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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	02/15/2022	11246951	17-093-EN	4718

32118 7590 01/26/2022

LAMBERT SHORTELL & CONNAUGHTON
100 Franklin Street
Suite 903
BOSTON, MA 02110

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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 11 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 Application Information Retrieval (PAIR) WEB site (http://pair.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 Data Management (ODM) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

S. Edward Neister, Dover, NH;

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

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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Office of the Chief Financial Officer

Document Code:WFEE

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Sale Accounting Date:01/05/2022

Sale Item Reference Number	Effective Date
15645480	01/04/2022

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I202215834403105	2501	UTILITY APPL ISSUE FEE	$600.00	Salea

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Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION:

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	Small	$600	$0	$600	$0	3/24/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS

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/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form 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 Lambert Shortell & Connaughton
2 David J. Connaughton, Jr.
3 Justin P. Tinger

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

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(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. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

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❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /David J. Connaughton, Jr./ Date 1/4/2022

Typed or printed name David J. Connaughton, Jr. Registration No. 67275

This collection of information 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 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, 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.

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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 disclosure of these records is required by the Freedom of Information Act.
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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 inspection 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:	44665657
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	04-JAN-2022
Filing Date:	10-JUL-2017
Time Stamp:	16:28:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

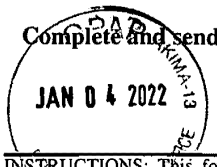
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	Issue_Fee_Transmittal_Form-Neister-17-093-EN-1-4-22.pdf	74006 a97fd6f98800ccfdcb82529cab611fb13b33a10e	no	2
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Total Files Size (in bytes):	74006

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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.
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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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(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION:

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	Small	$600	$0	$600	$0	3/24/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS

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/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form 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 Lambert Shortell & Connaughton
2 David J. Connaughton, Jr.
3 Justin P. Tinger

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 has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

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

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

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /David J. Connaughton, Jr./ Date 1/4/2022

Typed or printed name David J. Connaughton, Jr. Registration No. 67275

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NOTICE OF ALLOWANCE AND FEE(S) DUE

32118 7590 12/24/2021

LAMBERT SHORTELL & CONNAUGHTON
100 Franklin Street
Suite 903
BOSTON, MA 02110

EXAMINER
YOO, REGINA M

ART UNIT	PAPER NUMBER
1799	

DATE MAILED: 12/24/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$600.00	$0	03/24/2022

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 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity 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.

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32118 7590 12/24/2021
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(Typed or printed name)
(Signature)
(Date)

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APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$600.00	$0	03/24/2022

EXAMINER	ART UNIT	CLASS-SUBCLASS
YOO, REGINA M	1799	422-121000

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

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1 _____
2 _____
3 _____

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

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(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) ❑Advance Order - # of Copies _____

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

❑ Electronic Payment via EFS-Web ❑ 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

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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.
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.
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. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 12/24/2021

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EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

DATE MAILED: 12/24/2021

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. 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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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.

Notice of Allowability	Application No. 15/645,480	Applicant(s) Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	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 amendment and affadavit/declaration under rule 131 filed 9/09/2021.
   ☐ 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 1,3,6-8,10,12-13,22-23 and 28-35 . 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 9/3/21, 9/9/21, 9/30/21.
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 _____.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of Pre-AIA or AIA Status

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

REASONS FOR ALLOWANCE

2. The following is an examiner's statement of reasons for allowance: the primary reason for allowance of the claims is due to filing and acceptance of the declaration under 37 C.F.R. 1.131 on 9/09/2021 which overcomes the prior art rejection (incorrectly indicated to be under 35 U.S.C. 102(a)(1) in the Office Action mailed 6/10/2021, but is more appropriate and correct under 35 U.S.C. 102(e) as the priority goes back to the provisional appl. no. 60/593,626 filed 1/31/2005) in view of Ressler (20050173652). See also examiner's statement of reasons for allowance in paragraph 3 on pp. 2-3 of Notice of Allowance mailed 3/22/2021.

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."

Conclusion

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. 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.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

CPC						
Symbol					**Type**	**Version**
A61L	/	2	/	0047	F	2013-01-01
A23B	/	7	/	015	I	2013-01-01
A23L	/	3	/	26	I	2013-01-01
A23L	/	3	/	28	I	2013-01-01
A61L	/	2	/	0011	I	2013-01-01
A61L	/	2	/	10	I	2013-01-01
A61N	/	5	/	0624	I	2013-01-01
B08B	/	17	/	00	I	2013-01-01
A61L	/	9	/	20	I	2013-01-01
A61N	/	2005	/	0661	A	2013-01-01
A61L	/	2202	/	22	A	2013-01-01
A61N	/	2005	/	063	A	2013-01-01
A61N	/	2005	/	0654	A	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	10 December 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20211210

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

INTERNATIONAL CLASSIFICATION					
CLAIMED					
A61L	/	2	/	00	

NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	10 December 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

☐ 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
1	1	6	10		19	12	28								
	2		11		20	13	29								
2	3	7	12		21	14	30								
	4	9	13	10	22	15	31								
	5		14	11	23	16	32								
3	6		15		24	17	33								
4	7		16		25	18	34								
5	8		17		26	8	35								
	9		18		27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	10 December 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20211210

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	RY
A23L3/26, 3/28	02/25/2019	RY
A23B7/015	02/25/2019	RY
B08B17/00	02/25/2019	RY
A61N5/0624	02/25/2019	RY

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* 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**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

consulted related case 14/254,957, 11/831,667	11/23/2019	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	04/22/2020	RY
EAST and PALM - Inventor Search	04/19/2020	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	04/20/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	06/05/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S25, S30, S32)	11/11/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S3,S35-S58;S73-S88)	03/13/2021	RY
EAST and PALM - Inventor Search (S5-S8,S10)	03/13/2021	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout (S14-S23, S25,S27,S29-S30,S33-S34;S60-S64,S67-S72)	03/13/2021	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S3,S5-S16,S18)	06/05/2021	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S25,S33-S37,S39-S45,S48-S49; S63-S76)	12/10/2021	RY
EAST and PALM - Inventor Search (S27-S28)	12/10/2021	RY
A61L2/0047, 2/0011, 2/10, 9/20,2202/22; A23L3/26, 3/28; A23B7/015 ; B08B17/00; A61N5/0624,2005/063, 2005/0654, 2005/0661 - see Search History Printout (S53-S59,S61-S62,S78; S80-S89)	12/10/2021	RY

