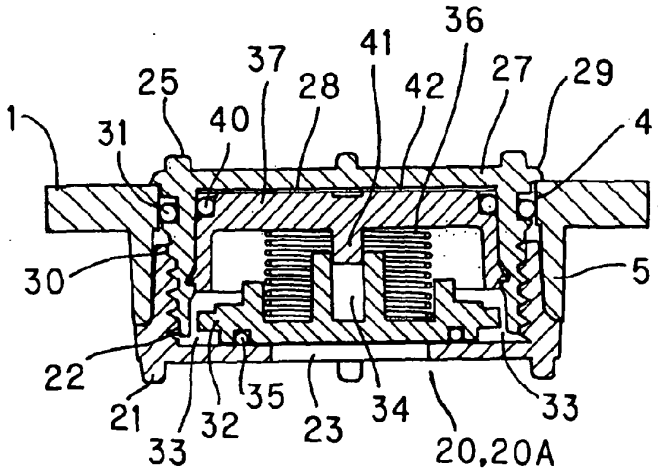


FIG. 4



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FIG. 5

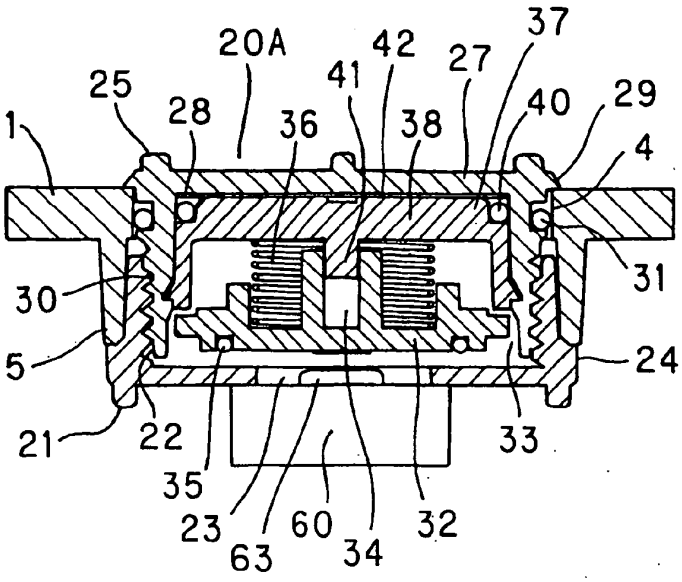
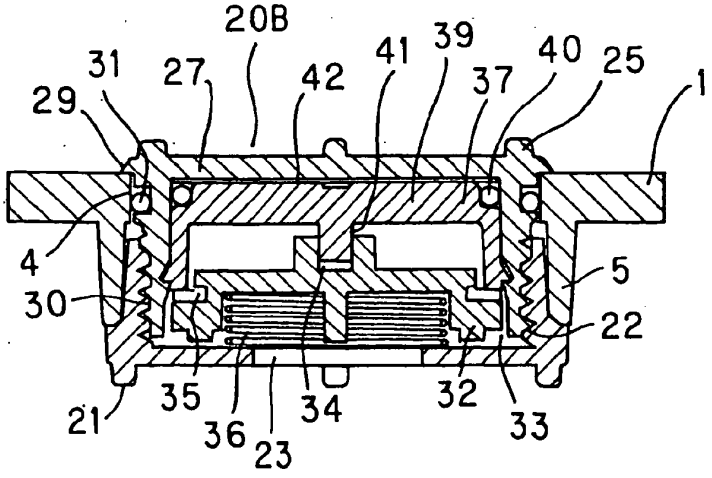


FIG. 6



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FIG. 7

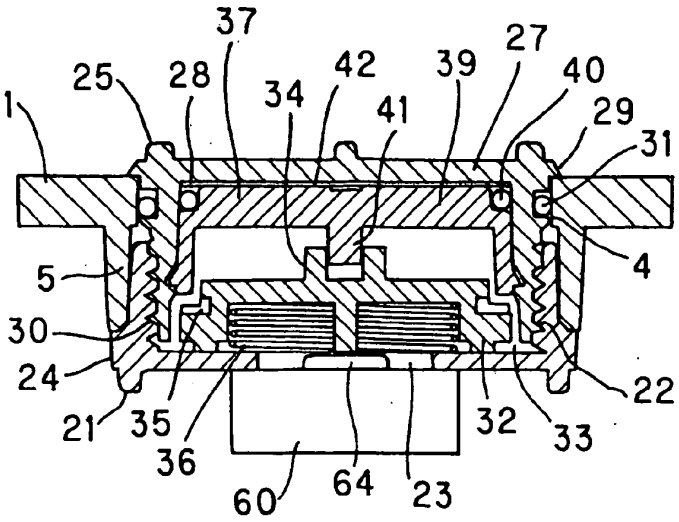
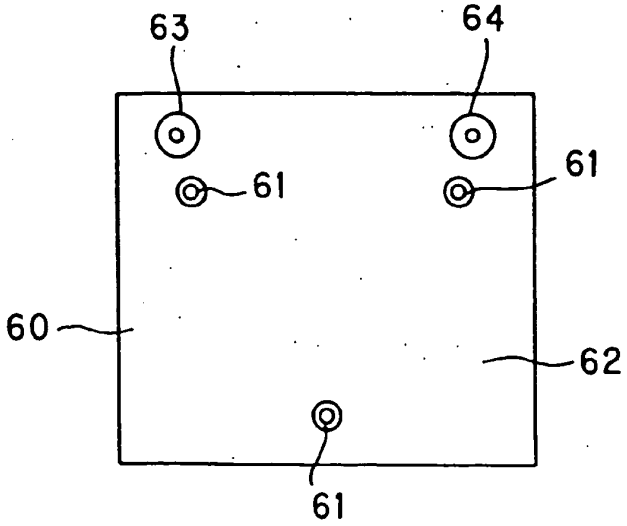


FIG. 8



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FIG. 9

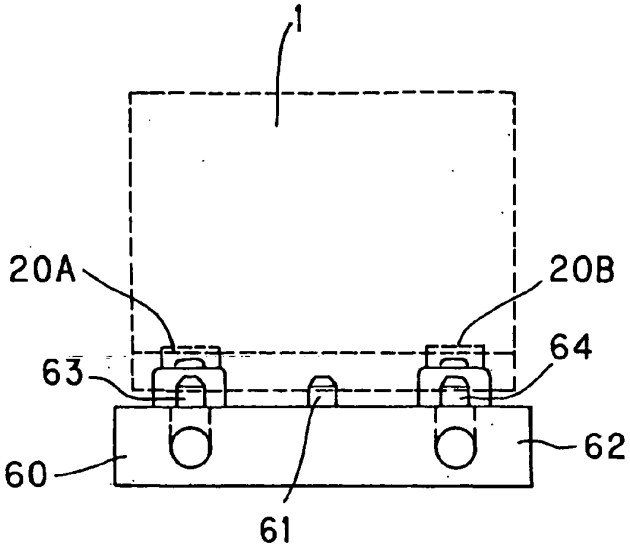
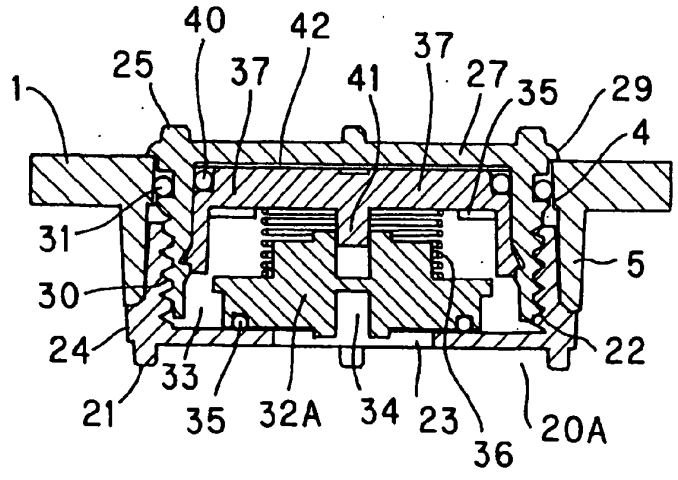
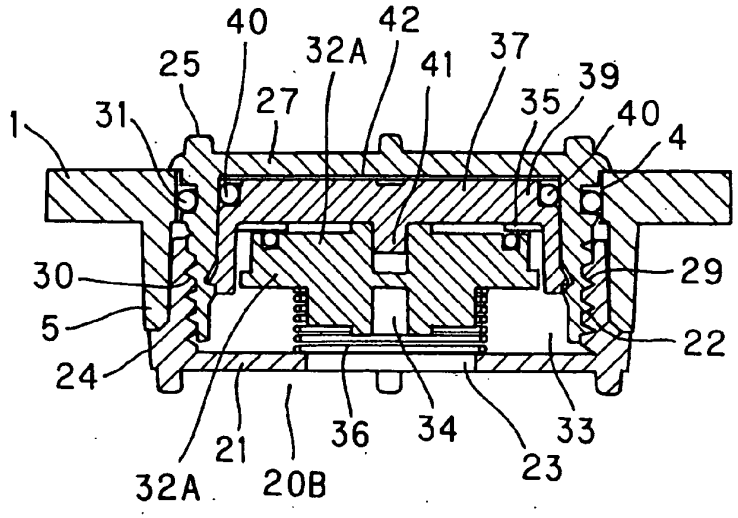


FIG. 10



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FIG. 11



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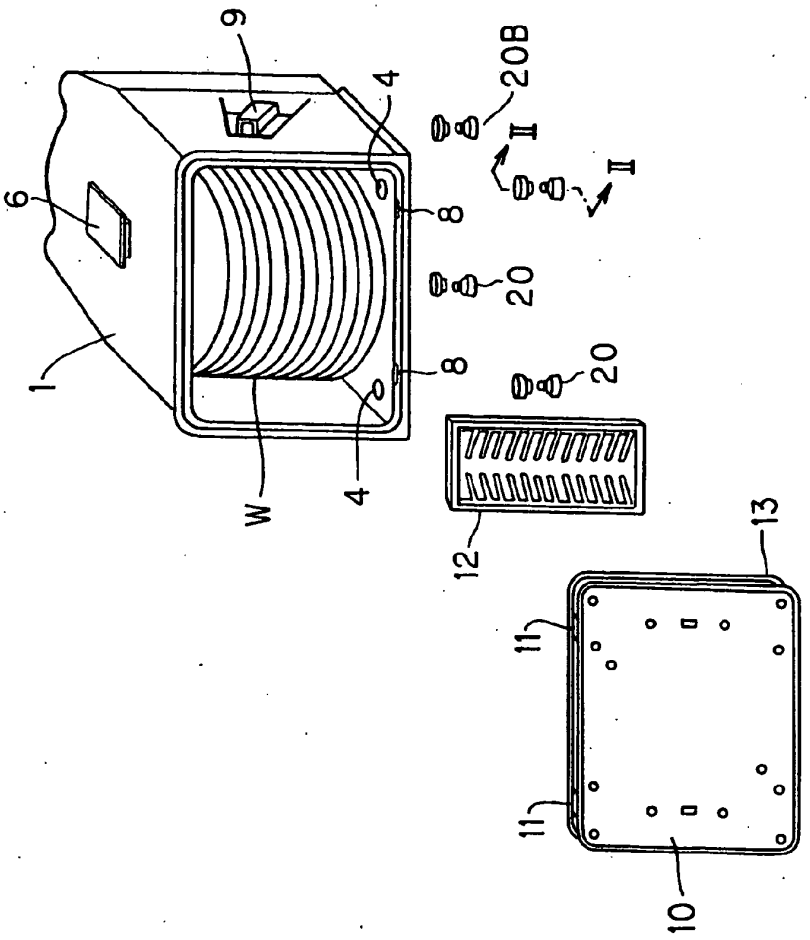
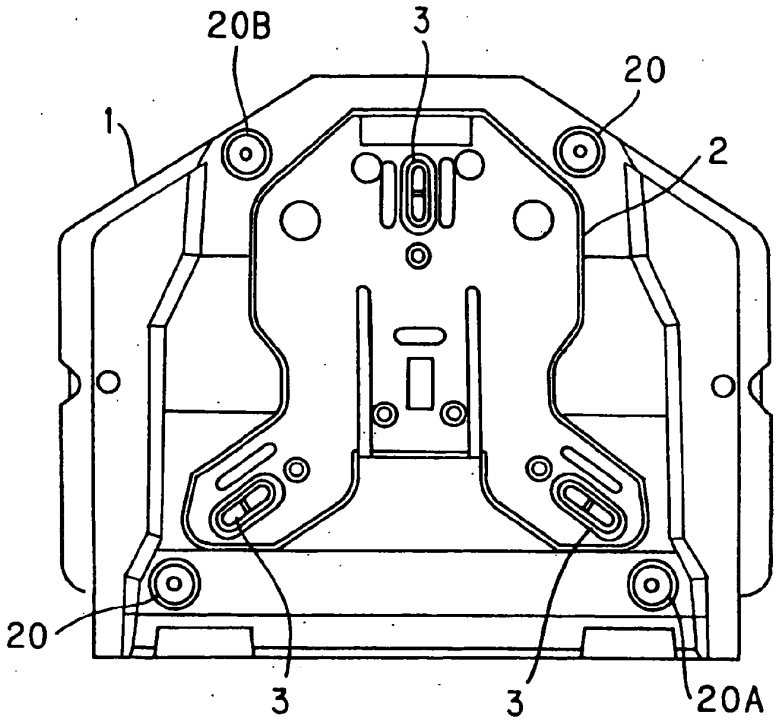


FIG. 12

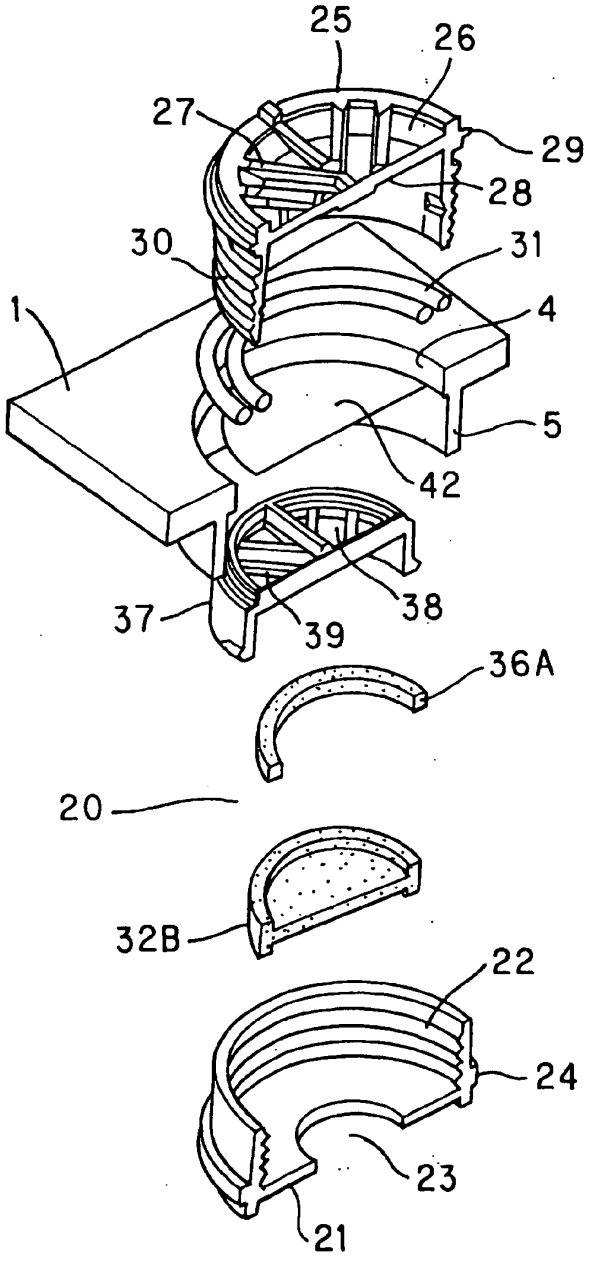
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FIG. 13



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FIG. 14



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FIG. 15

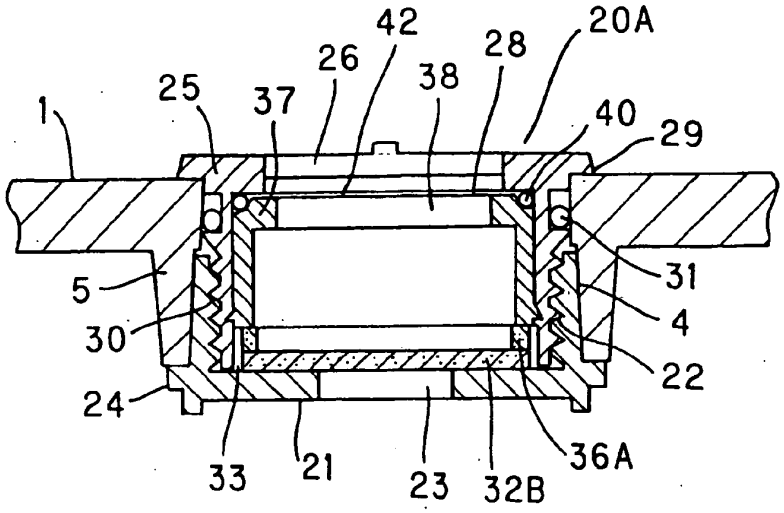
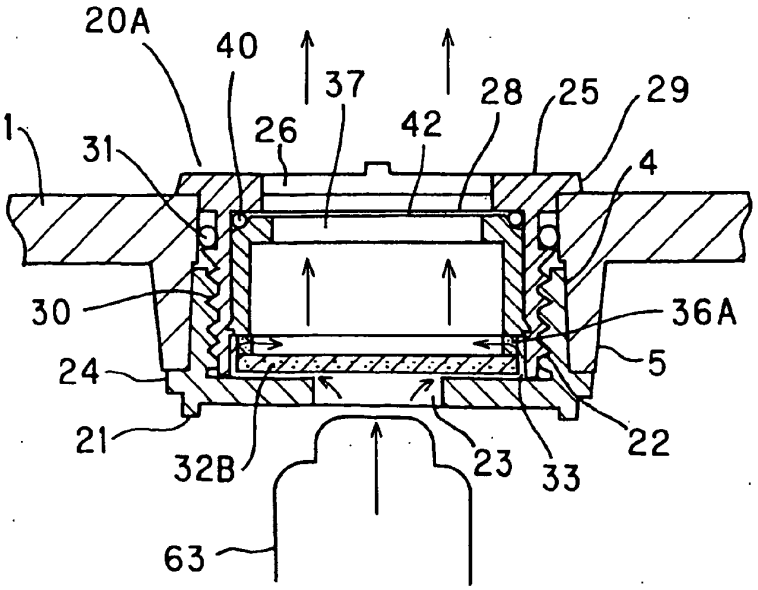


FIG. 16



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FIG. 17

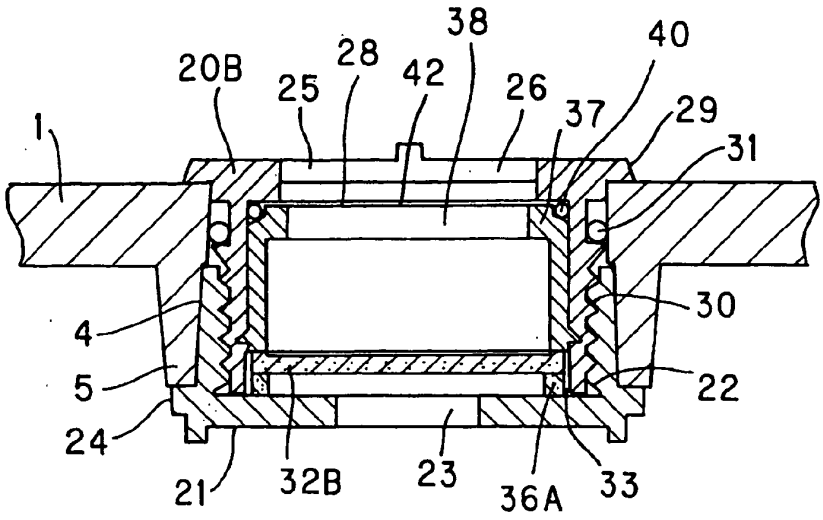
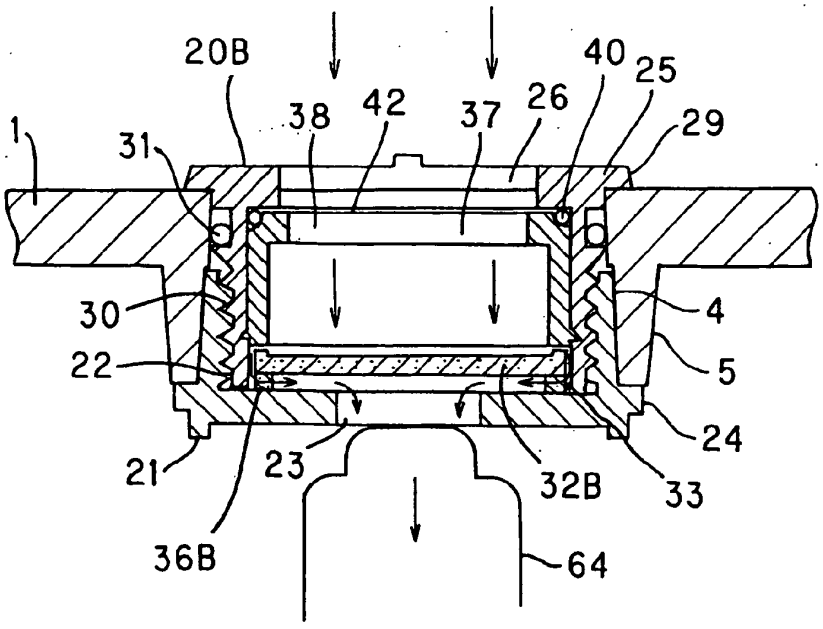
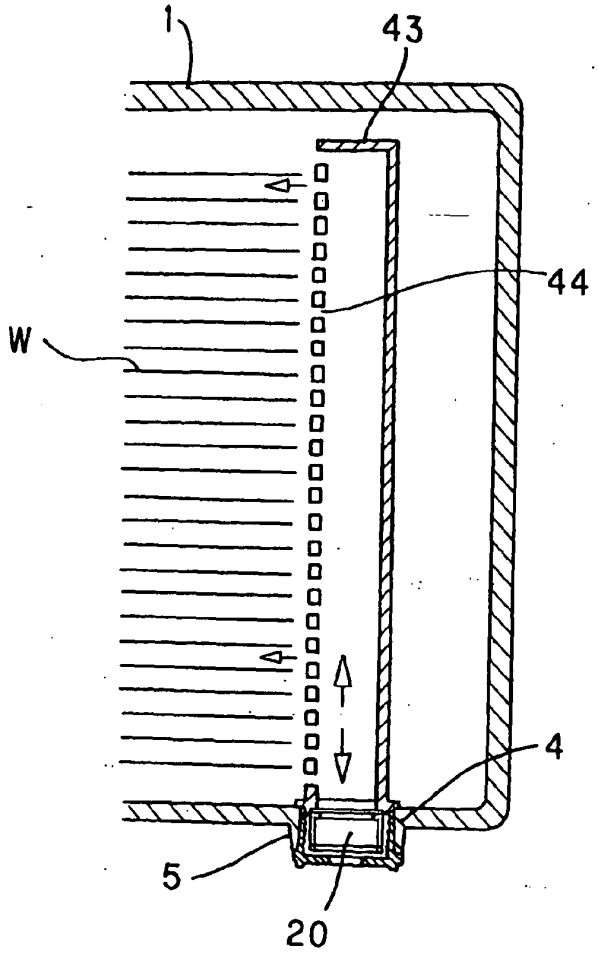


FIG. 18



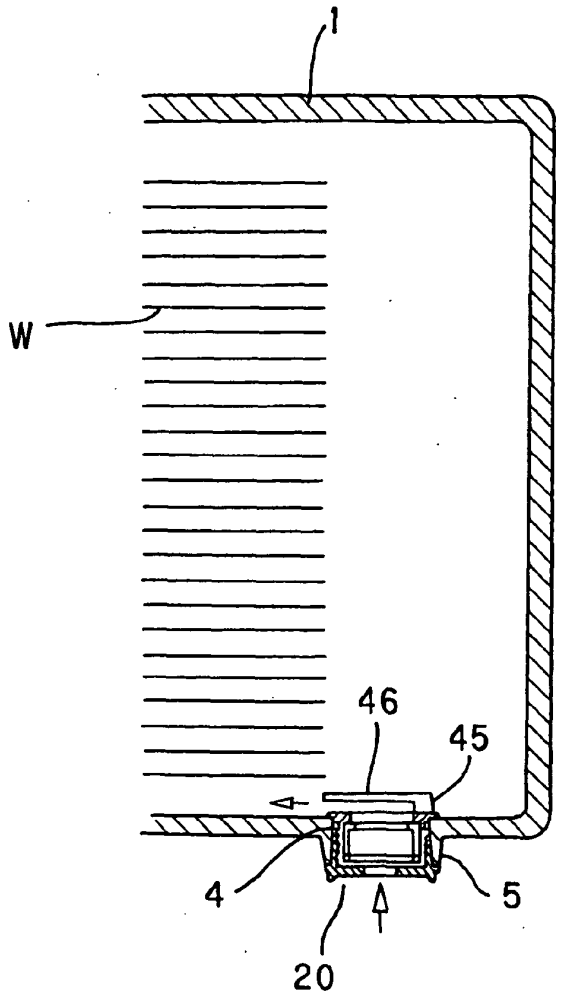
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FIG. 19



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FIG. 20



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FIG. 21

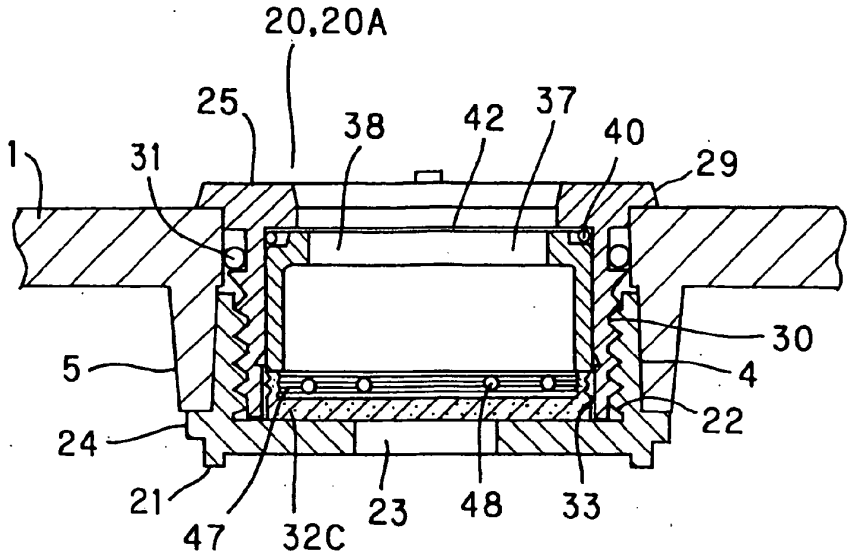
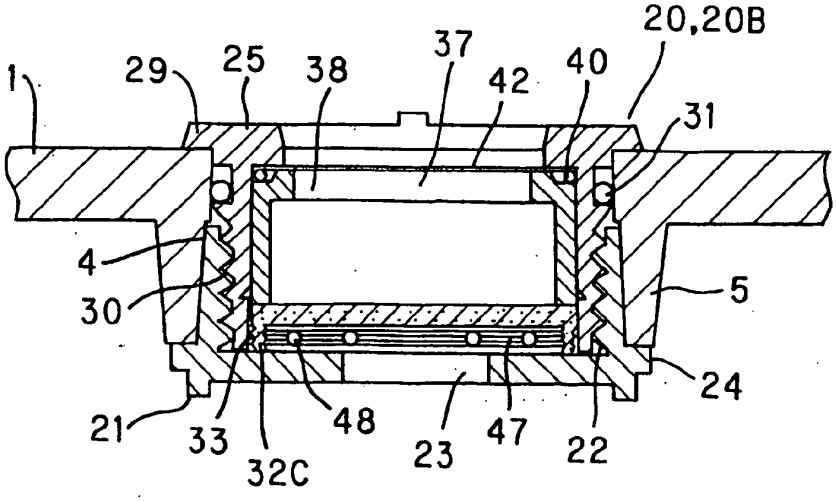


FIG. 22



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FIG. 23

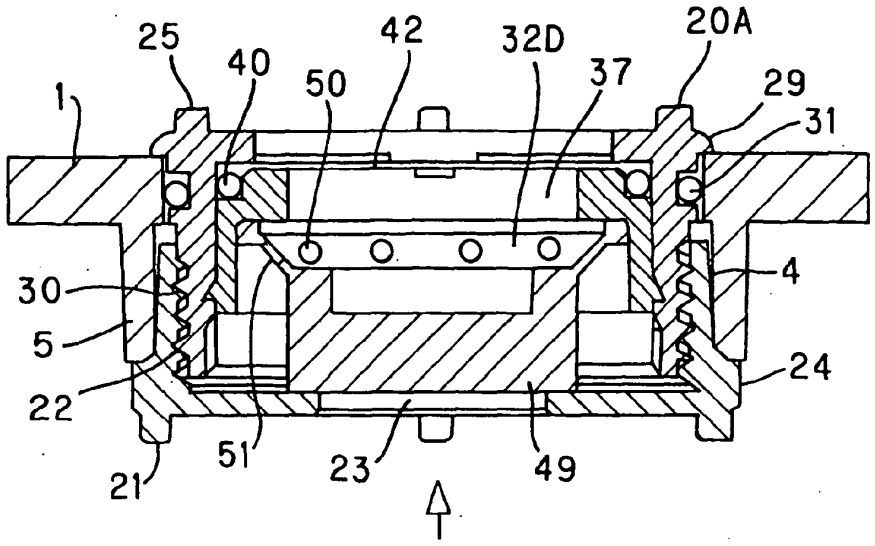
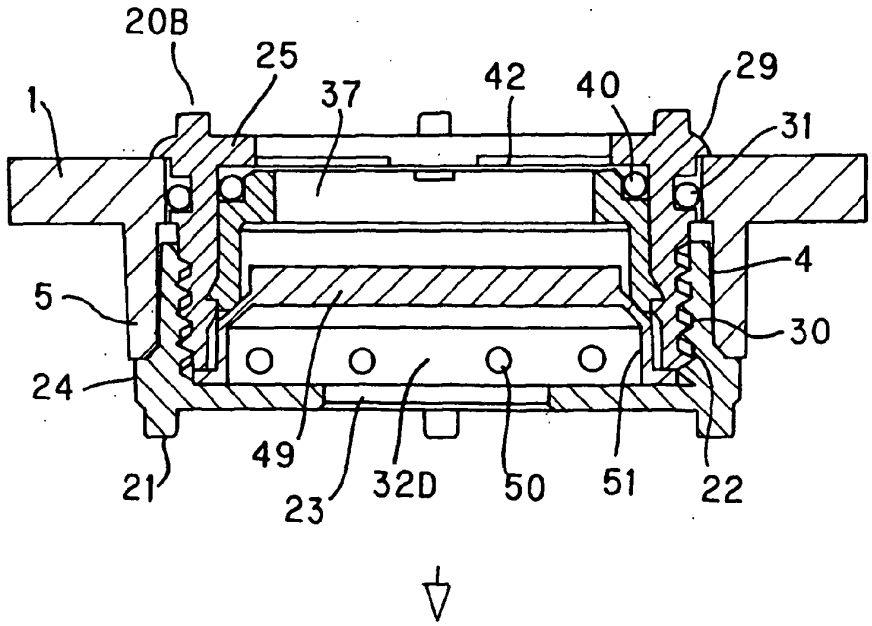


FIG. 24



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(86) International application number:
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(54) **WAFER CONTAINER WITH TUBULAR ENVIRONMENTAL CONTROL COMPONENTS**

WAFER-CONTAINER MIT RÖHRENFÖRMIGEN UMWELTSTEUERKOMPONENTEN

RÉCIPIENT À PLAQUETTES POURVU DE COMPOSANTS DE CONTRÔLE ENVIRONNEMENTAL TUBULAIRES

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR

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(73) Proprietor: **Entegris, Inc.**
Billerica, MA 01821 (US)

(72) Inventors:
- **WATSON, James, A.**
  Eden Prairie
  MN 55346 (US)
- **BURNS, John**
  Colorado Springs
  CO 80918 (US)
- **FORBES, Martin, L.**
  Divide
  CO 80814 (US)
- **FULLER, Matthew, A.**
  Colorado Springs
  CO 80907 (US)
- **SMITH, Mark, V.**
  Colorado Springs
  CO 80908 (US)

(74) Representative: **Patentanwälte Geyer, Fehners & Partner mbB**
Perhamerstrasse 31
80687 München (DE)

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US-A1- 2004 182 472

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EP 2 272 088 B1

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a front opening container for wafers 300 mm and larger, comprising a container portion having a container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving section in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the backside has a pair of corner regions extending from the top of the container portion to the bottom of the container portion, a door to fit in the open front and latchable to the door frame, a pair of elongate tubular environmental control components positioned in the corner regions, each elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein each of the elongate tubular environment control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port.

[0002] Wafer containers and reticle pods generally are sealed containers known as FOUPs (front opening unified pods), FOSBs (front opening shipping boxes), or SMIF (standard mechanical interface) pods. These containers provide a microenvironment to isolate and control the environment surrounding a wafers and substrates used in manufacturing integrated circuits, during storage, transport and processing of the materials. Processing of such materials traditionally has been carried out in a particulate free environment generally known as a "clean room". However, maintenance of such "clean rooms" in a contaminant free state can require a great deal of care and effort, particularly during processing of the materials.

[0003] The internal atmosphere of such microenvironments can be more readily controlled and maintained. Often, such containers are purgible with inert gas or clean dry air (CDA) or extra CDA. It has been observed that contamination of reticles in such containers can be caused not only by discrete particles but also by hazing occurring on wafers or reticles. See Publication WO 2007/149513 A2, owned by the owner of the instant application, which is incorporated herein by reference and included in the Appendix to this application. Such hazing can also occur on wafers in wafer containers and be detrimental thereto, see U.S. Patent No. 5,346,518 which is incorporated herein by reference. Also relevant, U.S. Patent No. 6,042,651, owned by the owner of the instant application, discloses using nozzled towers in bottom opening SMIF pods and a front opening wafer container that uses wafer shelf assemblies as purge outlets. Problems associated with such structures and optimal use of such structures has not been adequately addressed.

[0004] For example, the use of desiccants and vapor getters in substrate containers typically require removal or disassembly of same before washing and such substrate containers as the fluids utilized can destroy the media for filtering and/or vapor absorption. Moreover, purge port plumbing within substrate containers is, aside from the media issues, difficult to clean and dry due to the enclosed areas used for transferring purge gases. A means for facilitating cleaning of such substrate containers without disassembly and removal of media and purge components would be very advantageous. Particularly, problematic in cleaning are free standing towers such as disclosed in U.S. Pat. No. 6,042,651. Moreover, such towers are subject to movement and potential dislocation due to their conventional positioning where they may be inadvertently contacted and their connection only at the base of the substrate container. Better positioning and attachment methods and structures would be advantageous, particularly methods that do not rely on holes or fasteners that extend through walls or other barriers separating the enclosed interior of the container from the exterior.

[0005] The use of discrete towers in a front opening pod, the use of more than one discharge tower, and the optimal placement and securement of discharge towers or tubular environmental control components has not heretofore been adequately considered and optimized to satisfactorily address reliability, haze, contamination and particulate control, and cleaning issues in front opening large diameter wafer containers. As a transition is made from 300mm wafers to 450mm wafers, improvements in these areas will be even more important.

[0006] JP 2003 168728 A describes a front opening wafer container of the type as mentioned at the beginning. The known container is provided with through-holes through which gas inside the container can be replaced. On a part of the through-holes a nozzle member provided with nozzles blowing out the gas against both sides of a wafer is fitted and the residual through-holes serve as exhaust vents. The nozzles of the nozzle member blow out clean air or inert gas directly against the wafers along both of their surfaces, by which a space where gas is stagnant can be eliminated.

SUMMARY OF THE INVENTION

[0007] In an embodiment of the invention, a wafer container includes a tubular environmental control component that is configured with an open interior and slots communicating with the interior of the wafer container. One or two of the tubular component may be strategically placed in back corners or compartments of the wafer container and may be connected to purge inlets on the bottom of the wafer container. Certain embodiments may have a filter in addition to or alternatively to the absorbent

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material. In certain embodiment an additional purge inlet port may be utilized for a total of three purge inlets. The tubular components or the purge ports may have a check valve therein to control the flow direction of gas (including air) into and out of the container and with respect to the tower. The purge port may utilize an elastomeric grommet and the tubular component sealingly connected thereto. The tubular component may have a getter media piece rolled in an elongate circular fashion forming or shaped as a tube and disposed within the tower. The media can provide active and/or passive filtration as well as having capabilities to be recharged.

[0008] One configuration of front opening wafer containers for 300mm sized wafers have a pair of compartments on each of the left and right side in the inside rear of the container portions. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. A feature and advantage of certain embodiments is utilizing these compartments for containing, completely or partially, elongate tubular environmental control components that extend substantially from a bottom wafer position to a top wafer position or from the bottom of the container portion to the top. In one embodiment, a tubular shape of getter material is exposed within the front opening container in one or both compartments with minimal containment of the getter and without being part of an active purge system. In another embodiment, a tubular environmental control component configured as a purge tower may be placed in one or both compartments. The tower may be configured as a containment portion that may contain media. The media can be filter and/or absorbent media.

[0009] In particular embodiments, the tubular environmental control component has apertures either for exuding purge gas into the open interior of the container portion or for allowing absorbant media in the component to absorb vapors, including humidity from the interior of the container portion. A feature and advantage is that such apertures may be selectively obstructed to stop communication between the interior of the tubular component and the open interior of the wafer container. This is highly advantageous for washing the container so that filters, getters, or other contents of the tubular component can be protected from the washing fluids without removing the components. The obstruction may be by an elastomeric strip that seals the apertures as by a rigid slidably attached member that can cover and uncover the apertures. Moreover such selective blocking can be adjustable to change the size of the openings between the interior of the container portion and the interior of the tubular component.

[0010] A feature and advantage of certain embodiments is that the tubular component with apertures may be horizontally offset form the purge inlet connected thereto. This provides clearance with respect to the wafers. Moreover, positioning the discharge aperture in the tubular component back in the recess or compartment is believed to provide better fluid flow characteristics for the purge gas. Positioning the tubular components in the back recess provides the advantage of protection of the purge component from bumping or inadvertent contact.

[0011] A feature and advantage of certain embodiments is the methods of attachment of environmental control components in the rear compartments. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. These internal compartments have walls that generally converge rearwardly. In a particular embodiment, a flexible elastomeric attachment member is secured intermediate the top of a tubular environmental control component and the polymer wall of the container portion. Such elastomeric attachment member secures the tower in place without apertures through the walls and optimally utilizes the high coefficient of friction between the polycarbonate container portion wall and the elastomeric material. The member may be shaped as a cap further providing the advantageous function of securing together elongate components that comprising the containment portion of tubular environmental control components. A tubular component may have such a member on both ends to utilize the high coefficient of friction and the compression of the elastomeric members to retain said tubular environmental control component within, totally or partially, the rearward compartment. In another embodiment a rigid bracket formed from metal or a rigid polymer may have spring teeth to wedge the bracket between opposing walls of the compartment wherein the teeth dig into the surface of the container portion wall. A feature and advantage of these attachment methods and structures is that the attachment utilizes the opposing walls for engagement of the attachment components without separate structure or fasteners that extend through walls of the wafer container. Therefore, wafer containers may be readily retrofitted with no modifications or reduced modifications to the product.

[0012] A feature and advantage of embodiments utilizing the tubular getter media is that a relatively high area of media is effectively exposed in a confined area in the wafer container. Moreover, the rear compartments work well for the tubular components that have no media and are utilized for pure purging.

[0013] A further feature and advantage of certain embodiments is that where purge gas is exhausted through the tower, the tubular getter media may be effectively recharged for periods when the environment therein is static.

[0014] A further feature and advantage of embodiments herein is that accommodation of the invention in existing configurations of 300 wafer containers requires minimal changes in such containers. A further feature and advantage is that aspects of the invention are highly

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suitable for larger wafer containers.

DESCRIPTION OF THE FIGURES

[0015]

Figure 1 is a perspective view of a front opening wafer container according to an embodiment of the invention;

Figure 2 is a bottom view of the wafer container of Figure 1;

Figure 3 is a front perspective view into the open front of a different embodiment of a container portion;

Figure 4 is a detail top view cross-sectional of the embodiment of Figure 3 showing the location of tubular components and purge ports with respect to the walls of the container portion and wafers therein;

Figure 5 is an elevational view of a tubular component;

Figure 6 is a detail view of attachment features suitable for securing the tower component to the bottom wall of a container portion of a front opening wafer container;

Figure 7 is a front elevation view of a container portion with a pair of tubular environmental control components configured as filter cartridges mounted therein with brackets;

Figure 8 is a perspective view of tubular environmental control components configured as an absorbent filter cartridge according to an embodiment of the present invention;

Figure 9 is a bracket suitable for attaching a tubular environmental control component to the back region of a wafer container such as is shown in Figures 4 and 5;

Figure 10 is a top cross sectional view illustrating an attachment means for a tubular environmental control component of a wafer container;

Figure 11 is a perspective view of a filter cartridge in a bracket;

Figure 12 is a perspective view of the bracket of Figure 11;

Figure 13 is a cross sectional view taken at line 13-13 of Figure 4;

Figure 14 is an exploded view of a tubular environmental control component according to an embodiment of the invention;

Figure 15 is an exploded view of a tubular environmental control component of the tubular environmental control component of Figure 14;

Figure 16 is a front side perspective view of a tubular environmental control component;

Figure 17 is a rear side view of the tubular environmental control component of Figure 16;

Figure 18 is a front perspective view of the tubular environmental control component of Figures 16 and 17 with a blocking member engaged therewith;

Figure 19 is a front side perspective view of a tubular environmental control component according to an embodiment of the invention;

Figure 20 is a detail view of the tubular environmental control component of Figure 19 opened revealing a living hinge;

Figure 21 is a container portion according to an embodiment of the invention; and

Figure 22 is a perspective view of an alternative embodiment of a blocking member 800 according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] Referring to Figures 1 and 2, a front opening wafer container 20 is depicted and generally includes door 24 and container portion 26. Container portion 26 has front opening 30 leading into open interior 32 where a plurality of wafers W are retained on wafer shelves 35. Door 24 has key access holes 36 with latch mechanism 38 partially illustrated in the interior of the door enclosure with latch tips 41 that engage recesses 39 in the container portion door frame 40. The wafer container has purge capabilities with a pair of forward purge ports 48 with purge grommets 50 which are secured into grommet receiving structure 51 on the bottom 52 of the container portion and rearward purge ports 54. Check valves 56 may be inserted into the grommets to control the direction of purging gas fluid flow. Tubular environmental control components configured as a first type of tubular environmental control component as purge towers 60 are illustrated which also may utilize grommets 62 and check valves 63. An exemplary location of purge ports is illustrated in Figure 2 with reference to the wafers W.

[0017] Referring to Figures 3, 4, and 13, further details of a wafer container with a different configuration portion 64 embodying the inventions are illustrated with appro-

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priate component placement. The container portion 64 has a shell 65 and closed top 66, a closed bottom 66.1, a closed left side 66.2, a closed right side 66.3, an open front 67, and a closed back 67.1. The interior of the container has a plurality of shelves 70 which may be secured to the container portion at the top and bottom of same. A kinematic coupling plate 74 (not shown in Figure 4) is positioned at the bottom of the container portion and has appropriate openings for receiving the front side grommets and rear side grommet 77 at rear ports 54. The openings will extend through the shell 65. The container portion has two rearward apertures 80 which extend from the interior 32 of the wafer container to the exterior.

[0018] A second type of tubular environmental control component 78 configured as a tower component as depicted in Figures 3 and 13 is inserted into the container portion 64 from the interior into the aperture 80. The tubular component has a containment portion 81, an offset portion 83, and port portion 85. Elastomeric grommet 77 may be sealingly placed in the lower portion 94 of the tubular component and a check valve 63 may be placed therein. A cylindrical shaped filter and/or getter media material 100 may be included in the containment portion and is configured to conform to the interior of the tubular component. Said tubular component has a plurality of axially-extending apertures 110 configured as horizontal slots disclosed therein. In a preferred embodiment, there may be a slit for each wafer with the slit position to discharge purge gas over the surface of the respective wafer. The media material, if in the containment portion, is thus exposed to the interior of the wafer container by way of said axially-extending openings. Of particular note of this container portion 64 are the rearward compartments 111 that are defined by rearward protrusions 112 at the back 67.1. The wall 113 is configured to provide two feet 114 when the container is tipped rearward 90 degrees whereby the front with door 24 is upward, such as for shipping. Each compartment 111 has a pair of sidewall portions 115, a back wall portion 116 and a compartment opening 117.

[0019] Referring to Figures 5 and 6, the tubular component 119 in this embodiment has vertical slits and has a plurality of fingers 122 that extend downwardly into the apertures 80 through the shell and kinematic coupling plate 74. Said fingers resiliently flex radially inward and allow a secure fit in the aperture in the bottom of the container portion. A flange 113 may facilitate proper seating of the component.

[0020] Referring to Figures 7-11, additional embodiments are depicted with a pair of tubular environmental control components configured as filter cartridges 200 mounted in approximately the same position, in rearward 3-sided compartments 111, and configured as getters without the associated active purge capability of the containers illustrated in Figures 1-4. Such cartridges may have an outer housing 210 formed of a polymer or other suitable material with media 211 positioned therein. In a preferred embodiment the cartridge and media will be tubular shaped. Bosses 212 on the cartridge of Figure 8 can be utilized to attach the cartridge directly to the container portion wall by way of screws extending through the exterior wall. Alternatively the bracket 220 as illustrated in Figure 9 and Figure 7 may be attached to the back wall of the container portion with the cartridge clamped therein.

[0021] Referring in particular to Figures 10, 11 and 12 a further embodiment of a filter cartridge 200 is illustrated and again has media 304 closed within a housing 308. The cartridge 200 is clamped within the clamp 320 which has resilient catch legs 330 with tabs 322 which can bite into the walls of the container simply by insertion therein with no further attachment mechanisms. Spring arms 336 secure the cartridge in the bracket.

[0022] Specific getter media which may be utilized in the cartridges and the towers illustrated herein is disclosed in international publication no. WO 2007/149513 A2 which is incorporated herein by reference. Similarly the methodology and system for recharging a getter that is part of a purge system within the wafer container as illustrated herein in Figures 2, 3 and 4 are described in detail with reference primarily to a reticle pod in said publication. Said systems and methodologies and equipment are also applicable herein and said references incorporated for the disclosure relating directly thereto.

[0023] Referring to Figures 14-18, details of a third type of tubular environmental control component 400 in accord with the inventions herein is illustrated. The component has a pair of a first type of elongate portions 402, that assemble together to form a containment portion 410 with a containment interior 414. The containment portion has an axis 418 and connects to an offset portion 83 that connects to a purge port portion 85. An elastomeric grommet 432 may fit in a grommet receiver 440. The two elongate portions are configured as elongate clam shell portions. A rearward portion 402 has edge portions 444 with latch portions 449 configured as loops. The forward portion 402 also has edge portions 448 with latch portions 452 configured as tabs to engage the loops. The latch portion operates to secure the elongate portion together while allowing disassembly for cleaning or media placement or replacement. The forward portion 402 has an aperture portion 451 with a plurality of apertures 453 that provide communication between the containment interior 414 and the open interior of the container portion.

[0024] Referring in particular to Figures 13-18, an elastomeric elongate blocking member 460 is configured as a strip to engage the aperture portion by having tabs 464 fit into and seal the aperture 453. Figures 13 and 18 illustrate the member 460 in a blocking position. Thus, the blocking member can selectively block or expose the interior of the containment portion to the interior of the container portion.

[0025] Referring still to Figures 13-18, an elastomeric retainer, configured as an elastomeric cap 500, resiliently expands and fits over the upper end portion 506 of the tubular component 400. The cap 500 has a dome shape

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and has an extension portion 516 that is configured to engage the interior surface 520 of the container portion at the top. The cap functions to secure the elongate portions together and further to engage resiliently the container portion whereby the vibration of tubular component and plastic to plastic contact, the plastic component portion and the shell, is minimized. The tubular component is inserted putting the cap under compression and the high friction between the elastomeric material of the cap and the hard plastic of the shell, typically polycarbonate, holds the tubular component in place.

[0026] Referring to Figures 19 and 20, a fourth type of tubular environmental control component 600 is shown. The component has a pair of a second type of clam shell portions 604 that are hinged together by a living hinge 610 or the like and a rear corner 670. The two shell portions may be latched with latch portions (620, 624). Apertures 630 provide communication between the interior 634 of the capsule portion or containment portion 644 and the open interior of the wafer container. The containment portion also may connect to an offset portion 83 and then to a purge port portion 85.

[0027] Referring to Figure 21, an embodiment of a wafer container 692 with a fifth type of tubular environmental control component 700 is placed in recesses 710 on the backside wall 714 of the container portion 718. The recesses may have apertures positioned and spaced from the top 720 to the bottom 722. Offset portion 83 may provide communication between the containment portion 730 and the purge port portion (not shown) positioned in the interior. This arrangement allows the tubular environmental control components to be changed without disturbing the interior of the container portion to the same level as some of the other embodiments.

[0028] Referring to figure 22, an alternative embodiment of a blocking member 800 is illustrated. This rigid plastic, for example polycarbonate, piece clamps around a tubular environmental control component, such as the configuration of Figure 19. Gripping fingers 810 may secure the member to the tubular member by locking on to the rear corner 670 with wedge shape teeth 812. In a further embodiment the blocking member may have apertures 820 that correspond with the apertures 630 on the tubular component. This component can then sidably engage with the tubular environmental control component by sliding vertically, can open, close or adjust the communication between the interior of the tubular component and the interior of the container portion. Similarly shaped rigid blocking components can have arcuate fingers that partially wrap around the tubular components with cylindrical or oval cross-sectional shapes.

[0029] The illustrated embodiments should be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

Claims

1. A front opening wafer container (20) for wafers 300 mm and larger, comprising:

   a container portion (26) having container wall that extends around a closed left side (66.2), a closed right side (66.3), a closed bottom (66.1), a closed top (66), and a closed backside (67.1) defining an open interior (32), the container portion (36) having a plurality of horizontal wafer shelves (35) spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior (32) for holding a stack of horizontal spaced apart wafers (W) seated in the shelves (35), a door frame (40) defining an open front (30), wherein the container portion wall (116) at the back side has a pair of corner regions extending from the top (66) of the container portion (26) to the bottom (66.1) of the container portion (26);
   a door (24) to fit in the open front (36) and latchable to the door frame (40);
   a pair of elongate tubular environmental control components (60, 78, 119, 400, 600, 700) positioned in the corner regions, each elongate tubular environmental control component (60, 78, 119, 400, 600, 700) having a containment portion (81, 420, 644, 730) with an interior and a plurality of apertures (110, 464) providing communication between the interior of the containment portion (81, 410, 644, 730) and the open interior (32) of the container portion (26), and wherein each of the elongate tubular environmental control component (60, 78, 119, 400, 600, 700) has an axis (418) that is upright and the elongate tubular environmental control component is connected to the bottom (66.1) of the container portion (26) at a purge port (54) **characterized in that** the purge port (54) is offset from the axis (418) of the tubular environmental control component (60, 78, 119, 400, 600, 700).

2. The front opening wafer container of claim 1 **characterized in that** each elongate tubular environmental control component (400, 600) is comprised of two elongate portions (402, 604), each elongate portion (402, 604) connected to the other by at least one of a plurality of latches (448, 452) and hinges (610), the two portions (402, 604) defining a containment portion (410, 644).

3. The front opening wafer container of claim 1 **characterized in that** the elongate tubular environmental control components (400) are each comprised of two elongate portions (402, 604) defining a containment portion (410), and wherein the elongate tubular control component (400) further comprises an elasto-

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meric cap (500) that resiliently expands to adheringly cover the top of the containment portion (410).

4. The front opening wafer container of claim 1 **characterized in that** the pair of elongate tubular environmental control components (700) are both outwardly exposed on the backside.

5. The front opening wafer container of claim 1 **characterized in that** the pair of elongate tubular environmental control components (60, 78, 119, 400, 600, 700) are spaced from the wall portions and the back side (67.1) and each elongate tubular environmental control component has a length and the length extends substantially a distance between the top wall portion (66) and the bottom wall portion (66.1).

6. The front opening wafer container of claim 2 further **characterized in that** it comprises an enlongate blocking member (460, 800) that is positionable on at least one of the tubular environmental control component (78, 400) to selectively obstruct the communication between the interior (414) of the containment portion (410) and the open interior of the container portion (26).

7. The front opening wafer container of claim 6 **characterized in that** the elongate blocking member (460) is formed of an elastomeric material and the tubular environmental control component (78, 400) has attachment structure extending around the plurality of apertures (110, 453) and said blocking component (460) resiliently engages to said attachment structure to sealingly block the communication between the interior (414) of the containment portion (410) and the open interior (32) of the container portion (26).

8. The front opening wafer container of claim 7 **characterized in that** the elongate blocking member (460, 800) is slidably engagable with one of the containment portions (410, 644) and is slidingly shiftable on said containment portion (410, 644) between a blocking position and an aperture open position.

9. The front opening wafer container of claim 1 **characterized in that** each of the containment portions (81, 420, 644, 730) has therein at least one of a filter material and an absorbent material.

Patentansprüche

1. Ein Wafer-Container (20) mit Frontöffnung für Wafer von 300 mm und größer, der folgendes umfaßt:

einen Containerabschnitt (26) mit einer Containerwand, die sich um eine geschlossene linke Seite (66.2), eine geschlossene rechte Seite (66.3), einen geschlossenen Boden (66.1), eine geschlossene Decke (66) und eine geschlossene Rückseite (67.1) erstreckt, welche einen offenen Innenraum (32) festlegen, wobei der Containerabschnitt (26) eine Vielzahl horizontaler, voneinander entfernter, darin befestigter Waferfächer (35) aufweist, die einen im allgemeinen zylindrischen Waferaufnahmebereich im offenen Innenraum (32) zum Haltern eines Stapels horizontaler, voneinander entfernter Wafer (W) festlegen, die in den Fächern (35) sitzen,
einen Türrahmen (40), der eine offene Front (30) festlegt, wobei die Wand (116) des Containerabschnitts an der Rückseite ein Paar Eckabschnitte aufweist, die von der Decke (66) des Containerabschnitts (26) bis zum Boden (66.1) des Containerabschnitts (26) verlaufen;
eine Türe (24) zum Einfügen in die offene Front (36) und an dem Türrahmen (40) verriegelbar;
ein Paar länglicher rohrförmiger Umwelt-Steuerkomponenten (60, 78, 119, 400, 600, 700), die in den Eckabschnitten positioniert sind, wobei jede längliche rohrförmige Umwelt-Steuerkomponente (60, 78, 119, 400, 600, 700) einen Einhausungsabschnitt (81, 420, 644, 730) mit einem Inneren und einer Vielzahl von Öffnungen (110, 464) aufweist, die eine Verbindung zwischen dem Inneren des Einhausungsabschnitts (81, 410, 644, 730) und dem offenen Innenraum (32) des Containerabschnitts (26) schaffen, und wobei jede der länglichen rohrförmigen Umwelt-Steuerkomponenten (60, 78, 119, 400, 600, 700) eine Achse (418) hat, die senkrecht steht, und die längliche rohrförmige Umwelt-Steuerkomponente mit dem Boden (66.1) des Containerabschnitts (26) an einem Spülport (54) verbunden ist, **dadurch gekennzeichnet, daß** der Spülport (54) gegenüber der Achse (418) der länglichen rohrförmigen Umwelt-Steuerkomponente (60, 78, 119, 400, 600, 700) versetzt ist.

2. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** jede längliche rohrförmige Umwelt-Steuerkomponente (400, 600) zwei längliche Abschnitte (402, 604) umfaßt, wobei jeder längliche Abschnitt (402, 604) am anderen befestigt ist durch zumindest einen aus einer Vielzahl von Riegeln (448, 452) und Scharnieren (610), wobei die beiden Abschnitte (402, 604) einen Einhausungsabschnitt (410, 644) festlegen.

3. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** jede der länglichen rohrförmigen Umwelt-Steuerkomponenten (400) zwei längliche Abschnitte (402, 604) umfaßt, die einen Einhausungsabschnitt (410) festle-

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gen, und wobei die längliche rohrförmige Steuerkomponente (400) zudem eine elastomere Kappe (500) aufweist, die sich elastisch dehnt, um die Oberseite des Einhausungsabschnitts (410) durch Anhaften abzudecken.

4. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** von dem Paar länglicher rohförmiger Umwelt-Steuerkomponenten (700) beide auf der Rückseite nach außen hin freiliegen.

5. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** das Paar länglicher rohrförmiger Umwelt-Steuerkomponenten (60, 78, 119, 400, 600, 700) von den Wandabschnitten und der Rückseite (67.1) beabstandet sind und jede längliche rohrförmige Umwelt-Steuerkomponente eine Länge aufweist und die Länge sich im wesentlichen über eine Entfernung zwischen dem Deckenwandbereich (66) und dem Bodenwandbereich (66.1) erstreckt.

6. Der Wafer-Container mit Frontöffnung nach Anspruch 2, weiter **gekennzeichnet dadurch, daß** er ein längliches Blockierglied (460, 800) umfaßt, das auf wenigstens einer der rohrförmigen Umwelt-Steuerkomponenten (78, 400) positionierbar ist, um wahlweise die Verbindung zwischen dem Inneren (414) des Einhausungsabschnitts (410) und dem offenen Innenraum des Containerabschnitts (26) zu versperren.

7. Der Wafer-Container mit Frontöffnung nach Anspruch 6, **dadurch gekennzeichnet, daß** das längliche Blockierglied (460) aus einem elastomeren Material gebildet ist und die längliche Umwelt-Steuerkomponente (78, 400) eine Befestigungsstruktur aufweist, die um die Vielzahl von Öffnungen (110, 453) herum verläuft, und die Blockierkomponente (460) elastisch mit der Befestigungsstruktur in Eingriff steht, um dichtend die Verbindung zwischen dem Inneren (414) des Einhausungsabschnitts (410) und dem offenen Innenraum (32) des Containerabschnitts (26) zu blockieren.

8. Der Wafer-Container mit Frontöffnung nach Anspruch 7, **dadurch gekennzeichnet, daß** das längliche Blockierglied (460, 800) in Gleiteingriff mit einem der Einhausungsabschnitte (410, 644) bringbar und gleitend verschieblich auf diesem Einhausungsabschnitt (410, 644) zwischen einer Blockierstellung und einer Offenstellung für die Öffnungen angebracht ist.

9. Der Wafer-Container mit Frontöffnung nach Anspruch 1, **dadurch gekennzeichnet, daß** jeder der Einhausungsabschnitte (81, 420, 644, 730) von einem Filtermaterial und einem absorbierenden Material in sich wenigstens eines aufweist.

Revendications

1. Récipient à plaquettes à ouverture frontale (20) pour plaquettes de 300 mm et supérieures, comprenant :

   une partie de récipient (26) ayant une paroi de récipient qui s'étend autour d'un côté gauche fermé (66.2), d'un côté droit fermé (66.3), d'un fond fermé (66.1), d'un sommet fermé (66) et d'un côté arrière fermé (67.1) définissant un intérieur ouvert (32), la partie de récipient (26) ayant une pluralité d'étagères de plaquette horizontales (35) espacées, fixées à l'intérieur de cette dernière et définissant une région de réception de plaquette généralement cylindrique dans l'intérieur ouvert (32) pour contenir un empilement de plaquettes espacées horizontales (W) installées dans les étagères (35), un bâti de porte (40) définissant une partie avant ouverte (30), dans lequel la paroi de partie de récipient (116) au niveau du côté arrière a une paire de régions de coin s'étendant à partir du sommet (66) de la partie de récipient (26) jusqu'au fond (66.1) de la partie de récipient (26) ;
   une porte (24) destinée à être montée dans la partie avant ouverte (36) et verrouillable par rapport au bâti de porte (40),
   une paire de composants de contrôle environnemental tubulaires allongés (60, 78, 119, 400, 600, 700) positionnés dans les régions de coin, chaque composant de contrôle environnemental tubulaire allongé (60, 78, 119, 400, 600, 700) ayant une partie de confinement (81, 420, 644, 730) avec un intérieur et une pluralité d'ouvertures (110, 464) fournissant la communication entre l'intérieur de la partie confinement (81, 410, 644, 730) et l'intérieur ouvert (32) de la partie de récipient (26), et dans lequel chacun des composants de contrôle environnemental tubulaires allongés (60, 78, 119, 400, 600, 700) a un axe (418) qui est droit et le composant de contrôle environnemental tubulaire allongé est raccordé au fond (66.1) de la partie de récipient (26) au niveau d'un orifice de purge (54),
   caractérisé en ce que l'orifice de purge (54) est décalé de l'axe (418) du composant de contrôle environnemental tubulaire (60, 78, 119, 400, 600, 700).

2. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** chaque composant de contrôle environnemental tubulaire allongé (400, 600) est composé de deux parties allongées (402, 604), chaque partie allongée (402,

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604) étant raccordée à l'autre par au moins l'un d'une pluralité de verrous (448, 452) et de charnières (610), les deux parties (402, 604) définissant une partie de confinement (410, 644).

3. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** les composants de contrôle environnemental tubulaires allongés (400) sont chacun composés de deux parties allongées (402, 604) définissant une partie de confinement (410), et dans lequel le composant de contrôle tubulaire allongé (400) comprend en outre un capuchon élastomère (500) qui subit une expansion résiliente pour recouvrir, par adhérence, le sommet de la partie de confinement (410).

4. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** la paire de composants de contrôle environnemental tubulaires allongés (700) sont tous deux exposés vers l'extérieur sur le côté arrière.

5. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** la paire de composants de contrôle environnemental tubulaires allongés (60, 78, 119, 400, 600, 700) sont espacés des parties de paroi et du côté arrière (67.1) et chaque composant de contrôle environnemental tubulaire allongé a une longueur et la longueur s'étend sensiblement sur une distance entre la partie de paroi supérieure (66) et la partie de paroi inférieure (66.1).

6. Récipient à plaquettes à ouverture frontale selon la revendication 2, **caractérisé en outre en ce qu'**il comprend un élément de blocage allongé (460, 800) qui peut être positionné sur au moins l'un des composants de contrôle environnemental tubulaires (78, 400) pour obstruer sélectivement la communication entre l'intérieur (414) de la partie de confinement (410) et l'intérieur ouvert de la partie de récipient (26).

7. Récipient à plaquettes à ouverture frontale selon la revendication 6, **caractérisé en ce que** l'élément de blocage allongé (460) est formé avec un matériau élastomère et le composant de contrôle environnemental tubulaire (78, 400) a une structure de fixation s'étendant autour de la pluralité d'ouvertures (110, 453) et ledit composant de blocage (460) met en prise de manière résiliente ladite structure de fixation pour bloquer de manière étanche la communication entre l'intérieur (414) de la partie de confinement (410) et l'intérieur ouvert (32) de la partie de récipient (26).

8. Récipient à plaquettes à ouverture frontale selon la revendication 7, **caractérisé en ce que** l'élément de blocage allongé (460, 800) peut se mettre en prise de manière coulissante avec l'une des parties de confinement (410, 644) et peut être déplacé de manière coulissante sur ladite partie de confinement (410, 644) entre une position de blocage et une position ouverte d'ouverture.

9. Récipient à plaquettes à ouverture frontale selon la revendication 1, **caractérisé en ce que** chacune des parties de confinement (81, 420, 644, 730) a, à l'intérieur de cette dernière, au moins l'un parmi un matériau de filtre et un matériau absorbant.

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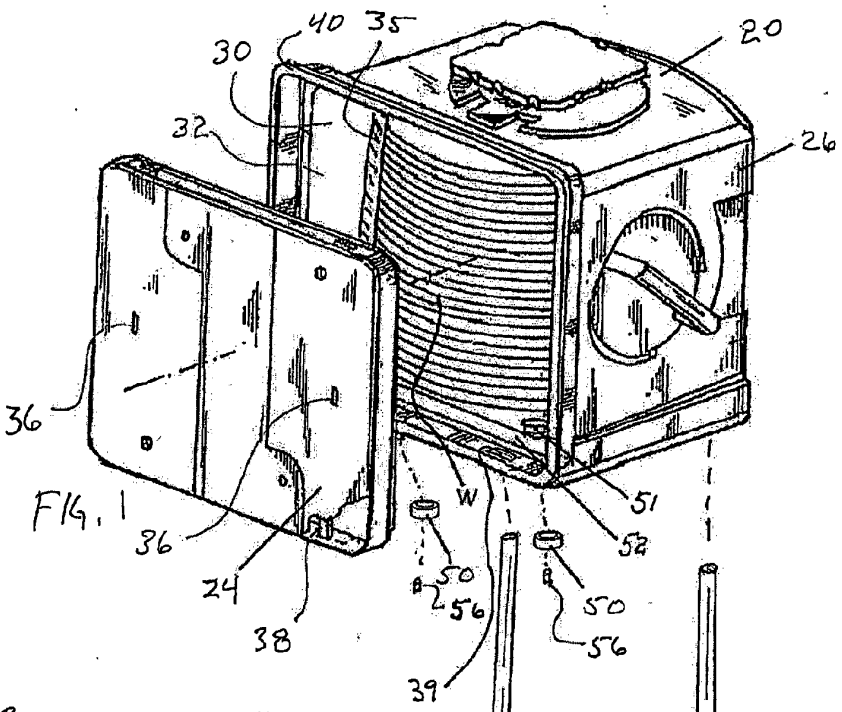


FIG. 1

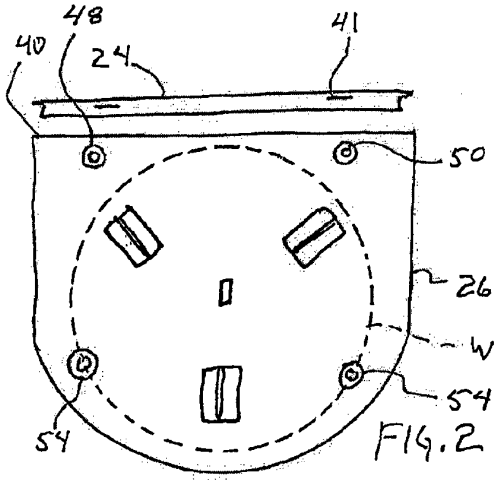


FIG. 2

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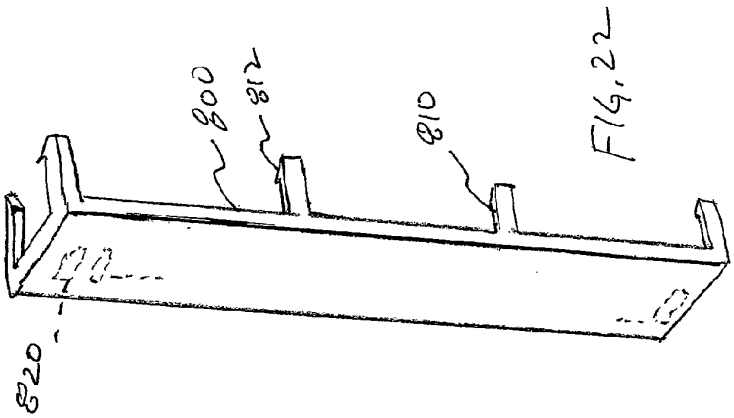


Fig. 22

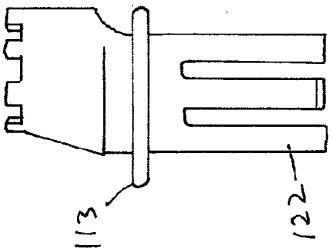


Fig. 6.

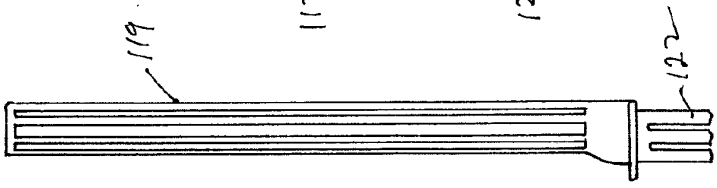


Fig. 5.

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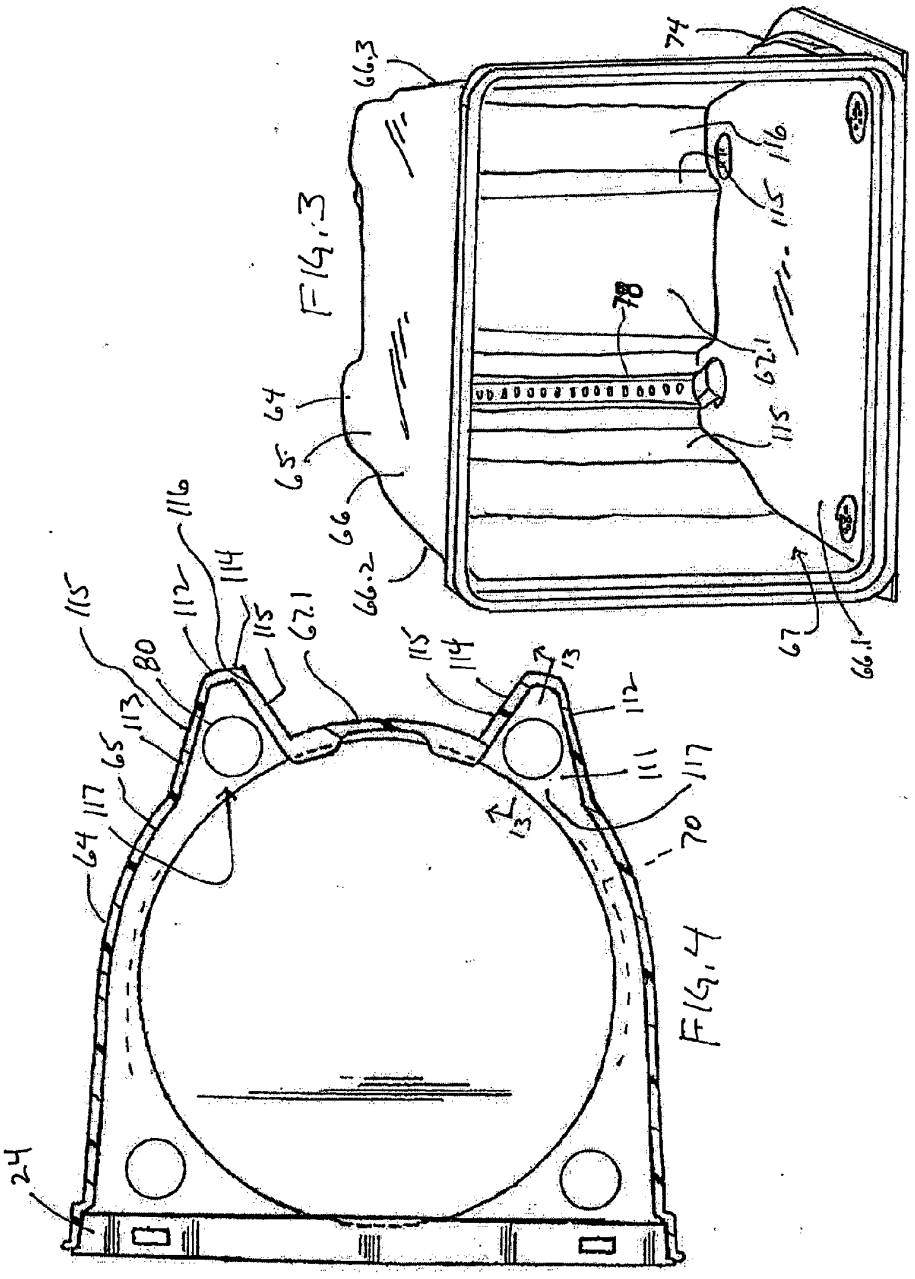


FIG. 3

FIG. 4

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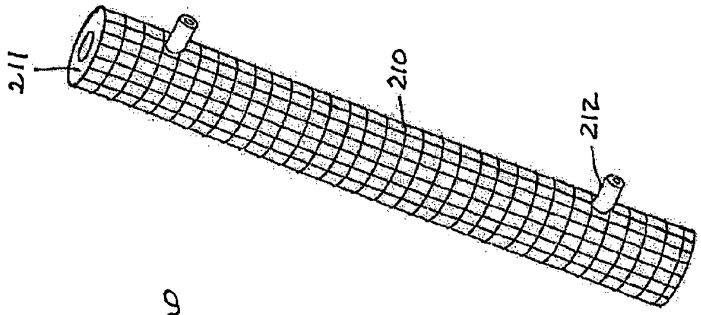


Fig. 8.

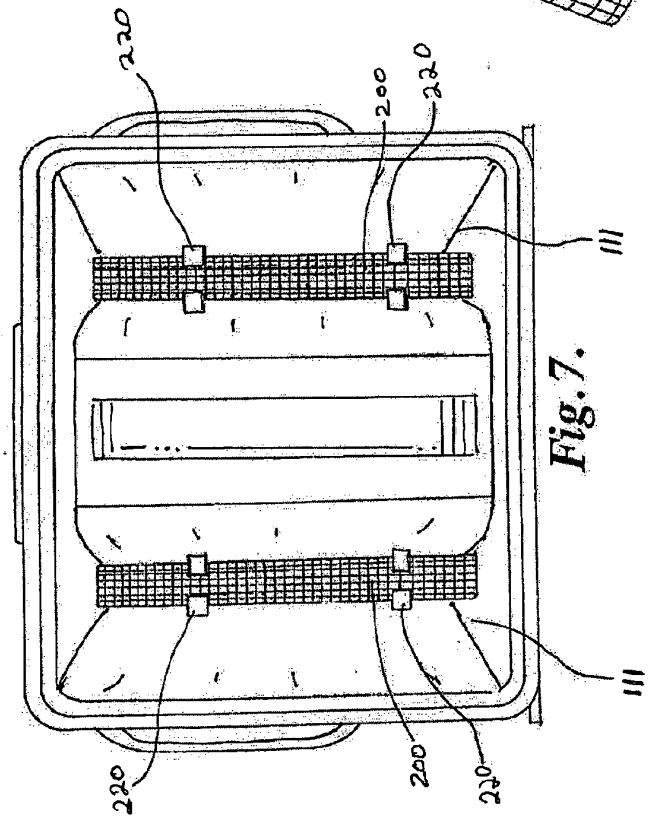


Fig. 7.

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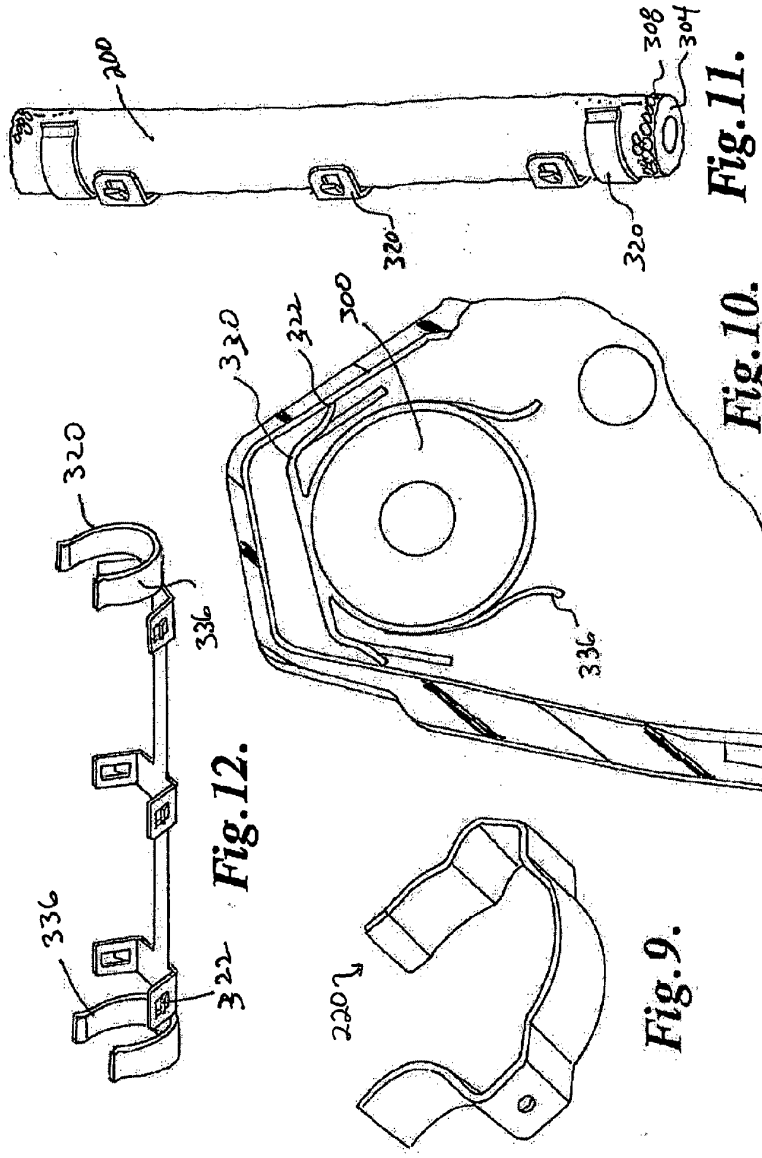


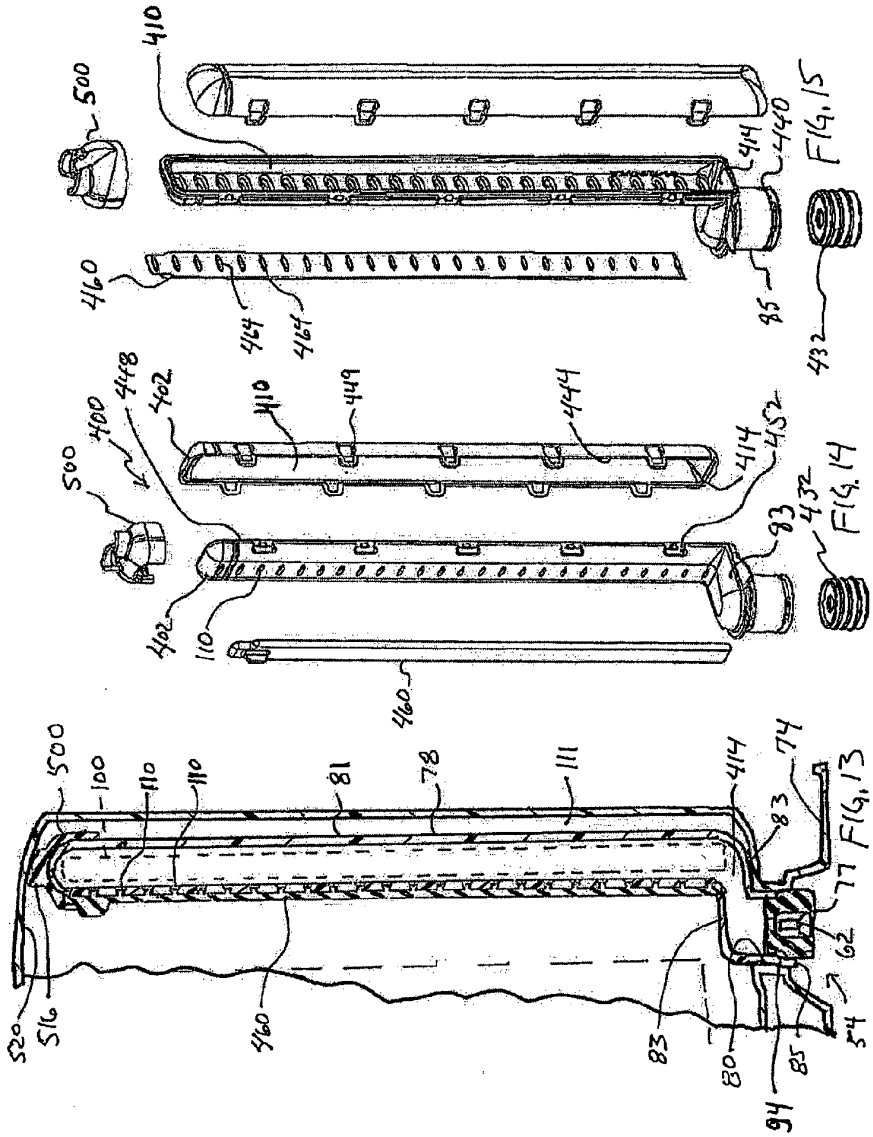
Fig.11.

Fig.10.

Fig.12.

Fig.9.

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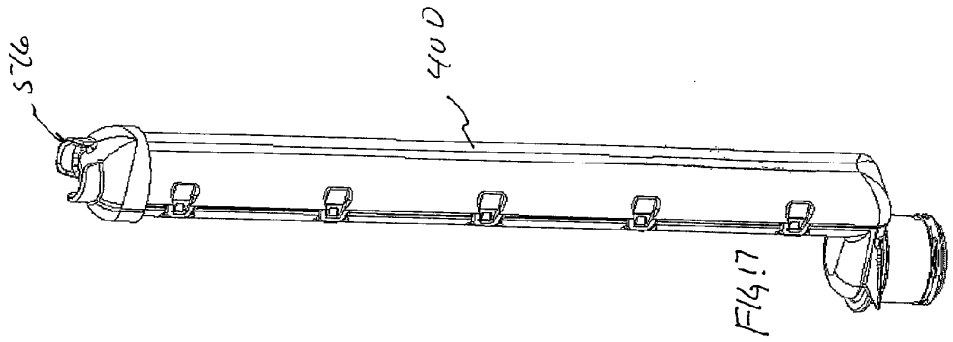


FIG 17

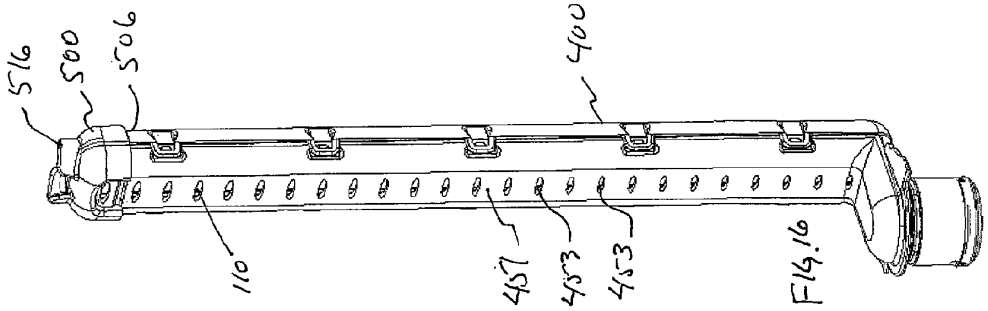


FIG 16

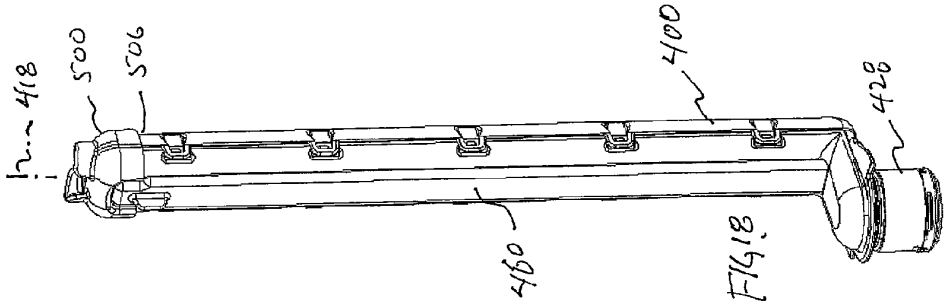


FIG 18

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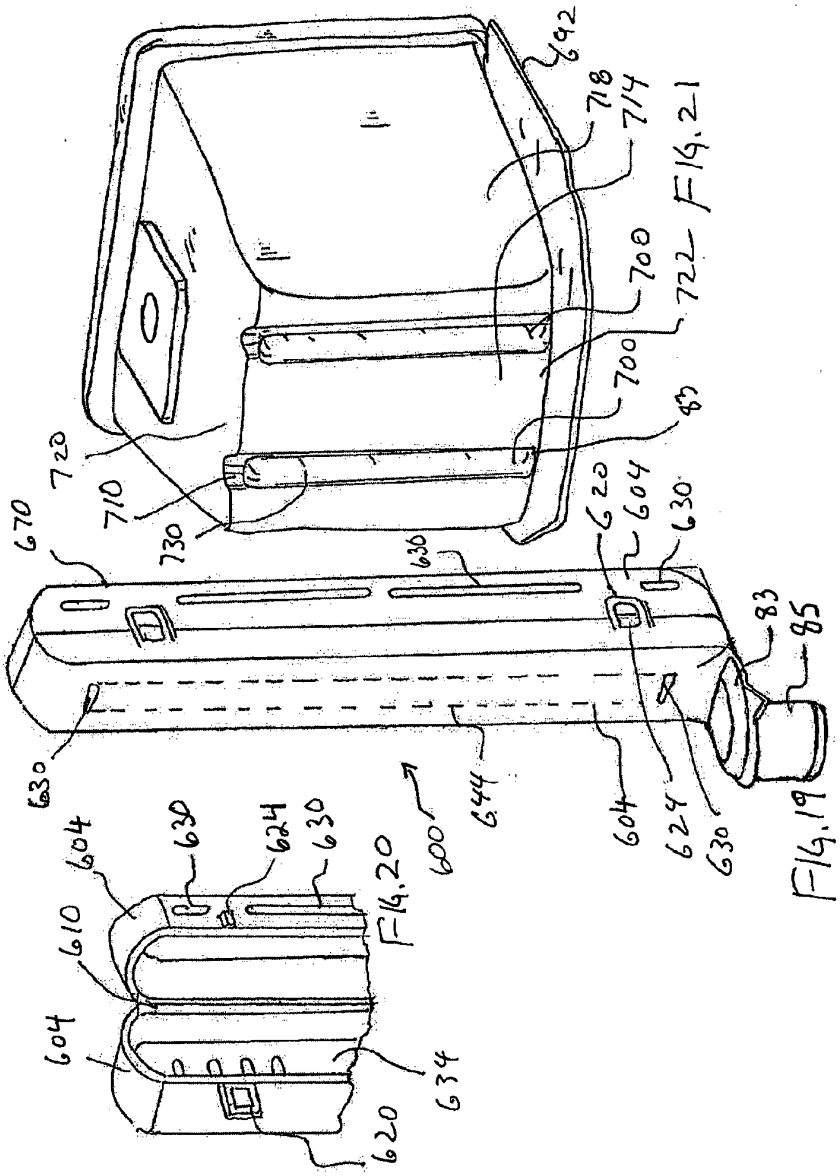


FIG. 19

FIG. 20

FIG. 21

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REFERENCES CITED IN THE DESCRIPTION

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- US 6042651 A **[0003] [0004]**
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PRECISION SUBSTRATE CONTAINER

Inventor(s): NAKAYAMA TAKAYUKI, ; SHINTANI WATARU

Applicant(s): SHIN ETSU POLYMER CO LTD

Classification: **- international:** ***B65D81/24; B65D85/86; H01L21/673; H01L21/68***

- cooperative:

Application number: JP20010366763 20011130

Priority number(s): JP20010366763 20011130

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Abstract of JP2003168728 (A)

PROBLEM TO BE SOLVED: To provide a substrate container which is capable of eliminating a space where gas stays stagnant and replacing gas inside the container completely with another. ;SOLUTION: This precision substrate container is composed of a container main body 2 and a lid 3 and provided with through-holes through which inner gas inside the container can be replaced with another. A nozzle member 5 provided with nozzles blowing out the gas against both sides of a precision substrate W is fitted on a part of the through-holes, and the residual through- holes are made to serve as exhaust vents. The nozzles of the nozzle member 5 blow out clean air or inert gas direct against the precision substrates along both of their surfaces, by which a space where gas stays stagnant can be eliminated, dust or the like can be prevented from adhering to the substrates, and gas inside the container can be completely replaced with another. ;COPYRIGHT: (C)2003,JPO

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B65D 81/24 (2006.01)　B65D 81/24　C
B65D 85/86 (2006.01)　B65D 85/38　R

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(73)特許権者　000190116
信越ポリマー株式会社
東京都中央区日本橋本町４丁目３番５号
(74)代理人　100093735
弁理士　荒井　鐘司
(74)代理人　100105429
弁理士　河野　尚孝
(74)代理人　100108143
弁理士　嶋崎　英一郎
(72)発明者　中山　孝行
新潟県糸魚川市大字大和川７１５　新潟ポリマー株式会社内
(72)発明者　新谷　渉
新潟県糸魚川市大字大和川７１５　新潟ポリマー株式会社内

最終頁に続く

(54)【発明の名称】精密基板収納容器

(57)【特許請求の範囲】

【請求項1】

開口部を有し、基板を横置きにして上下方向に並べて収納する容器本体と、前記開口部をシール可能に閉鎖する蓋体とからなり、内外に連通する複数の貫通孔を利用して容器内部の気体を置換できる精密基板収納容器において、前記貫通孔は、ノズル部材が取り付けられるか、あるいは排気孔として用いられ、前記ノズル部材は、一端に開口部と、開口部の外周部に形成されたねじ部と、つば部とを有する中空円筒状をなし、さらに、ノズル部材は、その側周壁に容器本体内に収納された精密基板の両面に気流を吹き付ける吹出孔と、前記開口部の内周には、フィルタ保持部材を取り付けるための係止凹部とを有し、リング状に形成された取り付けパーツを介して前記貫通孔に取り付けられ、残りの前記貫通孔を排気孔とすることを特徴とする精密基板収納容器。

【請求項2】

前記ノズル部材の吹出孔が、前記容器本体内に精密基板が収納された際の該精密基板の中心に向けている請求項１記載の精密基板収納容器。

【請求項3】

前記ノズル部材が、リング状に形成された取り付けパーツを介して容器本体の貫通孔に取り付けられ、前記取り付けパーツには、内周にねじ部が形成され、外周にはつば部が形成されていて、前記貫通孔に挿通されたノズル部材のねじ部と前記貫通孔の内周との間に取り付けパーツを差し込み、この取り付けパーツのねじ部をノズル部材のねじ部に螺合していくときに、ノズル部材に形成されたつば部が貫通孔の外周リブの上縁に接触し、取り

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付けパーツのつば部が貫通孔の端縁下部に接触して、固定される請求項１または２記載の精密基板収納容器。
【請求項4】
　前記容器本体が、前面に開口部を有し、前記排気孔となる貫通孔が蓋側の容器本体に設けられ、前記ノズル部材が取り付けられる貫通孔が、前記容器本体の奥側に設けられ、かつ前記各貫通孔が、前記容器本体内に精密基板が収納された際の該精密基板の投影部分以外の部分に設けられてなる請求項１～３のいずれか１項に記載の精密基板収納容器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、半導体ウェーハやマスクガラス等の精密基板（以下、単に基板と略記することもある）を収納して、保管、運搬等に使用される精密基板収納容器に関し、特には基板収納容器内部の気体を置換するためのノズル部材を有する精密基板収納容器に関する。
【０００２】
【従来の技術】
従来、精密基板収納容器は、開口部を有する容器本体とこの開口部を密閉する蓋体とからなり、容器本体内の対向する内側壁に形成された支持部に複数枚の精密基板を収納し、蓋体に取り付けられたシールガスケットを用いて、基板収納容器内部を密閉状態として、精密基板の保管や搬送に使用されている。
このような精密基板収納容器では、保管中に基板が汚染されることがないように、基板収納容器内の空気を窒素若しくは不活性ガスまたは乾燥空気等に置換して保管することが知られている（特開平８－１９１１００号公報、特開平９－１３４９５２号公報参照）。
【０００３】
【発明が解決しようとする課題】
上記密閉した精密基板収納容器には、一般にフィルタを備えた吹込孔と排気孔が設けられ、これらの孔を用いて基板収納容器内の気体交換を行っているが、基板収納容器の内部は、収納した複数の基板によって仕切られているため、基板収納容器内の完全な気体交換を行おうとすると、一回の気体交換に５分～１０分も時間がかかり効率が悪かった。
また、基板収納容器内は、収納した基板の数だけ内部が仕切られて複雑な空間をなすため、気体の置換がうまく行われない澱み部分が形成され、この澱み部分に、酸素や基板収納容器の材料、あるいは加工及び／または処理された基板表面から僅かに出る有機汚染ガスや金属イオン等が貯まったままで吹き込まれたガスと置換されず、精密基板が汚染されたり、酸化されてしまうという問題があった。
【０００４】
本発明は、このような問題点を解決するためになされたもので、クリーンエアーや不活性ガスを直接精密基板の両面に吹き付けるようにすることにより、基板収納容器内の澱み部分を無くして容器内部のガスの置換を完全に行い、精密基板への塵挨等の付着を防ぎ、基板の汚染を防止できる基板収納容器を提供するものである。
【０００５】
【課題を解決するための手段】
　前記課題を解決するために、請求項１の精密基板収納容器は、開口部を有し、基板を横置きにして上下方向に並べて収納する容器本体と、前記開口部をシール可能に閉鎖する蓋体とからなり、内外に連通する複数の貫通孔を利用して容器内部の気体を置換できる精密基板収納容器において、前記貫通孔は、ノズル部材が取り付けられるか、あるいは排気孔として用いられ、前記ノズル部材は、一端に開口部と、開口部の外周部に形成されたねじ部と、つば部とを有する中空円筒状をなし、さらに、ノズル部材は、その側周壁に容器本体内に収納された精密基板の両面に気流を吹き付ける吹出孔と、前記開口部の内周には、フィルタ保持部材を取り付けるための係止凹部とを有し、リング状に形成された取り付けパーツを介して前記貫通孔に取り付けられ、残りの前記貫通孔を排気孔とすることを特徴とする。

請求項２の精密基板収納容器は、前記ノズル部材の吹出孔が、前記容器本体内に精密基板が収納された際の該精密基板の中心に向けている

【０００６】

また、請求項３の精密基板収納容器は、前記ノズル部材が、リング状に形成された取り付けパーツを介して容器本体の貫通孔に取り付けられ、前記取り付けパーツには、内周にねじ部が形成され、外周にはつば部が形成されていて、前記貫通孔に挿通されたノズル部材のねじ部と前記貫通孔の内周との間に取り付けパーツを差し込み、この取り付けパーツのねじ部をノズル部材のねじ部に螺合していくときに、ノズル部材に形成されたつば部が貫通孔の外周リブの上縁に接触し、取り付けパーツのつば部が貫通孔の端縁下部に接触して、固定される。

さらに、請求項４の精密基板収納容器は、前記容器本体が、前面に開口部を有し、前記排気孔となる貫通孔が蓋側の容器本体に設けられ、前記ノズル部材が取り付けられる貫通孔が、前記容器本体の奥側に設けられ、かつ前記各貫通孔が、前記容器本体内に精密基板が収納された際の該精密基板の投影部分以外の部分に設けられてなる。

【０００７】

【発明の実施の形態】

以下、本発明の一実施の形態を添付図面に基づいて説明する。

図１は本発明の基板収納容器を表す斜視図であり、図２は本発明のノズル部材を基板収納容器に配置した状態を表す図１のII－II面による切断平面図であり、図３は本発明のノズル部材を配置した図１に表す基板収納容器のIII－III面による切断平面図である。また、図４は本発明の基板収納容器に取り付けられるノズル部材を表す正面図であり、図５はノズル部材の拡大底面図である。図６は本発明のノズル部材の取付け状態を表す図２のVI－VI面による断面図、図７は本発明のノズル部材の別の取付け状態を表す、図６に相当する断面図であり、図８は本発明の別の実施形態を表す基板収納容器の図２に相当する断面図である。

【０００８】

図１～図３に示す本発明の基板収納容器１は、前面に開口部を有し基板を横置きにして上下方向に並べて収納する容器であって、容器本体２と蓋体３とからなり、容器本体２には、その対向する左右の内側壁に、精密基板Ｗ（図３では１枚のみを示す）の周縁部を断面コ字状の開放部内で係止して水平に支持する支持部４，４が、上下方向にそれぞれ一定間隔で形成されており、蓋体３の内面には、精密基板Ｗの端縁部を押圧保持するリテーナ３０が取り付けられ、蓋体の側壁にはシールガスケット３１が取り付けられて、容器本体の開口部１２を蓋体３でシール可能に密閉できるようになっている。

また、容器本体２には、内外に連通する４個の貫通孔a_1、a_1，a_2、a_2が設けられ、これらの一部の貫通孔a_1には、容器本体２内に収納された精密基板Ｗの両面に気流を吹き付けるノズル部材５が取り付けられ、残りの貫通孔a_2は、排気孔６として使用されている。

【０００９】

このノズル部材５は、図４に示すように、一端に開口部７を有する中空円筒状に形成され、その側周壁には、円周方向に延びた複数の長円状の吹出孔８，８が軸方向に一定間隔で形成されている。

また、開口部７の外周壁には、容器本体２に設けられた貫通孔a_1に取り付けるためのねじ部９が螺刻形成され、このねじ部９の内周壁には、図５に示すように、フィルタを取り付けるための係止凹部１０が形成され、かつ開口には、内周壁から放射状に伸びるリブ１１が形成されている。フィルタ１８は、このリブ１１と後述するフィルタ保持部材１５に設けられる同様のリブ１６（図６）との間で、挟持状に取り付けられる。

【００１０】

本発明のノズル部材５は、図２、図６に示すように、容器本体２の開口部１２と対向する奥側の二箇所に形成された貫通孔a_1の内周面に形成されたねじ部１３に、ノズル部材５のねじ部９が螺着されて容器本体２の内部に取り付けられる。

この取付け構造では、上記螺着部以外のノズル部材５と容器本体２の接触部に気密性を高めるためのＯリング１４を設けることが好ましい。
ノズル部材５は、容器本体２に取り付けられた際、その各吹出孔８，８が、一対の支持部４，４に支持された基板Ｗに指向する向きに配置され、かつ各吹出孔８が隣接する基板と基板の間隙部に近接した位置に配設されるようになっている。
なお、図３では、ノズル部材５の吹出孔８は判り易くするため、容器本体２の対向する内壁面に向けて描かれているが、上述したように基板Ｗに指向する向きであれば、吹出孔の中心が精密基板Ｗの中心に向くようにノズル部材が配置されることが好ましい。
【００１１】
フィルタをノズル部材５の開口部７に取り付けるために使用されるフィルタ保持部材１５は、図６及び図１０に示すように、リング（筒）状に形成され、一端のノズル部材５側の開口部に形成された放射状のリブ１６を有し、ノズル部材５の開口部７の内周壁に設けられた係止凹部１０に、フィルタ保持部材１５の外周壁に設けた係止突起１７を嵌め込むことにより、ノズル部材５の開口部７の内周に取り付けられる。
【００１２】
この取り付けに際し、放射状のリブ１６にフィルタ１８を載せて、フィルタ保持部材１５をノズル部材５の開口部７に挿入することにより、フィルタ１８は、ノズル部材５の放射状のリブ１１とフィルタ保持部材１５の放射状のリブ１６との間に挟持状に取り付けられる。
なお、フィルタ保持部材１５とノズル部材５の接触部には、気密性を高めるためにＯリング１９を取り付けることが望ましい。
【００１３】
フィルタ１８は、ＨＥＰＡ、ＵＬＰＡなどの塵挨除去用フィルタや、各種ケミカルフィルタ（活性炭、アニオン、カチオン）などが使用でき、これらを一種または複数種併用して使用することができる。なおフィルタの厚さや外形寸法等は限定されない。
【００１４】
図２に示すように、ノズル部材５が取り付けられる貫通孔a_1に対向する容器本体２の開口部１２側に設けられた貫通孔a_2は、ガスパージする際の排気孔６として使用される。
この排気孔６は、図に示したようにノズル部材５と同数設ける必要はなく、ノズル部材より少く若しくは多く設けるようにしてもよく、また、容器本体２のみならず蓋体３に設けるようにしてもよい。
排気孔６には、ノズル部材５に取り付けたのと同様に、フィルタ保持部材１５を取り付けてフィルタ１８を介して、基板収納容器内部の気体を外部へ排気することが好ましい。
この場合、排気孔となる容器本体の貫通孔の内周にフィルタ部材を取り付ける係止凹部と放射状や格子状のフィルタ保持リブを設けておくとよい。
【００１５】
なお、排気は容器内に供給されるガスにもよるが、自然排気の他にも、排気孔に開閉弁を取り付けておき、排気管路に連通された部品を開閉弁に挿入して連通させて外部に排気したり、真空ポンプ等を使って強制排気させるようにしてもよい。
ノズル部材５が取り付けられる貫通孔a_1及び排気孔６として使用される貫通孔a_2は、いずれも収納した精密基板の貫通孔設置面（図示の場合、基板収納容器の底面）への投影部分の外側に設けることが好ましく、これにより収納した基板に邪魔されず容器内の気流がスムーズになって効率のよい吹込み及び排気が可能となる。
【００１６】
　ノズル部材５の容器本体２への取り付けは、前記したように、容器本体２の貫通孔a_1に形成したねじ部１３に、ノズル部材５に設けられたねじ部９を直接螺合させて行うこともできるが、図７に示すように取付けパーツ２２を用いて行うこともできる。
　この取付けパーツ２２は、リング（筒）状に形成され内周に、ノズル部材５のねじ部９と噛み合うねじ部２３が螺刻され、外周部にはつば部２４が形成されている。
【００１７】

取付けパーツ２２を使用してノズル部材５を容器本体２に取り付けるには、まず、ノズル部材５の開口部７を容器本体２の貫通孔a_1に内側から挿通させて、貫通孔a_1の内周面とノズル部材５のねじ部９との間隙に、取付けパーツ２２を差し込む。
次いで、取付けパーツ２２のねじ部２３をノズル部材５のねじ部９に螺合させて締付けていくと、ノズル部材５の外周に設けられたつば部２０が、容器本体２の貫通孔a_1の上端部周縁に形成された外周リブ２１に、取付けパーツ２２の外周面から突出したつば部２４が貫通孔a_1の端縁下部に、それぞれ圧接されて、ノズル部材５が容器本体２に強固に取り付けられる。
このような取付けパーツ２２を使用すれば、図６に示した取付構造と異なり、容器本体２の貫通孔a_1にねじ加工をする必要がないので、容器本体の生産性が向上する。
【００１８】
また、ノズル部材は、図８に示すように、容器本体２の蓋体３に取り付けるようにしてもよい。
この場合、排気孔６はノズル部材５から離れた容器本体２の奥側に設けた貫通孔a_2に、一ないし複数箇所に設けることが望ましく、また、ノズル部材５は、図９に示すように、開口部７のねじ部９を、蓋体３の内部に形成した貫通孔a_1から蓋体３の内側に突出した取付部２５を使って蓋体３に取り付けることができる。
この取付部２５は、蓋体３の貫通孔a_1を、蓋体３に沿って上方に折曲した中空構造になっていて、内周壁にはノズル部材５のねじ部９に螺合できるねじ部２６が螺刻されており、蓋体３の外に連通する開口部２７に配管等を連結させて、ここからガスパージをすることができるようになっている。
【００１９】
本発明によるノズル部材は、ポリエチレン、ポリプロピレン、ＡＢＳ樹脂、ポリスチレン、ポリカーボネート、ポリブチレンテレフタレートなどの熱可塑性樹脂およびポリエステル系、ポリオレフィン系、ポリスチレン系などの熱可塑性エラストマーを用いることができる。
【００２０】
次に、本発明の精密基板収納容器のガスパージについて説明する。
本発明の精密基板収納容器のガスパージは、容器本体２に取り付けられたノズル部材５の開口部７に、外部に設けられたドライクリーンエアーや窒素等の不活性ガス等の供給源に連通したガス注入口（図示せず）を連結し、前記気体を基板収納容器の内部に供給して行われる。
ノズル部材５に注入されたガスは、フィルタ１８を介してクリーンな状態でノズル部材５の中空部に充満され、吹出孔８，８から基板収納容器１の内部へ充満していく。
【００２１】
このとき新たに供給されるガスは、容器本体２の支持部４，４に支持された精密基板Ｗの上面と下面に沿うように流れて、ガスパージ前に精密基板収納容器に充満していた空気は、排気孔６，６からフィルターを介して外部へ排気されていく。
このように、ノズル部材を使用して精密基板収納容器内に供給ガスの流れを作ることで、精密基板を汚染するおそれのある精密基板収納容器の材料や金属配線等の加工処理された基板表面からの微量の揮発性ガスを、精密基板表面から取り除きながらガスパージすることができ、精密基板の汚染防止効果がきわめて有効に得られる。
特に多数の精密基板を収納した基板収納容器では、多数の基板によって細かく区切られた容器内部の隅々まで、澱み無く流れ効率よくガスパージができる。
【００２２】
また、本発明のノズル部材を使って、ドライクリーンエアーや不活性ガスを注入して精密基板に沿う供給ガスの流れを作り外部に排気することにより、基板収納容器内に僅かに存在するパーティクルを供給ガスで容器内に巻き上げて精密基板に付着させてしまうこともなく、基板の汚染を防止でき、かつ基板によって遮られる空間部を短時間で効率よくパージすることができるので生産性が向上する。

Entegris, EX1002, p. 908

さらに、本発明の基板収納容器を使って、精密基板を保管している間中、常に不活性ガスを基板表面に吹き付けておくことができるので、揮発性ガスによる保管中の基板汚染を防止できると共に、基板表面の自然酸化膜形成を防止できるので、基板表面の厚さが変動せず精度の良い加工や処理ができる。

【００２３】

ノズル部材５の開口部７や容器本体２の排気孔６に、外部に設けられるガスパージ用の供給口及び排気口に挿入して係合可能な開閉弁を設けておくと、基板収納容器内に外界のエアーが自然吸気されることがなくなるので、基板収納容器を不活性ガスで満たした状態で長期間保管しておくことができる。

以上、本発明を前記実施の形態に基づき説明したが、本発明は前記実施の形態例に限定されるものではなく、その要旨を逸脱しない範囲で種々変更が可能である。

【００２４】

【発明の効果】

本発明の精密基板収納容器によれば、収納した複数の精密基板の表裏両面に沿って、クリーンエアーや不活性ガスを直接吹き付けることができるので、保管中でも精密基板を汚染することなく、ガスパージの際の滞留部分もないため短時間で効率よくガスパージすることができる。

【図面の簡単な説明】

【図１】　本発明の精密基板収納容器を表す斜視図である。

【図２】　本発明のノズル部材を精密基板収納容器に配置した状態を表す図１のII-II面による切断平面図である。

【図３】　本発明のノズル部材を配置した図１に表す精密基板収納容器のIII-III面による切断平面図である。

【図４】　本発明の精密基板収納容器に取り付けられるノズル部材を表す正面図である。

【図５】　図４のノズル部材の拡大底面図である。

【図６】　本発明のノズル部材の取付け状態を表す図２のVI－VI面による断面図である。

【図７】　本発明のノズル部材の別の取付け状態を表す図６に相当する断面図である。

【図８】　本発明の別の実施形態を表す精密基板収納容器の図２に相当する断面図である。

【図９】　本発明のノズル部材用取付具の取付け状態を示す模式的断面図である。

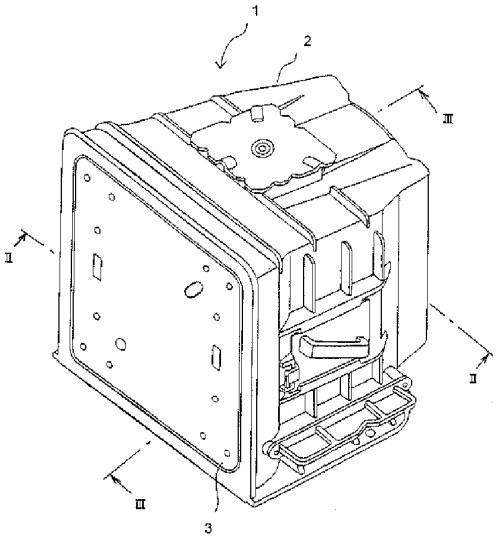
【図１０】　本発明に使用するフィルタ部分の組立斜視図である。

【符号の説明】

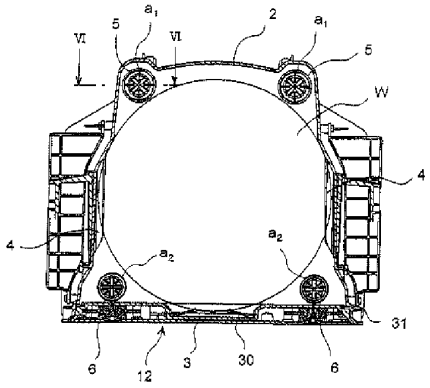
１　精密基板収納容器
２　容器本体
３　蓋体
４　支持部
５　ノズル部材
６　排気孔
７　ノズル部材の開口部
８　吹出孔
９　ねじ部
１０　係止凹部
１１　リブ
１２　容器本体の開口部
１３　ねじ部
１４　Ｏリング
１５　フィルタ保持部材
１６　放射状のリブ
１７　係止突起
１８　フィルタ

１９　Ｏリング
２０　つば部
２１　外周リブ
２２　取付けパーツ
２３　ねじ部
２４　取付けパーツのつば部
２５　取付部
２６　取付部のねじ部
２７　取付部の開口部
３０　リテーナ
３１　シールガスケット
a_1，a_2　貫通孔
Ｗ　基板

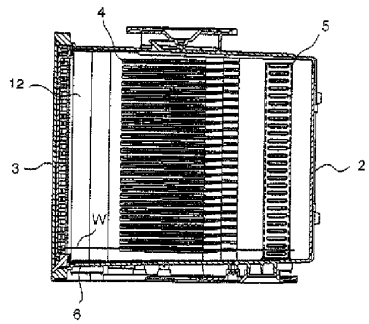
【図1】



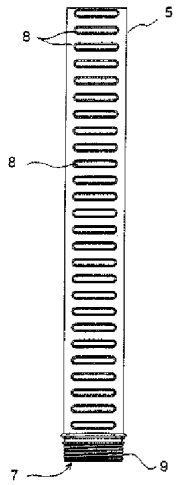
【図2】



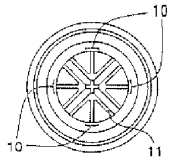
【図3】



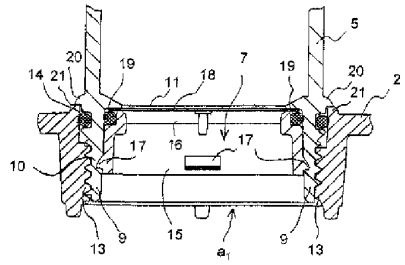
【図4】



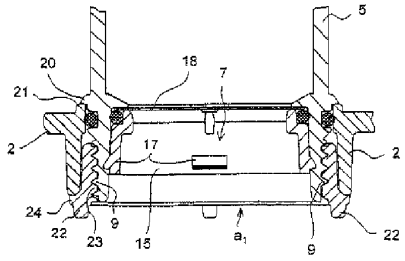
【図5】



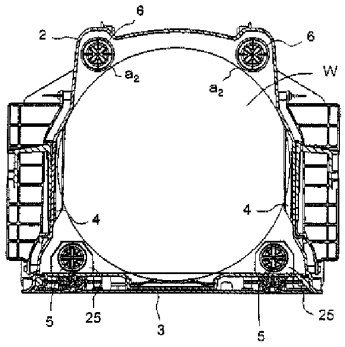
【図6】



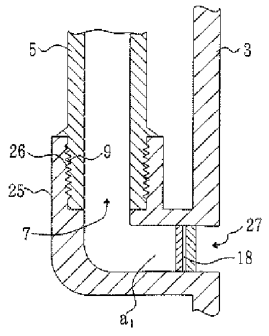
【図7】



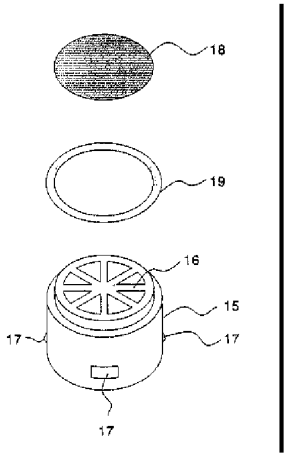
【図8】



【図9】



【図10】



審査官　植村　森平

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特表２００１－５１６５００（ＪＰ，Ａ）

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Espacenet

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PURGE VALVE AND SUBSTRATE STORING CONTAINER

Inventor(s): OGAWA OSAMU

Applicant(s): SHIN ETSU POLYMER CO LTD

Classification: **- international:** ***B65D85/86; F16K15/06; H01L21/673***
- cooperative:

Application number: JP20090122802 20090521 Global Dossier

Priority number(s): JP20090122802 20090521

Also published as: JP2010270823 (A)

Abstract of JP2010270823 (A)

PROBLEM TO BE SOLVED: To provide a purge valve configured so that mounting operation can be further easily or rapidly performed by imparting bidirectionality to the valve, and the number of gas supply ports or the like can be also increased as needed, and a substrate storing container. SOLUTION: The purge valve includes a valve case 21 fitted to a through-hole 4 of a bottom plate 3 of a container body; a hollowed internal pressure regulating valve element 39 reciprocatingly inserted to the valve case 21 through a coil spring 27 to open and close the valve case 21; an external pressure regulating valve element 44 reciprocatingly inserted to the internal pressure regulating valve element 39 through a coil spring 41 to open and close the internal pressure regulating valve element 39; and a gas filtering filter 48 interposed between the valve case 21 and the internal pressure regulating valve element 39 and external pressure regulating valve element 44. When gas is distributed from one end toward the other end of the valve case 21, the external pressure regulating valve element 44 is moved backward to open the closed internal pressure regulating valve element 39, and when the gas is distributed from the other end toward one end of the valve case 21, the internal pressure regulating valve element 39 is moved backward to open the closed valve case 21. ;COPYRIGHT: (C)2011,JPO&INPIT

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(51)Int.Cl.		F I		
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H01L 21/673	(2006.01)	H01L	21/68	T
B65D 85/86	(2006.01)	B65D	85/38	R

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(73)特許権者　000190116
信越ポリマー株式会社
東京都千代田区神田須田町一丁目９番地
(74)代理人　100112335
弁理士　藤本　英介
(74)代理人　100101144
弁理士　神田　正義
(74)代理人　100101694
弁理士　宮尾　明茂
(72)発明者　小川　統
埼玉県さいたま市北区吉野町１－４０６－１　信越ポリマー株式会社内

審査官　所村　陽一

最終頁に続く

(54)【発明の名称】基板収納容器

(57)【特許請求の範囲】
【請求項１】
基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換する基板収納容器であって、
複数のパージバルブの構成を同一とし、
各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の内圧調整弁体と、この内圧調整弁体に往復動可能に挿入支持され、内圧調整弁体を開閉する外圧調整弁体と、バルブケースと内圧調整弁体及び外圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と内圧調整弁体及び外圧調整弁体との間にフィルタを介在し、
バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じた内圧調整弁体との間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じたバルブケースとの間を開放するようにしたことを特徴とする基板収納容器。
【請求項２】

基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換する基板収納容器であって、

複数のパージバルブの構成を同一とし、

各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の外圧調整弁体と、この外圧調整弁体に往復動可能に挿入支持され、外圧調整弁体を開閉する内圧調整弁体と、バルブケースと外圧調整弁体及び内圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と外圧調整弁体及び内圧調整弁体との間にフィルタを介在し、

バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じたバルブケースとの間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じた外圧調整弁体との間を開放するようにしたことを特徴とする基板収納容器。

【請求項３】

容器本体を構成する底板の基板の投影領域と重ならない箇所に複数の貫通孔を穿孔し、各貫通孔にパージバルブをスペーサリングと緩み防止リングとを介して嵌め付けた請求項１又は２記載の基板収納容器。

【請求項４】

容器本体の内部後方に、容器本体の背面壁内面との間に気体隔離用のチャンバ領域を形成する区画遮蔽板を取り付け、チャンバ領域にパージバルブを連通させ、区画遮蔽板には、基板方向に不活性ガスを噴出する噴出口を形成した請求項１、２、又は３記載の基板収納容器。

【請求項５】

バルブケースを、内圧調整弁体と外圧調整弁体とを収納する筒形ケースと、フィルタを収納して筒形ケースに着脱自在に嵌め合わされる少なくとも中空の保持ケースとに分割し、筒形ケースの一端部側を略漏斗形に形成してその内面を内圧調整弁体に密接してシールするガイド傾斜面とし、筒形ケース内の一端部側と残部との境界付近には、内圧調整弁体を支持する支持部を形成した請求項１、３、又は４記載の基板収納容器。

【請求項６】

内圧調整弁体を筒形に形成してその一端部側の周面には筒形ケースのガイド傾斜面に密接するシール部材を取り付け、内圧調整弁体の他端部側を略漏斗形に形成してその内面をガイド支持斜面とし、外圧調整弁体を略柱形に形成してその周面には内圧調整弁体のガイド支持斜面に密接するシール部材を取り付けた請求項５記載の基板収納容器。

【発明の詳細な説明】

【技術分野】

【０００１】

本発明は、半導体ウェーハやマスクガラスからなる基板等を収納して保管、搬送、輸送等する際に使用される基板収納容器に関するものである。

【背景技術】

【０００２】

近年、半導体部品の配線の狭ピッチ化や微細化が進んでいるが、このような動向に鑑み、半導体ウェーハを収納する基板収納容器には、高度な密封性と取扱いの自動化とが求められている。係る要望に鑑み、基板収納容器は、ガスパージの際に利用される逆止弁付きのタイプが開発されている（特許文献１、２、３参照）。

【０００３】

逆止弁付きの基板収納容器は、図示しないが、複数枚の半導体ウェーハを整列収納する

容器本体と、この容器本体の開口部を開閉する蓋体とを備え、容器本体の周壁に、複数の逆止弁がそれぞれ装着されている。各逆止弁は、円筒形のバルブケースと、このバルブケースにバネを介し往復動可能に支持され、円環形のシール面を有する弁体とを備えて構成されている。バルブケースは、容器本体の外部に露出する筒形ケースと、この筒形ケースに着脱自在に螺嵌されて容器本体内に位置する保持筒とに分割構成されている。

【先行技術文献】

【特許文献】

【０００４】

【特許文献１】特開２００４－１４６６７６号公報

【特許文献２】特開２００４－１７９４４９号公報

【特許文献３】特開２００２－５２１１８９号公報

【発明の概要】

【発明が解決しようとする課題】

【０００５】

従来における基板収納容器は、以上のように構成され、逆止弁のバルブケースに弁体が単に弾性支持されているので、ガス給気用の逆止弁とガス排気用の逆止弁の双方が必要となり、その結果、容器本体の周壁に複数の逆止弁を取り付ける作業が実に複雑かつ煩雑で、作業の簡素化や迅速化を図ることができないという問題がある。

【０００６】

また従来、ストッカーでの保管時のガスパージ等、ゆっくりとガスを給気可能な工程においては、ガス供給ポートとガス排気ポートとが１：１の比率で割り当てて運用されているが、急速にガスを給気する工程では、ガス供給ポート数を増加したい場合がある。しかしながら、ガス給気用の逆止弁とガス排気用の逆止弁の仕様が異なるときには、各逆止弁が専用品なので、ガス供給ポートの数を迅速に増やすことができないおそれが少なくない。

【０００７】

本発明は上記に鑑みなされたもので、バルブに双向性を付与して取付け作業の簡素化や迅速化を図ることができ、しかも、必要に応じてガス供給ポートの数等を迅速に増やすことのできる基板収納容器を提供することを目的としている。

【課題を解決するための手段】

【０００８】

本発明においては上記課題を解決するため、基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換するものであって、

複数のパージバルブの構成を同一とし、

各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の内圧調整弁体と、この内圧調整弁体に往復動可能に挿入支持され、内圧調整弁体を開閉する外圧調整弁体と、バルブケースと内圧調整弁体及び外圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と内圧調整弁体及び外圧調整弁体との間にフィルタを介在し、

バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じた内圧調整弁体との間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じたバルブケースとの間を開放するようにしたことを特徴としている。

【０００９】

また、本発明においては上記課題を解決するため、基板を収納する容器本体と、この容器本体の開口した正面を開閉する蓋体とを備え、これら容器本体と蓋体のいずれか一方に複数の貫通孔を設け、この複数の貫通孔に、気体を給排気してその流通を制御する双方向性のパージバルブをそれぞれ嵌着し、この複数のパージバルブにより、容器本体内の空気を不活性ガスに置換するものであって、

複数のパージバルブの構成を同一とし、

各パージバルブは、両端部間で空気あるいは不活性ガスを流通させる中空のバルブケースと、このバルブケースに往復動可能に挿入支持され、このバルブケースを開閉する中空の外圧調整弁体と、この外圧調整弁体に往復動可能に挿入支持され、外圧調整弁体を開閉する内圧調整弁体と、バルブケースと外圧調整弁体及び内圧調整弁体との間に介在されるフィルタとを含み、バルブケースの一端部を開口して容器本体の外部に向け、バルブケースの他端部を容器本体の内部に向け、このバルブケースの他端部に少なくとも通気性を付与するとともに、バルブケースの他端部内と外圧調整弁体及び内圧調整弁体との間にフィルタを介在し、

バルブケースの一端部から他端部方向に不活性ガスが流通する場合には、外圧調整弁体を往動させてその閉じたバルブケースとの間を開放し、バルブケースの他端部から一端部方向に容器本体内の空気が流通する場合には、内圧調整弁体を往動させてその閉じた外圧調整弁体との間を開放するようにしたことを特徴としている。

【００１０】

なお、容器本体を構成する底板の基板の投影領域と重ならない箇所に複数の貫通孔を穿孔し、各貫通孔にパージバルブをスペーサリングと緩み防止リングとを介して嵌め付けることができる。

また、容器本体の内部後方に、容器本体の背面壁内面との間に気体隔離用のチャンバ領域を形成する区画遮蔽板を取り付け、チャンバ領域にパージバルブを連通させ、区画遮蔽板には、基板方向に不活性ガスを噴出する噴出口を形成することができる。

【００１１】

また、バルブケースを、内圧調整弁体と外圧調整弁体とを収納する筒形ケースと、フィルタを収納して筒形ケースに着脱自在に嵌め合わされる少なくとも中空の保持ケースとに分割し、筒形ケースの一端部側を略漏斗形に形成してその内面を内圧調整弁体に密接してシールするガイド傾斜面とし、筒形ケース内の一端部側と残部との境界付近には、内圧調整弁体を支持する支持部を形成することもできる。

【００１２】

また、内圧調整弁体を筒形に形成してその一端部側の周面には筒形ケースのガイド傾斜面に密接するシール部材を取り付け、内圧調整弁体の他端部側を略漏斗形に形成してその内面をガイド支持斜面とし、外圧調整弁体を略柱形に形成してその周面には内圧調整弁体のガイド支持斜面に密接するシール部材を取り付けることが可能である。

【００１３】

また、スペーサリングに、バルブケースの保持ケースを位置決めする位置決め部を形成することが可能である。

また、区画遮蔽板に、区画遮蔽板の内部と噴出口とを隔離するフィルタを取り付け、このフィルタにより、所定の圧力に蓄積された気体を噴出口から外部に噴出させることが可能である。

【００１４】

また、バルブケースの筒形ケースに、弾性を有する接触キャップを交換可能に取り付け、この接触キャップに流通口を設けても良い。

また、バルブケースの保持ケースに中空のノズルタワーを突出形成し、このノズルタワーには、気体用の噴出孔を設けても良い。

さらに、ノズルタワーの噴出孔を、ノズルタワーの内部から外部に向かうにしたがい徐々に広がるよう形成しても良い。

【００１５】

ここで、特許請求の範囲におけるバルブケースには内圧調整弁体を各種のバネ部材を介して挿入し、この内圧調整弁体には外圧調整弁体を各種のバネ部材を介して挿入することができる。このバルブケースの他端部は、通気性があれば、開口していても良いし、必要数の孔を備えた閉塞面でも良い。また、気体には、少なくともドライエアー、窒素ガス、アルゴンガス等の不活性ガスが含まれる。シール部材には、少なくとも弾性のOリングやガスケット等が含まれる。本発明に係るパージバルブは、半導体関連の分野のみならず、化学、測定分析、製薬、バイオ等の分野でも使用することができる。

【００１６】

パージバルブは、必要に応じ、上下、前後、左右、斜め方向に向けて使用することができる。このパージバルブは、基板収納容器に取り付けられる場合には、容器本体の貫通孔に取り付けることもできるし、蓋体に貫通孔を設け、この貫通孔に取り付けることもできる。また、基板には、少なくとも単数複数の半導体ウェーハ、液晶基板、ガラス基板、マスクガラス等が該当する。基板収納容器の容器本体は、透明、不透明、半透明を特に問うものではない。

【００１７】

本発明によれば、容器本体あるいは蓋体の開口に分割構造のパージバルブを取り付ける場合には、バルブケースの筒形ケースに内圧調整弁体と外圧調整弁体とを組み合わせて収納するとともに、バルブケースの保持ケースにフィルタを収納して固定し、開口に保持ケースを一方向から嵌め入れ、開口から他方向に露出した保持ケースの露出部にバルブケースの筒形ケースを嵌め合わせれば、開口にパージバルブを取り付けることができる。

【００１８】

次に、バルブケースの開口した一端部側から通気性の他端部方向に気体が供給される場合には、気体の圧力により、外圧調整弁体が往動して内圧調整弁体から離れ、内圧調整弁体と外圧調整弁体との間の流路が開放される。この流路の開放により、気体は、バルブケースの一端部側からパージバルブの流路を経由してバルブケースの他端部方向に流れる。

【００１９】

これに対し、バルブケースの他端部側から一端部方向に気体が供給される場合には、気体の圧力により、内圧調整弁体が往動してバルブケースの内面から離れ、バルブケースと内圧調整弁体との間の流路が開放される。この流路の開放により、気体は、バルブケースの他端部側からパージバルブの流路を経由してバルブケースの一端部側に流れる。

【発明の効果】

【００２０】

本発明によれば、ガス給気用としても、ガス排気用としても使用可能な双方向性のパージバルブを用いるので、ガス給気用の逆止弁とガス排気用の逆止弁の双方を個別に要したり、パージバルブの取付位置に留意する必要がない。したがって、容器本体や蓋体に複数のパージバルブを取り付ける作業が容易になり、作業の簡素化や迅速化を図ることができるという効果がある。また、ガス給気用とガス排気用の仕様が異なることがなく、専用品のバルブを省略することができるので、急速にガスを給気する工程でも、ガス供給ポートの数を迅速に増やすことができる。

【００２１】

また、容器本体を構成する底板の基板の投影領域と重ならない箇所に複数の貫通孔を穿孔し、各貫通孔にパージバルブをスペーサリングと緩み防止リングとを介して嵌め付ければ、成形された容器本体が金型から脱型されるときの抜きテーパに伴う加工誤差を補正したり、基板収納容器の貫通孔からのバルブケースの脱落を防止することができる。

【００２２】

また、容器本体の内部後方に、容器本体の背面壁内面との間に気体隔離用のチャンバ領域を形成する区画遮蔽板を取り付け、チャンバ領域にパージバルブを連通させ、区画遮蔽板には、基板方向に不活性ガスを噴出する噴出口を形成すれば、容器本体に収納された基板方向に向けて気体を効果的に噴射することができ、基板の汚染や酸化の防止を図ることが可能になる。

Entegris, EX1002, p. 918

【００２３】
また、バルブケースを、内圧調整弁体と外圧調整弁体とを収納する筒形ケースと、フィルタを収納して筒形ケースに着脱自在に嵌め合わされる少なくとも中空の保持ケースとに分割すれば、内圧調整弁体、外圧調整弁体、あるいはフィルタを必要に応じ、簡単に交換等することが可能になる。
【００２４】
また、筒形ケースの一端部側を略漏斗形に形成してその内面を内圧調整弁体に密接してシールするガイド傾斜面とすれば、内圧調整弁体がガイド傾斜面に案内されて適切な位置で密接し、良好なシール状態を得ることが可能になる。また、筒形ケース内の一端部側と残部との境界付近に、内圧調整弁体を支持する支持部を形成すれば、バルブケースからの内圧調整弁体の脱落を簡易な構成で防ぐことができる。
【００２５】
さらに、内圧調整弁体を筒形に形成してその一端部側の周面には筒形ケースのガイド傾斜面に密接するシール部材を取り付けたり、外圧調整弁体を略柱形に形成してその周面には内圧調整弁体のガイド支持斜面に密接するシール部材を取り付ければ、シール部材の密接により、バルブケースからの気体の漏洩を防ぐことができる。
【図面の簡単な説明】
【００２６】
【図１】本発明に係る基板収納容器の実施形態を模式的に示す分解斜視図である。
【図２】本発明に係る基板収納容器の実施形態を模式的に示す断面平面図である。
【図３】本発明に係る基板収納容器の実施形態を模式的に示す平面図である。
【図４】本発明に係る基板収納容器の実施形態を模式的に示す正面図である。
【図５】本発明に係る基板収納容器の実施形態を模式的に示す底面図である。
【図６】本発明に係る基板収納容器の実施形態を模式的に示す断面説明図である。
【図７】本発明に係る基板収納容器の実施形態におけるパージバルブの給気状態を模式的に示す断面説明図である。
【図８】本発明に係る基板収納容器の実施形態におけるパージバルブの排気状態を模式的に示す断面説明図である。
【図９】本発明に係る基板収納容器の第２の実施形態を模式的に示す断面側面図である。
【図１０】本発明に係る基板収納容器の第２の実施形態を模式的に示す正面図である。
【図１１】本発明に係る基板収納容器の第２の実施形態を模式的に示す底面図である。
【図１２】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す斜視説明図である。
【図１３】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す正面図である。
【図１４】図１３のＸＩＶ－ＸＩＶ線断面説明図である。
【図１５】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す平面図である。
【図１６】本発明に係る基板収納容器の第２の実施形態における保持ケースを模式的に示す底面図である。
【図１７】本発明に係る基板収納容器の第３の実施形態を模式的に示す断面説明図である。
【図１８】本発明に係る基板収納容器の第３の実施形態における区画遮蔽板を模式的に示す説明図である。
【図１９】本発明に係る基板収納容器の第３の実施形態における他の区画遮蔽板を模式的に示す説明図である。
【図２０】本発明に係る基板収納容器の第４の実施形態を模式的に示す断面説明図である。
【発明を実施するための形態】
【００２７】

Entegris, EX1002, p. 919

以下、図面を参照して本発明の実施形態を説明すると、本実施形態における基板収納容器は、図１～図８に示すように、複数枚の半導体ウェーハＷを収納する容器本体１と、この容器本体１の開口した正面を開閉する蓋体１０とを備え、容器本体１に複数の貫通孔４を穿孔し、各貫通孔４には、ガスを給排気する双方向性のパージバルブ２０を嵌着して容器本体１内の空気を窒素ガス等の不活性ガスに置換し、半導体ウェーハＷの表面酸化等を防止するようにしている。

【００２８】

半導体ウェーハＷは、図２に示すように、例えば７７５μｍの厚さを有するφ３００ｍｍのシリコンウェーハからなり、周縁部に図示しない位置合わせや識別用のノッチが平面半円形に切り欠かれており、容器本体１に２５枚が整列して収納される。

【００２９】

容器本体１と蓋体１０とは、所定の樹脂を含有する成形材料によりそれぞれ射出成形される。この成形材料中の所定の樹脂としては、例えば力学的性質や耐熱性等に優れるポリカーボネート、ポリエーテルエーテルケトン、ポリエーテルイミド、あるいは環状オレフィン樹脂等があげられる。成形材料には、カーボン、カーボン繊維、金属繊維、カーボンナノチューブ、導電性ポリマー、帯電防止剤、又は難燃剤等が必要に応じて選択的に添加される。

【００３０】

容器本体１は、図２～図５に示すように、複数枚の半導体ウェーハＷを上下方向に並べて整列収納する不透明のフロントオープンボックスタイプに形成され、開口した横長の正面を水平横方向に向けた状態で半導体加工装置や気体置換装置上に位置決めして搭載されたり、洗浄槽の洗浄液により洗浄される。この容器本体１の内部両側、すなわち両側壁の内面には、半導体ウェーハＷを水平に支持する左右一対の支持片２が対設され、この一対の支持片２が上下方向に所定のピッチで配列される。

【００３１】

容器本体１の底板３は、収納された半導体ウェーハＷの投影領域と重ならない箇所、例えば前後両側の四隅部付近に貫通孔４がそれぞれ穿孔して配設され、この複数の貫通孔４に、容器本体１の内外を連通するパージバルブ２０がそれぞれＯリング３２を介し着脱自在に嵌合される。底板３には、ボトムプレート５が締結ビスを介して下方から水平に螺着され、この底板３あるいはボトムプレート５の前部両側と後部中央とには、基板収納容器、具体的には容器本体１を位置決めする位置決め具６が締結ビスやボスを介しそれぞれ螺着される。

【００３２】

複数の位置決め具６は、図５に示すように、前部一側の位置決め具６Ａが中空の円錐台形に形成されて半導体加工装置や気体置換装置の位置決めピンによりＸ方向（左右幅方向）、Ｙ方向（奥行き方向）、Ｚ方向（高さ方向）に一義的に嵌合位置決めされ、前部他側の位置決め具６Ｂが断面Ｖ溝形に形成されて半導体加工装置や気体置換装置の位置決めピンに対して左右横方向に自由度を確保するとともに、位置決め具６Ａと共にＹ方向の位置決めを行い、半導体加工装置や気体置換装置に基板収納容器が搭載された際の正面の平行度に資するよう機能する。また、後部中央の位置決め具６Ｃは、平面に形成され、位置決めピンに接触して高さ方向に位置決めする。

【００３３】

容器本体１の天板には、工場の天井搬送機構に把持される搬送用のトップフランジが締結ビスを介し水平に螺着される。また、容器本体１の背面壁７には、透明の覗き窓が選択的に形成され、この覗き窓により、容器本体１の内部が外部から視覚的に観察・把握される。容器本体１の両側壁の表面には、補強や変形防止の他、指等を干渉させることのできるグリップ部が設けられる。また、容器本体１の正面の周縁には、外方向に張り出すリムフランジ８が膨出形成され、このリムフランジ８内に着脱自在の蓋体１０がガスケットを介し蓋体開閉装置により嵌合される。

【００３４】

蓋体１０は、図２に示すように、容器本体１の正面内に嵌合する横長の筐体１１と、この筐体１１の開口した表面（正面）を被覆する表面プレート１２と、これら筐体１１と表面プレート１２との間に介在される施錠機構１４とを備えて構成される。この蓋体１０の筐体１１は、基本的には浅底の断面略皿形に形成され、裏面の中央部には、半導体ウェーハＷを弾発的に保持するフロントリテーナ１３が着脱自在に装着される。

【００３５】

施錠機構１４は、特に限定されるものではないが、例えば表面プレート１２の操作口を貫通した蓋体開閉装置の操作ピンに回転操作される左右一対の回転プレートと、各回転プレートの回転に伴い上下方向にスライドする複数のスライドプレートと、各スライドプレートのスライドに伴い筐体１１から突出してリムフランジ８の施錠穴に係止する複数の施錠爪とを備えて構成される。

【００３６】

複数のパージバルブ２０は、給気用としても、排気用としても使用可能であるが、好ましくは容器本体１の内部後方に位置する左右一対のパージバルブ２０が給気用として使用され、容器本体１の正面側の内部前方に位置する左右一対のパージバルブ２０が排気用として使用される。各パージバルブ２０は、中空のバルブケース２１の一端部である下端部が開口し、このバルブケース２１の他端部である上端部には少なくとも通気性が付与されており、バルブケース２１の上下両端部間にかけて空気や不活性ガス等からなるガス（図の矢印参照）を流通させ、かつガスの流通を制御するバルブである。

【００３７】

パージバルブ２０は、図１、図６～図８に示すように、容器本体１の底板３の貫通孔４に嵌着される分割構造のバルブケース２１と、このバルブケース２１内に拡径のコイルバネ２７を介し往復動可能に挿入支持され、バルブケース２１を開閉する中空の内圧調整弁体３９と、この内圧調整弁体３９内に縮径のコイルバネ４１を介し往復動可能に挿入支持され、内圧調整弁体３９を開閉する外圧調整弁体４４と、バルブケース２１の上端部内と内圧調整弁体３９及び外圧調整弁体４４との間に介在されるフィルタ保持具４６とを備え、このフィルタ保持具４６に、ガス濾過用のフィルタ４８が保持される。

【００３８】

パージバルブ２０のバルブケース２１、内圧調整弁体３９、外圧調整弁体４４、フィルタ保持具４６は、特に限定されるものではないが、例えば容器本体１や蓋体１０と同様の成形材料によりそれぞれ成形される。

【００３９】

バルブケース２１は、図１、図６～図８に示すように、組み合わされた内圧調整弁体３９と外圧調整弁体４４とを収納して容器本体１の外部に露出する筒形ケース２２と、フィルタ保持具４６を収納して筒形ケース２２に容器本体１内から着脱自在に螺嵌される保持ケース２９とを備え、これら筒形ケース２２と保持ケース２９とが視覚的な認識を容易にする観点から相互に異なる形に構成されており、容器本体１の貫通孔４にその内外方向からスペーサリング３５と緩み防止リング３７とを介して嵌着される。

【００４０】

筒形ケース２２は、基本的には円筒形に形成されてその下端部側が半径外方向に略漏斗形に拡開形成され、この下端部側の直線的に傾斜した内面が内圧調整弁体３９に密接してシールするガイド傾斜面２３とされる。

【００４１】

筒形ケース２２の内周面は、上端部側周方向に保持ケース２９と螺合する螺子２４が螺刻形成され、この上端部側と下端部側との境界付近には、半径内方向に突出する平面リング形の支持部２５が形成されるとともに、この支持部２５の平坦な上面には平面リング形の保持突起２６が形成されており、この保持突起２６に内圧調整弁体３９がコイルバネ２７の下端部を介して位置決め保持される。また、筒形ケース２２の上端面には、緩み防止リング３７と係合接触する複数の微小突起２８が間隔をおいて配列形成される。

【００４２】

Entegris, EX1002, p. 921

保持ケース２９は、基本的には円筒形に形成されてその外周面下部には筒形ケース２２の螺子２４と螺合する螺子溝３０が周方向に螺刻形成され、開口した通気性の上端部には、フィルタ４８に接触する格子形の仕切りリブ３１が架設されており、容器本体１の貫通孔４内に気密用のＯリング３２を介し着脱自在に密嵌される。この保持ケース２９の内周面周方向には、フィルタ保持具４６用の複数の係止穴３３が間隔をおいて配列形成される。

【００４３】

スペーサリング３５は、保持ケース２９に嵌合するリングに形成され、容器本体１の貫通孔４にパージバルブ２０が嵌着される際、貫通孔４の周縁部と保持ケース２９のフランジ３４付きの上端部との間に容器本体１内から選択的に介在配備され、成形された容器本体１が金型から脱型されるときの脱型用抜きテーパに伴う寸法誤差を補正するよう機能する。このスペーサリング３５の上面には、低い円柱形の位置決め部３６が突出形成され、この位置決め部３６が保持ケース２９を位置決めするよう機能する。

【００４４】

緩み防止リング３７は、保持ケース２９に嵌合するリングに形成され、容器本体１の貫通孔４にパージバルブ２０が嵌着される際、貫通孔４の周縁部とバルブケース２１の筒形ケース２２との間に容器本体１外から選択的に介在配備される。この緩み防止リング３７は、下面に複数の凹凸３８が形成され、この複数の凹凸３８が対向する筒形ケース２２の微小突起２８と相互に係合接触することにより、湿度や衝撃等の作用で筒形ケース２２が緩んで脱落するのを防止するよう機能する。

【００４５】

内圧調整弁体３９は、図１、図６～図８に示すように、基本的には保持ケース２９よりも縮径の円筒形に形成されてその下端部側の周面には切り欠きが周方向に凹み形成され、この切り欠きに筒形ケース２２のガイド傾斜面２３に弾接する気密用のＯリング４０が嵌着されており、バルブケース２１の内面との間にガス用の流路を形成する。内圧調整弁体３９の上端部側は、半径外方向に略漏斗形に拡開形成されて保持ケース２９の内面に僅かな隙間をおいて近接するとともに、コイルバネ２７の上端部に係止し、内面が外圧調整弁体４４とそのコイルバネ４１用のガイド支持斜面４２とされる。

【００４６】

内圧調整弁体３９の内面の上端部側と下端部との境界付近には、コイルバネ４１の上端部に干渉する段差部４３が半径内方向に向けて突出形成される。また、コイルバネ２７は、内圧調整弁体３９に外側から嵌合されて筒形ケース２２の支持部２５に支持され、内圧調整弁体３９を上方に弾圧付勢する。

【００４７】

外圧調整弁体４４は、同図に示すように、基本的には内圧調整弁体３９よりもやや背の低い略円柱形に形成されてその下端部にはフランジが半径外方向に突出形成され、このフランジにコイルバネ４１の下端部が支持されており、内圧調整弁体３９の内面との間にガス用の流路を形成する。この外圧調整弁体４４の上端部側の周面には切り欠きが周方向に凹み形成され、この切り欠きに内圧調整弁体３９のガイド支持斜面４２に弾接する気密用のＯリング４５が嵌着される。また、コイルバネ４１は、内圧調整弁体３９に内側から嵌合されてその段差部４３と外圧調整弁体４４のフランジとの間に介在され、外圧調整弁体４４を下方に弾圧付勢する。

【００４８】

フィルタ保持具４６は、同図に示すように、背の低い通気性の円筒形あるいはリングに形成されてその開口部内には格子形の仕切りリブ４７が架設され、この仕切りリブ４７上にフィルタ４８を支持しており、保持ケース２９内に着脱自在に嵌合されてその仕切りリブ３１との間にフィルタ４８を挟持するよう機能する。このフィルタ保持具４６の外周面には、複数の係止爪４９が周方向に間隔をおいて配列形成され、各係止爪４９が保持ケース２９の係止穴３３に係止してフィルタ保持具４６を位置決め固定するよう機能する。

【００４９】

Entegris, EX1002, p. 922

フィルタ４８は、例えば高純度アルミナやポリテトラフルオロエチレン等の材料を使用して薄い円板に形成され、フィルタ保持具４６中を流通するガス中のパーティクルを除去し、半導体ウェーハW等の汚染を防止する。

【００５０】

上記構成において、容器本体１の貫通孔４にパージバルブ２０を嵌着する場合には、先ず、バルブケース２１の筒形ケース２２に内圧調整弁体３９と外圧調整弁体４４とをコイルバネ２７・４１を介してそれぞれ収納し、バルブケース２１の保持ケース２９にフィルタ４８を備えたフィルタ保持具４６を収納して位置決め固定し、保持ケース２９にスペーサリング３５を嵌合する。

【００５１】

こうして保持ケース２９にスペーサリング３５を嵌合したら、容器本体１の貫通孔４に保持ケース２９をスペーサリング３５と共に容器本体１内からＯリング３２を介し下向きに嵌入し、保持ケース２９を位置決めし、その後、貫通孔４から露出した保持ケース２９の下端部にバルブケース２１の筒形ケース２２を緩み防止リング３７と共に嵌合して螺嵌し、筒形ケース２２と緩み防止リング３７とを相互に圧接して筒形ケース２２の緩みを未然に防止するようにすれば、容器本体１の貫通孔４にパージバルブ２０を強固に嵌着することができる。

【００５２】

なお、内圧調整弁体３９と外圧調整弁体４４については、内圧調整弁体３９と外圧調整弁体４４の上下を１８０°反転させ、外圧調整弁体４４の内部に内圧調整弁体３９を位置させ、この状態でバルブケース２１に収納することもできる。この場合、保持ケース２９の内部に、外圧調整弁体４４との間をシールするガイド傾斜面２３を形成すると良い。また、筒形ケース２２内のコイルバネ２７に外圧調整弁体４４を支持させ、保持ケース２９に嵌合したフィルタ保持具４６に内圧調整弁体３９を支持させると良い。

【００５３】

次に、双方向性のパージバルブ２０を用いて容器本体１内の空気を不活性ガス等に置換する場合について説明するが、置換前のパージバルブ２０は、筒形ケース２２のガイド傾斜面２３に内圧調整弁体３９のＯリング４０が密接してシールし、内圧調整弁体３９のガイド支持斜面４２に外圧調整弁体４４のＯリング４５が密接してシールするので、容器本体１の内外にガスが過誤により漏洩することがない（図６参照）。

【００５４】

次いで、容器本体１内に不活性ガスが外部から給気される場合には、不活性ガスの給気圧力により、外圧調整弁体４４がコイルバネ４１を圧縮しつつ上昇してそのＯリング４５を内圧調整弁体３９のガイド支持斜面４２から離隔させ、内圧調整弁体３９と外圧調整弁体４４との間の流路が開放される。この流路の開放により、不活性ガスは、外部からパージバルブ２０の流路を経由して容器本体１内に給気される（図７参照）。

【００５５】

不活性ガスの給気が停止すると、外圧調整弁体４４がコイルバネ４１の復元作用により下降してそのＯリング４５を内圧調整弁体３９のガイド支持斜面４２に密接させるが、この際、外圧調整弁体４４のＯリング４５は、テーパ形のガイド支持斜面４２に案内されつつ適切に密接し、良好なシール状態を確保する。

【００５６】

次いで、不活性ガスの給気に伴い、容器本体１内の圧力が高まり、容器本体１内の空気が外部に排気される場合には、空気の圧力により、内圧調整弁体３９がコイルバネ２７を圧縮しつつ下降してそのＯリング４０を筒形ケース２２のガイド傾斜面２３から離隔させ、バルブケース２１と内圧調整弁体３９との間の流路が開放される。この流路の開放により、空気は、容器本体１内からパージバルブ２０の流路を経由して容器本体１の外部に排気される（図８参照）。

【００５７】

容器本体１内の圧力が低下すると、内圧調整弁体３９がコイルバネ２７の復元作用によ

Entegris, EX1002, p. 923

り上昇してそのＯリング４０を筒形ケース２２のガイド傾斜面２３に密接させるが、この際、内圧調整弁体３９のＯリング４０は、テーパ形のガイド傾斜面２３に案内されつつ適切に密接し、良好なシール状態を確保する。

【００５８】

上記構成によれば、ガス給気用としても、ガス排気用としても使用可能な双方向性のパージバルブ２０を用いるので、ガス給気用の逆止弁とガス排気用の逆止弁の双方を個別に要したり、パージバルブ２０の取付位置に留意する必要が全くない。したがって、容器本体１に複数のパージバルブ２０を取り付ける作業がきわめて容易になり、作業の簡素化や迅速化を図ることができる。

【００５９】

また、ガス給気用とガス排気用の仕様が異なることがなく、専用品のバルブを省略することができるので、ガス供給ポートの数を迅速に増やすことができる。さらに、バルブケース２１の筒形ケース２２と保持ケース２９との外観が相互に異なる形なので、視覚的に容易に把握することができ、筒形ケース２２を保持ケース２９と誤って取り付けること等がなく、取付ミスの防止や部品管理の容易化が大いに期待できる。

【００６０】

次に、図９～図１６は本発明の第２の実施形態を示すもので、この場合には、ガス給気用として使用される複数のパージバルブ２０の保持ケース２９をそれぞれ仕切りリブ３１を有しない中空に形成してその上面には容器本体１内の下方から上方に伸びる細長いノズルタワー５１を一体形成し、各ノズルタワー５１を中空に形成してその周壁には容器本体１の前方に不活性ガスを噴射する噴出孔５２を複数配列するようにしている。

【００６１】

各保持ケース２９は、その外周面中央付近に嵌合溝５０が周方向に切り欠かれ、この嵌合溝５０に気密用のＯリング３２が嵌合される。また、各ノズルタワー５１は、やや先細りの中空円錐台形に形成され、周壁の上下方向には、複数枚の半導体ウェーハＷやその間に不活性ガスを噴射する噴出孔５２が一定間隔で複数配列されており、不活性ガスを下方から上方に導くよう機能する。

【００６２】

各噴出孔５２は、不活性ガスの広範囲に亘る拡散噴射を図る観点から、ノズルタワー５１の内部から外部に向かうにしたがい徐々に広がるよう断面略漏斗形に拡開形成され、半導体ウェーハＷの表裏両面に不活性ガスを効率的に噴射する。

なお、フィルタ保持具４６は、リングに形成されてその開口部内にフィルタ４８を直接的に支持したり、仕切りリブ４７を介して間接的に支持しており、保持ケース２９内に着脱自在に嵌合される。その他の部分については、上記実施形態と略同様であるので説明を省略する。

【００６３】

本実施形態においても上記実施形態と同様の作用効果が期待でき、しかも、容器本体１内に不活性ガスを単に供給するのではなく、容器本体１内に収納された半導体ウェーハＷの表裏両面等に向けて不活性ガスを直接噴射するので、半導体ウェーハＷの表面酸化の防止が大いに期待できるのは明らかである。

【００６４】

次に、図１７～図１９は本発明の第３の実施形態を示すもので、この場合には、容器本体１の内部後方の両側部に、容器本体１の背面壁７内面との間にガス隔離用のチャンバ領域５３をシール状態に区画形成する区画遮蔽板５４をそれぞれ配設し、各区画遮蔽板５４には、半導体ウェーハＷにガスを噴出する噴出口５５を必要数穿孔し、チャンバ領域５３に給気用のパージバルブ２０を連通させるようにしている。

【００６５】

区画遮蔽板５４は、容器本体１の上下方向に伸びる断面略皿形に形成され、容器本体１の背面壁７内面に熱溶着や超音波溶着等の方法で直接固定されたり、あるいは容器本体１の背面壁７内面にシール部材、係合穴、係合爪等を介して着脱自在に装着される。この区

Entegris, EX1002, p. 924

画遮蔽板５４の半導体ウェーハＷに対向する対向壁には、横長の噴出口５５が上下方向に並べて穿孔されたり、あるいは複数枚の半導体ウェーハＷの高さに相当する縦長の噴出口５５が穿孔される。

【００６６】

区画遮蔽板５４の内面には、区画遮蔽板５４の内部と噴出口５５とを隔離するポリプロピレン等からなるブリージングフィルタ５６が選択的に貼着され、このブリージングフィルタ５６が一定の圧力に蓄積されたガスを区画遮蔽板５４の内部から噴出口５５を介して外部に均一に噴出するよう機能する。噴出口５５は、必要に応じ、区画遮蔽板５４の内部から外部に向かうにしたがい徐々に広がるよう断面略漏斗形に拡開形成され、半導体ウェーハＷの表裏両面に不活性ガスを効率的に噴射する。その他の部分については、上記実施形態と略同様であるので説明を省略する。

【００６７】

本実施形態においても上記実施形態と同様の作用効果が期待でき、容器本体１内に収納された複数枚の半導体ウェーハＷの間や半導体ウェーハＷの表裏両面に向けて不活性ガスを直接噴射することができるので、半導体ウェーハＷの表面酸化の防止が大いに期待できる。

【００６８】

次に、図２０は本発明の第４の実施形態を示すもので、この場合には、筒形ケース２２の下端部に、断面略Ｕ字形の接触キャップ５７を交換可能に取り付け、この接触キャップ５７の平坦部中央には、ガス供給ポートあるいはガス排気ポートに圧接して連通する流通口５８を丸く穿孔するようにしている。

【００６９】

接触キャップ５７は、筒形ケース２２よりも弾力性に富む熱可塑性エラストマーにより弾性の平面リング形に形成され、ポートのノズル形状に応じて外形や流通口５８が形成される。このような接触キャップ５７は、筒形ケース２２の下端部外周面に高さ調整可能に着脱自在に螺嵌されたり、摩擦係合を利用して圧入されることにより、ガス供給ポートあるいはガス排気ポートと筒形ケース２２とを連通する。その他の部分については、上記実施形態と略同様であるので説明を省略する。

【００７０】

本実施形態においても上記実施形態と同様の作用効果が期待でき、ポートのノズル形状に対応する接触キャップ５７のみを筒形ケース２２の下端部に装着すれば良いので、ポートのノズル形状に応じてパージバルブ２０自体を交換する必要が全くない。また、接触キャップ５７の高さを容易に調整することができるので、ポートのノズルとの接触性を向上させることができる。さらに、接触キャップ５７が損傷した場合にも、接触キャップ５７のみを交換すれば良いので、部品点数の削減が期待できる。

【００７１】

なお、上記実施形態では容器本体１の底板３の四隅部付近に貫通孔４をそれぞれ穿孔して各貫通孔４にパージバルブ２０を嵌合したが、容器本体１の底板３の一隅部付近に貫通孔４を穿孔して貫通孔４にパージバルブ２０を嵌合しても良いし、容器本体１の天板、背面壁７、側壁に貫通孔４を穿孔し、この貫通孔４にパージバルブ２０を嵌合しても良い。また、筒形ケース２２の外周面に螺子２４を螺刻形成し、保持ケース２９の内周面に、筒形ケース２２の螺子２４と螺合する螺子溝３０を螺刻形成しても良い。

【００７２】

また、バルブケース２１の筒形ケース２２と保持ケース２９とを螺子結合ではなく、係止フックと係止ホックとの係止、あるいは摩擦抵抗等により結合しても良い。また、上記実施形態ではスペーサリング３５の上面に円柱形の位置決め部３６を突出形成したが、スペーサリング３５に位置決め部３６を凹み形成しても良い。また、ガス排気用として使用されるパージバルブの保持ケース２９上面に細長いノズルタワー５１を形成することもできる。

【００７３】

Entegris, EX1002, p. 925

また、ノズルタワー５１を中空の円柱形や円錐形に形成したり、ノズルタワー５１の一部を曲げることもできる。さらに、ノズルタワー５１の噴出孔５２は、長孔、楕円孔、ノズルタワー５１の長軸方向に必要数形成されるスリット孔でも良いし、焼結合金や多孔質材料からなる無数の微小孔等とすることもできる。

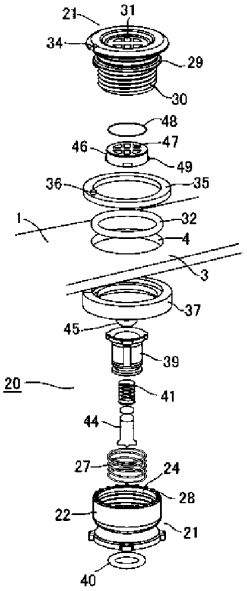
【符号の説明】

【００７４】

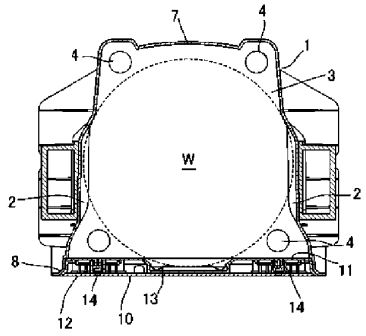
1	容器本体
3	底板
4	貫通孔
7	背面壁
１０	蓋体
２０	パージバルブ
２１	バルブケース
２２	筒形ケース
２３	ガイド傾斜面
２５	支持部
２７	コイルバネ
２９	保持ケース
２７	コイルバネ
３２	Ｏリング
３５	スペーサリング
３７	緩み防止リング
３９	内圧調整弁体
４０	Ｏリング（シール部材）
４１	コイルバネ
４２	ガイド支持斜面
４４	外圧調整弁体
４５	Ｏリング（シール部材）
４６	フィルタ保持具
４８	フィルタ
５１	ノズルタワー
５２	噴出孔
５３	チャンバ領域
５４	区画遮蔽板
５５	噴出口
５７	接触キャップ
５８	流通口
W	半導体ウェーハ（基板）

Entegris, EX1002, p. 926

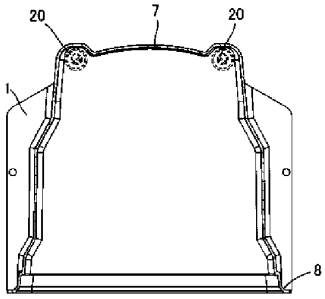
【図１】



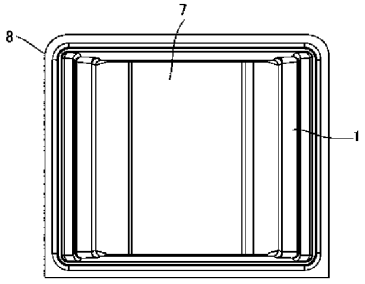
【図２】



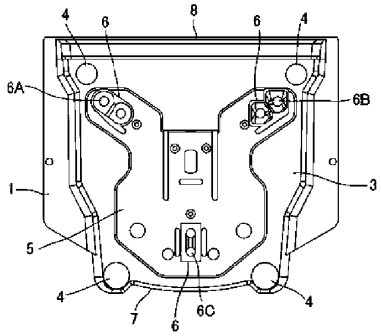
【図３】



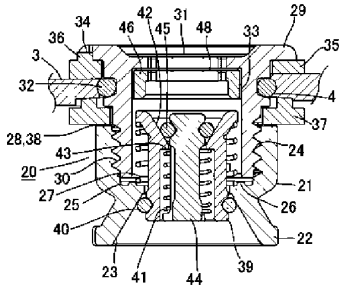
【図４】



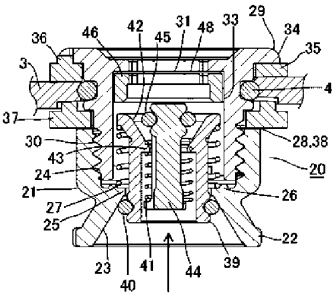
【図５】



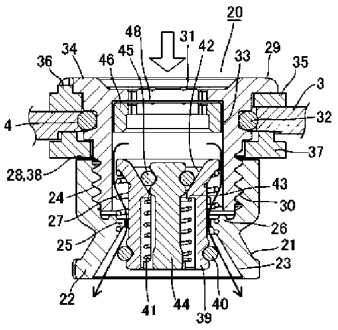
【図６】



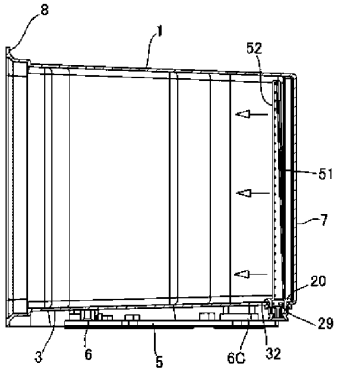
【図７】



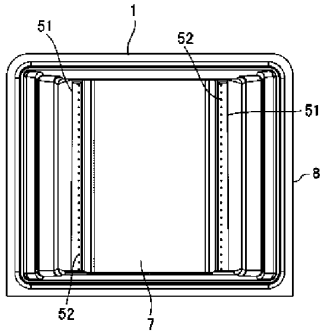
【図８】



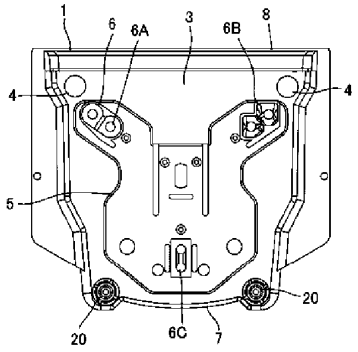
【図９】



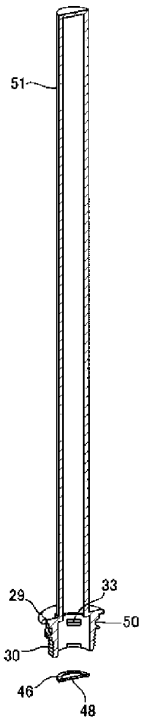
【図１０】



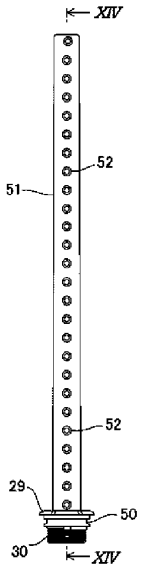
【図１１】



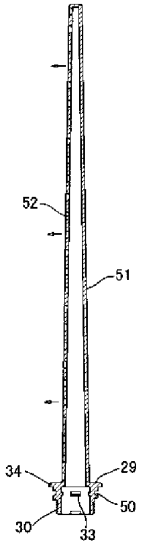
【図１２】



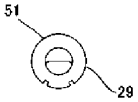
【図１３】



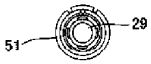
【図１４】



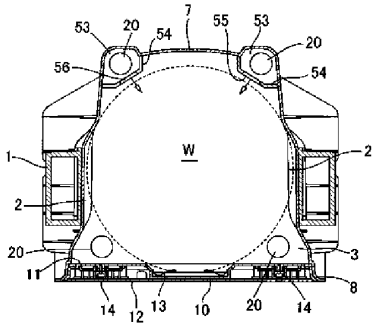
【図１５】



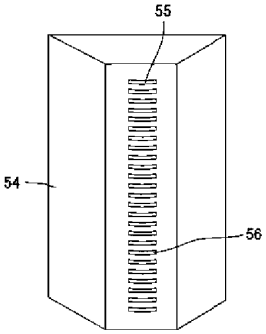
【図１６】



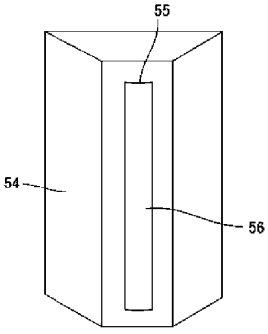
【図１７】



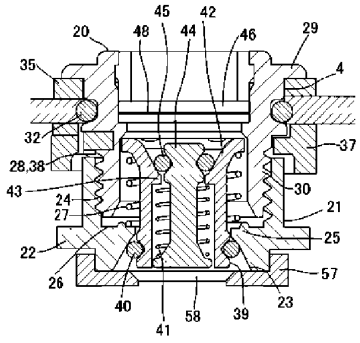
【図１８】



【図１９】



【図２０】



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特開２００３－２４０１４３（ＪＰ，Ａ）
特開２００８－１８９３３８（ＪＰ，Ａ）
実開昭５３－１３２０２９（ＪＰ，Ｕ）
特開２００５－２５６９８３（ＪＰ，Ａ）
実公昭４８－０２９２１９（ＪＰ，Ｙ１）
実開昭５０－０２００５５（ＪＰ，Ｕ）
実開昭５２－０３７１３９（ＪＰ，Ｕ）
特開２００４－０２２６７４（ＪＰ，Ａ）
特開２０１０－２６７７６１（ＪＰ，Ａ）
特表２００２－５２１１８９（ＪＰ，Ａ）
特開２００５－１６７１６８（ＪＰ，Ａ）
特開２００４－０２２８１６（ＪＰ，Ａ）

(58)調査した分野(Int.Cl.，ＤＢ名)
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Ｆ１６Ｋ ２１／００－２４／０６，
Ｆ１６Ｋ １／００－１／５４，
Ｆ１６Ｋ １７／００－１７／１６８，
Ｆ１６Ｋ １７／１６－１７／３４，
Ｈ０１Ｌ ２１／６８，
Ｂ６５Ｄ ８５／８６

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SUBSTRATE TRANSPORT CONTAINER

Inventor(s): TANAKA AKIRA; KISHI TAKASHI ± (TANAKA AKIRA, ; KISHI TAKASHI)

Applicant(s): EBARA CORP ± (EBARA CORP)

Classification: **- international:** ***B65D81/24; B65D85/86; G03F7/20; H01L21/673;*** (IPC1-7): B65D81/24; B65D85/86; H01L21/68
- cooperative: G03F1/66 (EP); G03F7/70741 (EP)

Application number: JP20000403875 20001204

Priority number(s): JP20000403875 20001204

Abstract of JP2002170876 (A)

PROBLEM TO BE SOLVED: To provide a substrate transport container which efficiently prevents a pollution to the contained substrates to be stored or transported from outer atmosphere, also which is made possible the atmosphere to be efficiently substituted in a short time by introducing a dry air or the like into the container. SOLUTION: A substrate transport container 10 comprises a container main body 12 in which substrates to be stored or transported are contained, and a door 14 which can tightly close the main body 12. A suction port 30 and air outlet 32 for communication or substitution of the air inside of the substrate transport container 10 with clean air, a duct 38 joined to the suction port 32 and extended into the container 10, and a straightening vane 40 disposed to a face directed inward of the container 10 of the duct 38 are provided for the substrate transport container 10.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
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(43)公開日　平成14年６月14日(2002.6.14)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード*（参考）
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85/86		85/38	Ｄ	

審査請求　未請求　請求項の数４　書面　（全　９　頁）

(21)出願番号　特願2000－403875(P2000－403875)

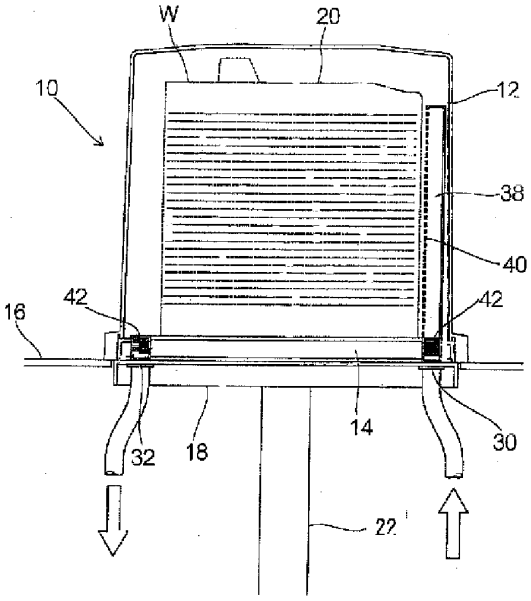
(22)出願日　平成12年12月４日(2000.12.4)

(71)出願人　000000239
株式会社荏原製作所
東京都大田区羽田旭町11番１号
(72)発明者　田中　亮
東京都大田区羽田旭町11番１号　株式会社荏原製作所内
(72)発明者　岸　貴士
東京都大田区羽田旭町11番１号　株式会社荏原製作所内
(74)代理人　100091498
弁理士　渡邉　勇　（外１名）

最終頁に続く

(54)【発明の名称】　基板搬送容器

(57)【要約】
【目的】　収容した保管又は搬送対象基板への外部雰囲気からの汚染を効率よく防止すると共に、乾燥気体等を容器内に導入してその雰囲気を短時間で効率的に置換できるようにした基板搬送容器を提供する。
【構成】　内部に保管又は搬送の対象とする基板を収納する容器本体１２と、容器本体１２に対して密閉可能なドア１４とで構成される基板搬送容器１０において、基板搬送容器１０内を清浄な気体で流通又は置換するための給気口３０及び排気口３２と、給気口３２に接続し容器１０内に延びるダクト３８と、ダクト３８の容器１０内方に向けた面に配置した整流板４０とを備えた。



Entegris, EX1002, p. 932

【特許請求の範囲】
【請求項１】　内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記基板搬送容器内を清浄な気体で流通または置換するための給気口及び排気口と、前記給気口に接続し前記容器内に延びるダクトと、該ダクトの容器内方に向けた面に配置した整流板とを備えたことを特徴とする基板搬送容器。
【請求項２】　前記給気口近傍に粒子除去用フィルタ及びガス状不純物除去用フィルタとを備えたことを特徴とする請求項１に記載の基板搬送容器。
【請求項３】　前記給気口と排気口に逆流防止機構を備えたことを特徴とする請求項１に記載の基板搬送容器。
【請求項４】　内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記容器本体を構成する主要材料を吸水率０．１％以下の高分子材料または不透湿材料で構成したことを特徴とする基板搬送容器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、半導体ウエハ、フォトマスクまたはハードディスク等の被処理物を、極めて清浄度の高い雰囲気下で保管または運搬するのに使用して好適な基板搬送容器に関する。
【０００２】
【従来の技術】例えば、半導体工場において製造工程中の半導体ウエハやフォトマスク等の基板を搬送・保管する時に、雰囲気空気中に存在する微量の粉塵やガス状不純物が半導体ウエハ等の対象物へ付着すると製品歩留まりの低下につながり、この傾向は、集積度の増加に伴って益々顕著になる。また、磁気ディスクにおいても、磁気抵抗ヘッドの登場により、記録の高密度化が一段と加速しており、粉塵だけでなくガス状不純物に対しての高い清浄度が求められつつある。さらに、半導体ウエハのコロージョン低減の観点から、基板を収納する雰囲気の湿度を低く維持する簡便な手段も求められている。
【０００３】このような搬送・保管の場合に基板を収容する清浄空間を作るため、モータファンと、ＨＥＰＡ（ｈｉｇｈ　ｅｆｆｉｃｉｅｎｃｙ　ｐａｒｔｉｃｌｅ　ａｉｒ）フィルタやＵＬＰＡ（ｕｌｔｒａ　ｌｏｗ　ｐｅｎｅｔｒａｔｉｏｎ　ａｉｒ）フィルタを搭載した基板搬送容器等が開発されている。また、例えば、半導体ウエハ周辺を局所的に清浄化する方法として、半導体ウエハを収納した基板搬送容器内を高純度の窒素で置換し、清浄度維持と自然酸化膜の成長を抑えるようにしたものがある。
【０００４】しかしながら、前記ＨＥＰＡフィルタやＵＬＰＡフィルタを使用したものでは、粒子状汚染物質は除去できるものの、微量の有機または無機ガスは除去できない。また、循環する空気が被処理物の清浄化に直接寄与しない部分に大量に流れたり、基板搬送容器内で滞留部があると、基板搬送容器内の換気効率の向上が望めず、清浄化された空気による被処理物の汚染防止効果が薄れてしまう。また、窒素に置換する方法では、例えばレジスト等を塗布した半導体ウエハ自身から発生する不純物を除去できない等の問題がある。
【０００５】即ち、例えば半導体ウエハの保管に当たっては、半導体素子の微細化により分子状汚染物質が問題になっている。例えば、レジスト等を塗布した半導体ウエハ自体からレジスト等の有機物成分が基板容器内壁に付着すると、その部分が汚染源となり不均一な自然酸化膜の成長や、化学増幅型レジストによるパターン不良が顕在化するという問題がある。また、化学気相成長による成膜や配線材料の多様化によって、多種多様な材料がこれらに用いられ、これらが容器内壁に付着すると、同様に清浄環境に維持すべき半導体ウエハの汚染源となる。
【０００６】一方で、半導体素子のうち、ＤＲＡＭは少品種大量生産品であるが、今後システムＬＳＩの占める割合が増大するという傾向が予測され、半導体生産も多品種少量生産に移行する傾向がある。これらの半導体ウエハの処理ロットは、工程間の高速搬送が要求されると共に、次処理までの保管時間がランダムとなる傾向がある。このようなわけで、これらの半導体ウエハを搬送・保管する基板搬送容器としては、上述した多様な汚染物質が発生する半導体製造工程、及び工程間処理待ち時間の多様化に対応して、常に清浄な環境下に半導体ウエハを維持することが要請されている。
【０００７】
【発明が解決しようとする課題】本発明は上記の課題に鑑み、収容した保管または搬送対象基板への外部雰囲気からの汚染を効率よく防止すると共に、乾燥気体等を容器内に導入してその雰囲気を短時間で効率的に置換できるようにした基板搬送容器を提供することを目的とする。
【０００８】
【課題を解決するための手段】請求項１記載の発明は、内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記基板搬送容器内を清浄な気体で流通または置換するための給気口及び排気口と、前記給気口に接続し前記容器内に延びるダクトと、該ダクトの容器内方に向けた面に配置した整流板とを備えたことを特徴とする基板搬送容器である。
【０００９】これにより、整流板の開口率を容器内の気体流れが均一となるように調整することで、給気口から整流板を備えたダクトを介して容器内に収容された多数の半導体ウエハ等の被処理基板間に均一に清浄な気体を供給することが出来る。従って、清浄ガスによる容器内

Entegris, EX1002, p. 933

の置換効率が改善され、短時間で清浄な気体の置換が行える。また、清浄な気体を流通しつつ例えば複数の半導体ウエハを保管する場合には、多数の半導体ウエハの間に清浄な気体が均一に流れ、これにより半導体ウエハ表面を効率的に清浄な気体に接触させつつ保管を行うことが出来る。

【００１０】請求項２記載の発明は、前記給気口近傍に粒子除去用フィルタ及びガス状不純物除去用フィルタとを備えたことを特徴とする請求項１に記載の基板搬送容器である。これにより、容器内に流入する清浄な気体中に含まれる粒子状汚染物質のみならずガス状汚染物質も除去することができる。従って、保管・搬送対象の基板に外部から導入されるガス中に含まれる物質による汚染を防止することが出来る。

【００１１】請求項３記載の発明は、前記給気口と排気口に逆流防止機構を備えたことを特徴とする請求項１に記載の基板搬送容器である。これにより、供給口のガス配管側のガス圧力が容器内部のガス圧力よりも高くなった時のみ、清浄な気体が容器内に供給され、容器内部のガス圧力が排気口外側のガス圧力よりも高くなった時に清浄な気体が容器内から排出される。従って、置換または流通する清浄な気体の逆流が防止される。

【００１２】請求項４記載の発明は、内部に保管または搬送の対象とする基板を収納する容器本体と、該容器本体に対して密閉可能なドアとで構成される基板搬送容器において、前記容器本体を構成する主要材料を吸水率０．１％以下の高分子材料または不透湿材料で構成したことを特徴とする基板搬送容器である。これにより、清浄な気体の容器内の置換を停止した時に、容器内壁面から容器内部に拡散する湿気の量が低減し、容器内の湿度を低く保つことができる。従って、処理対象基板の湿気による汚染に基づく不良等を防止することが出来る。

【００１３】

【発明の実施の形態】以下、本発明の実施の形態について図１乃至図８を参照しながら説明する。

【００１４】図１及び図２は、本発明の実施の形態の基板搬送容器を示す。この基板搬送容器は、例えば直径が２００ｍｍ程度の半導体ウエハ（被処理基板）Ｗをカセットに収納した状態で容器内に収容し、搬送・保管等を行うものである。この基板搬送容器１０は、底面にカセットに収納した被処理基板を出し入れする開口部を有した角筒状の容器本体１２と、その開口部を閉塞するドア１４とから構成されている。ドア１４は装置１６側に設けられた基板搬出入ドア自動開閉装置１８に連結されて、容器本体１０の底面の開口部を開閉可能としている。

【００１５】ドア１４上にはカセット２０が搭載され、これに多数の半導体ウエハＷが収納されている。ドア１４にはラッチ機構を備え、基板搬出入ドア自動開閉装置１８によりドア１４に設けられたラッチを外して昇降機構２２を下げることにより、ドア１４と共にカセット２０を容器本体１２から取り出し、更にカセット２０に搭載した半導体ウエハＷをカセット２０から取り出すことができる。そして、半導体ウエハを容器１２内に収容する場合には、半導体ウエハＷを搭載したカセット２０をドア１４に載せて、昇降機構１８を上昇させてカセット２０を容器本体１２内に挿入し、基板搬出入ドア自動開閉装置１８によりドア１４に設けられたラッチ機構をロックすることによりドア１４が容器本体１２に固定される。ドア１４と容器本体１２との接触部にはガスケット等が配置され、容器１０内を気密に保つことができる。

【００１６】処理済み半導体ウエハを収容した容器１０を装置１６のロードポートから切り離して搬送する場合等には、切り離す直前に容器１０内部の清浄な気体による置換が行われる。この清浄な気体は、不活性ガス、乾燥空気、または湿り空気が用いられる。このような場合に、清浄な気体による容器内部の置換時間を削減するためには、高流量で且つ置換効率を上げることが重要である。このため、この容器１０においては清浄な気体の吹き出し口の面積を増加させ、且つ容器内を均一に清浄な気体が流れるような構成を有している。

【００１７】清浄ガス置換は通常、半導体製造装置に取り付けられたドア自動開閉装置上において、ウエハを装置に搬入する前、又は処理の終わったウエハを容器内に収納した後に実施する。その他の時期としては、例えばＡＧＶ（ＡｕｔｏｍａｔｅｄＧｕｉｄｅｄ　Ｖｅｈｉｃｌｅ）等の基板搬送装置や、保管庫、保管棚といった搬送・保管している時期に実施することもある。ドア自動開閉装置上においてガス置換する場合は、大流量、例えば１０～４０Ｌ／ｍｉｎで容器内を短時間で、高速置換することが重要である。このため、この容器１０においては清浄な気体の吹き出し口の面積を増加させ、且つ容器内を均一に清浄な気体が流れるような構成を有している。一方、保管庫で保管する場合には、例えば０．５～５Ｌ／ｍｉｎ程度の低流量でゆっくり置換すれば良い。この清浄な気体は、高純度な窒素ガス、不活性ガス、乾燥空気が用いられるが、用途によっては湿度４０％ＲＨ程度の高純度な湿り空気を用いても構わない。ガスの置換の方法は、例えば、給気ポートにガスを連続的に注入しながら排気ポートから連続的に排気したり、給気ポートから一定流量のガスを注入後一旦止めて、排気ポートから一定流量排気する操作を繰り返したり、或いは給気ポートはガスを流し続けて、排気ポートから間欠的に排気する方法等がある。置換は、容器内にもともと閉じ込められていた空気と、注入する清浄気体が効率良く混合・置換できる方法が良い。従って、単に清浄ガスを連続的に流し、連続的に排気するよりも、給気・排気を断続的に繰り返したり、給気は連続にして、排気を断続的に実施したり、給気は断続的にして、排気を連続的に実施するような方法が良い。

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【００１８】図３（ａ）（ｂ）（ｃ）（ｄ）はドアの構造の詳細を示す。（ａ）はドア１４の下面を示し、容器１０内を清浄な気体で流通または置換するための給気口３０及び排気口３２が配置されている。更にドア１４の下面には基板搬出入ドア自動開閉装置１８と係合する位置決め穴３４が設けられ、基板搬出入ドア自動開閉装置１８に立設したピンと係合することにより、ドア１４を基板搬出入ドア自動開閉装置１８に対して固定する。ドアラッチ３６は、これを回転することにより、ドア１４内に設けられたラッチ機構をロックすることでドア１４を容器本体１２に固定い、またアンロックすることでドア１４を容器本体１２から開放可能とする。給排気口３０，３２、位置決め穴３４、ドアラッチ３６等の寸法及び配置は、Ｓｅｍｉ規格等により統一されている。

【００１９】ドア１４には容器１０内の半導体ウエハWが配置される一番上の高さ近傍迄延在するダクト３８が配置されている。このダクト３８は、その先端３８ａが閉塞されていて、容器１０の内方に向かう面に図４に示す多数の開口を有する整流板４０が配置されている。この整流板４０には、図示するように多数の開口を有し、この開口率は給気口側が大きく、ダクト３８の先端部に向かうに従い小さくなるように構成されている。このダクト３８及び整流板４０によりドア１４の底面に設けられた給気口３０から供給される清浄な気体はダクト３８内を上昇し、先端部が閉塞されているので、気体の流れは９０° 向きを変えて整流板から吹き出させることができる（図１及び図２参照）。仮に整流板４０の開口率を均一にしておくと、ダクト３８の上端部が閉塞されているため、ダクトの上部程供給圧力が高くなり、吹き出し量が増える。従って、ダクト３８の下部において開口率を高くし、ダクトの上部に行くに従い開口率を低くすることで、ダクトの高さ方向に沿って均一な吹き出し量が得られる。

【００２０】このようなダクト３８と整流板４０を設けることにより、清浄な気体の吹き出し面積を拡大することができ、これにより通過面風速を低下させ、高流量で且つ容器内ガスの置換効率を上げることができる。これにより清浄な気体の容器１０内部の置換時間を低減することができる。

【００２１】図５は、本発明の基板搬送容器の乾燥ガスによる置換特性を示した図である。即ち、乾燥ガスによる置換に際して、相対湿度の変化を示したグラフであり、図中の黒い△印は通常のポリカーボネート容器を用いた場合であり、流量が５Ｌ／ｍｉｎであり、図中の×印は、流量が１０Ｌ／ｍｉｎの場合である。図示するように、下限湿度までの到達時間は約１５分程度かかり、流量による差は殆どない。これに対して、白い○印は本発明の吸水率０．１％以下の高分子材料を用いた容器であり、同様に乾燥ガスの流量が１０Ｌ／ｍｉｎである場合を示し、約５分程度で下限湿度まで到達する。このことは、乾燥ガスの置換効率が高いことを示しており、乾燥ガスをダクト３８から整流板４０を介して均一な流れを形成するように容器内に供給することで、置換効率が改善されることを示している。

【００２２】尚、この実施の形態では整流板として多数の円形の開口を有するパンチングプレートを用いた例について示したが、異なる通気抵抗を持った不織布を張り付け、ダクトに沿って均一な吹き出し量が得られるように通気抵抗を調整するようにしてもよい。また、この実施の形態では整流板を備えたダクトをドアに設けた例について示したが、容器本体に固定するようにしてもよい。

【００２３】次に、給気口に備えた逆止弁について図５を参照して説明する。逆止弁４２は、スプリング４４により固定部４６に固定されている。固定部４６と逆止弁４２の接触部にはＯリングシール４８が備えられている。従って、逆止弁４２の下流側Ａの圧力が上流側Ｂの圧力よりも高い時には、（ａ）に示すようにスプリング４４が伸張して逆止弁４２が閉止状態となる。また、逆止弁４２の下流側Ａの圧力が上流側Ｂの圧力よりも低い時には、（ｂ）に示すようにスプリング４４が収縮して逆止弁４２が開放状態となる。

【００２４】次に、図６を参照して、給気口とダクトとの接続について説明する。給気口３２には上述した逆止弁４２を備えている。フィルタ５０は、ＵＬＰＡ沪材等の粒子状汚染物質捕捉フィルタと、ガス状不純物捕捉フィルタ５４とを備えている。粒子状汚染物質捕捉フィルタ５２は、種々のフィルタが知られているが、疎水性で且つ不純物放出がないフッ素形樹脂を用いたＵＬＰＡフィルタが好適である。ガス状不純物捕捉フィルタ５４は、活性炭、添着活性炭、活性炭素繊維、ゼオライト、シリカゲル、イオン交換不織布または繊維の内これらを単独または組み合わせて用いることができる。この実施形態においては、活性炭５４ａとこれをサンドイッチ状に挟み込むイオン交換不織布５４ｂが用いられている。これらのガス状不純物を捕捉するフィルタは、粒子状汚染物質捕捉フィルタの負荷を軽減するために発塵しない材料を用いることが好ましい。いずれのフィルタも、その平均面風速を０．１ｍ／ｓ以下、好ましくは０．０５ｍ／ｓにして、接続するガス配管やパージ配管から流入した外気中に含まれる汚染物質を確実に捕捉することができることが必要である。

【００２５】半導体ウエハの容器内への保管時で、最も困難なのは湿度の問題である。この実施の形態の基板搬送容器１０においては、その容器本体１２とドア１４との材料を吸水率０．１％以下の高分子材料または不透湿材料で構成している。これらの材料はＡＳＴＭ（Ａｍｅｒｉｃａｎ Ｓｏｃｉｅｔｙ ｆｏｒ Ｔｅｓｔｉｎｇ ａｎｄ Ｍａｔｅｒｉａｌｓ）Ｄ５７０規格により定められている。半導体ウエハ等の搬送・保管容器に使用

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される一般的な材料の吸水率を述べると、ＰＣ（ポリカーボネート）０．２%、ＰＢＴ（ポリブチレンテレフタレート）０．０８%、ＰＥＥＫ（ポリエーテルエーテルケトン）０．１４%、ＰＥＩ（ポリエーテルイミド）０．２５%、ＰＰ（ポリプロピレン）０．０３%である。

【００２６】この容器１０の構成材料として好ましいのは、吸水率０．１%以下であり、これに該当するものとしてＰＥ（ポリエーテルイミド）＜０．０１%、ＰＰ（ポリプロピレン）０．０３%、ＰＢＴ（ポリブチレンテレフタレート）０．０６～０．０８%、ＰＰＳ（ポリフェニレンスルフィド）０．０２%、ＰＴＦＥ＜０．０１%、ＰＣ（カーボン２０%添加ポリカーボネート）０．１%、ＰＢＴ（カーボン２０%添加ポリブチレンテレフタレート）０．０５%などがある。特にこの容器材料として好ましいものは、吸水率が低く、耐薬品性が良好であり、高温での安定性が高く、且つ成型収縮率が低い材料が好ましく、ＰＰＳ（ポリフェニレンスルフィド）、カーボン添加ポリブチレンテレフタレート（ＰＢＴ）、カーボン添加ポリカーボネートが特に好ましい。

【００２７】また、低湿度にすると、ウエハが帯電しやすくなるので、少なくともウエハに接するウエハ支持部材とウエハ支持部材から容器下部に接地するドアは、カーボン等を添加した導電性材料が特に好ましい。更に、ガス状不純物捕捉素子として用いるイオン交換不織布や活性炭は、製造直後の状態で水を吸着しているので、予め脱水処理をして使用するのが好ましい。

【００２８】容器内を乾燥ガス、即ち乾燥空気または水分を含まない不活性ガスと置換すると、置換直後は湿度は略０%の限界湿度まで低下する。しかしながら、この状態で乾燥ガスの供給を停止して放置しておくと、容器内壁面の高分子材料が保持している水分が湿度勾配によって容器内部に拡散する。従って、乾燥ガスにより置換した容器内部の湿度は、時間の経過と共に増大する。図８は、この一例を示し、乾燥ガスによる置換後に略０%の相対湿度が従来の市販ＰＣ（ポリカーボネート）容器を使用した場合には、数時間後には３０%以上に上昇することを示している。本発明の実施形態の吸水率０．０２%のポリフェニレンスルフィド（ＰＰＳ）を使用することで、乾燥ガスにより置換直後の略０%の相対湿度は数時間以上経過しても略１２%程度に留まり、顕著な湿度上昇抑制効果が確認された。これにより保管搬送時の容器内湿度が上昇することが防止できることは明らかである。尚、自然酸化膜の成長は暗所で保管することにより抑制効果があることが知られている。このため、容器本体を構成する材料は、光透過性材料よりも光遮断性材料を用いることが好ましい。

【００２９】図５は、本発明の基板搬送容器の乾燥ガスによる置換特性を示した図である。即ち、乾燥ガスによる置換に際して、相対湿度の変化を示したグラフであり、図中の黒い△印は通常のポリカーボネート容器を用いた場合であり、流量が５Ｌ／ｍｉｎであり、図中の×印は、流量が１０Ｌ／ｍｉｎの場合である。図示するように、下限湿度までの到達時間は約１５分程度かかり、流量による差は殆どない。これに対して、白い○印は本発明の吸水率０．１%以下の高分子材料を用いた容器であり、同様に乾燥ガスの流量が１０Ｌ／ｍｉｎである場合を示し、約５分程度で下限湿度まで到達する。このことは、乾燥ガスの置換効率が高いことを示しており、乾燥ガスをダクト３８から整流板４０を介して均一な流れを形成するように容器内に供給することで、置換効率が改善されることを示している。

【００３０】尚、上述した実施の形態においては、容器の材料としてポリフェニレンスルフィドを用い、乾燥ガスをダクトを介して開口率を調整した整流板から均一に流す例について説明したが、本発明の趣旨を逸脱することなく種々の変形実施例が可能なことは勿論である。

【００３１】次に、本発明の第二の実施の形態を図９乃至図１４を参照しながら説明する。本発明の実施の形態は、３００mmウエハ用ＦＯＵＰ（Ｆｒｏｎｔ　Ｏｐｅｎｉｎｇ　Ｕｎｉｆｉｅｄ　Ｐｏｄ）に適用した例である。本基板搬送容器は、容器本体１２と容器前面に配置されたドア１４と、位置決めピンを受けるキネマティックカップリング等を持つ底板５８と、容器本体内部に配置されて、複数枚の半導体ウエハWを支えるウエハ支持部材５６と、容器本体１２に取り付けられた給気ポート３０と排気ポート３２及び給気ポート３２の下流側に配置されてガス吹き出し口に多孔板４０を持ったダクト３８から構成される。ＦＯＵＰはＳＥＭＩ規格により、ポッド底部に位置決めピンや各種識別用穴などが配置されるため、給気・排気ポートはそれらに干渉しないようドアから見て左右の下部に配置している。本発明の第一の実施の形態と同様に、給気・排気ポートには逆流防止弁４２とフィルタ５２が内蔵されている。容器内のガスは、ガス置換装置、ドアオープナ、搬送装置、保管庫などの所定の位置に着座した後、給気ポートから不活性ガスなどが給気されると、フィルタ５４で不純物が除去され、ダクト３８を通り、多孔板４０からドアに向かう流れが形成される。半導体ウエハW通過後のガスは排気ポート３２から排気され、容器内を効率良くガス置換できる。

【００３２】

【発明の効果】以上説明したように本発明によれば、基板搬送容器内を清浄な気体で流通または置換する際に、清浄な気体をダクトを介して整流板から均一に容器内に流すことで、容器内のガスの滞留を生じることなく効率的な置換が行える。これにより、清浄な気体による置換時間を短縮することができ、半導体工場等における生産の効率化が図れる。また、清浄な気体が容器内を均一に流れることで、容器内に保管する多数の半導体ウエハ等

に均一に新鮮な清浄ガスを供給してこれらを清浄に保つことができる。また、ガス状不純物捕捉素子を備えたフィルタを設けると共に逆流防止弁を備えることで、容器内に保管する半導体ウエハ等の汚染を防止することができる。更にまた、容器を構成する主要材料を、吸水率が０．１%以下の高分子材料または不透湿材料を用いることで、容器内壁面からの湿気の拡散による相対湿度の上昇を防止できる。

【００３３】総じて本発明によれば、ガス状汚染物質を除去しつつ、短時間で乾燥ガス等の置換が行え、且つ容器内湿度が上昇しないようにした基板搬送容器が提供される。従って、多品種少量生産等の半導体デバイス等の製造方式に用いて有用である。

【図面の簡単な説明】

【図１】本発明の実施の形態の基板搬送容器の立面図である。

【図２】図１に示す基板搬送容器の平面図である。

【図３】図１に示す基板搬送容器のドアの構造を示す、（ａ）下面の平面図、（ｂ）X矢視図、（ｃ）上面の平面図、（ｄ）Y矢視図である。

【図４】整流板の構造令を示した図である。

【図５】本発明の容器と従来例の容器とを対比した乾燥ガスの供給停止後の容器内の相対湿度の上昇を示すグラフである。

【図６】逆流防止弁の構造を模式的に示した図であり、（ａ）は閉止状態を示し、（ｂ）は開放状態を示す。

【図７】給気口とダクトとの接続構造例を示した図である。

【図８】本発明の容器と従来例の容器とを対比した乾燥ガスによる容器内部の置換特性を示すグラフである。

【図９】本発明の第２の実施の形態の基板搬送容器の側面図である。

【図１０】本発明の第２の実施の形態の基板搬送容器の下面図である。

【図１１】図９のＡ－Ａ断面図である。

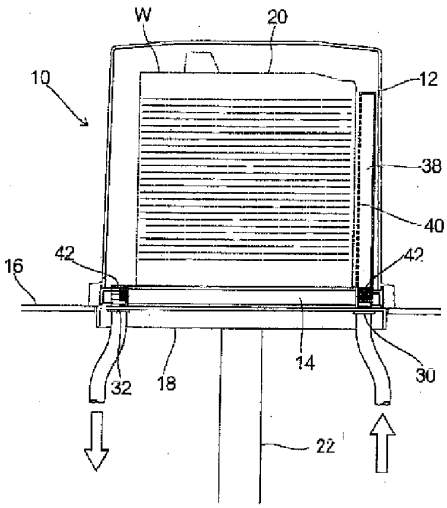
【図１２】図１１のＢ－Ｂ断面図である。

【図１３】図１１のＣ－Ｃ断面図である。

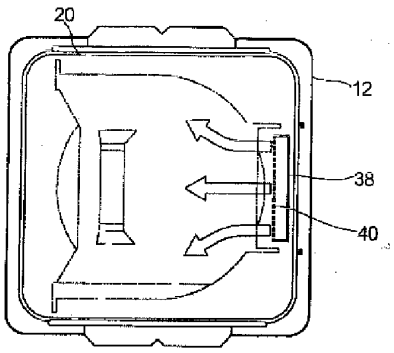
【符号の説明】

１０　基板搬送容器
１２　容器本体
１４　ドア
２０　カセット
３８　ダクト
４０　整流板
４２　逆流防止弁
５２　フィルタ

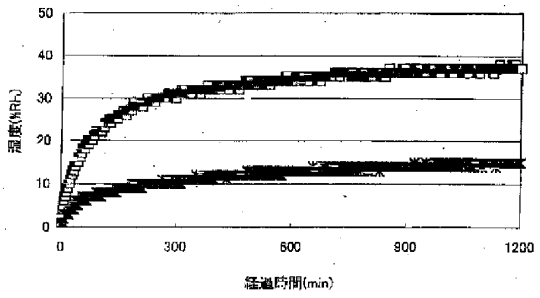
【図１】



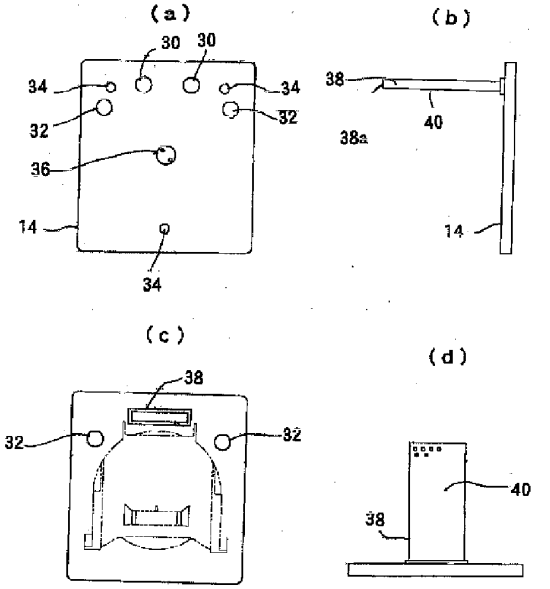
【図２】



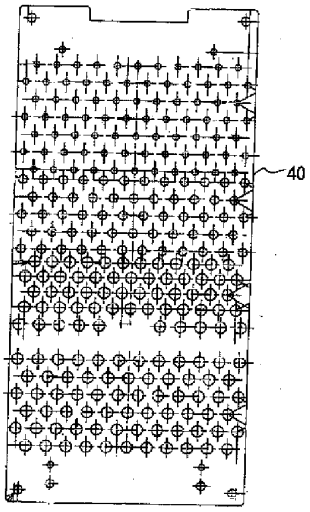
【図８】



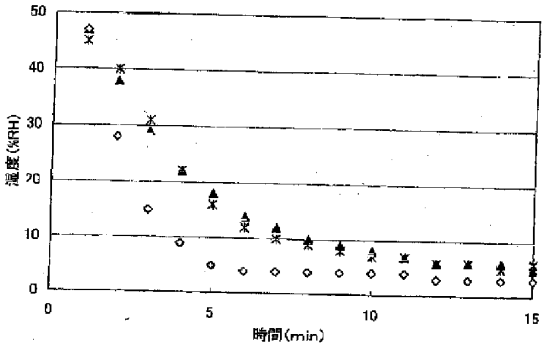
【図3】


(a)
30
30
34
34
32
32
36
14
34
(b)
38
40
38a
14
(c)
38
32
32
(d)
40
38

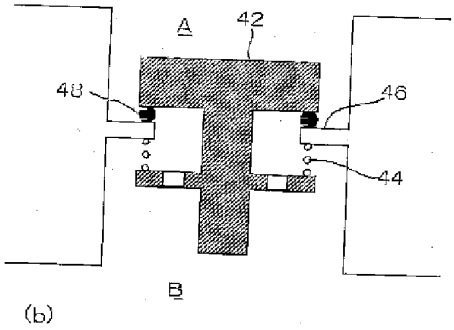
【図4】


40

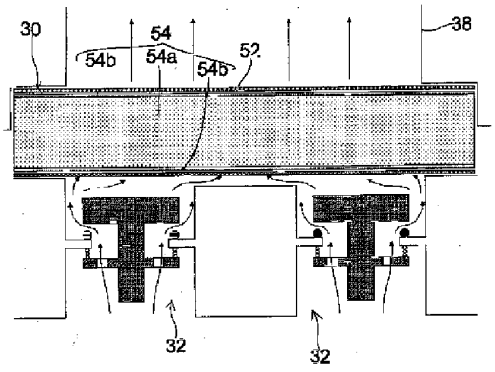
【図5】

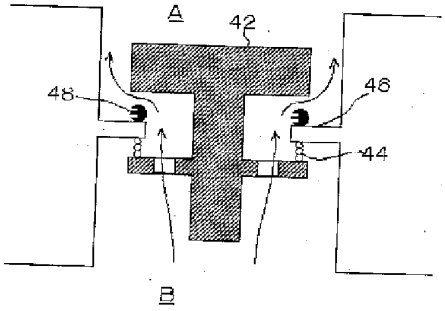

50
40
30
20
10
0
湿度(%RH)
0
5
10
15
時間(min)