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A61L	2/0047, 2/0011, 2/10, 9/20	04/22/2020	RY
A23L	3/26, 3/28	04/22/2020	RY
A23B	7/015	04/22/2020	RY
B08B	17/00	04/22/2020	RY
A61N	5/0624	04/22/2020	RY
UPDATED	SEARCH		
A61L	2/0047, 2/0011, 2/10, 9/20	03/13/2021	RY
A23L	3/26, 3/28	03/13/2021	RY
A23B	7/015	03/13/2021	RY
B08B	17/00	03/13/2021	RY
A61N	5/0624	03/13/2021	RY
UPDATED	SEARCH		
A61L	2/0047, 2/0011, 2/10, 9/20,2202/22	12/10/2021	RY
A23L	3/26, 3/28	12/10/2021	RY
A23B	7/015	12/10/2021	RY
B08B	17/00	12/10/2021	RY
A61N	5/0624, 2005/063, 2005/0654, 2005/0661	12/10/2021	RY

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	15645480
Filing Date	2017-07-10
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

U.S.PATENTS Remove

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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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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							

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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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

	1	VON SONNTAG, Disinfection by free radicals and UV-radiation, WATER SUPPLY 4 (1986)
/R.M.Y/	2	GATES, F. L., A Study of the bactericidal action of ultra violet light, J. GEN. PHYSIOLOGY 14 (1930)

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

EXAMINER SIGNATURE

Examiner Signature	/REGINA M YOO/	Date Considered	11/26/2021

*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	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-08-30
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	1	("20100028201").PN.	US-PGPUB; USPAT	OR	OFF	2021/12/09 13:31
S2	1	S1 and (human or animal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 13:31
S3	1	("20140227132").PN.	US-PGPUB; USPAT	OR	OFF	2021/12/09 14:18
S4	1	S3 and (human or animal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 14:19
S5	1	("20180353629").PN.	US-PGPUB; USPAT	OR	OFF	2021/12/09 16:01
S6	1	S5 and (human or animal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 16:01
S7	1	S5 and (human or animal) and skin	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 16:05
S8	1	S5 and skin	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 16:06

S9	1	S5 and living	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 16:07
S10	0	S5 and (cover near6 lamp)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 16:08
S11	1	S5 and (cover and lamp)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 16:08
S12	39	("4524079" | "6165170" | "8481985" | "7217936" | "20050173652" | "20070045561" | "3672126" | "5492676" | "5750072" | "5993738" | "6235090" | "20040131497" | "20060004425" | "20040120846" | "20040166018" | "7918229" | "20070102280" | "4317041" | "4458153" | "20050186108" | "20060188835" | "6149717" | "7381976" | "4909254" | "6730113" | "9690201" | "20040120850" | "5843374" | "6960201" | "6099799" | "7326387" | "20080255498" | "5364645" | "5505904" | "5753106" | "20100222852" | "8088289" | "20070255266" | "6283986").PN.	US-PGPUB; USPAT	OR	ON	2021/12/09 17:43
S13	1	("20050173652").PN.	US-PGPUB; USPAT	OR	OFF	2021/12/09 17:47
S14	0	S13 and blood	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 17:48
S15	0	S13 and tissue	US-PGPUB; USPAT; USOCR;	OR	ON	2021/12/09 17:48

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S16	1	("20180353629").PN.	US-PGPUB; USPAT	OR	OFF	2021/12/09 21:15
S17	1	S16 and (human or animal) and tissue	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 21:15
S18	1	S16 and ((human or animal) near tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 21:15
S19	1	S16 and ((human or animal) and living)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/09 21:29
S20	4	WO-2007084145-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 11:08
S21	0	S20 and (animal or human) and tissue	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 11:09
S22	0	S20 and (animal or human)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 11:09

S23	0	S20 and (blood or tissue or skin or cells)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 11:09
S24	1	("8753575").PN.	US-PGPUB; USPAT	OR	OFF	2021/12/10 11:12
S25	1	S24 and (blood or tissue or skin or cells)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 11:12
S26	54	neister-s-edward.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:31
S27	2	S26 and (tissue and (human or animal)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:32
S28	3	S26 and (tissue and photons and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:35
S29	58,972	(tissue and (human or animal)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:42
S30	12,304	(tissue and (human and animal)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/12/10 13:42

			DERWENT; IBM_TDB			
S31	746	(tissue and photons and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:42
S32	56	((animal and human) and tissue and photons and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:43
S33	1	((animal and human) and tissue and photons and wavelength and "peak wavelength").clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 13:43
S34	2	(tissue and (human or animal) and wavelength and photons and destroy$3 and (DNA or RNA)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:02
S35	6	(tissue and (human or animal) and wavelength and photons and destroy$3).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:02
S36	2	(tissue and (human or animal) and wavelength and photons and destroy$3 and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:03
S37	3	(tissue and wavelength and photons and destroy$3 and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/12/10 14:04

			DERWENT; IBM_TDB			
S38	64	(tissue and (human or animal) and destroy$3 and (DNA or RNA)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:04
S39	2	(tissue and (human or animal) and destroy$3 and (DNA or RNA) and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:05
S40	2	(tissue and (human or animal) and destroy$3 and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:05
S41	2	(tissue and (human or animal) and (DNA or RNA) and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:05
S42	4	((human or animal) and (DNA or RNA) and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:42
S43	4	((human or animal) and photons and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:43
S44	6	((human or animal) and absorption and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/12/10 14:43

			DERWENT; IBM_TDB			
S45	4	((human or animal) and "Chemical bonds" and (proteins or DNA or RNA) and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:43
S46	23	((human or animal) and wavelength and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 14:51
S48	4	(microorganism and (human or animal) and wavelength and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 15:04
S49	3	(microorganism and tissue and wavelength and ("222 nm" or "222 nanometer")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 15:22
S50	51,323	(A61L2/0047 or A23B7/015 or A23L3/26 or A23L3/28 or A61L2/0011 or A61L2/10 or A61L9/20 or A61N5/0624 or B08B17/00 or A61L2202/22 or A61N2005/063 or A61N2005/0654 or A61N2005/0661).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 15:27
S52	139	S50 and (microorganism and (human or animal) and wavelength and ("222 nm" or "222 nanometer"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 15:28
S53	74	S50 and (microorganism and tissue and (human or animal) and wavelength and ("222 nm" or "222 nanometer"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/12/10 15:28

			DERWENT; IBM_TDB			
S54	73	S50 and (microorganism and tissue and (human or animal) and wavelength and ("222 nm" or "222 nanometer") and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 15:29
S55	73	S50 and (microorganism and tissue and (human or animal) and tissue and wavelength and ("222 nm" or "222 nanometer") and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 15:39
S56	45	S50 and (photons and microorganism and tissue and (human or animal) and wavelength and ("222 nm" or "222 nanometer") and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 16:13
S57	47	S50 and (photons and microorganism and (human or animal) and wavelength and ("222 nm" or "222 nanometer") and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 16:13
S58	47	S50 and (photons and microorganism and (human or animal) and ("222 nm" or "222 nanometer") and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 16:15
S59	115	S50 and (microorganism and (human or animal) and ("222 nm" or "222 nanometer") and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 16:15
S60	51,323	(A61L2/0047 or A23B7/015 or A23L3/26 or A23L3/28 or A61L2/0011 or A61L2/10 or A61L9/20 or A61N5/0624 or B08B17/00 or A61L2202/22 or A61N2005/063 or A61N2005/0654 or A61N2005/0661).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2021/12/10 18:20

			DERWENT; IBM_TDB			
S61	45	S60 and (microorganism and (human or animal) and ("222 nm" or "222 nanometer") and (destroy$3 with (proteins or DNA or RNA)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 18:20
S62	58	S60 and ((human or animal) and ("222 nm" or "222 nanometer") and (destroy$3 with (proteins or DNA or RNA)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 18:23
S77	51,323	(A61L2/0047 or A23B7/015 or A23L3/26 or A23L3/28 or A61L2/0011 or A61L2/10 or A61L9/20 or A61N5/0624 or B08B17/00 or A61L2202/22 or A61N2005/063 or A61N2005/0654 or A61N2005/0661).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 22:19
S78	80	S77 and ((human or animal) and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4) with (proteins or DNA or RNA)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/12/10 22:19

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S63	4	((human or animal) and ("222 nm" or "222 nanometer") and (destroy$3 with (proteins or DNA or RNA))).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:27
S64	4	((human or animal) and ("222 nm" or "222 nanometer") and (destroy$3 and (proteins or DNA or RNA))).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:38
S65	4	((human or animal) and ("222 nm" or "222 nanometer") and photon and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:39
S66	4	((human or animal) and ("222 nm" or "222 nanometer") and photons and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:39

S67	3	(tissue and ("222 nm" or "222 nanometer") and photons and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:40
S68	11	(wavelength and ("222 nm" or "222 nanometer") and photons and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:40
S69	3	(tissue and ("222 nm" or "222 nanometer") and photons and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:49
S70	3	(tissue and ("222 nm" or "222 nanometer") and absorption and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:59
S71	3	(tissue and ("222 nm" or "222 nanometer") and peak and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 19:59
S72	3	(tissue and ("222 nm" or "222 nanometer") and "chemical bonds" and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 20:00
S73	5	(("222 nm" or "222 nanometer") and "chemical bonds" and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 20:02
S74	11	(("222 nm" or "222 nanometer") and photons and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 20:02
S75	11	(microorganism and ("222 nm" or "222 nanometer") and photons and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 20:03
S76	11	(microorganism and ("222 nm" or "222 nanometer") and photons and (substance or surface) and (proteins or DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/12/10 20:04
S79	12,147	(A61L2/0047 or A23B7/015 or A23L3/26 or A23L3/28 or A61L2/0011 or A61L2/10 or A61L9/20 or A61N5/0624 or B08B17/00 or A61L2202/22 or A61N2005/063 or A61N2005/0654 or A61N2005/0661).cpc.	US-PGPUB; USPAT	OR	ON	2021/12/10 22:15
S80	57	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and (destroy$3 with (proteins or DNA or RNA)))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:16
S81	79	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4) with (proteins or DNA or RNA)))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:19
S82	49	S79 and (tissue and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4) with (proteins or DNA or RNA)))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:30

S83	50	S79 and (tissue and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4 or destruct$3) with (proteins or DNA or RNA)))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:31
S84	47	S79 and (tissue and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4 or destruct$3) and photons and (proteins or DNA or RNA)))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:34
S85	53	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4 or destruct$3) and photons and (proteins or DNA or RNA)))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:43
S86	34	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4 or destruct$3) and photons and issue))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:46
S87	53	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and ((destroy$3 or denatur$5 or kill$3 or inactivat$4 or destruct$3) and photons and tissue))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:46
S88	54	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and (photons and tissue))	US-PGPUB; USPAT	OR	ON	2021/12/10 22:59
S89	94	S79 and ((human or animal) and ("222 nm" or "222 nanometer") and tissue)	US-PGPUB; USPAT	OR	ON	2021/12/10 23:01

12/10/2021 11:45:45 PM
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15645480
Filing Date	2017-07-10
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

U.S.PATENTS Remove

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
/R.M.Y/	1	6283986		2001-09-04	Johnson	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

/R.M.Y/	1	SILVERSTEIN, ROBERT M.; BASSLER, G. CLAYTON; MORRILL, TERENCE C.; Spectrometric identification of organic compounds, 4th Edition, March 10, 1981, Wiley, page 329	
/R.M.Y/	2	Techniques for Modern Aquaculture: Proceedings of an Aquacultural Engineering Conference, 21-23 June 1993, Spokane, Washington. 1993. United States: American Society of Agricultural Engineers, page 481	

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EXAMINER SIGNATURE

Examiner Signature	/REGINA M YOO/	Date Considered	11/26/2021

*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.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

CERTIFICATION STATEMENT

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OR

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See attached certification statement.

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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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-09-08
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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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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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
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15645480
Filing Date	2017-07-10
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

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/R.M.Y/	1	9690201		2017-06-27	Tsujita	

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Signature	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-09-30
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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Doc code: IDS
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	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
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	Attorney Docket Number	17-093-EN

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Examiner Initial*	Cite No	Foreign Document Number[3]	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]
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Electronic Acknowledgement Receipt	
EFS ID:	43914868
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	30-SEP-2021
Filing Date:	10-JUL-2017
Time Stamp:	14:37:59
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)	IDS8.pdf	611940 57239b5523eb72cb04a5c4e32a4aadfc46f21193	no	4

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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.