【図6】

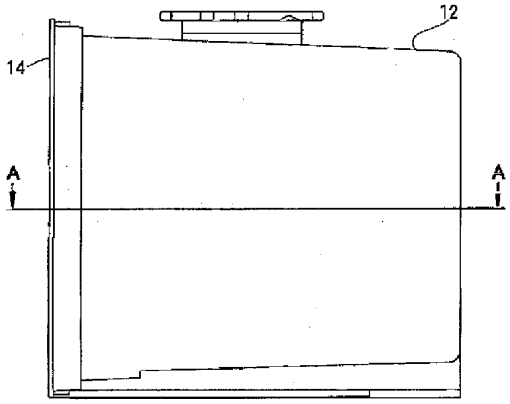

(a)
A
42
48
46
44
B
(b)

【図7】

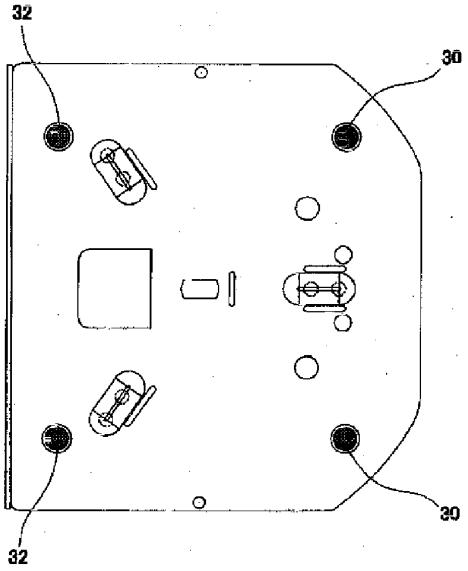

30
54
54b
54a
54b
52
38
32
32


A
42
48
46
44
B

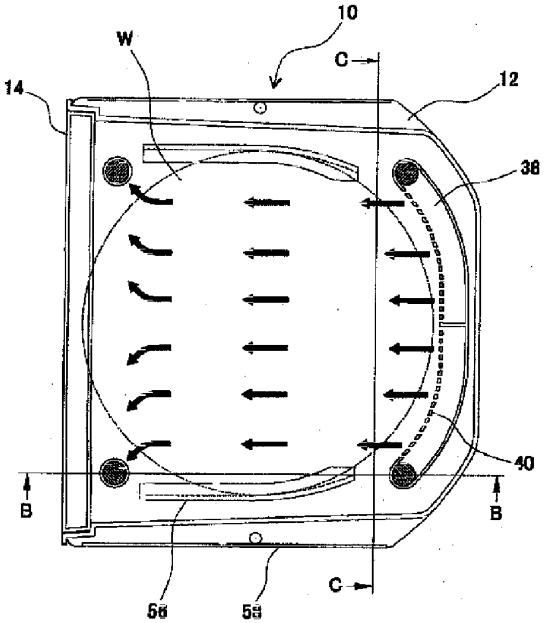
【図9】



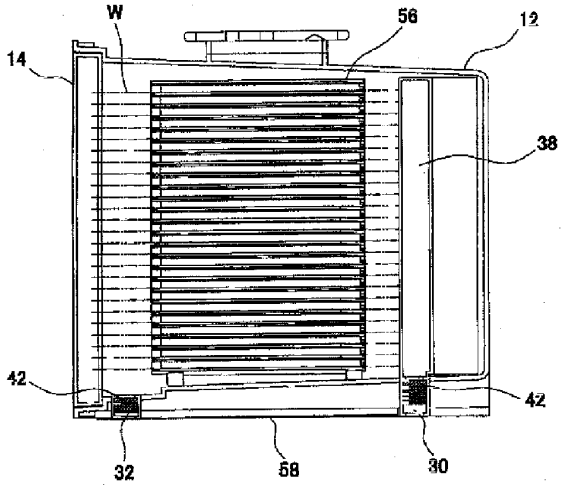
【図10】



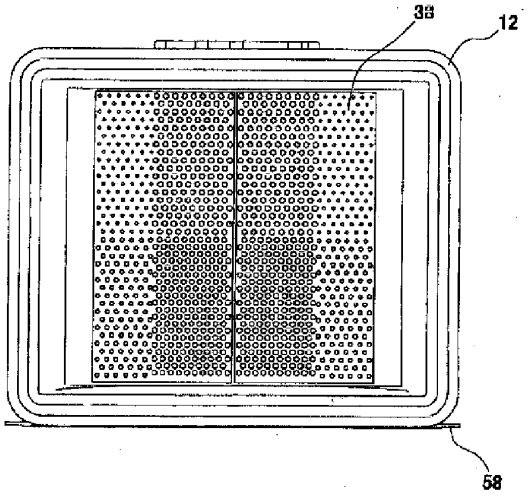
【図11】



【図12】



【図13】



フロントページの続き

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BB14A BC06A CA04 CA05
FA01 FC01 GA19
3E096 AA06 BA16 BB04 CA02 CB03
DA25 DA30 DB06 DC02 EA02X
FA03 FA22 GA03
5F031 CA02 CA05 CA07 DA09 EA02
EA14 EA19 EA20 NA16 PA26

Espacenet

Bibliographic data: JP2020150245 (A) — 2020-09-17

GAS DIFFUSING DEVICE AND SUBSTRATE CARRIER THEREOF

Inventor(s): HU SHI ZHENG; LIN DI ± (胡 石政, ; 林 廸)

Applicant(s): UNIV NAT TAIPEI TECH ± (國立臺北科技大學)

Classification: **- international:** ***B65D81/18; B65D85/86; H01L21/673***
- cooperative:

Application number: JP20190115487 20190621 Global Dossier

Priority number(s): TW20190108541 20190313

Abstract of JP2020150245 (A)

To provide a gas diffusing device and a substrate carrier thereof.SOLUTION: A gas diffusing device according to the present invention directly attaches a gas diffusing device and does not affect an elements inside a carrier by utilizing a structure of a substrate carrier and an opening thereof. The gas diffusing device is provided with a tubular portion that has an acute-angled side and an obtuse-angled side, and whose material is a sintered polymer with multiple holes, an inlet portion connected to one end of the tubular portion and having a first base and an intake port, and a stopper portion connected to the other end of the tubular portion and provided with a second base.SELECTED DRAWING: Figure 1

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B65D 85/86	(2006.01)	B65D	85/86	400	3E096
B65D 81/18	(2006.01)	B65D	81/18	Z	5F131

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(33)優先権主張国・地域又は機関
台湾 (TW)

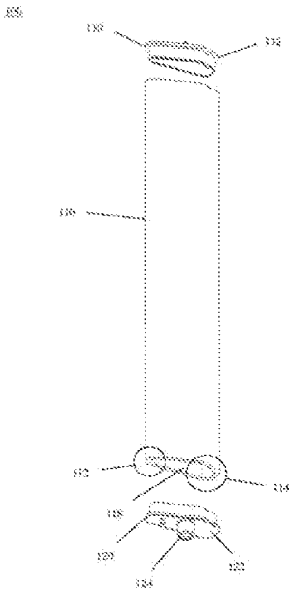
(71)出願人　513197703
國立臺北科技大學
台灣台北市大安區忠孝東路三段１號
(74)代理人　110002262
ＴＲＹ国際特許業務法人
(72)発明者　胡　石政
台灣台北市大安區忠孝東路三段１號
(72)発明者　林　廸
台灣台北市大安區忠孝東路三段１號

Ｆターム(参考)　3E067 AA11 AB41 AC03 BA01A BB15A BC06A BC07A CA04 EB27 EE41 FA01 FC01 GA18
3E096 BA15 BA16 BB05 CA02 CB03 DA17 EA02X EA02Y FA03 FA19 GA03

最終頁に続く

(54)【発明の名称】気体拡散装置及びその基板キャリア

【要約】
【課題】　気体拡散装置及びその基板キャリアを提供することを課題とする。
【解決手段】　本発明は、基板キャリア及びその開孔の構造を利用して、直接気体拡散装置を取り付け、かつキャリア内部の素子に影響を及ぼすことがない気体拡散装置を提供する。気体拡散装置は、鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、前記管状部の一端と接続され、第１基台と吸気口とを備えた入口部と、前記管状部の他端と接続され、第２基台を備えたストッパー部と、を含む。
【選択図】　図１



Entegris, EX1002, p. 942

【特許請求の範囲】
【請求項１】
鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、
前記管状部の一端と接続され、第１基台と吸気口とを備え、かつ前記吸気口が前記管状部と同一軸線上に配置される入口部と、
前記管状部の他端と接続され、第２基台を備えたストッパー部と、
を含むことを特徴とする、気体拡散装置。
【請求項２】
前記第１基台及び前記第２基台と前記管状部との嵌合部位に気密リングを更に有することを特徴とする、請求項１に記載の気体拡散装置。
【請求項３】
前記気密リングの寸法は、前記管状部の両端管口の寸法と同一であることを特徴とする、請求項２に記載の気体拡散装置。
【請求項４】
前記複数孔の孔径サイズは１μｍ～４５μｍであることを特徴とする、請求項１に記載の気体拡散装置。
【請求項５】
前記焼結されたポリマーは、高密度ポリエチレン（ＨＤＰＥ）或いは超高分子量ポリエチレン（ＵＰＥ）であることを特徴とする、請求項１に記載の気体拡散装置。
【請求項６】
開口部を備えた容器と、
前記開口部と閉成する扉と、
前記容器内に設けられた少なくとも１個の請求項１に記載の気体拡散装置と、
を含む基板キャリアにおいて、
前記容器は、底板を更に含み、かつ前記底板が少なくとも１個の開孔を備え、
前記吸気口が前記少なくとも１個の開孔上に設けられる、
ことを特徴とする、基板キャリア。
【請求項７】
前記第１基台及び前記第２基台と前記管状部との嵌合部位に気密リングを更に有することを特徴とする、請求項６に記載の基板キャリア。
【請求項８】
前記気密リングの寸法は、前記管状部の両端管口の寸法と同一であることを特徴とする、請求項６に記載の基板キャリア。
【請求項９】
前記複数孔の孔径サイズは、１μｍ～４５μｍであることを特徴とする、請求項６に記載の基板キャリア。
【請求項１０】
前記焼結されたポリマーは、高密度ポリエチレン（ＨＤＰＥ）或いは超高分子量ポリエチレン（ＵＰＥ）であることを特徴とする、請求項６に記載の基板キャリア。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、基板キャリアに用いることのできる気体拡散装置に関し、特に、入口部を偏位配置する必要なく、キャリア内部素子を避けることができる気体拡散装置及びその基板キャリアに関する。
【背景技術】
【０００２】
ウエハケース又はレチクルケースは、半導体製造工程間の搬送及びウエハ或いはレチクルの保管に運用される装置であり、素子が製造工程内で汚染されることを防止するため、

ウエハケース又はレチクルケースの底部に気体充填孔を設け、ウエハケース又はレチクルケースの内部に気体を充填する方式により、ケース内環境の清浄度を維持する。ケース内の清浄を保持するため、通常ウエハケース又はレチクルケースの底部に気体充填孔が開設されている。しかしながら、気体充填孔を通じて吸気する気体充填方式は、往々にしてウエハケース又はレチクルケース内の気流分布が不均一となり、気流の死角が生じることで、湿度の不均一或いは局所の清浄度が要求を満たさない問題が生じていた。

【０００３】

前記問題点に鑑み、業者は、ケース内に整流装置を追加で取り付け、気体充填孔から入り込んだ気体を先に整流装置内に貯めてから均一にウエハケース又はレチクルケースの内部に向けて拡散させ、気流の死角という問題を減少させることができる。気体拡散装置がケース内においてウエハ或いはレチクルに接触しないように、整流装置の入口ジョイントに通常オフセット部（例えば特許文献１）が設けられ、或いは拡散器の整流孔口とウエハケースの気体充填孔を平行にオフセットするよう設計させることで、ウエハケース内のウエハ保管位置（特許文献２）を避ける。

【０００４】

しかしながら、この挙動は、容器の気体充填口と整流装置の吸気口のオフセットにより、整流装置内部に充填する気体の圧力抵抗が増加し、気体を整流装置内に容易に貯めることができなくなり、容器内部に拡散する気体流量が過小になるため、容器の遠い場所まで吹き込むことができなかった。

【先行技術文献】

【特許文献】

【０００５】

【特許文献１】台湾特許番号第Ｉ６０６５３４号

【特許文献２】台湾実用新案番号第Ｍ５４８５９８号

【発明の概要】

【発明が解決しようとする課題】

【０００６】

本発明は、上記の様々な欠陥を解決するため、既存の基板キャリア及びその開孔の構造を利用して、直接気体拡散装置を取り付け、かつキャリア内部の素子に影響を及ぼすことがない気体拡散装置を提供する。

【課題を解決するための手段】

【０００７】

気体拡散装置は、鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、前記管状部の一端と接続され、第１基台と吸気口とを備え、かつ前記吸気口が前記管状部と同一軸線上に配置される入口部と、前記管状部の他端と接続され、第２基台を備えたストッパー部と、を含む。

【０００８】

さらに言えば、前記第１基台及び前記第２基台と前記管状部との嚙合部位に各々気密リングを更に有することで、気体填充過程中において、管状部と入口部及びストッパー部の接続部位の隙間から漏れることを効果的に防止することができる。

【０００９】

また、本発明は、気体拡散装置を備えた基板キャリアを更に提出する。前記基板キャリアは、開口部を備えた容器と、前記開口部と閉成する扉と、鋭角側と鈍角側とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部と、前記管状部の一端と接続され、第１基台と吸気口とを備え、かつ前記吸気口が前記管状部と同一軸線上に配置される入口部と、前記管状部の他端と接続され、第２基台を備えたストッパー部とを含み、前記容器内に設けられた少なくとも１個の気体拡散装置と、を含む。前記容器は、底板を更に含み、かつ前記底板が少なくとも１個の開孔を備え、前記吸気口が前記少なくとも１個の開孔に設けられる。

【００１０】

以上の本発明に対する略述は、本発明の幾つか態様及び技術的特徴に対し基本的な説明を行うことを目的とする。発明の略述は、本発明に対する詳細な記述ではないため、その目的は特別に本発明のキーとなる或いは重要要素を挙げることなく、本発明の範囲を画定するために用いられることはなく、簡明な方式でのみ本発明の数種概念を開示する。

【図面の簡単な説明】

【００１１】

【図１】本発明の好ましい実施例に係る気体拡散装置を示す模式図である。

【図２】本発明の好ましい実施例に係る管状部を示す模式図である。

【図３】本発明の好ましい実施例に係る入口部を示す模式図である。

【図４】本発明の好ましい実施例に係るストッパー部を示す模式図である。

【図５】本発明の好ましい実施例に係る基板キャリアを示す模式図である。

【発明を実施するための形態】

【００１２】

本発明の技術的特徴及び実用効果を理解し、明細書の内容に基づいて実施できるため、更に図面に示す好ましい実施例で次の通り詳細に説明する。

【００１３】

本発明に係る基板（例えば半導体ウェハ或いはレチクル等）キャリアに運用される気体拡散装置は、清浄気体を基板キャリアの容器内に均一に吹き込むことで、容器内部の例えば酸素、水蒸気或いは他の気体分子による汚染物質を除去できる。本発明の気体拡散装置に関しては、まず図１を参照すると、本発明の好ましい実施例に係る気体拡散装置１００を示す模式図であり、図１に示すように、本実施例の気体拡散装置１００は、管状部１１０と入口部１２０とストッパー部１３０とを含む。

【００１４】

具体的に言えば、前記管状部１１０（図２を参照しながら）は、五角形の管体構造を呈し、かつ五角形の管体構造が同時に鈍角側１１４と鋭角側１１２とを備える。前記構造設計は、管体構造上下両端の鈍角側１１４及び鋭角側１１２で画成された内方に凹む平面が気体拡散装置１００を基板キャリアに取り付けた時、管状部１１０がキャリア内部に搬送された半導体ウェハ或いはレチクルに接触することを効果的に防止できることを目的とする。よって、前記内方に凹む平面は、基板の待避面とも呼ぶこともでき、気体拡散装置１００が基板キャリア内部に簡単に取り付けられて容器環境を清浄することができる。

【００１５】

他に、前記管状部１１０の材料は、複数孔のある焼結されたポリマーを選択でき、清浄気体を管状部１１０の内部から前記複数孔を経由して流出させると共に基板キャリア内部に均一に吹き込むことで清浄の目的を達成できる。本実施例において、焼結されたポリマーの材料は、高密度ポリエチレン（Ｈｉｇｈ－Ｄｅｎｓｉｔｙ　Ｐｏｌｙｅｔｈｙｌｅｎｅ、ＨＤＰＥ）又は超高分子量ポリエチレン（Ｕｌｔｒａ－Ｈｉｇｈ　Ｍｏｌｅｃｕｌａｒ　Ｗｅｉｇｈｔ　ｐｏｌｙｅｔｈｙｌｅｎｅ、ＵＰＥ）から選択でき、吸水率が０．１～５％を下回り、かつ疎水性を持つ超高分子量ポリエチレンが好適である。超高分子量ポリエチレンは、高度な靭性及び耐衝撃性を持ち、同時に耐食性、耐薬品性及び極めて低い摩擦係数を持ち、その表面が疎水性を有し、水の通気プレート表面における接触角が１００°～１３０°の範囲（例えば１１３°）にあり、かつ滑り角が存在しない（３６０°内において水玉を回転しても動かない）。

【００１６】

管状部１１０内の圧力の大きさは、管状部１１０上の複数孔の大きさ及び個数によって決まり、清浄気体が基板キャリアの隅隅に吹き込むことができることを基準とする。本実施例において、管状部に備えられた各孔の孔径サイズが０．０１μｍ～１３０μｍで、好ましい孔径サイズが１μｍ～４５μｍであり、孔が大きすぎると、圧力不足が生じて気体をキャリア内部の遠い場所に吹き込むことができなくなり、孔が小さすぎると、内部圧力抵抗が過大となって清浄気体が流出できなくなる。

【００１７】

次に、同時に図３を参照すると、本発明の好ましい実施例に係る入口部を示す模式図である。図１及び図３に示すように、入口部１２０は、前記管状部１１０の一端と接続して設けられ、かつ前記入口部１２０が第１基台１２２と、前記第１基台１２２の表面に配置された吸気口１２４とを含む。管状部１１０が鈍角側１１４及び鋭角側１１２で画成された基板待避面を備えるため、入口部１２０に設けられた吸気口１２４の軸心線は、管状部１１０の一端にある管口１１８の軸心線とつながって同一直線になることができる点に留意されたい。言い換えると、前記吸気口１２４は前記管状部１１０の一端にある管口１１８と同一軸線上に配置される。こうして、気体拡散装置１００は、基板キャリア内部に設けられた開孔（気体充填孔）上に直接接続でき、同時にキャリア内部の半導体ウェハ或いはレチクル等の基板保管位置を避けることができる。

【００１８】

オフセット部（ｕｎｉｔａｒｙ　ｏｆｆｓｅｔ　ｐｏｒｔｉｏｎ）を備えた入口ジョイントを使用し、又は拡散器の整流孔口とウエハケースの気体充填孔を平行オフセット設計に採用することで、ウエハケース内のウェハ保管位置を避けるという従来技術に対比すると、本発明は、管状部１１０がウエハ待避面を備える特殊な構造設計を通じて気体拡散装置１００を基板キャリア内部の開孔（すなわち、気体拡散装置１００の吸気口１２４と基板キャリア内部の開孔の軸心が同一線上にある）に直接取り付けさせることができ、オフセット部或いは平行オフセット設計で入口部に形成される比較的大きな圧力抵抗を効果的に低下させる。これにより、清浄気体充填過程中において、気体を基板キャリア内部の開孔から気体拡散装置１００に直接入らせると共に、簡単に清浄気体を基板キャリアの内部に吹き込んで、キャリア内部の清浄効果を維持できる。

【００１９】

最後に、同時に図４を参照すると、本発明の好ましい実施例に係るストッパー部を示す模式図である。図１及び図３に示すように、ストッパー部１３０は、前記管状部１１０の入口部１２０に対向する他端に接続され、かつ前記ストッパー部１３０が第２基台１３２を含む。ストッパー部１３０の役目は、管状部１１０内に充填される清浄気体が外部に漏えいするのを防止するためであり、管状部１１０内の気体圧力が時間の経過に伴い徐々に飽和に達して最大静圧（Ｓｔａｔｉｃ　Ｐｒｅｓｓｕｒｅ）になると、清浄気体が管状部１１０上にある複数孔から基板キャリアの内部までに拡散されてキャリア内部の隅隅まで吹き込まれることで、内部の酸素、水蒸気或いは他の気中分子状汚染物質を除去する。

【００２０】

さらに言えば、前記第１基台１２２及び前記第２基台１３２の一側と前記管状部１１０との嚙合部位に気密リング１２６、１３６を更に有し、かつ清浄気体が入口部１２０と管状部１１０との接合部の隙間或いはストッパー部１３０と管状部１１０との接合部の隙間から漏れないように、前記気密リング１２６、１３６の寸法は、前記管状部１１０の両端管口１１８の寸法と同一で、気密性を高めることができる。

【００２１】

また、本発明の別の実施例において、前記気体拡散装置を備えた基板キャリアを更に提出する。図１及び図５を参照すると、本発明の好ましい実施例に係る基板キャリアを示す模式図である。図５に示すように、前記基板キャリア２００は、開口部２１２を備えた容器２１０と、前記開口部２１２と閉成する扉２２０と、鋭角側１１２と鈍角側１１４とを備え、かつその材料が複数孔のある焼結されたポリマーである管状部１１０と、前記管状部１１０の一端と接続され、第１基台１２２と吸気口１２４とを備え、かつ前記吸気口１２４が前記管状部１１０と同一軸線上に配置される入口部と、前記管状部１１０の他端と接続され、第２基台１３２を備えたストッパー部とを含み、前記容器２１０内に設けられた少なくとも１個の気体拡散装置１００と、を含む。

【００２２】

さらに言えば、前記容器２１０は、底板２３０を更に含み、かつ前記底板２３０が少なくとも１個の開孔２３２を備え、前記開孔２３２が清浄気体を前記開孔２３２内部に充填するための外部清浄気体填充装置（図示せず）に接続できる。前記管状部１１０の一端に

ある吸気口１２４は、前記少なくとも１個の開孔２３２に配置され、吸気口１２４を通じて前記開孔２３２と接続することで、清浄気体填充装置で填充された清浄気体を前記開孔２３２と接続された吸気口１２４を経由して管状部１１０内に導入し、管状部１１０内の気体が一定圧力に達した後、複数孔を経由して外方へ拡散し、一定の方向に開口部２１２に向かって清浄気体の気流を誘導することで、容器２１０内部の環境を吹き払う。

【００２３】

填充された清浄気体は、窒素（N_2）等の不活性ガス或いは乾燥圧縮空気（ＣＤＡするることができる。

【００２４】

具体的に言えば、前記基板キャリア２００は、レチクルを搬送したレチクルケ半導体ウェハを搬送したウエハケースとすることができ、本実施例においてフー ont Opening Unified Pod、FOUP）を用いる

【００２５】

本実施例において、気体拡散装置１００の台数が２台で、かつ両気体拡散装置１００は容器２１０内部の開口部２１２に対向する端に配置され、気体拡散装置１００の設置は清浄気体が容器内において空気と十分混合させることができ、気流の死角が生じないため、気中分子状汚染物質を除去できる。その他の可能な実施例において、基板キャ内に１台の気体拡散装置１００のみが配置された時、気体拡散装置による汚染物質除去の効果を最大化にさせるため、容器の開口部２１２及び気体拡散装置１００を気体拡散装置１００の一つの対角線両端の相対位置に設けることができ、気体拡散装置１００と開口部２１２との間の相対位置が対角線両端にある方式は、清浄気体を基板キャリア２００移動させた時、比較的長い経路を持たせ、清浄気体と空気の混合時間も長くなり、死角発生確率も下がるため、容易に気中分子状汚染物質を除去できる。しかしながら板キャリア２００内における少なくとも１台の気体拡散装置１００の台数及び配置位置は、利用用者の需要に応じて調整できるため、本発明ではこれを制限しない。

【産業上の利用可能性】

【００２６】

本発明は、気体拡散装置がウェハ待避面を備えた特殊な構造設計を通じて、気体拡置を基板キャリア内部の開孔（すなわち、気体拡散装置の吸気口と基板キャリア内部の孔の軸心が同一線上にある）に直接取り付けさせることで、オフセット部或いは平セット設計で生じる大きな圧力抵抗を効果的に低下させ、従って清浄気体の充填過程おいて、気体を基板キャリア内部の開孔から気体拡散装置に直接入らせることができ、また容易に清浄気体を基板キャリアの内部に吹き込まれることで、キャリア内部の清浄の効果を維持できる。

【００２７】

以上に説明するものは、本発明の好ましい実施例であって、本発明の実施範囲はような実施例に限定されるものではなく、本発明の特許請求の範囲及び明細書の内づいて均等の範囲内で各種の変更や修飾を加えるものは、本発明にカバーされる属する。

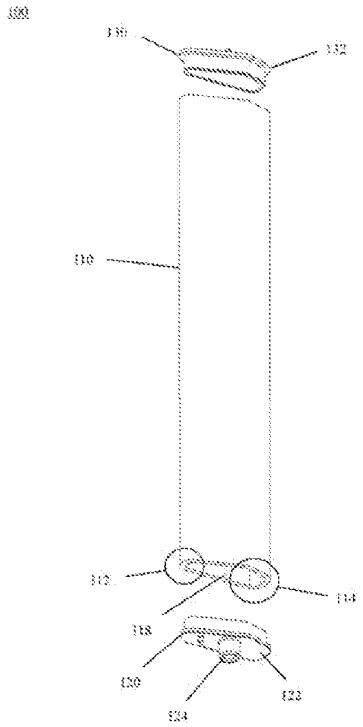
【符号の説明】

【００２８】

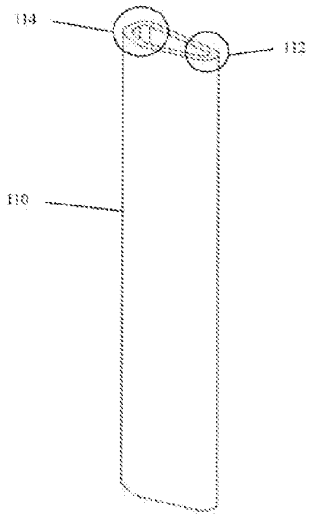
１００… 気体拡散装置
１１０… 管状部
１１２… 鋭角側
１１４… 鈍角側
１１８… 管口
１２０… 入口部
１２２… 第１基台
１２４… 吸気口
１２６… 気密リング

１３０…ストッパー部
１３２…第２基台
１３６…気密リング
２００…基板キャリア
２１０…容器
２１２…開口部
２２０…扉
２３０…底板
２３２…開孔

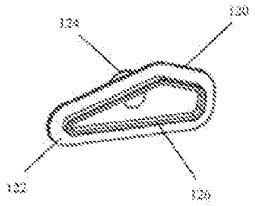
【図１】



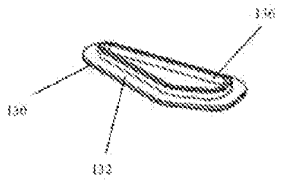
【図２】



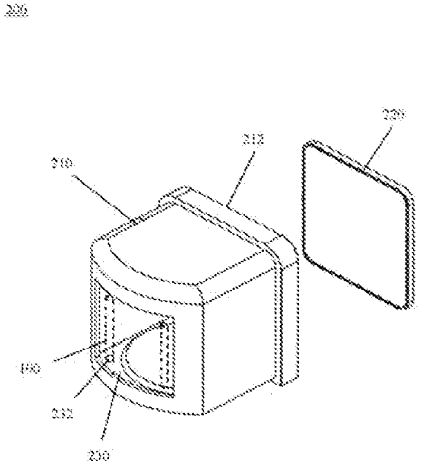
【図３】



【図４】



【図５】



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(71) Applicant *(for all designated States except US)*: **ENTEGRIS, INC.** [US/US]; 3500 Lyman Boulevard, Chaska, MN 55318 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **WATSON, James, A.** [US/US]; 6499 Mistral Lane, Eden Prairie, MN 55346 (US). **BURNS, John** [US/US]; 6046 Bow River Drive, Colorado Springs, CO 80918 (US). **FORBES, Martin, L.** [US/US]; 993 Ridge Road, Divide, CO 80814 (US). **FULLER, Matthew, A.** [US/US]; 1731 North Nevada Avenue, Colorado Springs, CO 80907 (US). **SMITH, Mark, V.** [US/US]; 4110 Bobbie Kay Place, Colorado Springs, CO 80908 (US).

(74) Agents: **CHRISTENSEN, Douglas, J.** et al.; Patterson, Thuente, Skaar & Christensen, P.A., 4800 IDS Center, 80 South Eighth Street, Minneapolis, MN 55402-2100 (US).

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(54) Title: WAFER CONTAINER WITH TUBULAR ENVIRONMENTAL CONTROL COMPONENTS

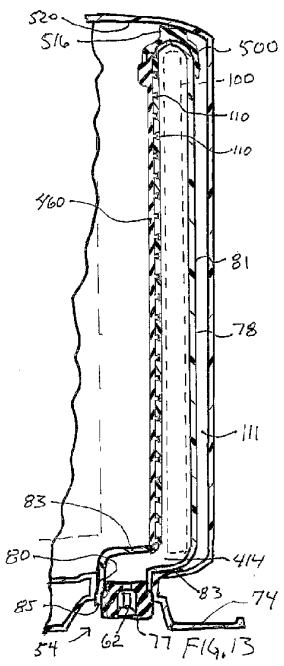


FIG. 13

(57) Abstract: A wafer container utilizes a rigid polymer tubular tower with slots and a "getter" therein for absorbing and filtering moisture and vapors within the wafer container. The tower preferably utilizes a purge grommet at the base of the container and may have a check valve therein to control the flow direction of gas (including air) into and out of the container and with respect to the tower. The tower is sealingly connected with the grommet. The tower may have a getter media piece rolled in an elongate circular fashion forming or shaped as a tube and disposed within the tower and may have axially extending. The media can provide active and/or passive filtration as well as having capabilities to be recharged. Front opening wafer containers for 300mm sized wafers generally have a pair of recesses on each of the left and right side in the inside rear of the container portions. These recesses are preferably utilized for elongate towers, such towers extending substantially from a bottom wafer position to a top wafer position. In alternative embodiment, a tubular shape of getter material is exposed within the front opening container without containment of the getter other than at the ends. The tubular getter form is preferably supported at discrete locations to maximize exposure to the internal container environment. A blocker member can selectively close the apertures. An elastomeric cap can facilitate securement of the tubular component in the container portion.

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WAFER CONTAINER WITH TUBULAR ENVIRONMENTAL CONTROL COMPONENTS

RELATED APPLICATION

The present application claims the benefit of U.S. Provisional Application No. 61/036,353 filed March 13, 2008, which is incorporated herein in its entirety by reference.

BACKGROUND OF THE INVENTION

Wafer containers and reticle pods generally are sealed containers known as FOUPs (front opening unified pods), FOSBs (front opening shpping boxes), or SMIF (standard mechanical interface) pods. These containers provide a microenvironment to isolate and control the environment surrounding a wafers and substrates used in manufacturing integrated circuits, during storage, transport and processing of the materials. Processing of such materials traditionally has been carried out in a particulate free environment generally known as a "clean room". However, maintenance of such "clean rooms" in a contaminant free state can require a great deal of care and effort, particularly during processing of the materials.

The internal atmosphere of such microenvironments can be more readily controlled and maintained. Often, such containers are purgible with inert gas or clean dry air (CDA) or extra CDA. It has been observed that contamination of reticles in such containers can be caused not only by discrete particles but also by hazing occurring on wafers or reticles. See Publication WO 2007/149513 A2, owned by the owner of the instant application, which is incorporated herein by reference and included in the Appendix to this application. Such hazing can also occur on wafers in wafer containers and be detrimental thereto, see U.S. Patent No. 5,346,518 which is incorporated herein by reference. Also relevant, U.S. Patent No. 6,042,651, owned by the owner of the instant application, discloses using nozzled towers in bottom opening SMIF pods and a front opening wafer container that uses wafer shelf assemblies as purge outlets. Problems associated with such structures and optimal use of such structures has not been adequately addressed.

For example, the use of desiccants and vapor getters in substrate containers typically require removal or disassembly of same before washing and such substrate containers as the fluids utilized can destroy the media for filtering and/or vapor absorption. Moreover, purge

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port plumbing within substrate containers is, aside from the media issues, difficult to clean and dry due to the enclosed areas used for transferring purge gases. A means for facilitating cleaning of such substrate containers without disassembly and removal of media and purge components would be very advantageous. Particularly, problematic in cleaning are free standing towers such as disclosed in U.S. Pat. No. 6,042,651. Moreover, such towers are subject to movement and potential dislocation due to their conventional positioning where they may be inadvertently contacted and their connection only at the base of the substrate container. Better positioning and attachment methods and structures would be advantageous, particularly methods that do not rely on holes or fasteners that extend through walls or other barriers separating the enclosed interior of the container from the exterior.

The use of discrete towers in a front opening pod, the use of more than one discharge tower, and the optimal placement and securement of discharge towers or tubular environmental control components has not heretofore been adequately considered and optimized to satisfactorily address reliability, haze, contamination and particulate control, and cleaning issues in front opening large diameter wafer containers. As a transition is made from 300mm wafers to 450mm wafers, improvements in these areas will be even more important.

SUMMARY OF THE INVENTION

In an embodiment of the invention, a wafer container includes a tubular environmental control component that is configured with an open interior and slots communicating with the interior of the wafer container. One or two of the tubular component may be strategically placed in back corners or compartments of the wafer container and may be connected to purge inlets on the bottom of the wafer container. Certain embodiments may have a filter in addition to or alternatively to the absorbent material. In certain embodiment an additional purge inlet port may be utilized for a total of three purge inlets. The tubular components or the purge ports may have a check valve therein to control the flow direction of gas (including air) into and out of the container and with respect to the tower. The purge port may utilize an elastomeric grommet and the tubular component sealingly connected thereto. The tubular component may have a getter media piece rolled in an elongate circular fashion forming or shaped as a tube and disposed within the tower. The media can provide active and/or passive filtration as well as having capabilities to be recharged.

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One configuration of front opening wafer containers for 300mm sized wafers have a pair of compartments on each of the left and right side in the inside rear of the container portions. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. A feature and advantage of certain embodiments is utilizing these compartments for containing, completely or partially, elongate tubular environmental control components that extend substantially from a bottom wafer position to a top wafer position or from the bottom of the container portion to the top. In one embodiment, a tubular shape of getter material is exposed within the front opening container in one or both compartments with minimal containment of the getter and without being part of an active purge system. In another embodiment, a tubular environmental control component configured as a purge tower may be placed in one or both compartments. The tower may be configured as a containment portion that may contain media. The media can be filter and/or absorbent media.

In particular embodiments, the tubular environmental control component has apertures either for exuding purge gas into the open interior of the container portion or for allowing absorbant media in the component to absorb vapors, including humidity from the interior of the container portion. A feature and advantage is that such apertures may be selectively obstructed to stop communication between the interior of the tubular component and the open interior of the wafer container. This is highly advantageous for washing the container so that filters, getters, or other contents of the tubular component can be protected from the washing fluids without removing the components. The obstruction may be by an elastomeric strip that seals the apertures as by a rigid slidably attached member that can cover and uncover the apertures. Moreover such selective blocking can be adjustable to change the size of the openings between the interior of the container portion and the interior of the tubular component.

A feature and advantage of certain embodiments is that the tubular component with apertures may be horizontally offset form the purge inlet connected thereto. This provides clearance with respect to the wafers. Moreover, positioning the discharge aperture in the tubular component back in the recess or compartment is believed to provide better fluid flow characteristics for the purge gas. Positioning the tubular components in the back recess

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provides the advantage of protection of the purge component from bumping or inadvertent contact.

A feature and advantage of certain embodiments is the methods of attachment of environmental control components in the rear compartments. These compartments reflect the interior structure formed by the pair of vertical external projections on the back wall of wafer containers that are utilized as feet or seating features when the container portion is rotated rearward ninety degrees. These internal compartments have walls that generally converge rearwardly. In a particular embodiment, a flexible elastomeric attachment member is secured intermediate the top of a tubular environmental control component and the polymer wall of the container portion. Such elastomeric attachment member secures the tower in place without apertures through the walls and optimally utilizes the high coefficient of friction between the polycarbonate container portion wall and the elastomeric material. The member may be shaped as a cap further providing the advantageous function of securing together elongate components that comprising the containment portion of tubular environmental control components. A tubular component may have such a member on both ends to utilize the high coeffidient of friction and the compression of the elastomeric members to retain said tubular environmental control component within, totally or partially, the rearward compartment. In another embodiment a rigid bracket formed from metal or a rigid polymer may have spring teeth to wedge the bracket between opposing walls of the compartment wherein the teeth dig into the surface of the container portion wall. A feature and advantage of these attachment methods and structures is that the attachment utilizes the opposing walls for engagement of the attachment components without separate structure or fasteners that extend through walls of the wafer container. Therefore, wafer containers may be readily retrofitted with no modifications or reduced modifications to the product.

A feature and advantage of embodiments utilizing the tubular getter media is that a relatively high area of media is effectively exposed in a confined area in the wafer container. Moreover, the rear compartments work well for the tubular components that have no media and are utilized for pure purging.

A further feature and advantage of certain embodiments is that where purge gas is exhausted through the tower, the tubular getter media may be effectively recharged for periods when the environment therein is static.

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A further feature and advantage of embodiments herein is that accommodation of the invention in existing configurations of 300 wafer containers requires minimal changes in such containers. A further feature and advantage is that aspects of the invention are highly suitable for larger wafer containers.

DESCRIPTION OF THE FIGURES

Figure 1 is a perspective view of a front opening wafer container according to an embodiment of the invention;

Figure 2 is a bottom view of the wafer container of Figure 1;

Figure 3 is a front perspective view into the open front of a different embodiment of a container portion;

Figure 4 is a detail top view cross-sectional of the embodiment of Figure 3 showing the location of tubular components and purge ports with respect to the walls of the container portion and wafers therein;

Figure 5 is an elevational view of a tubular component;

Figure 6 is a detail view of attachment features suitable for securing the tower component to the bottom wall of a container portion of a front opening wafer container;

Figure 7 is a front elevation view of a container portion with a pair of tubular environmental control components configured as filter cartridges mounted therein with brackets;

Figure 8 is a perspective view of tubular environmental control components configured as an absorbent filter cartridge according to an embodiment of the present invention;

Figure 9 is a bracket suitable for attaching a tubular environmental control component to the back region of a wafer container such as is shown in Figures 4 and 5;

Figure 10 is a top cross sectional view illustrating an attachment means for a tubular environmental control component of a wafer container;

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Figure 11 is a perspective view of a filter cartridge in a bracket;

Figure 12 is a perspective view of the bracket of Figure 11;

Figure 13 is a cross sectional view taken at line 13-13 of Figure 4;

Figure 14 is an exploded view of a tubular environmental control component according to an embodiment of the invention;

Figure 15 is an exploded view of a tubular environmental control component of the tubular environmental control component of Figure 14;

Figure 16 is a front side perspective view of a tubular environmental control component;

Figure 17 is a rear side view of the tubular environmental control component of Figure 16;

Figure 18 is a front perspective view of the tubular environmental control component of Figures 16 and 17 with a blocking member engaged therewith;

Figure 19 is a front side perspective view of a tubular environmental control component according to an embodiment of the invention;

Figure 20 is a detail view of the tubular environmental control component of Figure 19 opened revealing a living hinge;

Figure 21 is a container portion according to an embodiment of the invention; and

Figure 22 is a perspective view of an alternative embodiment of a blocking member 800 according to the present invention.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figures 1 and 2, a front opening wafer container 20 is depicted and generally includes door 24 and container portion 26. Container portion 26 has front opening 30 leading into open interior 32 where a plurality of wafers W are retained on wafer shelves 35. Door 24 has key access holes 36 with latch mechanism 38 partially illustrated in the interior of the door enclosure with latch tips 41 that engage recesses 39 in the container portion door frame 40. The wafer container has purge capabilities with a pair of forward purge ports 48 with purge grommets 50 which are secured into grommet receiving structure 51 on the bottom 52 of the container portion and rearward purge ports 54. Check valves 56 may be inserted into the grommets to control the direction of purging gas fluid flow. Tubular environmental control components configured as purge towers 60 are illustrated which also may utilize grommets 62 and check valves 64. An exemplary location of purge ports is illustrated in Figure 2 with reference to the wafers W.

Referring to Figures 3, 4, and 13, further details of a wafer container with a different configuration portion 64 embodying the inventions are illustrated with appropriate component placement. The container portion 64 has a shell 65 and closed top 66, a closed bottom 66.1, a closed left side 66.2, a closed right side 66.3, an open front 67, and a closed back 67.1. The interior of the container has a plurality of shelves 70 which may be secured to the container portion at the top and bottom of same. A kinematic coupling plate 74 (not shown in Figure 4) is positioned at the bottom of the container portion and has appropriate openings for receiving the front side grommets and rear side grommet 77 at rear ports 54. The openings will extend through the shell 65. The container portion has two rearward apertures 80 which extend from the interior 32 of the wafer container to the exterior.

The tubular environmental control component 78 configured as a tower component as depicted in Figures 3 and 13 is inserted into the container portion 64 from the interior into the aperture 80. The tubular component has a containment portion 81, an offset portion 83, and port portion 85. Elastomeric grommet 77 may be sealingly placed in the lower portion 94 of the tubular component and a check valve 62 may be placed therein. A cylindrical shaped filter and/or getter media material 100 may be included in the containment portion and is configured to conform to the interior of the tubular component. Said tubular component has a plurality of axially-extending apertures 110 configured as horizontal slots disclosed therein. In a preferred embodiment, there may be a slit for each wafer with the slit position to

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discharge purge gas over the surface of the respective wafer. The media material, if in the containment portion, is thus exposed to the interior of the wafer container by way of said axially-extending openings. Of particular note of this container portion 64 is the rearward compartments 111 that are defined by rearward protrusions 112 at the back 67.1. The wall 113 is configured to provide two feet 114 when the container is tipped rearward 90 degrees whereby the front with door 24 is upward, such as for shipping. Each compartment 111 has a pair of sidewall portions 115, a back wall portion 116 and a compartment opening 117.

Referring to Figures 5 and 6, the tubular component 119 in this embodiment has vertical slits and has a plurality of fingers 122 that extend downwardly into the apertures 80 through the shell and kinematic coupling plate 74. Said fingers resiliently flex radially inward and allow a secure fit in the aperture in the bottom of the container portion. A flange 113 may facilitate proper seating of the component.

Referring to Figures 7-11, additional embodiments are depicted with a pair of tubular environmental control components configured as filter cartridges 200 mounted in approximately the same position, in rearward 3-sided compartments 202, and configured as getters without the associated active purge capability of the containers illustrated in Figures 1-4. Such cartridges may have an outer housing 210 formed of a polymer or other suitable material with media 211 positioned therein. In a preferred embodiment the cartridge and media will be tubular shaped. Bosses 212 on the cartridge of Figure 8 can be utilized to attach the cartridge directly to the container portion wall by way of screws extending through the exterior wall. Alternatively the bracket 220 as illustrated in Figure 9 and Figure 7 may be attached to the back wall of the container portion with the cartridge clamped therein.

Referring in particular to Figures 10, 11 and 12 a further embodiment of a filter cartridge 300 is illustrated and again has media 304 closed within a housing 308. The cartridge 300 is clamped within the clamp 320 which has resilient catch legs 330 with tabs 322 which can bite into the walls of the container simply by insertion therein with no further attachment mechanisms. Spring arms 335 secure the cartridge in the bracket.

Specific getter media which may be utilized in the cartridges and the towers illustrated herein is disclosed in international publication no. WO 2007/149513 A2 which is incorporated herein by reference. Similarly the methodology and system for recharging a getter that is part of a purge system within the wafer container as illustrated herein in Figures

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2, 3 and 4 are described in detail with reference primarily to a reticle pod in said publication. Said systems and methodologies and equipment are also applicable herein and said references incorporated for the disclosure relating directly thereto.

Referring to Figures 14-18, details of a tubular environmental control component 400 in accord with the inventions herein is illustrated. The component has a pair of elongate portions 402, 406 that assemble together to form a containment portion 410 with a containment interior 414. The containment portion has an axis 418 and connects to an offset portion 422 that connects to a purge port portion 428. An elastomeric grommet 432 may fit in a grommet receiver 440. The two elongate portions are configured as elongate clam shell portions. A rearward portion 406 has edge portions 444 with latch portions 448 configured as loops. The forward portion 402 also has edge portions 448 with latch portions 452 configured as tabs to engage the loops. The latch portion operates to secure the elongate portion together while allowing disassembly for cleaning or media placement or replacement. The forward portion 402 has an aperture portion 451 with a plurality of apertures 453 that provide communication between the containment interior 414 and the open interior of the container portion.

Referring in particular to Figures 13-18, an elastomeric elongate blocking member 460 is configured as a strip to engage the aperture portion by having tabs 464 fit into and seal the aperture 453. Figures 13 and 18 illustrate the member 460 in a blocking position. Thus, the blocking member can selectively block or expose the interior of the containment portion to the interior of the container portion.

Referring still to Figures 13-18, an elastomeric retainer, configured as an elastomeric cap 500, resiliently expands and fits over the upper end portion 506 of the tubular component 400. The cap 500 has a dome shape and has an extension portion 516 that is configured to engage the interior surface 520 of the container portion at the top. The cap functions to secure the elongate portions together and further to engage resiliently the container portion whereby the vibration of tubular component and plastic to plastic contact, the plastic component portion and the shell, is minimized. The tubular component is inserted putting the cap under compression and the high friction between the elastomeric material of the cap and the hard plastic of the shell, typically polycarbonate, holds the tubular component in place.

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Referring to Figures 19 and 20, another embodiment of the tubular environmental control component 600 is shown. The component has two clam shell portions 604, 606 that are hinged together by a living hinge 610 or the like. The two shell portions may be latched with latch portions. Apertures 630 provide communication between the interior 634 of the capsule portion or containment portion 644 and the open interior of the wafer container. The containment portion also may connect to an offset portion 650 and then to a purge port portion 654.

Referring to Figure 21, an embodiment of a wafer container 692 with a tubular environmental control component 700 is placed in recesses 710 on the backside wall 714 of the container portion 718. The recesses may have apertures positioned and spaced from the top 720 to the bottom 722. Offset portion 726 may provide communication between the containment portion 730 and the purge port portion (not shown) positioned in the interior. This arrangement allows the tubular environmental control components to be changed without disturbing the interior of the container portion to the same level as some of the other embodiments.

Referring to figure 22, an alternative embodiment of a blocking member 800 is illustrated. This rigid plastic, for example polycarbonate, piece clamps around a tubular environmental control component, such as the configuration of Figure 19. Gripping fingers 810 may secure the member to the tubular member by locking on to the rear corner 670 with wedge shape teeth 812. In a further embodiment the blocking member may have apertures 820 that correspond with the apertures 630 on the tubular component. This component can then sidably engage with the tubular environmental control component by sliding vertically, can open, close or adjust the communication between the interior of the tubular component and the interior of the container portion. Similarly shaped rigid blocking components can have arcuate fingers that partially wrap around the tubular components with cylindrical or oval cross-sectional shapes.

The present invention may be embodied in other specific forms without departing from the spirit of the essential attributes thereof; therefore, the illustrated embodiments should be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than to the foregoing description to indicate the scope of the invention.

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CLAIMS

1. A front opening wafer container for wafers 300 mm and larger, the container comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a inwardly extending recess extending from the top of the container portion to the bottom of the container portion, at both lateral sides of the recess a protruding portion of the shell defines a pair of upright feet for seating the wafer container when the wafer container is rotated backwardly with the open front facing upwardly, the feet defining interior compartments,

each compartment having a pair of opposing side wall portions, a back wall portion, two interior vertical corners, a top wall portion and a bottom wall portion;

a door to fit in the open front and latchable to the door frame;

at least one elongate tubular environmental control component, secured within one of said compartments and being spaced from the pair of side wall portions and the back wall portion, the elongate tubular environmental control component having a length and the length extending substantially a distance between the top wall portion and the bottom wall portion.

2. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprised of two elongate portions, each elongate portion connected by a plurality of latches for securing the elongate portions together, the two portions defining a containment region.

3. The front opening wafer container of claim 2 wherein the two elongate portions are hinged together defining a containment portion and the containment portion contains at least one of a filtration material or a vapor absorbent material.

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4. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component has a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein the elongate tubular environmental control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port that is offset from the axis of the tubular environmental control component.

5. The front opening wafer container of claim 4 further comprising an elongate blocking member that is positionable on the tubular environmental control component to selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

6. The front opening wafer container of claim 5 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

7. The front opening wafer container of claim 5 wherein the elongate blocking member is slidably engagable with the containment portion and is slidingly shiftable on between a blocking position and an aperture open position.

8. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprised of two elongate portions defining a containment portion, and wherein the elongate tubular control component further comprises an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion.

9. The front opening wafer container of claim 1 further comprising an additional elongate tubular environmental control component located in an interior compartment and wherein the two elongate tubular environmental control components are both connected to a purge inlets on the bottom of the wafer container, and wherein the wafer container has a further purge inlet positioned on the bottom of the wafer container proximate to the door

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frame, and further comprises a purge outlet on the bottom of the wafer container proximate the door frame.

10. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprises an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion and wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

11. The front opening wafer container of claim 1 wherein the elongate tubular environmental control component is comprised of a vapor absorbent material and the wafer container further comprises a bracket with spring arms to secure the bracket intermediate the pair of side wall portions of one of the compartments, the elongate tubular environmental control component removably attachable to the bracket.

12. A front opening wafer container for wafers 300 mm and larger, comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

a door to fit in the open front and latchable to the door frame;

a pair of elongate tubular environmental control components positioned in the corner regions, each elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein each of the elongate tubular environmental control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port that is offset from the axis of the tubular environmental control component.

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13. The front opening wafer container of claim 12 wherein the pair of elongate tubular environmental control components are both outwardly exposed on the backside.

14. The front opening wafer container of claim 12 the pair of elongate tubular environmental control are spaced from the wall portions and the back side and the elongate tubular environmental control component has a length and the length extends substantially a distance between the top wall portion and the bottom wall portion.

15. The front opening wafer container of claim 12 wherein each elongate tubular environmental control component is comprised of two elongate portions, each elongate portion connected to the other by at least one of a plurality of latches and hinges, the two portions defining a containment portion.

16. The front opening wafer container of claim 15 further comprising an elongate blocking member that is positionable on at least one of the tubular environmental control component to selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

17. The front opening wafer container of claim 16 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

18. The front opening wafer container of claim 16 wherein the elongate blocking member is slidably engagable with one of the containment portions and is slidingly shiftable on said containment portion between a blocking position and an aperture open position.

19. The front opening wafer container of claim 12 wherein the elongate tubular environmental control components are each comprised of two elongate portions defining a containment portion, and wherein the elongate tubular control component further comprises an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion.

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20. The front opening wafer container of claim 8 wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

21. The front opening wafer container of claim 12 wherein each of the containment portions has therein at least one of a filter material and an absorbent material.

22. A front opening wafer container for wafers 300 mm and larger, the wafer container comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

a door to fit in the open front and latchable to the door frame;

an elongate tubular environmental control component positioned in one of the corner regions, said elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein said elongate tubular environmental control component has an axis that is upright and the elongate tubular environmental control component is connected to the bottom of the container portion at a purge port that is offset from the axis of the tubular environmental control component, and wherein the elongate tubular environmental control component is comprised of two elongate portions, each elongate portion connected to the other by at least one of a plurality of latches and hinges, the two portions defining a containment portion.

23. The front opening wafer container of claim 22 wherein the containment portion has therein at least one of a filter material and an absorbent material.

24. The front opening wafer container of claim 22 further comprising an elongate blocking member that is positionable on the tubular environmental control component to

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selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

25. The front opening wafer container of claim 24 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

26. The front opening wafer container of claim 22 wherein the elongate blocking member is slidably engagable with one of the containment portions and is slidingly shiftable on said containment portion between at least a blocking position and an aperture open position.

27. The front opening wafer container of claim 22 wherein the elongate tubular environmental control component is further comprised an elastomeric cap that resiliently expands to adheringly cover the top of the containment portion.

28. The front opening wafer container of claim 27 wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

29. The front opening wafer container of claim 1 wherein each of the containment portions has therein at least one of a filter material and an absorbent material.

30. A front opening wafer container comprising:

a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

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a door to fit in the open front and latchable to the door frame;

an elongate tubular environmental control component positioned in the container portion and extending subantially from the bottom of the container portion to the top of the container portion, said elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein said elongate tubular environmental control component has an axis that is upright and is connected to the bottom of the container portion at a purge port and wherein the elongate tubular environmental control component is further comprised of an elongate blocking member that is positionable on the tubular environmental control component to selectively obstruct the communication between the interior of the containment portion and the open interior of the container portion.

31. The front opening wafer container of claim 30 wherein the elongate blocking member is formed of an elastomeric material and the tubular environmental control component has attachment structure extending around the plurality of apertures and said blocking component resiliently engages to said attachment structure to sealingly block the communication between the interior of the containment portion and the open interior of the container portion.

32. The front opening wafer container of claim 30 wherein the elongate blocking member is formed of a rigid polymer and is slidably engagable with one of the containment portions and is slidingly shiftable on said containment portion between at least a blocking position and an aperture open position.

33. The front opening wafer container of claim 30 wherein the elongate tubular environmental control component is further comprised a cap formed of elastomeric material that resiliently expands to adheringly cover the top of the containment portion.

34. The front opening wafer container of claim 33 wherein the cap has a shell engaging portion whereby the tubular environmental control component has two opposing ends and is secured at both ends to the container portion.

35. A front opening wafer container comprising:

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a container portion having container wall that extends around a closed left side, a closed right side, a closed bottom, a closed top, and a closed backside defining an open interior, the container portion having a plurality of horizontal wafer shelves spaced apart, affixed therein and defining a generally cylindrical wafer receiving region in the open interior for holding a stack of horizontal spaced apart wafers seated in the shelves, a door frame defining an open front, wherein the container portion wall at the back side has a pair of corner regions extending from the top of the container portion to the bottom of the container portion;

a door to fit in the open front and latchable to the door frame;

a pair of elongate tubular environmental control component positioned in the container portion, one at each of the corner regions and extending substantially from the bottom of the container portion to the top of the container portion, each of said elongate tubular environmental control component having a containment portion with an interior and a plurality of apertures providing communication between the interior of the containment portion and the open interior of the container portion, and wherein said elongate tubular environmental control component is connected to the bottom of the container portion at a purge port inlet, and wherein the container portion has an additional purge port inlet, and the container portion further has a purge port outlet.

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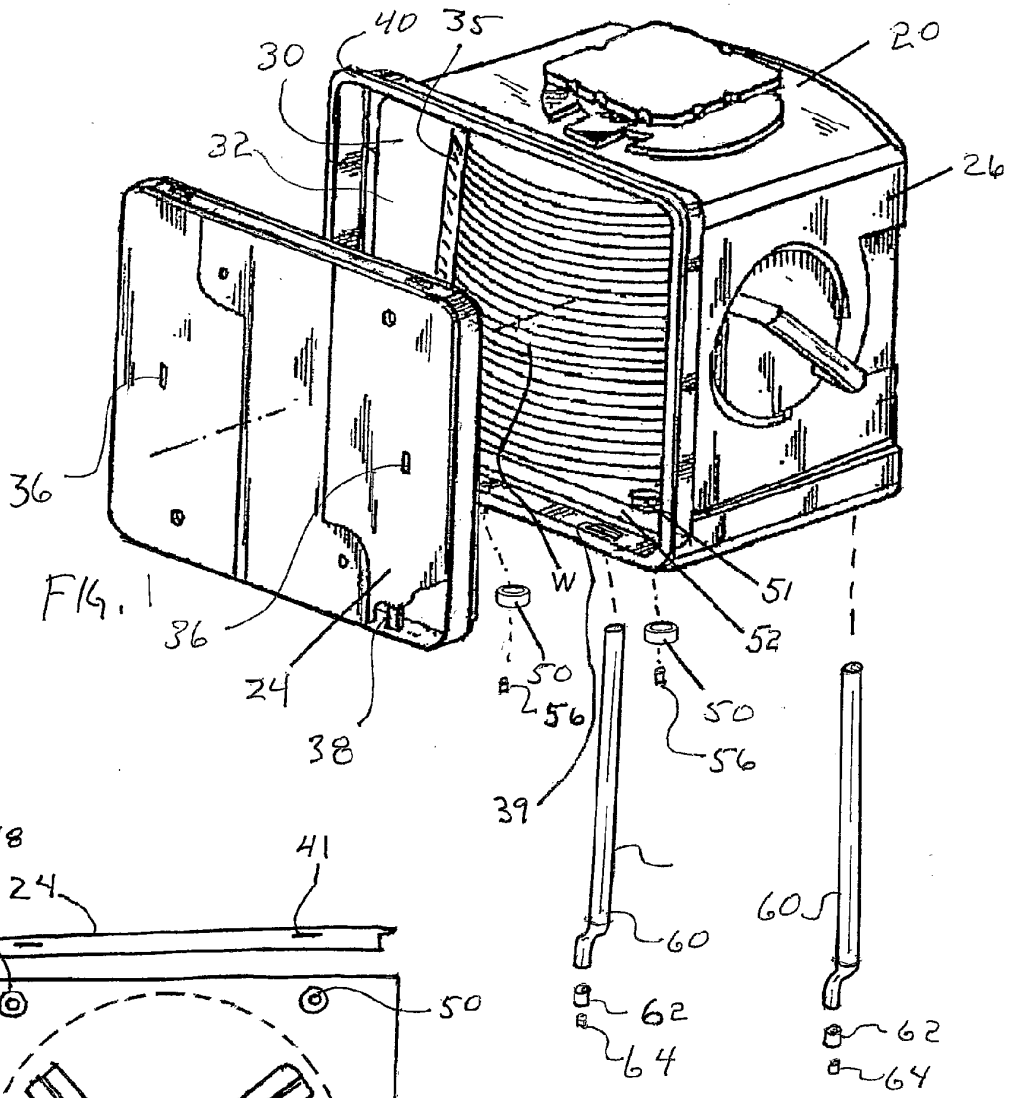

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Fig. 1

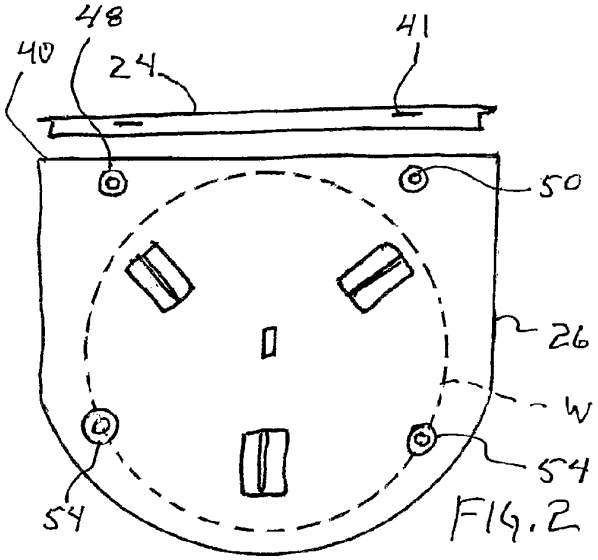

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Fig. 2

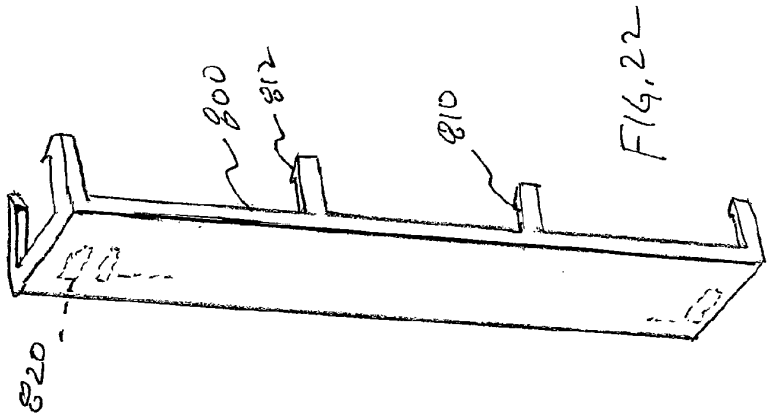


Fig. 22

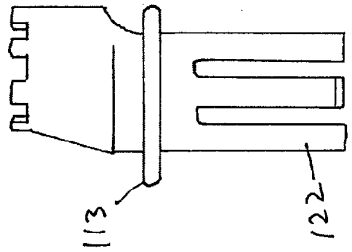


Fig. 6.

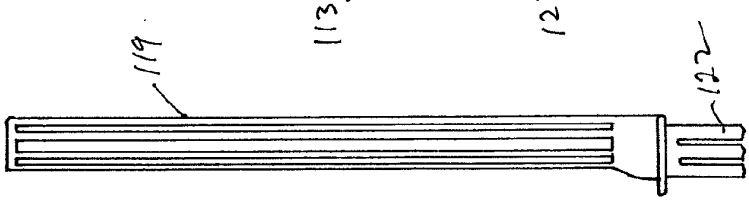


Fig. 5.

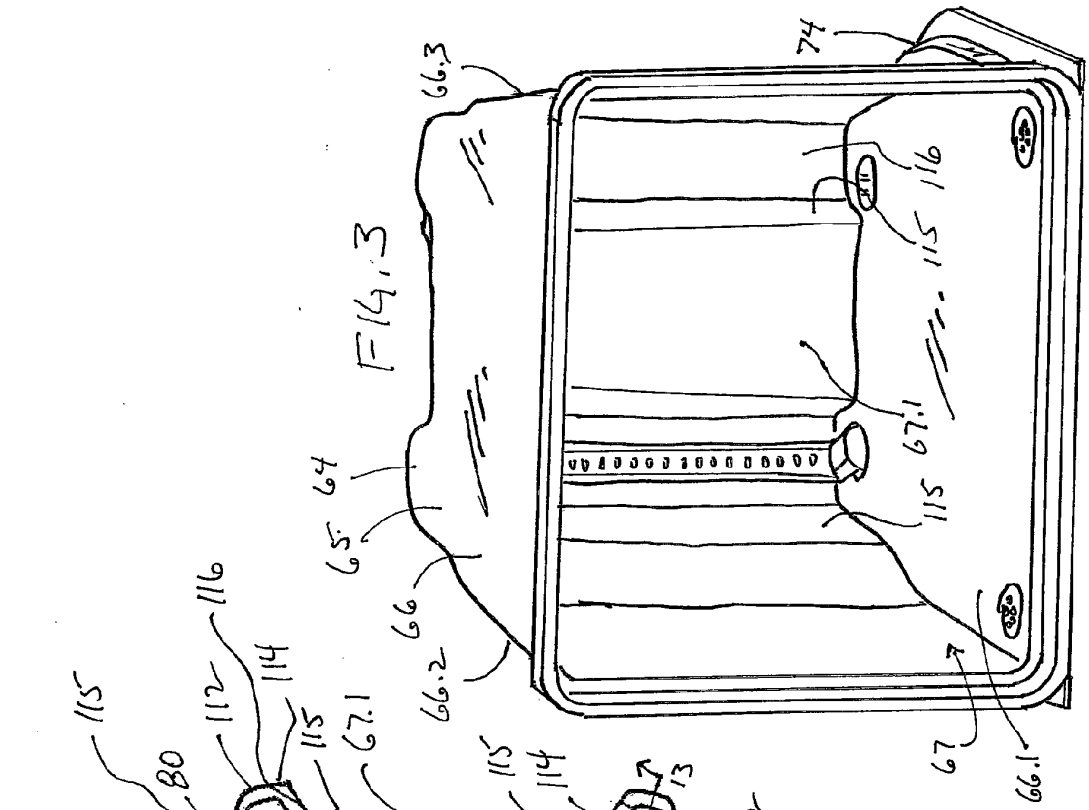

74
66.3
116
115
67.1
64
65
66
66.2
67
66.1

FIG. 3

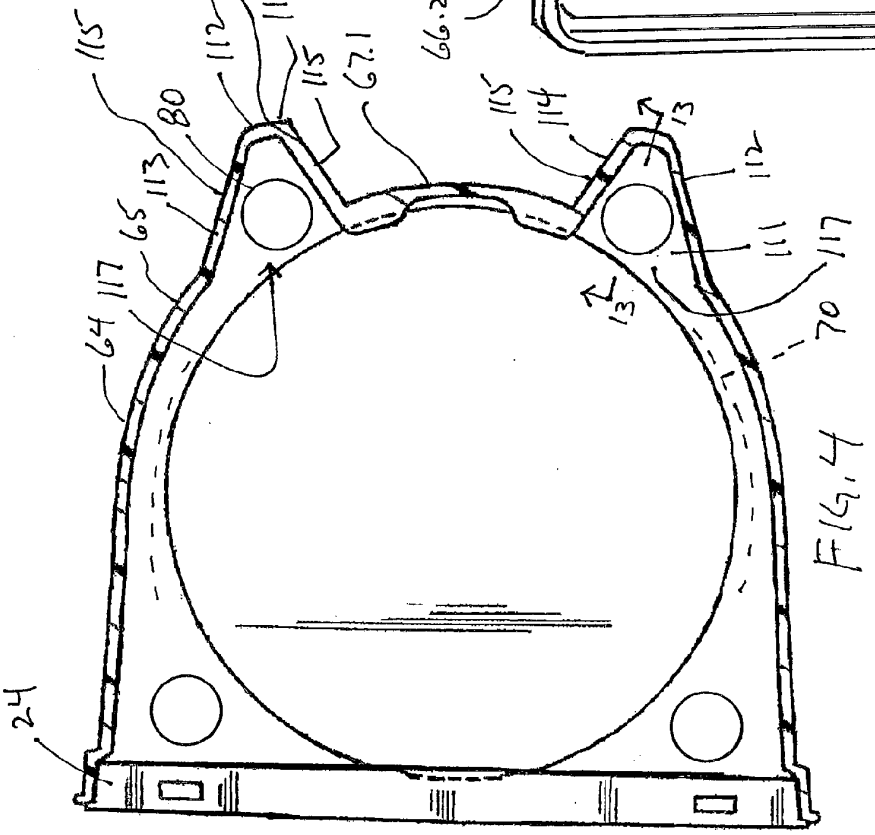

115
116
112
114
115
67.1
80
113
65
117
64
24
115
114
13
112
111
117
70

FIG. 4

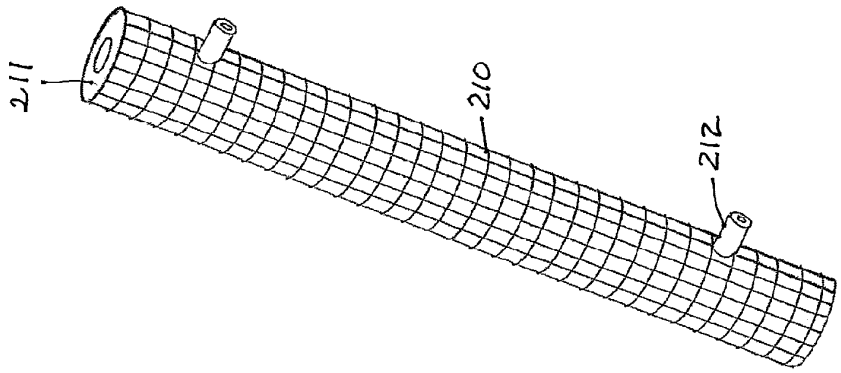


Fig.8.

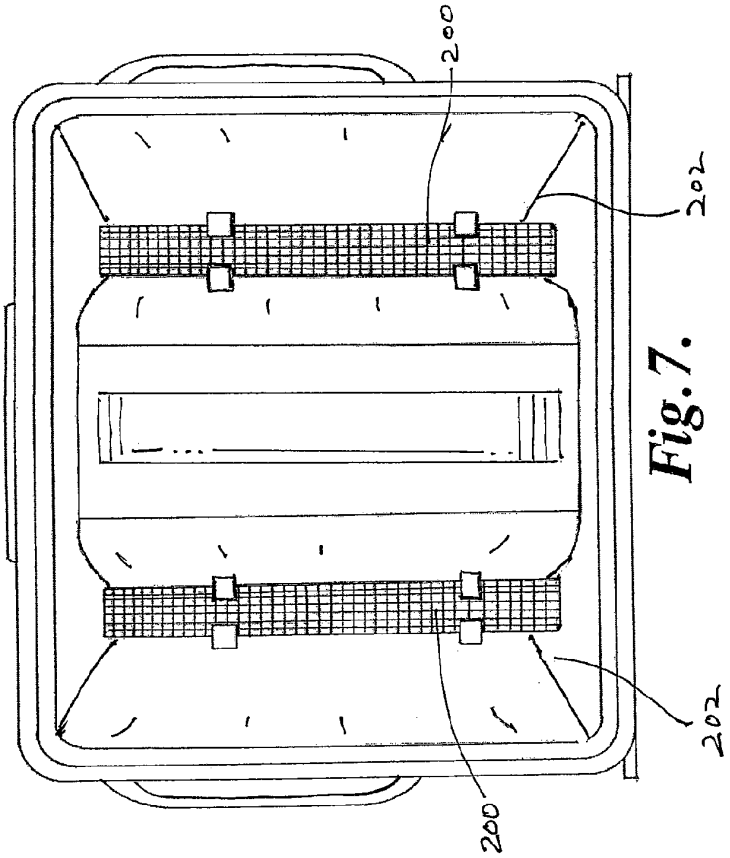


Fig.7.

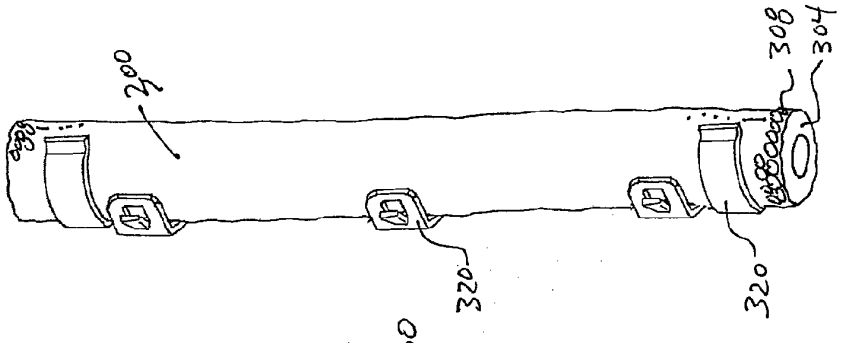


Fig. 11.

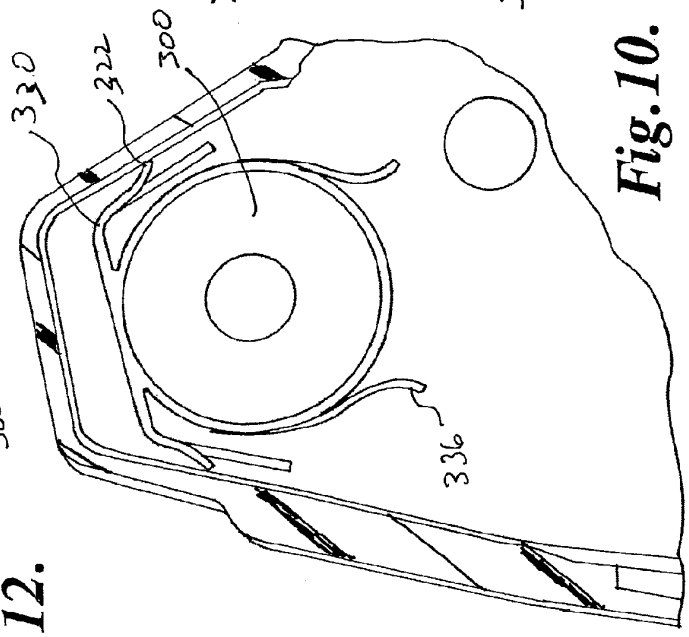


Fig. 10.

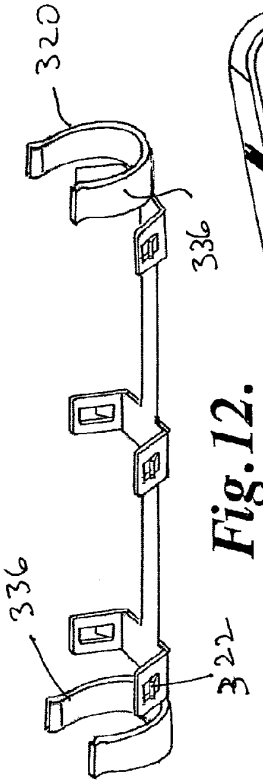


Fig. 12.

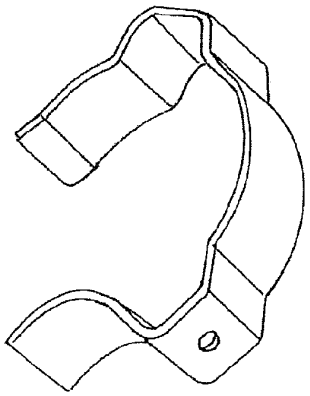
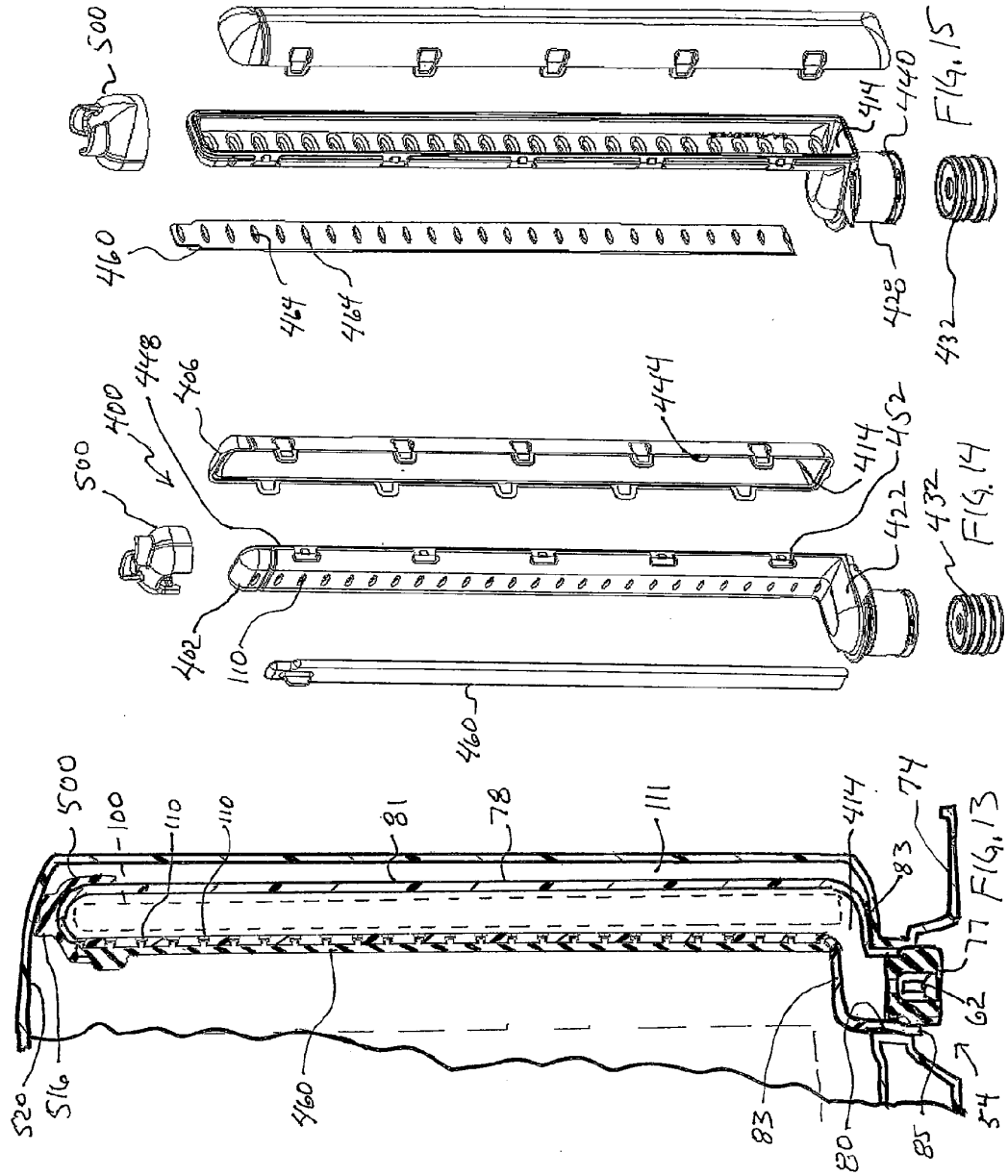
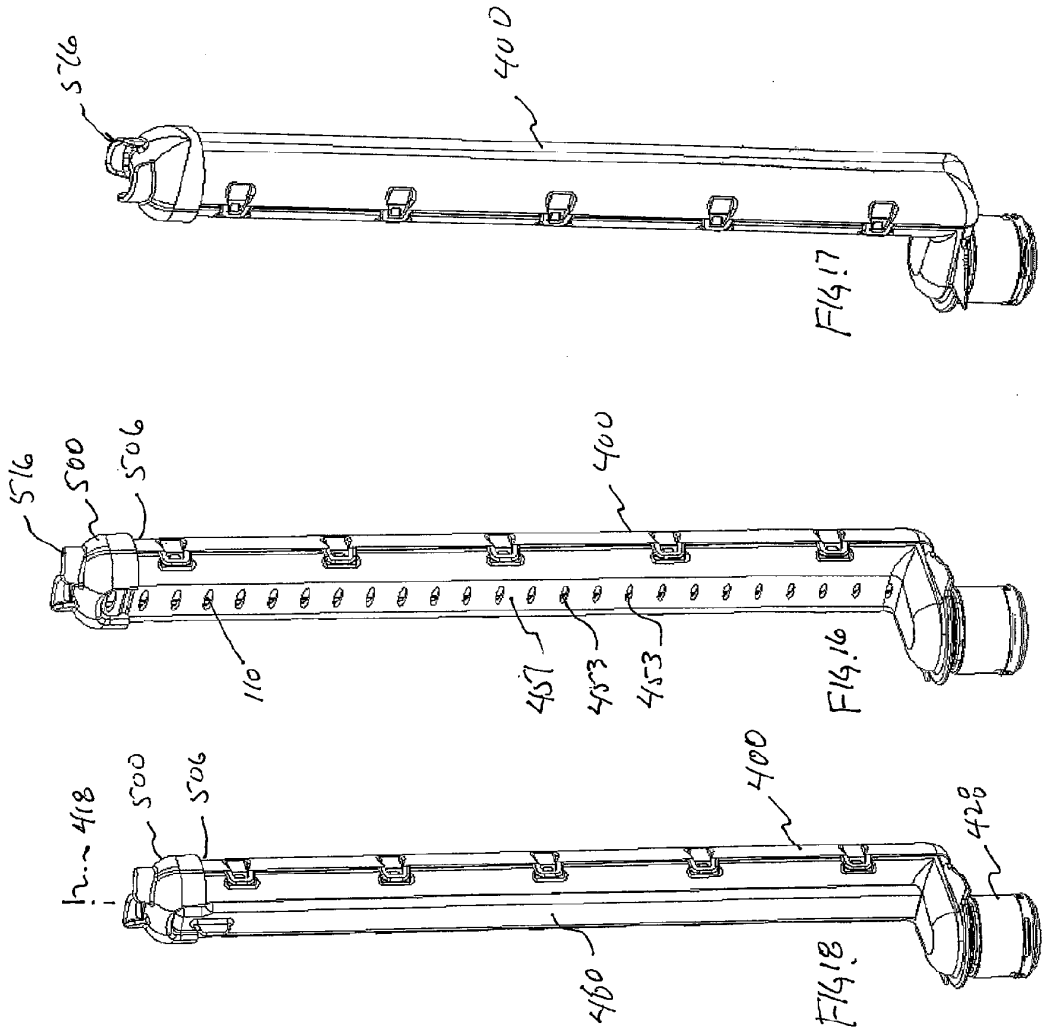


Fig. 9.

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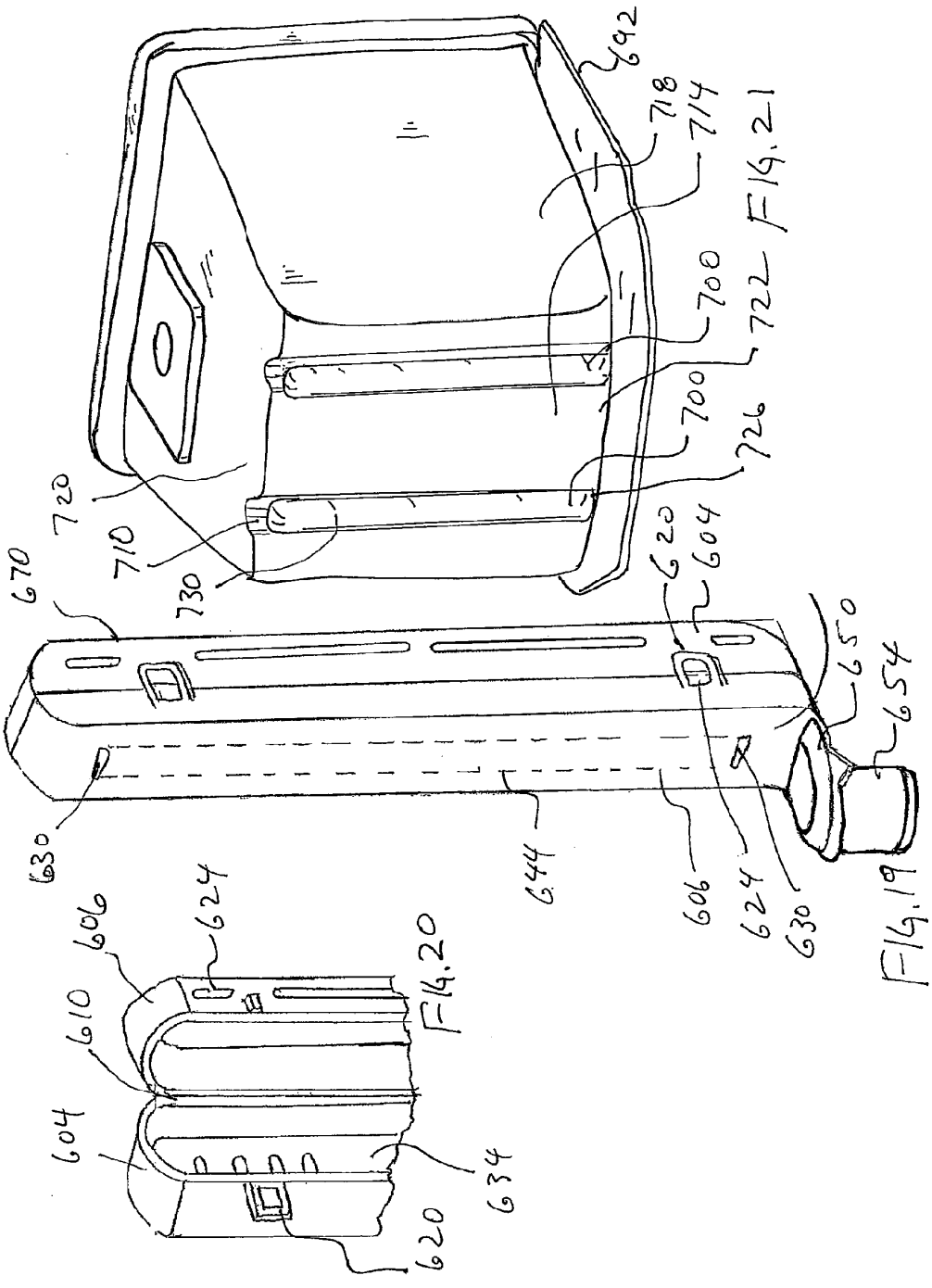


FIG. 21

FIG. 19

FIG. 20

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(71) Applicant *(for all designated States except US)*: **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billerica, MA 01821 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BURNS, John** [US/US]; 6046 Bow River Drive, Colorado Springs, CO 80918 (US). **SMITH, Mark** [US/US]; 4110 Bobbie Kay Place, Colorado Springs, CO 80908 (US). **FULLER, Matthew** [US/US]; 1731 North Nevada Avenue, Colorado Springs, CO 80907 (US).

(74) Agents: **CHRISTENSEN, Douglas, J.** et al.; Patterson Thuente Christensen Pedersen, P.A., 4800 IDS Center, 80 South Eighth Street, Minneapolis, MN 55402-2100 (US).

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(54) Title: POROUS BARRIER FOR EVENLY DISTRIBUTED PURGE GAS IN A MICROENVIRONMENT

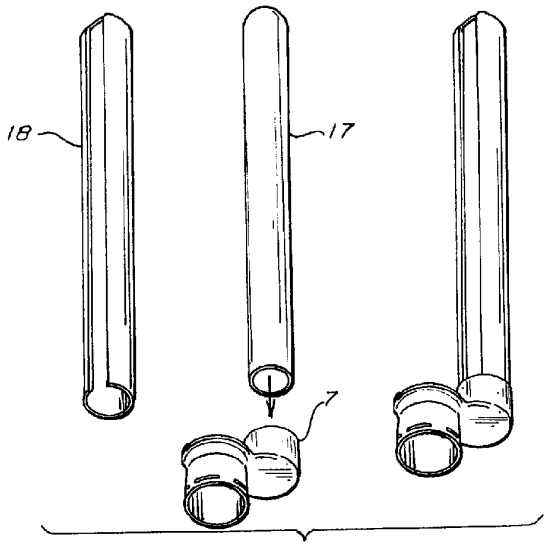


Fig.5

(57) Abstract: An improved system and method for purging a microenvironment to desired levels of relative humidity, oxygen, or particulates through the implementation of a purge gas delivery apparatus and method that provides even distribution of the purging gas within the microenvironment. A substrate container has a tower therein with a fluid flow passageway extending the length of the tower. Apertures with porous media between the aperture and fluid flow passageway regulate the volume and pressure of air discharging at each aperture. Alternatively, the tower may be formed of a porous tubular polymeric material. A sleeve may direct the discharge purge gas in the interior.

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POROUS BARRIER FOR EVENLY DISTRIBUTED PURGE GAS IN A MICROENVIRONMENT

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 61/285,218, filed December 10, 2009, which is incorporated herein in its entirety by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention relates to transportable substrate containers suitable for use in storing or transporting objects such as semiconductor wafers in an extremely clean environment and more particularly to systems and methods for purging the environment within said container to desired levels of relative humidity, oxygen, and airborne particulates.

BACKGROUND OF THE INVENTION

During transport or storage of substrates, if traces of dust or gaseous impurities present in the surrounding air adhere to the semiconductor wafers or other objects, the subsequent product yield from the affected wafer is lowered. This tendency becomes increasingly noticeable as the degree of integration increases. Accordingly, there is an increased demand for the environment within these transport containers to achieve a high level of cleanliness regarding not only dust but also gaseous impurities.

Currently to produce a clean space for accommodating substrates when transported or stored, microenvironments are purged using an inert gas which is injected into the interior of the container through an inlet port causing the air within the container to exit through an outlet port. These purge gas inlet and outlet ports are generally located on the bottom surface of the container shell and extend from the interior through the shell bottom surface where they interface with the purge gas delivery system. This method uses a check valve and circular PTFE particulate filter located in the purge inlet port to control and filter the incoming purge gas. The inert purge gas then replaces the air and

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contaminants within the container and the contaminated air is forced out of the container through the purge outlet port or the door opening if the door is removed.

Other methods of delivering purge gas into the container have been designed to provide the improved environment within the container, these prior art attempts have significant drawbacks which precipitate the need for the present invention. For example, U.S. patent number 6,221,163 to Roberson et al. discloses a system and method for molecular contamination control permitting purging a container to desired levels of relative humidity, oxygen, or particulates. The container includes an inlet port and an outlet port, each including a check valve and filter assembly for supplying a clean, dry gaseous working fluid to maintain low levels of moisture, oxygen, or particulates. The inlet port is connected with a gaseous working fluid source and the outlet port is connected to an evacuation system. The integral directional flow check valves operate at very low pressure differentials (such as less than 10 millibar). In one embodiment, flow of purge gas inside the container can be directed towards the substrates with one or more nozzle towers to encourage laminar flow inside the pod. One or more outlet towers, having a similar function to that of the inlet tower may also be provided to encourage laminar flow inside the container. This method has a particulate filter located in the check valve/filter assembly located in the bottom of the tower. The disadvantage of this method is that as the purge gas flows through the orifices of the tower, the distribution of gas decreases from the tower top orifice to the tower bottom orifice. This results in an extended time to evacuate the water and oxygen from the microenvironment.

One goal of purging is to decrease humidity and oxygen levels in the internal volume of the microenvironment. A challenge of purging is to evenly distribute the purge gas fast and effectively over the substrates within the container. Current purging methods, using inlet and outlet ports at the bottom of the container do not meet either requirement of purging fast or effectively because the path of least resistance for the purge gas flow is directly from the inlet to the outlet. Little of the gas flows between the wafers, and the volume between the wafers is a dead zone that is not immediately affected by the purge gas. This results in non-uniform humidity and oxygen levels within the microenvironment. Utilizing the purge tower improves the speed and effectiveness of the purge, but the orifices in the tower still do not evenly distribute the purge gas between the wafers even with the implementation of graduated orifices. In effect, as the purge gas

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flows through the orifices of the tower, the distribution of gas decreases from the top orifice to the bottom orifice. This results in ineffective evacuation of water and oxygen from the microenvironment.

Another goal of purging is to remove airborne contaminants from the environment within the container. These contaminants are primarily trapped in the filtering mechanism in the purge ports and are effectively removed when the container is purged. However, the containers are reusable and prior to reuse must be cleaned. As a part of the cleaning process, a human operator must remove the purge tower and the purge port/filter mechanisms to keep water from accumulating in these devices. Contaminants are introduced into the microenvironment from the human operator during the process of removing/reinstalling the purge towers and purge ports/filters.

A need therefore exists for an improved purging method which solves the problems of evacuating the wafer container in a fast and efficient manner. In particular, a need exists for a purging method and apparatus that can allow the purge gas to accumulate in the tower so that as the gas accumulates and the pressure inside of the tower increases therefore the gas flows through the tower into the microenvironment and is evenly distributed between the wafers. Another need is to minimize or eliminate human operators from reaching inside the container. Currently, operators must reach inside the container to remove and reinstall the purge towers and purge ports/filters when the container is cleaned and returned to service.

SUMMARY OF THE INVENTION

In view of the above mentioned problems, the present invention provides for an improved system and method for purging a microenvironment to desired levels of relative humidity, oxygen, or particulates through the implementation of a purge gas delivery apparatus and method that provides even distribution of the purging gas within the microenvironment.

An additional advantage of the present invention is that the purge tower porous barrier may be composed of a hydrophobic material that prevents water from entering the purge tower during the cleaning process which consequently eliminates the need to remove the purge gas delivery apparatus during the cleaning process which avoids

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introducing particles into the microenvironment from the removal and reinstallation process of the purge gas delivery apparatus after cleaning.

Further advantages of the invention are that the porous barrier may be formed into shapes that match the non-flat geometry of the purge tower and by resisting the flow of gas, the porous barrier allows for the purge gas to accumulate in the tower. As the gas accumulates, the pressure inside the tower increases and when the pressure is sufficient to overcome the barrier material, the gas flows through the barrier material into the wafer container and is evenly distributed among the installed wafers in the container.

A further advantage of the invention is that the purge tower significantly reduces the relative humidity level within the microenvironment in instances where the wafer access door has been removed.

A further advantage of the invention si that the purge tower porous barrier improved purging efficiency from top to bottom of the microenvironment.

In one preferred embodiment, the microenvironment includes an inlet port and an outlet port, each including a check valve assembly and a purge tower connected to the inlet port and the outlet port for a clean, dry gaseous working fluid that is used to provide controlled low levels of moisture, oxygen, and particulate content around the materials contained in the microenvironment. The microenvironment container inlet port is connected with a gaseous working fluid source, and the outlet port is connected with an evacuation system. In operation, according to one embodiment, the tower includes a sealing grommet in the tower base portion that maintains a seal against the container shell to prevent undesired chemicals or particulates from entering into the interior of the wafer container. Thus, any flow between the interior and exterior of the wafer container is limited to passing through the passageway defined by the grommet. Types of fluid flows include the introduction of purging gases such as nitrogen into the interior of the wafer container. The fluid flow can be further limited by the porous barrier element. The porous barrier provides filtering to the purge gas to remove particulates as well as oxygen and humidity from the purge gas prior to the gas being introduced into the interior of the wafer container. The integral directional flow check valves operate at very low pressure differentials. In this embodiment, a porous membrane barrier is placed in the inlet tower directly behind the tower orifices. The membrane barrier improves the performance of the

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tower in two ways. For the first improvement, the membrane barrier allows for the purge gas to evenly pressurize within the tower. The pressurized gas then evenly flows through the membrane and the tower orifices and into the container interior. The orifices in the tower can be of any shape including a continuous vertical opening from top to bottom of the tower such that the tower has a "C" shape as viewed from the top down. This results in evenly distributed purge gas between the substrates in the microenvironment and the tower resulting in an improved reduction in relative humidity and oxygen from the microenvironment. For the second improvement, the barrier can be manufactured from a material with hydrophobic characteristics that act as a water barrier during the cleaning of the microenvironment. This hydrophobic water barrier keeps water out of the purge tower and consequently the purge port during the cleaning process. The porous membrane barrier also functions as a particle filter which removes particles from the gas flow which eliminates the need for a particle filter in the purge port at the base of the tower.

In an additional embodiment, the membrane barrier is manufactured out of a porous polymer that is formable into geometry that matches the geometry of the tower. A benefit of the formed barrier is that it can also be used to seal the mating surfaces of the rear and slotted front portions that make up the purge tower. Additionally, the barrier can be formed into a flat woven shape and used to cover the orifices in the front portion of the tower.

An additional embodiment, the purge tower itself can be fabricated from the same porous polymer material as is used for the membrane barrier avoiding the need for orifices, radial slots, or separate tower portions to form the tower. This tower may be manufactured as a capped porous tube that attaches directly to the inlet/outlet ports on the bottom surface of the container. This tower can be made as a "C" shaped sleeve that can be situated such that flow is directed towards the substrates or towards the container wall, or any other direction desired simply by how the sleeve is positioned in the microenvironment.

An additional embodiment is that the porous membrane filter can be made as a bladder that is installed within the tower. In this embodiment, the porous material not only covers the purge tower nozzles but also the reveal between the front and back portions of the purge tower. This allows for any leakage through the reveal to be filtered as well as any water to be blocked from coming into the tower through the reveal. The purge gas is

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injected into the filter bladder at the base of the tower and subsequently is dispersed through the bladder walls, through the tower slots and into the container interior. The bladder can be manufactured either as a complete tube that is installed between the front and back portions of the tower, or as a complete tube that is installed between the front and back portions of the tower.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1A is a front opening wafer container.

FIG. 1B shows a front opening wafer container with one purge tower installed.

FIG. 2 is a front view of the tower showing the gas dispersal slots

FIG. 3.is an exploded view of the back portion of the tower, the porous membrane barrier and the slotted front portion of the tower

FIG. 4 shows the purge gas flow into the tower and subsequently out through the barrier membrane and the tower slots into the container interior.

FIG. 5 is an exploded view of the purge tower made of porous polymer material which is then press-fit into the molded base portion.

FIG. 6 is an exploded view of the tower and porous membrane bladder.

FIG. 7 is a cross section view of the complete tube shape bladder showing the gas inlets and the different wall section thickness which enables the purge gas flow toward the disperse slots in the front portion of the tower.

FIG. 8 shows the respective flow data for porous polyethylene and porous polypropylene in the presence of air pressure and water pressure.

FIG. 9 shows the reduction in relative humidity measured at wafer slot #1, wafer slot #13 and wafer slot #25 with the door removed before and after purge with the present invention.

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DETAILED DESCRIPTION OF THE INVENTION

FIG. 1A illustrates a configuration of a substrate container configured as a wafer container assembly **1** known as a FOUP or FOSB comprising an open front **2**, a front door **3**, and an enclosure portion **4**. Wafers W are inserted and removed horizontally through the open front. Slots formed in the interior sides hold the substrates, in this case semiconductor wafers. Front door **3** with seal sealingly engages with enclosure portions **4** to form an interior space that is isolated from the ambient atmosphere. Receiving structure **5** for the purge towers **6** may be in the bottom wall of the enclosure portion.