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.:	15/645,480		
First Named Inventor:	S. Edward Neister	Art Unit:	1799
Filed:	July 10, 2017	Examiner:	Yoo, Regina M.

Lambert Shortell & Connaughton
100 Franklin Street, Suite 903
Boston, MA 02110

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO JUNE 10, 2021 OFFICE ACTION

This is a response to the Office Action issued on June 10, 2021 by the U.S. Patent and Trademark Office in connection with the above-identified application. A response to the June 10, 2021 Office Action is due September 10, 2021. Accordingly, this response is being timely filed.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on ~~or in~~ a substance or on a surface comprising the steps of:

generating photons of a wavelength corresponding to a peak absorption wavelength of proteins, or DNA, or RNA, the wavelength being ~~222nm~~ 222 nm;

directing the photons to a substance or surface to be disinfected, whereby the photons are generated to destroy a plurality of chemical bonds within the proteins, DNA, or RNA of the microorganism[[s]]; and

wherein the substance or surface to be disinfected is human or animal tissue.

2. (Canceled).
3. (Previously Presented) The process of claim 1 wherein the human or animal tissue is one of blood, an organ, or a wound.
4. (Canceled).
5. (Canceled).
6. (Original) The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. (Original) The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. (Previously Presented) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. (Canceled).
10. (Original) The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
11. (Canceled).
12. (Previously Presented) The process of claim 1 wherein the step of generating photons comprises activating a lamp.

13. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.
14. -21 (Canceled).
22. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 40 mJ/cm^2 to the substance or surface to be disinfected.
23. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 60 mJ/cm^2 to the substance or surface to be disinfected.
24. -27 (Canceled).
28. (Previously Presented) The process of claim 1 wherein the human or animal tissue is skin.
29. (New) The process of claim 1 wherein the human or animal tissue is human tissue.
30. (New) The process of claim 1 wherein the human or animal tissue is human skin.
31. (New) The process of claim 1 wherein the human or animal tissue is tissue of a living animal.
32. (New) The process of claim 1 wherein the human or animal tissue is tissue of a living human.
33. (New) The process of claim 1 wherein the human or animal tissue is skin of a living human.
34. (New) The process of claim 1 wherein the human or animal tissue is skin of a living animal.
35. (New) The process of claim 12 wherein the lamp comprises a cover, the cover transparent to 222 nm.

Remarks

Applicant thanks the Office for the attention accorded to the present application in the June 10, 2021 Office Action. Claims 1, 3, 6-8, 10, 12-13, 22-23 and 28 were pending in the subject application. Applicant further thanks Examiner Yoo for time spent in an examiner interview on August 20, 2021.

Without prejudice or disclaimer, Applicant has herein amended claim 1 and added new claims 29-35. Upon entry of this amendment, claims 1, 3, 6-8, 10, 12-13, 22-23 and 28-35 will be pending in the present application.

The amendments to the claims are primarily to correct matters of form and/or clarity in response to the Office's recommendation. Applicant asserts that all claims are supported in the specification as originally filed. No new matter has been added.

The claim amendments and cancellations made herein are made solely to expedite prosecution of the instant application, and should not be construed as acquiescence to the Office's rejections. Applicant reserves the right to pursue the cancelled and/or non-elected subject matter in one or more divisional or continuation applications.

Applicant respectfully traverses all rejections and asserts that the claims are now in condition for allowance.

Claim Objections

Applicant has amended claim 1 to address the Examiner's objections. Accordingly, this objection is now believed to be moot.

35 U.S.C. 102 Rejections

In the present Office Action, the Examiner rejected claims 1, 3, 6, 12 and 28 under 35 U.S.C. 102(e) as being anticipated by Ressler (2005/0173652).

Applicant has included a 37 C.F.R. 1.131 declaration herewith to antedate Ressler.

The 37 C.F.R. 1.131 declaration, included, provides evidence of conception and actual reduction to practice of the claimed invention prior to the provisional application filing date of Ressler on February 11, 2004, including testing of the skin of a hand (tissue) using 222 nm. The evidence provided demonstrates conception and actual reduction to practice of the claimed process using 222 nm on human or animal tissue prior to the provisional application date of Ressler on February 11, 2004. Applicant respectfully requests consideration of the Rule 131 declaration and removal of Ressler from consideration.

As such, Applicant respectfully asserts that the 35 U.S.C. 102(e) rejection based on Ressler be reconsidered, in light of the Rule 131 declaration, and withdrawn.

Rejections under 35 U.S.C. § 103(a)

In the present Office Action, the Examiner rejected claims 7, 13, and 22-23 under 35 U.S.C. 103(a) as being anticipated by Ressler (20050173652).

As noted above, Applicant has included a 37 C.F.R. 1.131 declaration herewith to antedate Ressler. Applicant respectfully asserts that the present rejection is now moot for at least these reasons. Applicant further respectfully disagrees that the claim limitations of

claims 7, 13, and 22-23 are obvious in light of Ressler because they would yield predictable results. This is not the case.

As such, Applicant respectfully requests that the 35 U.S.C. 103(a) rejection based on Ressler be reconsidered in light of the Rule 131 declaration, and withdrawn.

Comments on Newly Added Claims

Applicant has added new claims 29-35 to further clarify the invention and to further distinguish from the prior art.

Conclusion

Applicant again thanks the Office for the attention accorded to the present Application in the June 10, 2021 office action. Applicant has herein amended claim 1 and added new claims 29-35. Applicant asserts that based on the amendment and comments presented herein, all of the pending claims are in condition for allowance. Early and favorable action is respectfully requested.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

/David J. Connaughton, Jr./
David J. Connaughton, Jr.
USPTO Reg. #67275
Lambert Shortell & Connaughton
100 Franklin Street, Suite 903
Boston, MA 02110
(617) 720-0091

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

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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EFS Web 2.1.17

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

	1	SILVERSTEIN, ROBERT M.; BASSLER, G. CLAYTON; MORRILL, TERENCE C.; Spectrometric identification of organic compounds, 4th Edition, March 10, 1981, Wiley, page 329	
	2	Techniques for Modern Aquaculture: Proceedings of an Aquacultural Engineering Conference, 21-23 June 1993, Spokane, Washington. 1993. United States: American Society of Agricultural Engineers, page 481	

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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	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-09-08
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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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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.