Referring to **FIG. 1B**, a purge tower **6** is shown that is part of the preferred embodiment enabling gaseous working fluid or purge gas inside a substrate container to be directed toward and away from substrates housed in the container using one or more uniquely configured towers **6** connected by a base portion **7** to the inlet port or the outlet port. Orifices are provided in each tower, preferable in the form of a series of spaced apart nozzles **8.** The gaseous purge fluid will sweep the container and its contents picking up residual moisture, oxygen and AMC's and encouraging movement of particulates toward the outlet port or door opening. U.S. Patent No. 6,221,163, owned by the owner of the instant invention, and International Publication No. WO2009/114798 A2, also owned by the owner of the instant application disclose certain structural configurations, assembly details, materials which may be applicable to embodiments of the inventions disclosed herein, said patent and publication are incorporated by reference herein

In an alternate embodiment, shown in **FIG. 5** the tower configuration can be in the form of a tower **17** made from the porous polymer material which is friction fitted onto the base unit **7**. One or more vent towers are also preferable connected to the outlet port or ports, having a structure and function similar to that of the inlet towers, to direct flow to the outlet valve for exhausting to the instrument suite.

FIGS. 3 and **4** show the interior of the tower with the porous material filter installed. **FIG. 3** is an exploded view of the entire tower. This view shows the tower rear portion **9** which is a molded separate part that is connected to the tower front portion **11** with a series of tabs **12** located on the tower rear portion **9** that fit into recesses **13** on the tower front portion **11. FIG. 3** is a cut away view of the interior of the tower **6** near the base portion **7** showing the tower grommet **16**, the purge gas inlet **14**, and the purge gas

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flow path through the grommet and into the tower flow conduit or fluid flow passageway **15** and out of the nozzle orifices **8**. Purge gas enters the tower **6** through the purge gas inlet **14,** passes through the gas conduit and the presence of the barrier filter configured as a strip of porous material **10** allows the gas pressure to build inside the tower until the pressure is sufficient to overcome the filter membrane and then is dispersed through the nozzle orifices **8** into the interior of the container at a uniform pressure and distribution from top to bottom. In other words, a pressure drop across the filter material allows a uniform pressure along the entire length of the tower that is greater that the pressure outside the tower in the interior of the container. The higher pressure along the length of the tower provides uniform air flow out each orifice or each outlet region or equal air discharge along the length of an outlet slot. The pressurization allows the purge gas to clean the interior volume through laminar flow across all of the substrates installed within the container. Ideally the diameter of the tower is .75 inches to 2.0 inches and the tower wall thickness is 1/16 inch to 3/8 inches. Ideally the length of the tower is 70% to 100% of the interior height of the container portion where the tower is located. And ideally the length of the tower portion is at least the distance between the lowermost substrate slot and the uppermost substrate slot.

The system and method of the invention are planned for use while the container is waiting for the next production station or step in the fabrication process. These periods have been estimated to be about six minutes to more than one hour long. Ideally, the container is completely purged to desired levels of relative humidity, oxygen, or particulates in a period of about 6 minutes or less. Relative humidity levels of about 0.1% or less have been achieved in about 5 minutes. Flow of the gaseous working fluid or purge gas is typically provided in the container at up to 20 SCFH, and at a pressure of from about zero to about 5 psi. Pressurized nitrogen gas and other inert gases are typically available at pressures from about 65 to about 125 psi, and the pressure of the working gas within the system is typically controlled using a point-of-use regulator, limiting feed pressure to the inlet of the container to a maximum of about 10 psi. Working pressures within the container are typically about 1 psi. The gaseous working fluid or purge gas is filtered to remove particulates as small as 0.10 – 2.0 microns at an efficiency of about 99.999%

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FIG. 5 shows the alternate embodiment of the tower configured as a tubular structure formed entirely of, or substantially entirely of, porous material so that the tower portions are no longer needed. Tower portion tubular structure **17** is molded from the porous barrier material and formed into the shape of the tower portion without the nozzle slots in the front portion. The molded purge tower is then friction fit attached to the base portion **7**. The purge gas behaves the same as in the preferred embodiment in that the gas in held within the tower until the pressure increases to a level sufficient to permeate the barrier material and proceed to the interior of the container. An alternate embodiment of the molded barrier is one in which the tower in made from the barrier material, however sleeve **18** is added that is "C" shaped in a horizontal cross section. This allows the purge gas to pass through the tower material and onto the substrates through the open slot running the entire length of the sleeve from top to bottom. This tower configuration allows improved directionality of the purge gas through the relatively large single purge slot that is adjustable by rotating the sleeve on the tower. The sleeve may provide a cap or end plug on the top of a tubular porous form that is otherwise open at the top.

FIG. 6 shows the bladder **19** which is molded out of the porous barrier polymer material so that it fits into the tower **6** and provides the purge gas filtering and pressurization by not only covering the orifice nozzles **8**, but also sealing the reveal **20** where the two separately molded tower halves **9** and **11** are mated. The bladder shown in the illustration is molded without a back side to facilitate the molding process. Therefore the bladder **19** must be inserted into the tower with the opening away from the orifices **8** in order to work properly. Each of the bladders has an interior fluid flow passageway 23 that extends the length of the bladder and the length or substantially the length of the tower. The bladders may be formed of a flexible woven polymeric porous material.

FIG. 7 shows an alternative construction for bladder **19**. This view, which is a cut away view of the bladder shows the different thicknesses of the walls of the bladder. The front bladder wall **22** is thinner that the rear bladder wall **21.** This different thickness facilitates the purge gas delivery since the gas will permeate faster and easier through the thinner wall **22** which is facing the tower orifices than through the thick rear wall **21.** This difference in wall thickness requires that the bladder is correctly installed. The porous material is preferably porous polymers such as polyethylene, polypropylene, PTFE (polytetrafluoroethylene), or PFA (perfluoroalkoxy). The porosity in the porous material

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may be, for example, be in the form of a foamed material, a fibrous material or a sintered material. The fibrous material can be woven or randomly packed or intertwined. The particular shapes herein can be formed by thermal molding or, in some cases, by machining rigid blocks or preforms of the porous material. Suitable porous polymers are available from GenPore, 1136 Morgantown Rd, Reading PA.

Appropriate porous materials used in the purge tower to improve the flow of the purge gas of the tower into the container by by making it uniform along the length of the tower by providing sufficient pressurization of the gas to build pressure within the tower prior to permeating through the barrier membrane filter material which provides for a uniform pressure and dispersion within the container and across all of the substrates. Simultaneously this material has hydrophobic characteristics such that it prohibits or minimizes water from entering the purge tower during the wash cycles of the recycling procedure. Keeping water out of the purge tower and the purge inlet and purge outlet minimizes the time required for the cleaning process and keeps the container cleaner.

Referring to **FIG. 8,** in an embodiment, the purge tower may be formed of a tubing portion **36** formed of porous material closable at the top end **38**, with a cap **40**, suitably formed of nonporous polymer that can be sealing fit over the top of the tubing. To direct the discharge on one side of the tower, non porous polymer blocking sleeve **44** configured as a tubing segment with a slit extending axially and formed of a non porous polymer, my be fitted around the porous tubing portion. The bottom may be secured to a nonporous polymer fitting **48** and connected at the bottom end to a purge port. The purge port is connectable to a purge gas source exterior of the container by conventional means. The purge tower may be pressurized such that flow velocities and flow volumes near the top of the tower are equal or substantially equal to such flow velocities and volumes near the bottom of the tower. Ideally the diameter of the tubing portion is .75 inches to 2.0 inches and the tubing portion wall thickness is 1/8 inch to 3/8 inches. Ideally the wall thickness of the tubing portion is 10% to 25% of the diameter. Ideally the length of the tubing portion is 70% to 100% of the interior height of the container portion where the tubing portion is located. And ideally the length of the tubing portion is at least the distance between the lowermost substrate slot and the uppermost substrate slot.

FIG. 9 shows the levels of relative humidity within the microenvironment before and after purging with the present invention installed and with the door removed.

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Measurements of relative humidity made before purging at wafer slot #13 indicates a relative humidity level **23** of between 40% and 45%. Another measurement made prior to purging at wafer slot #1 indicates a relative humidity level **24** of between 35% and 40%. After purging, relative humidity measurements at wafer slot #25 indicate a relative humidity level **26** of between 20% and 25%. Another measurement made after purging at wafer slot #13 also indicates a relative humidity level **25** of between 20% and 25%.

While the present invention has been described herein in conjunction with a preferred embodiment, a person with ordinary skill in the art, .after reading the foregoing, can effect changes, substitutions of equivalents and other types of alterations to those set forth herein. Each embodiment described above can also have included or incorporated therewith such variations as disclosed in regard to any or all of the other embodiments. Thus, it is intended that protection granted by Letters Patent hereon be limited in breadth and scope only by definitions contained in the appended claims and any equivalents thereof.

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CLAIMS

What is claimed is:

1. A system for transporting substrates comprising:

a substrate container having a container portion with an opening for loading/unloading substrates, a door adapted to sealably cover the opening;

a substrate carrying section disposed in the transport container;

an apparatus comprising an inlet tower adapted to be mounted to substrate container portion for admitting a gaseous working fluid to the interior of the container for purging the substrate container body with the gaseous working fluid;

the inlet tower having a length and one or more outlet regions arranged along the length of the tower, and an interior flow passageway extending the length of the tower,

filter media positioned at each outlet region intermediate the one or more outlet regions and the interior flow passageway whereby the gaseous working fluid being admitted to the substrate container may be filtered and the gaseous fluid.

2. The apparatus if claim 1, wherein the one or more outlet regions of said inlet tower comprises a plurality of orifices and the filter material comprises a strip of porous material that covers the orifices, the strip of porous material extending in the interior of the tower.

3. The apparatus of claim 1, wherein said inlet tower comprises a porous polymeric material that blocks water from the interior of the tower.

4. A system for transporting substrates comprising:

a substrate transport container having a container body with an opening and a wafer loading/unloading door adapted to sealably cover the opening;

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an apparatus for admitting a gaseous working fluid to the interior of the container comprising an inlet tower formed of porous barrier material and a filter in the tower formed of the same porous barrier material.

5. The apparatus of claim 4, wherein said inlet tower formed of the porous barrier material has in cross section, a "C" shape.

6. A system for transporting substrates comprising:

a substrate transport container having a container body with an opening and a wafer loading/unloading door adapted to sealably cover the opening; and

an apparatus for admitting a gaseous working fluid to the interior of the container comprising an inlet tower and a bladder portion made from the porous filter material, the bladder portion extending a length of the inlet tower.

7. The apparatus of claim 6, wherein said bladder has one side that is thinner than an opposite side.

8. The apparatus of claim 6, wherein said bladder has a length and is open on one side of said elongate bladder, said opening extending at least substantially the length of the elongate bladder.

9. A method of maintaining the environment within the wafer transport container to avoid damage to the substrates, the method comprising steps of:

placing a porous barrier material in the purge tower apparatus covering the orifices.

10. The method of claim 9 wherein, the porous barrier material is in the form of a bladder.

11. The method of claim 9 wherein, the porous barrier material is in the form of a bladder with the back side missing.

12. The method of claim 9 wherein, the porous barrier material is in the form of the purge tower.

13. The method of claim 9 wherein, the porous barrier is a strip of porous material.

14. The method of claim 9 wherein, the porous material comprising one of sintered material, fibrous material, or foamed material.

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15. A method of providing equalized purging flow of a gasous material along the length of a purge tower in a substrate container, the method comprising providing a purge tower with an interior connected to a purge gas source exterior of the container, the purge tower having a plurality of apertures, and providing porous material adjacent the apertures while leaving open a gaseous flow path the length of the tower that is not blocked by porous material.

16. A method of providing equalized purging flow of a gasous fluid along the length of a purge tower in a substrate container, the method comprising providing a purge tower of a tubing portion and formed of a porous polymer, the tubing portion closed at a top end and connected at the bottom end to a purge port; connecting the purge port to a purge gas source exterior of the container, providing a pressurization of the purge tower such that flow velocities and volumes near the top of the tower are equal or substantially equal to such flow velocities and volumes near the bottom of the tower.

17. The method of claim 16 wherein the method further provides adjusting the direction of the purge flow utilizing an elongate sleeve with a lengthwise slot, the sleeve conforming to and fitted to the tubing portion.

18. A substrate container comprising:

a substrate container having a container portion with an opening for loading/unloading substrates, a door adapted to sealably cover the opening; the substrate container having

a substrate carrying region in the transport container and further comprising an inlet tower mounted to container portion in the interior of the for admitting a gaseous working fluid to the interior of the container for purging the wafer container body with the gaseous working fluid;

the inlet tower having a length and one or more outlet regions arranged along the length of the tower, and an interior flow passageway extending the length of the tower, the tower comprising a filter media formed as a tubular structure extending the length of the tower, the tubular structure having an axial fluid flow passageway connecting to a purge

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port at the bottom of the container portion for allowing purge gas to flow up the tubular structure and to exit the tubular structure along the entire length of the tubular structure.

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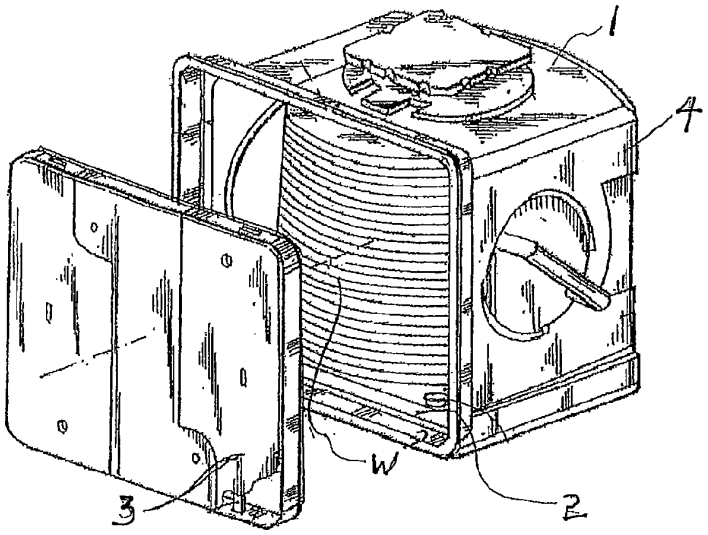


Fig. 1A

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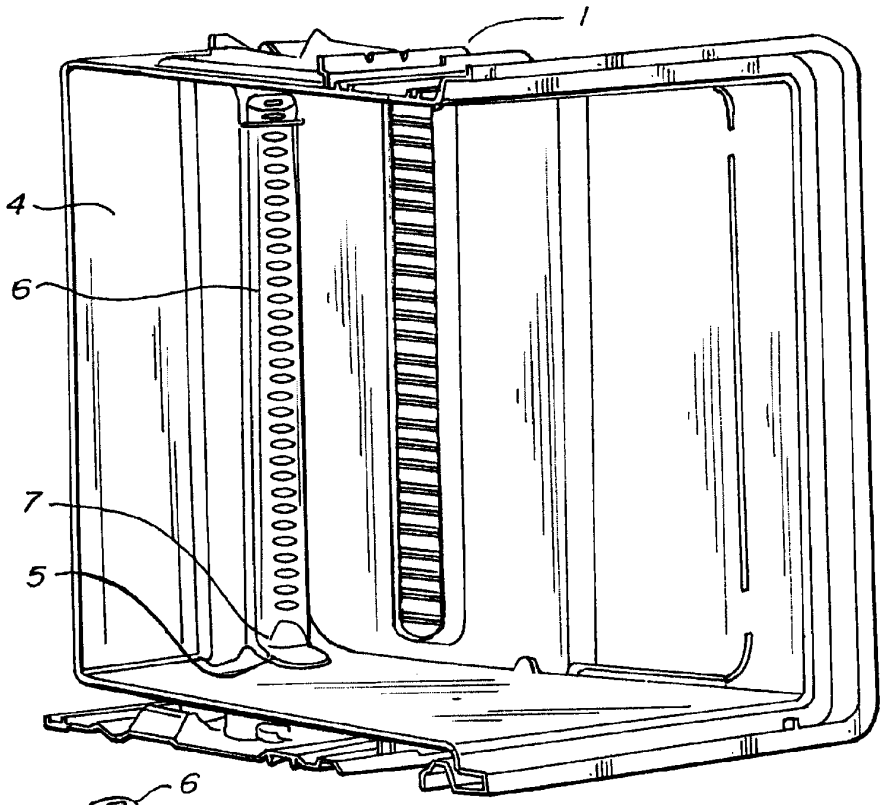


Fig.1B

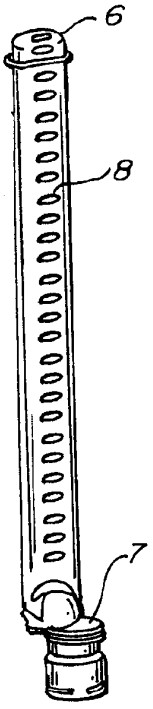


Fig.2

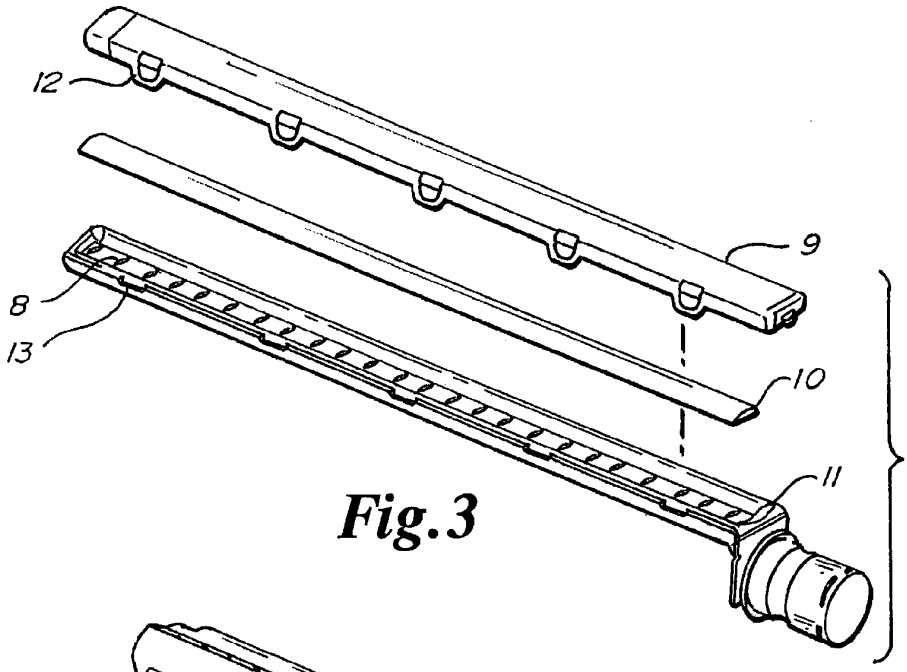


Fig.3

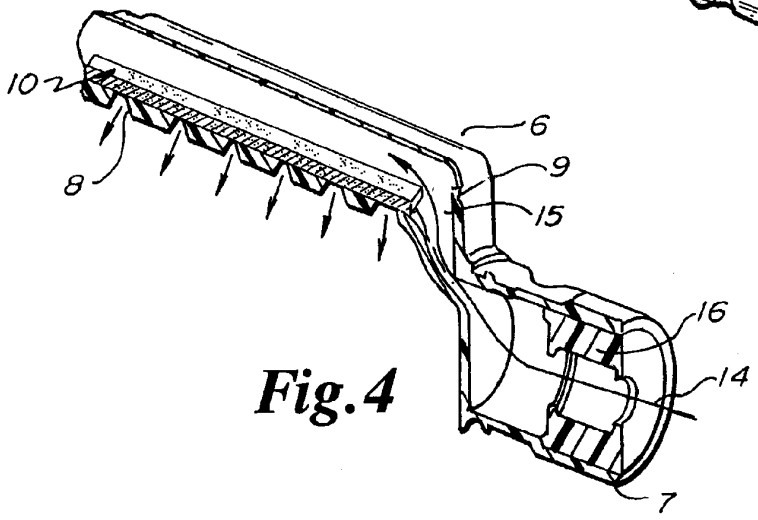


Fig.4

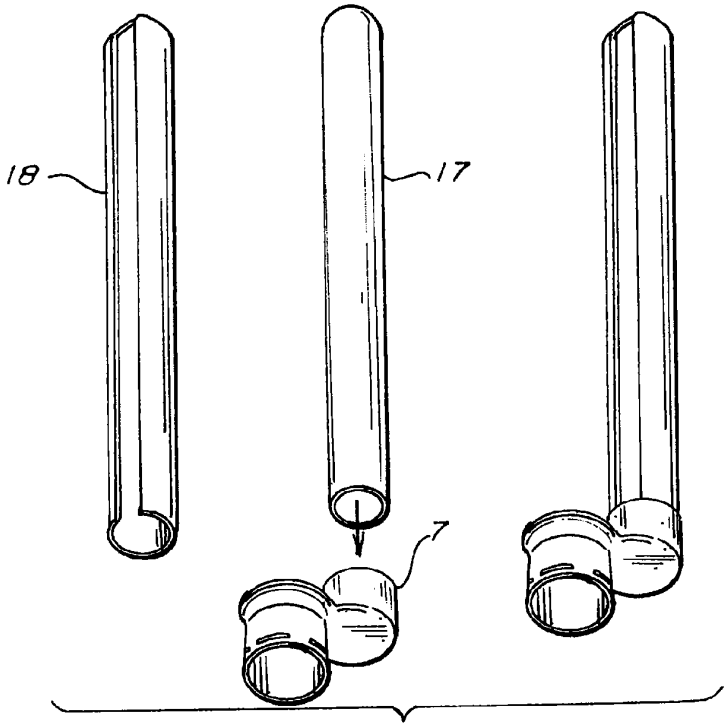


Fig.5

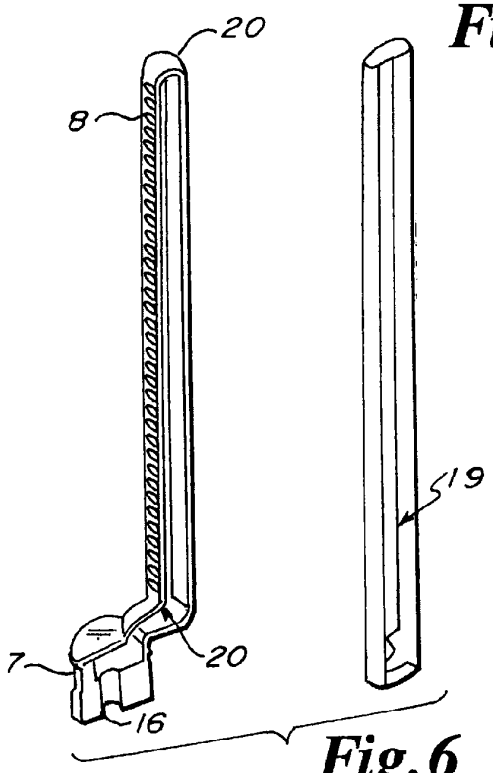


Fig.6

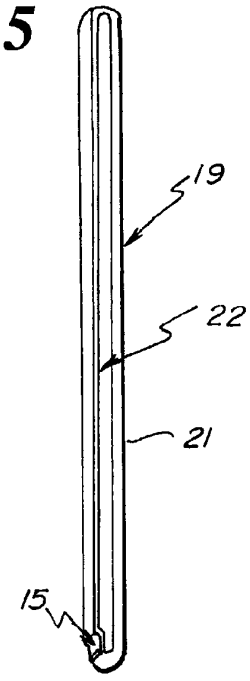


Fig.7

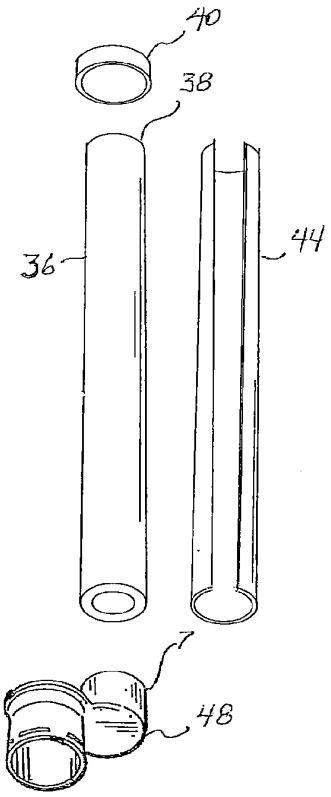


Fig.8

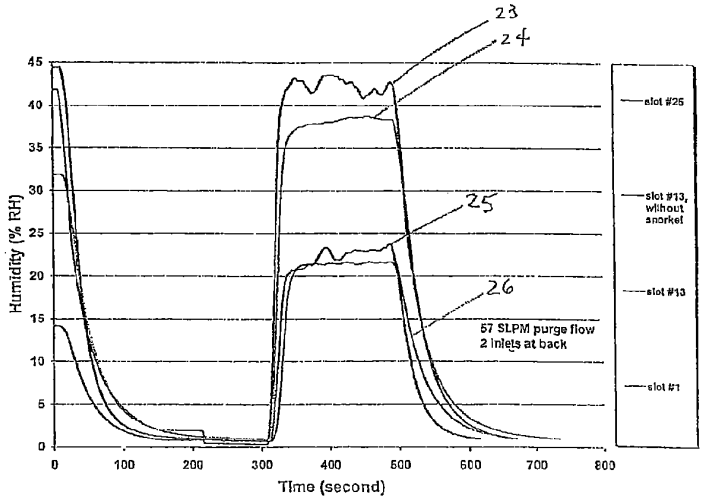


Fig.9

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(71) Applicant: **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billercia, MA 01821 (US).

(72) Inventors: **GLAVAN, Kyle**; 5764 Golden Field Land, Castle Rock, CO 80104 (US). **KING, Jeffery J.**; 5235 Iron Horse Triangle, Colorado Springs, CO 80917 (US). **FULLER, Matthew**; 1731 N. Nevada Avenue, Colorado Springs, CO 80907 (US).

(74) Agents: **STEINBERG, Donald R.** et al.; Wilmer Cutler Pickering Hale and Dorr LLP, 60 State Street, Boston, MA 02109 (US).

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[Continued on next page]

(54) Title: INTERNAL PURGE DIFFUSER WITH OFFSET MANIFOLD

(57) Abstract: A purge tower assembly for a substrate container. The assembly may include a purge interface body, including a base portion and a top portion, for mounting to a bottom plate of a substrate container. The base portion may include a substantially tubular base sidewall and the top portion may have a top sidewall positioned on the top edge of the base portion. The top portion may include an inlet nozzle for mounting through a rearward inlet in the bottom plate. The inlet nozzle may have a substantially tubular sidewall extending upwardly from the top sidewall and defining an interior of the inlet nozzle. The base portion and the top sidewall may define an offset conduit portion disposed connected to the base portion and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion.

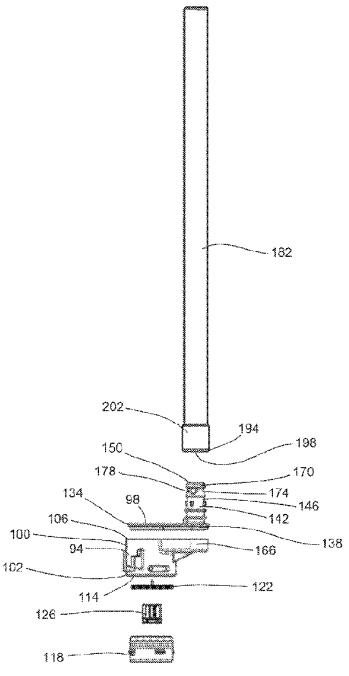


FIG. 4

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GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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INTERNAL PURGE DIFFUSER WITH OFFSET MANIFOLD

FIELD OF THE DISCLOSURE

The disclosure is directed generally to purge systems for micro-environments, and more specifically to diffuser towers for substrate containers.

RELATED APPLICATIONS

The present application claims the benefit of the earlier filing date of U.S. Patent Application No. 62/214,464, filed on September 4, 2015 and U.S. Patent Application No. 62/263,194, filed on December 4, 2015, the contents of which are incorporated by reference herein in their entireties.

BACKGROUND

During insertion or removal of substrates from a substrate container, traces of dust, gaseous impurities, or increased humidity can be introduced into the substrate container, adversely affecting product yield of the resident wafers. Accordingly, there is an increased demand for controlling the environment within these containers during substrate handling to achieve or maintain a high level of cleanliness.

A microenvironment within a substrate container is, in some instances, purged using an inert gas that is injected into the interior of the container through an inlet port causing the air within the container to exit through an outlet port. Systems and methods of delivering purge gas into the container have been designed to provide an improved environment within the container.

As front opening unified pods (FOUPs) were developed, bottom purge ports were introduced by carrier manufacturers to enable the purging of the interior environment with clean dry air (CDA) or inert purge. These purge modules were introduced below the internal bottom surface of the FOUP shell.

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When purge diffusers were introduced, it became apparent that if the diffuser was assembled axially to the purge interface it would not only interfere with the wafer handling exclusion volume but also the wafers stored inside of the FOUP. Instead, without making any modifications to the existing shell design, the diffuser tube was designed to be internally offset axially.

U.S. Patent No. 9,054,144 to Burns et al. ("Burns") discloses a substrate container with a purge tower that includes a base portion and a diffuser tower portion connected by an offset conduit. The offset conduit enables the tower portion to be offset toward the back of the container, thereby enabling the interior space to be better utilized for substrate storage and handling and provided a more compact design. The disclosure of Burns is hereby incorporated by reference herein except for express definitions and patent claims contained therein.

SUMMARY

Conventional purge towers that utilize an offset conduit are configured so that the offset conduit is inside the substrate container and projected upward from the floor of the substrate container such that the offset conduit portion is not flush with the floor. While the conduit can be sized so that the lowermost wafer passes over the conduit, it has been found that the protruding conduit can still interfere with the operation of robotic end effectors during insertion or removal of the lowermost wafer. The interference can cause collisions between the end effector and the conduit, thereby generating particles and can also lead to wafer mishandling.

Another issue with conventional offset purge towers is that they must be mounted to the interior of the substrate container. For configurations where the overall length of the offset purge tower is greater than the floor-to-ceiling clearance of the substrate container, problems can arise when trying to upright the purge tower during assembly. The upper

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extremity of the diffuser portion may collide with the ceiling of the substrate container, which may damage one or both of the diffuser portion and the substrate container. In some instances, the desired length of the diffuser portion may need to be compromised.

Various embodiments of the present disclosure are directed to a purge diffuser assembly that frees up additional space within the wafer container for wafer storage and manipulation, while allowing for the flow of purge gas. Accordingly, various embodiments of the disclosure present a lower probability of contaminating the interior surfaces of the substrate container due to collisions between the end effector and the purge tower assembly. Furthermore, in various embodiments of the disclosure, the effective length of the diffuser portion of the purge tower assembly is increased such that purge gas outlets are located closer to the floor of the substrate container than with conventional purge tower assemblies. By locating purge outlets closer to the floor, the flow of purge gas beneath the lowermost wafer of the substrate container can be increased for improved purge performance.

Various embodiments of the disclosure provide an offset conduit that is external to the substrate container instead of being internal to the container, the conduit being routed underneath the floor of the substrate container. The additional space provided by locating the offset conduit external to the substrate container enables robotic end effectors to maneuver beneath a lowermost wafer stored therein without colliding with the offset conduit.

Also, some embodiments are configured so that the diffuser portion of the purge tower may be active at the floor level of the substrate container. That is, the effective length of the diffuser portion begins at a height on the diffuser portion that corresponds with the floor of the substrate container. This enables purge gas to enter the substrate container at floor level, so that purge flow beneath the lowermost substrate is increased relative to conventional purge towers. In one embodiment, the effective portion of the diffuser portion is lowered by as much as 4.5 mm relative to conventional diffusers.

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Some embodiments of the disclosure present an externally offset purge tower assembly that is assembled externally and can be mounted and dismounted from the exterior of the substrate container. Some embodiments of the disclosure include a diffuser portion that is detachable and re-attachable to a purge interface body of the externally offset purge tower assembly, so that the diffuser portion is affixed to the purge interface body after the purge interface body is mounted to the substrate container. Through both of these embodiments, the problem of excessive length of the purge tower assembly is eliminated.

Also contemplated are embodiments that reduce the profile of an internal conduit by providing a recess in the floor of the container through which the conduit is routed. The offset conduit and recess may be sized so that the uppermost extremity of the offset conduit is at or below the interior level of the floor of the substrate container. In such an embodiment, reduced profile of the offset conduit, though internal, provides the same effect as an external offset conduit with respect to end effector clearance and enhances purging of the lowermost substrate.

Various embodiments of the disclosure are directed to a purge tower assembly for a substrate container that includes a purge interface body for connection to a bottom plate of a substrate container. The purge interface body may include a base portion and a top portion. The base portion may have a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge. The bottom edge may define a first aperture, concentric about a first axis, for access to an interior of the base portion.

In one or more embodiments the top portion is connected to the top edge of the base portion. The top portion may have a top sidewall positioned on the top edge of the base portion for upwardly covering the bottom aperture. The top portion may include an inlet nozzle for mounting through an inlet in the bottom plate of the substrate container. The inlet nozzle may have a substantially tubular nozzle sidewall extending upwardly from the top

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sidewall to a nozzle edge. The nozzle edge may define a second aperture, concentric about a second axis, for access to an interior of the inlet nozzle. In certain embodiments, the second axis is substantially parallel to and positioned rearward of the first axis. In one or more embodiments, the purge interface body includes an offset conduit portion disposed between the base portion and the inlet nozzle. The base portion and the inlet nozzle may be in fluid communication via the offset conduit portion.

The purge tower assembly includes a diffuser portion. In one or more embodiments, the diffuser portion is a diffuser portion including a porous diffuser sidewall and defining a diffuser passageway that extends into the diffuser portion along a diffuser axis. The diffuser sidewall may define an opening at a bottom portion of the diffuser portion that may be operatively coupled to the inlet nozzle for fluid communication between the base portion, the inlet nozzle, and the diffuser portion. Additionally or alternatively, the diffuser portion may comprise an exterior shell with a plurality of through apertures formed therein.

The above summary is not intended to describe each illustrated embodiment or every implementation of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings included in the present application are incorporated into, and form part of, the specification. They illustrate embodiments of the present disclosure and, along with the description, serve to explain the principles of the disclosure. The drawings are only illustrative of certain embodiments and do not limit the disclosure.

FIG. 1 is a perspective view of a substrate container, according to an embodiment of the disclosure.

FIG. 2 is a front elevational view of a purge tower assembly, according to an embodiment of the disclosure.

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FIG. 3 is a cross-sectional view of the purge tower assembly of FIG. 2, according to an embodiment of the disclosure.

FIG. 4 is an exploded view of the purge tower assembly of FIG. 4, according to an embodiment of the disclosure.

FIG. 5 is an enlarged, partial perspective view of a purge tower assembly, according to an embodiment of the disclosure.

FIG. 6 is a front elevational view of purge tower assemblies mounted in a substrate container, according to an embodiment of the disclosure.

FIG. 7 is a cross-sectional view of the purge tower assembly and substrate container taken at line 7-7 of FIG. 6.

FIG. 8 is a cross-sectional view of a substrate container and an exploded view of a purge tower assembly, according to an embodiment of the disclosure.

FIG. 9 is a partial bottom perspective view of a substrate container including openings for a purge tower assembly, according to an embodiment of the disclosure.

FIG. 10 is a partial bottom perspective view of a substrate container including a conveyor plate, according to an embodiment of the disclosure.

FIG. 11 is a partial bottom perspective view of a substrate container including a conveyor plate mounted to a bottom plate, according to an embodiment of the disclosure.

FIG. 12 is a partial cross section view of a substrate container including a conveyor plate mounted to a bottom plate, according to an embodiment of the disclosure.

FIG. 13 is a partial bottom perspective view of a substrate container including an externally mounted purge assembly, according to an embodiment of the disclosure.

FIG. 14 is a partial perspective view of an interior of a substrate container including an externally mounted purge tower assembly, according to an embodiment of the disclosure.

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FIG. 15 is a partial perspective view of an interior of a substrate container including an externally mounted purge tower assembly, according to an embodiment of the disclosure.

FIG. 16 is a cross-sectional view of a substrate container including a recess with an internally mounted purge tower assembly, according to an embodiment of the disclosure.

FIG. 17 is a close up cross-sectional view of the purge tower assembly and substrate container taken at line 7-7 of FIG. 6

While embodiments of the disclosure are amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the disclosure to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

DETAILED DESCRIPTION

Referring to FIG. 1, a substrate container 30 for storing a plurality of substrates is depicted, according to an embodiment of the disclosure. As used herein, the plurality of substrates include substrates used in the manufacture of semiconductors, printed circuit boards, flat panel displays, and/or the like. For purposes of illustration, a single substrate 32a is presented. In certain embodiments, the substrate container 30 includes two opposing side portions 34, a top portion 36, a bottom plate 38 and a back portion 42. The bottom plate 38 defines an interior surface or floor 40 for the substrate container 30. A front portion 44 of the substrate container 30 includes a door frame 46 that defines a door opening 48 for insertion and removal of substrates 32. A door 52 is adapted to seal and cover the door opening 48. The door opening 48 of the substrate container 30 lies in a plane that is substantially parallel to a vertical direction 54. In various embodiments, the substrate container 30 is characterized as containing a microenvironment 64.

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In one or more embodiments, a pair of slotted sidewalls 66 are disposed within the substrate container 30, each being proximate a respective one of the side portions 34. The slotted sidewalls 66 are aligned so that the slots face each other to define a plurality of slot positions 68, and are spaced apart so that the substrate(s) 32 are supported therebetween. For purposes of this disclosure, a lowermost slot position 68a (i.e., the slot closest to the bottom plate 38) of the plurality of slot positions 68 is identified as the "first" slot, with the slot numbers increasing in the upward direction. For purposes of illustration, such as in FIGS. 6-8 and 15-16, described below, a substrate 32b is presented, and is depicted as occupying the lowermost slot 68a.

In various embodiments, the substrate container 30 further includes at least one purge tower assembly 70 disposed within the substrate container 30. In various embodiments, the purge tower assembly 70 may be operatively coupled to a gas source (not depicted) external to the substrate container 30 for introduction of a gaseous working fluid into the substrate container 30. In certain embodiments, one or more of the purge tower assemblies 70 are oriented to direct the gaseous working fluid toward the door opening 48 in order to purge the substrate container 30.

In certain embodiments, the substrate container 30 further includes a conveyor plate 71 positioned below the bottom plate 38. In various embodiments, the conveyor plate 71 is mounted to the bottom of the substrate container 30 for machine based positioning and alignment of the substrate container 30 during various substrate processing steps.

Referring to FIGS. 2-5, a purge tower assembly 70 is depicted, according to an embodiment of the disclosure. In the depicted embodiment, the purge tower assembly 70 includes a purge interface body 90 including a base portion 94 and a top portion 98. In one or more embodiments, the purge interface body 90 is appropriately sized and shaped for mounting externally on a substrate container 30. For example, the purge interface body may

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be mounted to a conveyor plate 71 of a substrate container 30. In some embodiments, the purge interface body may be mounted to the bottom plate 38. In some embodiments, the purge interface body 90 may be mounted between the bottom plate 38 and a conveyor plate 71.

In various embodiments, for example in FIG. 3, the base portion 94 has tubular shape defined by a sidewall 100 that extends from a bottom edge 102 to a top edge 106. The tubular shape of the sidewall 100 defines an interior portion 110 and, at the bottom edge 102, defines a bottom aperture 114 for access into the interior portion 110. In various embodiments, the base portion 94 includes components for coupling to an outside fluid source. For example, in some embodiments, the base portion includes a grommet 118, filter 122, and a valve 126 mounted in the bottom aperture 114 and in the interior portion 110 (FIG. 4). In certain embodiments, the bottom aperture 114 is concentric with an axis 130.

In one or more embodiments, for example in FIG. 5, the sidewall 100 defines a plurality of apertures 119 in the base portion 94. In certain embodiments, each of the apertures 119 are spaced circumferentially about the sidewall 100 and about the axis 130. In various embodiments, the apertures 119 are receptacles for lugs protruding from the side of the grommet 118 for fitting and placement of the grommet 118 within the interior 110 of the base portion 94. For example, in some embodiments, the grommet 118 is a flexible component and lugs may elastically compressing during insertion into the interior 110 of the base portion and then expand outwardly into apertures 119 to lock the grommet in place.

In some embodiments, the base portion 94 includes support portions 120. The support portions 120 may be outwardly extending portions of material integral with the sidewall 100. In certain embodiments, the support portions 120 function as handles or grips for manipulation of the purge interface body 90. In some embodiments, the support portions 120

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are flexible beams that snap fit into undercut features in the conveyor plate for installation of the body 90 to a substrate container, described further herein.

In one or more embodiments, the top portion 98 includes a top sidewall 134 that is substantially planar and connected to the base portion 94 along the top edge 106. In some embodiments, the top sidewall 134 is connected to the top of the base portion 94. The base portion 94 and the top portion 98 may be connected by techniques available to the artisan, for example, ultrasonic or heat welding, snap fits, adhesive bonding, or by other suitable techniques.

Additionally, for example in FIG. 3, the top sidewall 134 may include an offset portion 138 extending to one side from the base portion 94. The offset portion 138 may include an inlet nozzle 142 offset from the base portion 94. In one or more embodiments, the inlet nozzle 142 has a tubular shape defined by a nozzle sidewall 146 extending upwardly from the top sidewall 134 to a nozzle edge 150. In one or more embodiments, the nozzle sidewall 146 defines an interior portion 154 and a nozzle aperture 158 at the nozzle edge 150. In various embodiments, the nozzle aperture 158 provides access to the interior portion 154 of the inlet nozzle 142. In certain embodiments, the nozzle aperture 158 is concentric about a second axis 162. In various embodiments, the second axis 162 is substantially parallel to the first axis 130.

In one or more embodiments, an offset conduit portion 166 is disposed between the base portion 94 and the inlet nozzle 142 (FIGS. 2 and 5). In one or more embodiments, the offset conduit portion 166 cooperates with the offset portion 138 of the top sidewall 134 to provide a passage between the base portion 94 and the inlet nozzle 142 for fluid communication between the components of the purge interface body 90.

In operation, fluid enters the purge tower assembly 70 through the check valve 126 and the bottom aperture 114, passing through the interior portions 110, 154 and through the

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nozzle aperture 158. Functionally, the offset conduit 166 diverts flow from the first axis 130 to the second axis 162.

In some embodiments, as shown in FIG. 5, the inlet nozzle 142 is a barbed nozzle including a barbed portion 170 and a tapered portion 174 of the nozzle sidewall 146. In certain embodiments, the barbed portion 170 defines an outer diameter of the inlet nozzle 142 and the tapered portion 174 defines a reduced outer diameter adjacent the barbed portion 170. In certain embodiments, the nozzle sidewall 146 defines a lateral aperture 178 between the barbed portion 170 and the tapered portion 174. Described further, the lateral aperture 178 is a hole or aperture in the nozzle sidewall 146 for low diffusion of gas into the substrate container 30.

In one or more embodiments, the purge tower assembly 70 includes a diffuser portion 182 coupled to the inlet nozzle 142 of the purge interface body 90. In some embodiments, the diffuser portion 182 includes a porous or perforated (apertured) sidewall 186. In some embodiments, the sidewall 186 defines a substantially tubular shape with a diffuser passageway that extends from a top face 190 of the diffuser portion 182 to a bottom edge 194. In one or more embodiments, the bottom edge 194 of the diffuser portion 182 defines an aperture 198 at a bottom portion 202 of the diffuser portion 182. In various embodiments, the aperture 198 may be sized for insertion of the inlet nozzle 142 for operative coupling between the two for fluid communication between the base portion 94, the inlet nozzle 142, and the diffuser portion 182.

In certain embodiments, the nozzle sidewall 186 includes external threads formed on an external surface of the nozzle sidewall 146 (not depicted). The diffuser portion 182 may include internal threads formed on an internal surface of the diffuser portion (not depicted). The threads of the diffuser portion 182 and the nozzle sidewall 186, when implemented, are compatible for coupling therebetween.

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In various embodiments, the diffuser portion 182 includes a widened portion 206 at the bottom portion of the diffuser portion 182. In certain embodiments, the widened portion 206 is widened outwardly, having an increased inner diameter relative to the main body of the diffuser portion for insertion and coupling with the inlet nozzle 146.

Referring to FIGS. 6-8, the purge tower assembly 70 is depicted in assembly in the substrate container 30 according to an embodiment of the disclosure. In the depicted embodiment, the substrate container 30 and the purge tower assembly 70 are the same or substantially similar as described herein. Accordingly, like elements are identified with like-numbered reference numerals.

In assembly, for example in FIG. 8, the purge interface body 90 may be assembled to the substrate container 30 by inserting the purge interface body 90 upwardly in direction 210, placing inlet nozzle 142 through a rearward inlet 214 in the bottom plate 38 and attaching the purge interface body 90 to an exterior surface of the bottom plate 38 in a rearward mounting region 218. In various embodiments, the rearward mounting region 218 is between the conveyor plate 71 and the bottom plate 38. The purge interface body 90 can be designed to assemble to the substrate container 30 to various vertical heights 222 relative to a purge fixture of a load port. In various embodiments, the vertical height 222 substantially matches the vertical height of existing substrate container(s). In one or more embodiments, the inlet nozzle 142 is sized such that, when mounted to the conveyor plate 71 of the substrate container 30, the nozzle edge 150 of the inlet nozzle 142 extends upwardly to about the first slot 68a of the substrate container 30.

Once the purge interface body 90 is inserted through the inlet 214, the diffuser portion 182 may be assembled thereto by accessing the inlet nozzle 142 at the rear of the substrate container 30 via the door opening 48. The diffuser portion 182 is then affixed to the inlet nozzle 142.

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Referring to FIGS. 9-14, various stages of assembly of the purge tower assembly 70 within substrate container 30 are depicted according to an embodiment of the disclosure. The substrate container 30 and the purge tower assembly 70 may be the same or substantially similar as described herein. Accordingly, like elements are identified with like-numbered reference numerals. In reference to FIG. 9, a bottom perspective view of a substrate container 30 and bottom plate 38 are depicted. In one or more embodiments, the bottom plate 38 includes a rearward inlet 214 for insertion of an inlet nozzle 142 of a purge tower assembly 70 (FIG. 8). Additionally, in some embodiments, the bottom plate 38 includes a mounting inlet 250. In various embodiments, the mounting inlet 250 is an aperture in the bottom plate 38 for receiving mounting means for mounting the conveyor plate 71 to the bottom plate 38 of the substrate container 30.

For example, in FIG. 10 a conveyor plate 71 is placed against the bottom plate 38 of the substrate container 30. The conveyor plate 71 may including mounting inlet 251 which is aligned with mounting inlet 250. A mounting mechanism 254, as depicted in FIG. 11, is received in the mounting inlet 250 and secures the conveyor plate 71 to the bottom plate 38. In one or more embodiments, the mounting mechanism 254 is a portion of material positioned in the bottom plate 38 for securing the conveyor plate 71 to the bottom of the substrate container 30. Depicted in FIGS. 11 and 12, the mounting mechanism 254 is a partial ring having a downwardly extending sidewall 258 and including a plurality of generally L-shaped slots 262 arranged circumferentially in the sidewall 258. In one or more embodiments, the L-shaped slots 262 are ramped having a vertical portion 263 and a horizontal or detent portion 264.

In various embodiments, the conveyor plate 71 may include a plurality of outwardly extending members or cams 265 in mounting inlet 251. Each of the cams 265 may correspond with the L-shaped slots 262 such that the conveyor plate 71 may be secured to the

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bottom plate 38 by downward insertion of the mounting mechanism 254 into the mounting inlets 250 and 251, receiving cams 265 into the vertical portions 263, and twisting the mounting mechanism 254 to guide the cams 254 upwardly and into the detent portion 264, securing the conveyor plate 71 to the bottom plate 38.

In various embodiments, the sidewall 254 includes a rearward opening 266 corresponding to the offset conduit portion 166. As such, when secured to the bottom plate 38, the offset conduit portion 166 extends rearwardly from the mounting mechanism 254 to reach the inlet nozzle 214.

In certain embodiments, various types of mounting mechanisms 254 may be used to secure the conveyor plate 71 to the bottom plate 38. For example, the mounting mechanism may use ultrasonic or heat welding, snap fits, adhesive bonding, or other suitable techniques. In some embodiments, the mounting mechanism 254 is integral with the bottom plate 38, such that the bottom plate 38 and the mounting mechanism are one continuous piece.

Depicted in FIGS. 12-13, one or more embodiments, the conveyor plate 71 includes locking features for the purge interface body 90, including one or more lateral openings 267 in the mounting inlet 251 which expose access to a support shelf 268. In various embodiments, the support shelves 268 are defined by undercut portions 269 in the conveyor plate 71. In various embodiments, the purge interface body 90 is secured to substrate container 30 by upwardly inserting the purge interface body 94 into the mounting inlet 251 and the inlet nozzle 142 (FIG. 2-4) into the rearward inlet 214. As the purge interface body 94 is upwardly inserted, the support portions 120 may engage with the sloped or barbed undercut portion 269 and flex until the purge interface body 94 has been fully inserted into the mounting inlet 251. Once inserted, the support portions 120 may “snap” onto the support shelves 268 to lock the purge interface body in place.

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In FIG. 14, the interior of the substrate container 30 is depicted. In the interior, the rearward inlet 214 and mounting mechanism 254 are depicted in the floor 40 of the substrate container 30. The purge interface body 90 is mounted to the substrate container 30 and the inlet nozzle 142 is depicted inserted through the rearward inlet 214 and extended into the interior of the container 30. In FIG. 15, a diffuser tower 182 is depicted, fitted onto the inlet nozzle 142.

Referring to FIGS. 16 and 17, cross-sectional views of a portion of a substrate container 30 and purge tower assembly 70 are depicted according to embodiments of the disclosure. In FIG. 15, the purge interface body 90 is mounted externally on the bottom plate 38, as described above. The mounting mechanism 254 is positioned in the floor 40 and secures the purge interface body 90 to the container 30. The inlet nozzle 142 enters into the interior of the container 30 through the rearward inlet 214. A diffuser portion 182 for diffusion of purge gas entering the substrate container 30 through the purge interface body 90 is fitted onto the inlet nozzle 142 such that a portion of the inlet nozzle 142 extends into the interior of the diffuser portion 182. Substrate 32b, positioned in the lowermost slot 68a, extends rearwardly in the container 30 towards the purge tower assembly 70. Because the purge interface body 90 is mounted externally, a clearance 290 is maintained between the lowermost substrate 32b and the floor 40 and the mounting mechanism 254 of the container.

In some embodiments, such as depicted in FIG. 16, the substrate container 30 defines a rearward recess 300 in the floor 40. In such embodiments, the purge interface body 90 is mounted internally within in the container 30. For example, the purge interface body 90 may be positioned in the recess 300 with the base portion 94 extending through an aperture 304 for connection to an external fluid source. The recess 300 may be sized so that the uppermost extremity of the purge interface body 90 is at or below the level of the floor 40 of the substrate container 30.

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Functionally, the recess 300 of the FIG. 16 embodiment reduces the profile of the offset conduit 166. Because of the reduced profile, the offset conduit 166, though internal to the container 30, provides the same clearance 290 as the external offset conduit arrangement of FIG. 15, and the same operational benefits with respect to end effector manipulation and gas purging.

Also depicted in FIG. 15 and 16, in one or more embodiments, the inlet nozzle 142 includes a lateral aperture 178, as described above. In various embodiments, the inlet nozzle 142 and the lateral aperture 178 are configured so that the diffuser portion 182 of the purge tower assembly 70 may be active at or near the floor 40 of the substrate container. For example, in some embodiments, the lateral aperture 178 is positioned at a height on the on the inlet nozzle 142 that corresponds with the floor 40 of the substrate container 30.

In operation, for both the embodiments of FIGS. 15 and 16, the clearance 290 provides maneuvering space beneath the substrate 32b for robotic end effectors (not depicted), with little or no interference from the components of the purge interface body 90. Also, having the base of the diffuser portion 182 at floor level, in combination with the clearance 290 provided by the external or the reduced profile offset conduit 166, enables purge gas to enter the substrate container 30 at floor level so that purge flow 308 is directed beneath the lowermost substrate 32b.

Each of the additional figures and methods disclosed herein can be used separately, or in conjunction with other features and methods, to provide improved devices and methods for making and using the same. Therefore, combinations of features and methods disclosed herein may not be necessary to practice the disclosure in its broadest sense and are instead disclosed merely to particularly describe representative and preferred embodiments.

Various modifications to the embodiments may be apparent to one of skill in the art upon reading this disclosure. For example, persons of ordinary skill in the relevant art will

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recognize that the various features described for the different embodiments can be suitably combined, un-combined, and re-combined with other features, alone, or in different combinations. Likewise, the various features described above should all be regarded as example embodiments, rather than limitations to the scope or spirit of the disclosure.

Persons of ordinary skill in the relevant arts will recognize that various embodiments can comprise fewer features than illustrated in any individual embodiment described above. The embodiments described herein are not meant to be an exhaustive presentation of the ways in which the various features may be combined. Accordingly, the embodiments are not mutually exclusive combinations of features; rather, the claims can comprise a combination of different individual features selected from different individual embodiments, as understood by persons of ordinary skill in the art.

Any incorporation by reference of documents above is limited such that no subject matter is incorporated that is contrary to the explicit disclosure herein. Any incorporation by reference of documents above is further limited such that no claims included in the documents are incorporated by reference herein. Any incorporation by reference of documents above is yet further limited such that any definitions provided in the documents are not incorporated by reference herein unless expressly included herein.

References to "embodiment(s)", "disclosure", "present disclosure", "embodiment(s) of the disclosure", "disclosed embodiment(s)", and the like contained herein refer to the specification (text, including the claims, and figures) of this patent application that are not admitted prior art.

For purposes of interpreting the claims, it is expressly intended that the provisions of 35 U.S.C. 112(f) are not to be invoked unless the specific terms "means for" or "step for" are recited in the respective claim.

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CLAIMS

What is claimed is:

1. A purge tower assembly for a substrate container, the purge tower assembly comprising:

a purge interface body for mounting to a bottom plate of a substrate container, the purge interface body including:

a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture for access to an interior of the base portion, the first aperture being concentric about a first axis; and

a top portion connected to the base portion, the top portion including a top sidewall positioned on the top edge of the base portion, the top portion including an inlet nozzle configured for mounting through an inlet in the bottom plate of the substrate container, the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the top sidewall to a nozzle edge, the nozzle edge defining a second aperture for access to an interior of the inlet nozzle, the second aperture concentric about a second axis substantially parallel to and positioned rearward of the first axis, wherein the top sidewall cooperates with the base portion to define an offset conduit portion disposed between the first aperture and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion.

2. The purge tower assembly of claim 1, further comprising:

a diffuser portion defining a diffuser passageway that extends into the diffuser portion along a diffuser axis, the diffuser passageway defining an opening at a bottom portion of the

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diffuser portion operatively coupled to the inlet nozzle for fluid communication between the base portion, the inlet nozzle, and the diffuser portion.

3. The purge tower assembly of claim 2, wherein the nozzle sidewall includes external threads formed on an external surface of the nozzle sidewall.

4. The purge tower assembly of claim 3, wherein the diffuser portion includes internal threads formed on an internal surface of the diffuser portion, the internal threads compatible with the external threads of the inlet nozzle for operative coupling between the diffuser portion and the inlet nozzle.

5. The purge tower assembly of claim 2, wherein the diffuser portion includes a widened portion at the bottom portion.

6. The purge tower assembly of claim 2, wherein the diffuser portion includes a porous diffuser sidewall.

7. The purge tower assembly of claim 1, wherein the base portion includes a grommet and a valve mounted in the first aperture for fluid communication with an external fluid source.

8. The purge tower assembly of claim 1, wherein the inlet nozzle is a barbed nozzle including a barbed portion and a tapered portion, the barbed portion defining an outer diameter of the barbed nozzle, the tapered portion defining a reduced outer diameter adjacent the barbed portion.

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9. The purge tower assembly of claim 8, wherein the nozzle sidewall defines a lateral aperture between the barbed portion and the tapered portion.

10. The purge tower assembly of claim 1, wherein the inlet nozzle is sized such that, when mounted to the bottom plate of the substrate container, the inlet nozzle extends upwardly to about a position of a first wafer contained within the substrate container.

11. The purge tower assembly of claim 1, wherein the top sidewall is substantially planar.

12. A substrate container for containing substrates, the substrate container comprising:

a container portion including two opposing sidewalls, a back sidewall, a top sidewall, and a bottom plate, the container portion defining an opening in a front portion of the substrate container for insertion and removal of substrates, the container portion mounted on a conveyor plate;

a door configured for covering and sealing the opening defined by the container portion; and

a purge interface body connected to the bottom plate, the purge interface body including:

a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture for access to an interior of the base portion, the first aperture concentric about a first axis;

a top portion connected to the base portion, the top portion having a substantially planar top sidewall positioned on the top edge of the base portion for upwardly covering the bottom aperture, the top portion including an inlet nozzle for

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mounting through an inlet in the bottom plate of the substrate container, the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the top sidewall to a nozzle edge, the nozzle edge defining a second aperture for access to an interior of the inlet nozzle, the second aperture concentric about a second axis substantially parallel to and positioned rearward of the first axis; and

an offset conduit portion disposed between the base portion and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion.

13. The substrate container of claim 12, further comprising a diffuser portion having a diffuser passageway that extends into the diffuser portion along a diffuser axis, the diffuser passageway defining an opening at a bottom portion of the diffuser portion operatively coupled to the inlet nozzle for fluid communication between the base portion, the inlet nozzle, and the diffuser portion.

14. The substrate container of claim 13, wherein the nozzle sidewall includes external threads formed on an external surface of the nozzle sidewall.

15. The substrate container of claim 14, wherein the diffuser portion includes internal threads formed on an internal surface of the diffuser portion, the internal threads compatible with the external threads of the inlet nozzle for operative coupling between the inlet nozzle and the diffuser portion.

16. The substrate container of claim 13, wherein the diffuser portion includes a widened portion at the bottom portion of the diffuser portion.

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17. The substrate container of claim 12, wherein the base portion includes a grommet and a valve mounted in the first aperture for fluid communication with an external fluid source

18. The substrate container of claim 12, wherein the inlet nozzle is a barbed nozzle including a barbed portion and a tapered portion of the tubular nozzle sidewall, the barbed portion defining an outer diameter of the barbed nozzle, the tapered portion defining a reduced outer diameter adjacent the barbed portion.

19. The substrate container of claim 18, wherein the nozzle sidewall defines a lateral aperture between the barbed portion and the tapered portion.

20. The substrate container of claim 12, wherein the inlet nozzle is sized such that, when connected to the bottom plate and the conveyor plate of the substrate container, the inlet nozzle extends upwardly to about a position of a first wafer contained within the substrate container.

21. A method of assembling a purge tower assembly to a substrate container, the method comprising:

upwardly inserting an inlet nozzle of a purge interface body into a rearward inlet in a bottom plate of a substrate container, the purge interface body including a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture concentric about a first axis, the purge interface body including a top positioned on the top edge of the base portion and including the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the

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top sidewall to a nozzle edge, the nozzle edge defining a second aperture concentric about a second axis that is substantially parallel to and positioned rearward of the first axis, the top sidewall and the base portion defining an offset conduit portion between the first aperture and the inlet nozzle for fluid communication; and

securing the purge interface body to the bottom plate of the substrate container when the inlet nozzle is inserted into the rearward inlet.

22. A substrate container, the substrate container comprising:

a container portion including two opposing sidewalls, a back sidewall, a top sidewall, and a bottom plate, the container portion defining an interior for insertion and removal of substrates, the interior having a floor including a rearward recess in the floor; and

a door configured for covering and sealing the opening defined by the container portion; and

a purge interface body mounted in the recess, the purge interface body including:

a base portion having a substantially tubular base sidewall extending upwardly from a bottom edge to a top edge, the bottom edge defining a first aperture for access to an interior of the base portion, the first aperture concentric about a first axis;

a top portion connected to the base portion, the top portion having a substantially planar top sidewall positioned on the top edge of the base portion for upwardly covering the bottom aperture, the top portion including an inlet nozzle for mounting through an inlet in the bottom plate of the substrate container, the inlet nozzle having a substantially tubular nozzle sidewall extending upwardly from the top sidewall to a nozzle edge, the nozzle edge defining a second aperture for access to an interior of the inlet nozzle, the second aperture concentric about a second axis substantially parallel to and positioned rearward of the first axis; and

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an offset conduit portion disposed between the base portion and the inlet nozzle, the base portion and the inlet nozzle in fluid communication via the offset conduit portion;

wherein the top sidewall is substantially flush with the floor.

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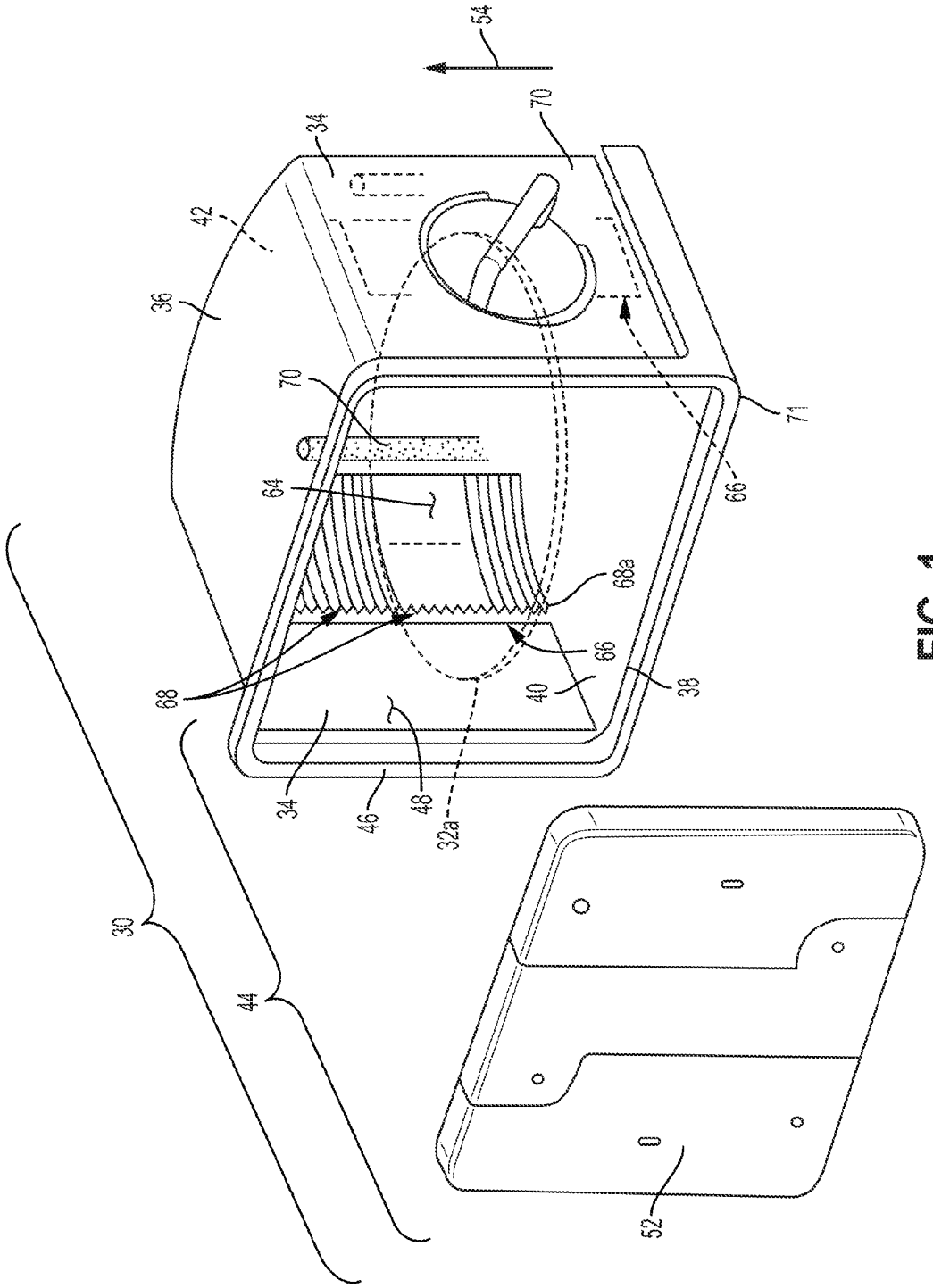


FIG. 1

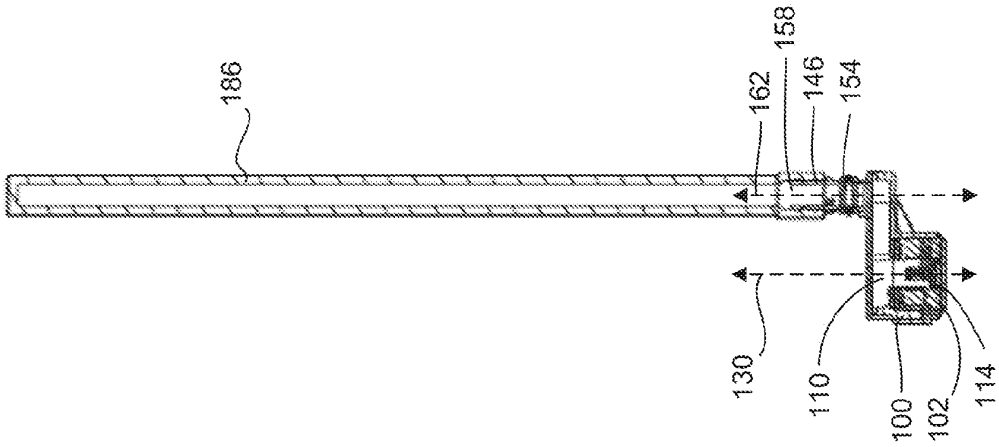

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FIG. 3

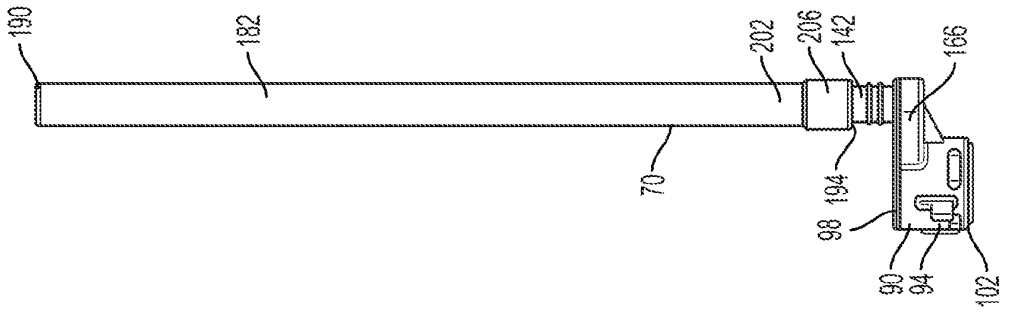

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FIG. 2

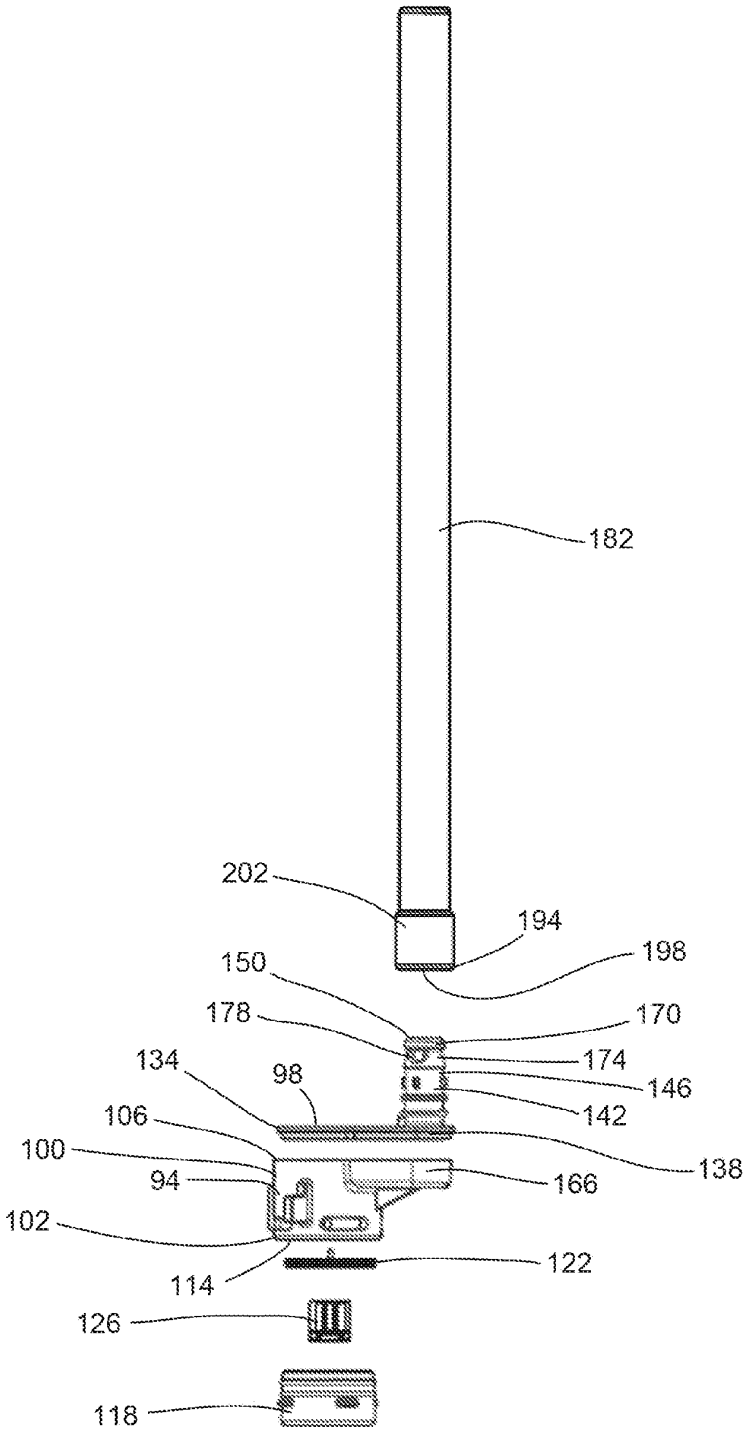

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FIG. 4

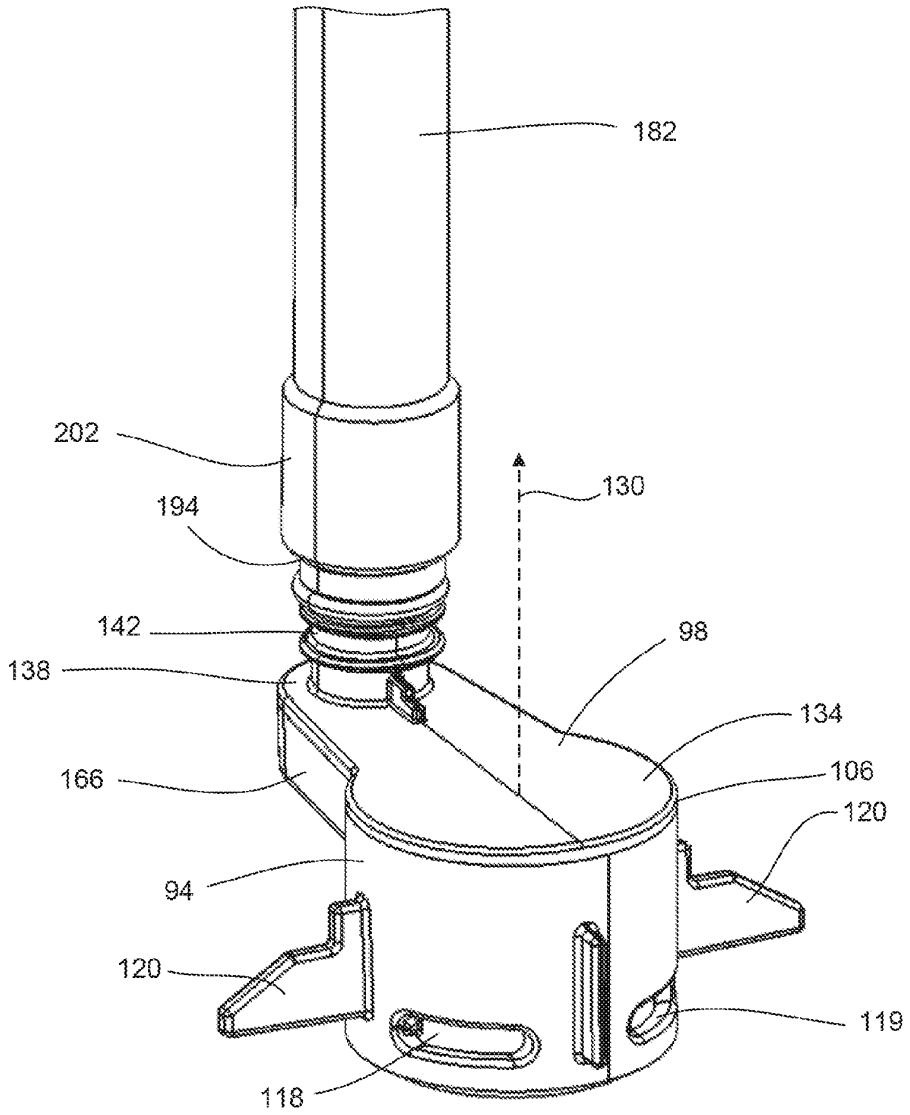


FIG. 5

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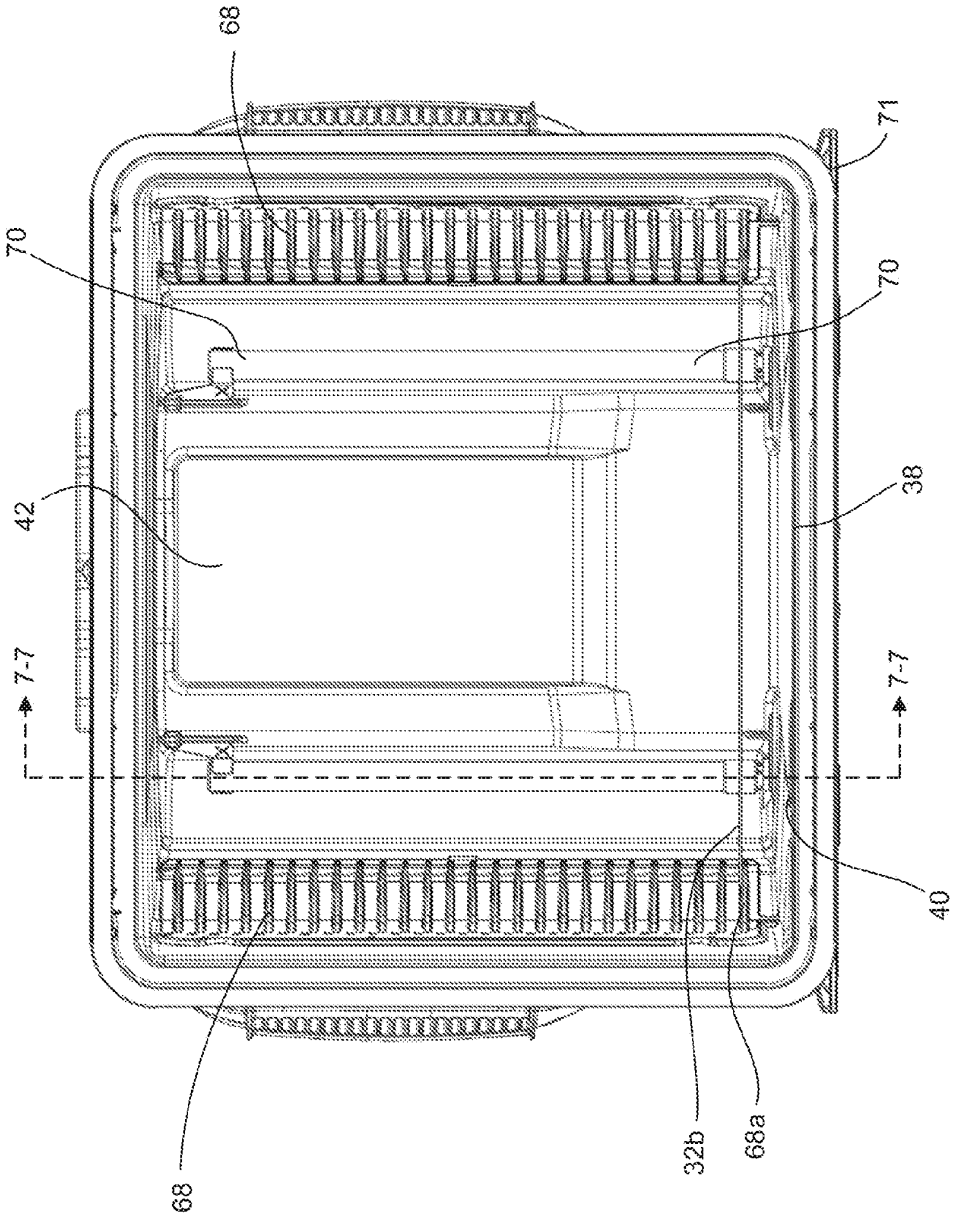


FIG. 6

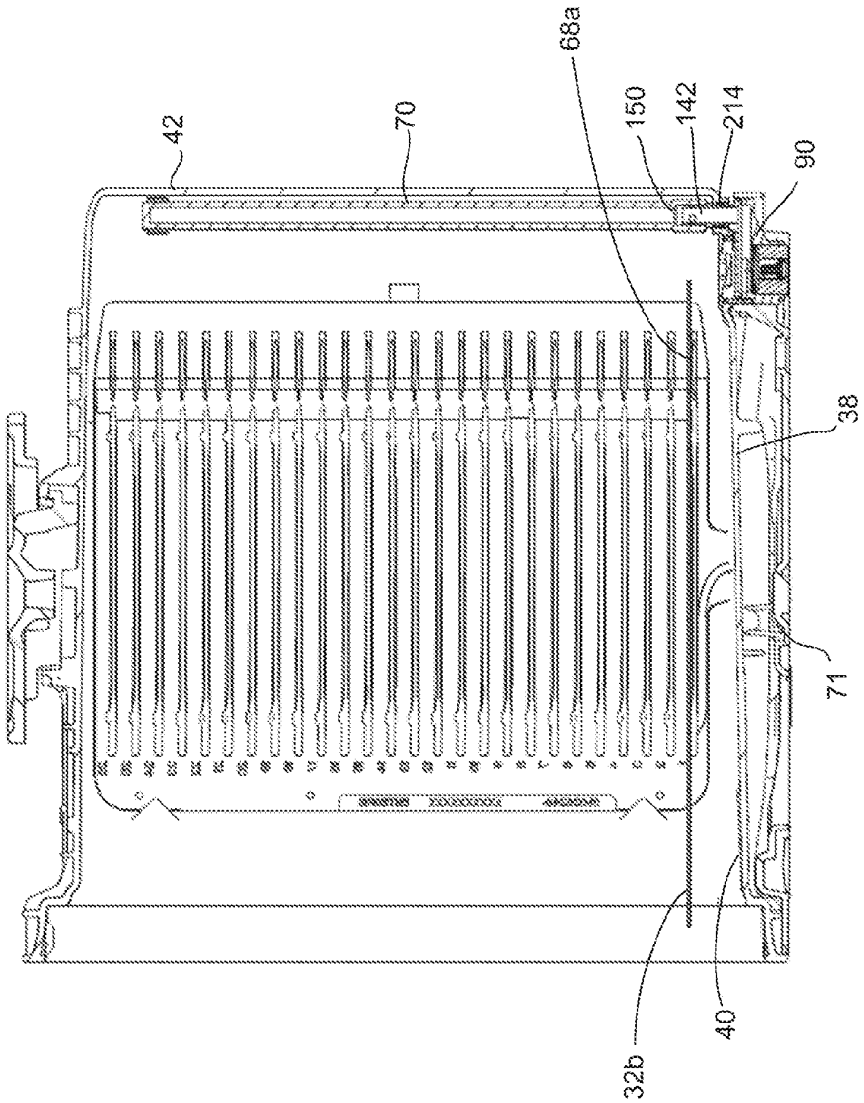


FIG. 7

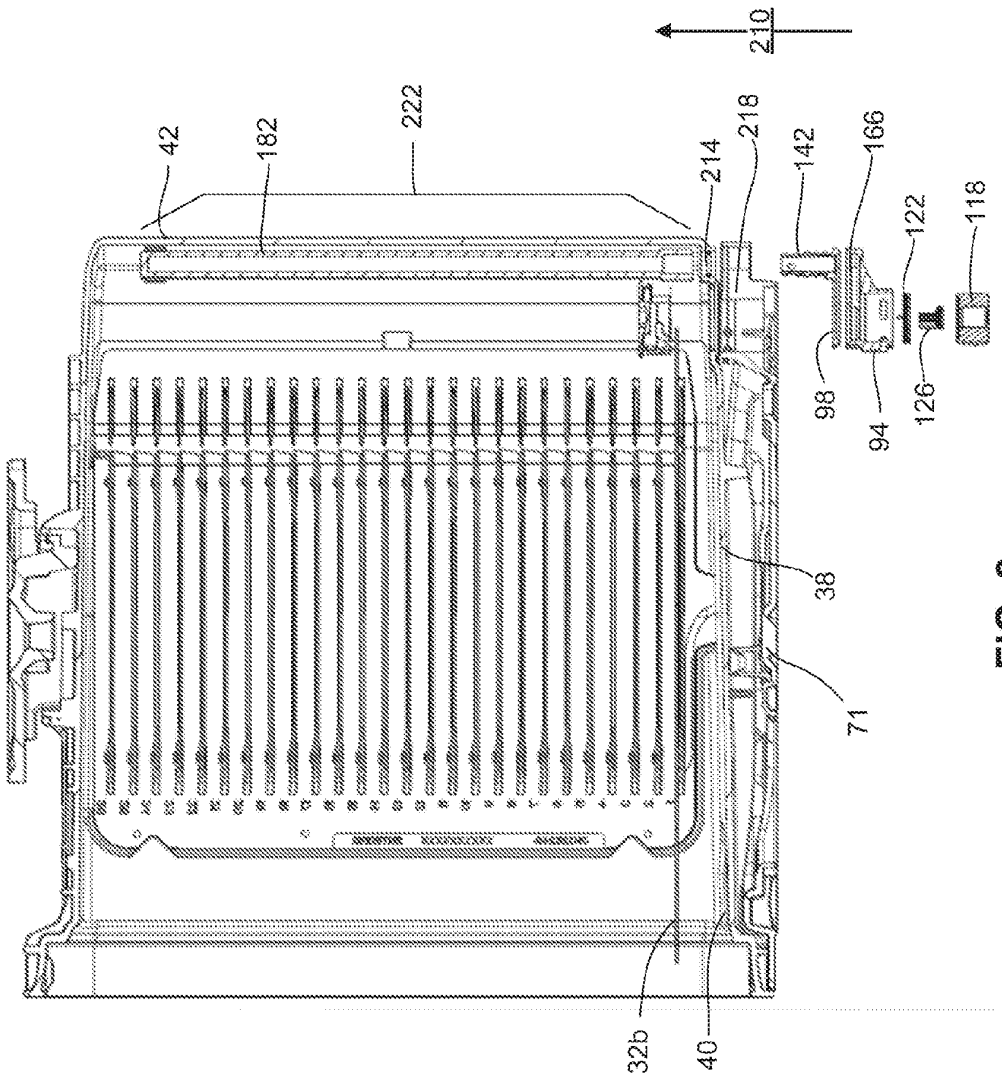


FIG. 8

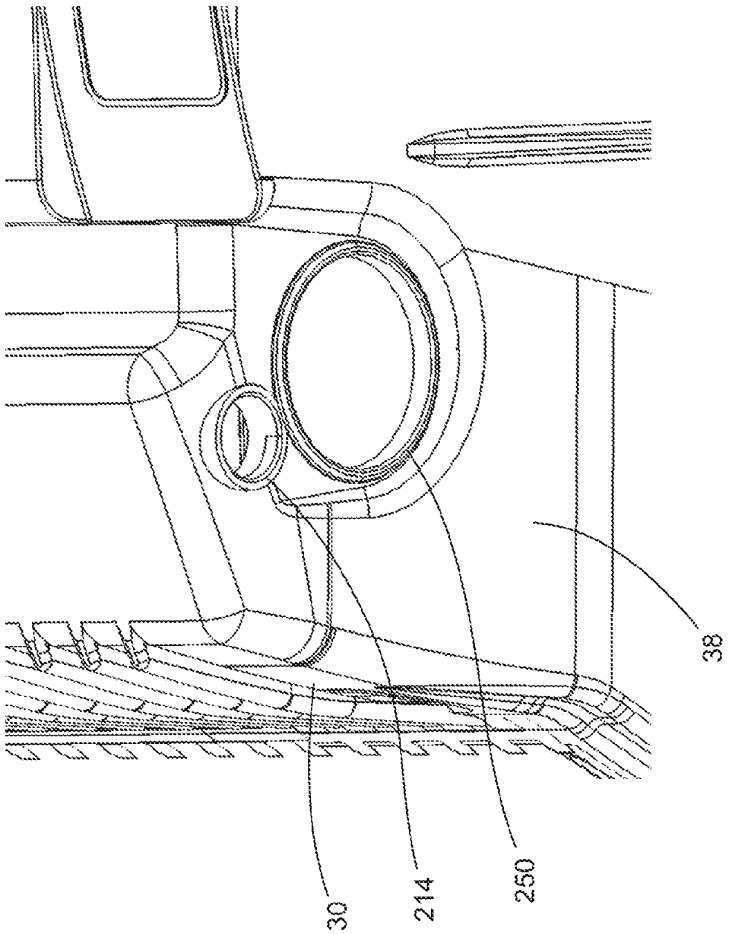


FIG. 9

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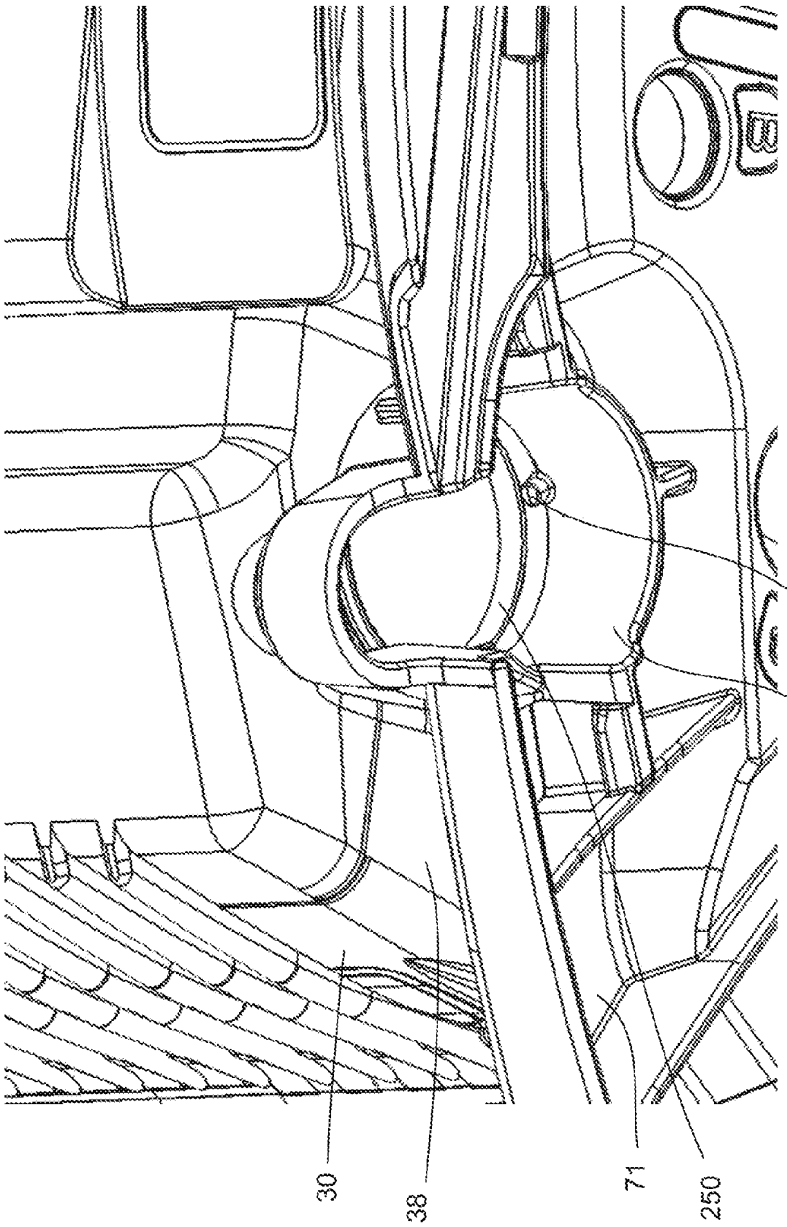


FIG. 10

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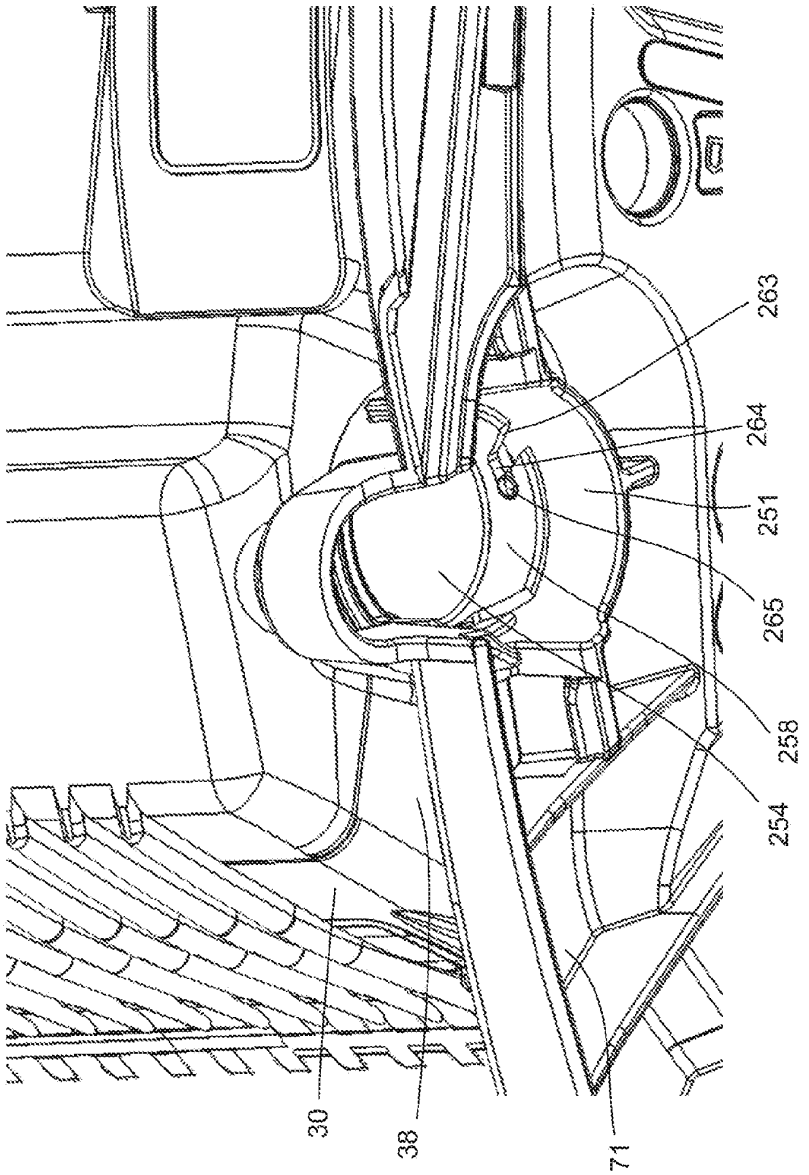


FIG. 11

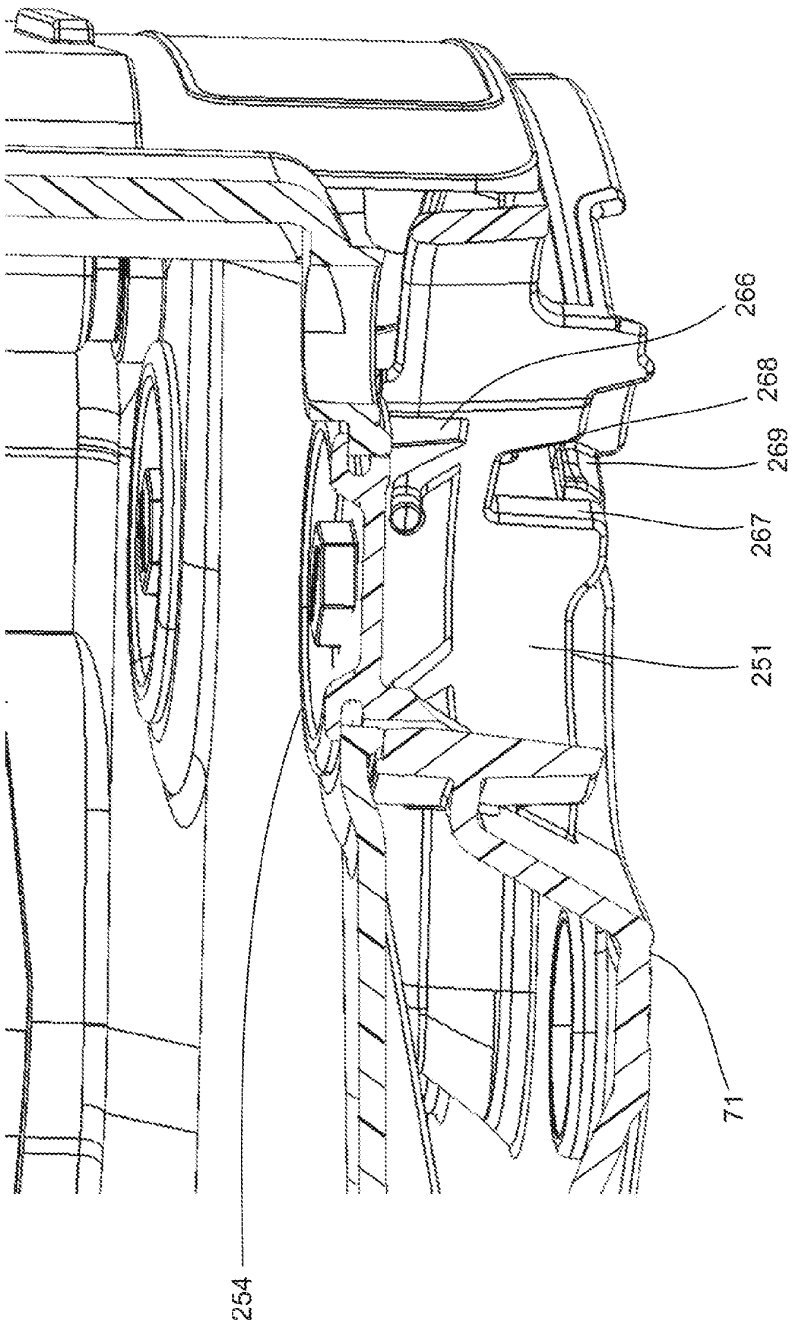


FIG. 12

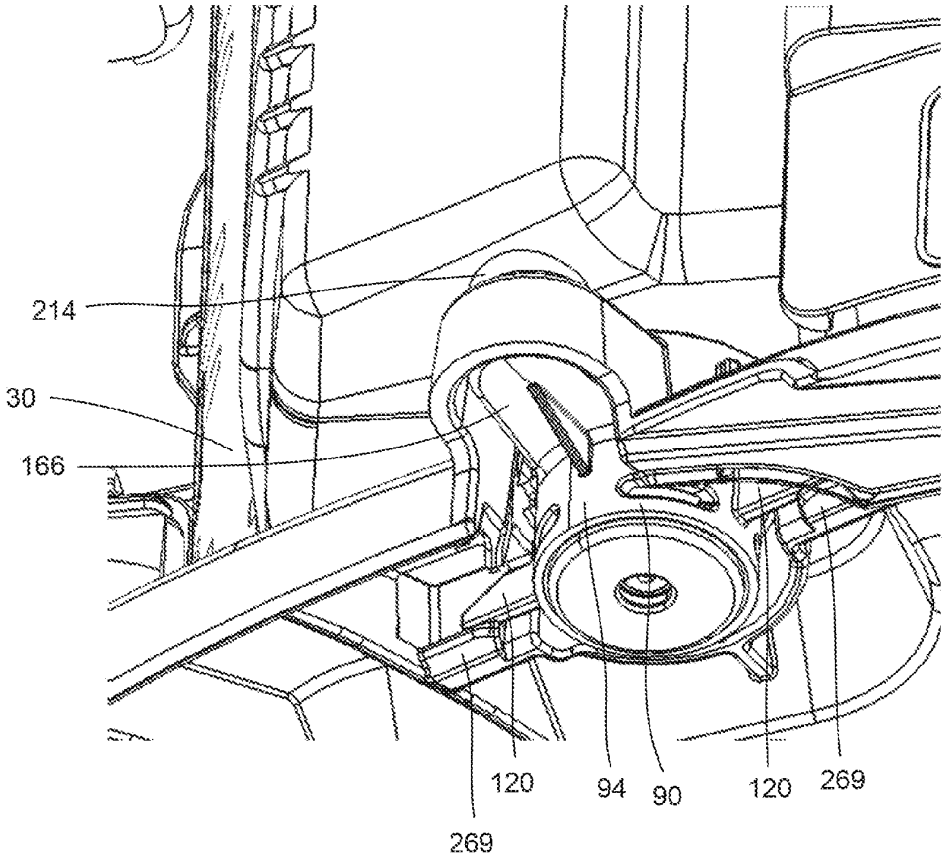


FIG. 13

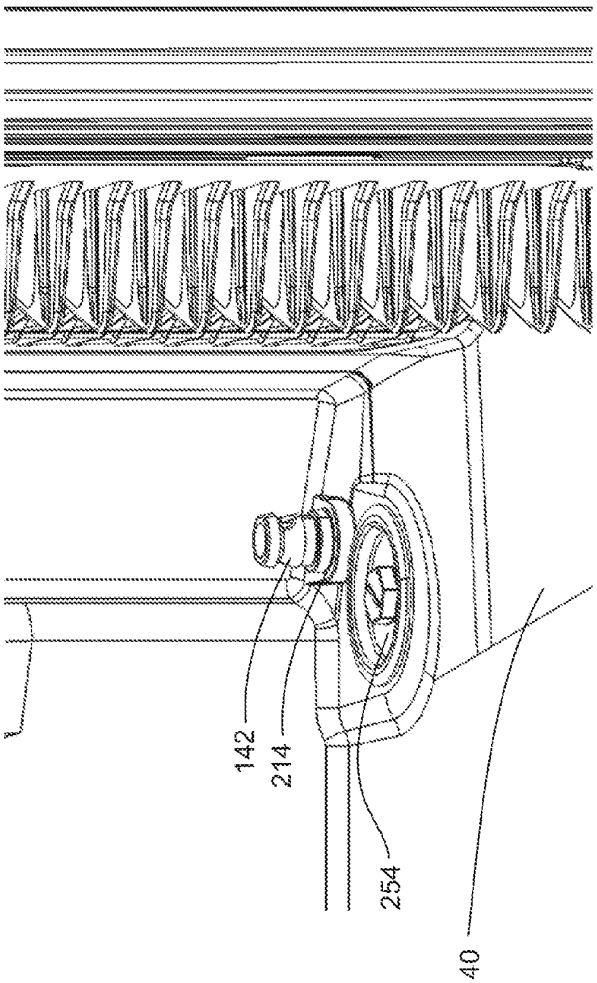


FIG. 14

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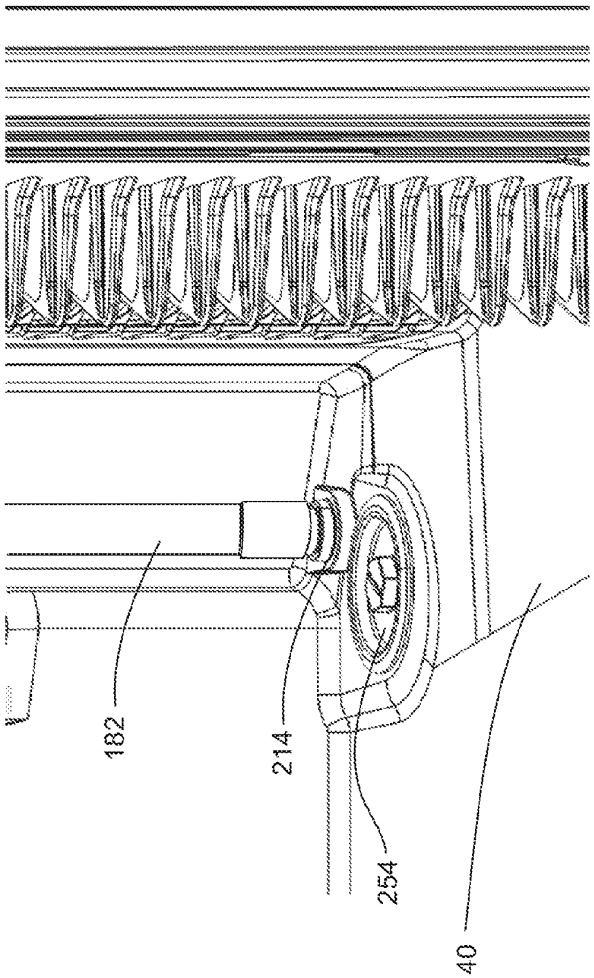


FIG. 15

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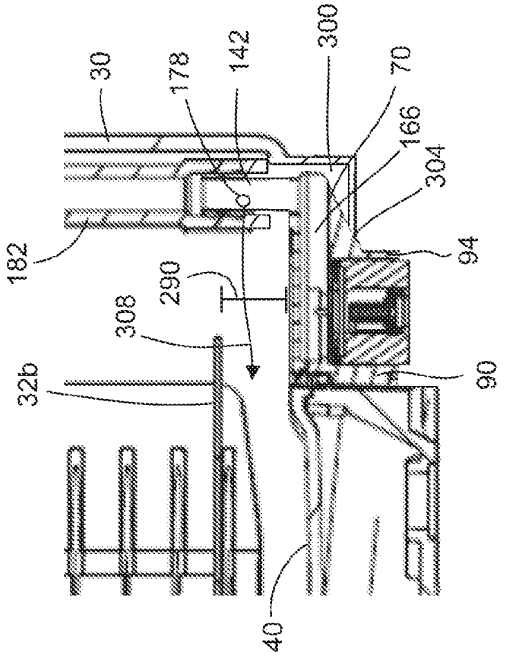

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FIG. 17

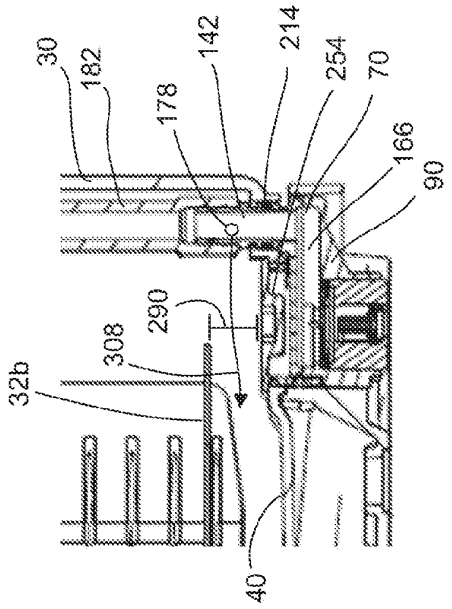

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FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/50085

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H01L 21/673, 21/02, 21/677; B65D 51/16 (2016.01)
CPC - H01L 21/67393, 21/02041, 21/677; B65D 51/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8): H01L 21/00, 21/02, 21/67, 21/673, 21/677; B65D 51/00, 51/16 (2016.01)
CPC: H01L 21/02, 21/02041, 21/02087, 21/0209, 21/02093, 21/67, 21/673, 21/6735, 21/67389, 21/67393, 21/677; B65D 51/00, 51/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH); Google Patent, Google Scholar, IEEE, Total Patent, EBSCO
Keywords: purge, clean, tower, substrate, wafer, container, box, pod, wall, door, opening, aperture, nozzle, valve, conduit, tube, diffuser

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	WO 2015/057739 A1 (ENTEGRIS, INC) April 23, 2015; page 8, lines 4-10, 18-22, page 21, line 3 to page 22, line 13, lines 20-28, page 23, lines 15-17, claims 19, 39, 56, figures 1, 16a-16c, 17a, 18b	1-11 & 22 --- 12-21
Y	US 2005/0115866 A1 (BURNS, J et al.) June 2, 2005; figures 2-4, paragraphs [0025], [0026]	12-20
Y	US RE39,241 E (FOSNIGHT, W) August 22, 2006; title, figures 3, 6c, 7, column 5, lines 9-37, 43-46, column 6, lines 1-15, 61-66, column 7, line 45 to column 8, line 21	21

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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(71) 出願人: 信越ポリマー株式会社 (**SHIN-ETSU POLYMER CO.,LTD.**) [JP/JP]; 〒1010041 東京都千代田区神田須田町一丁目9番地 Tokyo (JP).