Electronic Patent Application Fee Transmittal					
Application Number:	15645480				
Filing Date:	10-Jul-2017				
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION				
First Named Inventor/Applicant Name:	S. Edward Neister				
Filer:	Gary Ervery Lambert/David Connaughton				
Attorney Docket Number:	17-093-EN				
Filed as Small Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	130	130
		Total in USD ($)		**130**

Electronic Acknowledgement Receipt	
EFS ID:	43725499
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	09-SEP-2021
Filing Date:	10-JUL-2017
Time Stamp:	16:29:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
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1		Response-Non-Final-OA-06-10.pdf	33926 7d5604d476a73ec05bbf8def21573bb3ba6f90ca	yes	6
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	3	
	Applicant Arguments/Remarks Made in an Amendment		4	6	
Warnings:					
Information:					
2	Affidavit-Rule 131-pre-AIA (FTI) ONLY	signed-Neister-1-131-Declaration.pdf	113602 a37fb1870f19e9696714fe968a46d909bfb13fca	no	3
Warnings:					
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3	Affidavit-Rule 131-pre-AIA (FTI) ONLY	Exhbit-A-_Redacted.pdf	2544301 c3b20895a1a59aefe934298d32592b296f2e19f0	no	3
Warnings:					
Information:					
4	Affidavit-Rule 131-pre-AIA (FTI) ONLY	Exhibit-B-Skin-test.pdf	3580354 aa03f69cde6df43bd7cd3a96165c7ff5e1745ea0	no	2
Warnings:					
Information:					
5	Affidavit-Rule 131-pre-AIA (FTI) ONLY	EXHIBIT_C.pdf	70678 c69289451da897a02f970e076bd1486395adbe25	no	1

Warnings:					
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6	Affidavit-Rule 131-pre-AIA (FTI) ONLY	EXHIBIT_D.pdf	51104 0bf179a5b0184c11c980dc284d377f22560c63f2	no	1
Warnings:					
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7	Affidavit-Rule 131-pre-AIA (FTI) ONLY	EXHIBIT_E.pdf	79840 42f97274ae45e322d3de39d6c6acb53fd8f82087	no	1
Warnings:					
Information:					
8	Information Disclosure Statement (IDS) Form (SB08)	IDS7.pdf	612232 6179fe6be429f0ac6d7b0e489d1774fefd3ca0b8	no	4
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9	Non Patent Literature	Techniques-for-Modern-Aquaculture-Proceedings-of-an-Aquacultural-Engineering-Conference.pdf	362011 b55b92dda038db63f1da69f8525930c37e427cfd	no	1
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10	Non Patent Literature	Spectrometric-dentification-of-organic-compounds-page-329.pdf	586845 0d98c0968b1da1ba053aab5deb40455b0915f75e	no	1
Warnings:					
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11	Fee Worksheet (SB06)	fee-info.pdf	38313 8128ae332e992eb3fa76a261d80feecef8ff7950	no	2
Warnings:					
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			Total Files Size (in bytes):	8073206	

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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.

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.:	15/645,480		
First Named Inventor:	S. Edward Neister	Art Unit:	1799
Filed:	July 10, 2017	Examiner:	Yoo, Regina M.

Lambert Shortell & Connaughton
100 Franklin Street, Suite 903
Boston, MA 02110

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Declaration Under 37 C.F.R. 1.131

This declaration is submitted under 37 C.F.R. 1.131 for U.S. Patent Application Serial Number 15/645,480, to establish invention and actual reduction to practice of the subject matter of the rejected claims prior to February 11, 2004.

I, S. Edward Neister, do hereby declare:

1. I am the inventor of the inventive subject matter described and shown in the present application.

2 Prior to February 11, 2004, the inventive subject matter claimed in the present application was completed and reduced to practice in the United States as evidenced by the following:

a. Prior to February 11, 2004, having earlier conceived the subject matter in the United States, I made the research and invention summary shown in Exhibit A (3

Pages). This disclosure is an internal report to the Board of Directors at Powerspan Corp., and includes discussions and descriptions of a disinfecting apparatus and methods of use for the device, targeting at least wavelengths at one of 222 nm and 282 nm, and noting that the apparatus can be used in a method which efficiently destroys microorganisms.

b. The subject matter of the present application was actually reduced to practice prior to February 11, 2004. Exhibit B (1 Page) describes the results of performing the method claimed, and Exhibits C-E (1 Page each) show photographs of different views of the subject of the present application that were taken before February 11, 2004.

c. Exhibit A describes the claimed method and related apparatus. This disclosure is an internal report to the Board of Directors at Powerspan Corp., and makes note of testing performed at the University of New Hampshire of the subject matter of the present invention.

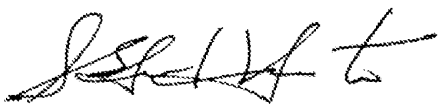
d. Exhibit B is a notebook page written by myself. The page describes the carrying out of the claimed method prior to February 11, 2004. This is a notebook page describing and recording testing and actions taken using the 222nm lamp. Specifically, it states in pertinent part "Tested lamp on back of hand 2 min exposure at $\approx$ 60mj/cm^2." The "lamp" referred to is the 222 nm lamp discussed in the present application, an example of which is shown in Exhibits C-E.

e. Exhibit C shows a photograph of a top view of the subject matter of the present application used in carrying out the claimed method.

f. Exhibit D shows a photograph of a bottom view of the subject matter of the present application used in carrying out the claimed method, showing the internal components.

g. Exhibit E shows a photograph of an end view of the subject matter of the present application used in carrying out the claimed method.

3. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application and any patent issuing thereon.



Date: 9/8/2021

S. Edward Neister

MEMORANDUM

REDACTED

To: Directors
From: Ed Neister
Subject: **UV Update**

SUMMARY

Ultraviolet (UV) light is photons with high energy content. The energy content of the photon changes as the wavelength changes. UV can be an effective tool to target select molecules to force excited state chemical action or radical formation. UV photons are very effective in creating mutations in living cells and breaking organic molecules. Powerspan is in the unique position of having experience with the dielectric barrier discharge (DBD) process (also known as a silent discharge) and its use to make a new and unique type of UV lamp. The use of UV for other applications may provide new markets that could be significant to the growth of Powerspan.