(72) 発明者: 小川 統 (**OGAWA Osamu**); 〒3310811 埼玉県さいたま市北区吉野町1丁目406番地1 信越ポリマー株式会社内 Saitama (JP). 冨永 公徳 (**TOMINAGA Kiminori**); 〒9410007 新潟県糸魚川市大字大和川715番地 信越ポリマー株式会社内 Niigata (JP).

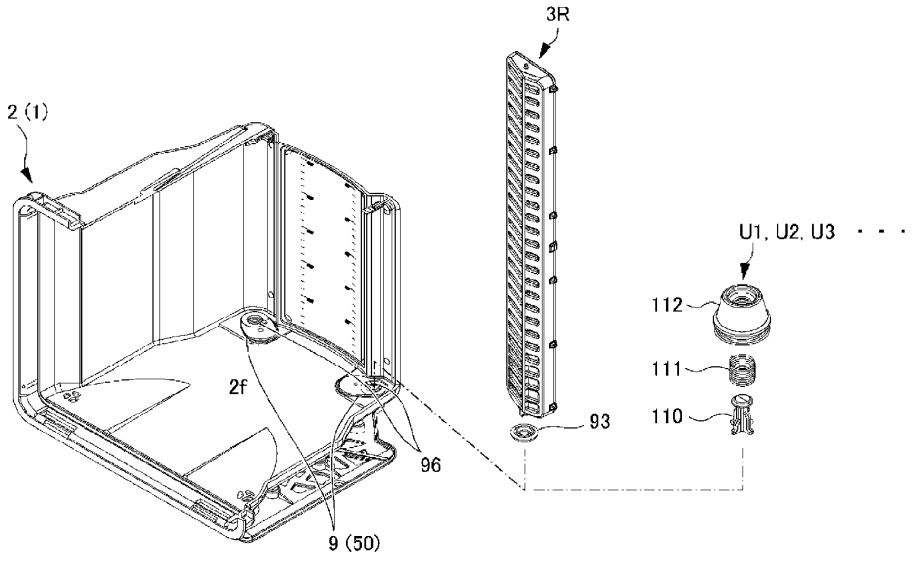
(74) 代理人: 坂本 智弘 (**SAKAMOTO Tomohiro**); 〒1600004 東京都新宿区四谷2－13 Tokyo (JP).

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(54) **Title:** SUBSTRATE STORAGE CONTAINER

(54) 発明の名称: 基板収納容器



(57) **Abstract:** The present invention provides a substrate storage container (1) provided with: a container body (2) that can house a substrate (W); and a gas supply member (50) that can supply a gas (G) from the outside of the container body (2) to an internal space, wherein the container body (2) is formed into a front-open box, and the gas supply member (50) is attached to a bottom surface (2f). The gas supply member (50) is configured such that function units (U; 3R, 3L, U1, U2, U3, U4) for changing the environment of the internal space to a different state are connected so as to be replaceable

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by being fitted. Thus, a substrate storage container that enables easy replacement of the function units for changing the environment of the internal space can be provided.

(57) 要約:本発明は、基板(W)を収納可能な容器本体(2)と、容器本体(2)の外部から内部空間に気体(G)を供給可能な給気部材(50)と、を備え、容器本体(2)をフロントオープンボックスに形成し、底面(2f)に給気部材(50)を取付けた基板収納容器(1)であって、給気部材(50)は、内部空間の環境を異なる状態に変更する機能ユニット(U;3R, 3L, U1, U2, U3, U4)が、嵌合によって交換可能に接続されているものである。これにより、内部空間の環境を変化させる機能ユニットを、簡単に交換することができる基板収納容器を提供することができる。

明　細　書

発明の名称 ： 基板収納容器

技術分野

[0001] 本発明は、複数枚の基板を収納する基板収納容器に関する。

背景技術

[0002] 基板収納容器は、半導体ウエハなどの基板を内部空間に収納し、倉庫での保管、半導体加工装置間での搬送、工場間での輸送などに使用されている。基板収納容器は、内部空間に収納した基板が酸化や汚染されないように、内部空間が窒素ガスなどの不活性ガスやドライエアで置換されることがある。

[0003] このような基板収納容器として、複数枚の基板を収納する容器本体と、容器本体の開口に着脱自在に嵌合される蓋体とを備え、容器本体の底板に、容器本体の外部から内部空間に気体を供給する給気部材がそれぞれ嵌着され、給気部材に連通する中空の吹出しノズル（機能ユニット；気体置換ユニット）を縦にして設け、吹出しノズルの周壁に、基板に向けて気体を吹出す吹出孔を設けたものが知られている（特許文献１及び２参照）。

先行技術文献

特許文献

[0004] 特許文献1：特開２０１６－００４９４９号公報

特許文献2：特開２０１６－０１５４２１号公報

発明の概要

発明が解決しようとする課題

[0005] しかしながら、特許文献１及び２にみられる基板収納容器では、機能ユニットと螺合部材とで容器本体を挟むようにして、機能ユニットを螺合により取付けているため、機能ユニットを交換する際、容器本体の内側及び外側の両側で、取付け又は取外し作業を行う必要があり、作業性が悪かった。

[0006] そこで、本発明は以上の課題に鑑みてなされたものであり、内部空間の環境を変化させる機能ユニットを、簡単に交換することができる基板収納容器

を提供することを目的とする。

課題を解決するための手段

[0007] （１）本発明に係る１つの態様は、複数枚の基板を収納可能な容器本体と、前記容器本体の外部から内部空間に気体を供給可能な給気部材と、を備え、前記容器本体をフロントオープンボックスに形成し、底面に前記給気部材を取付けた基板収納容器であって、前記給気部材は、前記内部空間の環境を異なる状態に変更する機能ユニットが、嵌合によって交換可能に接続されているものである。

（２）上記（１）の態様において、前記給気部材は、前記気体を濾過する濾過部材を有してもよい。

（３）上記（１）又は（２）の態様において前記機能ユニットは、前記給気部材から供給された前記気体を貯留するハウジング部材と、前記ハウジング部材の開口を覆うカバー部材と、前記ハウジング部材及び前記カバー部材の少なくとも一方に形成された前記気体を吹出す吹出孔と、を含む気体置換ユニットであってもよい。

（４）上記（１）又は（２）の態様において、前記機能ユニットは、前記内部空間への前記気体の流通を可能にするチェックバルブを含むバルブユニットであってもよい。

（５）上記（１）又は（２）の態様において、前記機能ユニットは、前記内部空間への前記気体の流通を不能にする閉塞ユニットであってもよい。

（６）上記（１）又は（２）の態様において、前記機能ユニットは、前記内部空間に供給される前記気体を浄化するフィルタ部材を含むフィルタユニットであってもよい。

（７）上記（１）から（６）までのいずれか１つの態様において、前記気体は、窒素ガス又はドライエアであってもよい。

発明の効果

[0008] 本発明によれば、内部空間の環境を変化させる機能ユニットを、簡単に交換することができる基板収納容器を提供することができる。

図面の簡単な説明

[0009] [図1]本発明の実施形態に係る基板収納容器の分解斜視図である。

[図2]容器本体の正面図である。

[図3]容器本体の底面図である。

[図4]容器本体の断面平面図である。

[図5]気体置換ユニットの斜視図である。

[図6]気体置換ユニットの分解斜視図である。

[図7]気体置換ユニットの（ａ）正面図、（ｂ）平面図、（ｃ）底面図、（ｄ）背面図である。

[図8]気体置換ユニットの図７（ａ）におけるＡ－Ａ断面図である。

[図9]容器本体の（ａ）正面概略図、（ｂ）気体置換ユニットの上部取付部の拡大斜視図、（ｃ）気体置換ユニットの下部取付部の拡大斜視図である。

[図10]気体置換ユニットの上部取付部の拡大斜視図である。

[図11]気体置換ユニットの（ａ）下部取付部の拡大図、（ｂ）断面斜視図である。

[図12]給気部材から流入した気体の流れを示す断面斜視図である。

[図13]交換可能な各種の機能ユニットを説明する概略図である。

[図14]バルブユニットを接続した状態における下部取付部の断面斜視図である。

[図15]閉塞ユニットを接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

[図16]小径フィルタユニットを接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

[図17]大径フィルタユニットを接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

発明を実施するための形態

[0010] 以下、本発明の実施形態について、図面を参照して詳細に説明する。なお、本明細書の実施形態においては、全体を通じて、同一の部材には同一の符

号を付している。また、図面中に、正面Ｆの方向及び後方（背面壁）Ｂの方向を、実線矢印で示している。また、左右は、正面Ｆから見た状態を指すものとする。

[0011] 基板収納容器１について説明する。図１は、本発明の実施形態に係る基板収納容器１の分解斜視図である。図２は、容器本体２の正面図であり、図３は、容器本体２の底面図であり、図４は、容器本体２の断面平面図である。

図１に示される基板収納容器１は、複数枚の基板Ｗを収納する容器本体２と、この容器本体２の開口に着脱自在に装着される蓋体４と、を備えている。基板収納容器１に収納される基板Ｗとしては、直径が３００ｍｍや４５０ｍｍの半導体ウエハ、マスクガラスなどが挙げられる。

[0012] 容器本体２は、正面開口枠２ａと、背面壁２ｂと、右側壁２ｃと、左側壁２ｄと、天面２ｅと、底面２ｆとで形成される、いわゆるフロントオープンボックスタイプのものである。

[0013] 蓋体４は、容器本体２の正面開口枠２ａの開口に装着されるもので、図示しないシールガスケットが容器本体２の正面開口枠２ａに対向するように取付けられている。この蓋体４を容器本体２に装着した際、シールガスケットは容器本体２と蓋体４との間の周縁部に密着し、基板収納容器１の内部空間の気密性を維持するように構成されている。

[0014] 容器本体２の背面壁２ｂには、更に後方Ｂに突出する突出部が左右両側に形成されている（図４参照）。この突出部は、容器本体２の正面Ｆの開口を上向きにして載置される際に、脚部として機能する。また、容器本体２の背面壁２ｂの中央外側には、収納された基板Ｗの枚数の補助となる目盛りなどが表示される（図１参照）。

[0015] 容器本体２の右側壁２ｃ及び左側壁２ｄの外側の中央付近には、握持操作用に機能するグリップ２３がそれぞれ取付けられている。

[0016] また、容器本体２の右側壁２ｃ及び左側壁２ｄの内側には、収納される基板Ｗを水平に支持する左右一対の支持片２１がそれぞれ複数設けられ、右側壁２ｃ及び左側壁２ｄの内側の後方Ｂ側には、基板Ｗを後方Ｂに向けて挿入

した際に、基板Ｗの挿入位置を規制する位置規制部２２がそれぞれ設けられている。

[0017] この左右一対の支持片２１は、上下方向に所定のピッチで配列され、各支持片２１が基板Ｗの周縁を支持する細長い板状に形成されている。実施形態では、２５枚の基板Ｗが支持できるように支持片２１が設けられているが、基板Ｗの最大収納枚数は２５枚に限らない。

[0018] このとき、基板Ｗは、容器本体２に必要に応じて満載状態で収納されたり、満載状態より少ない数が収納されたり、収納位置が変えられたりするため、容器本体２への収納枚数及び収納状態は、基板収納容器１の使用態様によって種々異なる。例えば、複数枚の基板Ｗが、上方又は下方に偏って収納されたり、１つ置きに収納されたりすることもある。

[0019] 容器本体２の天面２ｅの外側には、ロボティックフランジなどのトップフランジ２５が取付けられている。このトップフランジ２５は、例えば、半導体製造工場の天井搬送車に把持され、工程間を搬送されたり、半導体加工装置などの蓋体開閉装置に位置決めに利用されたりする。

[0020] 容器本体２の底面２ｆの外側には、容器本体２を位置決め、載置するためのボトムプレート２６が取付けられている。

[0021] 容器本体２や蓋体４、また、グリップ２３、トップフランジ２５、ボトムプレート２６などの付属品は、所要の樹脂を含有する成形材料により射出成形されたり、射出成形された複数の部品の組み合わせにより構成されたりする。成形材料に含まれる樹脂としては、例えばポリカーボネート、シクロオレフィンポリマー、ポリエーテルイミド、ポリエーテルケトン、ポリエーテルエーテルケトン、ポリブチレンテレフタレート、ポリアセタール、液晶ポリマーといった熱可塑性樹脂やこれらのアロイなどが挙げられる。

[0022] また、これらの樹脂には、カーボン繊維、カーボンパウダー、カーボンナノチューブ、導電性ポリマーなどからなる導電性物質やアニオン、カチオン、非イオン系などの各種帯電防止剤が必要に応じて添加される。さらに、紫外線吸収剤や、剛性を向上させる強化繊維なども必要に応じて添加される。

なお、容器本体２、蓋体４、グリップ２３、トップフランジ２５及びボトムプレート２６などは、透明、不透明、半透明のいずれでもよいが、容器本体２及び蓋体４は、透明が好ましい。

[0023] ここで、容器本体２の底面２ｆには、図３に示すように、３つの給気部材５０と１つの排気部材６０とが設けられている。これらの給気部材５０及び排気部材６０は、基板収納容器１の外部から内部空間に又は内部空間から外部に気体Ｇを流通させることにより、収納した基板Ｗの表面の変質を抑制したり、基板収納容器１の内部空間と外部との圧力差を解消したりするように機能する。

[0024] このうち、２つの給気部材５０が、底面２ｆの後方Ｂの左右両側に設けられており、また、１つの給気部材５０と１つの排気部材６０とが、底面２ｆの正面Ｆ付近の左又は右側に設けられている。そして、これらの給気部材５０に、後述する各種の機能ユニットＵが接続されている（図１３参照）。なお、正面Ｆ付近の給気部材５０は、排気部材６０として使用される場合もある。

[0025] 給気部材５０は、容器本体２の底面２ｆに形成された凹部に装着されるグロメット５０ａと、グロメット５０ａの端部に取付けられた、通気性を有する濾過部材５１と、逆止弁５２とを有している。グロメット５０ａは、エラストマーなどの弾性樹脂部材で形成されている。濾過部材５１は、供給される気体Ｇを濾過し、塵埃を除去するもので、不織布フィルタなどが用いられる。

[0026] 逆止弁５２は、弁を閉止する方向にコイルバネ５３により付勢されて、バルブハウジング５４に収容されている。なお、本実施形態では、給気部材５０は、逆止弁５２を有するものとしたが、後述する機能ユニットＵの種類によっては、逆止弁５２を有さないものであってもよい。

[0027] 一方、排気部材６０は、逆止弁（図示なし）を有するとともに、例えば、湿度（又は濃度）センサを取付けることで、基板収納容器１の内部空間を気体Ｇで置換した後、基板収納容器１の内部空間の湿度（又は濃度）を測定す

ることができ、基板収納容器１の内部空間への気体Ｇの置換が正常に行われているかの管理を行うことができる。

[0028] つづいて、基板収納容器１の内部空間の環境を変化させる各種の機能ユニットＵの構成について順に説明する。図１３は、交換可能な各種の機能ユニットＵを説明する概略図である。

機能ユニットＵとしては、気体置換ユニット３Ｒ，３Ｌ、バルブユニットＵ１、閉塞ユニットＵ２、小径フィルタユニットＵ３、大径フィルタユニットＵ４などが挙げられる。

[0029]（気体置換ユニット３Ｒ，３Ｌ）

まず、基板収納容器１の内部空間を気体置換ユニット３Ｒ，３Ｌにより気体Ｇに置換する構成について説明する。図５は、気体置換ユニット３Ｒ，３Ｌの斜視図であり、図６は、気体置換ユニット３Ｒ，３Ｌの分解斜視図である。図７は、気体置換ユニット３Ｒ，３Ｌの（ａ）正面図、（ｂ）平面図、（ｃ）底面図、（ｄ）背面図である。図８は、気体置換ユニット３Ｒ，３Ｌの図７におけるＡ－Ａ断面図である。なお、図５から図８は、正面Ｆから見て右側の気体置換ユニット３Ｒについて示す。

[0030] 気体置換ユニット３Ｒ，３Ｌは、容器本体２の内部空間を気体Ｇで置換するもので、基板Ｗが挿入された状態でも基板Ｗと干渉しないように、容器本体２の後方Ｂ（背面壁２ｂ又は突出部付近）の左右両側に、長手方向を縦にして備えられている（図１及び２参照）。

[0031] この気体置換ユニット３Ｒ，３Ｌは、容器本体２の内部空間に気体Ｇを吹出すものである。吹出す気体Ｇとしては、不活性ガスやドライエアが挙げられる。さらに、不活性ガスとしては、窒素ガス、アルゴンガスなどが挙げられるが、コスト面から窒素ガスが好ましい。

[0032] 気体置換ユニット３Ｒ，３Ｌについて更に詳細に説明する。ただし、気体置換ユニット３Ｌは、図２に示されるように、気体置換ユニット３Ｒと左右対称なものである点を除いて、同じ形状・構造であるから、説明を省略する。

[0033] 図５に示される気体置換ユニット３Ｒは、ハウジング部材３１と、カバー部材３２とを含み、略５角形柱状に形成されているが、形状はこれに限られない。また、気体置換ユニット３Ｒは、容器本体２などと同様の樹脂で形成されても、異なる樹脂で形成されてもよい。

[0034] ハウジング部材３１は、気体Ｇを貯留するように、一方が開口した面となる箱状に形成されており、この開口した面を覆うように、カバー部材３２が、爪などの係止手段（係合手段）によって取付けられている。これらのハウジング部材３１とカバー部材３２とで、気体Ｇを貯留する空間が形成されている。

[0035] ここで、ハウジング部材３１は、所定の角度で交差し、大きさの異なる２つの面部３１Ａ，３１Ｂを有している。面部３１Ａと面部３１Ｂとの交差角度は、内角で１２０°から１７０°の範囲である。また、面部３１Ａの面積は、面部３１Ｂの面積より大きく形成されている。

[0036] ハウジング部材３１の下面には、給気部材５０からの気体Ｇが流れ込む円筒状の接続具３１１が突出して設けられている。接続具３１１の近傍には、気体置換ユニット３Ｒの左右方向の回転を止め、回転方向の位置決めをする回止め突起３１２が形成されている（図７参照）。一方、ハウジング部材３１の上面には、容器本体２に位置決め固定するための円柱状の位置決め突起３１３が形成されている。

[0037] ハウジング部材３１の面部３１Ａには、図７（ａ）に示すように、横長の略矩形状の吹出孔が、縦方向（長手方向）に上から順に、第１吹出孔３１ａ，３１ｂ，３１ｃ・・・３１ｘ，３１ｙ，３１ｚ（以下、必要に応じて「第１吹出孔群３１ａ－ｚ」という。）が２６か所に形成されている。

[0038] ハウジング部材３１の面部３１Ｂには、同じく横長の略矩形状の吹出孔が、縦方向（長手方向）に上から順に、第３吹出孔３３ａ，３３ｂ，３３ｃ・・・３３ｘ，３３ｙ，３３ｚ（以下、必要に応じて「第３吹出孔群３３ａ－ｚ」という。）として２６か所に形成されている。

[0039] 第１吹出孔群３１ａ－ｚと、第３吹出孔群３３ａ－ｚとを、所定の角度で

交差する面部３１Ａ，３１Ｂにそれぞれ形成することにより、気体Ｇの吹出方向を異ならせることができ、気体Ｇが基板収納容器１の内部空間に拡散し易くなる。

[0040] 最上段の第１吹出孔３１ａの開口高さは、２段目の第１吹出孔３１ｂの開口高さよりも、少し大きく、すなわち、第１吹出孔３１ａの開口面積は、第１吹出孔３１ｂの開口面積よりも、少し大きい。また、第１吹出孔３１ｂから第１吹出孔３１ｕまでの開口面積は、すべて等しく、第１吹出孔３１ｖから第１吹出孔３１ｙまでの開口面積は、第１吹出孔３１ｕの開口面積よりも徐々に大きくなり、第１吹出孔３１ｚの開口面積は、第１吹出孔３１ｙの開口面積よりも小さい。また、第３吹出孔群３３ａ－ｚについても同様である。

[0041] そして、最下段の第１吹出孔３１ｚ及び第３吹出孔３３ｚは、容器本体２の最下段の支持片２１に支持された基板Ｗよりも下方に位置している。ただし、最下段の基板Ｗよりも下方に位置する第１吹出孔３１ｚ及び第３吹出孔３３ｚは、１つに限らず複数であってもよい。

[0042] このように、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚは、下方側の開口面積を大きくしているため、下方から供給される気体Ｇの直進性が高くても、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚの下方から上方にわたって、気体Ｇが均一に吹出される。また、最下段の基板Ｗの下にも第１吹出孔３１ｚ及び第３吹出孔３３ｚが形成されているので、最下段の基板Ｗと底面２ｆとの間にも、気体Ｇが吹出されるから、クリーンルーム内のダウンフローのエアが容器本体２の正面Ｆの開口から内部に侵入しても、底面２ｆの上面を正面Ｆに向かって吹出す気体Ｇによって、必要以上に流れ込むことがない。

[0043] 一方、カバー部材３２には、図７（ｄ）に示すように、略矩形又は正方形状の吹出孔が、縦方向（長手方向）に上から順に、第２吹出孔３２ａ，３２ｂ・・３２ｅ，３２ｆ（以下、必要に応じて「第２吹出孔群３２ａ－ｆ」という。）として６か所に形成されている。最上段の第２吹出孔３２ａの高さ

位置は、第１吹出孔３１ｃの高さ位置と略同じで、以下、第２吹出孔３２ｂと第１吹出孔３１ｈとが、第２吹出孔３２ｃと第１吹出孔３１ｍとが、第２吹出孔３２ｄと第１吹出孔３１ｓとが、第２吹出孔３２ｅと第１吹出孔３１ｗとが、第２吹出孔３２ｆと第１吹出孔３１ｙとが、略同じ高さでそれぞれ一致している。

[0044] ここで、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚのそれぞれの合計開口面積Ｓ１，Ｓ２，Ｓ３の比率は、容器本体２に収納された複数の基板W間での湿度のバラツキがより小さくなるように調節できる。開口面積の調節は、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚの各吹出孔が異なるハウジング部材３１及びカバー部材３２を準備することや、適宜の吹出孔を閉止することで実施できる。

[0045] 図４に戻って、気体置換ユニット３Ｒ，３Ｌは、上述したように容器本体２の後方Ｂ（背面壁２ｂ又は突出部付近）の左右両側に備えられているため、吹出した気体Ｇを基板収納容器１の内部空間に均一に拡散させるためには、基本的に第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚから正面Ｆ側に向かって吹出し、空気を気体Ｇで置換することになる。このとき、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚが設けられた位置よりも後方Ｂ側の、背面壁２ｂから右側壁２ｃ又は左側壁２ｄ付近にも空気が存在するため、後方Ｂに向かって第２吹出孔群３２ａ－ｆからも気体Ｇを吹出す方がよい。

[0046] そして、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚが設けられた位置よりも正面Ｆ側の空間は、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚが設けられた位置よりも後方Ｂ側の空間と比較するとかなり大きいため、正面Ｆ側を向く第１吹出孔群３１ａ－ｚの合計開口面積Ｓ１及び第３吹出孔群３３ａ－ｚの合計開口面積Ｓ３は、後方Ｂ側を向く第２吹出孔群３２ａ－ｆの合計開口面積Ｓ２よりも、大きくする方がよい。

[0047] また、気体置換ユニット３Ｒ，３Ｌは、前述したように基本的に正面Ｆ側

に向かって気体Ｇを吹出すが、右側壁２ｃ又は左側壁２ｄ付近に備えられるため、右側壁２ｃ又は左側壁２ｄに沿って正面Ｆに向かう気体Ｇは、少なくてもよいが、逆に、容器本体２の中央に向かう気体Ｇは、多い方がよい。そのため、第１吹出孔群３１ａ－ｚの合計開口面積Ｓ１は、第３吹出孔群３３ａ－ｚの合計開口面積Ｓ３よりも、大きくする方がよい。

[0048] これらを踏まえると、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚのそれぞれの合計開口面積Ｓ１，Ｓ２，Ｓ３は、Ｓ１：Ｓ２：Ｓ３＝３：１：２などとしてもよい。

[0049] 図６に戻って、ハウジング部材３１の内側には、通気性を有するフィルタ部材３４が設けられており、同じくカバー部材３２の内側には、通気性を有するフィルタ部材３５が設けられている。フィルタ部材３４，３５としては、例えば、不織布フィルタなどが挙げられる。

[0050] そして、円筒状の接続具３１１から導入された気体Ｇは、ハウジング部材３１とカバー部材３２とで形成される空間に導入され、貯留される。貯留された気体Ｇは、フィルタ部材３４，３５を介して、第１吹出孔群３１ａ－ｚ、第２吹出孔群３２ａ－ｆ及び第３吹出孔群３３ａ－ｚから容器本体２の内部空間に吹出される。

[0051] 気体置換ユニット３Ｒの容器本体２への取付方法について説明する。図９は、容器本体２の（ａ）正面概略図、（ｂ）気体置換ユニット３Ｒの上部取付部の拡大斜視図、（ｃ）気体置換ユニット３Ｒの下部取付部の拡大斜視図である。図１０は、気体置換ユニット３Ｒの上部取付部の拡大斜視図である。図１１は、気体置換ユニット３Ｒの（ａ）下部取付部の拡大図、（ｂ）断面斜視図である。

[0052] 気体置換ユニット３Ｒは、位置決め固定部材８及びオフセット部材９により容器本体２に取付けられている。具体的には、気体置換ユニット３Ｒの上部が、位置決め固定部材８に取付けられ、気体置換ユニット３Ｒの下部が、オフセット部材９に取付けられる。

[0053] そこで、容器本体２の背面壁２ｂの左右両側には、位置決め固定部材８を

固定するために、円形の貫通孔２７が形成されており、また、貫通孔２７の上部には、ストッパ２８が形成されている。一方、容器本体２の底面２ｆの左右両側には、オフセット部材９を固定するために、取付孔２９が形成されている。この取付孔２９は、円形でなく大きな円と小さな円を繋いだ略楕円形状で形成されている。

[0054] 図１０に示される位置決め固定部材８は、細長い形状で、一端側が略板状で、他端側が矩形の軸で形成されている。この軸の周囲には、３つの円盤状のフランジ８１，８２，８３が他端側に向かって形成されている。軸端のフランジ８３と中間のフランジ８２は、背面壁２ｂの貫通孔２７の径より小さく形成され、貫通孔２７に挿入される。中間のフランジ８２には、小径の段部が形成され、Ｏリング８４Ａが嵌め込まれている。内側のフランジ８１にも、小径の段部が形成され、Ｏリング８４Ｂが嵌め込まれている。内側のフランジ８１及びＯリング８４Ｂは、貫通孔２７の径より大きく形成されており、位置決め固定部材８の他端側を貫通孔２７に挿入した際、容器本体２とフランジ８１の間にＯリング８４Ｂが挟まるため、気体Ｇが漏れることがない。

[0055] 位置決め固定部材８を貫通孔２７に挿入後、軸端のフランジ８３と容器本体２の間に位置する矩形の軸に、内側が矩形状に形成され、外径が貫通孔２７より大きいＣリング８５を挟むことにより、位置決め固定部材８が貫通孔２７を介して容器本体２に固定される。具体的には、軸端のフランジ８３を外側に引っ張りながら、Ｏリング８４Ｂをフランジ８１と容器本体２との間で潰しながら、Ｃリング８５を差し込むことで密封性が高まる。

[0056] また、位置決め固定部材８の一端側は、上方に屈曲した板形状で、細長いスリット８６が形成されている。このスリット８６には、ハウジング部材３１の位置決め突起３１３とストッパ２８が嵌り込む。端部８７は、更に上部に湾曲し、その更に先端にはＵ字型の切欠き８８が形成されている。

[0057] 図１１に示されるオフセット部材９は、底面２ｆの内側に位置するオフセットプレート押さえ９０と、底面２ｆの外側に位置するオフセットプレート

９５との間に、気体Ｇが流通する隙間が形成されるように、Ｏリング９４を介して組立てられている。

[0058] オフセットプレート押さえ９０には、ハウジング部材３１の回止め突起３１２が嵌り込む凹部９２が形成されており、回止め突起３１２が凹部９２に嵌り込むことで、回転する気体置換ユニット３Ｒの方向及び位置が決まる。また、オフセットプレート押さえ９０には、気体置換ユニット３Ｒの接続具３１１を差し込む差込孔９６が形成されており、接続具３１１は、パッキン９３を介して差込孔９６に差し込まれる。取付孔２９には、このオフセットプレート押さえ９０がＯリング９１を介して嵌め込まれる。

[0059] オフセットプレート９５は、平面視で、パッキン９３の中心位置からズレた位置に、給気部材５０の中心が位置するように、給気部材５０を嵌め込む凹部が形成されている。

[0060] このような構成により、気体置換ユニット３Ｒは、まず下部の接続具３１１がオフセット部材９に取付けられ、その後、上部の位置決め突起３１３が位置決め固定部材８に取付けられて、容器本体２に取付けられる。

[0061] 具体的には、気体置換ユニット３Ｒの下部の接続具３１１をパッキン９３に差し込んで傾いた状態から、気体置換ユニット３Ｒの上部の位置決め突起３１３を、端部８７側からスリット８６に向かって押し込むことで、位置決め固定部材８が湾曲して、位置決め突起３１３が、スリット８６に嵌り込む。と同時に、位置決め突起３１３は、ストッパ２８にも当接することで、スリット８６内での位置が決められ、気体置換ユニット３Ｒの上部が位置決め固定される。

[0062] 気体Ｇの流れについて説明する。図１２は、給気部材５０から流入した気体Ｇの流れを示す断面斜視図である。なお、気体Ｇの流れは、矢印で示す。

図１２において、給気部材５０から高圧で導入された気体Ｇは、濾過部材５１を通過し、オフセットプレート押さえ９０とオフセットプレート９５との隙間を流れ、後方Ｂのオフセットプレート押さえ９０と気体置換ユニット３Ｒの下部の接続具３１１との接続部に向かう。

[0063] その後、気体Ｇは気体置換ユニット３Ｒの貯留空間を進みながら（図８参照）、第１吹出孔群３１ａ－ｚ、第３吹出孔群３３ａ－ｚ及び第２吹出孔群３２ａ－ｆから吹出される。このとき、気体Ｇは、正面Ｆ側の中央付近及び右側壁２ｃに向かう方向と、後方Ｂ側の背面壁２ｂに向かう方向との、異なる３方向に吹出される（図４参照）。

[0064] ここで、第１吹出孔群３１ａ－ｚから容器本体２の正面Ｆ側の中央付近に向かって吹き出される気体Ｇの方向及び第３吹出孔群３３ａ－ｚから容器本体２の右側壁２ｃ又は左側壁２ｄに向かって吹出される気体Ｇの方向について具体的に説明する。

[0065] 第１吹出孔群３１ａ－ｚ又は第３吹出孔群３３ａ－ｚの吹出開口の延長方向、つまり、第１吹出孔群３１ａ－ｚ又は第３吹出孔群３３ａ－ｚが形成された面部３１Ａ又は面部３１Ｂの中央を通る法線が、右側壁２ｃ又は左側壁２ｄに交差することなく、容器本体２の正面開口枠２ａの開口に到達する範囲であることが好ましい。更に好ましくは、気体置換ユニット３Ｒの場合、面部３１Ａの法線が、容器本体２の正面開口枠２ａの開口からの法線ＮＬ（垂線）に対して１０°から４０°の範囲であり、面部３１Ｂの法線が、容器本体２の正面開口枠２ａの開口からの法線ＮＬ（垂線）を挟んで、中央側５°から右側壁２ｃ側１０°の範囲である。なお、気体置換ユニット３Ｌの場合は、気体置換ユニット３Ｒと対称となる。

[0066] このような範囲となるように、面部３１Ａ及び面部３１Ｂ（あるいは、第１吹出孔群３１ａ－ｚ及び第３吹出孔群３３ａ－ｚ）を形成し、気体置換ユニット３Ｒ，３Ｌを容器本体２の内部に備えることで、各吹出孔から吹出された気体Ｇは、容器本体２の右側壁２ｃ又は左側壁２ｄに、衝突して反射することがない。そのため、気体Ｇの気流に乱れが起きることがないから、容器本体２の内部空間を気体Ｇで素早く確実に置換することができる。

[0067] 蓋体４が容器本体２に装着されている場合には、容器本体２に気体Ｇが高圧で供給され、内部空間に充満すると、気体Ｇは、図３に示した排気部材６０から容器本体２の外部に流出する。この空気の流出により、基板収納容器

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１の内部空間がパージガスである気体Ｇに置換される。

[0068] 一方、蓋体４が装着されていない場合には、図示しないクリーンルームなど外部装置からのダウンフローのエアが、容器本体２の正面Ｆから流れ込むが、このエアに抗しながら、基板収納容器１の内部空間がパージガスである気体Ｇに置換される。

[0069] （バルブユニットＵ１）

図１４は、バルブユニットＵ１を接続した状態における下部取付部の断面斜視図である。

バルブユニットＵ１は、給気部材５０から基板収納容器１の内部空間への気体Ｇの流通を可能にするが、内部空間の気体Ｇが給気部材５０に逆流しない、チェックバルブ１１０を含むものである。

[0070] バルブユニットＵ１は、図１４に示すように、弁座１１３を有する略円筒状のバルブハウジング１１２と、コイルバネ１１１によって弁座１１３に付勢されるチェックバルブ１１０と、で構成されている。チェックバルブ１１０及びバルブハウジング１１２は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。

[0071] 上述した気体置換ユニット３Ｒ，３Ｌは、収納された基板W間に均一に気体Ｇを吹出すように構成されているのに対して、このバルブユニットＵ１は、給気部材５０から供給される気体Ｇの圧力が、コイルバネ１１１の付勢力に打ち勝って、チェックバルブ１１０を、弁座１１３から離間したときに、基板収納容器１の内部空間へ気体Ｇを流通させるようになっており、内部空間における気体Ｇの均一性が重要でない場合などに利用される。

[0072] バルブユニットＵ１を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、バルブハウジング１１２を差し込み、２つのフランジ１１４で嵌合係止すればよい。

[0073] （閉塞ユニットＵ２）

図１５は、閉塞ユニットＵ２を接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

閉塞ユニットＵ２は、給気部材５０から基板収納容器１の内部空間への気体Ｇの流通を不能にするものである。

[0074] 閉塞ユニットＵ２は、図１５に示すように、キノコ状のプラグ本体１２０と、プラグ本体１２０の棒状部が装着される装着孔１２２を有するとともに、差込孔９６に差し込まれ、嵌合係止されるパッキン１２１と、で構成されている。プラグ本体１２０は、プラスチック樹脂などで形成されており、パッキン１２１は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。

[0075] 閉塞ユニットＵ２を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、パッキン１２１を差し込み、嵌合係止し、プラグ本体１２０を装着孔１２２に挿入装着すればよい。

[0076] （小径フィルタユニットＵ３）

図１６は、小径フィルタユニットＵ３を接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

小径フィルタユニットＵ３は、給気部材５０から基板収納容器１の内部空間に供給される気体Ｇを浄化するフィルタ部材１３０を含むものである。

[0077] 小径フィルタユニットＵ３は、図１６に示すように、通気性を有するフィルタ部材１３０と、フィルタ部材１３０が接着又は保持固定される大径円筒部を有する二段円筒状のフィルタハウジング１３３と、フィルタハウジング１３３の小径円筒部が装着される装着孔１３２を有するとともに、差込孔９６に差し込まれ、嵌合係止されるパッキン１３１と、で構成されている。フィルタハウジング１３３は、プラスチック樹脂などで形成され、パッキン１３１は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。また、フィルタ部材１３０は、不織布フィルタなどで形成されている。

[0078] 小径フィルタユニットＵ３を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、パッキン１３１を差し込み、嵌合係止し、フィルタハウジング１３３を装着孔１３２に挿入装着すればよい。なお、小径フィル

Entegris, EX1002, p. 1060

タユニットＵ３は、約１０Ｌ／ｍｉｎの気体Ｇを供給しても、通過圧損が小さいため、嵌合のみで接続されていても、嵌合が外れるようなことがない。

[0079] （大径フィルタユニットＵ４）

図１７は、大径フィルタユニットＵ４を接続した状態における下部取付部の（ａ）斜視図、（ｂ）断面斜視図である。

大径フィルタユニットＵ４は、小径フィルタユニットＵ３と同様に、給気部材５０から基板収納容器１の内部空間に供給される気体Ｇを浄化するフィルタ部材１４０を含むものである。

[0080] 大径フィルタユニットＵ４は、図１７に示すように、通気性を有するフィルタ部材１４０と、フィルタ部材１４０が接着又は保持固定される大径円筒部を有する二段円筒状のフィルタハウジング１４３と、フィルタハウジング１４３の小径円筒部が装着される装着孔１４２を有するとともに、差込孔９６に差し込まれ、嵌合係止されるパッキン１４１と、で構成されている。フィルタハウジング１４３は、プラスチック樹脂などで形成され、パッキン１４１は、フッ素系樹脂、エラストマー、ゴムなどの所定の弾性を有する各種材料で形成されている。また、フィルタ部材１４０は、不織布フィルタなどで形成されている。

[0081] 大径フィルタユニットＵ４を給気部材５０に接続する場合は、オフセット部材９の差込孔９６に、パッキン１４１を差し込み、嵌合係止し、フィルタハウジング１４３を装着孔１４２に挿入装着すればよい。なお、大径フィルタユニットＵ４は、フィルタ部材１４０の面積が、小径フィルタユニットＵ３のフィルタ部材１３０の面積よりも約４倍大きいため、例えば、約３０Ｌ／ｍｉｎの大量の気体Ｇを供給する場合でも、通過圧損を小さくすることができる。

[0082] 上述した気体置換ユニット３Ｒ，３Ｌは、収納された基板W間に均一に気体Ｇを吹出すように構成されているのに対して、この小径フィルタユニットＵ３及び大径フィルタユニットＵ４は、基板収納容器１の内部空間における気体Ｇの均一性が重要でない場合などに利用される。なお、気体置換ユニッ

ト３Ｒ，３Ｌは、フィルタ部材３４，３５を含むものであるから、フィルタユニット３Ｒ，３Ｌと言い換えることもできる。

[0083] 以上のとおり、本発明の実施形態に係る基板収納容器１は、複数枚の基板Ｗを収納可能な容器本体２と、容器本体２の外部から内部空間に気体Ｇを供給可能な給気部材５０と、を備え、容器本体２をフロントオープンボックスに形成し、底面２ｆに給気部材５０を取付けた基板収納容器１であって、給気部材５０は、内部空間の環境を異なる状態に変更する機能ユニットＵが、嵌合によって交換可能に接続されているものである。

[0084] これにより、給気部材５０に各種の機能ユニットＵを取付けることができるため、容器本体２から機能ユニットＵを簡単に取付け又は取外しをすることができる。容器本体２を洗浄する際も、機能ユニットＵを容易に取外すことができ、容器本体２内を隅々まで洗浄することができる。また、取外した機能ユニットＵも簡単に洗浄することができる。

[0085] 実施形態では、給気部材５０は、気体を濾過する濾過部材５１を有する。これにより、フィルタを有さない機能ユニットＵを接続する場合であっても、機能ユニットＵから、塵埃を含んだ気体Ｇが吹出されることを抑制できるし、また、フィルタユニットＵ２，Ｕ３などのフィルタを有する機能ユニットＵを接続する場合は、二重に塵埃を除去することができ、機能ユニットＵのフィルタ交換間隔を長くすることができる。さらに、容器本体２を洗浄する際に使用される洗浄液などの液体が、疎水性の濾過部材５１により、液体の侵入を防止することができる。

[0086] 実施形態では、機能ユニットＵは、給気部材５０から供給された気体Ｇを貯留するハウジング部材３１と、ハウジング部材３１の開口を覆うカバー部材３２と、ハウジング部材３１及びカバー部材３２の少なくとも一方に形成された気体を吹出す吹出孔と、を含む気体置換ユニット３Ｒ，３Ｌである。これにより、気体置換ユニット３Ｒ，３Ｌの吹出孔から吹出した気体Ｇは、容器本体２の中央付近、側壁２ｃ，２ｄ、背面壁２ｂに向かって流すことができる。

Entegris, EX1002, p. 1062

[0087] 実施形態では、機能ユニットＵは、内部空間への気体Ｇの流通を可能にするチェックバルブ１１０を含むバルブユニットＵ１である。これにより、基板収納容器１の内部空間における気体Ｇの均一性が重要でない場合などは、気体置換ユニット３Ｒ，３Ｌを利用する必要がない。

[0088] 実施形態では、機能ユニットＵは、内部空間への気体Ｇの流通を不能にする閉塞ユニットＵ２である。これにより、給気部材５０を介して、基板収納容器１の内部空間と外部の雰囲気との間で、気体Ｇ又は空気などが流通することを、より確実に防止することができる。

[0089] 実施形態では、機能ユニットＵは、内部空間に供給される気体Ｇを浄化するフィルタ部材を含むフィルタユニットＵ３，Ｕ４である。これにより、供給される気体Ｇに塵埃が含まれていても、フィルタ部材１３０，１４０で捕獲することができるため、容器本体２内に塵埃が吹出されることがなく、基板収納容器１の内部空間が汚染されることがない。

[0090] 実施形態では、気体Ｇは、窒素ガス又はドライエアである。これにより、基板収納容器１の内部空間に気体Ｇを供給した場合、内部空間が不活性又は低湿度に維持されるので、基板Ｗの表面は変質することがない。

[0091] （変形例）

実施形態の気体置換ユニット３Ｒ，３Ｌにおいて、第１吹出孔群３１ａ－ｚ、第３吹出孔群３３ａ－ｚ及び第２吹出孔群３２ａ－ｆの開口面積や数量や配置も実施形態に限らず、底面２ｆの上面に沿って吹き込むダウンフローエアなどの外部からエアに対向できるように、下方の吹出風量を増やすように構成してもよい。

[0092] また、第２吹出孔群３２ａ－ｆを選択的に塞いだり、追加で穿設したりすることで、正面Ｆ方向及び後方Ｂ方向への吹出風量の比率を調整してもよい。さらに、オフセット部材９の凹部９２の位置を変更することで、気体置換ユニット３Ｒ，３Ｌの方向を変更してもよい。あるいは、ハウジング部材３１の２つの面部３１Ａ，３１Ｂの交差角度を変更したり、面積を変更したりして、吹出方向及び／又は吹出風量の比率を調整してもよい。なお、これら

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の変更は、成形金型に入れ子を用いることで対応することができる。

[0093] また、ハウジング部材３１は、上部でなく中央部で位置決め固定されてもよく、あるいは、上部及び中央部で位置決め固定されてもよい。このとき、背面壁２ｂに形成される貫通孔２７の位置は、適宜変更され、位置決め固定部材８の形状も適宜変更される。

[0094] 上記実施形態において、気体置換ユニット３Ｒ，３Ｌの他に、他の気体置換ユニットを複数備えてもよいし、逆に気体置換ユニット３Ｒ又は３Ｌのいずれか１つであってもよい。また、気体置換ユニット３Ｒ，３Ｌは、後方Ｂの左右の２か所に限らず、後方Ｂの中央部に基板Ｗと干渉しない領域があれば、その領域に配置してもよい。

[0095] 以上、本発明の好ましい実施形態について詳述したが、本発明は上述した実施形態に限定されるものではなく、特許請求の範囲に記載された本発明の要旨の範囲内において、種々の変形、変更が可能である。

符号の説明

[0096] １　基板収納容器

２　容器本体、２ａ　正面開口枠、２ｂ　背面壁、２ｃ　右側壁、２ｄ　左側壁、２ｅ　天面、２ｆ　底面、２１　支持片、２２　位置規制部、２３　グリップ、２５　トップフランジ、２６　ボトムプレート、２７　貫通孔、２８　ストッパ、２９　取付孔

３Ｒ，３Ｌ　気体置換ユニット、３１　ハウジング部材、３１Ａ，３１Ｂ　面部、３１１　接続具、３１２　回止め突起、３１３　位置決め突起、３２　カバー部材、３１ａ・・・３１ｚ　第１吹出孔、３２ａ・・・３２ｆ　第２吹出孔、３３ａ・・・３３ｚ　第３吹出孔、３４，３５　フィルタ部材

４　蓋体

５０　給気部材、５０ａ　グロメット、５１　濾過部材、５２　逆止弁、５３　コイルバネ、５４　バルブハウジング

６０　排気部材

８　位置決め固定部材、８１，８２，８３　フランジ、８４Ａ，８４Ｂ　Ｏリング、８５　Ｃリング、８６　スリット、８７　端部、８８　切欠き

９　オフセット部材、９０　オフセットプレート押さえ、９１　Ｏリング、９２　凹部、９３　パッキン、９４　Ｏリング、９５　オフセットプレート、９６　差込孔

Ｆ　正面、Ｂ　後方、Ｇ　気体、Ｗ　基板、ＮＬ　法線

Ｕ　機能ユニット

Ｕ１　バルブユニット、１１０　チェックバルブ、１１１　コイルバネ、１１２　バルブハウジング

Ｕ２　閉塞ユニット、１２０　プラグ本体、１２１　パッキン

Ｕ３　小径フィルタユニット、１３０　フィルタ部材、１３１　パッキン、１３３　フィルタハウジング

Ｕ４　大径フィルタユニット　１４０　フィルタ部材、１４１　パッキン、１４３　フィルタハウジング

請求の範囲

[請求項1] 複数枚の基板を収納可能な容器本体と、

前記容器本体の外部から内部空間に気体を供給可能な給気部材と、を備え、

前記容器本体をフロントオープンボックスに形成し、底面に前記給気部材を取付けた基板収納容器であって、

前記給気部材は、前記内部空間の環境を異なる状態に変更する機能ユニットが、嵌合によって交換可能に接続されている

ことを特徴とする基板収納容器。

[請求項2] 前記給気部材は、前記気体を濾過する濾過部材を有する

ことを特徴とする請求項１に記載の基板収納容器。

[請求項3] 前記機能ユニットは、

前記給気部材から供給された前記気体を貯留するハウジング部材と、

前記ハウジング部材の開口を覆うカバー部材と、

前記ハウジング部材及び前記カバー部材の少なくとも一方に形成された前記気体を吹出す吹出孔と、を含む気体置換ユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項4] 前記機能ユニットは、前記内部空間への前記気体の流通を可能にするチェックバルブを含むバルブユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項5] 前記機能ユニットは、前記内部空間への前記気体の流通を不能にする閉塞ユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

[請求項6] 前記機能ユニットは、前記内部空間に供給される前記気体を浄化するフィルタ部材を含むフィルタユニットである

ことを特徴とする請求項１又は２に記載の基板収納容器。

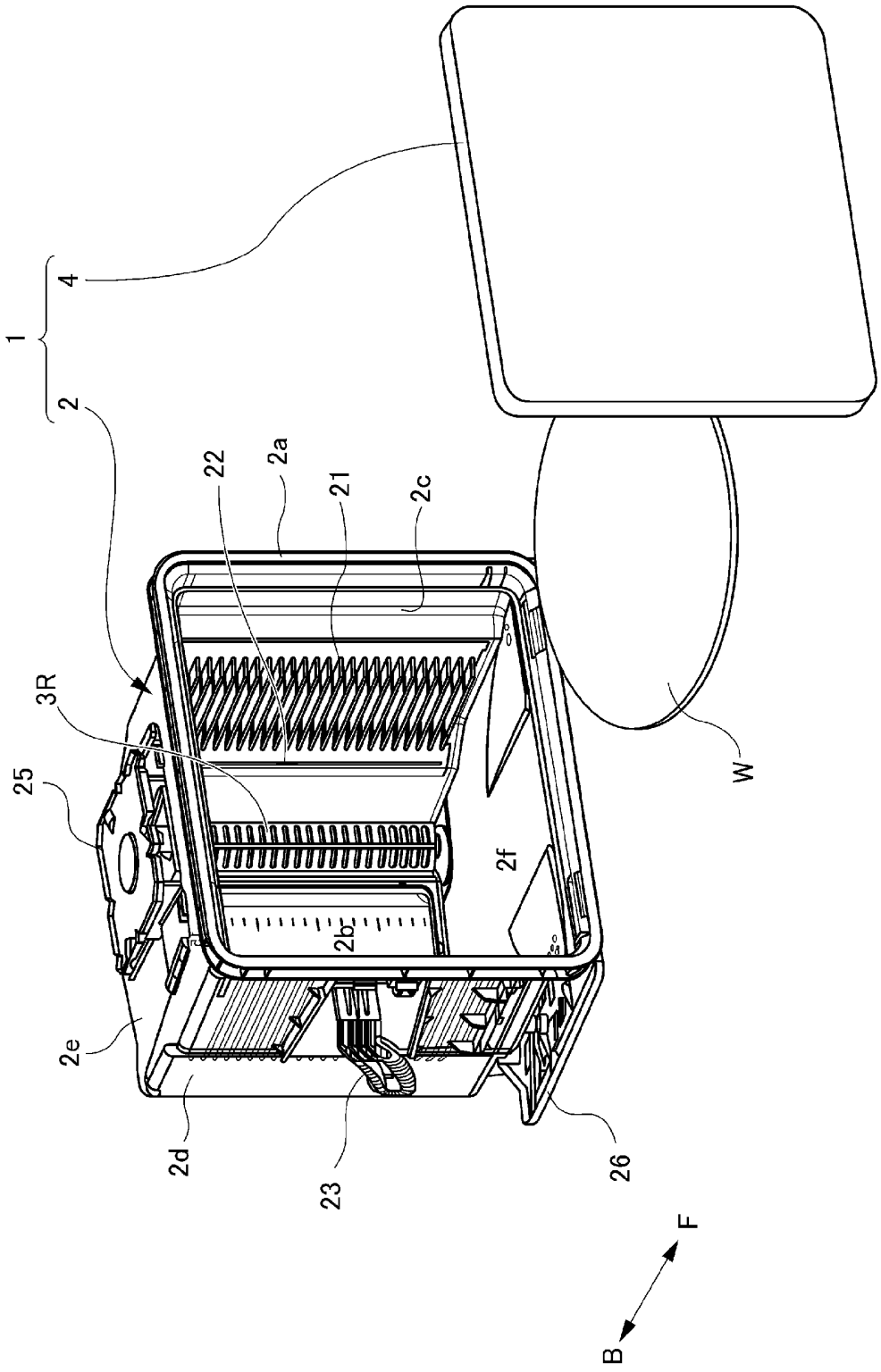
[請求項7] 前記気体は、窒素ガス又はドライエアである

Entegris, EX1002, p. 1066

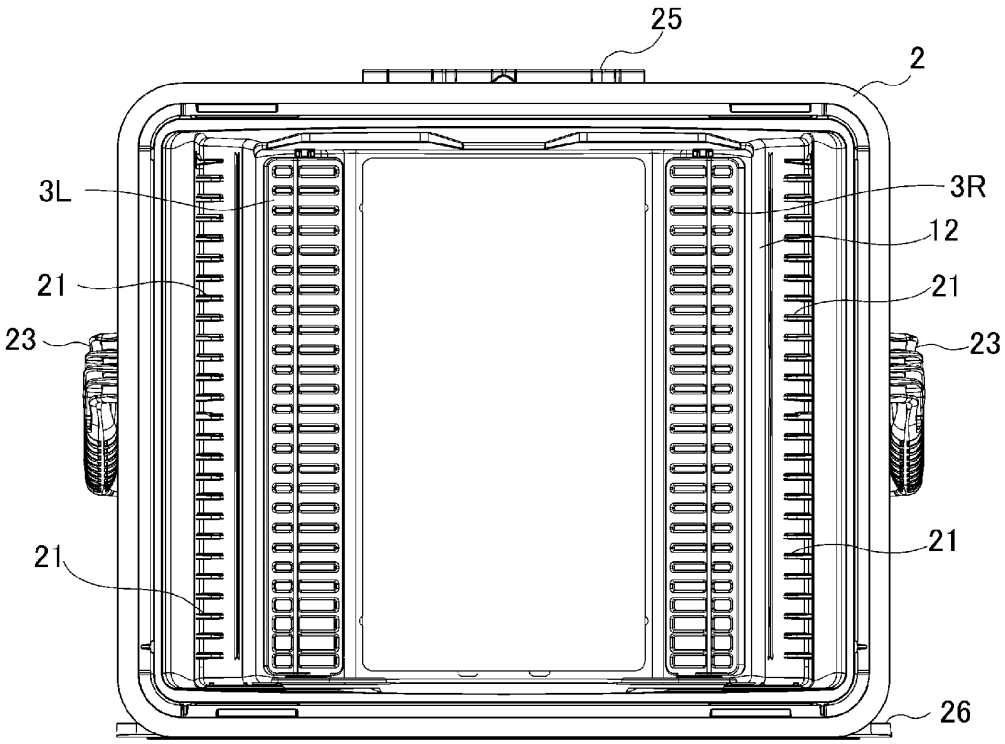
ことを特徴とする請求項１から６までのいずれか１項に記載の基板収納容器。

Entegris, EX1002, p. 1067

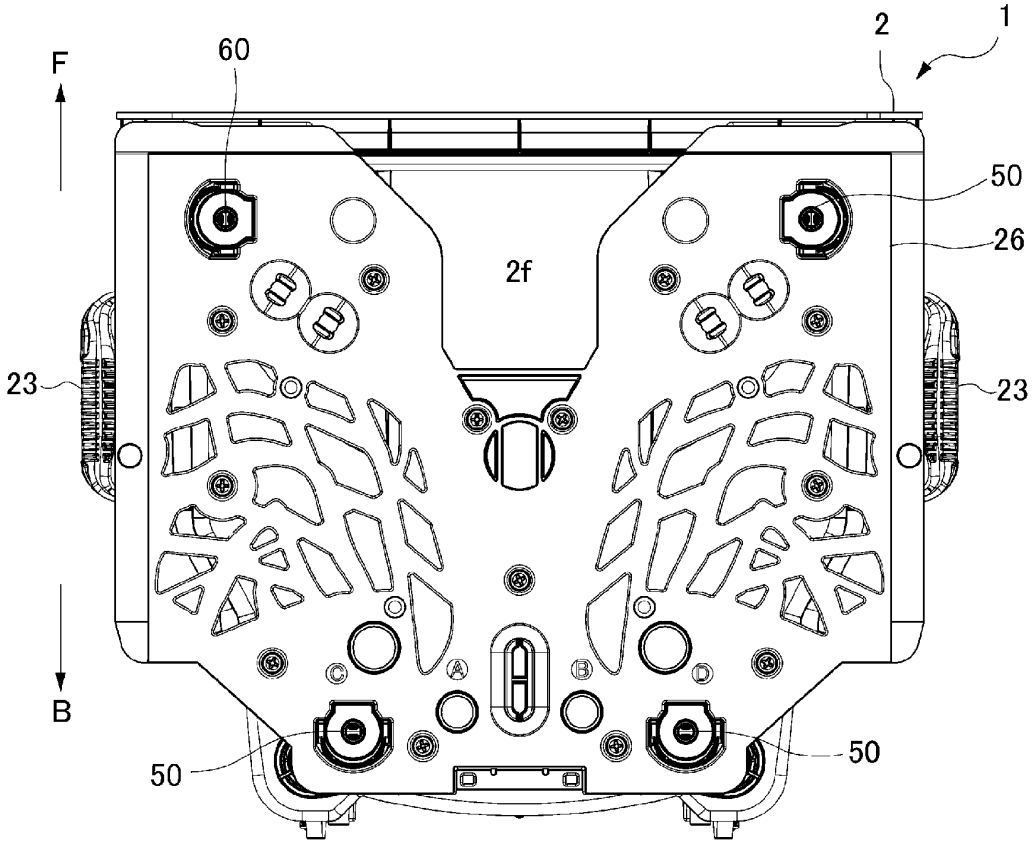
[図1]



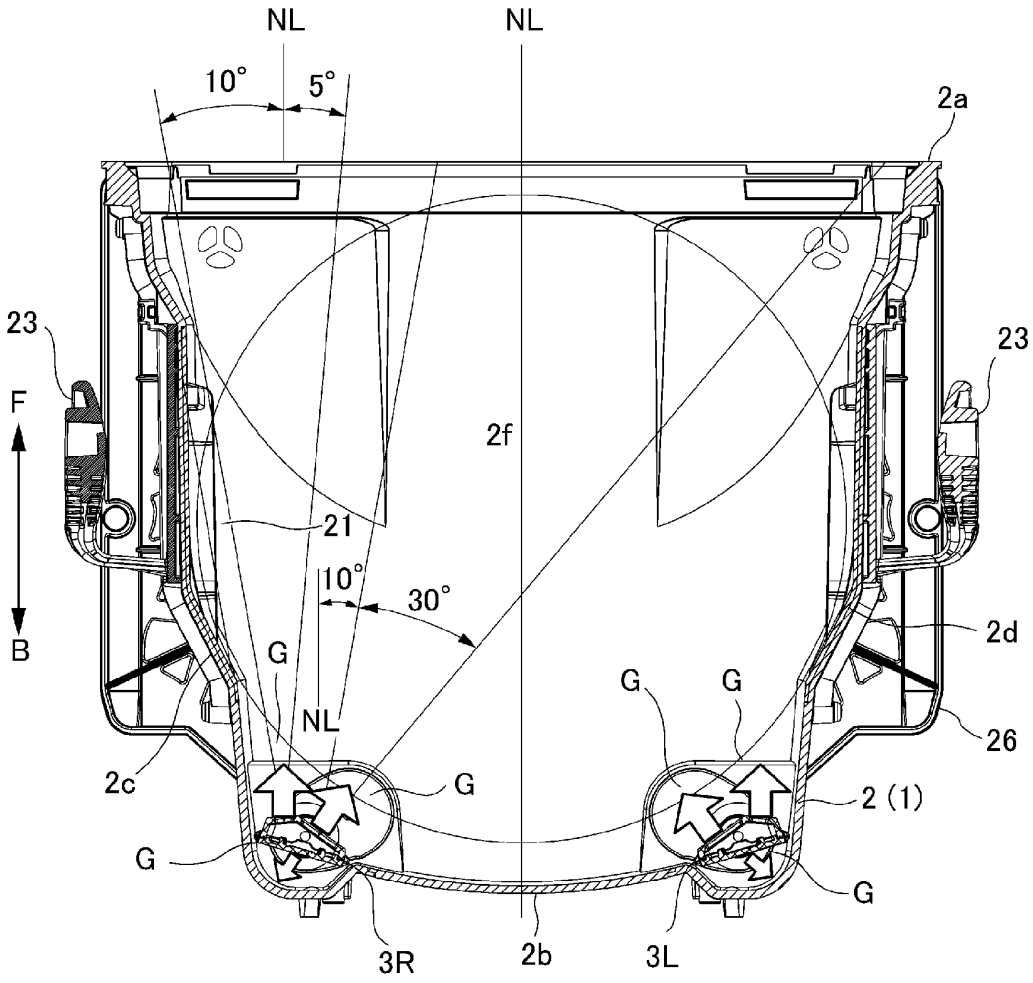
[図2]



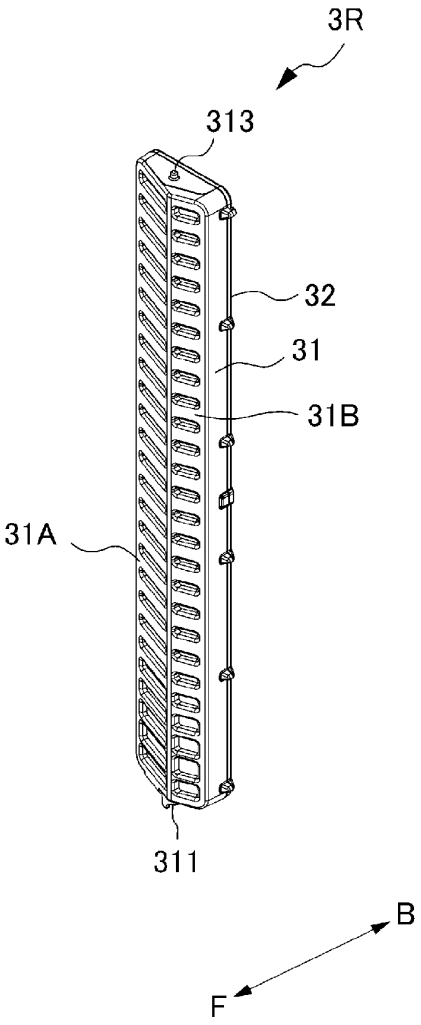
[図3]



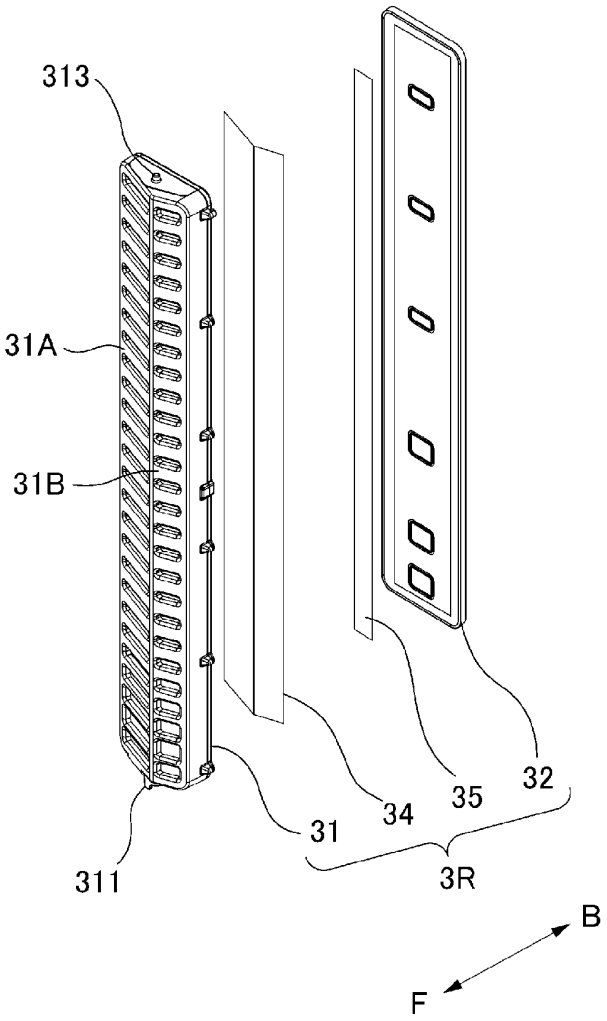
[図4]



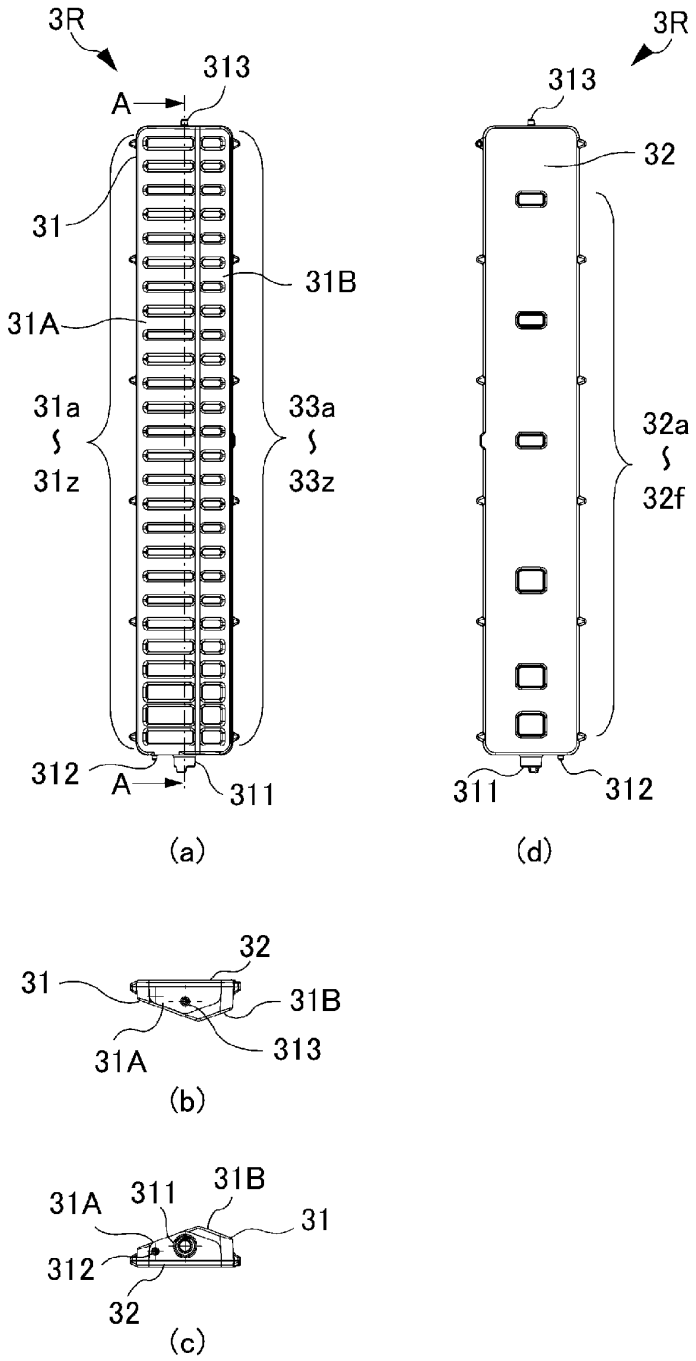
[図5]



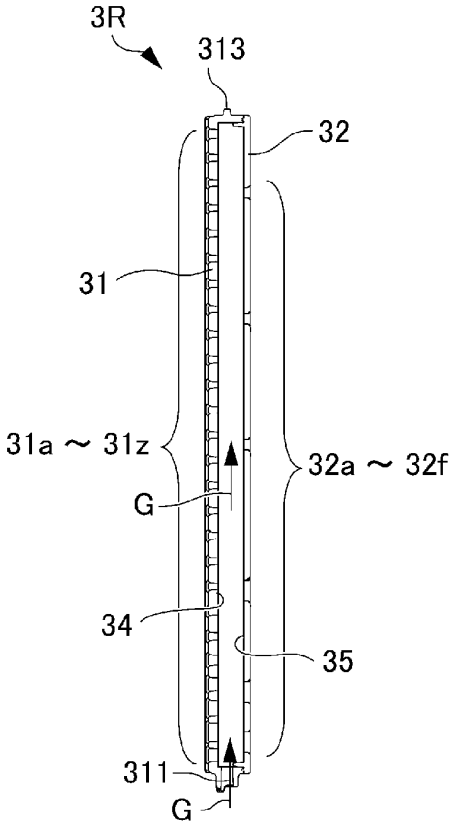
[図6]



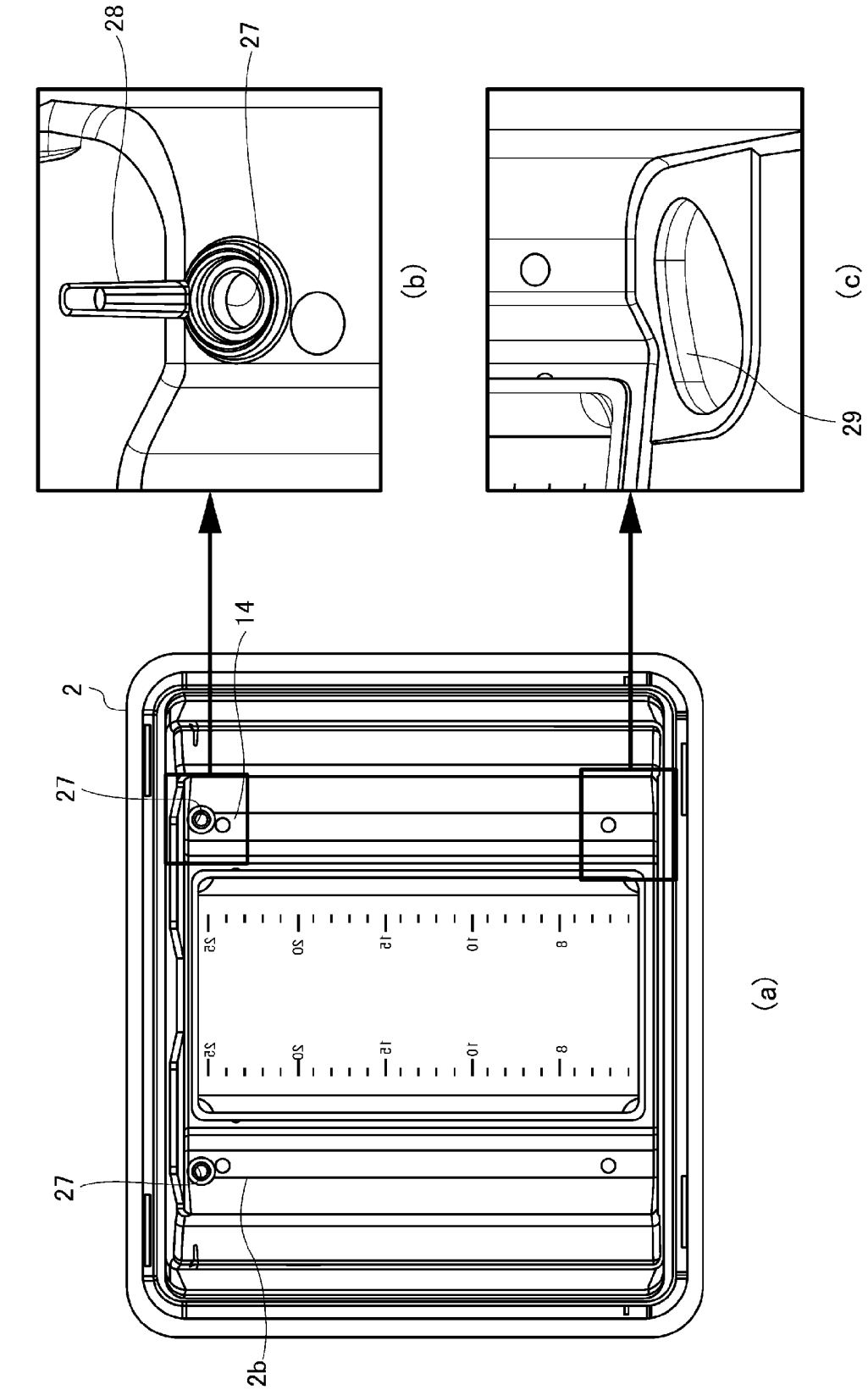
[図7]


3R
313
A
31
31B
31A
31a
31z
33a
33z
312
A
311
(a)
3R
313
32
32a
32f
311
312
(d)
32
31
31B
31A
313
(b)
31A
311
31B
31
312
32
(c)

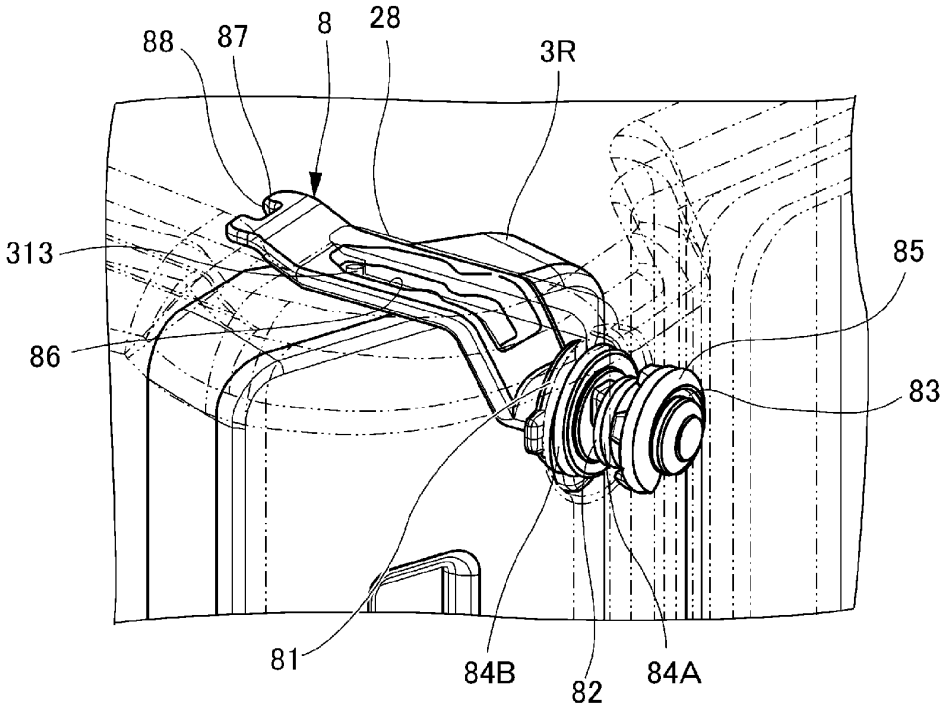
[図8]



[図9]

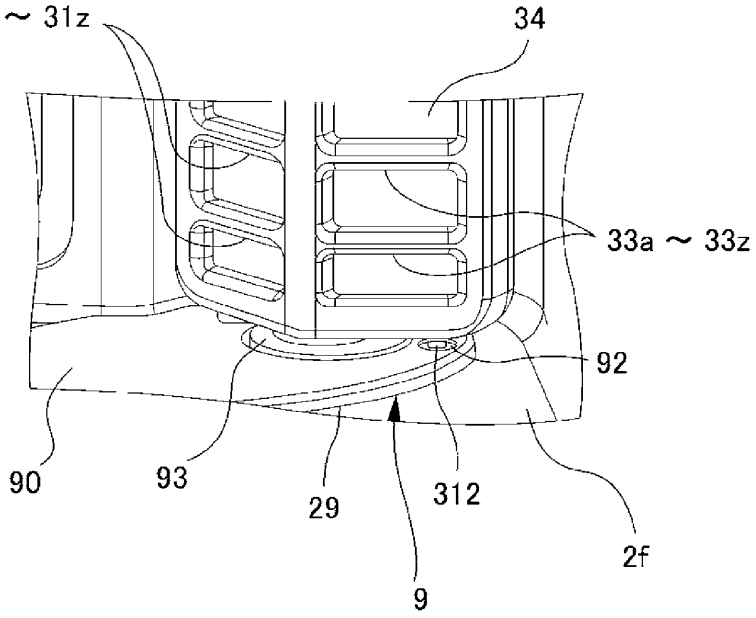


[図10]

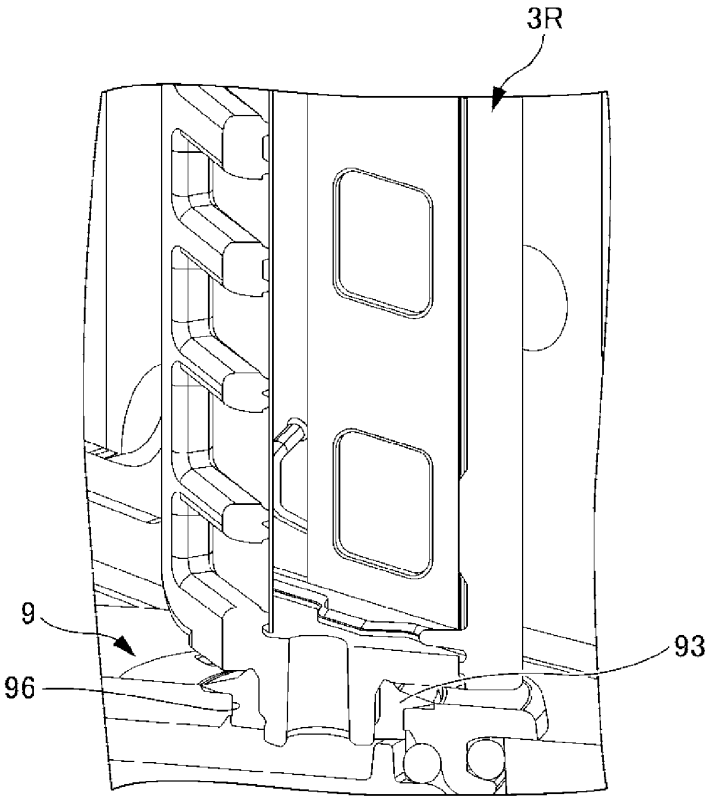


[図11]

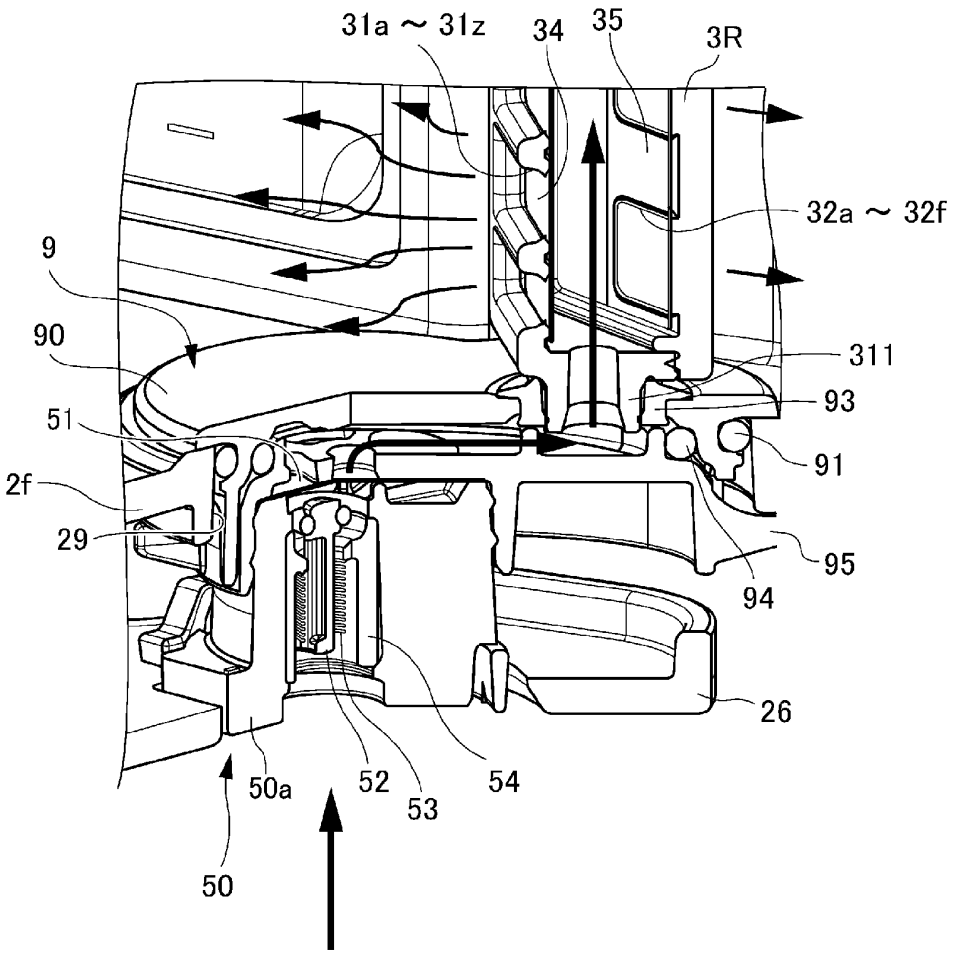
(a)



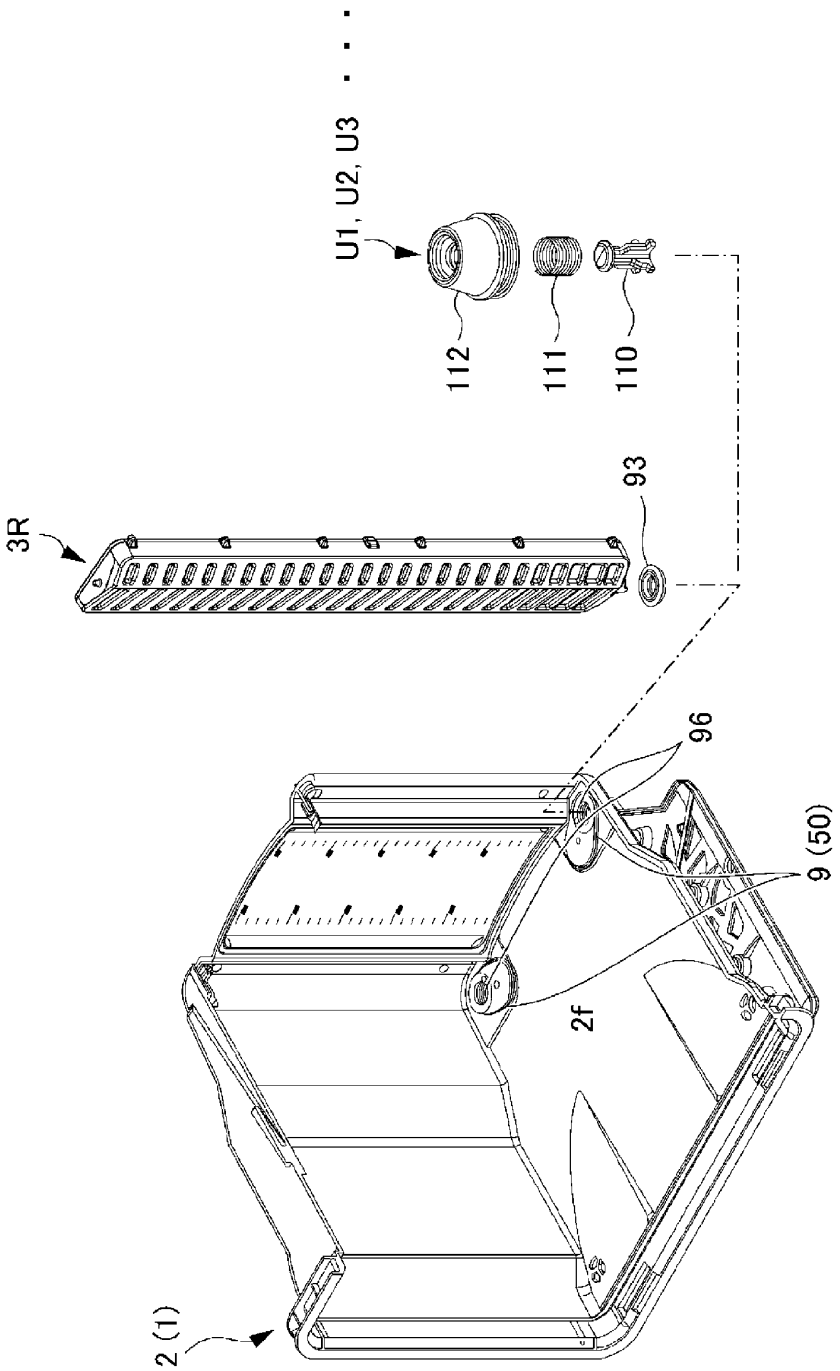
(b)



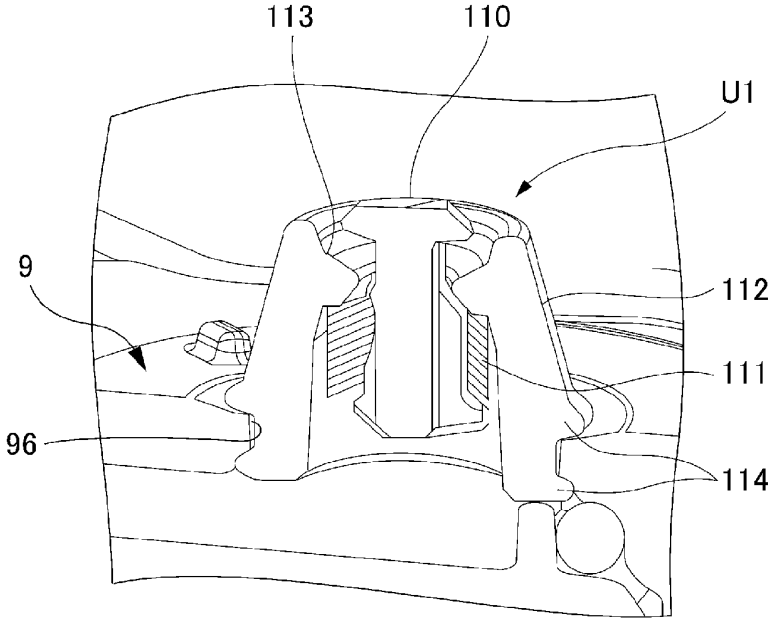
[図12]


31a ～ 31z
34
35
3R
32a ～ 32f
9
90
311
93
51
91
2f
29
95
94
26
50a
52
53
54
50

[図13]

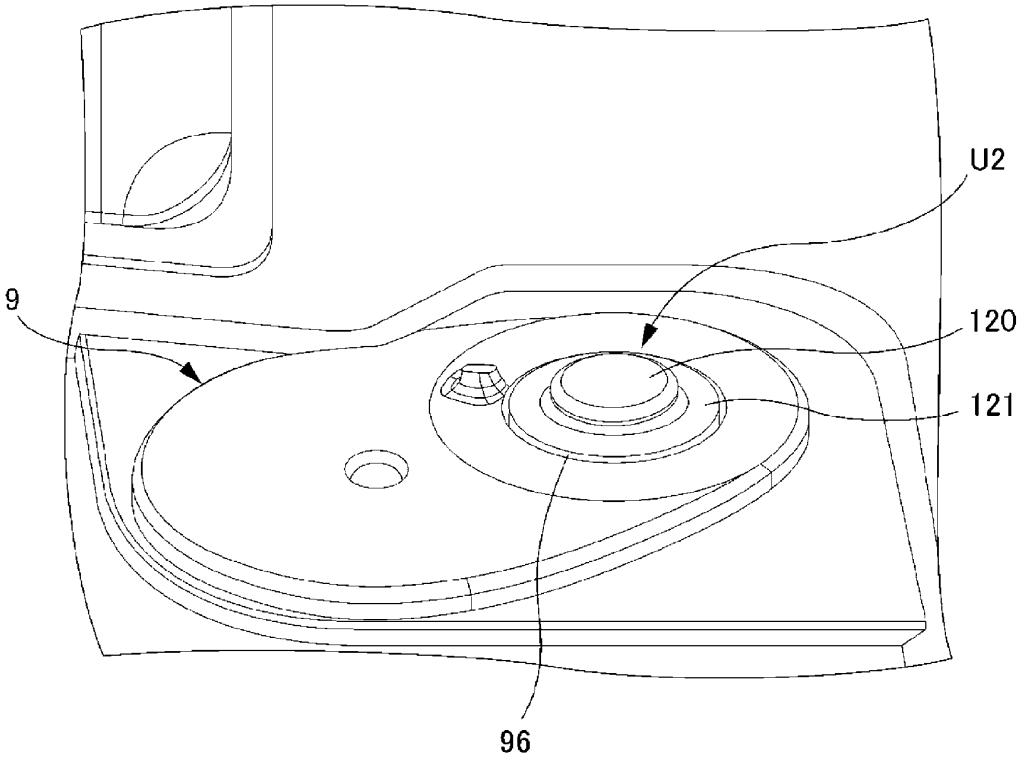


[図14]

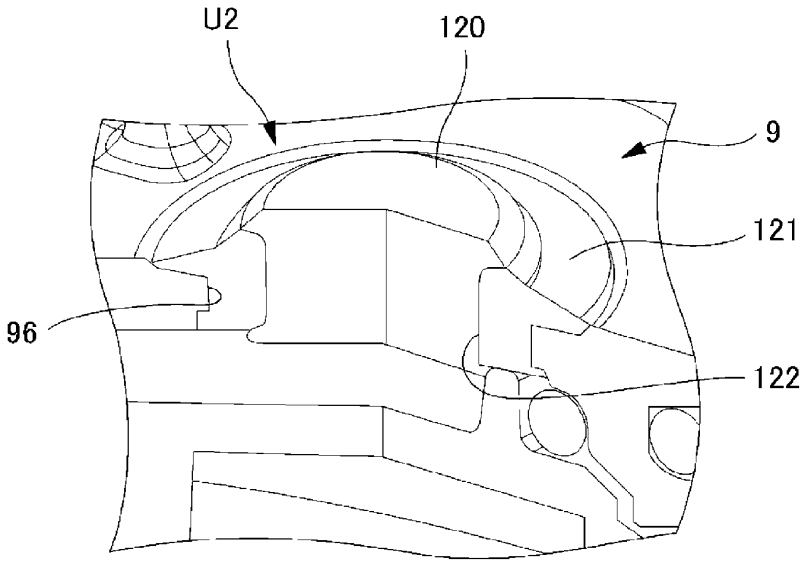


[図15]

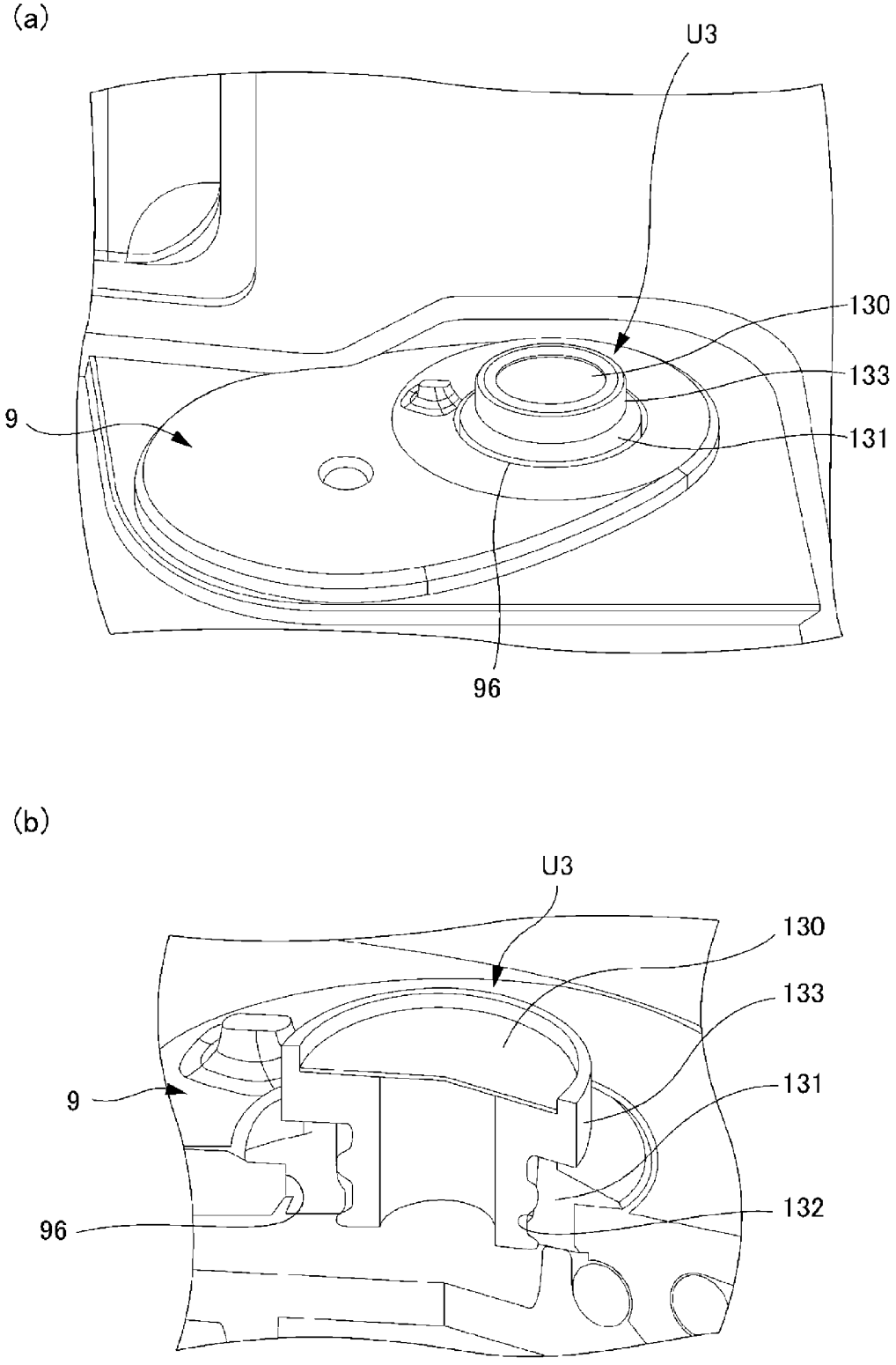
(a)



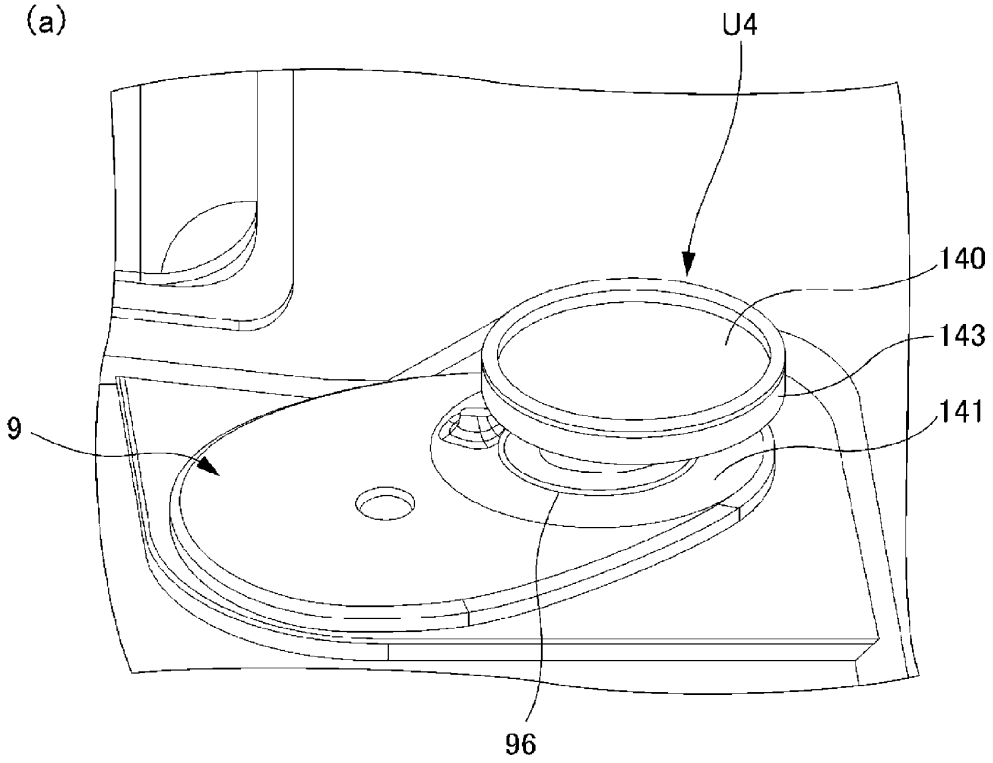
(b)

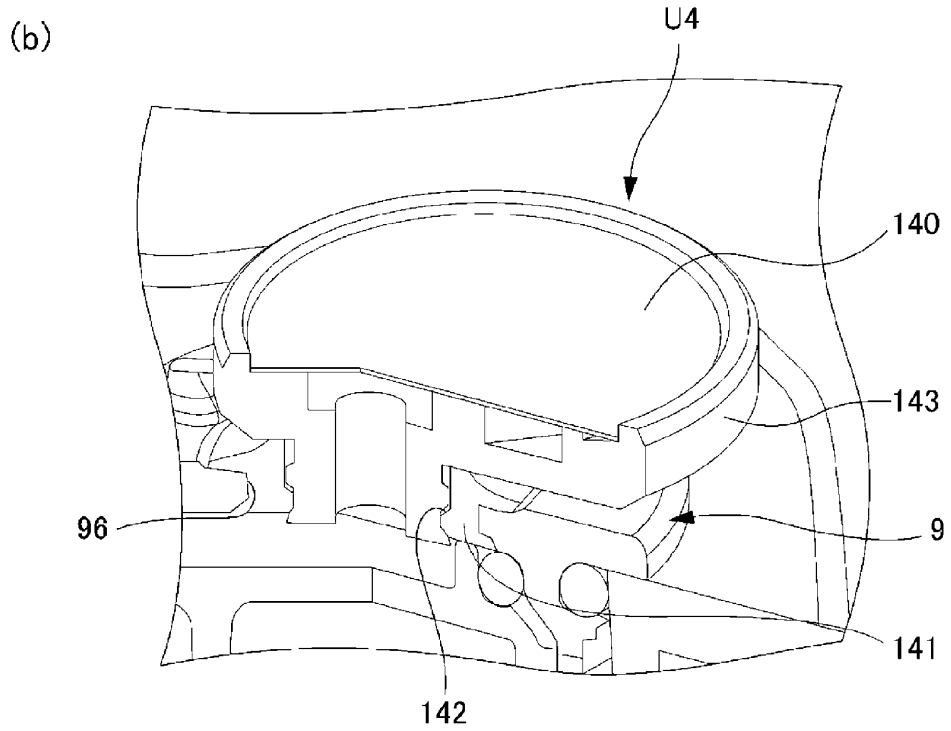


[図16]



[図17]





INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/005296

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. H01L21/673(2006.01)i, B65D85/30(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. H01L21/673, B65D85/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2016/013536 A1 (SHIN-ETSU POLYMER CO., LTD.) 28 January 2016, paragraphs [0038]-[0092], fig. 3-13 & US 2017/0213752 A1, paragraphs [0075]-[0130], fig. 3-13 & DE 112015003423 T & CN 106537574 A & KR 10-2017-0038846 A & TW 201622047 A	1-4, 6-7 5
Y	JP 2011-181930 A (ENTEGRIS, INC.) 15 September 2011, claims, paragraphs [0017]-[0035], fig. 1-6 & US 2005/0252827 A1, claims, paragraphs [0023]-[0041], fig. 1-6 & WO 2005/102872 A2 & EP 1737763 A2 & KR 10-2007-0007936 A & CN 1968872 A & TW 200605372 A	5

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23.03.2018	03.04.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/005296

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2016/135952 A1 (MIRAIAL CO., LTD.) 01 September 2016, paragraphs [0075]-[0094], fig. 11, 12 & TW 201630668 A	1-7
A	JP 2014-160783 A (SHIN-ETSU POLYMER CO., LTD.) 04 September 2014, paragraphs [0016]-[0047], fig. 1-17 (Family: none)	1-7
A	WO 2016/089912 A1 (ENTEGRIS, INC.) 09 June 2016, entire text, all drawings & US 2017/0271188 A1 & CN 107110389 A & KR 10-2017-0088411 A & TW 201633429 A & JP 2018-505546 A	1-7
A	JP 2016-538732 A (ENTEGRIS, INC.) 08 December 2016, entire text, all drawings & US 2016/0276190 A1 & WO 2015/057739 A1 & EP 3058585 A1 & TW 201530679 A & KR 10-2016-0068937 A & CN 105900217 A	1-7

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国際調査報告

国際出願番号　ＰＣＴ／ＪＰ２０１８／００５２９６

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Int.Cl.　H01L21/673(2006.01)i, B65D85/30(2006.01)i

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Int.Cl.　H01L21/673, B65D85/30

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２０１８年
日本国実用新案登録公報	１９９６－２０１８年
日本国登録実用新案公報	１９９４－２０１８年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
X Y	WO 2016/013536 A1 (信越ポリマー株式会社) 2016.01.28, 段落[0038]-[0092], 図 3-13 & US 2017/0213752 A1, 段落[0075]-[0130], 図 3-13 & DE 112015003423 T & CN 106537574 A & KR 10-2017-0038846 A & TW 201622047 A	1-4, 6-7 5

☑ Ｃ欄の続きにも文献が列挙されている。　☐ パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの
「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「Ｏ」口頭による開示、使用、展示等に言及する文献
「Ｐ」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「Ｔ」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「Ｘ」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
「Ｙ」特に関連のある文献であって、当該文献と他の１以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
「＆」同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
２３．０３．２０１８	０３．０４．２０１８

国際調査機関の名称及びあて先	特許庁審査官（権限のある職員）		
日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	宮久保　博幸	５Ｏ	３１３６
	電話番号　０３－３５８１－１１０１　内線　３５５９		

様式ＰＣＴ／ＩＳＡ／２１０（第2ページ）（２０１５年1月）

Entegris, EX1002, p. 1087

Ｃ（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
Y	JP 2011-181930 A (インテグリス・インコーポレーテッド) 2011.09.15, 特許請求の範囲, 段落[0017]-[0035], 図 1-6 & US 2005/0252827 A1, 特許請求の範囲, 段落[0023]-[0041], 図 1-6 & WO 2005/102872 A2 & EP 1737763 A2 & KR 10-2007-0007936 A & CN 1968872 A & TW 200605372 A	5
A	WO 2016/135952 A1 (ミライアル株式会社) 2016.09.01, 段落[0075]-[0094], 図 11-12 & TW 201630668 A	1-7
A	JP 2014-160783 A (信越ポリマー株式会社) 2014.09.04, 段落[0016]-[0047], 図 1-17 (ファミリーなし)	1-7
A	WO 2016/089912 A1 (ENTEGRIS, INC.) 2016.06.09, 全文, 全図 & US 2017/0271188 A1 & CN 107110389 A & KR 10-2017-0088411 A & TW 201633429 A & JP 2018-505546 A	1-7
A	JP 2016-538732 A (インテグリス・インコーポレーテッド) 2016.12.08, 全文, 全図 & US 2016/0276190 A1 & WO 2015/057739 A1 & EP 3058585 A1 & TW 201530679 A & KR 10-2016-0068937 A & CN 105900217 A	1-7

Entegris, EX1002, p. 1088

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
05 March 2020 (05.03.2020)

WIPO | PCT

(10) International Publication Number
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(51) International Patent Classification:
H01L 21/673 (2006.01) *H01L 21/67* (2006.01)
H01L 21/677 (2006.01)

(21) International Application Number:
PCT/US2019/048247

(22) International Filing Date:
27 August 2019 (27.08.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

62/723,979	28 August 2018 (28.08.2018)	US
62/837,389	23 April 2019 (23.04.2019)	US
62/874,647	16 July 2019 (16.07.2019)	US

(71) Applicant: **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billerica, Massachusetts 01821 (US).

(72) Inventors: **SMITH, Mark V.**; 4110 Bobbie Kay Place, Colorado Springs, Colorado 80908 (US). **THELEN, Nicholas**; 1713 Arbor Way, Colorado Springs, Colorado 80905 (US). **FULLER, Matthew A.**; 4910 Sunbird Cliffs Drive, Colorado Springs, Colorado 80919 (US). **ZABKA, Michael C.**; 24496 W. Cedar Lake Drive, New Prague, Minnesota 56071 (US). **MOON, Sung In**; 1979 Schoolmaster Drive, Chaska, Minnesota 55318 (US). **PUGLIA, John P.**; 64 Pierce Road, Townsend, Massachusetts 01469 (US).

(74) Agent: **GATES, Catherine D.** et al.; 129 Concord Road, Billerica, Massachusetts 01821 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: MEMBRANE DIFFUSER FOR A SUBSTRATE CONTAINER

(57) Abstract: Purge diffusers for use in systems for transporting substrates include: i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface; ii) filter media secured to the outer surface of the purge diffuser core; and iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates. The purge diffuser core may be a unitary article, may be formed by injection molding, and may include diverters internal to the internal purge gas channel.

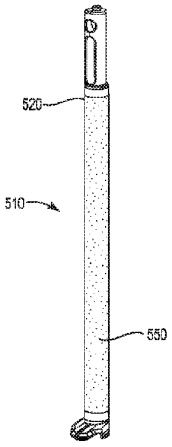


FIG. 7A

WO 2020/046867 A1

[Continued on next page]

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

MEMBRANE DIFFUSER FOR A SUBSTRATE CONTAINER

Cross-Reference to Related Applications

[0001] This application claims the benefit of: United States Provisional Application No. 62/723,979, filed August 28, 2018; United States Provisional Application No. 62/837,389, filed April 23, 2019; and United States Provisional Application No. 62/874,647, filed July 16, 2019, all of which are incorporated herein by reference in their entireties for all purposes.

Technical Field

[0002] This disclosure relates to systems for transporting or storing substrates which include a container and a system for purging the environment within the container to desired levels of relative humidity, oxygen, and airborne particulates.

Background of the Disclosure

[0003] In general, specialized carriers or containers are utilized for transporting and/or storing batches of silicon wafers or substrates before, during and after processing of the wafers or substrates. The term substrate as used herein can refer to one or more of semiconductor wafers, magnetic discs, flat panel substrates, and other such substrates.

[0004] Such containers are generally configured to axially arrange the substrates in slots, and to support the substrates in slots by or near their peripheral edges. The substrates are conventionally removable from the containers in a radial direction upwardly or laterally. Exemplary containers used to convey wafers or substrates can include front opening unified pods (FOUPs) or front opening shipping boxes (FOSBs). In certain configurations, the container portions of the substrate carriers have been provided with openings or passageways to facilitate the introduction and/or exhaustion of gases such as nitrogen or other purified gasses, into the internal environment of the carrier to displace ambient air that might contain contaminants.

[0005] During processing of semiconductor substrates or wafers, the presence of or generation of particulates can present significant contamination problems. Contamination is accepted as the single largest cause of yield loss in the semi-conductor industry. As the size of integrated circuitry has continued to be reduced, the size of particles which can contaminate an integrated circuit has also become smaller making minimization of contaminants all the more critical.

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[0006] Currently, to produce a clean space for accommodating substrates when transported or stored, the internal environment of the carrier is purged using an inert gas or clean dry air (CDA) which is injected into the interior of the container through an inlet port causing the air within the container to exit through an outlet port. These purge gas inlet and outlet ports are generally located on the bottom surface of the container body or shell and extend from the interior through the shell bottom surface where they interface with the purge gas delivery system. One goal of purging is to decrease humidity and oxygen levels in the internal volume of the microenvironment. A challenge of purging is to evenly distribute the purge gas fast and effectively over the substrates within the container. Another goal of purging is to remove airborne contaminants from the environment within the container. However, these contaminants may become trapped in filtering mechanisms of the purge system itself, leading to cross-contamination and requiring additional cleaning.

[0007] A need therefore exists for improved purging methods and equipment which solve the problems of evacuating the wafer container in a fast and efficient manner while at the same time controlling relative humidity and oxygen concentration internal environment of the wafer container. Additionally, a need exists for a purging method and apparatus that can allow high flow rates of purge gas at low pressure differentials while minimizing the propensity of the purge system itself to entrain contaminants.

Summary

[0008] Briefly, the present disclosure provides purge diffusers for use in systems for transporting substrates as well as systems comprising such purge diffusers. According to various embodiments as described herein, the present disclosure provides a purge diffuser that minimizes particulate contamination while at the same time controlling relative humidity and oxygen concentrations within an internal environment of a container containing such a purge diffuser. Additionally, the purge diffuser is capable of controlling back pressure in the system so as not to lose a static seal interface with a static purge source during high flow rates of an inert gas while achieving particle filtration efficiencies of greater than 99%.

[0009] Purge diffusers according to the present disclosure generally include: i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface; ii) filter media secured to the outer surface of the purge diffuser core; and iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates. These elements are arranged such that purge gas entering through the

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purge port connector enters the internal purge gas channel, exits the internal purge gas channel through the diffuser ports, and passes through the filter media into the interior of a substrate container. In some embodiments, the purge diffuser core is a unitary article of integral construction and, in some cases, is fabricated from an injection-moldable, melt processable polymer in a single molding. In various non-limiting embodiments, the filter media can be directly bound to the outer surface of the purge diffuser core, e.g., by weld bonds, secured to the outer surface of the purge diffuser core by an adhesive, or secured to the outer surface of the purge diffuser core by a filter media bracket, in which case the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core. Such a filter media bracket may be attached to the purge diffuser core by welding, friction fit, adhesive, fasteners, or other mechanisms. In certain embodiments, the filter media can include a mesh scrim disposed or wrapped over the outer surface of the filter media to protect the filter media.

[0010] According to various embodiments, the filter media is a porous hydrophobic film or membrane including a polyolefin, polyester, polysulfone, or fluoropolymer, and can have a thickness of between: 10 and 1300 micrometers; of between 10 and 1000 micrometers; of between 10 and 500 micrometers; or of between 40 and 150 micrometers. In some embodiments, the filter media is porous hydrophobic membrane, and in certain embodiments, the filter media is a hydrophobic ultra-high molecular weight polyethylene (UPE) membrane. In many cases, the membrane or film is preferably not pleated and is a non-pleated membrane or film. The film or membrane can be employed to enable sieving or non-sieving of contaminants, depending on the potential contaminants.

[0011] According to various embodiments, the purge diffuser core includes a plurality of diffuser ports. Purge gas exits the internal purge gas channel through diffuser ports and passes through the filter media disposed or wrapped over the purge diffuser core and into the interior of the substrate container.

[0012] In some embodiments, the purge diffuser core additionally includes one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel. In some embodiments, the diverters are staggered to enable injection-molding of the purge diffuser core as a unitary article in a single molding.

[0013] In other embodiments, the present disclosure provides systems including purge diffusers according to the present disclosure and a substrate container including a container portion with

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an opening, a door adapted to be received in the opening so as to seal the internal environment of the substrate container, and a purge port to admit purge gas to an interior of the substrate container. The purge diffuser is mounted by its purge port connector to the purge port. In some embodiments the substrate container is a Front Opening Unified Pod (FOUP).

[0014] In another embodiment, the present disclosure provides methods of making purge diffusers according to the present disclosure, comprising: a) molding the purge diffuser core as single unitary article; and b) securing filter media to the outer surface of the purge diffuser core. In some embodiments, molding the purge diffuser core as single unitary article is accomplished by injection molding. In some embodiments, securing filter media to the outer surface of the purge diffuser core is accomplished by welding methods such as impulse welding.

[0015] In still another embodiment, the present disclosure provides methods of purging a system for transporting substrates according to the present disclosure comprising passing a flow of purge gas through the purge port into the purge diffuser and thereby into the interior of the substrate container. In some embodiments, the purge gas is nitrogen and the purge diffuser provides a greater flow of purge gas to lower portions of the interior of the substrate container than to higher portions of the interior of the substrate container.

[0016] The preceding summary of the present disclosure is not intended to describe each embodiment of the present disclosure. The details of one or more embodiments of the disclosure are also set forth in the description below. Other features, objects, and advantages of the disclosure will be apparent from the description and from the claims.

Brief Description of the Drawing

[0017] The disclosure may be more completely understood in consideration of the following description of various illustrative embodiments in connection with the accompanying drawings

[0018] FIG.1 is a perspective view of one embodiment of a system for transporting substrates according to the present disclosure.

[0019] FIG. 2 is a perspective view of one embodiment of a purge diffuser core according to the present disclosure.

[0020] FIG. 3 is a cutaway view of the purge diffuser core of FIG. 2.

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[0021] FIG. 4 is a perspective view of one embodiment of a purge diffuser core according to the present disclosure.

[0022] FIG. 5 is a perspective view of one embodiment of a purge diffuser according to the present disclosure incorporating the purge diffuser core of FIG. 4.

[0023] FIGS. 6A and 6B are perspective views of a detail of one embodiment of a purge diffuser core of FIG. 4.

[0024] FIG. 7A is a perspective view of a purge diffuser according to an embodiment of the present disclosure.

[0025] FIG. 7B is an exploded view of the purge diffuser of FIG. 7B.

[0026] FIG. 8 is a graphic showing the open door relative humidity performance of a purge diffuser according to an embodiment of the present disclosure.

[0027] While the disclosure is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit aspects of the disclosure to the particular illustrative embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the disclosure.

Detailed Description

[0028] As used in this specification and the appended claims, the singular forms "a", "an", and "the" include plural referents unless the content clearly dictates otherwise. As used in this specification and the appended claims, the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.

[0029] As used herein, "have", "having", "include", "including", "comprise", "comprising" or the like are used in their open ended sense, and generally mean "including, but not limited to." It will be understood that the terms "consisting of" and "consisting essentially of" are subsumed in the term "comprising," and the like.

[0030] The term "about" generally refers to a range of numbers that is considered equivalent to the recited value (e.g., having the same function or result). In many instances, the term "about" may include numbers that are rounded to the nearest significant figure.

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[0031] The term "directly bound" refers to two materials that are in direct contact with each other and bound together.

[0032] The term "integral" or "integral construction" refer to a construction that is a single piece, though it may include elements that can be separately named, that may be a unitary article, or that may be formed from multiple pieces where multiple pieces are permanently joined (such as by welding, permanent adhesive, permanent fasteners, or methods that cannot be reversed non-destructively) to form a single piece construction.

[0033] The term "unitary" or "unitary article" refer to an article that is a single piece, though it may include elements that can be separately named, that is formed from a single piece or aliquot of material without division of that piece or aliquot (such as by stamping, molding, forging, machining, sculpting, or the like), and that lacks seams or joints between elements.

[0034] Numerical ranges expressed using endpoints include all numbers subsumed within that range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4 and 5).

[0035] All scientific and technical terms used herein have meanings commonly used in the art unless otherwise specified.

[0036] The following detailed description should be read with reference to the drawings in which similar elements in different drawings are numbered the same. The detailed description and the drawings, which are not necessarily to scale, depict illustrative embodiments and are not intended to limit the scope of the invention. The illustrative embodiments depicted are intended only as exemplary. Selected features of any illustrative embodiment may be incorporated into an additional embodiment unless clearly stated to the contrary.

[0037] The present disclosure provides purge diffusers for use in systems for transporting substrates, and systems comprising such purge diffusers. Such systems typically include a substrate container comprising a container portion including a top wall, a bottom wall, a back wall and two side walls defining an opening, a door adapted to be received in the opening to seal the internal environment, and a purge port to admit purge gas to an interior of the substrate container. Some such substrate containers are typically known as a FOUPs or FOSBs. Substrates may be inserted and removed, typically horizontally through an open front. Slots formed in the interior sides hold the substrates, most typically semiconductor wafers. The door engages with the enclosure to form a sealed interior space that is isolated from the ambient atmosphere. Typically, the door and substrate container are adapted to be manipulated by

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automated or robotic mechanisms. Likewise, substrates may be placed in or removed from the substrate container by automated or robotic mechanisms. The purge port may be in the bottom wall (or floor) of the enclosure portion, and typically includes hardware to mount and form a seal with the purge port connector of a purge diffuser.

[0038] The purge diffuser, according to the various embodiments described herein, is adapted to distribute purge gas in the interior of the substrate container. Purge gas is directed through the purge port and purge port connector into the purge gas channel interior to the purge diffuser. The purge gas exits the internal purge gas channel through diffuser ports and passes through the filter media into the interior of a substrate container. By use of a purge diffuser, the distribution of purge gas within the interior of the substrate container may be controlled to avoid dead spots and achieve desired distribution. Any suitable purge gas may be used, which may include clean dry air (CDA) and inert gasses such as nitrogen. The design of the purge diffuser may be adapted to the selected purge gas. For example, where a lighter-than-air gas such as nitrogen is in use, greater flow to lower portions of the interior of the substrate container may result in a more even purging of the container and its contents from contaminants, particulates, and humidity. In some embodiments, the substrate container may additionally include a purge outlet port to allow purge gas to flow out of the container. In others, the container is purged with the door removed and purge gas exits through the open front of the container.

[0039] Purge diffusers according to the present disclosure include a purge diffuser core having an internal purge gas channel and one or more diffuser ports allowing exit of purge gas from the internal purge gas channel to the exterior of the purge diffuser core and into the interior of the substrate container. The purge diffuser core may include features for attachment to mounting apparatus, typically at the end of the purge diffuser core opposite the purge port connector. In some embodiments, the purge diffuser core is of an integral construction such that it is a unitary article. The purge diffuser core may be fabricated any suitable material, which may include injection-moldable materials, melt processable polymers, fluoropolymers, polyolefins, or fluorinated polyolefins. In some cases, the purge diffuser core can be fabricated from carbon-filled materials to facilitate the elimination of electro-static discharge. The material from which the purge diffuser core is fabricated should be selected to minimize outgassing.

[0040] In some cases, the purge diffuser can be sized so as to minimize the material mass of the purge diffuser within the internal environment of the substrate container. Material mass in a substrate container can absorb off-gassing (Airborne Molecular Contamination – AMC) from

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wafer processes such as boron, ammonia, chlorine or fluorene and then later desorb these contaminants back into the container environment potentially causing wafer yield loss. Reducing the amount of material in the internal environment environment can improve the propensity for AMC absorption and desorption. One method for reducing material mass within the internal environment of the wafer container is to reduce the overall length or height of the purge diffuser relative to the interior height of the substrate container and more particularly, relative to the interior height of the substrate as measured from a top wall of the container portion to the bottom wall of the container portion of the substrate container. In some embodiments, the length or height of the purge diffuser is not more than 85% of the height of the interior of the substrate container as measured from the top wall to the bottom wall of the container portion of the substrate container, in others not more than 75%, 65%, 60%, 55%, 50%, 45% or 40% of the height of the substrate container. In some such embodiments, the length or height of the purge diffuser is at least 20% of the interior height of the substrate container, in others at least 25%, 30%, or 35% of the interior height of the substrate container. In some cases, the purge diffuser can have a length ranging from: 100mm to 170 mm; 105mm to 160mm; or from 110mm to 150mm. In one particular embodiment, the purge diffuser has a length of 150mm. In another embodiment, the purge diffuser has a length of 110mm. The overall length of the purge diffuser as measured relative to the height of the substrate container can be selected or optimized based on the intended application. For example, the length of the purge diffuser can be optimized based on the type of purge gas, the flow rate of the purge gas, and/or the acceptable levels of relative humidity and oxygen in the environment of the container and/or the nature of the contaminants to be entrained by the purge diffuser, but not limited to these. In some embodiments, a purge diffuser having a reduced height or length relative to the height or of the substrate container can be used with in combination with other embodiments, as disclosed herein, used to reduce contaminants within the internal environment of the container and/or for controlling relative humidity and oxygen levels.

[0041] The internal purge gas channel may have a length equal to or less than the length of the purge diffuser core. In some embodiments, the length of the internal gas channel is not more than 85% of the interior height of the substrate container, in others not more than 75%, 65%, 60%, 55%, 50%, 45% or 40%. In some such embodiments, the length of the internal gas channel is at least 20% of the interior height of the substrate container, in others at least 25%, 30%, or 35%.

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[0042] The purge diffuser can include a plurality of diffuser ports distributed along the length of the purge diffuser core. Purge gas exits the internal purge gas channel through diffuser ports. In some cases, the purge gas exits the internal purge gas channel and passes through filter media disposed or wrapped over the purge diffuser core and into the interior of the substrate container. The diffuser ports can have any suitable shape, size, and position along the length of the purge diffuser core. The distribution and characteristics of diffuser ports may be selected to achieve a desired distribution of purge gas flow and be uniform or may vary. In some embodiments, rows of diffuser ports are offset from each other such that every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser. This design enables manufacture of the purge diffuser core as a unitary article with a continuous interior channel (the internal purge gas channel) by molding processes, such as an injection molding process using side pulls, cams, cam actions or slides.

[0043] In some embodiments, the purge diffuser core additionally includes diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core, i.e., an internal surface of the purge diffuser core bordering the internal purge gas channel. The diverters may be of any suitable shape, such as fins or pegs, or may bridge across the internal purge gas channel from a first location on the inner surface of the purge diffuser core to a second, separate, location on the inner surface of the purge diffuser core. The diverters may impede but typically do not block flow of purge gas to further portions of the internal purge gas channel. The distribution and characteristics of diverters may be selected to achieve a desired distribution of purge gas flow. The distribution and characteristics of diverters may be uniform along the length of the internal purge gas channel or may vary. In some embodiments, the diffuser core includes diverters in a first segment of the internal purge gas channel proximal to the purge port and does not include diverters in a second segment of the internal purge gas channel distal from the purge port.

[0044] The purge diffuser core can be fabricated by any suitable method. Typically, hot melt molding methods may be used, such as injection molding. In some cases, as described herein, the purge diffuser core is injection molded to produce an integrally formed, unitary article.

[0045] Purge diffusers according to the present disclosure include filter media disposed over and secured to the outer surface of the purge diffuser core. The filter media may be present in

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segments or, more typically, may be in the form of a single sheet wrapped around the circumference of the purge diffuser core. In some embodiments, the filter media is directly bound to the outer surface of the purge diffuser core, such as by weld bonds, including without limitation heat-weld bonds, impulse-weld bonds and ultrasonic-weld bonds. Welding or bonding the filter media to the purge diffuser core provides the desirable feature of leak-proof bonding the filter media to the purge diffuser core without the use of adhesives or fasteners.

[0046] In other embodiments, the filter media is secured to the outer surface of the purge diffuser core by an adhesive. In still other embodiments, the filter media is secured to the outer surface of the purge diffuser core by a filter media bracket, wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core. A filter media bracket may be attached to the purge diffuser core by welding, friction fit, adhesive, fasteners, or other suitable mechanisms. After attachment, filter media make be shrunk in place by application of heat to generate a tighter fit to the purge diffuser core. Typically, the filter media covers each diffuser port of the purge diffuser core. Typically, the filter media is attached such that purge gas exiting through diffuser ports cannot enter the interior of the substrate container without passing through the filter media. In some embodiments, the filter media can be provided with a mesh scrim disposed over the filter media to provide protection to the filter media and to permit safe handling of the filter media. The mesh scrim may be affixed to the filter media without adhesives or fasteners. In some cases, the mesh scrim can be wrapped about an outer surface of the filter media. Alternatively, the mesh scrim can be impulse welded to the filter media.

[0047] The filter media may be of any suitable material that is useful for controlling relative humidity and oxygen may additionally remove particulates from a gas stream passing through the filter media. In various embodiments, the filter media may include woven, non-woven, sieving, non-sieving, melt blown, core and sheath, film, or membrane materials and may include polyolefin (including polypropylene, polyethylene, high density polyethyelene, or ultra-high molecular weight polyethylene), polyester, polysulfone, fluoropolymer, polyamide or polyimide polymers. The filter media is preferably not pleated such that it is a non-pleated filter media. In some embodiments, the filter media is a porous hydrophobic film. In other embodiments, the filter media is a porous hydrophobic membrane. In one embodiment, the filter media is a porous hydrophobic ultra-high molecular weight polyethylene membrane. Filter media may be laser-ablated to modify porosity. In some embodiments the filter media has a thickness of between;

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10 and 1300 micrometers; of between 10 and 1000 micrometers; of between 10 and 500 micrometers; or of between 40 and 150 micrometers.

[0048] In one aspect, filter media can be characterized with regard to a property known as "bubble point," which is an understood property of a porous filter membrane. Bubble point corresponds to pore size, which may correspond to filtering performance, e.g., as measured by retention. A smaller pore size can correlate to a higher bubble point and often to higher filtering performance (higher retention). Preferred membranes for the filter media exhibit a combination of a relatively higher bubble point and a useful level of flow (flow rate). Examples of useful mean bubble points of membrane filter media can be in a range from 2 to 400 psi, e.g., in a range from 5 to 15 psi. To measure the mean bubble point, a sample of filter media is placed in a holder. Air is pressurized through the holder and the flow rate measured as a function of pressure. A low surface tension fluid, HFE-7200 (3M) is then introduced to the membrane to wet the membrane. Air is pressurized through the holder at the interior of the filter media, and the air flow is measured as a function of pressure. The mean bubble point is the pressure at which the ratio of the air flow of the wet membrane to the air flow of the dry membrane is 0.5. The test is performed at a temperature in a range of between 20 and 25 degrees Celsius.

[0049] In some embodiments, exemplary membrane filter media may have pores of a size (average pore size) to be considered either a microporous filtration membrane or an ultrafiltration membrane. A microporous membrane can have an average pore size in a range on from about 0.05 micrometers to about 10 micrometers. An ultrafiltration membrane can have an average pore size in a range from 0.001 micrometers to about 0.05 micrometers. Pore size is often reported as average pore size of a porous material, which can be measured by known techniques such as by Mercury Porosimetry (MP), Scanning Electron Microscopy (SEM), Liquid Displacement (LLDP), or Atomic Force Microscopy (AFM).

[0050] Purge diffusers according to the present disclosure typically include a purge port connector for mounting the purge diffuser to a purge port of a substrate container. In some embodiments, the purge port connector is an integral construction with the purge diffuser core such that the purge core and the purge port connector form a unitary article. In other embodiments, the purge port connector is part separate from but attachable to the purge diffuser core. The purge port connector and purge diffuser core are typically connected in a sealable manner, such that purge gas does not escape the purge diffuser between the purge port connector

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and purge diffuser core. The purge port connector may be made of any suitable material, including those recited above for the purge diffuser core.

[0051] With reference to FIG. 1, a system for transporting substrates according to one embodiment of the present disclosure includes substrate container 190. Front edge 192 of substrate container 190 surrounds a front opening and is adapted to accept a door (not shown) adapted to seal the opening defined by front edge 192. Typically, the door (not shown) and substrate container 190 are adapted to be manipulated by automated or robotic mechanisms. Purge diffuser 110 is depicted without filter media secured to the outer surface, revealing purge diffuser core 120. Purge diffuser core 120 includes diffuser ports 130, 132 arranged in lengthwise rows, according to an embodiment. In the embodiment depicted in FIG. 1, a first row of diffuser ports 130 is offset from a second row of diffuser ports 132, with the centers of diffuser ports 130 generally aligned with the boundaries between diffuser ports 132 and vice versa. Purge diffuser core 120 also includes an internal purge gas channel (not visible). Purge port connector 140 is attached to the bottom end of purge diffuser core 120. Purge port connector 140 is mounted to a purge port (not visible, as it is occupied and covered by purge port connector 140). The purge port passes through substrate container 190. During purge of substrate container 190, purge gas enters through the purge port into purge port connector 140 and thereby into the internal purge gas channel of purge diffuser core 120. The purge gas then exits the internal purge gas channel through diffuser ports 130, 132. When filter media is installed on the outer surface of purge diffuser core 120, purge gas exiting the internal purge gas channel through diffuser ports 130, 132. passes through the filter media, and into interior 194 of substrate container 190. Substrate container 190 is also equipped with substrate supports 196 which define slots for storage of substrates (not shown) by or near their peripheral edges. Optional mounting hardware 180 can provide additional attachment of purge diffuser 110 to substrate container 190, as necessary or desired.

[0052] With reference to FIGS. 2 and 3, these figures are a perspective view and a cutaway view (respectively) of one embodiment of a purge diffuser core according to the present disclosure. Purge diffuser core 220 is connected at its bottom end to purge port connector 240. Purge port connector 240 is adapted to connect to a purge port of a substrate container. Purge diffuser core 220 includes internal purge gas channel 260, which provides passage of purge gas entering through the purge port through purge port connector 240 to all diffuser ports 230, 232, 234. Purge diffuser core 220 includes diffuser ports 230, 232, 234 arranged in lengthwise rows. In some embodiments, as depicted in FIGS. 2 and 3, the row of diffuser ports 230 is offset from the

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rows of diffuser ports 232, 234, with the centers of diffuser ports 230 generally aligned with the boundaries between diffuser ports 232, 234 and vice versa. When diffuser ports 230, 232, 234 are staggered in this manner, every portion of internal purge gas channel 260 between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser. This design enables manufacture of purge diffuser core 220 as a unitary article with a continuous interior channel (internal purge gas channel 260) by molding processes, such as an injection molding process using side pulls, cams, cam actions or slides. Purge diffuser core 220 is adapted to engage with mounting hardware component 280.

[0053] Purge diffuser core 220 optionally may additionally include diverters 265 which project into internal purge gas channel 260 from inner surfaces of purge diffuser core 220 which border internal purge gas channel 260. Diverters 265 slow and/or direct the flow of purge gas, but do not fully block flow of purge gas to further points along internal purge gas channel 260. In this embodiment, diverters 265 bridge across internal purge gas channel 260 from a first location on the inner surface of purge diffuser core 220 to a second and separate location on the inner surface of purge diffuser core 220. In this embodiment, purge diffuser core 220 includes diverters 265 in first segment 266 of internal purge gas channel 260, proximal to purge port connector 240, and does not include diverters in second segment 267 of internal purge gas channel 260 distal to purge port connector 240.

[0054] With reference to FIGS. 4 and 5, FIG. 4 is a perspective view of one embodiment of a purge diffuser core according to the present disclosure. FIG. 5 is a perspective view of one embodiment of a purge diffuser according to the present disclosure incorporating the purge diffuser core of FIG. 4. Purge diffuser 410 includes purge diffuser core 420. Purge diffuser core 420 is connected at its bottom end to purge port connector 440. Purge port connector 440 is adapted to connect to a purge port of a substrate container. Purge diffuser core 420 includes an internal purge gas channel (not visible), which provides passage of purge gas entering through the purge port through purge port connector 440 to all diffuser ports 430, 432. Purge diffuser core 420 includes diffuser ports 430, 432 arranged in lengthwise rows. The row of diffuser ports 430 is offset from the rows of diffuser ports 432, with the centers of diffuser ports 430 generally aligned with the boundaries between diffuser ports 432 and vice versa. As noted above, when diffuser ports 430, 432 are staggered in this manner, every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line

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perpendicular to the length of the purge diffuser. This design enables manufacture of purge diffuser core 420 as a unitary article with a continuous interior channel (the internal purge gas channel) by molding processes, such as an injection molding process using side pulls, cams, cam actions or slides.

[0055] With reference to FIGS. 6A and 6B, these figures are perspective views of a detail of the purge diffuser core of FIG. 4 and its assembly. Purge diffuser core 420 is connected at its bottom end to purge port connector 440. Engaging tabs 442 securely attach purge port connector 440 to purge diffuser core 420. Seal 444 prevents escape of purge gas at the interface between purge port connector 440 and purge diffuser core 420. Diffuser ports 430, 432 are shown.

[0056] Referring again to FIG. 5, filter media 450 is secured to the outer surface of purge diffuser core 420 such that purge gas from the purge port entering purge diffuser 410 through purge port connector 440 enters the internal purge gas channel, exits the internal purge gas channel through diffuser ports 430, 432, and passes through filter media 450 into the interior of the substrate container.

[0057] FIG. 7A is a perspective view and FIG. 7B is an exploded view of a purge diffuser 510 according to yet another embodiment. Purge diffuser 510 includes a porous membrane disposed over purge diffuser core 520. Similar to those embodiments discussed above with reference to FIGS. 4 and 5, Purge diffuser core 520 is connected at its bottom end to purge port connector 540. Purge port connector 540 is adapted to connect to a purge port of a substrate container. Purge diffuser core 520 includes an internal purge gas channel (not visible), which provides passage of purge gas entering through the purge port through purge port connector 540 to all diffuser ports 530, 532. Purge diffuser core 520 includes diffuser ports 530, 532 arranged in lengthwise rows. The row of diffuser ports 530 is offset from the rows of diffuser ports 532, with the centers of diffuser ports 530 generally aligned with the boundaries between diffuser ports 532 and vice versa. As noted above, when diffuser ports 530, 532 are staggered in this manner, every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser. Filter media 550 is secured to the outer surface of purge diffuser core 520 such that purge gas from the purge port entering purge diffuser 510 through purge port connector 540 enters the internal purge gas channel, exits the internal purge gas channel through diffuser ports 530, 532, and passes through filter media 550 into the interior of the substrate container.

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[0058] As shown in FIG. 7B, a mesh scrim 545 can be disposed over disposed over the filter media 550 to provide protection to the filter media 550 and to permit safe handling of the filter media 550. The mesh scrim may be affixed to the filter media without adhesives or fasteners. In some cases, the mesh scrim 545 can be wrapped about an outer surface of the filter media 550. Alternatively, the mesh scrim 545 can be impulse welded to the filter media 550.

[0059] As described herein filter media 450, 550 may be of any suitable material that is useful for controlling relative humidity and oxygen may additionally remove particulates from a gas stream passing through the filter media. In various embodiments, the filter media may include woven, non-woven, sieving, non-sieving, melt blown, core and sheath, film, or membrane materials and may include polyolefin (including polypropylene, polyethylene, high density polyethyelene, or ultra-high molecular weight polyethylene), polyester, polysulfone, fluoropolymer, polyamide or polyimide polymers. The filter media is preferably not pleated such that it is a non-pleated filter media. In some embodiments, the filter media is a porous hydrophobic film. In other embodiments, the filter media is a porous hydrophobic membrane. In a preffered embodiment, the filter media is a porous hydrophobic ultra-high molecular weight polyethylene (UPE) membrane. In some cases, the UPE membrane is selected such that it provides greater than 99% particle retention and less than 65 kPa of backpressure in the system.

[0060] FIG. 8 is a graphic showing the open door relative humidity (RH%) performance of a purge diffuser including a UPE membrane, in accordance with embodiments described herein. Relative humidity levels were measured using a sensor positioned at the front, left right and back of the substrate container. The initial relative humidity level in the environment was 50% RH. Purge gas was introduced into the substrate container with the door removed. The test was repeated for each of the twenty-five wafers contained within the substrate container. As shown in FIG. 8, the UPE membrane purge diffuser is effective at minimizing the relative humidity levels in the container environment at each wafer and at each position during the open door purge test.

Selected Embodiments

[0061] The following numbered embodiments are intended to further illustrate the present disclosure but should not be construed to unduly limit this disclosure.

Embodiment 1. A system for transporting substrates comprising:

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a) a substrate container comprising a container portion with an opening, a door adapted to seal the opening, and a purge port to admit purge gas to an interior of the substrate container; and

b) a purge diffuser mounted to the purge port, the purge diffuser comprising:

i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface; and

ii) filter media secured to the outer surface of the purge diffuser core;

arranged such that there is a continuous path for purge gas entering through the purge port to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media into the interior of the substrate container.

Embodiment 2. The system according to embodiment 1 wherein the purge diffuser core is a unitary article.

Embodiment 3. The system according to embodiment 1 wherein the purge diffuser core is a unitary article comprising an injection-moldable material and made in a single molding.

Embodiment 4. The system according to embodiment 3 wherein the injection-moldable material is a melt processable polymer.

Embodiment 5. The system according to any of embodiments 1-4 wherein the filter media is directly bound to the outer surface of the purge diffuser core.

Embodiment 6. The system according to embodiment 5 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds.

Embodiment 7. The system according to embodiment 5 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds selected from heat-weld bonds, impulse-weld bonds and ultrasonic-weld bonds.

Embodiment 8. The system according to any of embodiments 1-4 wherein the filter media is secured to the outer surface of the purge diffuser core by an adhesive.

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Embodiment 9. The system according to any of embodiments 1-4 wherein the filter media is secured to the outer surface of the purge diffuser core by a filter media bracket, wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core.

Embodiment 10. The system according to any of embodiments 1-9 wherein the filter media is a porous hydrophobic film comprising a polyolefin, polyester, polysulfone, or fluoropolymer.

Embodiment 11. The system according to any of embodiments 1-9 wherein the filter media is a hydrophobic ultra-high molecular weight polyethylene membrane.

Embodiment 12. The system according to any of embodiments 1-11 wherein the purge port is comprised in a first wall of the substrate container which faces an opposite wall of the substrate container across the interior of the substrate container; wherein the minimum distance between the purge port and the opposite wall is the height of the interior of the substrate container; wherein the purge diffuser has a purge diffuser length which is the distance that the purge diffuser extends toward the opposite wall when mounted to the purge port; and wherein the purge diffuser length is not more than 85% of the height of the interior of the substrate container.

Embodiment 13. The system according to embodiment 12 wherein the purge diffuser length is not more than 60% of the height of the interior of the substrate container.

Embodiment 14. The system according to embodiment 12 or 13 wherein the purge diffuser length is at least 20% of the height of the interior of the substrate container.

Embodiment 15. The system according to any of embodiments 1-14 wherein the purge port is comprised in a first wall of the substrate container which faces an opposite wall of the substrate container across the interior of the substrate container; wherein the minimum distance between the purge port and the opposite wall is the height of the interior of the substrate container; wherein the internal purge gas channel has an internal purge gas channel length which is the distance that the internal purge gas channel extends toward the opposite wall when the purge diffuser is mounted to the purge port; and wherein the internal purge gas channel length is not more than 85% of the height of the interior of the substrate container.

Embodiment 16. The system according to embodiment 14 wherein the internal purge gas channel length is not more than 60% of the height of the interior of the substrate container.

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Embodiment 17. The system according to embodiment 14 or 15 wherein the internal purge gas channel length is at least 20% of the height of the interior of the substrate container.

Embodiment 18. The system according to any of embodiments 1-17 wherein the purge diffuser core additionally comprises one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel.

Embodiment 19. The system according to embodiment 18 wherein one or more diverters bridge across the internal purge gas channel from a first location on the inner surface of the purge diffuser core to a second location on the inner surface of the purge diffuser core, the second location being separated from the first location.

Embodiment 20. The system according to embodiment 17 or 19 wherein the diffuser core comprises one or more diverters in a first segment of the internal purge gas channel proximal to the purge port and does not comprise diverters in a second segment of the internal purge gas channel distal to the purge port.

Embodiment 21. The system according to embodiment 20 wherein the first segment is smaller than the second segment.

Embodiment 22. The system according to any of embodiments 1-21 wherein the diffuser ports are staggered such that every portion of the internal purge gas channel between the diffuser ports closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser.

Embodiment 23. The system according to any of embodiments 1-22 wherein the substrate container is a Front Opening Unified Pod (FOUP).

Embodiment 24. The system according to any of embodiments 1-23 wherein the substrates are semiconductor wafers.

Embodiment 25. A purge diffuser for use in a system for transporting substrates comprising:

i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface;

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ii) filter media secured to the outer surface of the purge diffuser core; and

iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates;

arranged such that there is a continuous path for purge gas entering through the purge port connector to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media.

Embodiment 26. The purge diffuser according to embodiment 25 wherein the purge diffuser core is an integral construction.

Embodiment 27. The purge diffuser according to embodiment 25 wherein the purge diffuser core is a unitary article.

Embodiment 28. The purge diffuser according to any of embodiments 24-25 wherein the purge diffuser core is a unitary article comprising an injection-moldable material and made in a single molding.

Embodiment 29. The purge diffuser according to embodiment 28 wherein the injection-moldable material is a melt processable polymer.

Embodiment 30. The purge diffuser according to any of embodiments 25-29 wherein the filter media is directly bound to the outer surface of the purge diffuser core.

Embodiment 31. The purge diffuser according to any of embodiments 25-29 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds.

Embodiment 32. The purge diffuser according to embodiment 31 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds selected from heat-weld bonds, impulse-weld bonds and ultrasonic-weld bonds.

Embodiment 33. The purge diffuser according to any of embodiments 25-29 wherein the filter media is secured to the outer surface of the purge diffuser core by an adhesive.

Embodiment 34. The purge diffuser according to any of embodiments 25-29 wherein the filter media is secured to the outer surface of the purge diffuser core by a filter media bracket,

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wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core.

Embodiment 35. The purge diffuser according to any of embodiments 25-29 wherein the filter media is a porous hydrophobic film comprising a polyolefin, polyester, polysulfone, or fluoropolymer.

Embodiment 36. The purge diffuser according to any of embodiments 25-35 wherein the filter media has a thickness of between 10 and 1300 micrometers.

Embodiment 37. The purge diffuser according to any of embodiments 25-36 wherein the purge diffuser core additionally comprises one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel.

Embodiment 38. The purge diffuser according to embodiment 37 wherein one or more diverters bridge across the internal purge gas channel from a first location on the inner surface of the purge diffuser core to a second location on the inner surface of the purge diffuser core, the second location being separated from the first location.

Embodiment 39. The purge diffuser according to embodiment 37 or 38 wherein the diffuser core comprises one or more diverters in a first segment of the internal purge gas channel proximal to the purge port connector and does not comprise diverters in a second segment of the internal purge gas channel distal to the purge port connector.

Embodiment 40. The purge diffuser according to embodiment 39 wherein the first segment is smaller than the second segment.

Embodiment 41. The purge diffuser according to any of embodiments 25-40 wherein the diffuser ports are staggered such that every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser.

Embodiment 42. A method of making a purge diffuser according to any of embodiments 25-41 comprising:

a) molding the purge diffuser core as single unitary article; and

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b) securing filter media to the outer surface of the purge diffuser core.

Embodiment 43. The method according to embodiment 42 wherein step a) is accomplished by injection molding.

Embodiment 44. The method according to embodiment 42 or 43 wherein step b) is accomplished by welding.

Embodiment 45. The method according to embodiment 42 or 43 wherein step b) is accomplished by impulse welding.

Embodiment 46. The method according to embodiment 42 or 43 wherein step b) is accomplished by attaching a filter media bracket, wherein the filter media is secured between the purge diffuser core and the filter media bracket and the filter media bracket is attached to the purge diffuser core.

Embodiment 47. A method of purging a system for transporting substrates according to any of embodiments 1-24, comprising passing a flow of purge gas through the purge port into the purge diffuser and thereby into the interior of the substrate container.

Embodiment 48. The method according to embodiment 45 wherein the purge gas is nitrogen.

Embodiment 49. The method according to embodiment 45 wherein the purge gas is clean dry air (CDA).

Embodiment 50. The method according to embodiment 47 wherein the purge diffuser provides a greater flow of purge gas to lower portions of the interior of the substrate container than to higher portions of the interior of the substrate container.

[0062] Various modifications and alterations of this disclosure will become apparent to those skilled in the art without departing from the scope and principles of this disclosure, and it should be understood that this disclosure is not to be unduly limited to the illustrative embodiments set forth hereinabove.

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What is claimed is:

1. A purge diffuser for use in a system for transporting substrates comprising:

i) a purge diffuser core having an internal purge gas channel, one or more diffuser ports and an outer surface;

ii) filter media secured to the outer surface of the purge diffuser core; and

iii) a purge port connector for mounting the purge diffuser to a purge port of a substrate container for transporting substrates;

arranged such that there is a continuous path for purge gas entering through the purge port connector to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media.

2. The purge diffuser according to claim 1 wherein the purge diffuser core is a unitary article.

3. The purge diffuser according to claim 1 wherein the purge diffuser core is a unitary article comprising an injection-moldable, melt processable polymer.

4. The purge diffuser according to any of claims 1-3 wherein the filter media is directly bound to the outer surface of the purge diffuser core by weld bonds.

5. The purge diffuser according to any of claims 1-3 wherein the filter media is secured to the outer surface of the purge diffuser core by an adhesive.

6. The purge diffuser according to any of claims 1-3, further comprising a scrim dispose over the filter media.

7. The purge diffuser according to any of claims 1-6 wherein the filter media is a porous hydrophobic film comprising a polyolefin, polyester, polysulfone, or fluoropolymer.

8. The purge diffuser according to any one of claims 1-6 wherein the filter media is a hydrophobic membrane comprising a polyolefin, polyester, polysulfone or fluoropolymer.

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9. The purge diffuser according to any of claims 1-8 wherein the filter media is a hydrophobic ultra-high molecular weight polyethylene membrane.

10. The purge diffuser according to any of claims 1-9 wherein the purge diffuser core additionally comprises one or more diverters which project into the internal purge gas channel from an inner surface of the purge diffuser core bordering the internal purge gas channel.

11. The purge diffuser according to any of claims 1-10 wherein the diffuser ports are staggered such that every portion of the internal purge gas channel between the diffuser port closest to the purge port connector and the diffuser port most distant from the purge port connector may be accessed through a diffuser port along a line perpendicular to the length of the purge diffuser.

12. A system for transporting substrates comprising:

a) a substrate container comprising a container portion with an opening, a door adapted to be received in the opening, and a purge port to admit purge gas to an interior of the container portion; and

b) a purge diffuser according to any of claims 1-11 mounted to the purge port by the purge port connector, arranged such that there is a continuous path for purge gas entering through the purge port to enter the internal purge gas channel, exit the internal purge gas channel through the diffuser ports, and pass through the filter media into the interior of the substrate container.

13. The system according to claim 12 wherein the purge port is defined in a first wall of the substrate container which faces an opposite wall of the substrate container across the interior of the substrate container; wherein a height of the substrate container is measured from a top wall to a bottom wall of the container portion and wherein a length of the purge diffuser is not more than 85% of the height the substrate container.

14. The system according to any of claims 12-13 wherein the substrate container is a front opening unified pod (FOUP).

15. A method of making a purge diffuser according to any of claims 1-11 comprising:

a) molding the purge diffuser core as single unitary article; and

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b) securing filter media to the outer surface of the purge diffuser core.

16. The method according to claim 15 wherein step a) is accomplished by injection molding.

17. The method according to claim 15 or 16 wherein step b) is accomplished by welding.

18. A method of purging a system for transporting substrates according to any of claims 12-14, comprising passing a flow of purge gas through the purge port into the purge diffuser and thereby into the interior of the substrate container.

19. The method according to claim 18 wherein the purge gas is nitrogen and the purge diffuser provides a greater flow of purge gas to lower portions of the interior of the substrate container than to higher portions of the interior of the substrate container.

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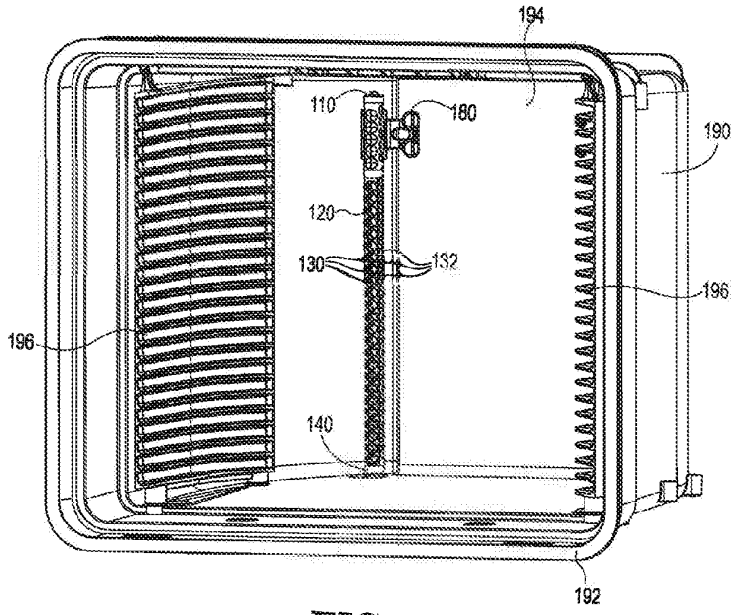


FIG. 1

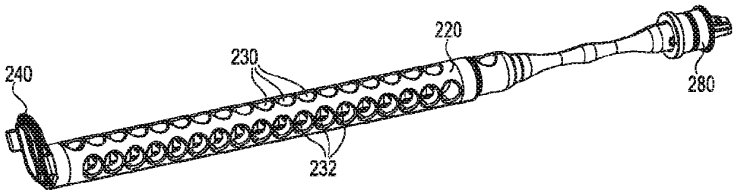


FIG. 2

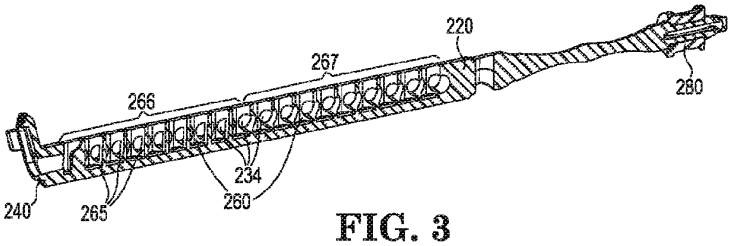


FIG. 3

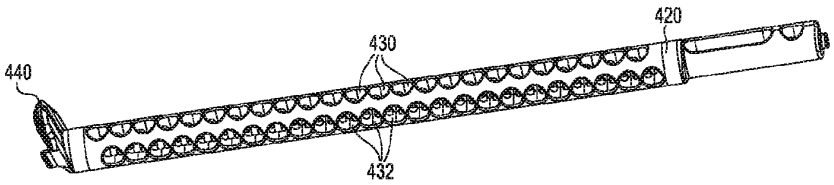


FIG. 4

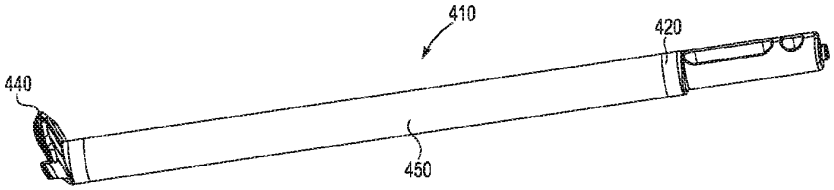


FIG. 5

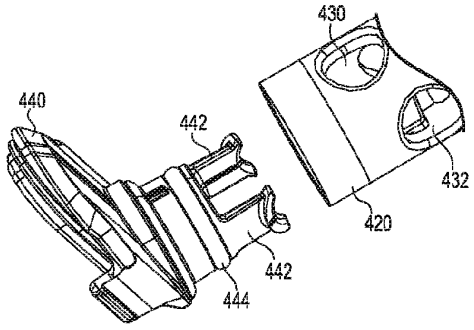


FIG. 6A

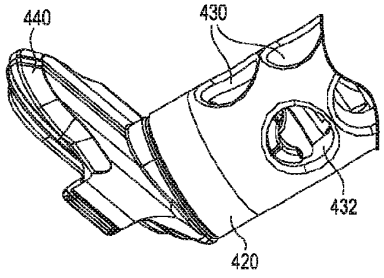


FIG. 6B

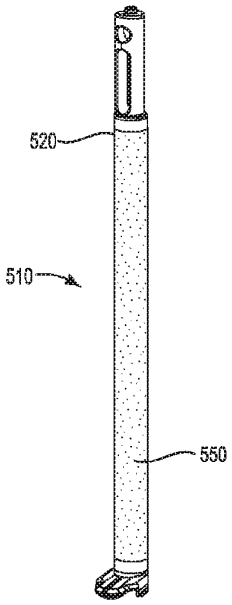


FIG. 7A

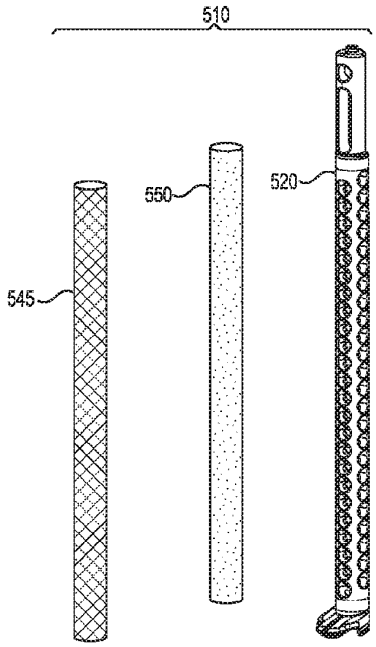


FIG. 7B

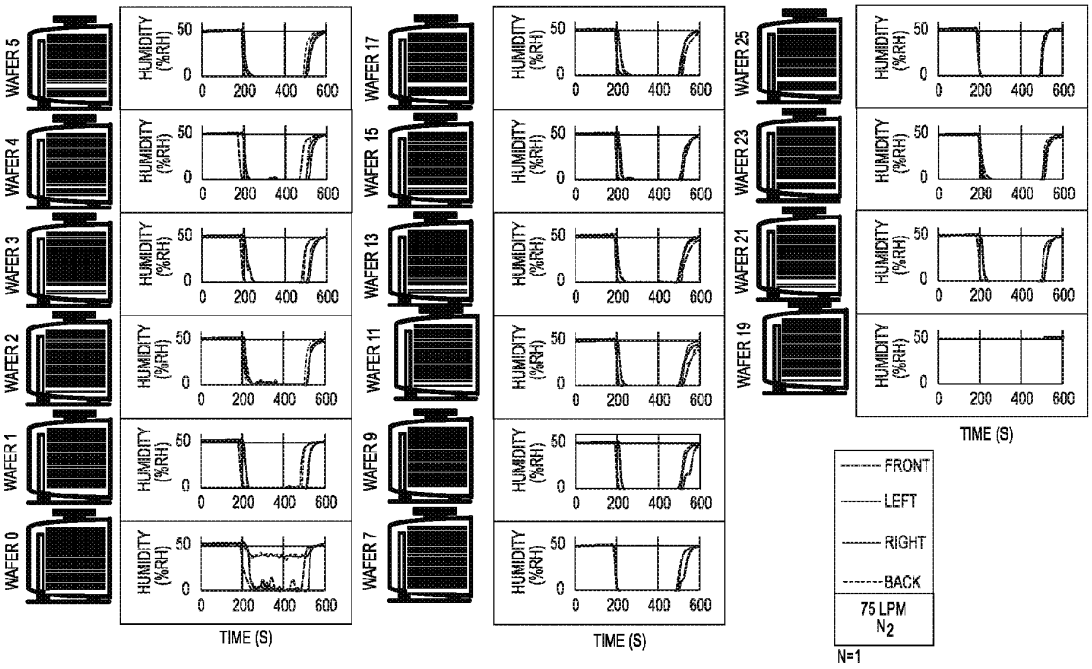

WAFER 5
WAFER 4
WAFER 3
WAFER 2
WAFER 1
WAFER 0
WAFER 17
WAFER 15
WAFER 13
WAFER 11
WAFER 9
WAFER 7
WAFER 25
WAFER 23
WAFER 21
WAFER 19
HUMIDITY (%RH)
50
0
0 200 400 600
TIME (S)
FRONT
LEFT
RIGHT
BACK
75 LPM N_2
N=1

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/048247

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 13,16,19
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 13, 16 and 19 are not clear, contrary to the requirement of PCT Article 6, because they each refer to a claim which does not comply with PCT Rule 6.4(a).

3. ☒ Claims Nos.: 7-12,14,15,17,18
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/048247

A. CLASSIFICATION OF SUBJECT MATTER

H01L 21/673(2006.01)i, H01L 21/677(2006.01)i, H01L 21/67(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L 21/673; B65D 85/86; H01L 21/02; H01L 21/324; H01L 21/67; H01L 21/677; H01L 21/68

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: FOUP, purge diffuser, channel, purge port, filter

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015-0348810 A1 (ENTEGRIS, INC.) 03 December 2015 See paragraphs [0016]-[0037] and figures 1B, 3, 6, 8.	1-6
Y	JP 2002-170874 A (EBARA CORP.) 14 June 2002 See paragraphs [0021]-[0027] and figures 1, 5, 6.	1,4,5
Y	KR 10-1748361 B1 (ZENSM CO., LTD.) 19 June 2017 See paragraphs [0057], [0059], [0070] and figure 1.	1,4,5
A	KR 10-1601600 B1 (CHO, CHANG HYEON) 09 March 2016 See paragraphs [0016]-[0018] and figure 3.	1-6
A	US 2018-0144965 A1 (LAM RESEARCH CORPORATION) 24 May 2018 See paragraphs [0086]-[0091] and figures 20-22.	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 December 2019 (13.12.2019)	**16 December 2019 (16.12.2019)**

Name and mailing address of the ISA/KR	Authorized officer
International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea	PARK, Hye Lyun
Facsimile No. +82-42-481-8578	Telephone No. +82-42-481-3463

Form PCT/ISA/210 (second sheet) (July 2019)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/048247

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		US 2016-0118282 A1	28/04/2016
		US 9881826 B2	30/01/2018

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(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2022年12月29日(29.12.2022)

WIPO | PCT

(10) 国際公開番号
WO 2022/269718 A1

(51) 国際特許分類:
H01L 21/673 (2006.01)

(21) 国際出願番号： PCT/JP2021/023474

(22) 国際出願日： 2021年6月21日(21.06.2021)

(25) 国際出願の言語： 日本語

(26) 国際公開の言語： 日本語

(71) 出願人: ミライアル株式会社 (**MIRAIAL CO., LTD.**) [JP/JP]; 〒1700013 東京都豊島区東池袋１丁目２４番１号 Tokyo (JP).

(72) 発明者: 松 鳥 千 明 (**MATSUTORI Chiaki**); 〒1700013 東京都豊島区東池袋１丁目２４番１号 ミライアル株式会社内 Tokyo (JP).

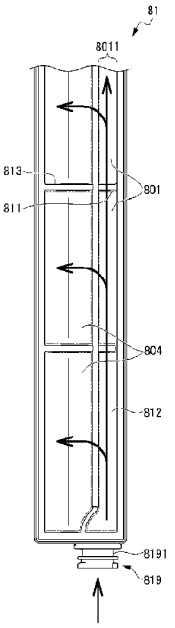
(74) 代理人: 正林 真之，外 (**SHOBAYASHI Masayuki** et al.); 〒1000005 東京都千代田区丸の内１－７－１２ サピアタワー Tokyo (JP).

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(54) **Title:** SUBSTRATE CONTAINER

(54) 発明の名称： 基板収納容器



(57) **Abstract:** A substrate container 1 includes: a container body 2; a lid 3; a gas passage 98, 99 that enables a substrate housing space 27 to communicate with a space outside of the container body 2; a gas ejection nozzle part 8 having multiple openings 841 for supplying a gas flowed into the gas passage 98, 99 to the substrate housing space 27; and a gas flow equalization part 801, 803, 804 that enables the gas to flow out from the multiple openings 841 at an equalized flow rate. The gas flow equalization part includes a gas retention chamber 801, a pre-outflow gas retention chamber 804, and an inter-chamber partition 812, 822 that prevents the gas retention chamber 801 and the pre-outflow gas retention chamber 804 from linearly communicating with each other and forms an inter-chamber flow path 806 through which the gas retention chamber 801 and the pre-outflow gas retention chamber 804 communicate with each other.

(57) 要約：容器本体２と、蓋体３と、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路９８、９９と、通気路９８、９９に流入した気体を基板収納空間２７に供給する複数の開口部８４１を有する気体噴出ノズル部８と、複数の開口部８４１から均一化された流量で気体を流出可能とする気体流量均一化部８０１、８０３、８０４と、を備え、気体流量均一化部は、気体滞留室８０１と、気体流出前保持室８０４と、気体滞留室８０１と気体流出前保持室８０４とを直線的に連通することを遮蔽して気体滞留室８０１と気体流出前保持室８０４とを連通する室間流路８０６を形成する室間間仕切り８１２、８２２と、を有する基板収納容器１である。

［続葉有］

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— 国際調査報告（条約第21条(3)）

明 細 書

発明の名称 ： 基板収納容器

技術分野

[0001] 本発明は、半導体ウェーハ、レチクル、プリント基板などの基板を収納、保管、搬送、輸送等する際に使用される基板収納容器に関する。

背景技術

[0002] 各種基板を収納する基板収納容器としては、容器本体と蓋体とを備える構成のものが、従来より知られている。

[0003] 容器本体の一端部は、容器本体開口部を有する。容器本体の他端部は、閉塞された筒状の壁部を有する。容器本体内には基板収納空間が形成されている。基板収納空間は、壁部により取り囲まれて形成されており、基板を収納可能である。蓋体は、容器本体開口部に対して着脱可能であり、容器本体開口部を閉塞可能である。側方基板支持部は、基板収納空間内において対をなすように壁部に設けられている。側方基板支持部は、蓋体によって容器本体開口部が閉塞されていないときに、隣接する基板同士を所定の間隔で離間させて並列させた状態で、基板の縁部を支持可能である。

[0004] 蓋体の部分であって容器本体開口部を閉塞しているときに基板収納空間に対向する部分には、フロントリテーナ（蓋体側基板支持部）が設けられている。フロントリテーナは、蓋体によって容器本体開口部が閉塞されているときに、基板の縁部を支持可能である。また、フロントリテーナと対をなすようにして、奥側基板支持部が壁部に設けられている。奥側基板支持部は、基板の縁部を支持可能である。奥側基板支持部は、蓋体によって容器本体開口部が閉塞されているときに、フロントリテーナと協働して基板を支持することにより、隣接する基板同士を所定の間隔で離間させて並列させた状態で、基板を支持する。

先行技術文献

特許文献

[0005] 特許文献1：特表２０１６－５３８７３２号公報

特許文献2：特開２０１７－１７２６４公報

特許文献3：特開２０１６－００４９４９公報

発明の概要

発明が解決しようとする課題

[0006] 基板収納空間と、基板収納容器の外部とを連通する通気孔である掃気孔を有する基板収納容器においては、蓋体を取り外した状態でクリーンドライエア（ＣＤＡ）や、窒素（N_2）がパージガスとして用いられ、基板収納容器の外部のロードポートから供給される当該パージガスは、容器本体の下面（外面）より貫通孔を通じて、基板収納容器内面に設置された気体噴出ノズル部へ供給される。これによりガスパージが行われる。この際、ガスパージによるパージガスの置換を確実に行うために、気体噴出ノズル部の複数の開口部から、パージガスが均一に供給されることが要求される。

[0007] 本発明は、基板収納空間において気体を気体噴出ノズル部の複数の開口部から均一に供給可能な基板収納容器を提供することを目的とする。

課題を解決するための手段

[0008] 本発明は、一端部に容器本体開口部が形成された開口周縁部を有し、他端部が閉塞された筒状の壁部を備え、前記壁部の内面によって、基板を収納可能であり前記容器本体開口部に連通する基板収納空間が形成された容器本体と、前記容器本体開口部に対して着脱可能であり、前記容器本体開口部を閉塞可能な蓋体と、前記基板収納空間と前記容器本体の外部の空間とを連通可能な通気路と、前記通気路に流入した気体を前記基板収納空間に供給する複数の開口部を有する気体噴出ノズル部と、前記複数の開口部から均一化された流量で気体を流出可能とする気体流量均一化部と、を備え、前記気体流量均一化部は、気体滞留室と、気体流出前保持室と、前記気体滞留室と前記気体流出前保持室とを直線的に連通することを遮蔽して前記気体滞留室と前記気体流出前保持室とを連通する室間流路を形成する室間間仕切りと、を有する基板収納容器に関する。

[0009] また、前記気体流量均一化部は、前記気体流出前保持室を複数の気体流出前保持分室に区画する区画壁を有することが好ましい。また、前記複数の気体流出前保持分室は均一の容積を有することが好ましい。また、前記気体滞留室は、分室間間仕切りにより複数の気体滞留分室に仕切られていることが好ましい。また、全ての前記気体滞留分室に連通する気体供給流路が形成されていることが好ましい。

[0010] また、前記気体噴出ノズル部は、開口部に連通するノズル部室を有し、前記ノズル部室は、疎水性膜を介して前記気体流出前保持室に連通することが好ましい。また、前記ノズル部室は、全ての開口部及び全ての前記気体流出前保持分室に連通することが好ましい。また、前記気体噴出ノズル部は、前記開口部から気体を所定の方向へ向けて流出させる所定方向流出部を有することが好ましい。

[0011] また、前記開口部は、前記基板収納空間に収納される複数の前記基板のそれぞれに対応して形成されていることが好ましい。また、前記気体噴出ノズル部と前記気体流量均一化部とを有する柱状の突出部を備え、前記突出部の基部は、前記容器本体の前記壁部に形成され前記通気路を形成する穴であってシール部材が設けられた穴に挿入される共に、前記突出部の先端側の部分は、前記容器本体の前記壁部に対して固定されることにより、前記突出部は前記容器本体に固定されることが好ましい。

発明の効果

[0012] 本発明によれば、基板収納空間において気体を気体噴出ノズル部の複数の開口部から均一に供給可能な基板収納容器を提供することができる。

図面の簡単な説明

[0013] [図1]本発明の実施形態に係る基板収納容器１に複数の基板Ｗが収納された様子を示す分解斜視図である。

[図2]本発明の実施形態に係る基板収納容器１の容器本体２を示す上方斜視図である。

[図3]本発明の実施形態に係る基板収納容器１の容器本体２を示す下方斜視図

である。

[図4]図３のＡ－Ａ線で切断した容器本体２を示す側方断面図である。

[図5]基板収納容器１の突出部８を示す斜視図である。

[図6]基板収納容器１の突出部８を示す分解斜視図である。

[図7]基板収納容器１の突出部８を構成する突出部本体部８１の内部のパージガスの流れを示す分解斜視図である。

[図8]基板収納容器１の突出部８を示す後方斜視断面図である。

[図9]基板収納容器１の突出部８を示す前方斜視断面図である。

[図10]基板収納容器１の突出部８を構成するノズル部室形成部８４を示す側面図である。

発明を実施するための形態

[0014] 〔基板収納容器１の全体構成〕

以下、本実施形態による基板収納容器１について、図面を参照しながら説明する。

図１は、基板収納容器１に複数の基板Ｗが収納された様子を示す分解斜視図である。図２は、基板収納容器１の容器本体２を示す上方斜視図である。図３は、基板収納容器１の容器本体２を示す下方斜視図である。図４は、図３のＡ－Ａ線で切断した容器本体２を示す側方断面図である。

[0015] ここで、説明の便宜上、後述の容器本体２から蓋体３へ向かう方向（図１における右上から左下へ向かう方向）を前方向Ｄ１１と定義し、その反対の方向を後方向Ｄ１２と定義し、これらをあわせて前後方向Ｄ１と定義する。また、後述の下壁２４から上壁２３へと向かう方向（図１における上方向）を上方向Ｄ２１と定義し、その反対の方向を下方向Ｄ２２と定義し、これらをあわせて上下方向Ｄ２と定義する。また、後述する第２側壁２６から第１側壁２５へと向かう方向（図１における右下から左上へ向かう方向）を左方向Ｄ３１と定義し、その反対の方向を右方向Ｄ３２と定義し、これらをあわせて左右方向Ｄ３と定義する。主要な図面には、これらの方向を示す矢印を図示している。

[0016] また、基板収納容器１に収納される基板Ｗ（図１参照）は、円盤状のシリコンウェーハ、ガラスウェーハ、サファイアウェーハ等であり、産業に用いられる薄いものである。本実施形態における基板Ｗは、直径３００ｍｍのシリコンウェーハである。

[0017] 図１～図４に示すように、基板収納容器１は、上述のようなシリコンウェーハからなる基板Ｗを収納して、工場内の工程において搬送する工程内容器として用いられたり、陸運手段・空運手段・海運手段等の輸送手段により基板を輸送するための出荷容器として用いられたりするものであり、容器本体２と、蓋体３とから構成される。容器本体２は、側方基板支持部としての基板支持板状部５と、奥側基板支持部６とを備えている。蓋体３は、蓋体側基板支持部としての図示しないフロントリテーナを備えている。

[0018] 容器本体２は、一端部に容器本体開口部２１が形成され、他端部が閉塞された筒状の壁部２０を有する。容器本体２内には基板収納空間２７が形成されている。基板収納空間２７は、壁部２０により取り囲まれて形成されている。壁部２０の部分であって基板収納空間２７を形成している部分には、基板支持板状部５が配置されている。基板収納空間２７には、図１に示すように、複数の基板Ｗを収納可能である。

[0019] 基板支持板状部５は、基板収納空間２７内において対をなすように配置された内装部品であり、壁部２０に着脱可能に固定されて設けられている。基板支持板状部５は、複数の基板Ｗの縁部に当接することにより、隣接する基板Ｗ同士を所定の間隔で離間させて並列させた状態で、複数の基板Ｗの縁部を支持可能である。基板支持板状部５の奥側には、奥側基板支持部６が基板支持板状部５と一体成形されて設けられている。

[0020] 奥側基板支持部６は、基板収納空間２７内において後述する図示しないフロントリテーナと対をなすように壁部２０に設けられている。奥側基板支持部６は、複数の基板Ｗの縁部に当接することにより、複数の基板Ｗの縁部の後部を支持可能である。

[0021] 蓋体３は、容器本体開口部２１を形成する開口周縁部２８に対して着脱可

Entegris, EX1002, p. 1130

能であり、容器本体開口部２１を閉塞可能である。図示しないフロントリテーナは、蓋体３の部分であって蓋体３によって容器本体開口部２１が閉塞されているときに基板収納空間２７に対向する部分に設けられている。フロントリテーナは、基板収納空間２７の内部において奥側基板支持部６と対をなすように配置されている。

[0022] フロントリテーナは、蓋体３によって容器本体開口部２１が閉塞されているときに、複数の基板Wの縁部に当接することにより複数の基板Wの縁部の前部を支持可能である。フロントリテーナは、蓋体３によって容器本体開口部２１が閉塞されているときに、奥側基板支持部６と協働して複数の基板Wを支持することにより、隣接する基板W同士を所定の間隔で離間させて並列させた状態で保持する。

[0023] 基板収納容器１は、プラスチック材等の樹脂で構成されており、特に説明が無い場合には、その材料の樹脂としては、たとえば、ポリカーボネート、シクロオレフィンポリマー、ポリエーテルイミド、ポリエーテルケトン、ポリブチレンテレフタレート、ポリエーテルエーテルケトン、液晶ポリマーといった熱可塑性樹脂やこれらのアロイ等が上げられる。これらの成形材料の樹脂には、導電性を付与する場合には、カーボン繊維、カーボンパウダー、カーボンナノチューブ、導電性ポリマー等の導電性物質が選択的に添加される。また、剛性を上げるためにガラス繊維や炭素繊維等を添加することも可能である。

[0024]〔容器本体２〕

以下、各部について、詳細に説明する。図１～図４に示すように、容器本体２の壁部２０は、奥壁２２と上壁２３と下壁２４と第１側壁２５と第２側壁２６とを有する。奥壁２２、上壁２３、下壁２４、第１側壁２５、及び第２側壁２６は、上述した材料により構成されており、一体成形されて構成されている。

[0025] 第１側壁２５と第２側壁２６とは対向しており、上壁２３と下壁２４とは対向している。上壁２３の後端、下壁２４の後端、第１側壁２５の後端、及

び第２側壁２６の後端は、全て奥壁２２に接続されている。上壁２３の前端、下壁２４の前端、第１側壁２５の前端、及び第２側壁２６の前端は、略長方形状をした容器本体開口部２１を形成する開口周縁部２８を構成する。

[0026] 開口周縁部２８は、容器本体２の一端部に設けられており、奥壁２２は、容器本体２の他端部に位置している。壁部２０の外面により形成される容器本体２の外形は箱状である。壁部２０の内面、即ち、奥壁２２の内面、上壁２３の内面、下壁２４の内面、第１側壁２５の内面、及び第２側壁２６の内面は、これらによって取り囲まれた基板収納空間２７を形成している。開口周縁部２８に形成された容器本体開口部２１は、壁部２０により取り囲まれて容器本体２の内部に形成された基板収納空間２７に連通している。基板収納空間２７には、最大で２５枚の基板Ｗを収納可能である。

[0027] 上壁２３及び下壁２４の部分であって、開口周縁部２８の近傍の部分には、基板収納空間２７の外方へ向かって窪んだラッチ係合凹部２３１Ａ、２３１Ｂ、２４１Ａ、２４１Ｂが形成されている。ラッチ係合凹部２３１Ａ、２３１Ｂ、２４１Ａ、２４１Ｂは、上壁２３及び下壁２４の左右両端部近傍に１つずつ、計４つ形成されている。

[0028] 上壁２３の外面においては、リブ２３５が、上壁２３と一体成形されて設けられている。リブ２３５は、容器本体２の剛性を高める。また、上壁２３の中央部には、トップフランジ２３６が固定される。トップフランジ２３６は、ＡＭＨＳ（自動ウェーハ搬送システム）、ＰＧＶ（ウェーハ基板搬送台車）等において基板収納容器１を吊り下げる際に、基板収納容器１において掛けられて吊り下げられる部分となる部材である。

[0029] 下壁２４には、ボトムプレート２４４が固定されている。ボトムプレート２４４は、下壁２４の外面を構成する下面の略全面に対向して配置される略長方形状の板状を有しており、下壁２４に固定されている。

[0030] 下壁２４の四隅近傍には、２種類の貫通孔である給気孔２４２と排気孔２４３が形成されている。本実施形態においては、下壁２４の前部の２箇所の貫通孔は、容器本体２の内部の気体を排出するための排気孔２４３であり、

後部の２箇所の貫通孔は、容器本体２の内部に気体を給気するための給気孔２４２である。

[0031] 給気孔２４２としての貫通孔には、付加部品としての給気用フィルタ部９８が配置されており、排気孔２４３としての貫通孔には、排気用フィルタ部９９が配置されている。即ち、給気用フィルタ部９８及び排気用フィルタ部９９の内部の気体の流路は、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路の一部を構成する。また、給気用フィルタ部９８と排気用フィルタ部９９とは、壁部２０に配置されており、給気用フィルタ部９８と排気用フィルタ部９９とにおいては、容器本体２の外部の空間と基板収納空間２７との間でフィルタ（図示せず）を介して気体が通過可能である。給気用フィルタ部９８に供給されたパージガスは、基板収納空間２７へ供給されるように構成されている。排気用フィルタ部９９は、基板収納空間２７から容器本体２の外部の空間へ気体を通過可能に構成されている。

[0032]〔突出部８〕

奥壁２２は、気体噴出ノズル部としての突出部８（図５参照）を有している。突出部８は、図６に示すように、突出部本体部８１と、内部壁部８２と、疎水性膜８３と、ノズル部室形成部８４と、を有しており、これらはこの順で、図６に示すように、互いに固定されて突出部８を構成する。

[0033] 突出部８は、２つで対をなして設けられている。環状の溝８１９１が形成され溝８１９１に図示しないシール部材であるＯリングが嵌められた突出部本体部８１の基部８１９が、給気用フィルタ部９８の内部の通気路に気密に連通するように、２つの給気孔２４２の近傍の容器本体２の下壁２４の部分に形成された穴に、１つずつ計２つ差し込み構造により差し込まれることにより、容器本体２の下壁２４に固定されている。容器本体２の下壁２４に形成された当該穴にも、基部８１９に対してシールをする図示しないシール部材が設けられている。また、突出部８の先端側の部分である突出部８の上部は、スナップフィット、又は、溶着等により、壁部２０を構成する奥壁２２に固定されている。

Entegris, EX1002, p. 1133

[0034] この構成により、一対の突出部８は、リブ状に容器本体開口部２１へ向って突出し、平行に奥壁２２の上端部から下端部に至るまで延びている。突出部８は中空の柱状を有している。

[0035] 突出部８は、基板収納空間２７と容器本体２の外部の空間とを連通可能な、給気用フィルタ部９８の内部の気体の流路である通気路に流入した気体を、基板収納空間２７に供給する複数の開口部８４１と、複数の開口部８４１から均一化された流量で気体を流出可能とする気体流量均一化部を有する。

[0036] 気体流量均一化部は、具体的には、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路（給気用フィルタ部９８の内部の気体の流路）と、開口部８４１と、の間に位置している。気体流量均一化部は、気体滞留室８０１と、気体流出前保持室８０４と、気体滞留室８０１と気体流出前保持室８０４とを直線的に連通することを遮蔽して気体滞留室８０１と気体流出前保持室８０４とを連通する室間流路８０６を形成する室間間仕切（本体側間仕切８１２、内壁側間仕切８２２）と、ノズル部室８０３と、を有している。

[0037] 図８、図９等に示すように、気体滞留室８０１は、突出部本体部８１と、内部壁部８２と、室間間仕切（本体側間仕切８１２、内壁側間仕切８２２）と、により囲まれる空間により構成されている。気体流出前保持室８０４は、突出部本体部８１と、内部壁部８２及び内部壁部８２に形成された貫通孔を塞ぐように設けられた疎水性膜８３と、室間間仕切（本体側間仕切８１２、内壁側間仕切８２２）と、により囲まれる空間により構成されている。ノズル部室８０３は、内部壁部８２及び内部壁部８２に形成された貫通孔を塞ぐように設けられた疎水性膜８３と、ノズル部室形成部８４と、により囲まれる空間により構成されている。

[0038] 気体滞留室８０１は、図６、図７に示すように、上下方向において所定の間隔で設けられた分室間間仕切り８１１により複数の気体滞留分室に仕切られている。分室間間仕切り８１１は、気体滞留室８０１を完全に区画してパージガスが複数の気体滞留分室の間を流通不能とするのではなく、内部壁部

８２との間にガス流通空間８０１１を形成している。このため、上下方向に隣接する気体滞留分室の間でパージガスの流通が可能である。

[0039] ガス流通空間８０１１は、上下方向において突出部８の最下部から最上部まで気体滞留室８０１が直線状に連通していない。具体的には、内部壁部８２から気体滞留室８０１の内方へ延びる分室間間仕切り８２３が、内部壁部８２に設けられている。従って、給気用フィルタ部９８の通気路から気体滞留室８０１へ流入したパージガスは、分室間間仕切り８１１と分室間間仕切り８２３とによりクランク形状の気体供給流路８０１１とされた、全ての気体滞留分室に連通する気体滞留室８０１の部分を通過して、気体滞留室８０１の最下端から最上端へ向かって流れるように構成されている。

[0040] 気体流出前保持室８０４は、図６、図７に示すように、上下方向において所定の間隔で設けられた区画壁８１３により、複数の気体流出前保持分室に区画されている。区画壁８１３は、気体流出前保持室８０４を完全に区画してパージガスが複数の気体流出前保持分室の間を流通不能とする。このため、各気体流出前保持分室に流入したパージガスは、疎水性膜８３を通して、ノズル部室８０３へ流入する。図６、図７に示すように、区画壁８１３により区画された複数の気体流出前保持分室は、均一の容積を有する。

[0041] 疎水性膜８３は、内部壁部８２に複数形成された貫通孔８２１の周囲であって内部壁部８２の前側に形成された凹部に嵌め込まれた状態で固定されている。疎水性膜８３は、基板収納容器１の容器本体２を洗浄する際に、濡れても流動抵抗が変化しない疎水性の膜により構成されている。疎水性膜８３としては、具体的には、通気性・疎水性能を持つ多孔質の膜、シート、又は疎水性能を持つコーティング品等が用いられ、本実施形態においては、ＰＴＦＥ膜が用いられる。

[0042] ノズル部室８０３の内部には、分室間間仕切りや区画壁は設けられていない。このため、下端部から上端部に至るまで連続して続く、１つの室として形成されている。図１０に示すように、ノズル部室８０３が形成されたノズル部室形成部８４の前側には、複数の開口部８４１が形成されている。開口

部８４１は、基板収納空間２７に収納可能な基板Wの一枚毎に対応した個数、具体的には、２５個形成されている。ノズル部室８０３は、全ての開口部８４１に連通しており、また、疎水性膜８３を通して、区画壁８１３により複数に区画された全ての気体流出前保持分室に連通する。

[0043] 開口部８４１の上側には、図１０に示すように、それぞれ前方向Ｄ１１へ進むにつれて下方向Ｄ２２に傾斜する傾斜庇８４２が、開口部８４１の下側よりも前方向Ｄ１１へ突出して設けられている。傾斜庇８４２は、互いに平行に延びている。傾斜庇８４２は、容器本体２を洗浄する際に、開口部８４１からノズル部室８０３への洗浄液の流入を阻む。また、傾斜庇８４２は、開口部８４１から気体を下方向Ｄ２２へ向けて流出させる所定方向流出部を構成する。

[0044]〔蓋体３〕

図１に示すように、蓋体３は、容器本体２の開口周縁部２８の形状と略一致する略長方形状を有している。蓋体３は容器本体２の開口周縁部２８に対して着脱可能であり、開口周縁部２８に蓋体３が装着されることにより、蓋体３は、開口周縁部２８によって取り囲まれる位置関係で、容器本体開口部２１を閉塞可能である。

[0045] 蓋体３の内面（図１に示す蓋体３の裏側の面）であって、蓋体３が容器本体開口部２１を閉塞しているときの開口周縁部２８のすぐ後方向Ｄ１２の位置に形成された段差の部分の面（シール面２８１）に対向する面には、蓋体３の外周縁部を一周するように、環状のシール部材４が取り付けられている。シール部材４は、蓋体３を一周するように配置されている。シール部材４は、弾性変形可能なポリエステル系、ポリオレフィン系など各種熱可塑性エラストマー、フッ素ゴム製、シリコンゴム製等である。

[0046] 蓋体３が開口周縁部２８に装着されたときに、シール部材４は、容器本体２のシール面２８１と蓋体３の内面とにより挟まれて弾性変形する。即ち、蓋体３と容器本体２との間にシール部材４が介在することにより、蓋体３と開口周縁部２８とが互いに当接せずに離間した状態で、蓋体３は、容器本体

開口部２１を閉塞可能である。開口周縁部２８から蓋体３が取り外されることにより、容器本体２内の基板収納空間２７に対して、基板Wを出し入れ可能となる。

[0047] 蓋体３においては、ラッチ機構が設けられている。ラッチ機構は、蓋体３の左右両端部近傍に設けられており、図１に示すように、蓋体３の上辺から上方向Ｄ２１へ突出可能な２つの上側ラッチ部３２Ａ、３２Ａと、蓋体３の下辺から下方向Ｄ２２へ突出可能な２つの下側ラッチ部３２Ｂ、３２Ｂと、を備えている。２つの上側ラッチ部３２Ａ、３２Ａは、蓋体３の上辺の左右両端近傍に配置されており、２つの下側ラッチ部３２Ｂ、３２Ｂは、蓋体３の下辺の左右両端近傍に配置されている。

[0048] 蓋体３の外面においては操作部３３が設けられている。操作部３３を蓋体３の前側から操作することにより、上側ラッチ部３２Ａ、３２Ａ、下側ラッチ部３２Ｂ、３２Ｂを蓋体３の上辺、下辺から突出させることができ、又は、上辺、下辺から突出させない状態とすることができる。上側ラッチ部３２Ａ、３２Ａが蓋体３の上辺から上方向Ｄ２１へ突出して、容器本体２のラッチ係合凹部２３１Ａ、２３１Ｂに係合し、且つ、下側ラッチ部３２Ｂ、３２Ｂが蓋体３の下辺から下方向Ｄ２２へ突出して、容器本体２のラッチ係合凹部２４１Ａ、２４１Ｂに係合することにより、蓋体３は、容器本体２の容器本体開口部２１に固定される。

[0049] 蓋体３の内側（図１における蓋体３の後方向Ｄ１２の側）においては、基板収納空間２７の外方（前方向Ｄ１１）へ窪んだ凹部（図示せず）が形成されている。凹部には、フロントリテーナ（図示せず）が固定されて設けられている。

[0050] フロントリテーナ（図示せず）は、フロントリテーナ基板受け部（図示せず）を有している。フロントリテーナ基板受け部（図示せず）は、左右方向に所定の間隔で離間して対をなすようにして２つずつ配置されている。このように対をなすようにして２つずつ配置されたフロントリテーナ基板受け部は、上下方向に２５対並列した状態で設けられている。基板収納空間２７内

に基板Wが収納され、蓋体３が閉じられることにより、フロントリテーナ基板受け部は、基板Wの縁部の端縁を支持する。

[0051]〔実施形態の効果〕

上記構成の本実施形態に係る基板収納容器１によれば、以下のような効果を得ることができる。

本実施形態に係る基板収納容器１は、一端部に容器本体開口部２１が形成された開口周縁部２８を有し、他端部が閉塞された筒状の壁部２０を備え、壁部２０の内面によって、基板Wを収納可能であり容器本体開口部２１に連通する基板収納空間２７が形成された容器本体２と、容器本体開口部２１に対して着脱可能であり、容器本体開口部２１を閉塞可能な蓋体３と、基板収納空間２７と容器本体２の外部の空間とを連通可能な通気路（給気用フィルタ部９８及び排気用フィルタ部９９の内部の気体の流路）と、通気路に流入した気体を基板収納空間２７に供給する複数の開口部８４１を有する気体噴出ノズル部としての突出部８と、複数の開口部８４１から均一化された流量で気体を流出可能とする気体流量均一化部（気体滞留室８０１、気体流出前保持室８０４）と、を備え、気体流量均一化部は、気体滞留室８０１と、気体流出前保持室８０４と、気体滞留室８０１と気体流出前保持室８０４とを直線的に連通することを遮蔽して気体滞留室８０１と気体流出前保持室８０４とを連通する室間流路８０６を形成する室間間仕切り（本体側間仕切８１２、内壁側間仕切８２２）と、を有する。

[0052] この構成により、気体滞留室８０１に滞留されたパージガスが、室間流路８０６を通って気体流出前保持室８０４の複数の各気体流出前保持分室に流され、ノズル部室８０３へ流入して滞留され、ノズル部室形成部８４の複数の開口部８４１のそれぞれから均一に流出することが可能となる。この結果、基板収納空間２７に収納されている基板Wに対して、複数の開口部８４１から均一にパージガスを供給することが可能となる。

[0053] また、本実施形態に係る基板収納容器１によれば、気体流量均一化部は、気体流出前保持室８０４を複数の気体流出前保持分室に区画する区画壁８１

３を有する。この構成により、気体流出前保持室８０４に流入したパージガスは、複数の気体流出前保持分室に分けられて、一時的に滞留させることが可能となる。これにより、複数の気体流出前保持分室に流入したパージガスの量に差があった場合であっても、一時的に滞留させられるため、一時的に滞留させられて各気体流出前保持分室で均一化されたパージガスが、ノズル部室８０３へ流入する。このため、ノズル部室８０３へ流入したパージガスが、所定の開口部８４１から強く流出することを抑えることが可能となる。

[0054] また、本実施形態に係る基板収納容器１によれば、複数の気体流出前保持分室は均一の容積を有する。この構成により、所定の気体流出前保持分室から疎水性膜８３を通して、ノズル部室８０３へ流入するパージガスの量の差が生ずることを極力抑えることが可能となる。

[0055] また、本実施形態に係る基板収納容器１によれば、気体滞留室８０１は、分室間間仕切り８１１により複数の気体滞留分室に仕切られている。この構成により、気体滞留室８０１の下端部に流入したパージガスが、勢いよく気体滞留室８０１の上端部にまで至ることを抑えることができる。このため、気体滞留室８０１の上端部に多くのパージガスが流れることを抑えることが可能となる。

[0056] また、本実施形態に係る基板収納容器１によれば、全ての気体滞留分室に連通する気体供給流路としてのガス流通空間８０１１が形成されている。この構成により、気体滞留室８０１に流入したパージガスを、全ての気体滞留分室に連通させて、各気体滞留分室から、気体流出前保持室８０４を構成する各気体流出前保持分室へ流すことが可能となる。

[0057] また、本実施形態に係る基板収納容器１によれば、気体噴出ノズル部としての突出部８は、開口部８４１に連通するノズル部室８０３を有し、ノズル部室８０３は、疎水性膜８３を介して気体流出前保持室８０４に連通する。この構成により、基板収納容器１の容器本体２を洗浄する際に、疎水性膜８３は、流動抵抗が変化せず、且つ、気体流出前保持室８０４に洗浄液が流入することを防止することが可能となる。

[0058] また、本実施形態に係る基板収納容器１によれば、ノズル部室８０３は、全ての開口部８４１、及び、気体流出前保持室８０４を構成する全ての気体流出前保持分室に連通する。この構成により、気体流出前保持室８０４を構成する全ての気体流出前保持分室に流入したパージガスを、全ての開口部８４１に連通するノズル部室８０３に流入させることが可能となる。

[0059] また、本実施形態に係る基板収納容器１によれば、気体噴出ノズル部としての突出部８は、開口部８４１から気体を所定の方向へ向けて流出させる所定方向流出部としての傾斜庇８４２を有する。この構成により、容器本体２の洗浄の際に、開口部８４１からノズル部室８０３へ洗浄液が流入することを抑えることが可能となる。

[0060] また、本実施形態に係る基板収納容器１によれば、開口部８４１は、基板収納空間２７に収納される複数の基板Wのそれぞれに対応して形成されている。この構成により、1つの開口部８４１から流出するパージガスが１つの基板Wに割り当てられているため、基板Ｗ１枚ずつに確実にパージガスを流すことが可能となる。

[0061] また、本実施形態に係る基板収納容器１によれば、気体噴出ノズル部と気体流量均一化部とを有する柱状の突出部８を備え、突出部８の基部８１９は、容器本体２の壁部２０に形成され通気路を形成する穴であってシール部材が設けられた穴に挿入される共に、突出部８の先端側の部分は、容器本体２の壁部２０に対して固定されることにより、突出部８は容器本体２に固定される。この構成により、突出部８を容器本体２に対して、容易に且つ確実に固定することが可能となる。

[0062]〔変形例〕

本発明は、上述した実施形態に限定されることはなく、特許請求の範囲に記載された技術的範囲において変形が可能である。

[0063] 例えば、実施形態においては、突出部を構成する突出部本体部、内部壁部、疎水性膜、ノズル部室形成部等の構成は、突出部８を構成する突出部本体部８１、内部壁部８２、疎水性膜８３、ノズル部室形成部８４等の構成に限