UV sources to kill water and air borne pathogens

Wastewater

UV light sources use mercury (254nm) lamps to treat drinking water, wastewater, and airborne pathogens. There are indications that mercury lamps are not ideal sources for these uses and a critical need exists for another type of source, particularly for drinking water. Conversations with Dr. James P. Malley, Jr.[1] led to a test of three different DBD lamps producing three different wavelengths. The test in [REDACTED] indicated that 253 and 258 nm emission performed at least as well as mercury light in destroying a marker virus MS-2. Dr. Malley indicated that there were some significant advantages of the DBD lamp compared to mercury sources.

An effort was made to determine the market scope for application of Dielectric Barrier Discharge (DBD) UV lamps. Frank and Ed made a visit to Trojan Technologies, one of the largest companies in wastewater UV treatment, to learn what was possible. What we found was that eximer lamps could not compete in price with the mercury lamps. Market size was also surprisingly small. Powerspan has elected to not pursue UV treatment of wastewater as a potential product area.

Drinking water

Dr. Malley stated that developing a UV lamp that did not contain mercury was paramount for drinking water treatment. Trojan Technologies however felt that a non-mercury lamp might be worth about $400. An eximer lamp would have a selling price three times that. Even though the market is growing at 25% per year, the size is too small to warrant Powerspan resources for the at least next four years.

---

[1] Associate Professor of Environmental Engineering, UNH; Chair – ERG (Environmental Research Group); President, International UV Association (IUVA)

Air pathogens

DEKA:

DEKA (Dean Kamen's company) is developing a vapor compression water distillation system that will be marketed to the third world countries. To date, they have demonstrated that the concept does make potable water. They need a UV source that would guarantee that no airborne or water borne pathogens can pass through the system. DEKA has expressed an interest in the 222 nm wavelength source as the most potent and desirable source for their application. Important to the overall system is the small size, ruggedness, inexpensive power supply, and variable power control. Effort is proceeding to support their effort by developing a small high voltage power supply and optimize the DBD lamp. Other wavelengths of interest would be 258, and 282 nm. DEKA is doing market analysis and will supply the results to Powerspan. The initial market appears large.

Tuberculosis:

The results of the UNH REDACT est indicated that 222 nm light more effectively deactivates airborne pathogens than mercury 254 nm light. There is a serious epidemic of drug resistant Tuberculosis in many third world countries. Dr. Ann Ginsberg[2] was encouraged by these results and said that she personally was concerned as well as people at CDC[3] that this epidemic could spread quickly because of high altitude jet plane travel. She asked that I contact people doing TB studies, and invited us to visit them for an informal discussion about the new UV source and to get their suggestions on the best course of action to follow to develop and promote its use. However, after talking to one the leading experts in the field, the market size is only third world countries, and they do not have the ability or will to pay for such development. Even though the concept of helping solve the world's problems is magnanimous, the current size of Powerspan does not justify spending resources on this problem today.

ECR Process on Gas Fired Turbines

Powerspan's patented process, **Electro Catalytic Oxidation (ECO)**, uses DBD to oxidize gas radicals in flue gas of coal-fired boilers to make acids of nitrogen and sulfur. Natural gas fired boilers produce ten times less nitrogen oxides. The ECO process is not economical to remove this low amount of NO. However, UV light may have a significant advantage to breaking the NO bond because of the high resonant condition of this molecule. The resulting reaction would be the formation of molecular nitrogen and oxygen. Because the eximer lamp is a relatively efficient UV producer, about 2% of the plants power could reduce NO emission to 1ppm. This process would then be **Electro Catalytic Reduction (ECR)**, using DBD and UV photons to reduce NO. Both an eximer lamp and a medium pressure mercury lamp will produce photons that are absorbed by the resonant lines of NO. Tests will determine to what extent each lamp will reduce this molecule, and what the conditions must be for efficient reduction.

---

[2] Chief – NIH Respiratory Diseases
[3] Center for Disease Control, Atlanta, Ga.

Eximer lamps

Simply put, a gas atom that bonds to itself and produces photons that have a wavelength (energy) that is different than what a single atom (resonant radiation) would produce is call an eximer. In physical terms, an eximer is a multi-atom molecule with a thermally unstable ground state. The silent discharge process is critical to the formation of efficient eximers in mixtures of rare gases with halogen-donating gases. It is very efficient in exciting the gas molecules so the gas remains relatively cool. At elevated temperatures, eximer formation is prevented and only resonant radiation occurs. An eximer does exist that emits at three principle absorption lines of NO. Even though this lamp is about 10% efficient, the NO molecule absorbs most of the emission. There is competing absorption by water vapor and oxygen at the lower emission lines of the eximer lamp. This significantly reduce its effectiveness.

Mercury lamps

Medium pressure mercury lamps are standard commercial products used primarily in the UV treatment of wastewater. Because they are inexpensive, relatively reliable and readily available, it is important to compare their emission with the eximer lamp, which is new and will require development. 15% of the mercury lamps emission covers the broad region of the NO absorption. The NO molecule will only absorb about 10% of this radiation, resulting in only about 1.5% effective absorption.

Exhibit B

OUTLINE FOR HALX C PATENT– REDACTED

1. 222nm is 10 to 100 times more efficient for breaking DNA bonds
2. 222nm breaks different DNA bonds, increasing effectiveness of irradiation
3. 222nm will break S-N, S-O, O-O, O-H, and C-F where 254 nm will not
4. 222nm is wavelength of choice for irradiating airborne disease
5. 222nm may prevent DNA repairing itself when irradiated with low level uv
6. BaSO4 reflector increases uv output from lamp
7. BaSO4 reflector to be used for uv reflection in any chamber design