定されない。

[0064] また、容器本体及び蓋体の形状、容器本体に収納可能な基板の枚数や寸法は、本実施形態における容器本体２及び蓋体３の形状、容器本体２に収納可能な基板Ｗの枚数や寸法に限定されない。

符号の説明

[0065] １　基板収納容器

２　容器本体

３　蓋体

５　側方基板支持部

６　奥側基板支持部

８　突出部

２０　壁部

２１　容器本体開口部

２５　第１側壁（側壁）

２６　第２側壁（側壁）

２７　基板収納空間

８３　疎水性膜

８０１　気体滞留室（気体流量均一化部）

８０３　ノズル部室

８０４　気体流出前保持室（気体流量均一化部）

８１１　分室間間仕切り

８１２　本体側間仕切（室間間仕切り）

８１３　区画壁

８１９　基部

８２２　内壁側間仕切（室間間仕切り）

８４１　開口部

８４２　傾斜庇（所定方向流出部）

８０１１　ガス流通空間

W　基板

請求の範囲

[請求項1] 一端部に容器本体開口部が形成された開口周縁部を有し、他端部が閉塞された筒状の壁部を備え、前記壁部の内面によって、基板を収納可能であり前記容器本体開口部に連通する基板収納空間が形成された容器本体と、

前記容器本体開口部に対して着脱可能であり、前記容器本体開口部を閉塞可能な蓋体と、

前記基板収納空間と前記容器本体の外部の空間とを連通可能な通気路と、

前記通気路に流入した気体を前記基板収納空間に供給する複数の開口部を有する気体噴出ノズル部と、

前記複数の開口部から均一化された流量で気体を流出可能とする気体流量均一化部と、を備え、

前記気体流量均一化部は、気体滞留室と、気体流出前保持室と、前記気体滞留室と前記気体流出前保持室とを直線的に連通することを遮蔽して前記気体滞留室と前記気体流出前保持室とを連通する室間流路を形成する室間間仕切りと、を有する基板収納容器。

[請求項2] 前記気体流量均一化部は、前記気体流出前保持室を複数の気体流出前保持分室に区画する区画壁を有する請求項１に記載の基板収納容器。

[請求項3] 前記複数の気体流出前保持分室は均一の容積を有する請求項２に記載の基板収納容器。

[請求項4] 前記気体滞留室は、分室間間仕切りにより複数の気体滞留分室に仕切られている請求項３又は請求項３に記載の基板収納容器。

[請求項5] 全ての前記気体滞留分室に連通する気体供給流路が形成されている請求項４に記載の基板収納容器。

[請求項6] 前記気体噴出ノズル部は、開口部に連通するノズル部室を有し、

前記ノズル部室は、疎水性膜を介して前記気体流出前保持室に連通

する請求項２～請求項５のいずれかに記載の基板収納容器。

[請求項7] 前記ノズル部室は、全ての開口部及び全ての前記気体流出前保持分室に連通する請求項６に記載の基板収納容器。

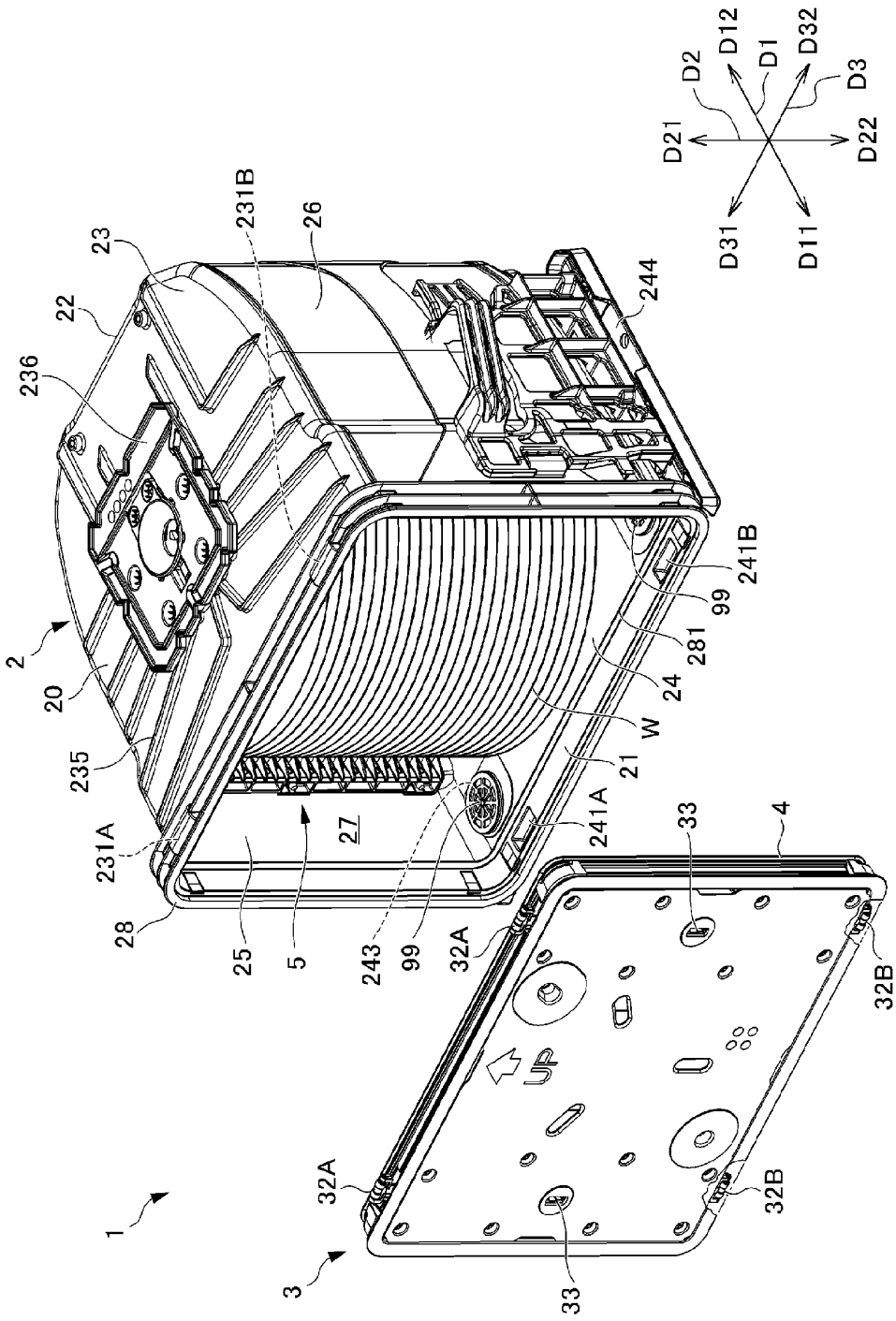
[請求項8] 前記気体噴出ノズル部は、前記開口部から気体を所定の方向へ向けて流出させる所定方向流出部を有する請求項１～請求項７のいずれかに記載の基板収納容器。

[請求項9] 前記開口部は、前記基板収納空間に収納される複数の前記基板のそれぞれに対応して形成されている請求項１～請求項８のいずれかに記載の基板収納容器。

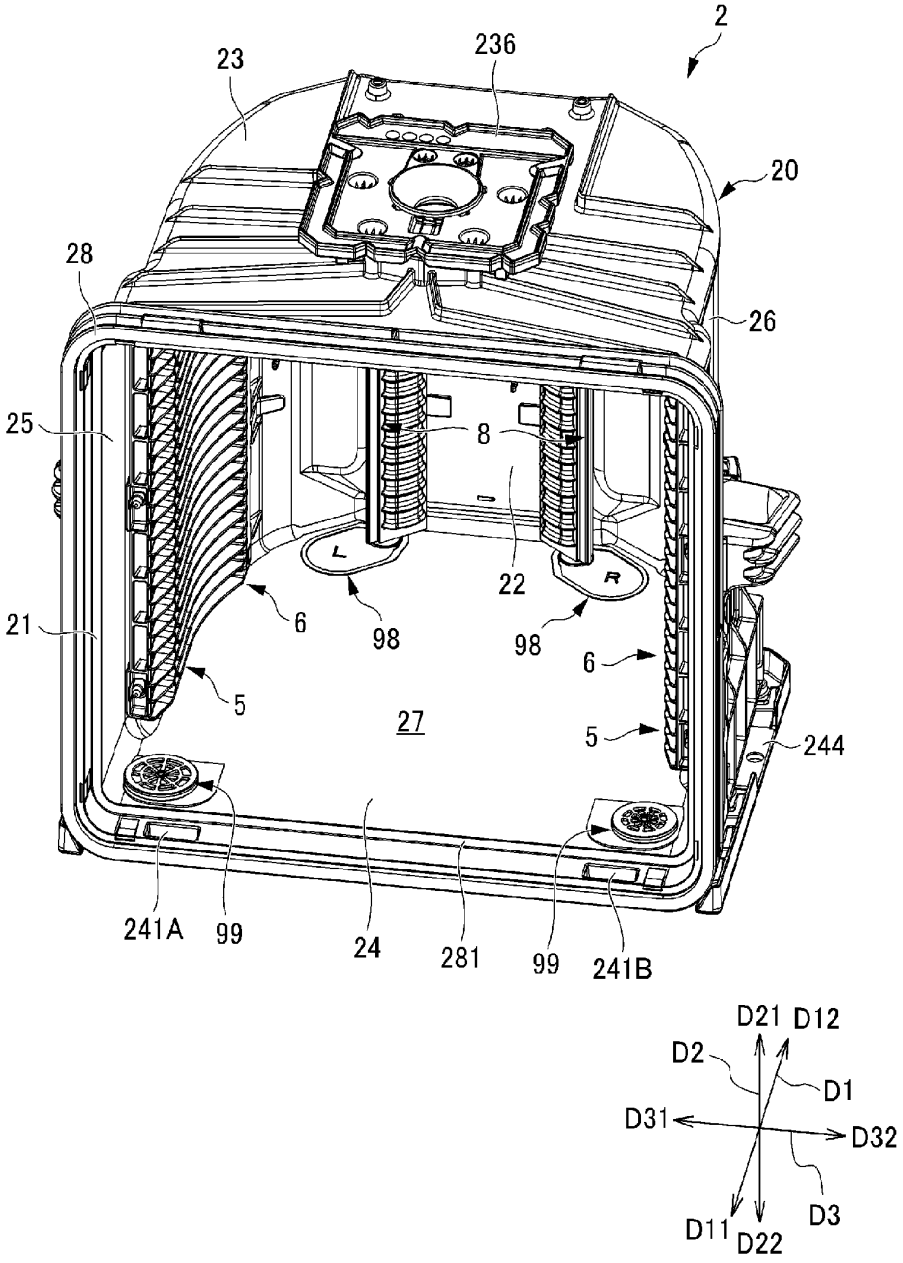
[請求項10] 前記気体噴出ノズル部と前記気体流量均一化部とを有する柱状の突出部を備え、

前記突出部の基部は、前記容器本体の前記壁部に形成され前記通気路を形成する穴であってシール部材が設けられた穴に挿入される共に、前記突出部の先端側の部分は、前記容器本体の前記壁部に対して固定されることにより、前記突出部は前記容器本体に固定される請求項１～請求項９のいずれかに記載の基板収納容器。

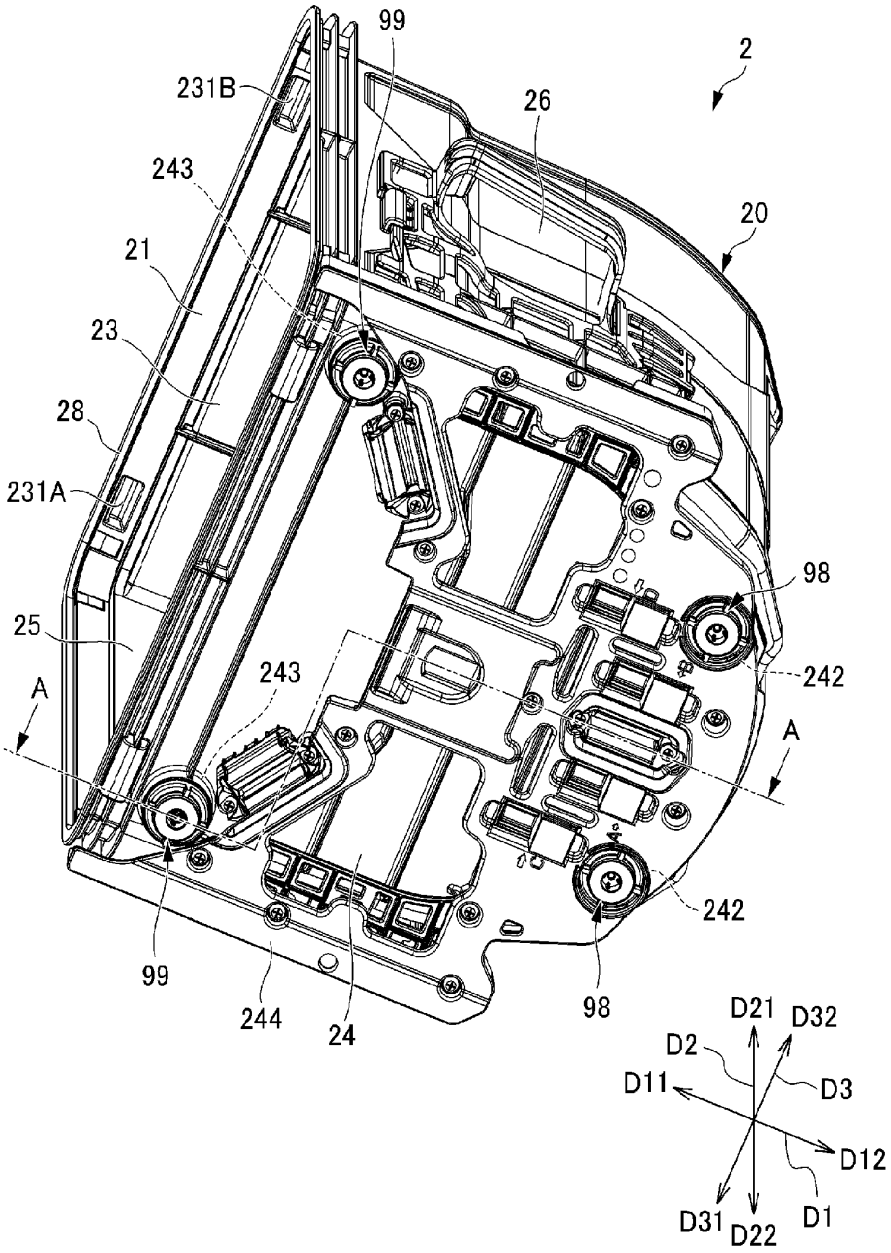
[図1]


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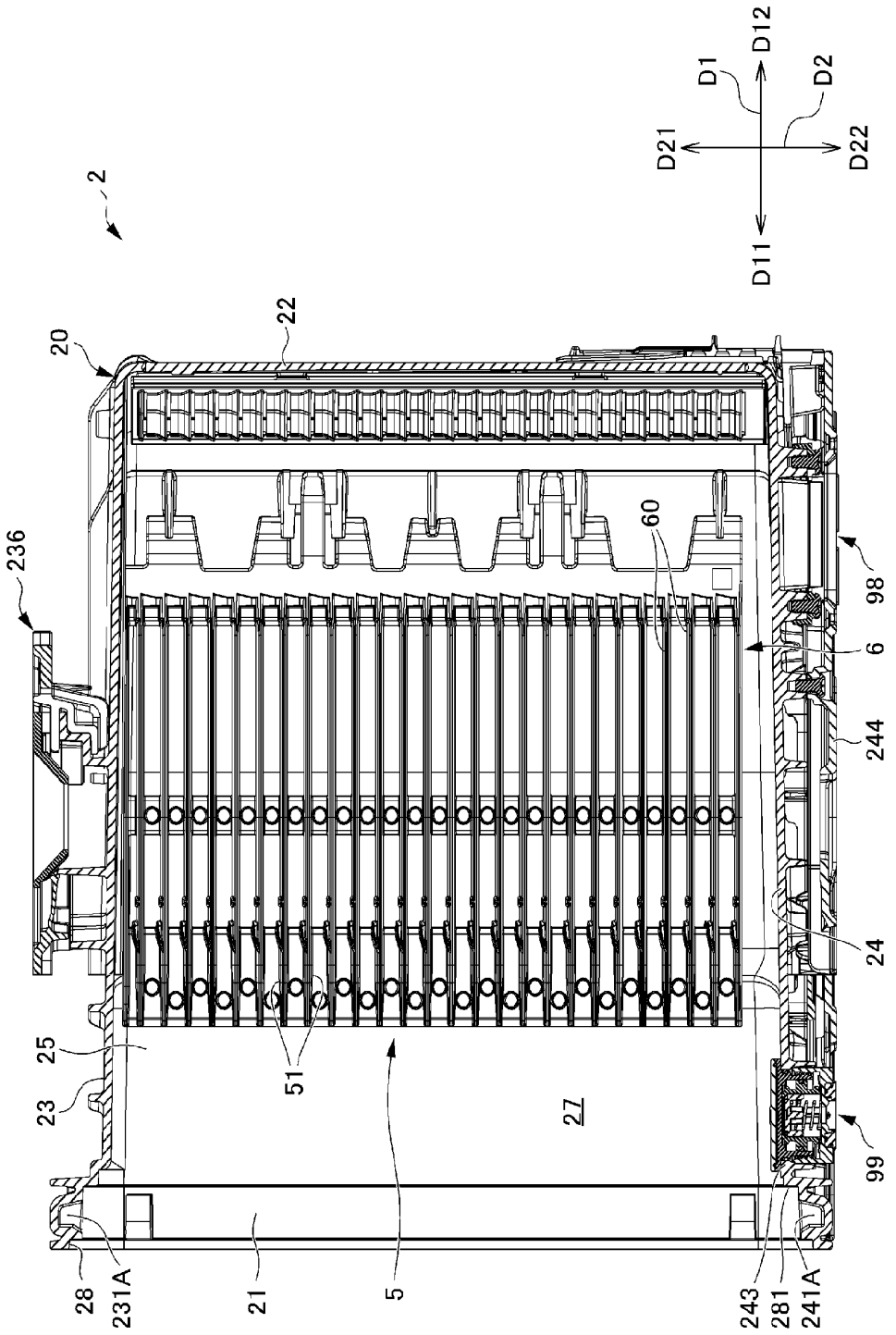
[図2]


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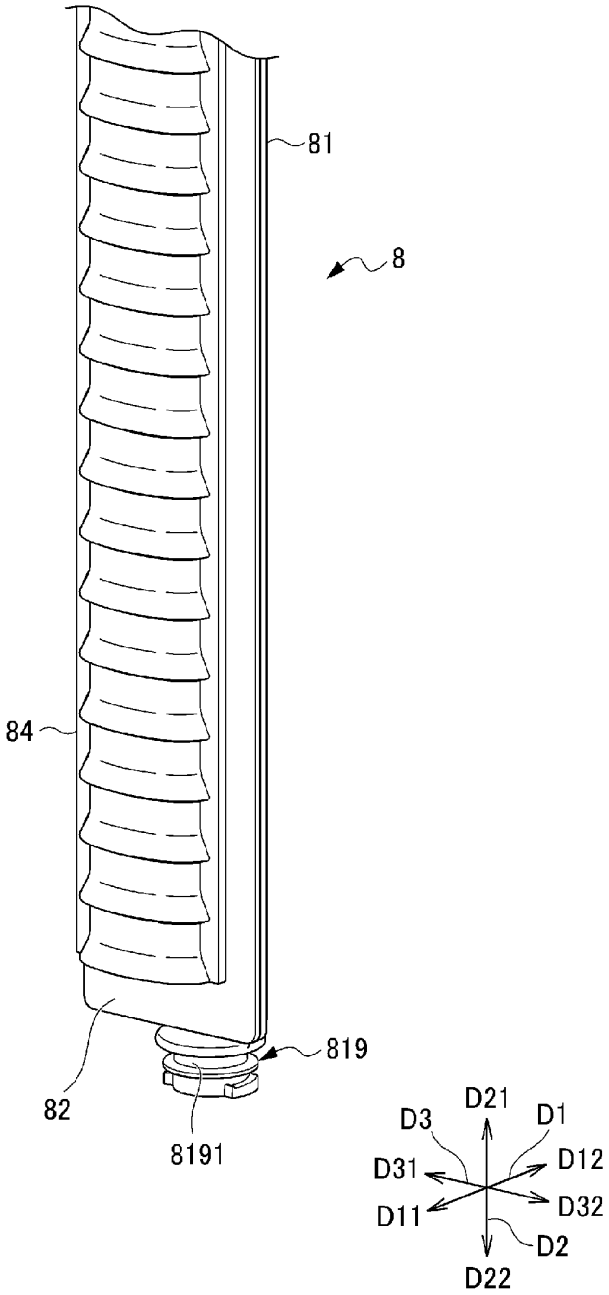
[図3]


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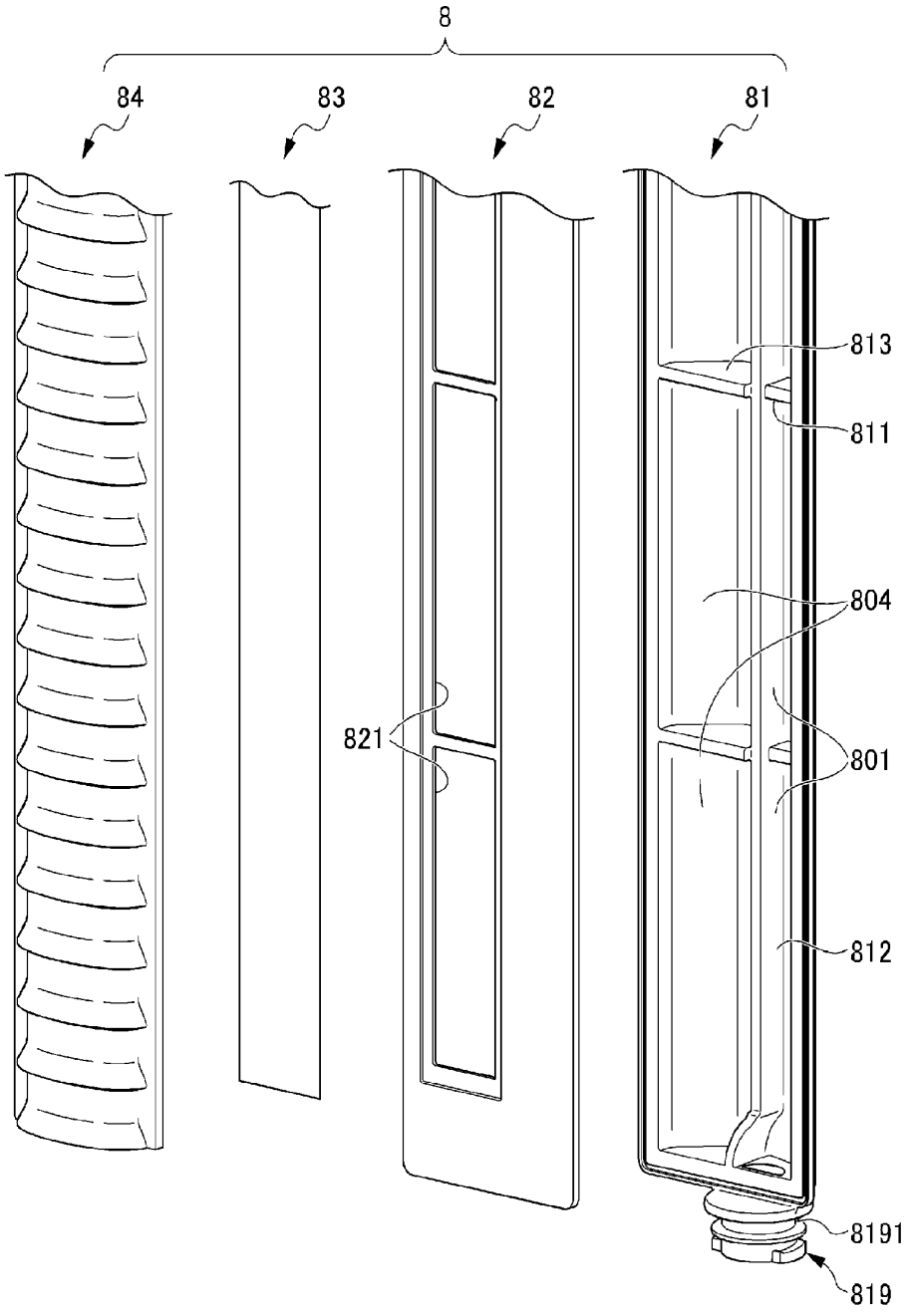
[図4]


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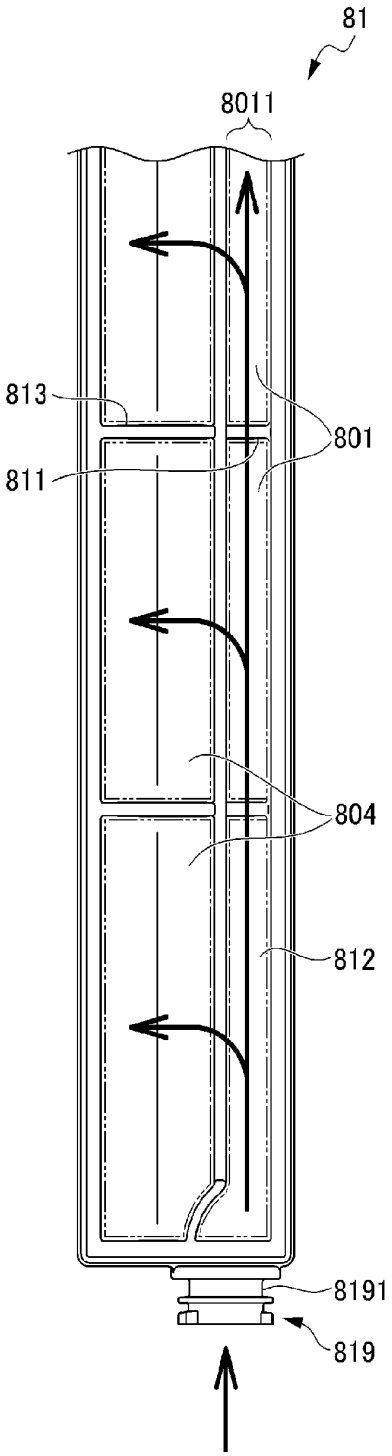
[図5]



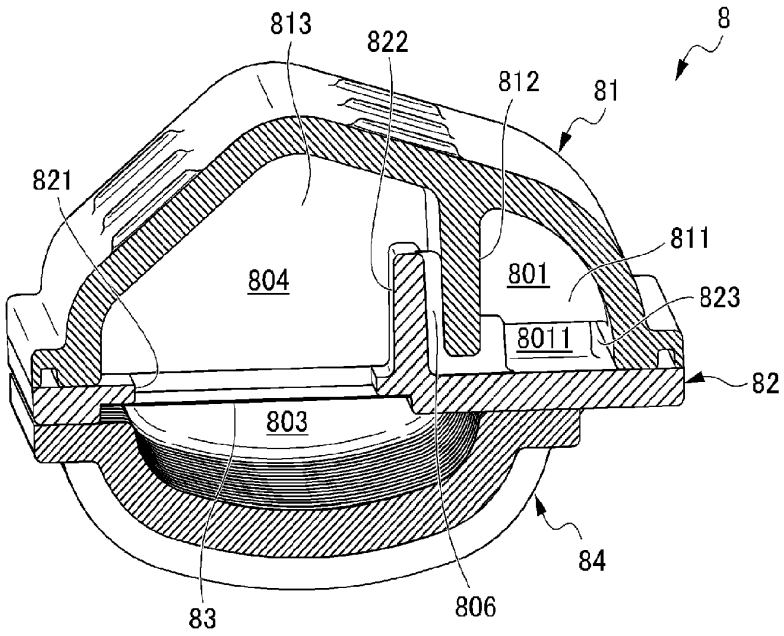
[図6]



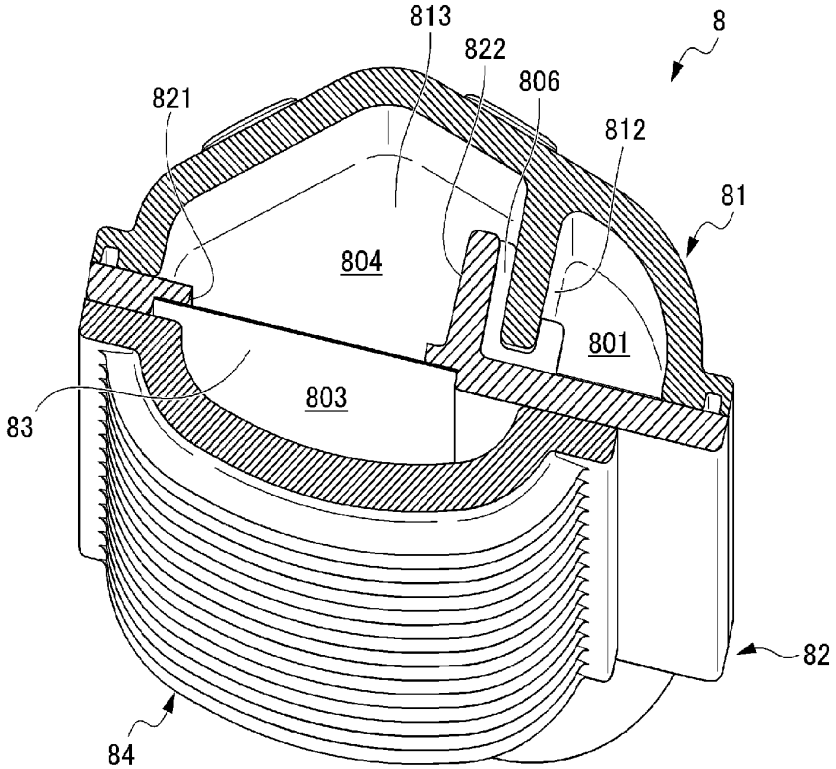
[図7]



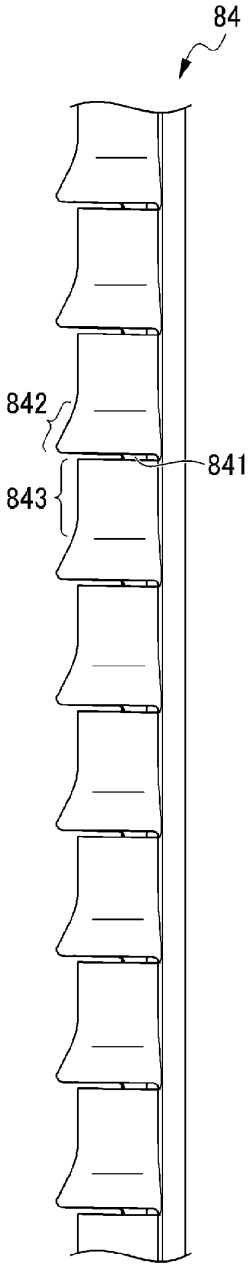
[図8]


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[図9]


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[図10]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/023474

A. CLASSIFICATION OF SUBJECT MATTER
H01L 21/673(2006.01)i
FI: H01L21/68 T

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L21/673

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2021/014653 A1 (MIRAIAL CO LTD) 28 January 2021 (2021-01-28) claim 1, paragraphs [0025]-[0065], fig. 1-6	1, 8-10
X	JP 3198841 U (GUDENG PRECISION INDUSTRIAL CO., LTD) 23 July 2015 (2015-07-23) paragraphs [0018]-[0024], fig. 1-3	1, 9, 10
A	KR 10-2020-0011290 A (SEMES CO., LTD.) 03 February 2020 (2020-02-03)	1-10
A	JP 2013-513951 A (ENTEGRIS, INC) 22 April 2013 (2013-04-22)	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 August 2021 (30.08.2021)	07 September 2021 (07.09.2021)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/023474

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
WO 2021/014653 A1	28 Jan. 2021	(Family: none)	
JP 3198841 U	23 Jul. 2015	US 2015/0357218 A1 paragraphs [0022]-[0031], fig. 1-3 CN 204558433 U KR 20-2015-0004506 U	
KR 10-2020-0011290 A	03 Feb. 2020	(Family: none)	
JP 2013-513951 A	22 Apr. 2013	US 2012/0297981 A1 CN 102812545 A KR 10-2012-0107987 A	

Entegris, EX1002, p. 1155

国際調査報告

国際出願番号
PCT/JP2021/023474

A. 発明の属する分野の分類（国際特許分類（ＩＰＣ））

H01L 21/673(2006.01)i
FI: H01L21/68 T

B. 調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

H01L21/673

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２０２１年
日本国実用新案登録公報	１９９６－２０２１年
日本国登録実用新案公報	１９９４－２０２１年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

C. 関連すると認められる文献

引用文献のカテゴリー*	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
X	WO 2021/04653 A1（ミライアル株式会社）28.01.2021（2021-01-28） 請求項1,段落[0025]-[0065],図1-6	1,8-10
X	JP 3198842 U（家登精密工業股▲ふん▼有限公司）23.07.2015（2015-07-23） 段落[0018]-[0024],図1-3	1,9,10
A	KR 10-2020-0011290 A (SEMES CO., LTD.) 03.02.2020 (2020-02-03)	1-10
A	JP 2013-513951 A（インテグリス・インコーポレーテッド）22.04.2013（2013-04-22）	1-10

☐ C欄の続きにも文献が列挙されている。

☑ パテントファミリーに関する別紙を参照。

* 引用文献のカテゴリー
"A" 特に関連のある文献ではなく、一般的技術水準を示すもの
"E" 国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
"L" 優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
"O" 口頭による開示、使用、展示等に言及する文献
"P" 国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
"T" 国際出願日又は優先日後に公表された文献であって出願と抵触するものではなく、発明の原理又は理論の理解のために引用するもの
"X" 特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
"Y" 特に関連のある文献であって、当該文献と他の１以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
"&" 同一パテントファミリー文献

国際調査を完了した日	国際調査報告の発送日
30.08.2021	07.09.2021

名称及びあて先
日本国特許庁(ISA/JP)
〒100-8915
日本国
東京都千代田区霞が関三丁目４番３号

権限のある職員（特許庁審査官）
湯川　洋介　5D 1788

電話番号 03-3581-1101 内線 3557

様式 PCT/ISA/210（第２ページ）（２０１５年１月）

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国際調査報告
パテントファミリーに関する情報

国際出願番号
PCT/JP2021/023474

引用文献	公表日	パテントファミリー文献	公表日
WO 2021/014653 A1	28.01.2021	（ファミリーなし）	
JP 3198841 U	23.07.2015	US 2015/0357218 A1 段落[0022]-[0031],図1-3 CN 204558433 U KR 20-2015-0004506 U	
KR 10-2020-0011290 A	03.02.2020	（ファミリーなし）	
JP 2013-513951 A	22.04.2013	US 2012/0297981 A1 CN 102812545 A KR 10-2012-0107987 A	

Entegris, EX1002, p. 1157

Electronic Acknowledgement Receipt

EFS ID:	48558484
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Debby Yew
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	08-SEP-2023
Filing Date:	08-AUG-2022
Time Stamp:	12:45:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	0114970255US2IDS.pdf	51832 7086d97c1dda2ad295748391917d98e49a578847	no	5

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	EP1343202A1.pdf	5384585 7827a69d557fa89306442fa7f818e5e4a608b79a	no	148
Warnings:					
Information:					
3	Foreign Reference	EP1555689B1.pdf	1544844 615e1cd6bfd8203d118691e98aa6f9c3c5d90e4c	no	31
Warnings:					
Information:					
4	Foreign Reference	EP2272088B1.pdf	1012801 5a4fde62b6c58814c187967d32b3e5ffedfe18d2	no	18
Warnings:					
Information:					
5	Foreign Reference	JP3960787B2.pdf	578747 517f2ddba4a64d2273f3142c63f67019b188a3c4	no	10
Warnings:					
Information:					
6	Foreign Reference	JP5241607B2.pdf	1016010 f9055941e4afc8ccdd1b3c568151735649d38758	no	18
Warnings:					
Information:					
7	Foreign Reference	JP2002170876A.pdf	699116 b0b01c38a48bcbc157bf2798d2e3887e0b8ef5f0	no	10
Warnings:					
Information:					
8	Foreign Reference	JP2020150245A.pdf	556824 ddd98bc8229742650ddad82e20a07995b97c6ea1	no	10
Warnings:					
Information:					

9	Foreign Reference	WO2009114798A2.pdf	1226841 d807c6b0f86ea426ebee4a3f268909a12d6a65c6	no	28
Warnings:					
Information:					
10	Foreign Reference	WO2011072260A2.pdf	881038 8bac234735dc373f475d7fb68cf4a98e4a040ecd	no	22
Warnings:					
Information:					
11	Foreign Reference	WO2017040913A1.pdf	1821165 d32005917c3281179607331 1b7267414fe321924	no	42
Warnings:					
Information:					
12	Foreign Reference	WO2018179964A1.pdf	1540454 bc1cca9b26eeec01f95e6869fd5bac1ddbab4c78	no	46
Warnings:					
Information:					
13	Foreign Reference	WO2020046867A1.pdf	2284062 55161358886a569402512659239998fb8343a9ef	no	35
Warnings:					
Information:					
14	Foreign Reference	WO2022269718A1.pdf	1286298 40a745b126965cd94179e94ae556eedc623094a8	no	34
Warnings:					
Information:					
		Total Files Size (in bytes):	19884617		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2	8112

21874 7590 08/24/2023

LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

EXAMINER	
CENTRAL, DOCKET	

ART UNIT	PAPER NUMBER
OPAP	

NOTIFICATION DATE	DELIVERY MODE
08/24/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patent@lockelord.com

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U.S. Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR/ PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
17/882,703	08/08/2022	Chiu et al.	0114970.255US2

	EXAMINER	
LOCKE LORD LLP P.O. BOX 55874 BOSTON, MA 02205	EDDIE C LEE	
	ART UNIT	PAPER
	2100	20230821

DATE MAILED: _____

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

A third-party submission under 37 CFR 1.290 has been filed on August 17, 2023, and is being entered in the above-identified application. Please allow a few days for the submission to be visible in the Patent Application Information Retrieval (PAIR) system.

/EDDIE C LEE/
TQAS, TC 2100

PTO-90C (Rev.04-03)

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
17/882,703	**08/17/2023 03:44:22 PM ET**	

Title of Invention

Application Information

APPLICATION TYPE		PATENT #	
CONFIRMATION #		FILED BY	Julie Bardon
PATENT CENTER #	62634407	FILING DATE	08/08/2022
CUSTOMER #	–	FIRST NAMED INVENTOR	
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Daniel Schulte

Documents

TOTAL DOCUMENTS: 3

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
Third-party-notification-request.pdf	1	Request for Notification of Non-compliant Third-Party Submission	14 KB
Concise-description-generated.pdf	2	Concise Description of Relevance	26 KB
third-party-preissuance-submission.pdf	2	Third-Party Submission Under 37 CFR 1.290	44 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

Third-party-notification-request.pdf	4172ED75B811C3C45C5A40CBC63705C24A982818F644F5E833698BA765BAE310440DB4EA12BB1E4471B6BD163E4D37DBF777F3CC399A9586CAFCE26595672E8C
Concise-description-generated.pdf	C99DEECE0E5724426C7FB05FE3D9516F222EBBEE646DA9A8A3895B715FFF7C06A6E29EF10A49B793D4C20C4503852ADF61EF15C19677E063D00A17D8EC148AAF
third-party-preissuance-submission.pdf	FBF08CB6CAB4D3AE924C356CE67D9753C5090CD16ACA3257AC08BAB54D89B43BE7704567D51A6ADC1713961BA249B73378BAC73C8DD9290F6886D981854056D8

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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THIRD-PARTY SUBMISSION UNDER 37 CFR 1.290

APPLICATION #
17882703

U.S. Patents

Cite #	Patent #	Kind Code[1]	Issue Date (YYYY/MM/DD)	First Named Inventor

U.S. patent application publications

Cite #	Publication #	Kind Code[1]	Publication Date (YYYY/MM/DD)	First Named Inventor
1	US 2023-0128154	A1	2023/04/27	Mark Smith

Foreign patents and published foreign patent applications

Cite #	Foreign Document #[3]	Country Code[2]	Kind Code[1]	Publication Date (YYYY/MM/DD)	Applicant, patentee or first named inventor	T[5]

Non-patent publications

Cite #	Author (if any), title of the publication, page(s) being submitted, publication date, publisher (where available), place of publication (where available).	T[5]	E[6]

Statements

The party making the submission is not an individual who has a duty to disclose information with respect to the above-identified application under 37 CFR 1.56.

This submission complies with the requirements of 35 U.S.C. 122(e) and 37 CFR 1.290.

Resubmission: This resubmission is being made responsive to a notification of non-compliance issued for an earlier filed third-party submission. The corrections in this resubmission are limited to addressing the non-compliance.
1. Fee previously paid: The party making this resubmission requests that the Office apply the previously-paid fee set forth in 37 CFR 1.290(f).
2. Fee exemption applies: The party making this resubmission states that no fee is required to accompany this resubmission as the undersigned is again making the fee exemption statement set forth in 37 CFR 1.290(g).

Signature	Name	Registration #
/Julie Bardon/	Julie Bardon	–

Examiner Signature	Date considered

*EXAMINER: Signature indicates all documents listed above have been considered,except for citations through which a line is drawn. Draw line through citation if not considered. Include a copy of this form with next communication to applicant. 1. If known, enter kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16. See MPEP 901.04(a). 2. Enter the country or patent office that issued the document, by two-letter code under WIPO standard ST.3. See MPEP 1851. 3. For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. 4. If known, enter the kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 . See MPEP 901.04(a). 5. Check mark indicates translation attached. 6. Check mark indicates evidence of publication attached.

Doc Code: 3P.RELEVANCE
Description: Concise Description of Relevance

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THIRD-PARTY SUBMISSION UNDER 37 CFR 1.290
CONCISE DESCRIPTION OF RELEVANCE

APPLICATION #
17882703

U.S. Patents

Cite #	Patent #	Concise Description of Relevance

U.S. patent application publications

Cite #	Publication #	Concise Description of Relevance
1	US 2023-0128154	Smith (2023/0128154) (with priority to 63/272,282, filed 10/27/2021) shows features of claims 8, 20, and 30 of Chiu 2023/0054753: a gas diffusion device having a buffering gas chamber having at least one or a plurality of gas intake channels, and at least one, two, or a plurality of porous tubes. Smith (2023/0128154) shows features of the recited "buffering gas chamber" of Chiu claims 8, 20, and 30. For example, it shows buffering gas chambers with multiple intake channels or porous tubes. See paragraph [0033] and figure 3A showing supply line 360 and flow paths 360A and 360B. See also figures 3B and 3C and paragraphs [0038] through [0041].

Foreign patent documents

Cite #	Foreign Document #	Concise Description of Relevance

Non-patent publications

Cite #	Reference	Concise Description of Relevance

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Ming-Chien Chiu et al.	Examiner:	Unassigned
Serial No.:	17/882,703	Group Art Unit:	Unassigned
Filed:	August 8, 2022	Docket No.:	0114970.255US2
Title:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME		

CHANGE OF ENTITY STATUS AND PAYMENT OF DEFICIENCIES

July 20, 2023

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CUSTOMER NO. 21874

Dear Sir/Madam:

Applicant/Assignee, Gudeng Precision Industrial Co., Ltd., hereby asserts that it is no longer claiming small entity status for the above-referenced issued patent. Applicant respectfully requests that the Office update the entity status to **large entity**. Accordingly, the deficiencies owed to USPTO should be calculated from July 1, 2021 for the above-identified patent application.

Pursuant to 37 CFR 1.28 (c) (1) and (c) (2), Applicant respectfully submits the calculation of the deficiencies owed is $2,130.00, and is itemized as follows:

Type of fee	Time of the payment	Fee actually paid ($)	LG Entity fee ($)	Deficiency owed ($)
Filing Fee	August 8, 2022	80.00	320.00	240.00
Search Fee	August 8, 2022	350.00	700.00	350.00
Examination Fee	August 8, 2022	400.00	800.00	400.00

Claims in Excess of 20	August 8, 2022	900.00	1,800.00	900.00
Independent Claims in Excess of 3	August 8, 2022	240.00	480.00	240.00
Total		$1,970.00	$4,100.00	$2,130.00

Applicant respectfully submits this statement, concurrently with a payment of $2,130.00. Applicant believes the payment of $2,130.00 covers all the deficiencies during the prosecution of the above-identified application, however, the Commissioner is hereby authorized to charge any deficiency of fees that may be required, and credit of any overpayments to Deposit Account No. 121781.

Respectfully submitted,

Locke Lord LLP

July 20, 2023



Tim Tingkang Xia
Attorney for Applicant on the Record
Reg. No. 45,242

Terminus 200
3333 Piedmont Rd. NE Ste. 2000
Atlanta, Georgia 30305
Phone: 404-806-4698
Fax: 404-870-4650
Customer No. 21874

Electronic Acknowledgement Receipt

EFS ID:	48324823
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Danielle Olive
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	20-JUL-2023
Filing Date:	08-AUG-2022
Time Stamp:	12:44:38
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Notification of loss of entitlement to small entity status	0114970255US2CHANGEOFENTITYSTATUSANDPAYMENTOFDEFICIENCIES.pdf	109479 15a364c94ab151dae5176007f6611b83652098b2	no	2

Warnings:

Information:	
Total Files Size (in bytes):	109479

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New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2

CONFIRMATION NO. 8112

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

PUBLICATION NOTICE

OC00000137450160

Title:GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Publication No.US-2023-0054753-A1
Publication Date:02/23/2023

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/882,703	08/08/2022	1716	1970	0114970.255US2	38	4

CONFIRMATION NO. 8112

CORRECTED FILING RECEIPT

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205



Date Mailed: 11/01/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Ming-Chien Chiu, NEW TAIPEI, TAIWAN;
CHIA-HO CHUANG, NEW TAIPEI, TAIWAN;
Kuo-Hua Lee, NEW TAIPEI, TAIWAN;
Shu-Hung Lin, NEW TAIPEI, TAIWAN;
Hao-Kang HSIA, NEW TAIPEI, TAIWAN;

Applicant(s)

GUDENG PRECISION INDUSTRIAL CO., LTD., New Taipei, TAIWAN;

Power of Attorney: The patent practitioners associated with Customer Number 21874

Domestic Priority data as claimed by applicant

This appln claims benefit of 63/316,391 03/03/2022
and claims benefit of 63/284,105 11/30/2021
and claims benefit of 63/233,878 08/17/2021

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Entegris, EX1002, p. 1175

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 08/18/2022
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/882,703**
Projected Publication Date: 02/23/2023
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Preliminary Class

156

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative,

this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

CORRECTED ADS FORM

Application Number	17882703
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Inventor Information

****If no data is shown, no data has been corrected****

	Data of Record	Updated Data
Order Number		
Name		
Residence Information		
Residency		
City		
State		
Country of Residence		
Mailing Address of Inventor		
Address 1		
Address 2		
City,State/Province, Postal Code		
Country		

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Application Information

	Data of Record	Updated Data
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	
Attorney Docket Number	0114970.255US2	
Entity Type	Small	

Domestic Benefit/National Stage Information

****If no data is shown, no data has been corrected****

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121,365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S. C. 119(e) or 120, and 37 CFR 1.78(a).

		Data of Record	Updated Data
	Prior Application Status		
	Application Number		
	Continuity Type		
	Prior Application Number		
	Filing Date (YYYY-MM-DD)		
	Patent Number		
	Issue Date (YYYY-MM-DD)		

Foreign Priority Information

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

****If no data is shown, no data has been corrected****

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

		Data of Record	Updated Data
	Application Number		
	Country		
	Filing Date		
	Access Code		

Applicant Information

****If no data is shown, no data has been corrected****
Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

	Data of Record	Updated Data
Applicant Type	ASG	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is		
Name of the Deceased or Legally Incapacitated Inventor		
Applicant is an Organization	Yes	
Name		
Organization Name	GUDENG PRECISION INDUSTRIAL CO., LTD.	
Address 1		
Address 2		

Corrected ADS 1.0

City,State/Province,Postal Code	New Taipei	
Country	~~CN~~	TW
Phone Number		
Fax Number		
Email Address		

Assignee Information including Non-Applicant Assignee Information

****If no data is shown, no data has been corrected****
Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office

	Data of Record	Updated Data
Order		
Applicant is an Organization		
Name		
Organization Name		
Mailing Address		
Address 1		
Address 2		
City,State/Province,Postal Code		
Country		
Phone Number		
Fax Number		
Email Address		

Signature

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Tim Tingkang Xia/	Registration Number	45242
First Name	Tim Tingkang	Last Name	Xia

Entegris, EX1002, p. 1183

Electronic Acknowledgement Receipt

EFS ID:	46904892
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Debby Yew
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	27-OCT-2022
Filing Date:	08-AUG-2022
Time Stamp:	12:02:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet to update/ correct info	CorrectedADS.pdf	99585 b8d38beb8e15c3c2d515f838ad64e21e354d095e	no	5

Warnings:

Information:	
Total Files Size (in bytes):	99585

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/882,703

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	38 minus 20 =	* 18	x 50 =	900	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1	x 240 =	240			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	1970		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/882,703	08/08/2022	1716	1970	0114970.255US2	38	4

CONFIRMATION NO. 8112

UPDATED FILING RECEIPT

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205



Date Mailed: 10/26/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Ming-Chien Chiu, NEW TAIPEI, TAIWAN;
CHIA-HO CHUANG, NEW TAIPEI, TAIWAN;
Kuo-Hua Lee, NEW TAIPEI, TAIWAN;
Shu-Hung Lin, NEW TAIPEI, TAIWAN;
Hao-Kang HSIA, NEW TAIPEI, TAIWAN;

Applicant(s)

GUDENG PRECISION INDUSTRIAL CO., LTD., New Taipei, CHINA;

Power of Attorney: The patent practitioners associated with Customer Number 21874

Domestic Priority data as claimed by applicant

This appln claims benefit of 63/316,391 03/03/2022
and claims benefit of 63/284,105 11/30/2021
and claims benefit of 63/233,878 08/17/2021

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Entegris, EX1002, p. 1187

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 08/18/2022
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/882,703**
Projected Publication Date: 02/23/2023
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Preliminary Class

156

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative,

this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

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SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Ming-Chien Chiu et al.	Examiner:	Unassigned
Serial No.:	17/882,703	Group Art Unit:	1716
Filed:	August 8, 2022	Docket No.:	0114970.255US2
Title:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME		

RESPONSE TO NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

Mail Stop: Missing Parts
Commissioner of Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

October 24, 2022

CUSTOMER NO. 21874

Dear Sir/Madam:

Submitted herewith is a response to the Notice to File Missing Parts of NonProvisional Application mailed August 23, 2022, indicating that English translations are needed in the prior-filed provisional applications.

Applicant respectfully submits that English translations were filed in each provisional application accordingly. Provisional application no. 63/316,391, English translation was filed on August 25, 2022. Provisional application no. 63/284,105, English translation was filed on March 10, 2022. Provisional application no. 63/233,878, English translation was filed on November 12, 2021.

No new matter is added.

It is believed the application is in condition for examination on the merits now.

Respectfully submitted,
LOCKE LORD LLP

October 24, 2022



Tim Tingkang Xia
Attorney for Applicant on the Record
Reg. No. 45,242

Terminus 200, Suite 1200
3333 Piedmont Rd. NE
Atlanta, GA 30305
T: 404-870-4698
Customer No. 21874

130097475v.1

Entegris, EX1002, p. 1191

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2

CONFIRMATION NO. 8112

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

FORMALITIES LETTER

OC000000135941017

Date Mailed: 08/23/2022

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The above-identified nonprovisional application is claiming the benefit of a prior-filed provisional application that is in a non-English language. Pursuant to 37 CFR 1.78(a)(5), applicant is required to file:

  1. In the prior-filed provisional application, an English language translation of the prior-filed provisional application and a statement that the translation is accurate; and

  2. In the above-identified nonprovisional application, a confirmation that the translation and statement have been filed in the prior-filed provisional application.

  To avoid abandonment of the above-identified nonprovisional application, applicant is required to file these items within the time period set forth in this notice, unless applicant files a corrected application data sheet in compliance with 37 CFR 1.76 and, if appropriate, an amendment to the specification, to delete the benefit claim within the time period. Please note that once applicant deletes the benefit claim to the prior-filed provisional application, the Office will not accept any resubmission of the benefit claim.

  Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

REPLY VIA ELECTRONIC FILING

A reply may be submitted via electronic filing only by registered users of the appropriate USPTO patent electronic filing system and must include:

- A separate document having the document description, "**Applicant response to Pre-Exam Formalities Notice**"; and
- the item(s) for which a reply period is set forth above.

For more information about electronic filing, contact the Patent Electronic Business Center (EBC) at 1-866-217-9197 or visit at https://www.uspto.gov/ebc.

NOTE: If the reply is not being submitted electronically, a copy of this notice must be included.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zmoguss/

Entegris, EX1002, p. 1193

Electronic Acknowledgement Receipt

EFS ID:	46876197
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Danielle Olive
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	24-OCT-2022
Filing Date:	08-AUG-2022
Time Stamp:	12:15:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	0114970255US2ResponseNFMP.pdf	104580 d9a82dbc629e88134630aea3c193fce8d1c4ee8c	no	1

Warnings:

Information:					
2	Miscellaneous Incoming Letter	0114970255US2CopyofNFMP.pdf	72564 8b03541a25cdd8ad086df029ce44a6b442c2f007	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	177144	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/882,703	08/08/2022	1716	1970	0114970.255US2	38	4

CONFIRMATION NO. 8112

CORRECTED FILING RECEIPT

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205



Date Mailed: 08/29/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Ming-Chien Chiu, NEW TAIPEI, TAIWAN;
CHIA-HO CHUANG, NEW TAIPEI, TAIWAN;
Kuo-Hua Lee, NEW TAIPEI, TAIWAN;
Shu-Hung Lin, NEW TAIPEI, TAIWAN;
Hao-Kang HSIA, NEW TAIPEI, TAIWAN;

Applicant(s)

GUDENG PRECISION INDUSTRIAL CO., LTD., New Taipei, CHINA;

Power of Attorney: The patent practitioners associated with Customer Number 21874

Domestic Priority data as claimed by applicant

This appln claims benefit of 63/316,391 03/03/2022
and claims benefit of 63/284,105 11/30/2021
and claims benefit of 63/233,878 08/17/2021

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Entegris, EX1002, p. 1196

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 08/18/2022
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/882,703**
Projected Publication Date: To Be Determined - pending completion of Missing Parts
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Preliminary Class

156

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative,

this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

CORRECTED ADS FORM

Application Number	17882703
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Inventor Information

****If no data is shown, no data has been corrected****

	Data of Record	Updated Data
Order Number		
Name		
Residence Information		
Residency		
City		
State		
Country of Residence		
Mailing Address of Inventor		
Address 1		
Address 2		
City,State/Province, Postal Code		
Country		

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Application Information

	Data of Record	Updated Data
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	
Attorney Docket Number	0114970.255US2	
Entity Type	Small	

Domestic Benefit/National Stage Information

****If no data is shown, no data has been corrected****

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121,365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S. C. 119(e) or 120, and 37 CFR 1.78(a).

		Data of Record	Updated Data
	Prior Application Status	pending	
	Application Number	17882703	
	Continuity Type	PRO	
	Prior Application Number	63316391	
	Filing Date (YYYY-MM-DD)	2022-03-03	
	Patent Number		
	Issue Date (YYYY-MM-DD)		

		Data of Record	Updated Data
	Prior Application Status		pending
	Application Number		17882703
	Continuity Type		PRO
	Prior Application Number		63284105
	Filing Date (YYYY-MM-DD)		2021-11-30
	Patent Number		
	Issue Date (YYYY-MM-DD)		

		Data of Record	Updated Data
	Prior Application Status		pending
	Application Number		17882703
	Continuity Type		PRO
	Prior Application Number		63233878
	Filing Date (YYYY-MM-DD)		2021-08-17
	Patent Number		
	Issue Date (YYYY-MM-DD)		

Foreign Priority Information

****If no data is shown, no data has been corrected****

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

		Data of Record	Updated Data
	Application Number		
	Country		
	Filing Date		
	Access Code		

Applicant Information

****If no data is shown, no data has been corrected****
Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

	Data of Record	Updated Data
Applicant Type		
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is		
Name of the Deceased or Legally Incapacitated Inventor		
Applicant is an Organization		
Name		
Organization Name		
Address 1		
Address 2		
City,State/Province,Postal Code		
Country		
Phone Number		
Fax Number		

Email Address		

Assignee Information including Non-Applicant Assignee Information

****If no data is shown, no data has been corrected****
Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office

	Data of Record	Updated Data
Order		
Applicant is an Organization		
Name		
Organization Name		
Mailing Address		
Address 1		
Address 2		
City,State/Province,Postal Code		
Country		
Phone Number		
Fax Number		
Email Address		

Signature

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Signature	/Tim Tingkang Xia/	Registration Number	45242
First Name	Tim Tingkang	Last Name	Xia

Corrected ADS 1.0

Electronic Acknowledgement Receipt

EFS ID:	46474878
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Debby Yew
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	24-AUG-2022
Filing Date:	08-AUG-2022
Time Stamp:	12:08:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet to update/ correct info	CorrectedADS.pdf	120600 da97be2ac29275db3720a244c286d1bb5969b4e0	no	6

Warnings:

Information:	
Total Files Size (in bytes):	120600

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

CORRECTED ADS FORM

Application Number	17882703
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Inventor Information

****If no data is shown, no data has been corrected****

	Data of Record	Updated Data
Order Number		
Name		
Residence Information		
Residency		
City		
State		
Country of Residence		
Mailing Address of Inventor		
Address 1		
Address 2		
City,State/Province, Postal Code		
Country		

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Application Information

	Data of Record	Updated Data
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	
Attorney Docket Number	0114970.255US2	
Entity Type	Small	

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		Data of Record	Updated Data
	Prior Application Status	pending	
	Application Number	17882703	
	Continuity Type	PRO	
	Prior Application Number	63316391	
	Filing Date (YYYY-MM-DD)	2022-03-03	
	Patent Number		
	Issue Date (YYYY-MM-DD)		

		Data of Record	Updated Data
	Prior Application Status		pending
	Application Number		17882703
	Continuity Type		PRO
	Prior Application Number		63284105
	Filing Date (YYYY-MM-DD)		2021-11-30
	Patent Number		
	Issue Date (YYYY-MM-DD)		

		Data of Record	Updated Data
	Prior Application Status		expired
	Application Number		17882703
	Continuity Type		PRO
	Prior Application Number		63233878
	Filing Date (YYYY-MM-DD)		2021-08-17
	Patent Number		
	Issue Date (YYYY-MM-DD)		

Foreign Priority Information

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Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

		Data of Record	Updated Data
	Application Number		
	Country		
	Filing Date		
	Access Code		

Applicant Information

****If no data is shown, no data has been corrected****
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	Data of Record	Updated Data
Applicant Type	ASG	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is		
Name of the Deceased or Legally Incapacitated Inventor		
Applicant is an Organization	Yes	
Name		
Organization Name	GUDENG PRECISION INDUSTRIAL CO., LTD.	
Address 1		
Address 2		
City,State/Province,Postal Code	New Taipei	
Country	~~TW~~	CN
Phone Number		
Fax Number		

Email Address		

Assignee Information including Non-Applicant Assignee Information

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	Data of Record	Updated Data
Order		
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City,State/Province,Postal Code		
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See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Corrected ADS 1.0

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Signature	/Tim Tingkang Xia/	Registration Number	45242
First Name	Tim Tingkang	Last Name	Xia

Corrected ADS 1.0

Electronic Acknowledgement Receipt	
EFS ID:	46474751
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Debby Yew
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	24-AUG-2022
Filing Date:	08-AUG-2022
Time Stamp:	11:58:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet to update/ correct info	CorrectedADS.pdf	121062 65ff14f432210bc0b56437786c7eb1867479b7e9	no	6

Warnings:

Information:	
Total Files Size (in bytes):	121062

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/882,703	08/08/2022	1716	1970	0114970.255US2	38	4

CONFIRMATION NO. 8112

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

FILING RECEIPT

OC000000135941016

Date Mailed: 08/23/2022

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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CHIA-HO CHUANG, NEW TAIPEI, TAIWAN;
Kuo-Hua Lee, NEW TAIPEI, TAIWAN;
Shu-Hung Lin, NEW TAIPEI, TAIWAN;
Hao-Kang HSIA, NEW TAIPEI, TAIWAN;

Applicant(s)

GUDENG PRECISION INDUSTRIAL CO., LTD., New Taipei, TAIWAN;

Power of Attorney: The patent practitioners associated with Customer Number 21874

Domestic Priority data as claimed by applicant

This appln claims benefit of 63/316,391 03/03/2022

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
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Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Entegris, EX1002, p. 1216

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If Required, Foreign Filing License Granted: 08/18/2022

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/882,703**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

Preliminary Class

156

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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

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Entegris, EX1002, p. 1219

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/882,703	08/08/2022	Ming-Chien Chiu	0114970.255US2

CONFIRMATION NO. 8112

21874
LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

FORMALITIES LETTER

OC000000135941017

Date Mailed: 08/23/2022

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The above-identified nonprovisional application is claiming the benefit of a prior-filed provisional application that is in a non-English language. Pursuant to 37 CFR 1.78(a)(5), applicant is required to file:

  1. In the prior-filed provisional application, an English language translation of the prior-filed provisional application and a statement that the translation is accurate; and

  2. In the above-identified nonprovisional application, a confirmation that the translation and statement have been filed in the prior-filed provisional application.

  To avoid abandonment of the above-identified nonprovisional application, applicant is required to file these items within the time period set forth in this notice, unless applicant files a corrected application data sheet in compliance with 37 CFR 1.76 and, if appropriate, an amendment to the specification, to delete the benefit claim within the time period. Please note that once applicant deletes the benefit claim to the prior-filed provisional application, the Office will not accept any resubmission of the benefit claim.

  Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

REPLY VIA ELECTRONIC FILING

A reply may be submitted via electronic filing only by registered users of the appropriate USPTO patent electronic filing system and must include:

- A separate document having the document description, "**Applicant response to Pre-Exam Formalities Notice**"; and
- the item(s) for which a reply period is set forth above.

For more information about electronic filing, contact the Patent Electronic Business Center (EBC) at 1-866-217-9197 or visit at https://www.uspto.gov/ebc.

NOTE: If the reply is not being submitted electronically, a copy of this notice must be included.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zmoguss/

Entegris, EX1002, p. 1221

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/882,703

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	38 minus 20 =	* 18	x 50 =	900	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1	x 240 =	240			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	1970		TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
Application Size Fee (37 CFR 1.16(s))									
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Ming-Chien		Chiu	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHIA-HO		CHUANG	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kuo-Hua		Lee	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Shu-Hung		Lin	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 5 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Hao-Kang		HSIA	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	21874		
Email Address	patent@lockelord.com	Add Email	Remove Email

Application Information:

Title of the Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME		
Attorney Docket Number	0114970.255US2	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	32	**Suggested Figure for Publication (if any)**	20

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Please Select One:	(•) Customer Number	( ) US Patent Practitioner	( ) Limited Recognition (37 CFR 11.9)
Customer Number	21874		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	63316391	2022-03-03
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16758865	Claims benefit of provisional	63284105	2021-11-30
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/CN2019/113628	Claims benefit of provisional	63233878	2021-08-17

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Remove Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

(●) Assignee	( ) Legal Representative under 35 U.S.C. 117	( ) Joint Inventor
( ) Person to whom the inventor is obligated to assign.	( ) Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. [x]

Organization Name	GUDENG PRECISION INDUSTRIAL CO., LTD.

Mailing Address Information For Applicant:

Address 1	9F., NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	**State/Province**	
Country TW		Postal Code	236
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (11-15)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Tim Tingkang Xia/			Date (YYYY-MM-DD)	2022-08-08
First Name	Tim Tingkang	Last Name	Xia	Registration Number	45242

Additional Signature may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	46359210
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Debby Yew
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	08-AUG-2022
Filing Date:	
Time Stamp:	10:59:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	0114970255US2ADS2.pdf	107868 ba436eab5cd5df952329eeaa8605b3c1490872e8	no	10

Warnings:

Information:	
This is not an USPTO supplied ADS fillable form	
Total Files Size (in bytes):	107868

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT7473037

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
MING-CHIEN CHIU	08/02/2022
CHIA-HO CHUANG	08/02/2022
KUO-HUA LEE	08/02/2022
SHU-HUNG LIN	08/02/2022
HAO-KANG HSIA	08/02/2022

RECEIVING PARTY DATA

Name:	GUDENG PRECISION INDUSTRIAL CO., LTD.
Street Address:	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.
City:	NEW TAIPEI
State/Country:	TAIWAN
Postal Code:	236

PROPERTY NUMBERS Total: 1

Property Type	Number
Application Number:	17882703

CORRESPONDENCE DATA

Fax Number:

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 6172390100
Email: patent@lockelord.com
Correspondent Name: LOCKE LORD LLP
Address Line 1: P.O. BOX 55874
Address Line 4: BOSTON, MASSACHUSETTS 02205

ATTORNEY DOCKET NUMBER:	0114970.255US2
NAME OF SUBMITTER:	TIM TINGKANG XIA
SIGNATURE:	/Tim Tingkang Xia/
DATE SIGNED:	08/08/2022
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 5

source=0114970255US2DecAssignment#page1.tif
source=0114970255US2DecAssignment#page2.tif
source=0114970255US2DecAssignment#page3.tif
source=0114970255US2DecAssignment#page4.tif
source=0114970255US2DecAssignment#page5.tif

Attorney Docket No. 0114970.255US2

LOCKE LORD LLP
3333 Piedmont Rd NE # 1200, Atlanta, GA 30305
Tel: (404) 870-4600

DECLARATION AND ASSIGNMENT FOR PATENT AND DESIGN APPLICATIONS

UNITED STATES PATENT RIGHTS, OR
UNITED STATES PLUS ALL FOREIGN PATENT RIGHTS

Title of Invention ⇨ **GAS DIFFUSION DEVICE, WAFER CONTAINER INCLUDING THE SAME AND METHOD FOR ASSEMBLING THE SAME**

As a below named inventor (hereinafter designated as the undersigned), I hereby declare that:

Application not Attached ⇨ This declaration is directed to the application attached hereto. If the application is not attached hereto, the application is as identified by the attorney docket number as set forth above and/or the following:

Enter Appln. No. ⇨ United States Application Number or PCT International Appln. No. _____

Enter Filing Date ⇨ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

WHEREAS, the undersigned has invented certain new and useful improvements described in the application identified.

Insert Name of Assignee ⇨ WHEREAS, **GUDENG PRECISION INDUSTRIAL CO., LTD.**

Insert Address of Assignee ⇨ of **9F.-5, No. 2, Sec. 4, Zhongyang Rd., Tucheng Dist., New Taipei City 236, Taiwan (R.O.C.)** ,

its heirs, successors, legal representatives and assigns (hereinafter designated as the Assignee) is desirous of acquiring the entire right, title and interest in and to said invention and in and to any Letters Patent(s) that may be granted therefor in the United States of America and

Check Box if Appropriate ⇨ ☐ **in any foreign countries.**

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, the undersigned has sold, assigned and transferred, and by these presents does (do) sell, assign and transfer unto said Assignee the full and exclusive right to the said invention in the United States of America, its territories, dependencies and possessions and the entire right, title and interest in and to any and all Letters Patent(s) which may be granted therefor in the United States of America, its territories, dependencies and possessions, and if the box above is designated, in any and all foreign countries; and to any and all divisions, reissues, continuations, conversions and extensions thereof for the full term or terms for which the same may be granted.

Entegris, EX1002, p. 1237

The undersigned agrees to execute all papers necessary in connection with this application and any continuing, divisional, conversion or reissue applications thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary or expedient.

The undersigned agrees to execute all papers necessary in connection with any interference which may be declared concerning this application or continuation, division, conversion or reissue thereof or Letters Patent(s) or reissue patent issued thereon and to cooperate with the Assignee in every way possible in obtaining and producing evidence and proceeding with such interference.

The undersigned agrees to execute all papers and documents and to perform any act which may be necessary in connection with claims or provisions of the International Convention for the Protection of Industrial Property or similar agreements.

The undersigned agrees to perform all affirmative acts which may be necessary to obtain a grant of (a) valid United States of America patent(s) or a grant of (a) valid United States of America and any foreign patent(s) to the Assignee and to vest all rights therein hereby conveyed to said Assignee as fully and entirely as the same would have been held by the undersigned if this Assignment and sale had not been made.

The undersigned hereby authorizes and requests the Patent and Trademark Office Officials in the United States of America and in any foreign countries to issue any and all Letters Patent(s) resulting from said application or any continuing, divisional conversion or reissue applications thereof to the said Assignee, as Assignee of the entire interest, and hereby covenants that he has the full right to convey the entire interest herein assigned, and that he has not executed, and will not execute, any agreement in conflict herewith.

The undersigned hereby grants the law firm of Locke Lord LLP the power to insert any further identification which may be necessary or desirable in order to comply with the rules of the U.S. Patent and Trademark Office.

The undersigned hereby covenants that no assignment, sale, agreement or encumbrance has been or will be made or entered into which would conflict with this assignment.

The undersigned hereby acknowledges that any willful false statement made in this declaration is punishable under 18 U.S.C. § 1001 by fine or imprisonment of not more than five (5) years, or both.

In witness whereof, executed by the undersigned on the date opposite the undersigned name.

LEGAL NAME OF INVENTOR

Inventor's Name ⇨ Inventor: Ming-Chien CHIU Date: 2022/08/02

Inventor's Signature ⇨ Signature: Ming-Chien Chiu

An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use a separate form for each inventor; or check the box below and complete the attached page(s) to list additional inventors.

☑ Additional inventors are being named on the 1 supplemental sheet(s) attached hereto.

Entegris, EX1002, p. 1238

Attorney Docket No. 0114970.255US2

SUPPLEMENTAL SHEET FOR DECLARATION AND ASSIGNMENT

ADDITIONAL INVENTOR(S)
Supplemental Sheet Page 1 of 1

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Chia-Ho Chuang Date: 2022/08/02

Inventor's Signature ⇨ Signature: Chia-Ho Chuang

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Kuo-Hua Lee Date: 2022/08/02

Inventor's Signature ⇨ Signature: Kuo-Hua Lee

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Shu-Hung Lin Date: 2022/08/02

Inventor's Signature ⇨ Signature: Shu-Hung Lin

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Hao-Kang HSIA Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

Doc code: Oath
Document Description: Oath or declaration filed

PTO/AIA/02 (07-13)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

SUBSTITUTE STATEMENT IN LIEU OF AN OATH OR DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (35 U.S.C. 115(d) AND 37 CFR 1.64)

Title of Invention	GAS DIFFUSION DEVICE, WAFER CONTAINER INCLUDING THE SAME AND METHOD FOR ASSEMBLING THE SAME

This statement is directed to:

☐ The attached application,

OR

☒ United States application or PCT international application number _____ filed on _____.

LEGAL NAME of inventor to whom this substitute statement applies:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

HAO-KANG HSIA

Residence (except for a deceased or legally incapacitated inventor):

City	State	Country
TAIPEI		TW

Mailing Address (except for a deceased or legally incapacitated inventor):

9F.-5, No. 2, Sec. 4, Zhongyang Rd., Tucheng Dist., New Taipei City 236, Taiwan (R.O.C.)

City	State	Zip	Country
TAIPEI			TW

I believe the above-named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application.

The above-identified application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this statement is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Relationship to the inventor to whom this substitute statement applies:

☐ Legal Representative (for deceased or legally incapacitated inventor only),

☐ Assignee,

☐ Person to whom the inventor is under an obligation to assign,

☐ Person who otherwise shows a sufficient proprietary interest in the matter (petition under 37 CFR 1.46 is required), or

☒ Joint Inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/AIA02 (07-13)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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SUBSTITUTE STATEMENT

Circumstances permitting execution of this substitute statement:

- ☐ Inventor is deceased.
- ☐ Inventor is under legal incapacity.
- ☒ Inventor cannot be found or reached after diligent effort, or
- ☐ Inventor has refused to execute the oath or declaration under 37 CFR 1.63.

If there are joint inventors, please check the appropriate box below:

- ☒ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) naming the entire inventive entity has been or is currently submitted.

OR

- ☐ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) has not been submitted. Thus, a Substitute Statement Supplemental Sheet (PTO/AIA/11 or equivalent) naming the entire inventive entity and providing inventor information is attached. See 37 CFR 1.64(b).

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

Name: Chia-Wei Chen | Date (Optional): 2021/07/12

Signature: Chia-Wei Chen

APPLICANT NAME AND TITLE OF PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

If the applicant is a juristic entity, list the applicant name and the title of the signer:

Applicant Name: GUDENG PRECISION INDUSTRIAL CO., LTD.

Title of Person Executing This Substitute Statement: Patent Engineer

The signer, whose title is supplied above, is authorized to act on behalf of the applicant.

Residence of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent):

City TAIPEI | State | Country TW

Mailing Address of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent)

No. 900 Shuijia, Hunnan Industrial Zone, Shenyang, China

City TAIPEI | State | Zip | Country TW

Note: Use an additional PTO/AIA/02 form for each inventor who is deceased, legally incapacitated, cannot be found or reached after diligent effort, or has refused to execute the oath or declaration under 37 CFR 1.63.

Entegris, EX1002, p. 1241

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 11/30/2014. OMB 0651-0051
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	August 8, 2022
First Named Inventor	Ming-Chien Chiu
Title	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
Art Unit	
Examiner Name	
Attorney Docket Number	0114970.255US2

SIGNATURE of Applicant or Patent Practitioner

Signature	/Tim Tingkang Xia/	Date (Optional)	
Name	Tim Tingkang Xia	Registration Number	45242
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 11/30/2014. OMB 0651-0051
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 21874

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

GUDENG PRECISION INDUSTRIAL CO., LTD.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Ming-Chien Chiu	Date (Optional)	2019.08.05
Name	Ming-Chien CHIU		
Title	CEO		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Filer:	Tim Tingkang Xia/Debby Yew
Attorney Docket Number:	0114970.255US2

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	80	80
UTILITY SEARCH FEE	2111	1	350	350
UTILITY EXAMINATION FEE	2311	1	400	400
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	2202	18	50	900
INDEPENDENT CLAIMS IN EXCESS OF 3	2201	1	240	240
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1970**

Electronic Acknowledgement Receipt	
EFS ID:	46359044
Application Number:	17882703
International Application Number:	
Confirmation Number:	8112
Title of Invention:	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
First Named Inventor/Applicant Name:	Ming-Chien Chiu
Customer Number:	21874
Filer:	Tim Tingkang Xia/Debby Yew
Filer Authorized By:	Tim Tingkang Xia
Attorney Docket Number:	0114970.255US2
Receipt Date:	08-AUG-2022
Filing Date:	
Time Stamp:	10:44:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1970
RAM confirmation Number	E202288A44250131
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	0114970255US2Trans.pdf	628042 7d008837052d32529c68c208b32fde4ac5115c5e	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	0114970255US2FeeTrans.pdf	1072405 a38fed7e0744572c02bb27569d65d42ffb28012c	no	1
Warnings:					
Information:					
3	Application Data Sheet	0114970255US2ADS2.pdf	96408 008429637e176a79ca61f0f9bca8800e196e05f3	no	10
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
4		0114970255US2Spec.pdf	294663 19a4d814596b27a616f3c25e6cde0986696ddc5d	yes	48

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	36
Claims	37	47
Abstract	48	48

Warnings:

Information:

5	Drawings-only black and white line drawings	0114970255US2Drawings.pdf	5195366 4a1640b6022c01db6b88ebed9094ab63ba87c8ea	no	32
Warnings:					
Information:					
6	Oath or Declaration filed	0114970255US2DecAssignment.pdf	2648539 c93db96ffebbd5da7c7e36f13424e3f91cc248ea	no	5
Warnings:					
Information:					
7	Power of Attorney	0114970255US2POA1.pdf	231664 a5f5d60876eb270ca1e1221eca3f15367025332f	no	2
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	48379 e4400dd884797c8148d4a574ef1dcc645337306c	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	10215466	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/15 (03-13)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	0114970.255US2
First Named Inventor	Ming-Chien Chiu
Title	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [✔] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [✔] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✔] **Specification** [*Total Pages* 48] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✔] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 32]
6. **Inventor's Oath or Declaration** [*Total Pages* 5] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [✔] Newly executed (original or copy)
   b. [ ] A copy from a prior application (37 CFR 1.63(d))
7. [✔] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✔] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [ ] **Other:** _____

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✔] The address associated with Customer Number: 21874 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Tim Tingkang Xia/	Date	August 8, 2022
Name (Print/Type)	Tim Tingkang Xia	Registration No. (Attorney/Agent)	45,242

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/SB/17 (10-20)
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FEE TRANSMITTAL

Complete if known	
Application Number	
Filing Date	August 8, 2022
First Named Inventor	Ming-Chien Chiu
Examiner Name	
Art Unit	
Practitioner Docket No.	0114970.255US2

☒ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) 1970

METHOD OF PAYMENT (check all that apply)

☐ Check ☒ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☒ Deposit Account Deposit Account Number: 121781 Deposit Account Name: Locke Lord LLP

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☒ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17 ☒ Credit any overpayment of fee(s)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**Fees Paid ($)**
Utility	320	160*	80	700	350	175	800	400	200	830
Design	220	110	55	160	80	40	640	320	160	
Plant	220	110	55	440	220	110	660	330	165	
Reissue	320	160	80	700	350	175	2,320	1,160	580	
Provisional	300	150	75	0	0	0		0	0	

* The $150 small entity status filing fee for a utility application is further reduced to $75 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	**Undiscounted Fee ($)**	**Small Entity Fee ($)**	**Micro Entity Fee ($)**
Each claim over 20 (including Reissues)	100	50	25
Each independent claim over 3 (including Reissues)	480	240	120
Multiple dependent claims	860	430	215

Total Claims		**Extra Claims**	**Fee ($)**		**Fee Paid ($)**
38	-20 or HP =	18 x	50	=	900

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		**Extra Claims**	**Fee ($)**		**Fee Paid ($)**
4	-3 or HP =	1 x	240	=	240

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	
Fee ($)	**Fee Paid ($)**

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $420 ($210 for small entity) ($105 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		**Extra Sheets**		**Number of each additional 50 or fraction thereof**		**Fee ($)**		**Fee Paid ($)**
80	- 100 =		/ 50 =		(round **up** to a whole number) x		=	

4. OTHER FEE(S) **Fees Paid ($)**

Non-English specification, $140 fee ($70 for small entity) ($35 for micro entity) _____

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity) _____

Other (e.g., late filing surcharge): _____ _____

SUBMITTED BY

Signature	/Tim Tingkang Xia/	Registration No. (Attorney/Agent) 45242	Telephone 404-870-4698
Name (Print/Type)	Tim Tingkang Xia		Date August 8, 2022

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Ming-Chien		Chiu	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	CHIA-HO		CHUANG	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kuo-Hua		Lee	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Shu-Hung		Lin	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

Inventor 5 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Hao-Kang		HSIA	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	NEW TAIPEI	Country of Residence	TW

Mailing Address of Inventor:

Address 1	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	State/Province	
Postal Code	236	Country	TW

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	21874		
Email Address	patent@lockelord.com	Add Email	Remove Email

Application Information:

Title of the Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME		
Attorney Docket Number	0114970.255US2	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	32	**Suggested Figure for Publication (if any)**	20

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	21874		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	63316391	2022-03-03
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16758865	Claims benefit of provisional	63284105	2021-11-30
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/CN2019/113628	Claims benefit of provisional	63233878	2021-08-17

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

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If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. [x]

Organization Name	9F.-5, NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.

Mailing Address Information For Applicant:

Address 1	9F., NO. 2, SEC. 4, ZHONGYANG RD.,TUCHENG DIST.		
Address 2			
City	NEW TAIPEI	**State/Province**	
Country TW		Postal Code	236
Phone Number		Fax Number	
Email Address			

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

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See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Tim Tingkang Xia/			Date (YYYY-MM-DD)	2022-08-08
First Name	Tim Tingkang	Last Name	Xia	Registration Number	45242

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0114970.255US2
	Application Number	
Title of Invention	GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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GAS DIFFUSION DEVICE, AND WAFER CONTAINER INCLUDING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims the benefits of U.S. Provisional Application Serial No. 63/233,878 and filed on August 17, 2021; and U.S. Provisional Application Serial No. 63/284,105 and filed on November 30, 2021; and U.S. Provisional Application Serial No. 63/316,391 and filed on March 3, 2022; all of which are expressly incorporated by reference herein in their entirety.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to a gas diffusion device, and more particularly, to a gas diffusion device for filling a specific gas and installed in a wafer container, and even more particularly, to a gas tower installed in a wafer container.

DESCRIPTION OF THE PRIOR ART

[0002] A dry gas or inert gas is generally filled in a wafer container, so as to reduce the humidity within the wafer container to below 10%. During a process of opening the wafer container, a pressure difference causes external air to enter an accommodating space in the container, leading to a sudden rise in the humidity. Moreover, particles may be carried by the external air and then become attached on surfaces of a wafer. Thus, the dry gas or inert gas needs to be persistently filled in the wafer container so as to resist

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against external air that enter when the container is opened.

[0003] However, a gas diffuser mounted in the wafer container is limited by an internal area of the wafer container, and the position of a through hole provided for gas filling at the bottom is fixed. Thus, in current gas filling technologies, a gas intake module is provided at the through hole for filling the wafer container with gas and the gas intake module is configured in a non-straight-through manner from the gas inlet through an air outlet path of a porous tube (gas tower). That is, the center axis of the gas intake module is offset from the center axis of the porous tube, so as to achieve of the object of gas filling by this winding structure and to solve the issue of a limited space in the wafer container. Such offset configuration or staggered arrangement policy requires the gas to pass through a winding path from the gas intake module to the porous tube, resulting in an increase of flow time and poor fluency due to the winding during the traveling process of the gas, further incurring a problem of poor purging efficiency. In addition, with an increasing demand of gas diffusion flow, although increasing the size of the porous tube can be a solution, the problem of a limited space of the wafer container is left unsolved. A conventional porous tube (gas tower) is designed as a circular tube that discharges air in a 360-degree manner, and this may cause turbulence in the interior space of the wafer container. Moreover, a porous tube with an increased radial size may interfere with the wafer.

[0004] The above offset configuration of the gas intake module and the porous tube further suffer from drawbacks of being difficult to install. On a downstream end of the winding path, that is, the bottom of the porous tube, breaking or damage may easily occur

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during installation, hence affecting the quality of airflow. A conventional porous tube is made of one single material, and a connecting structure between the porous tube and the gas intake module is susceptible to problems of breaking or poor airtightness during an assembly process, causing particles to become attached to the surface of the wafer. Furthermore, as shown in FIG. 1, a pair of diffuser assemblies are usually arranged in a wafer container (10), and the both the diffuser assemblies have respective gas intake modules (11) and porous tubes (12), wherein each gas intake modules (11) has a check valve (13). A gas filling disk surface (14) can be connected to the gas intake module (11) at the bottom of the wafer container (10) and supply a gas. In case of degraded performance or malfunction of one of the check valves (13), a difference is caused between incoming airflows of the two diffuser assemblies, causing non-uniform airflows entering the interior of the container or an insufficient total flow. In addition, a wafer can be placed in the wafer container (10) in a high-temperature condition during a semiconductor fabrication process, such that the temperature of the interior space of the wafer container (10) also becomes high, which may even undesirably affect performance of components assembled on the wafer container (10).

[0005] In view of the above, there is a need for a person skilled in the art to develop an improved gas diffusion device, so as to solve the problems of inconsistent gas filling performance and hence poor airflow quality caused by such conventional non-straight-through structure and fragile structure at the connection of the porous pipe, as well as the problem of degraded performance caused by the internal high temperature of a wafer container.

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SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a gas diffusion device including: at least one porous tube, having a longitudinal space, the longitudinal space having a closed end and an open end; and at least one collar, connected to the open end, configured to buffer a corresponding coupling structure on a bottom portion of a wafer container to which the porous tube is assembled so as to prevent breaking of the open end.

[0007] In one specific embodiment, the shape of a horizontal cross section of the porous tube is an ellipsoid or an elongated narrow shape having a long axis and a short axis, or a circle having a diameter.

[0008] In one specific embodiment, the coupling structure at the bottom portion defines a through channel which allows a gas to enter the longitudinal space.

[0009] In one specific embodiment, the porous tube or the collar is made of a thermal resistant material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

[0010] In one specific embodiment, the through channel has a center axis which is located within the longitudinal space.

[0011] In one specific embodiment, when the porous tube is assembled in the wafer container, one side surface of the porous tube faces a plurality of wafers in a wafer container, the side surface has a plurality of recesses formed thereon, and a level of each of the recesses is between those of two adjacent wafers in the wafer container.

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[0012] In one specific embodiment, the porous tube is formed by assembling a top cover, a tower and an open end that are detachable.

[0013] It is another object of the present invention to provide a gas diffusion device installed in a wafer container having an accommodating space. The gas diffusion device includes: a buffering gas chamber, configured at a bottom portion of the wafer container, the bottom portion provided with at least one coupling structure defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and at least one porous tube, having a longitudinal space, the porous tube installed to the coupling structure of the wafer container, the longitudinal space of the porous tube communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial.

[0014] In one specific embodiment, the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis. The center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial.

[0015] In one specific embodiment, the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis. The center axis of

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the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial. The center axis of the longitudinal space of the porous tube is offset from the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis.

[0016] In one specific embodiment, the longitudinal space of the porous tube has a closed end and an open end. The open end receives the corresponding coupling structure, so that the gas enters the longitudinal space by passing through the buffering gas chamber and the open end.

[0017] In one specific embodiment, the shape of a horizontal cross section of the porous tube is an ellipsoid or an elongated narrow shape having a long axis and a short axis, or a circle having a diameter.

[0018] In one specific embodiment, the gas diffusion device further includes: a first collar, arranged in the open end, the first collar located between the open end and the coupling structure.

[0019] In one specific embodiment, the gas diffusion device further includes: a second collar, located between the first collar and the coupling structure when the second collar is disposed on the coupling structure so as to reinforce airtightness.

[0020] In one specific embodiment, the material of the first collar is softer than the material of the porous tube to prevent breaking of the open end.

[0021] In one specific embodiment, the second collar and the porous tube are sintered or bonded into an integral to prevent breaking of the open end.

[0022] In one specific embodiment, the coupling structure, the porous tube, the first

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collar and/or the collar are/is made of a thermal resistant material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

[0023] In one specific embodiment, the gas diffusion device further includes: an airflow guiding member, arranged adjacent to one side of the porous tube, the airflow guiding member configured to adjust an airflow direction of the gas entering the accommodating space.

[0024] In one specific embodiment, the gas diffusion device further includes: at least one gas intake module, communicatively coupled to the buffering gas chamber, the gas intake module having the gas intake center axis, supplying the gas in one single gas intake direction to pass through the gas intake channel and enter the buffering gas chamber.

[0025] It is another object of the present invention to provide a gas diffusion device installed in a wafer container having an accommodating space. The gas diffusion device includes: a gas cartridge, disposed at a bottom portion of the wafer container so as to define a buffering gas chamber, the bottom portion provided with at least two coupling structures, each of the coupling structures defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and at least two porous tubes, each of the porous tubes having a longitudinal space, the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, the longitudinal spaces of the

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two porous tubes communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the at least two porous tubes and enter the accommodating space.

[0026] In one specific embodiment, the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space has a center axis. The center axis of each of the through channels, the center axis of the open end of each of the porous tubes, the center axis of the longitudinal space of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial.

[0027] In one specific embodiment, the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis. The center axis of each of the through channels, the center axis of the open end of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial. The center axis of the longitudinal space of each of the porous tubes is offset from the center axis of the through channel, the center axis of the open end of the porous tube and the gas intake center axis.

[0028] In one specific embodiment, the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tube has a center axis. The center axis of each of the through channels, the center axis of the open end of each of the porous tubes, and the center axis of the

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longitudinal space of each of the porous tubes are coaxial. The position of a gas intake center axis along which the gas passes is offset from the center axis of the through channel , the center axis of the open end and the center axis of the longitudinal space that are coaxial.

[0029] In one specific embodiment, the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis. The center axis of each of the through channels and the center axis of the open end of each of the porous tubes are coaxial. A gas intake center axis along which the gas passes and the center axis of the longitudinal space are both offset from the center axis of the through channel and the center axis of the open end that are coaxial.

[0030] In one specific embodiment, the gas cartridge has a bottom portion and a sidewall extending from the bottom portion, and the gas intake channel is formed at the bottom portion of the gas cartridge.

[0031] In one specific embodiment, the gas cartridge is installed at the bottom portion of the wafer container, such that the bottom portion and the sidewall of the gas cartridge and the bottom portion of the wafer container define the buffering gas chamber.

[0032] In one specific embodiment, a plurality of annular sidewalls further extend from a lower surface of the bottom portion of the gas cartridge. Each of the annular sidewalls defines an installation space for filling with a gas intake module. The gas intake module has the gas intake center axis. The installation space, the gas intake channel at the bottom portion of the gas cartridge and the buffering gas chamber communicate with one

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another, such that the gas in one single air intake direction supplied by the gas intake module passes through the gas intake channel and enters the buffering gas chamber.

[0033] In one specific embodiment, the wafer container includes a base plate installed at the bottom portion of the wafer container, and the buffer gas chamber is between the bottom portion and the base plate of the wafer container.

[0034] In one specific embodiment, the base plate is made of a material including a self-lubricating material.

[0035] It is yet another object of the present invention to provide a wafer container including: a shell, including a bottom portion, the bottom portion configured with a plurality of coupling structures, the coupling structures defining a plurality of through channels; a buffering gas chamber, formed below the bottom portion, the buffering gas chamber having a plurality of gas intake channels, the gas intake channels fluid communicating with the corresponding through channels; and a plurality of porous tubes, each of the porous tubes having an open end, the open end correspondingly connecting with the coupling structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel, allowing a gas to pass through the porous tubes and enter an accommodating space of the shell.

[0036] In one specific embodiment, the wafer container further includes a door detachably combined with the shell, and a pair of support portions configured on an inner side of the shell. The wafer container is made of a thermal resistance material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

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[0037] In one specific embodiment, the wafer container includes a base plate connected below the shell to support the shell, and the buffering gas chamber is between the bottom portion and the base plate of the shell.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] Reference can be made to the drawings and description below to better understand the present invention. Non-limiting and non-exhaustive embodiments are described with reference to the drawings below. It is to be noted that the components in the drawings are not necessarily drawn to their actual sizes, and are depicted to focus on the description on structures and principles.

[0039] FIG. 1 is a schematic diagram of a conventional wafer container filled with a gas by a pair of diffusion assemblies;

[0040] FIG. 2 is an exploded diagram of a wafer container according to a first embodiment of the present invention;

[0041] FIG. 3 is a front view of a wafer container according to the first embodiment of the present invention;

[0042] FIG. 4 is an internal top view of a wafer container according to the first embodiment of the present invention;

[0043] FIG. 5 is a section diagram of FIG. 4 along the line A-A;

[0044] FIG. 6 is an enlarged partial diagram of FIG. 5, showing a gas diffusion device according to the first embodiment of the present invention;

[0045] FIG. 7 shows a gas diffusion device according to a second embodiment of the

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present invention;

[0046] FIG. 8A and FIG. 8B show different variation examples of shapes of a porous tube;

[0047] FIG. 9A and FIG. 9B show relations between different shapes of a porous tube and a gas intake module;

[0048] FIG. 10A and FIG. 10B show (coaxial) porous tubes according to different embodiments;

[0049] FIG. 11A and FIG. 11B show (non-coaxial) porous tubes according to different embodiments;

[0050] FIG. 12A and FIG. 12B show a gas diffusion device according to a third embodiment of the present invention;

[0051] FIG. 13A and FIG. 13B are schematic diagrams of variations examples of a porous tube and a baffle plate;

[0052] FIG. 14A and FIG. 14B are schematic diagrams of other variation examples of a porous tube and a baffle plate;

[0053] FIG. 15A and FIG. 15B are schematic diagrams of yet other variations examples of a porous tube and a baffle plate;

[0054] FIG. 16 is a variation example of a combination of a porous tube and a baffle plate;

[0055] FIG. 17 shows a wafer container according to a second embodiment of the present invention;

[0056] FIG. 18 is an exploded diagram of a gas cartridge of the present invention;

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[0057] FIG. 19 is a section diagram of a gas cartridge configured at a wafer container of the present invention;

[0058] FIG. 20 is an enlarged partial section diagram of a gas cartridge configured at a wafer container of the present invention;

[0059] FIG. 21A to FIG. 21D are schematic diagrams of configurations of a porous tube and a gas cartridge according to some embodiments;

[0060] FIG. 22 shows a porous tube according to another embodiment of the present invention;

[0061] FIG. 23A and FIG. 23B show variation examples of slotted holes of a porous tube; and

[0062] FIG. 24A and FIG. 24B show other variation example of slotted holes of a porous tube.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0063] To better describe the present invention, specific examples and specific embodiments are given with the accompanying drawings below. However, the subject matter of the application may be specifically implemented in various different forms, and the construction covered or asserted by the subject matter of the application is not limited to any exemplary specific embodiments disclosed in the detailed description of the application; it should be understood that the specific embodiments are non-limiting and are not to be construed as restrictive. Similarly, the present invention is to provide a reasonably broad scope for the subject matter applied or covered by the subject matter. In

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addition, the asserted subject matter may be implemented in form of a method, device or system.

[0064] The expression "one embodiment" used in the literature of the application does not necessarily refer to the same specific embodiment, and the expression "other/another (some/certain) embodiments" used in the literature of the application does not necessarily refer to different specific embodiments. The object of the above is, for example, to include combination of all or part of the exemplary specific embodiments by the subject matter set forth.

[0065] Refer to FIG. 2 to FIG. 5. FIG. 2 shows an exploded diagram of a wafer container (20) according to a first embodiment of the present invention. FIG. 3 shows a front view (excluding a door) of the wafer container (20) according to the first embodiment of the present invention. FIG. 4 shows an internal top view (including wafers W) of the wafer container (20) according to the first embodiment of the present invention. FIG. 5 shows a section diagram of FIG. 4 according to the line A-A. The wafer (20) includes a shell (21) and a door (22). The shell (21) has an accommodating space for accommodating wafers. The door (22) is detachably connected to an opening (23) on a front end of the shell (21), so as to open and close the accommodating space. A pair of support portions (24) are individually configured in the accommodating space of the shell (21), and are respectively located on opposite inner sidewalls of the shell (21). Moreover, the sizes and areas of the support portions (24) are sufficient for supporting and stacking multiple wafers. A gas intake module (25) is detachably assembled at a bottom portion of the wafer container (20), and is close to a rear end of the water container (20). A gas

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discharge module (26) is detachably assembled at the bottom portion of the wafer container (20), and is close to a front end of the water container (20). In this embodiment, the numbers of the gas intake module (25) and the gas discharge module (26) are two for example, and the numbers used can be adjusted in response to actual operations. A bottom end of a porous tube (27) (or a gas tower) is detachably assembled on the rear end of the wafer container (20) and fluid communicates with the gas intake module (25). A top end of the porous tube (27) may be positioned an on inner side of the shell (21) by a positioning component (not shown). Although not shown in FIG. 2, an airflow guiding member or a baffle plate may be provided between the porous tube (27) and the rear end of the shell (21), as shown in FIG. 12A and FIG. 12B. The bottom portion of the shell (21) is detachably connected to a base plate (29).

[0066] As shown in FIG. 3 to FIG. 5, the porous tube (27) is located in the rear end of the wafer container (20), and extends vertically from a bottom portion (201) toward a top portion (202) of the wafer container (20). The height extending by the porous tube (27) covers as much as possible a stacking height of a maximum number of wafers (W) that can be accommodated in the accommodating space, or is at least greater than that of an upper surface of the wafer (W) located at an uppermost position. Gas discharge holes of the porous tube (27) are fundamentally configured at levels between wafers and blow in a direction toward the opening (23). The present invention adopts a straight-through configuration, and so a space is preserved between inner walls (203) of the wafer container (20). This space is sufficient for accommodating the porous tubes (27), and the structural design of the porous tubes (27) can be adjusted in response to actual

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requirements, hence providing applications of numerous different variations examples, with associated details to be described shortly.

[0067] FIG. 6 shows an enlarged partial diagram of FIG. 5 (as indicated by dotted lines), showing a gas diffusion device according to the first embodiment of the present invention. The gas intake module (25) and the porous tube (27) are installed on the shell (21) of the wafer container (20). The gas intake module (25) includes an elastic sleeve (251) and a check valve (252). The elastic sleeve (251) has a gas intake channel passing through two ends thereof, and the check valve (252) is securely accommodated in the gas intake channel. A filter membrane (253) is configured between the elastic sleeve (251) and the bottom portion (201) of the shell (21) to filter an incoming gas. To prevent an overly large pressure of the incoming gas from causing a deforming or a breaking of the filter membrane (253), the elastic sleeve (251) has a larger diameter at the inner wall close to the bottom portion (201), and so a buffering gas chamber (254) is formed between the gas intake channel and the filter membrane (253). Before passing through the filter membrane (253), the gas is dispersed laterally in the buffering gas chamber (254), so as to reduce the pressure applied on the filter membrane (253). At least one annular sidewall (204) extending downward is formed at the bottom portion (201) of the shell (21), and defines an installation space for accommodating the gas intake module (25). The outer diameter of the elastic sleeve (251) may be slightly larger than the inner diameter of the annular sidewall (204), and a sealing ring may be provided between the elastic sleeve (251) and the annular sidewall (204), thereby securely accommodating the elastic sleeve (251) in the installation space of the annular sidewall (204). A plurality of

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flanges are formed on an outer side of the elastic sleeve (251); however, in other embodiments, an outer side surface of the elastic sleeve (251) may also be a flat surface.