REDACTED

REDACTED

REDACTED

EXHIBIT C

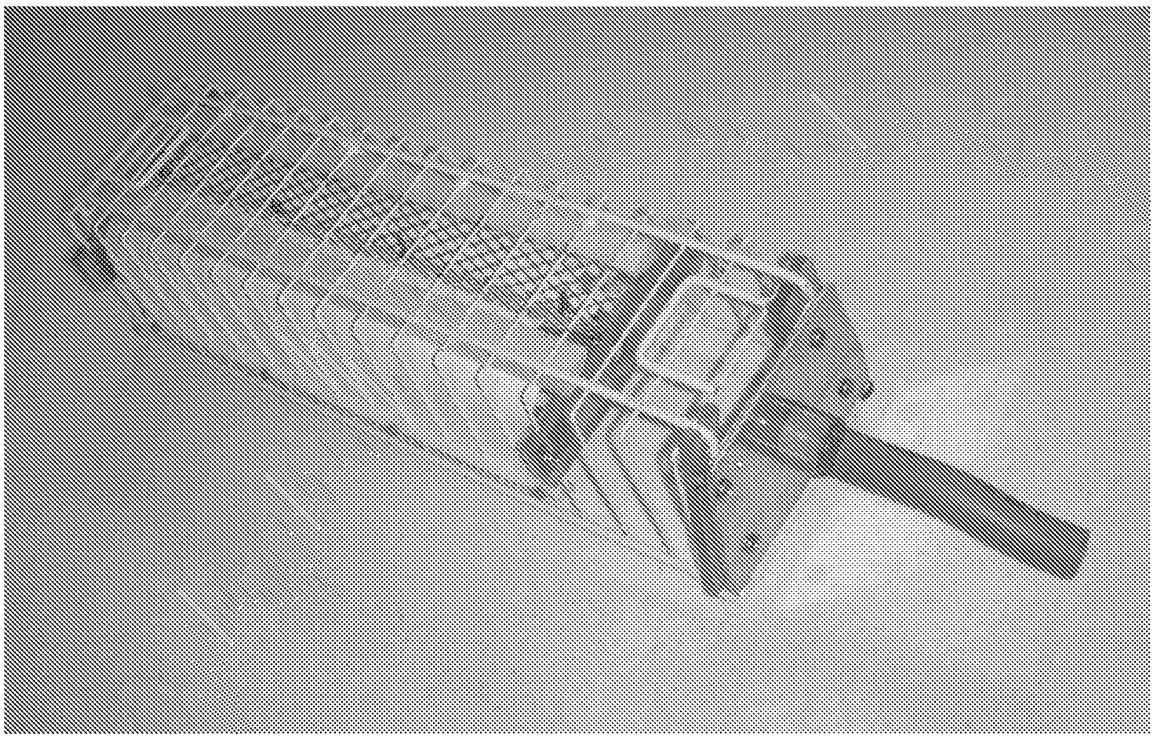


EXHIBIT C

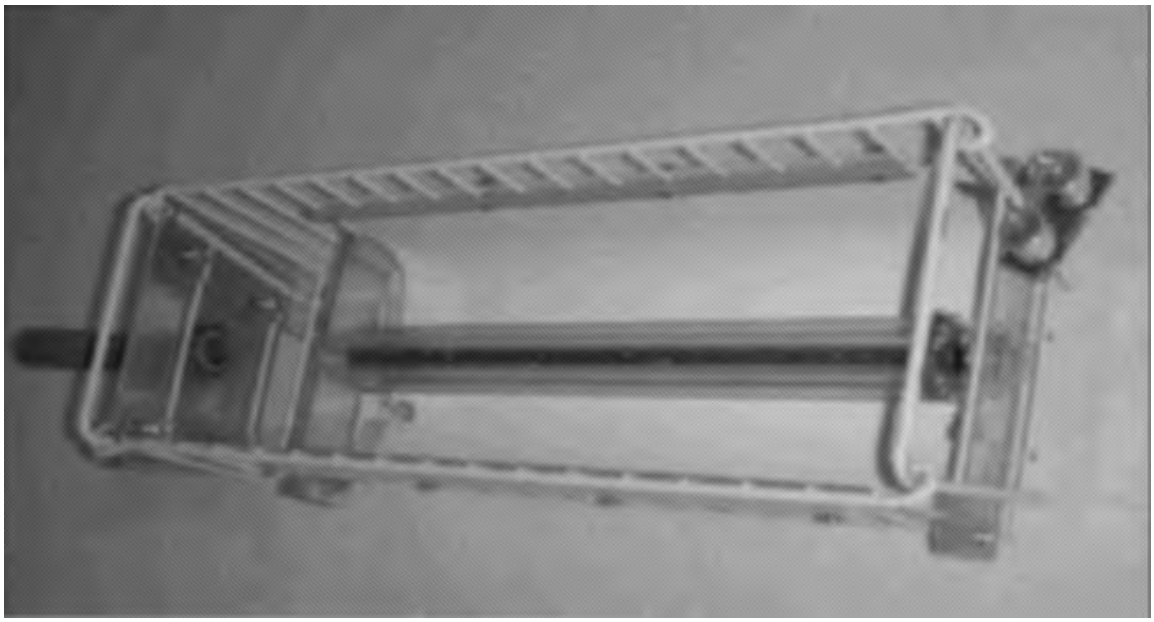
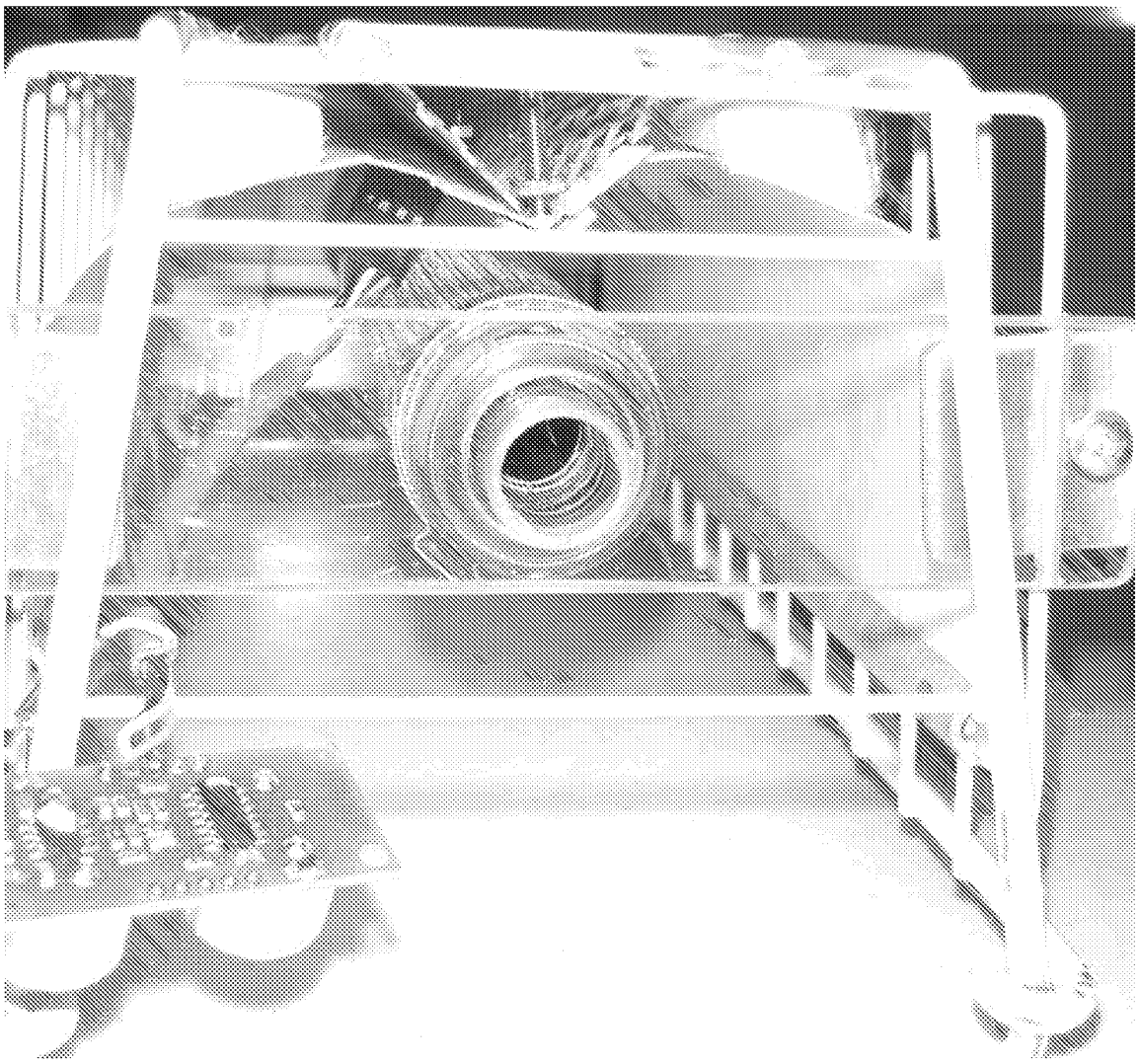