[0068] The base plate (29) is capable of retaining the gas intake module (25) in the installation space of the annular sidewall (204). When the base plate (29) is assembled to the bottom portion (201) of the shell (21), a part of the base plate (29) is held at the bottom end of the elastic sleeve (251), such that the elastic sleeve (251) is clamped between the bottom portion (201) and the base plate (29). As shown in FIG. 1, a gas filling disk surface (14) can be held below the base plate (29) and apply a fluid (for example, a gas) pressure on the check valve (252) in the elastic sleeve (251) to open the check valve (252) , so as to allow the gas to pass through the check valve (252) and enter the gas intake channel of the elastic sleeve (251). In this embodiment, the base plate (29) includes an operable locking component for locking or releasing the elastic sleeve (251). The filter membrane (253) may be configured in the gas intake channel of the elastic sleeve (251) to filter out particles, thus effectively preventing particles from entering the accommodating space of the wafer container (20). The base plate (29) is usually placed on a load port of an apparatus, and may be selectively made of a self-lubricating material, which is fundamentally a composite material including at least two materials. Thus, the coefficient of friction of part or all of the base plate (29) is lower than the coefficient of friction of a contact interface of the load port, so as to more readily move the base plate (29) on the interface of the load port.

[0069] At least one coupling structure (205) is provided at the bottom portion (201) of the wafer container (20). For example, the coupling structure (205) is formed as

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extending upward from an inner side surface of the bottom portion (201) of the shell (21), and the structure of the coupling structure (205) may be designed as a tower-like nozzle and has a through channel (206) passing through the bottom portion (201) and the accommodating space. The coupling structure (205) is configured to connect the porous tube (27). The porous tube (27) has a longitudinal space (272), which has a closed end and an open end (271). The outer diameter of the coupling structure (205) is slightly smaller than the inner diameter of the porous tube (27), such that the open end (271) of the porous tube (27) can sleeve the coupling structure (205) and the gas can pass through the through channel (206) and enter the longitudinal space (272) of the porous tube (27).

[0070] Gas filling by applying a straight-through manner of the present invention is described below. The coupling structure (205) defines the through channel (206) having a center axis (C). It should be noted that, a gas intake center axis of the gas and the center axis (C) of the coupling structure (205) are coaxial, and a center axis of the gas intake module (25) and the gas intake center axis are also coaxial, wherein the gas intake module (25) supplies the gas in one single gas intake direction that passes through the gas intake channel and enters the buffering gas chamber (254). As shown in FIG. 6, in the gas diffusion device according to the first embodiment, the gas intake channel, the buffering gas chamber (254), the through channel (206) and the accommodating space communicate with one another. Since the porous tube (27) is installed to the coupling structure (205) of the wafer container (20), the longitudinal space (272) of the porous tube (27) communicates with the buffering gas chamber (254). Moreover, the open end (271) of the porous tube (27) has a center axis, and the longitudinal space (272) of the

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porous tube (27) has a center axis. When the center axis (C) of the coupling structure (205), the center axis of the open end (271) of the porous tube (27) and the gas intake center axis are coaxial, the gas in one single gas intake direction supplied by the gas intake module (25) passes through the gas intake channel and enters the buffering gas chamber (254), and the buffering gas chamber (254) then allows the gas to sequentially pass through the open end (271) and the longitudinal space (272) of the porous tube (27) to enter the accommodating space. Such straight-through configuration ensures that the airflow follows a straight path to enter the porous tube (27) from the gas intake module (25), and provides a shortest path for the gas to directly purge the wafers in the accommodating space, hence enhancing purging efficiency as well as effectively mitigating the problem of increased humidity when the door (22) opens from the shell (21). In other words, the present invention is capable of solving various drawing including degraded purging efficiency and increased humidity of the gas in the accommodating space caused by an increased airflow path of the conventional winding structural design.

[0071] Further, the present invention further includes at least one collar (273), which is configured to be connected in the open end (271) of the porous tube (27). The collar (273) has a buffering and protection effect, and is made of material that is softer than the material of the porous tube (27). When the open end (271) of the porous tube (27) is assembled to the corresponding coupling structure (205) on the bottom portion (201) of the wafer container (20), the collar (273) can prevent stress engagement between the open end (271) and the couplings structure (205) and hence from the problem of breaking of

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the open end (271) or the entire porous tube (27). The collar (273) of the present invention may be an independent component, or the collar (273) and the porous tube (27) may be sintered or bonded into an integral. The porous tube (27) and the collar (273) are made of a thermal resistant material, which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

[0072] FIG. 7 shows a gas diffusion device according to a second embodiment of the present invention. One primary difference from the gas diffusion of the first embodiment is that, along with an increasing demand of the amount of diffusion airflow, without changing the area of the accommodating space of the existing wafer container, the present invention designs a porous tube (27') structure capable of increasing the amount of airflow by providing a maximum space utilization rate for the space between the waters and the inner walls (203) of the wafer container (20). The size of the porous tube (27') is increased, and the increased part extends toward the inner walls (203) of the shell (21). Without changing the structural design where the gas intake center axis of the gas and the center axis (C) of the coupling structure (205) are coaxial, the center axis of the open end (271) of the porous tube (27') and a center axis (C') of a longitudinal space (272') are non-coaxial, because the size of the porous tube (27') is increased toward the inner walls (203) of the shell (21). That is to say, the center axis (C') of the longitudinal space (272') of the porous tube (27') is offset from the center axis (C) of the coupling structure (205), the center axis of the open end (271) of the porous tube (27') and the gas intake center axis.

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[0073] It should be understood that, although the center axis (C) of the coupling structure (205) and the center axis (C') of the longitudinal space (272') of the porous tube (27') are non-coaxial, but the center axis (C) of the coupling structure (205), the center axis of the open end (271') of the porous tube (27') and the gas intake center axis are still coaxial. Thus, the gas in one single gas intake direction supplied by the gas intake module (25) passes through the gas intake channel and enters the buffering gas chamber (254), and the buffering gas chamber (254) then allows the gas to sequentially pass through the open end (271') and the longitudinal space (272') of the porous tube (27') and enter the accommodating space. That is, the airflow fundamentally still follows a shortest path (straight-through manner) for the gas to directly purge the wafers in the accommodating space. Moreover, with the increased size of the porous tube (27') and the increased amount of airflow, purging efficiency is enhanced at the same time.

[0074] FIG. 8A and FIG. 8B are partial top views of an interior of a wafer container, showing different variation examples of shapes of the porous tubes (827A, 827B). To prevent an interference on edges of the wafers (W), the shape of the porous tubes (827A, 827B) is an elongated narrow shape having a long axis and a short axis, wherein the short axis is usually a primary direction of gas diffusion and may be directed toward the centers of the wafers. The porous tube (827B) in FIG. 8B extends longer in the long axis direction, so that the porous can provide a broader coverage range for gas diffusion.

[0075] FIG. 9A and FIG. 9B show perspectives of top views to present relations between different shapes of a porous tube, a coupling structure and a gas intake module.

[0076] In FIG. 9A, a porous tube (927A, 927B), a coupling structure (9205A, 9205B)

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and a gas intake module (925A, 925B) are coaxial. The shape of a horizontal cross section of a longitudinal space of the porous tubes (927A, 927B) is an elongated narrow shape having a short axis (X) and a long axis (Y), and a horizontal cross section of a through channel of the coupling structure (9205A, 9205B) is a circle. And both of the shapes of a horizontal cross section of a longitudinal space of the porous tubes (927A, 927B) and a horizontal cross section of a through channel of the coupling structure (9205A, 9205B) are an elongated narrow shape. In this embodiment, the porous tube is not limited to being an elongated narrow shape, and the shape of the structure may be adjusted in response to actual requirements, so as to change the flow direction of the gas and increase the area for purging the wafers in the accommodating space; for example, the cross section area along the long axis (Y) of the porous tube (927A) is greater than that along the long axis (Y) of the porous tube (927B), and thus the gas discharge area is also larger.

[0077] Also referring to FIG. 7, the center axis of the open end of a porous tube (927C, 927D, 927E) is offset from a coupling structure (9205C, 9205D, 9205E) and a gas intake module (925C, 925D, 925E). The shape of the horizontal cross section of the longitudinal space of the porous tube (927C, 927D, 927E) may be the elongated narrow shape, a circle having a diameter and an ellipsoid having a diameter, respectively, and the shape of the cross section of the through channel of the coupling structure (9205C, 9205D, 9205E) may be an elongated narrow and circles, respectively. The center axes of the coupling structures (9205C, 9205D, 9205E) are all located in the longitudinal spaces of the porous tubes (927C, 927D, 927E). In this embodiment, to increase the area for purging the

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wafers in the accommodating space, the cross section areas along the short axes (X) of the porous tubes (927C, 927D, 927E) are increased, and so the gas discharge areas are correspondingly increased. To prevent the increased cross section areas from interfering the wafers, the cross section areas along the short axes (X) of the porous tubes (927C, 927D, 927E) extend toward the inner walls (203) of the shell (21).

[0078] Considering certain restrictions of injection molding, FIG. 10A and FIG. 10B show (coaxial) porous tubes according to different embodiments. FIG. 10A shows an assembly and exploded diagram of a porous tube (1027A), which has a tower (70) extending longitudinally, a top cover (71) and an open end (72). The top cover (71) serves as a closed end, and the top cover (71) and the open end (72) are respectively detachably connected to a top end and a bottom end of the tower (70) so as to define a longitudinal space. The area of the longitudinal space shown in FIG. 10A is greater than the area of an opening space of the open end (72). The tower (70), the top cover (71) and the open end (72) of the porous tube (1027B) in FIG. 10B are a formed integral, and so the area of the longitudinal space is greater than the area of the opening space of the open end (72). These two types of porous tubes (1027A, 1027B) may provide different gas diffusion performance, and both have a characteristic that the center axis of the longitudinal space and the center axis of the open end (72) are coaxial.

[0079] FIG. 11A and FIG. 11B shows (non-coaxial) porous tubes according to different embodiments. A porous tube (1027C, 1027D) has a characteristic that the longitudinal space is offset from the center axis of the open end (72). As shown in FIG. 11A, the porous tube (1027C) may be an integral component, and the area of the

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longitudinal space of the tower (70) of the porous tube (1027C) is greater than the opening space of the open end (72). Again referring to FIG. 11B, the tower (70) and the top cover (71) of the porous tube (1027D) are detachable, the tower (70) and the open end (72) are an integral component, and the area of the longitudinal space of the tower (70) is larger than the area of the opening space of the open end (72).

[0080] FIG. 12A and FIG. 12B show a gas diffusion device according to a third embodiment of the present invention. The cross section side view of FIG. 12A shows that an airflow guiding member, that is, a baffle plate (274), is further provided between the porous tube (27) and the inner walls (203). The baffle plate (274) extends longitudinally along the porous tube (27) and has a same or slightly higher extension height. As shown in FIG. 12B, the shape of a horizontal cross section of the baffle plate (274) is defined by at least one arc so as to shield a partial periphery of the porous tube (27). In an example where the porous tube (27) is configured to perform radial diffusion, the baffle plate (274) guides the gas and returns the gas back to a region of the wafers, so as to prevent excessive gas from flowing meaninglessly on the inner side of the shell. The structure and pattern of the baffle plate (274) are not limited in the present invention, and the structural angle and shape of the baffle plate (274) may be adjusted in response to actual requirements, so as to achieve the requirement and object of controlling the direction of airflow.

[0081] FIG. 13A and FIG. 13B shows schematic diagrams of variations examples of a porous tube and a baffle plate. Taking a porous tube (1327A) being an elongated narrow shape for example, the baffle plate is formed by a backplate (80) and two flanks (81, 81').

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A horizontal length (d) of the porous tube (1327A) is smaller than a horizontal length (D) of the baffle plate. An included angle between the flank (81) and the backplate (80) is θ1, and an included angle between the flank (81') and the backplate (80) is θ2. FIG. 13A shows that the included angles θ1 and θ2 and shapes of the two flanks (81, 81') are the same, and so the controlled directions of airflow are controlled to be the same. FIG. 13B shows that the shapes of the two flanks (81, 81') are the same, but the included angles θ1 and θ2 are different, and so the controlled directions of airflow are different, with the diffusion direction of airflow with respect to the included angle θ2 being greater than that with respect to the included angle θ1. It should be understood that, the included angle and shape of the flank can determine the performance of gas diffusion.

[0082] FIG. 14A and FIG. 14B shows schematic diagrams of other variation examples of a porous tube and a baffle plate. Taking a porous tube (1327B) being an ellipsoid for example, the baffle plate is an arc backplate (83). A horizontal length (d) of the porous tube (1327B) is smaller than a horizontal length (D) of the baffle plate. Two side ends to a vertex of the arc backplate (83) may define an included angle θ. When the extension length (D) of the included angle θ with respect to the two side ends are different, the controlled directions of airflow are also different. FIG. 14A shows that the included angles θ and arcs on the two sides of the arc backplate (83) are the same, that is, the controlled directions of airflow are the same. FIG. 14B shows that the extension length (D) and the included angles θ1 and θ2 on the two sides are different, and so the controlled directions of airflow are also different, wherein the diffusion angle of airflow with respect to the included angle θ1 is greater than that with respect to the included angle θ2.

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[0083] FIG. 15A and FIG. 15B show schematic diagrams of yet other variations examples of a porous tube and a baffle plate. Taking a porous tube (1327C) being a circle for example, the baffle plate is an arc backplate (84). A horizontal length (d) of the porous tube (1327C) is smaller than a horizontal length (D) of the baffle plate. Two side ends to a vertex of the arc backplate (84) may define an included angle θ. FIG. 15A shows that the included angles θ and arcs on the two sides of the arc backplate (84) are the same, which means the controlled directions of airflow are the same. FIG. 15B shows that the extension length (D) and the included angles θ1 and θ2 on the two sides are different, and so the controlled directions of airflow are also different, wherein the diffusion angle of airflow with respect to the included angle θ2 is greater than that with respect to the included angle θ1.

[0084] It is known from the variation examples above that, the baffle plate may be a symmetrical or asymmetrical configuration with respect to the porous tube. In an asymmetrical configuration, the degree of asymmetry may be determined by the included angle θ, or may be achieved by the baffle plate and by means of being staggered from the porous tube. The included angle θ may be between 0 degree and 90 degrees; however the present invention is not limited to the examples above. By applying the baffle plate in conjunction with the porous tube, in addition to achieving the object of controlling the direction of airflow, the issue of turbulence generated in the interior space of the wafer container (20) due to gas discharge in a 360-degree manner of a conventional circular tube structure is also resolved.

[0085] FIG. 16 shows schematic diagrams of variation examples of combinations of a

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circular porous tube, an ellipsoidal porous tube and an elongated narrow porous tube. These baffle plates may be formed to match outer surfaces of these porous tubes; that is, the baffle plates may be adhered to the outer surfaces of these porous tubes to form seamless combinations. In the case where the porous tube is in a radiation diffusion form, part of the diffusion holes may be shielded by the baffle plate such that the gas is forced to be diffused through the unshielded part, hence increasing the amount of flow in all directions. In other embodiments, the porous tube may also has part of the diffusion holes formed thereon to achieve the same object.

[0086] FIG. 17 shows a wafer container (20') according to a second embodiment of the present invention. The same element numerals and symbols and the same associated details of the wafer container (20') as those of the wafer container (20) of the first embodiment are omitted herein for brevity, and only the differences are described. The wafer container (20') of the second embodiment includes a gas cartridge (90), which is detachably connected to the bottom portion of the shell (21). The gas cartridge (90) can provide effects of a buffering tolerance and a communicating space for the gas before the gas enters an interior space of the wafer container (20'), with associated details given below. When the base plate (29) is assembled to the bottom portion of the shell (21), the gas cartridge (90) is kept between the bottom portion of the shell (21) and the base plate (29). In fact, the bottom portion of the shell (21) is inclined, and as shown in FIG. 5, the bottom portion (201) gradually ascends from the front end to the rear end. Thus, there is a sufficient space for configuring the gas cartridge (90) between the rear end of the base plate (29) and the rear end of the bottom portion (201) of the shell (21); however, the

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present invention is not limited to the example above.

[0087] Referring to FIG. 18 and FIG. 19, FIG. 18 shows an exploded diagram of the gas cartridge (90) configured at the bottom portion (201) of the wafer container (20'). FIG. 19 shows a section diagram of the gas cartridge (90) configured at the wafer container (20') of the present invention. The gas cartridge (90) consists of a bottom portion (91), a sidewall (92) extending from the bottom portion (91) and the bottom portion (201) of the shell (21). The bottom portion (91) and the sidewall (92) are fundamentally formed an elongated narrow housing of the gas cartridge (90). An elongated narrow groove (93) is formed on an outer side surface of the bottom portion (201) of the shell (21), and is configured to accommodate the elongated narrow housing formed by the bottom portion (91) and the sidewall (92). The elongated narrow groove (93) and the elongated housing define a buffering gas chamber (97) in between. Refer to FIG. 20 showing an enlarged partial section diagram of the gas cartridge (90) configured at the wafer container (20') of the present invention. The coupling structure (205) and the through hole (206) thereof are formed on an inner side surface of the bottom portion (201) of the shell (21), wherein the coupling structure (205) is located on an opposite side surface of the elongated narrow groove (93). The elongated narrow groove (93) communicates with the accommodating space of the wafer container (20') via the through channel (206) of each coupling structure (205). One or more positioning mechanisms (94) may be further provided in the elongated narrow groove (93) to position the accommodated elongated narrow housing. An elongated narrow sealing ring (95) is provided between a contact surface between the sidewall (92) and the elongated narrow

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groove (93), so as to achieve an annular sealing function.

[0088] A plurality of annular sidewalls (96) further extend from the lower surface of the bottom portion (91) of the gas cartridge (90), and without changing the number and positions of nozzles on the applied load port used in coordination with the wafer container (20'), are implemented by a pair of annular sidewalls (96) as an example in this embodiment. Each annular sidewall (96) defines an installation space for filling by a gas intake module (25), wherein the installation space may be a cylindrical space so as to match the structural form of the gas intake module (25). A gas intake channel (98) is formed at the bottom portion (91) of the gas cartridge (90), and the gas intake channel (98) communicates with the installation space.

[0089] The gas intake module (25) includes the elastic sleeve (251), the check valve (252), the filter membrane (253) and the sealing ring (255). The sealing ring (255) may be provided between the gas intake module (25) and the annular sidewall (96) so as to achieve airtightness, thus preventing gas leakage of the gas cartridge (90). Moreover, the elongated narrow housing of the gas cartridge (90) may be fixed to the bottom portion (201) of the shell (21) by a known connection means, for example, screw connection or other connections in any forms, which are to be encompassed within the scope of protection of the present invention.

[0090] It is known from above that, the buffering gas chamber (97) is defined between the elongated narrow groove (93) and the elongated narrow housing, and the buffering gas chamber (97) has an elongated narrow space and thus covers the two gas intake channels (98) formed at the bottom portion (91) of the gas cartridge (90), providing a

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function of a common buffering space of the two gas intake channels. In this embodiment, the two gas intake channels are configured with two coupling structures (205) and two porous tubes (27) in corresponding numbers as an example. It should be noted that, the numbers may be designed and adjusted in response to actual requirements, and the present invention does not define the numbers configured for the implementation forms. The gas intake channel (98) of the buffering gas chamber (97) fluid communicates with a gas passage of the gas intake module (25), and each coupling structure (205) defines the through channel (206) having a center axis and fluid communicating with the porous tube (27). The through channel (206) allows a gas to enter the longitudinal space of the porous tube (27), and the gas eventually purges the accommodating space from the longitudinal space.

[0091] In continuation of the description above, the gas intake module (25) supplies the gas in one single gas intake direction that passes through the gas intake channel (98) and enters the buffering gas chamber (97), and the buffering gas chamber (97) is capable of balancing air pressures of the two gas intake modules (25). In other words, in case of a difference in the pressures of the incoming gas, the gas can be diffused in the elongated narrow space of the buffering gas chamber (97) to achieve a balanced air pressure. Thus, the buffering gas chamber (97) provides the gas with a balanced air pressure that travels from the through channel (206) of each coupling structure (205), passes through the porous tube (27) and enters the accommodating space of the wafer container (20'). At this point, the gas diffusion performance of the porous tube (27) is consistent. Therefore, the present invention also resolves the numerous problems of an uneven airflow entering

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the interior of the container or an insufficient total flow caused by a difference in the incoming air of a conventional diffuser.

[0092] Advantages of provided by the structural design of the present invention are further described below. The bottom end (that is, the open end) of the porous tube (27) may be mounted to the coupling structure (205) through a collar (273, that is, the second collar). Moreover, another collar (275, that is, the first collar) may be further provided in the open end of the porous tube (27). The materials of the collars (273, 275) are softer than the material of the porous tube (27). With the protection component including the two collars (273, 275), the porous tube (27) is prevented from breaking of the open end caused by overly large stress during sleeving, and airtightness between the porous tube (27) and the coupling structure (205) can be further enhanced. In addition to a combined type, the collar (275) may also be attached by means of sintering or bonding to the open end of the porous tube (27), so as to achieve the object of protecting the open end. Other components included in the gas intake module (25), the coupling structure (205), the porous tube (27), the collars (273, 275), the gas cartridge (90) and/or the wafer container (20') are made of one or more thermal resistant materials. Preferably, the thermal resistant material is selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI, LCP, and a combination of at least two of the above.

[0093] Other variation embodiments of the wafer container (20') of the second embodiment are further described below. Refer to FIG. 21A to FIG. 21D showing schematic diagrams of configurations of a porous tube and a gas cartridge according to

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some embodiments. FIG. 21A shows the gas intake direction is a same center axis (C). The coupling structure (205) is formed as extending from the bottom portion (201) of the wafer container (20'). The open end (271) of the longitudinal space (272) of the porous tube (27) has a center axis, and the longitudinal space (272) has a center axis. The center axis of the through channel (206), the center axis of the open end (271) of the porous tube (27), the center axis of the longitudinal space (272) of the porous tube (27) and the gas intake center axis of the gas intake module (25) are coaxial, and are presented as the center axis (C). The gas has gas intake direction directed straight through along the same center axis (C) into the longitudinal space (272) of the porous tube (27), and purges the accommodating space in the wafer container (20').

[0094] FIG. 21B shows the gas intake direction is not a same center axis. Two gas intake channels (98) are formed at the bottom portion (91) of the gas cartridge (90) to serve as the function of a common buffering space of the two gas intake channels. Thus, although the gas intake direction is not the same center axis, the technical feature of a straight-through gas intake direction is also achieved, and the problems of the increased flow time and poor fluency due to the winding during the traveling process of the gas are not resulted. The center axis of the through channel (206), the center axis of the open end (271) of the porous tube (27) and the center axis of the longitudinal space (272) of the porous tube (27) are coaxial, and are presented as the center axis (C'). The gas intake center axis of the gas intake module (25) is presented as the center axis (C). The position of the center axis (C) along which the gas passes through is offset from the center axis (C'). Although under the offset configuration, the gas from the gas intake module (25)

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does not follow a straight line to enter the longitudinal space (272). However, before entering the porous tube (27), the gas is already diffused in the buffering gas chamber (97) and forms a more stable pressure, and this ensures consistent gas diffusion performance of the each porous tube (27).

[0095] In another embodiment, the gas intake direction is not a same center axis, as shown in FIG. 21C. Along with the increased demand of the amount of diffused airflow, a porous tube (27) with an increased amount of airflow is designed by increasing the size of the porous tube (27), with the increased part extending toward the inner walls (203) of the shell (21). The gas intake center axis of the gas intake module (25) is presented as the center axis (C). The center axis of the through channel (206) and the center axis of the open end (271) of the porous tube (27) are coaxial, and are presented as the center axis (C'). The center axis of the longitudinal space (272) of the porous tube (27) is presented as the center axis (C"). The two gas intake channels (98) are formed at the bottom portion (91) of the gas cartridge (90) to serve as the function of a common buffering space of the two gas intake channels. Thus, although the center axis (C), the center axis (C') and the center axis (C") are all offset, the traveling path of the gas is not increased, and the amount of airflow can be increased to enhance purging performance.

[0096] In another embodiment, the gas intake direction is not a same center axis. As shown in FIG. 21D, the size of the porous tube (27) is increased, and the increased part extends toward the inner walls (203) of the shell (21). The center axis of the through channel (206) and the center axis of the open end (271) of the porous tube (27) are coaxial, and are presented as the center axis (C). The center axis of the longitudinal space

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(272) of the porous tube (27) is presented as the center axis (C"), and the position of the center axis (C) along which the gas passes through is offset from the center axis (C"). Although under the offset configuration, before entering the longitudinal space (272) of the porous tube (27), the gas is already diffused in the buffering gas chamber (97) and forms a more stable pressure, and this ensures consistent gas diffusion performance of the each porous tube (27). Moreover, the amount of airflow is increased, so as to enhance the purge efficiency of the porous tube (27) with respect to the accommodating space in the wafer container (20').

[0097] FIG. 22 shows a porous tube (2227) according to another embodiment of the present invention and the shape of a longitudinal cross section along a parallel long axis direction (Y). The open end of the porous tube (2227) is detachably connected to the collar (275), so as to adhere the collar (275) on an inner side of the open end. As shown in the longitudinal cross section in the drawing, the inner side of the open end is provided with a shoulder (60) configured to combine the collar (275). The hardness of the collar (275) may be lower than the hardness of the porous tube (2227), so as to protect the structure of the open end. The collar (275) may be tapered so as to easily enter the open end. Alternatively, the collar (275) may be adhered to the inner side of the open end by a specific means, such as heating and sintering. Thus, the reinforced open end can be mounted on the coupling structure (205) to prevent breaking of the open end.

[0098] FIG. 23A and FIG. 23B show variation examples diffusion holes (slotted holes) of a porous tube. FIG. 23A shows that the longitudinal space of the porous tube has a horizontal cross section with a circular shape. The slotted hole (2300) is a space that

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diverges from the inside to the outside. FIG. 23B shows that an outer side of each slotted hole (2300) has a tapered space, and the slotted holes (2300) are all arranged between top-and-down adjacent wafers (W), allowing the diffused airflow (as indicated by the arrows) to flow smoothly between the wafers.

[0099] FIG. 24A and FIG. 24B show other variation examples of diffusion holes (slotted holes) of a porous tube. FIG. 24A shows that the longitudinal space of the porous tube has a horizontal cross section with an elongated narrow shape. The slotted hole (2400) is a space that diverges from the inside to the outside. FIG. 24B shows that an outer side of each slotted hole (2400) has a recessed space formed by a curved surface, and the slotted holes (2400) are all arranged between top-and-down adjacent wafers (W), allowing the diffused airflow (as indicated by the arrows) to flow smoothly between the wafers.

[0100] In conclusion of the above, in order to resolve the issues of a high temperature caused by fabrication processes during a carrying process of wafer in the prior art and hence a rise in the temperature of an interior space of a wafer container, such that performance of the overall wafer container and all components thereof are undesirably affected, the wafer container of the present invention and all the components thereof are made of thermal resistant materials; that is to say, all the elements disclosed by the present invention are to be encompassed within the scope of protection of the present invention.

[0101] Although certain details are used to describe the present invention as above for better understanding, it is to be understood that certain changes and modifications may be

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implemented within the scope of protection of the claims. Therefore, the embodiments above are intended for illustration purposes, and are not to be construed as limitations. Moreover, the present invention is not restrained by the details given in the description, and equivalent modifications made be made without departing from the field and spirit of the appended claims.

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CLAIMS

What is claimed is:

1. A gas diffusion device, comprising:

at least one porous tube, having a longitudinal space, the longitudinal space having a closed end and an open end; and

at least one collar, connected to the open end, configured to buffer a corresponding coupling structure on a bottom portion of a wafer container to which the porous tube is assembled so as to prevent breaking of the open end.

2. The gas diffusion device according to claim 1, wherein a shape of a horizontal cross section of the porous tube is an ellipsoid or an elongated narrow shape having a long axis and a short axis, or a circle having a diameter.

3. The gas diffusion device according to claim 1, wherein the coupling structure at the bottom portion defines a through channel which allows a gas to enter the longitudinal space.

4. The gas diffusion device according to claim 1, wherein the porous tube or the collar is made of a thermal resistant material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

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5. The gas diffusion device according to claim 3, wherein the through channel has a center axis which is located within the longitudinal space.

6. The gas diffusion device according to claim 1, wherein:

when the porous tube is assembled in the wafer container, one side surface of the porous tube faces a plurality of wafers in the wafer container, the side surface has a plurality of recesses formed thereon, and a level of each of the recesses is between those of two adjacent wafers in the wafer container.

7. The gas diffusion device according to claim 1, wherein the porous tube is formed by assembling a top cover, a tower and the open end that are detachable.

8. A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

a buffering gas chamber, configured at a bottom portion of the wafer container, the bottom portion provided with at least one coupling structure, the coupling structure defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and

at least one porous tube, having a longitudinal space, the porous tube installed to the coupling structure of the wafer container, the longitudinal space of

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the porous tube communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the porous tube and enter the accommodating space, a gas intake center axis of the gas and a center axis of the coupling structure being coaxial.

9. The gas diffusion device according to claim 8, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial.

10. The gas diffusion device according to claim 8, wherein the coupling structure is formed as extending from the bottom portion of the wafer container, an open end of the porous tube has a center axis, and the longitudinal space of the porous tube has a center axis; the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis are coaxial; the center axis of the longitudinal space of the porous tube is offset from the center axis of the coupling structure, the center axis of the open end of the porous tube and the gas intake center axis.

11. The gas diffusion device according to claim 8, wherein the longitudinal space of the porous tube has a closed end and an open end, and the open end receives the

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corresponding coupling structure, so that the gas enters the longitudinal space by passing through the buffering gas chamber and the open end.

12. The gas diffusion device according to claim 8, wherein a shape of a horizontal cross section of the porous tube is an ellipsoid or an elongated narrow shape having a long axis and a short axis, or a circle having a diameter.

13. The gas diffusion device according to claim 12, further comprising:

a first collar, arranged in the open end, the first collar located between the open end and the coupling structure.

14. The gas diffusion device according to claim 13, further comprising:

a second collar, located between the first collar and the coupling structure when the second collar is disposed on the coupling structure so as to reinforce airtightness.

15. The gas diffusion device according to claim 13, wherein a material of the first collar is softer than a material of the porous tube to prevent breaking of the open end.

16. The gas diffusion device according to claim 14, wherein the second collar and the porous tube are sintered or bonded into an integral to prevent breaking of the open

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end.

17. The gas diffusion device according to claim 15, wherein the coupling structure, the porous tube, the first collar and/or the second collar are/is made of a thermal resistant material which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

18. The gas diffusion device according to claim 8, further comprising:

an airflow guiding member, arranged adjacent to one side of the porous tube, the airflow guiding member configured to adjust an airflow direction of the gas entering the accommodating space.

19. The gas diffusion device according to claim 8, further comprising:

at least one gas intake module, communicatively coupled to the buffering gas chamber, the gas intake module having the gas intake center axis, supplying the gas in one single gas intake direction to pass through the gas intake channel and enter the buffering gas chamber.

20. A gas diffusion device, installed in a wafer container having an accommodating space, the gas diffusion device comprising:

a gas cartridge, configured at a bottom portion of the wafer container to

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define a buffering gas chamber, the bottom portion provided with at least two coupling structures, each of the coupling structures defining a through channel having a center axis, the buffering gas chamber having at least one gas intake channel, the gas intake channel, the buffering gas chamber, the through channel and the accommodating space communicating with one another; and

at least two porous tubes, each of the porous tubes having a longitudinal space, the at least two porous tubes respectively installed to corresponding coupling structures of the wafer container, the longitudinal spaces of the two porous tubes communicating with the buffering gas chamber, the buffering gas chamber providing a gas to pass through the at least two porous tubes and enter the accommodating space.

21. The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, the center axis of the longitudinal space of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial.

22. The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container,

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an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes and a gas intake center axis along which the gas passes are coaxial; the center axis of the longitudinal space of each of the porous tubes is offset from the center axis of the through channel, the center axis of the open end of the porous tube and the gas intake center axis.

23. The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of the longitudinal space of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tube has a center axis; the center axis of each of the through channels, the center axis of the open end of each of the porous tubes, and the center axis of the longitudinal space of each of the porous tubes are coaxial; a position of a gas intake center axis along which the gas passes is offset from the center axis of the through channel , the center axis of the open end and the center axis of the longitudinal space that are coaxial.

24. The gas diffusion device according to claim 20, wherein the at least two coupling structures are formed as extending from the bottom portion of the wafer container, an open end of each of the porous tubes has a center axis, and the longitudinal space of each of the porous tubes has a center axis; the center axis of each of the

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through channels and the center axis of the open end of each of the porous tubes are coaxial; a gas intake center axis along which the gas passes and the center axis of the longitudinal space are both offset from the center axis of the through channel and the center axis of the open end that are coaxial.

25. The gas diffusion device according to claim 20, wherein the gas cartridge has a bottom portion and a sidewall extending from the bottom portion, and the gas intake channel is formed at the bottom portion of the gas cartridge.

26. The gas diffusion device according to claim 20, wherein the gas cartridge is installed at the bottom portion of the wafer container, such that the bottom portion and the sidewall of the gas cartridge and the bottom portion of the wafer container define the buffering gas chamber.

27. The gas diffusion device according to claim 20, wherein a plurality of annular sidewalls further extend from a lower surface of the bottom portion of the gas cartridge, each of the annular sidewalls defines an installation space for filling with a gas intake module, and the gas intake module has the gas intake center axis; the installation space, the gas intake channel at the bottom portion of the gas cartridge and the buffering gas chamber communicate with one another, such that the gas in one single air intake direction supplied by the gas intake module passes through the gas intake channel and enters the buffering gas chamber.

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28. The gas diffusion device according to claim 20, wherein the wafer container comprises a base plate installed at the bottom portion of the wafer container, and the buffer gas chamber is between the bottom portion and the base plate of the wafer container.

29. The gas diffusion device according to claim 28, wherein the base plate is made of a material comprising a self-lubricating material.

30. A wafer container, comprising:

a shell, comprising a bottom portion, the bottom portion configured with a plurality of coupling structures, the coupling structures defining a plurality of through channels;

a buffering gas chamber, formed below the bottom portion, the buffering gas chamber having a plurality of gas intake channels, the gas intake channels communicating with the corresponding through channels; and

a plurality of porous tubes, each of the porous tubes having an open end, the open end correspondingly sleeved connecting with the coupling structure at the bottom portion and communicating with the buffering gas chamber via the corresponding through channel, allowing a gas to pass through the porous tubes and enter an accommodating space of the shell.

31. The wafer container according to claim 30, wherein the porous tube has a

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longitudinal space, the longitudinal space has a closed end and an open end, and the gas in the buffering gas chamber is capable of passing through the open end to enter the longitudinal space.

32. The wafer container according to claim 30, further comprising:

a collar, arranged between the open end and the coupling structure, a material of the collar being softer than a material of the porous tube to prevent breaking of the open end.

33. The wafer container according to claim 30, further comprising:

a gas cartridge, having a bottom portion and a sidewall extending from the bottom portion, the bottom portion of the gas cartridge having the gas intake channels formed thereon.

34. The wafer container according to claim 33, wherein the gas cartridge is installed at the bottom portion of the shell, such that the gas cartridge and the bottom portion of the shell define the buffering gas chamber.

35. The wafer container according to claim 33, wherein a plurality of annular sidewalls further extend from the bottom portion of the gas cartridge, and each of the annular sidewalls defines an installation space for filling with a gas intake module.

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36. The wafer container according to claim 30, wherein the wafer container further comprises a door detachably combined with the shell, and a pair of support portions configured on an inner side of the shell, and the wafer container is made of a thermal resistance material, which is one or a combination of at least two selected from a group consisting of PEEK, HTPC, FKM, PPS, PPO, chlorinated polyether, POB, TORLON, EP, PF, PEI, PI and LCP.

37. The wafer container according to claim 30, further comprising:

a base plate, connected below the shell to support the shell;

wherein the buffering gas chamber is between the bottom portion and the base plate of the shell.

38. The wafer container according to claim 37, wherein the base plate is made of a material comprising a self-lubricating material.

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ABSTRACT OF THE DISCLOSURE

The present invention provides a wafer container and a gas diffusion device applied in the wafer container. The wafer container includes a shell, and all components included and applied on the shell are made of thermal resistance materials. The gas diffusion device and the wafer container, when assembled together, utilize a coupling structure and a collar as a protection mechanism for the gas diffusion device. The gas diffusion device has a buffering chamber that provides a buffering tolerance and a communicating space for the gas before the gas enters an interior space of the wafer container.

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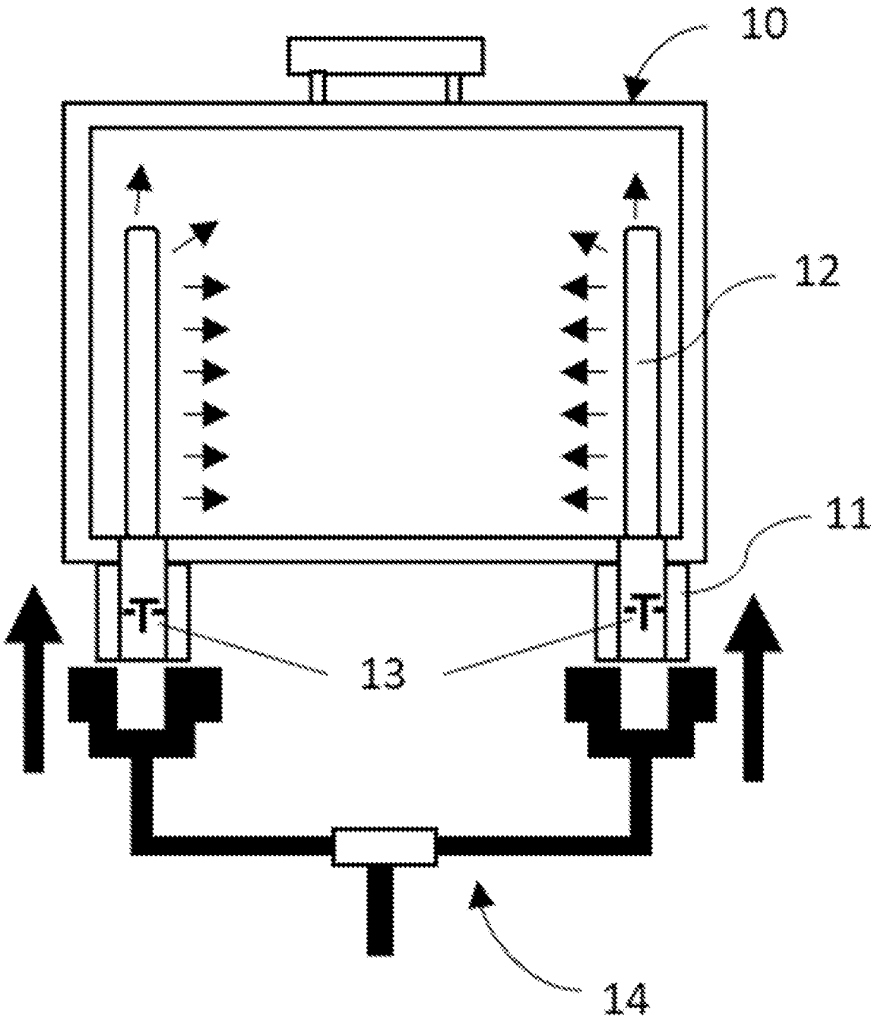


FIG.1

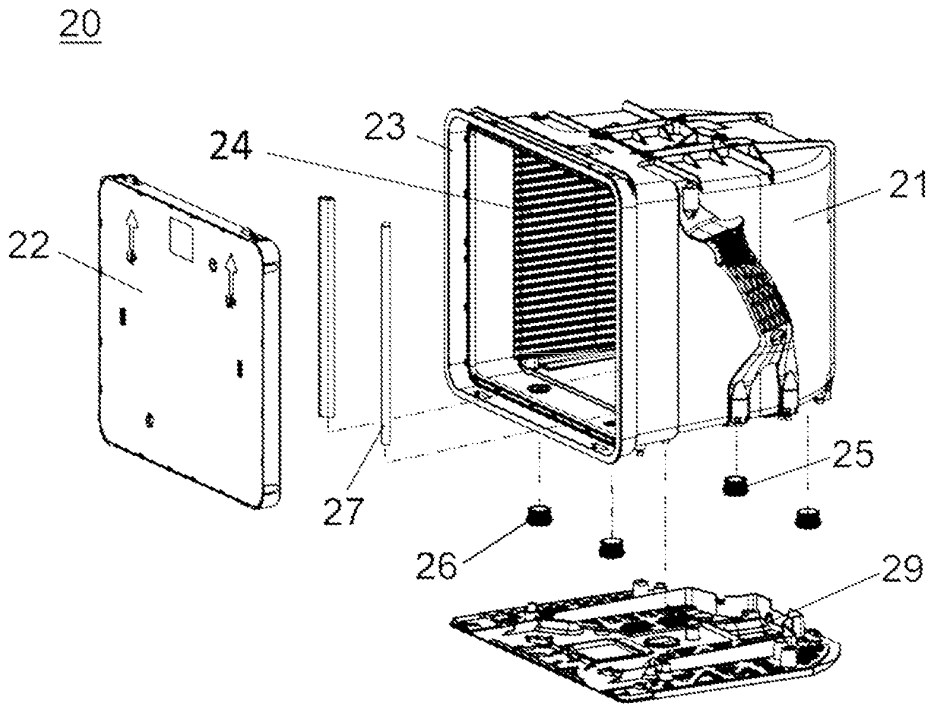


FIG.2

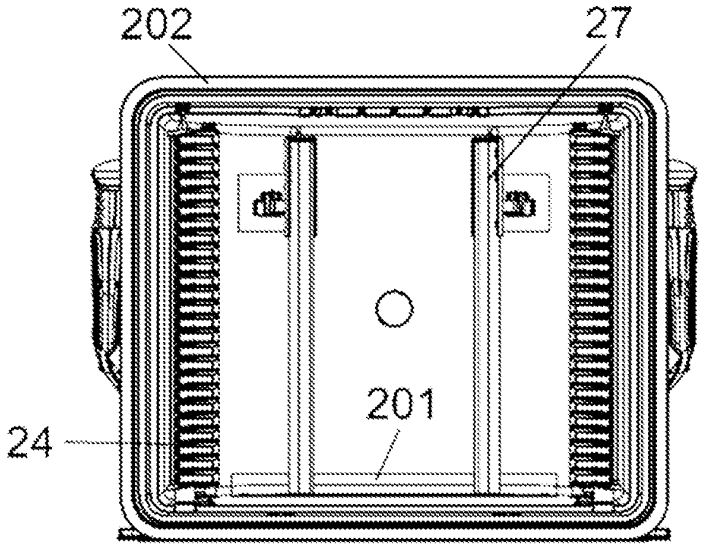


FIG.3

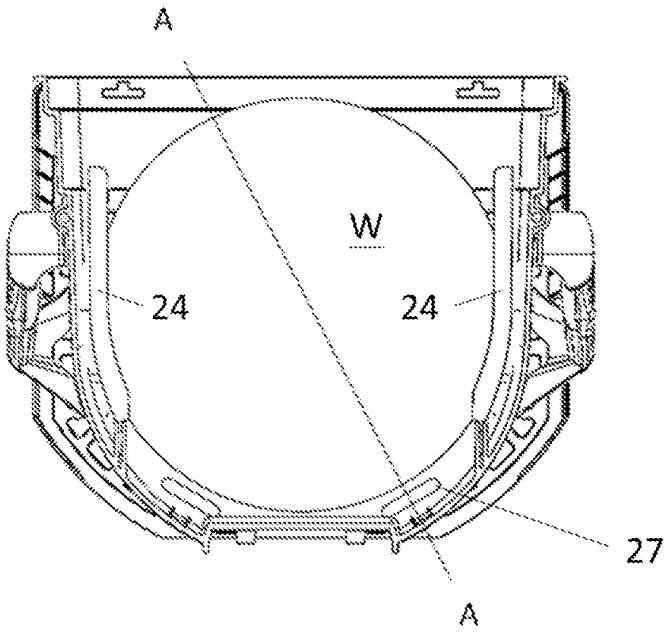


FIG.4

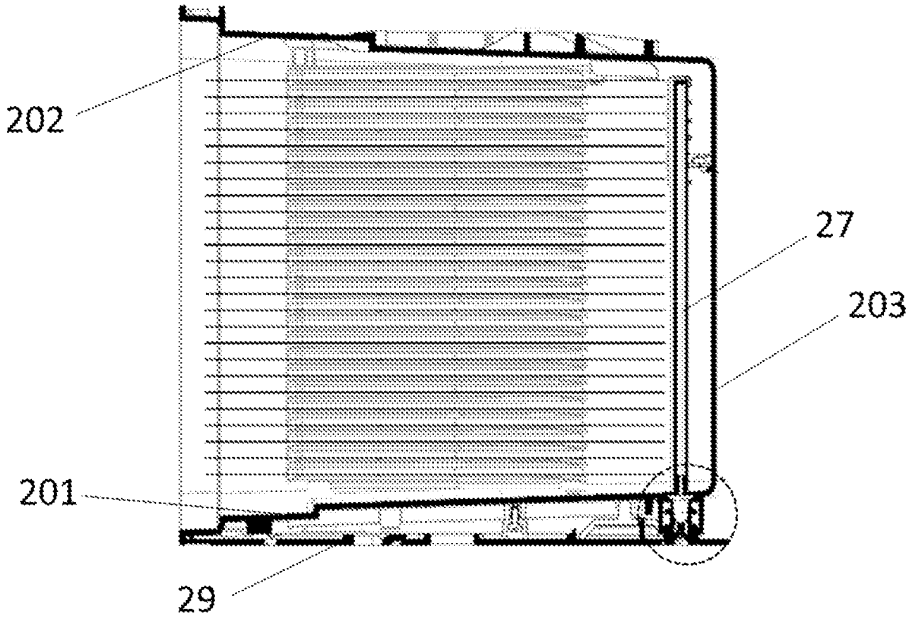


FIG.5

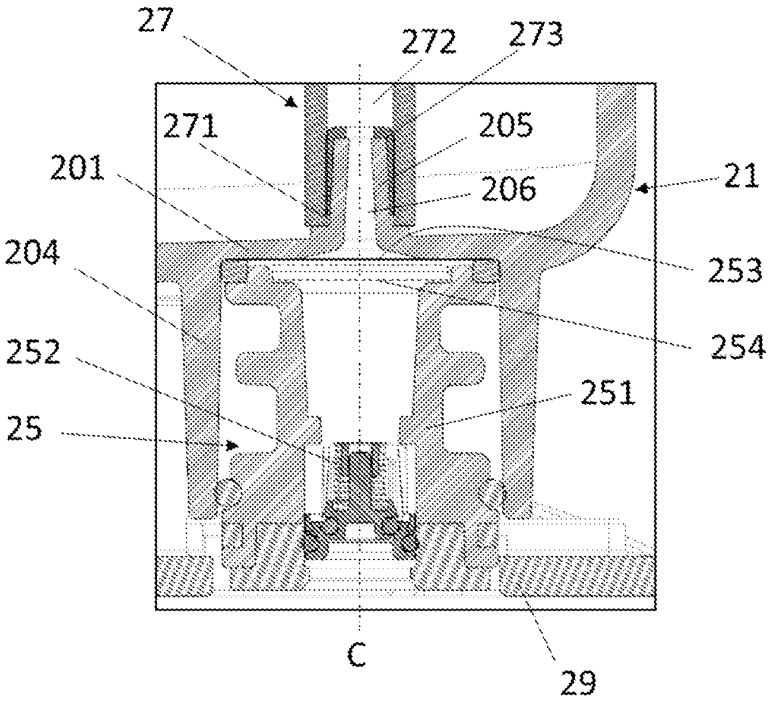


FIG.6

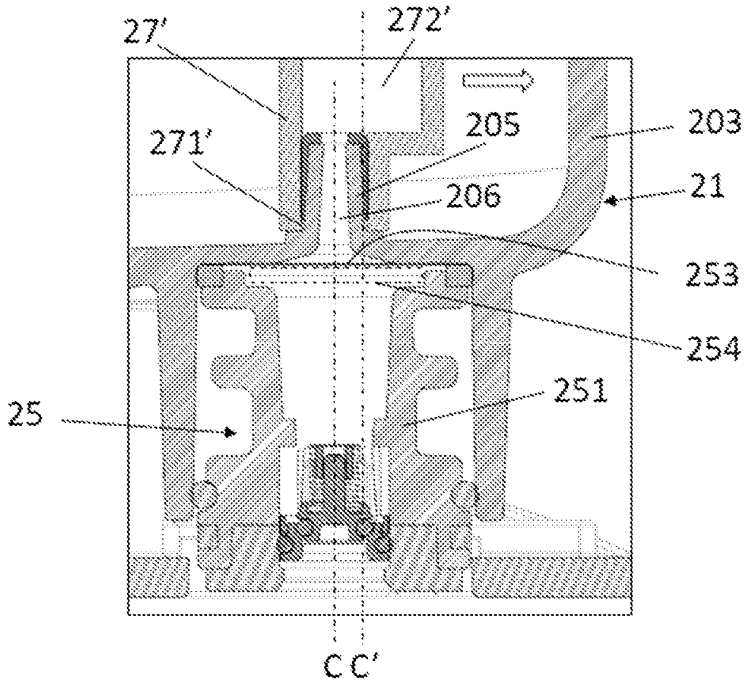


FIG.7

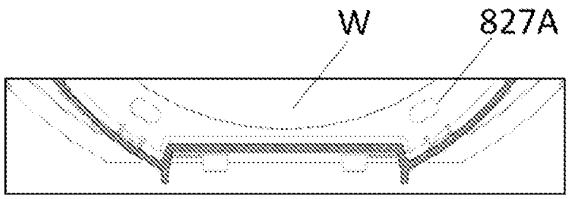


FIG.8A

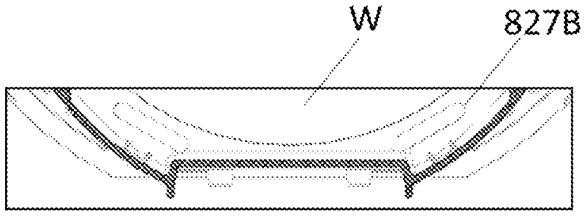


FIG.8B

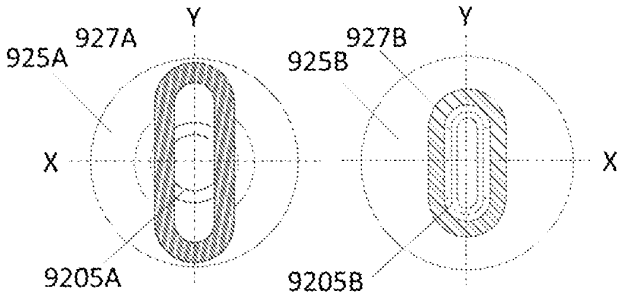


FIG.9A

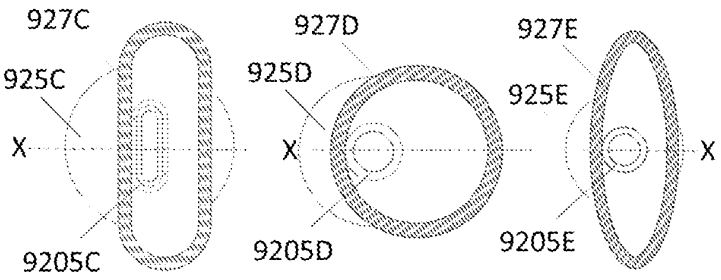


FIG.9B

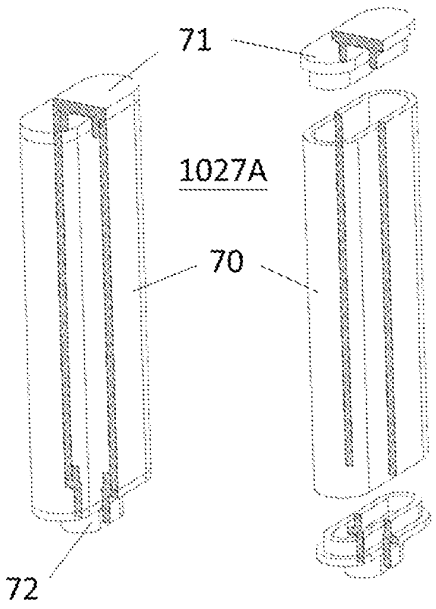


FIG.10A

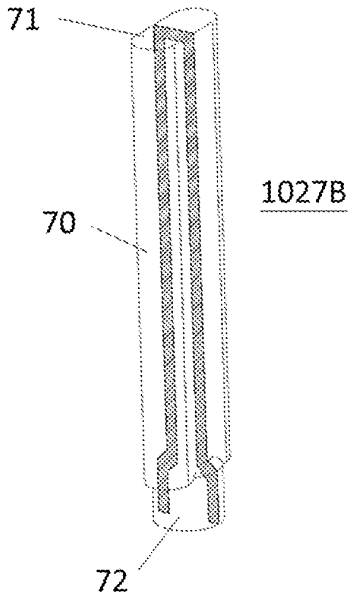


FIG.10B

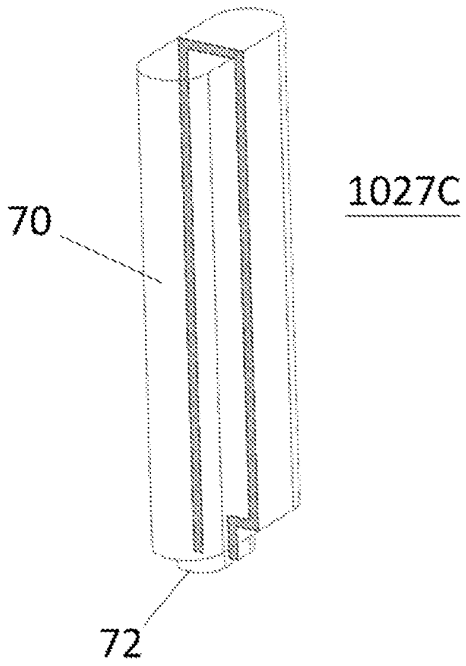


FIG.11A

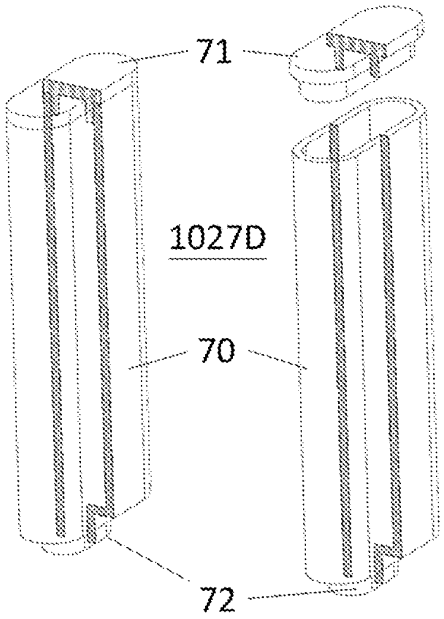


FIG.11B

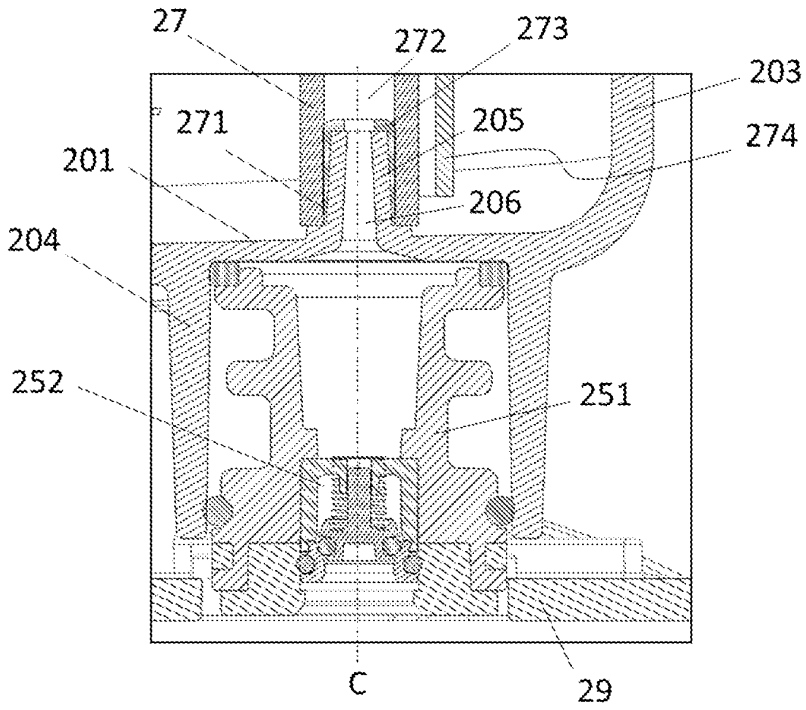


FIG.12A

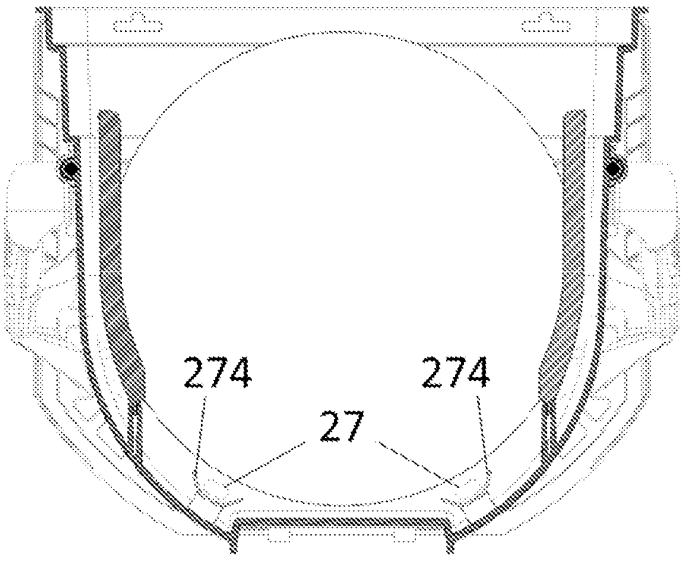


FIG.12B

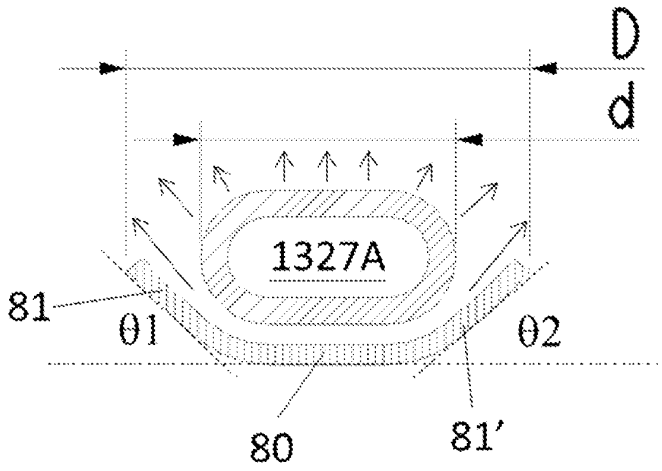


FIG.13A

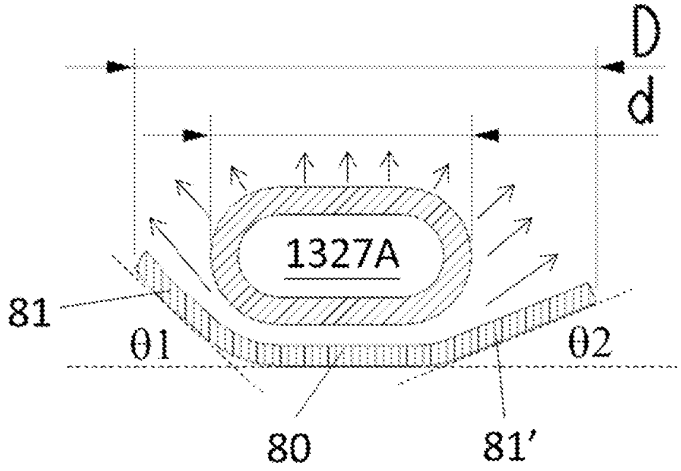


FIG.13B

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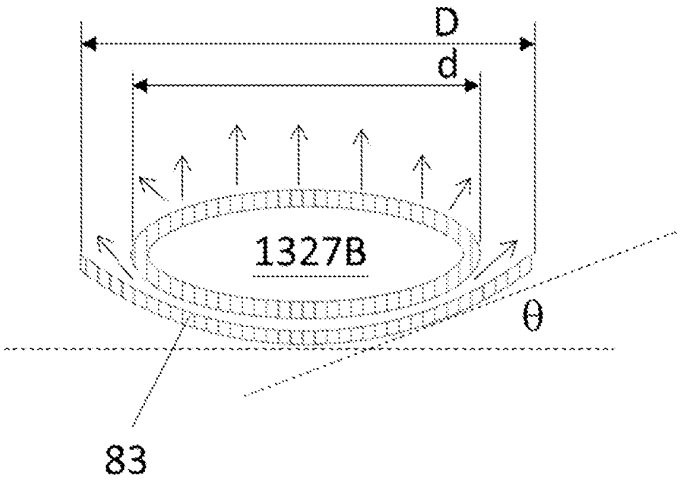


FIG.14A

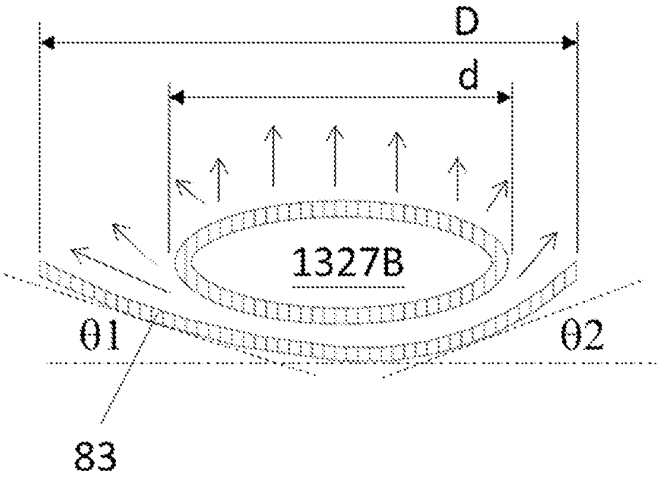


FIG.14B

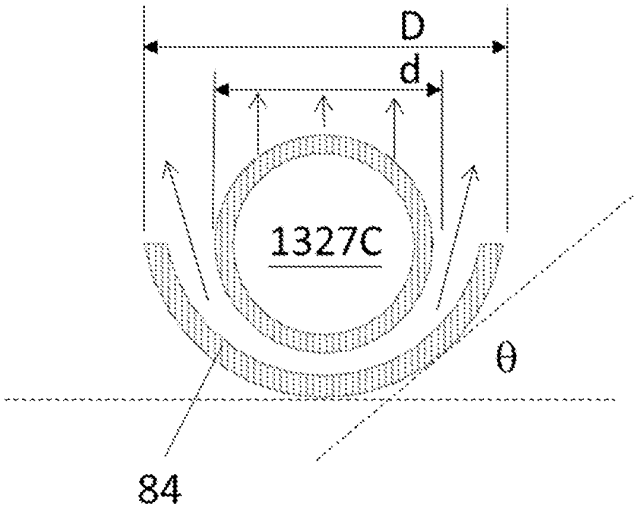


FIG.15A

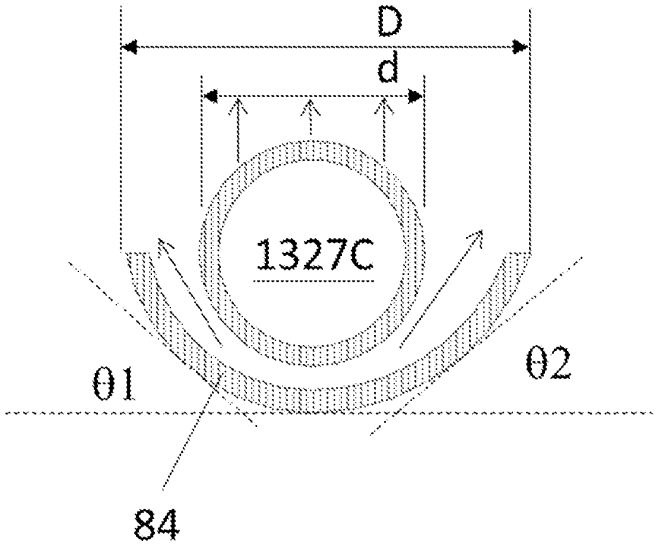


FIG.15B

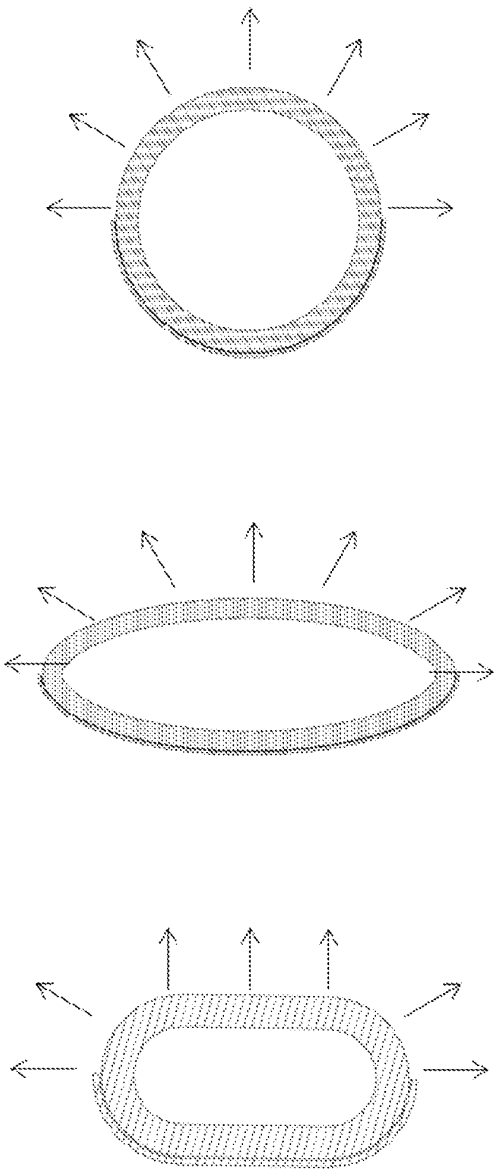


FIG.16

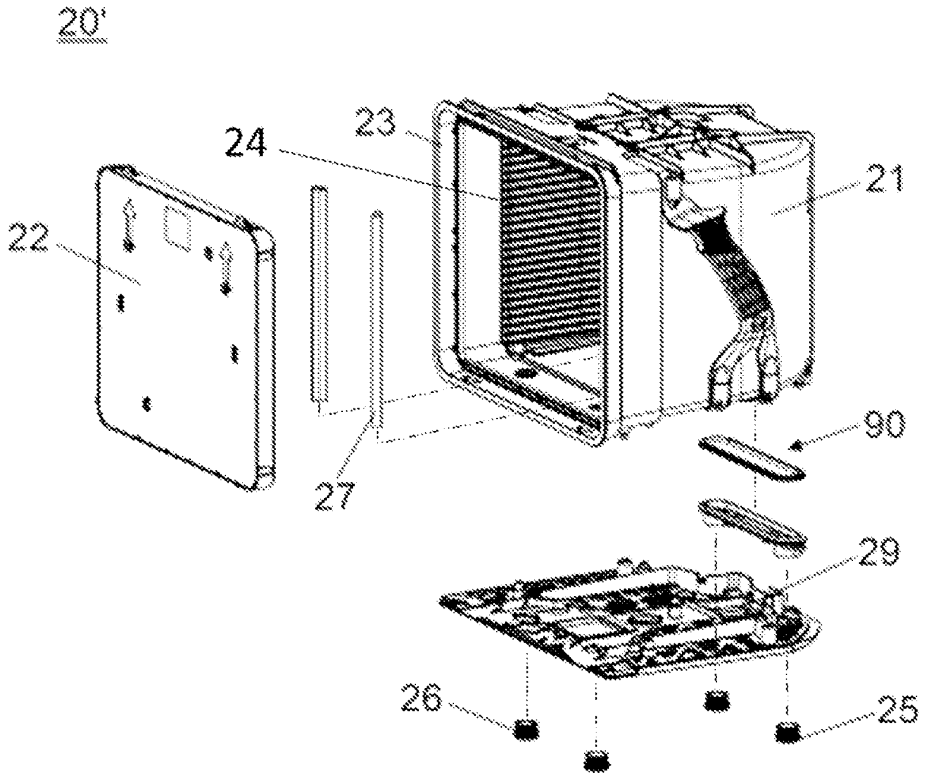


FIG.17

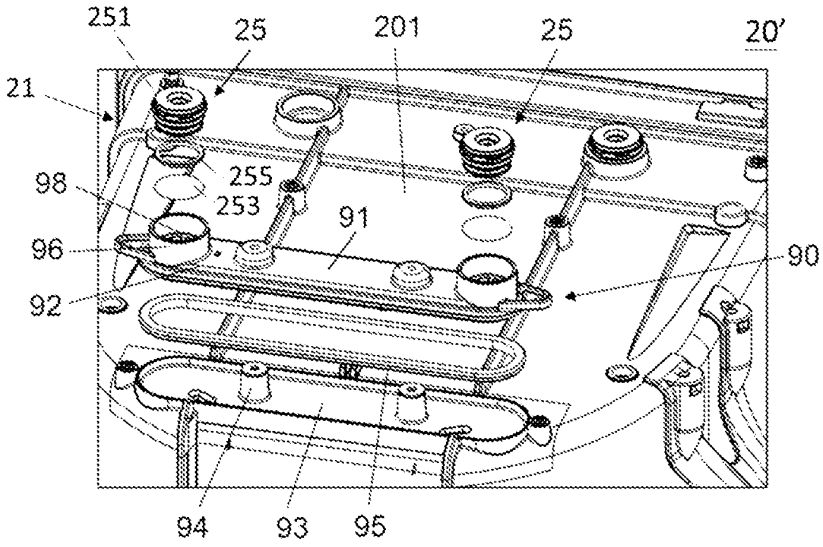


FIG.18

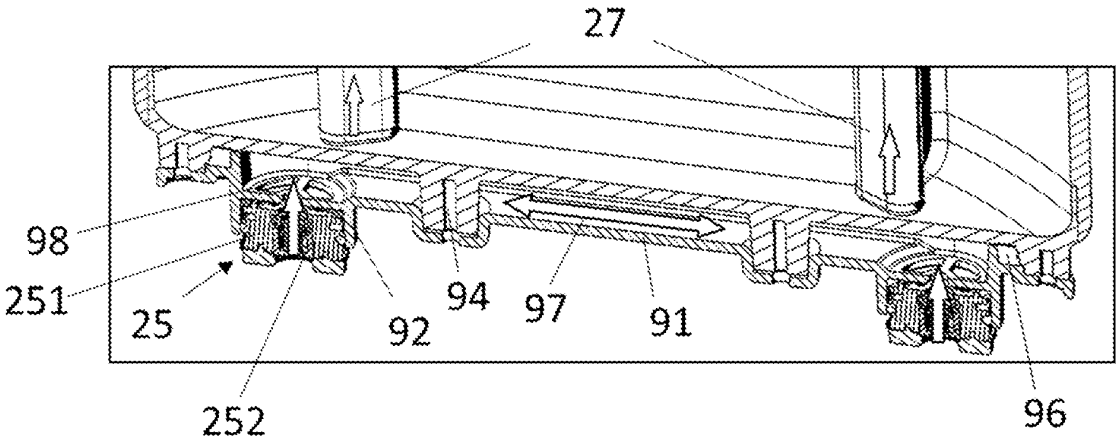


FIG.19

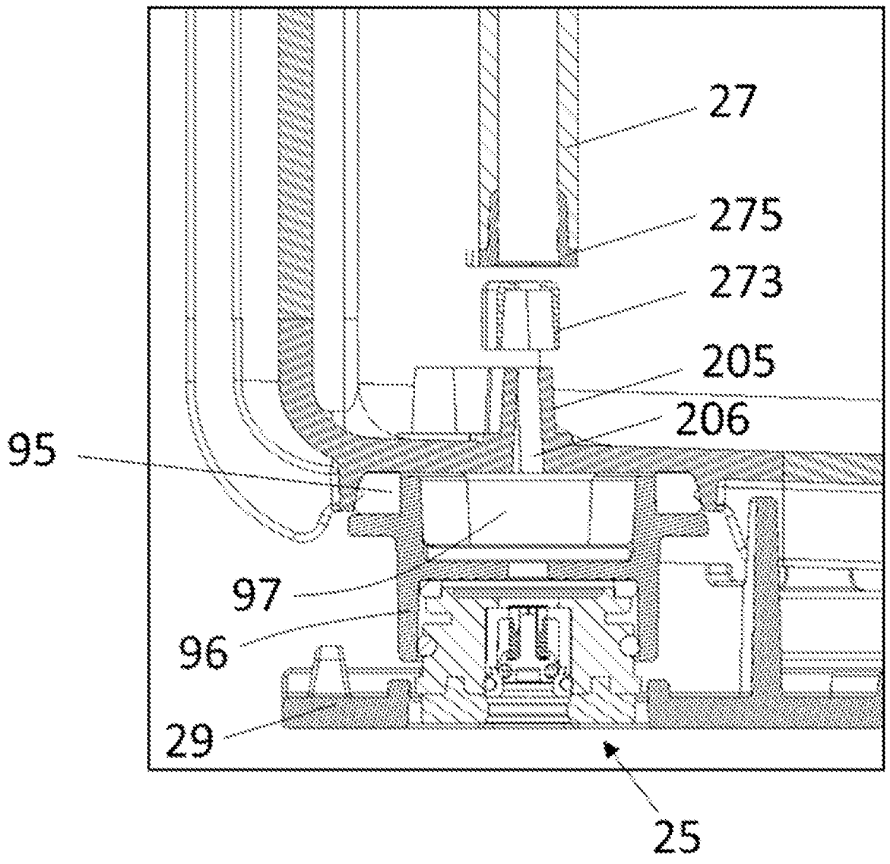


FIG.20

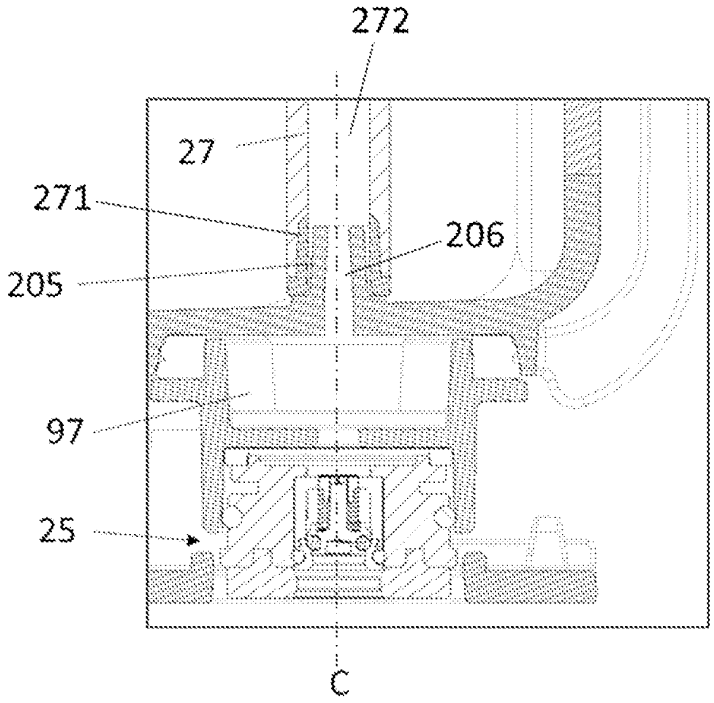


FIG.21A

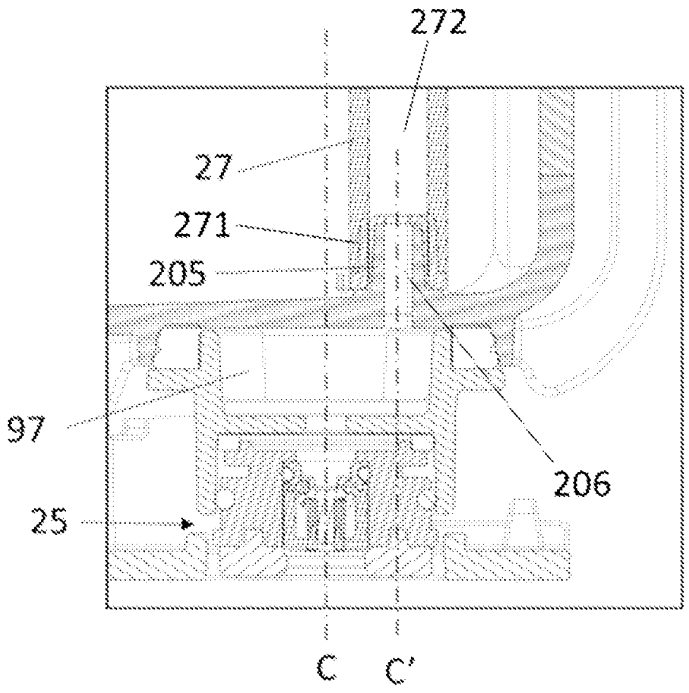


FIG.21B

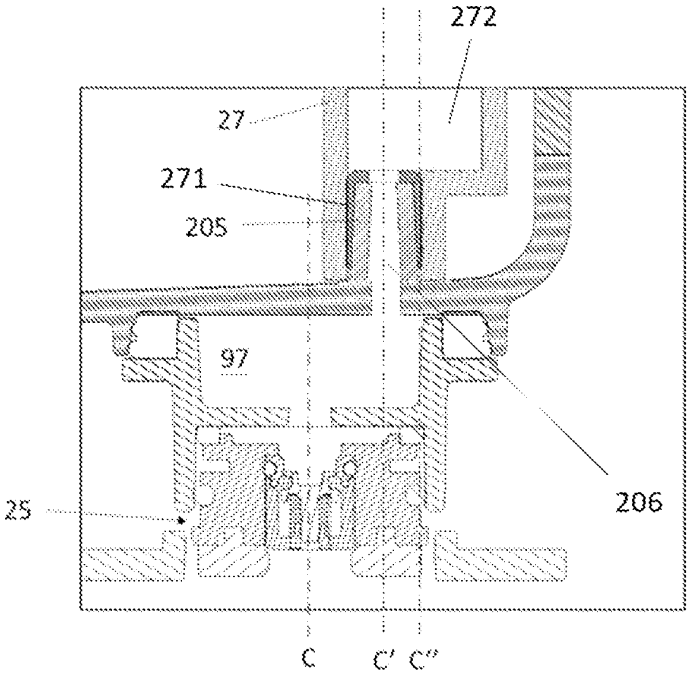


FIG.21C

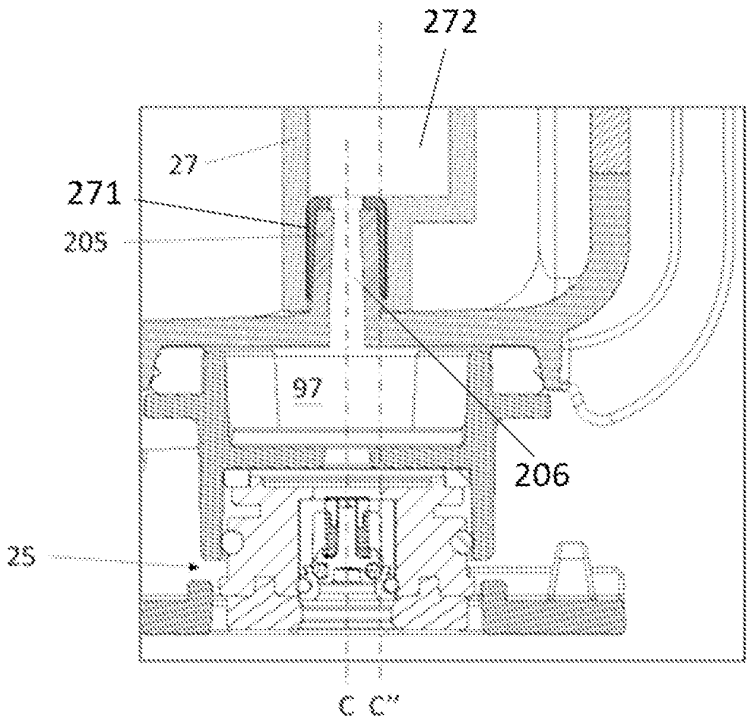


FIG.21D

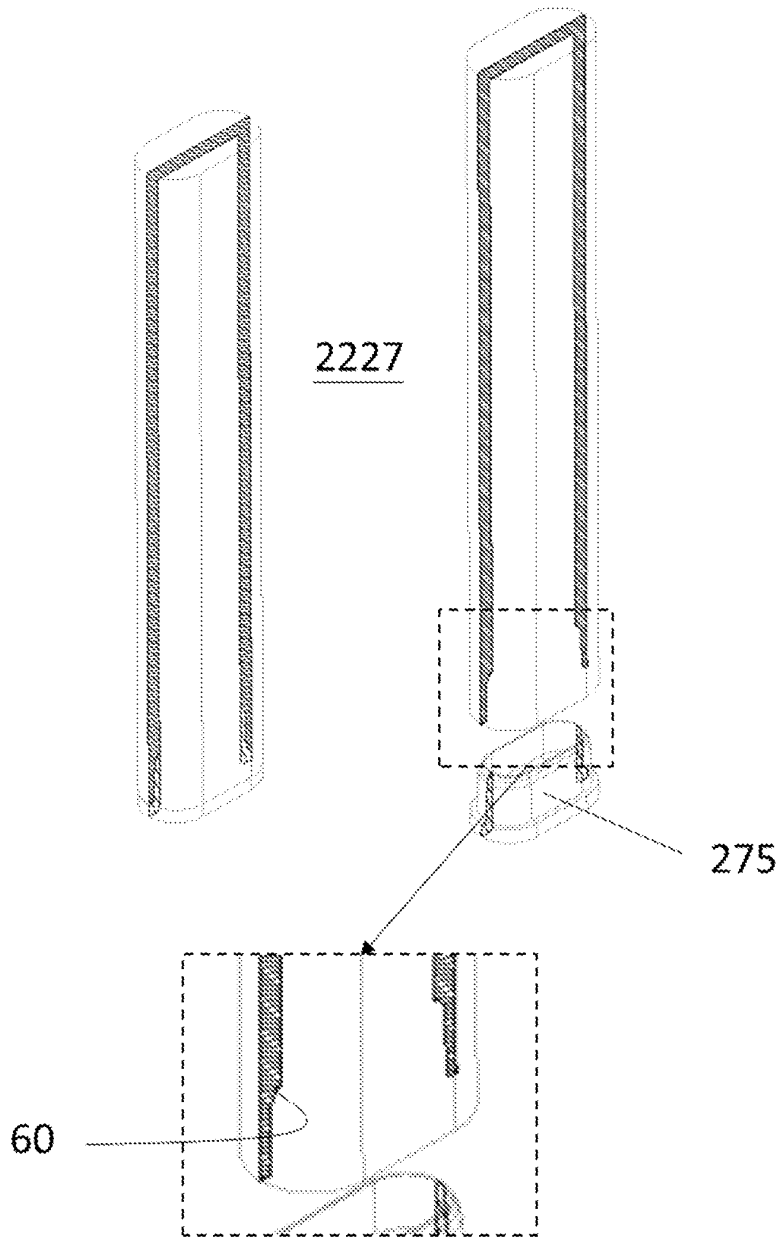


FIG.22

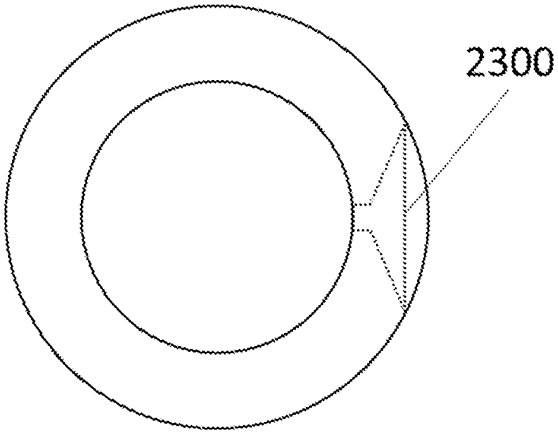


FIG.23A

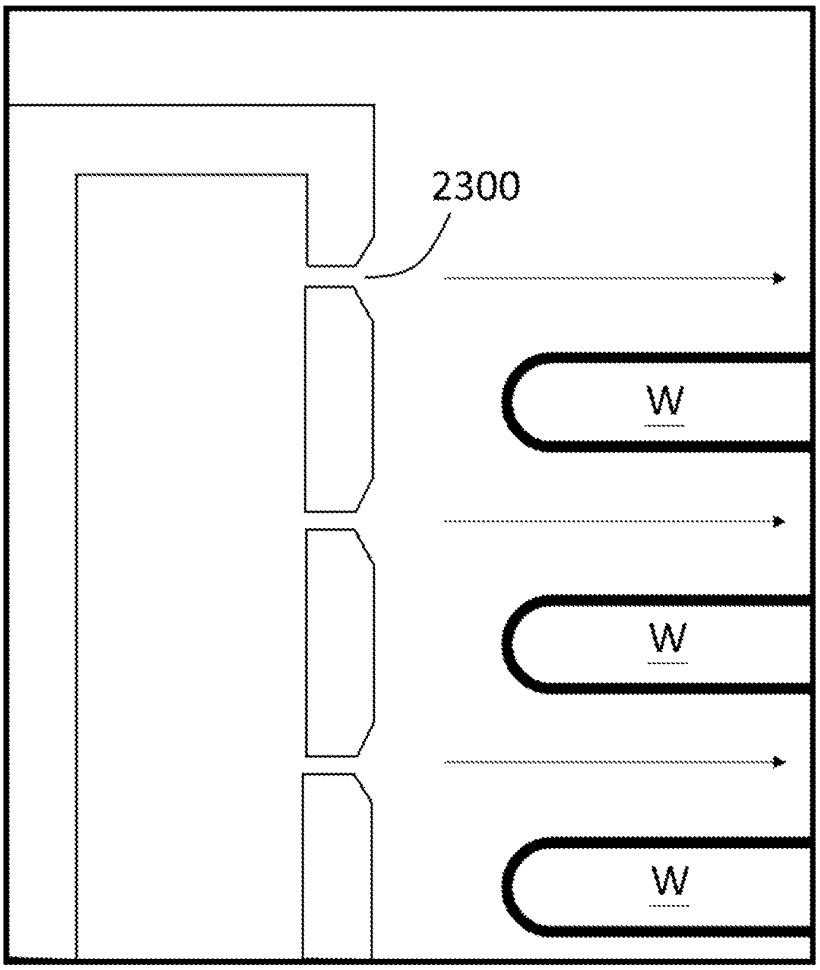


FIG.23B

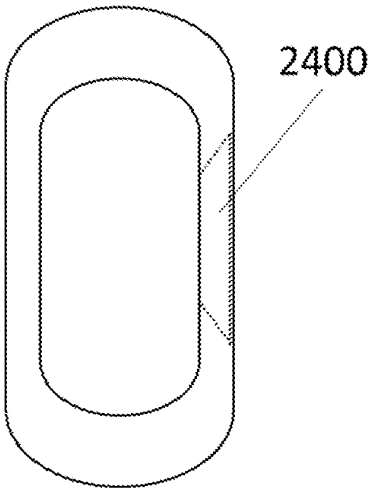


FIG.24A

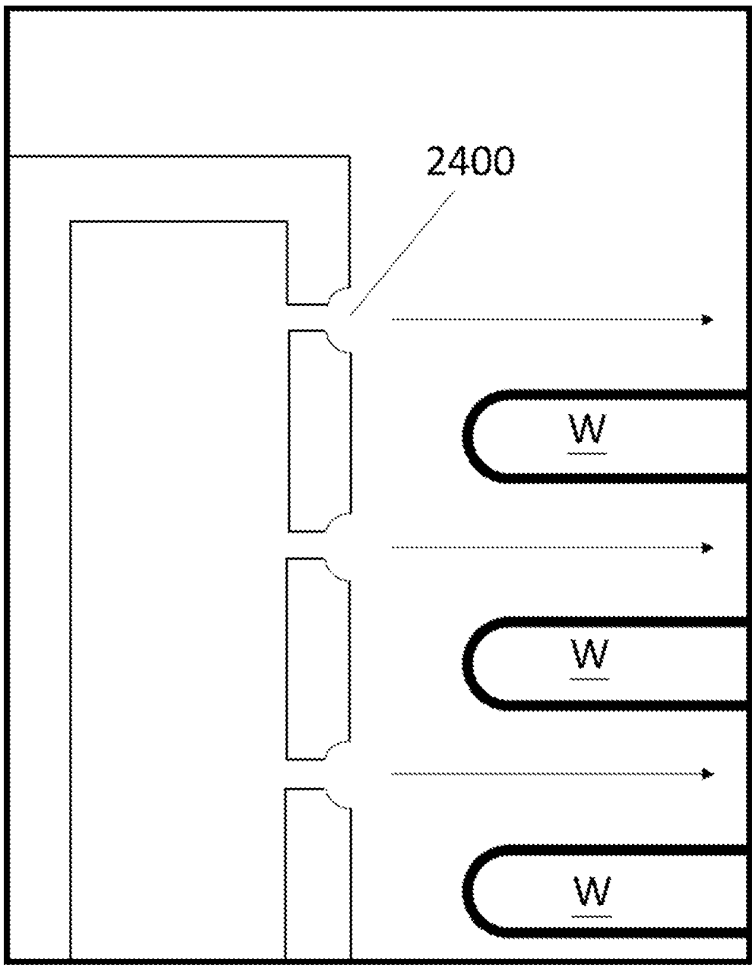


FIG.24B

Attorney Docket No. 0114970.255US2

LOCKE LORD LLP
3333 Piedmont Rd NE # 1200, Atlanta, GA 30305
Tel: (404) 870-4600

DECLARATION AND ASSIGNMENT FOR PATENT AND DESIGN APPLICATIONS

UNITED STATES PATENT RIGHTS, OR
UNITED STATES PLUS ALL FOREIGN PATENT RIGHTS

Title of Invention ⇨ **GAS DIFFUSION DEVICE, WAFER CONTAINER INCLUDING THE SAME AND METHOD FOR ASSEMBLING THE SAME**

As a below named inventor (hereinafter designated as the undersigned), I hereby declare that:

Application not Attached ⇨ This declaration is directed to the application attached hereto. If the application is not attached hereto, the application is as identified by the attorney docket number as set forth above and/or the following:

Enter Appln. No. ⇨ United States Application Number or PCT International Appln. No. _____

Enter Filing Date ⇨ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

WHEREAS, the undersigned has invented certain new and useful improvements described in the application identified.

Insert Name of Assignee ⇨ WHEREAS, **GUDENG PRECISION INDUSTRIAL CO., LTD.**

Insert Address of Assignee ⇨ of **9F.-5, No. 2, Sec. 4, Zhongyang Rd., Tucheng Dist., New Taipei City 236, Taiwan (R.O.C.)** ,

its heirs, successors, legal representatives and assigns (hereinafter designated as the Assignee) is desirous of acquiring the entire right, title and interest in and to said invention and in and to any Letters Patent(s) that may be granted therefor in the United States of America and

Check Box if Appropriate ⇨ ☐ **in any foreign countries.**

NOW, THEREFORE, for good and valuable consideration, the receipt of which is hereby acknowledged, the undersigned has sold, assigned and transferred, and by these presents does (do) sell, assign and transfer unto said Assignee the full and exclusive right to the said invention in the United States of America, its territories, dependencies and possessions and the entire right, title and interest in and to any and all Letters Patent(s) which may be granted therefor in the United States of America, its territories, dependencies and possessions, and if the box above is designated, in any and all foreign countries; and to any and all divisions, reissues, continuations, conversions and extensions thereof for the full term or terms for which the same may be granted.

Entegris, EX1002, p. 1341

The undersigned agrees to execute all papers necessary in connection with this application and any continuing, divisional, conversion or reissue applications thereof and also to execute separate assignments in connection with such applications as the Assignee may deem necessary or expedient.

The undersigned agrees to execute all papers necessary in connection with any interference which may be declared concerning this application or continuation, division, conversion or reissue thereof or Letters Patent(s) or reissue patent issued thereon and to cooperate with the Assignee in every way possible in obtaining and producing evidence and proceeding with such interference.

The undersigned agrees to execute all papers and documents and to perform any act which may be necessary in connection with claims or provisions of the International Convention for the Protection of Industrial Property or similar agreements.

The undersigned agrees to perform all affirmative acts which may be necessary to obtain a grant of (a) valid United States of America patent(s) or a grant of (a) valid United States of America and any foreign patent(s) to the Assignee and to vest all rights therein hereby conveyed to said Assignee as fully and entirely as the same would have been held by the undersigned if this Assignment and sale had not been made.

The undersigned hereby authorizes and requests the Patent and Trademark Office Officials in the United States of America and in any foreign countries to issue any and all Letters Patent(s) resulting from said application or any continuing, divisional conversion or reissue applications thereof to the said Assignee, as Assignee of the entire interest, and hereby covenants that he has the full right to convey the entire interest herein assigned, and that he has not executed, and will not execute, any agreement in conflict herewith.

The undersigned hereby grants the law firm of Locke Lord LLP the power to insert any further identification which may be necessary or desirable in order to comply with the rules of the U.S. Patent and Trademark Office.

The undersigned hereby covenants that no assignment, sale, agreement or encumbrance has been or will be made or entered into which would conflict with this assignment.

The undersigned hereby acknowledges that any willful false statement made in this declaration is punishable under 18 U.S.C. § 1001 by fine or imprisonment of not more than five (5) years, or both.

In witness whereof, executed by the undersigned on the date opposite the undersigned name.

LEGAL NAME OF INVENTOR

Inventor's Name ⇨ Inventor: Ming-Chien CHIU Date: 2022/08/02

Inventor's Signature ⇨ Signature:

An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use a separate form for each inventor or check the box below and complete the attached page(s) to list additional inventors.

☑ Additional inventors are being named on the 1 supplemental sheet(s) attached hereto.

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Attorney Docket No. 0114970.255US2

SUPPLEMENTAL SHEET FOR DECLARATION AND ASSIGNMENT

ADDITIONAL INVENTOR(S)
Supplemental Sheet Page 1 of 1

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Chia-Ho Chuang Date: 2022/08/02

Inventor's Signature ⇨ Signature: Chia-Ho Chuang

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Kuo-Hua Lee Date: 2022/08/02

Inventor's Signature ⇨ Signature: Kuo-Hua Lee

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Shu-Hung Lin Date: 2022/08/02

Inventor's Signature ⇨ Signature: Shu-Hung Lin

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Hao-Kang HSIA Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

LEGAL NAME OF JOINT INVENTOR, IF ANY

Inventor's Name ⇨ Inventor: Date:

Inventor's Signature ⇨ Signature:

Doc code: Oath
Document Description: Oath or declaration filed

PTO/AIA/02 (07-13)
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SUBSTITUTE STATEMENT IN LIEU OF AN OATH OR DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (35 U.S.C. 115(d) AND 37 CFR 1.64)

Title of Invention	GAS DIFFUSION DEVICE, WAFER CONTAINER INCLUDING THE SAME AND METHOD FOR ASSEMBLING THE SAME

This statement is directed to:

☐ The attached application,

OR

☒ United States application or PCT international application number _____ filed on _____.

LEGAL NAME of inventor to whom this substitute statement applies:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

HAO-KANG HSIA

Residence (except for a deceased or legally incapacitated inventor):

City	State	Country
TAIPEI		TW

Mailing Address (except for a deceased or legally incapacitated inventor):

9F.-5, No. 2, Sec. 4, Zhongyang Rd., Tucheng Dist., New Taipei City 236, Taiwan (R.O.C.)

City	State	Zip	Country
TAIPEI			TW

I believe the above-named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application.

The above-identified application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this statement is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Relationship to the inventor to whom this substitute statement applies:

☐ Legal Representative (for deceased or legally incapacitated inventor only),

☐ Assignee,

☐ Person to whom the inventor is under an obligation to assign,

☐ Person who otherwise shows a sufficient proprietary interest in the matter (petition under 37 CFR 1.46 is required), or

☒ Joint Inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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SUBSTITUTE STATEMENT

Circumstances permitting execution of this substitute statement:

- ☐ Inventor is deceased.
- ☐ Inventor is under legal incapacity.
- ☒ Inventor cannot be found or reached after diligent effort, or
- ☐ Inventor has refused to execute the oath or declaration under 37 CFR 1.63.

If there are joint inventors, please check the appropriate box below:

- ☒ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) naming the entire inventive entity has been or is currently submitted.

OR

- ☐ An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) has not been submitted. Thus, a Substitute Statement Supplemental Sheet (PTO/AIA/11 or equivalent) naming the entire inventive entity and providing inventor information is attached. See 37 CFR 1.64(b).

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

Name: Chia-Wei Chen	Date (Optional): 2021/8/12

Signature: Chia-Wei Chen

APPLICANT NAME AND TITLE OF PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

If the applicant is a juristic entity, list the applicant name and the title of the signer:

Applicant Name: GUDENG PRECISION INDUSTRIAL CO., LTD.

Title of Person Executing This Substitute Statement: Patent Engineer

The signer, whose title is supplied above, is authorized to act on behalf of the applicant.

Residence of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent):

City TAIPEI	State	Country TW

Mailing Address of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent)

No. 900 Shuijia, Hunnan Industrial Zone, Shenyang, China

City TAIPEI	State	Zip	Country TW

Note: Use an additional PTO/AIA/02 form for each inventor who is deceased, legally incapacitated, cannot be found or reached after diligent effort, or has refused to execute the oath or declaration under 37 CFR 1.63.

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