EXHIBIT E



PTO/SB/06 (09-11)
Approved for use through 1/31/2014. 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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/645,480	Filing Date 07/10/2017	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	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 $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ 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	09/09/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 0		x $240 =	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".	/TERRY BRYANT/
*** 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.

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	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

U.S.PATENTS							Remove
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.							Add

U.S.PATENT APPLICATION PUBLICATIONS							Remove
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.							Add

FOREIGN PATENT DOCUMENTS								Remove
Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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							
If you wish to add additional Foreign Patent Document citation information please click the Add button								Add

NON-PATENT LITERATURE DOCUMENTS			Remove
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	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

	1	VON SONNTAG, Disinfection by free radicals and UV-radiation, WATER SUPPLY 4 (1986)	
	2	GATES, F. L., A Study of the bactericidal action of ultra violet light, J. GEN. PHYSIOLOGY 14 (1930)	

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

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	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-08-30
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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.

Electronic Acknowledgement Receipt	
EFS ID:	43681056
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	03-SEP-2021
Filing Date:	10-JUL-2017
Time Stamp:	12:07:50
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)	IDS6.pdf	612157 0c34af029dab3994b5fe74e12c7daeff97cfe0ed	no	4

Warnings:

Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
2	Non Patent Literature	GATES.pdf	607004 8b995fe1fb2b7780ac3af9cd6e3c0d378eb89c19	no	12
Warnings:					
Information:					
			Total Files Size (in bytes):	1219161	

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

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 08/25/2021

LAMBERT SHORTELL & CONNAUGHTON
100 Franklin Street
Suite 903
BOSTON, MA 02110

EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

NOTIFICATION DATE	DELIVERY MODE
08/25/2021	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):

info@lambertpatentlaw.com

Applicant-Initiated Interview Summary	**Application No.** 15/645,480	**Applicant(s)** Neister, S. Edward		
	Examiner REGINA M YOO	**Art Unit** 1799	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
REGINA M YOO	Primary Examiner	Telephonic
David Connaughton, Jr.	Attorney of Record	

Date of Interview: 20 August 2021

Issues Discussed:

Other

Sample of declaration to be filed to overcome the prior art of Ressler was provided and discussed as to whether it is adequate and effective to establish priority and to overcome the prior art rejection. Examiner indicated that while the evidence appears to provide evidence for prior invention/disclosure of an apparatus or a device that may be utilized for performing the claimed process it does not not appear to provide evidence of conception and actual reduction to practice of the claimed process of using 222 nm on human or animal tissue prior to the provisional application date of Ressler on February 11, 2004. Attorney indicated that other evidence more suitable and applicable to claimed process will be provided in the declaration that will be filed officially to overcome the prior art.

	/REGINA M YOO/ Primary Examiner, Art Unit 1799

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 06/10/2021

LAMBERT SHORTELL & CONNAUGHTON
100 Franklin Street
Suite 903
BOSTON, MA 02110

EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

NOTIFICATION DATE	DELIVERY MODE
06/10/2021	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):

info@lambertpatentlaw.com

Office Action Summary	Application No. 15/645,480	Applicant(s) Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	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 12 April 2021.

☐ 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) 1,3,6-8,10,12-13,22-23 and 28 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) 1,3,6-7,12-13,22-23 and 28 is/are rejected.

8) ☑ Claim(s) 8 and 10 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 _____ 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: _____.

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 4/12/2021 has been entered.

Claim Objections

3. Claims 1, 3, 6-8, 10, 12-13, 22-23, and 28 are objected to because of the following informalities: in line 4 of Claim 1, delete "222nm" and insert --222 nm--. Appropriate correction is required.

Claim Rejections - 35 USC § 102

4. 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.

5. Claim(s) 1, 3, 6, 12, and 28 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Ressler (20050173652).

As to Claim 1, Ressler ('652) discloses a process for destroying a DNA or RNA of a microorganism on or in a substance or on a surface (see) comprising the steps of:

generating photons of a wavelength corresponding to a peak absorption wavelength of proteins, or DNA, or RNA, the wavelength being 222nm (see entire document, particularly p. 1 [0011], p. 2 [0019], p. 5 Claim 2);

directing the photons to a substance or surface to be disinfected, whereby the photons are generated to destroy a plurality of chemical bonds within the proteins, DNA, or RNA of the microorganisms (see entire document, particularly Abstract, [0011]-0012], [0019]-[0022], [0026]-[0034]); and

wherein the substance or surface to be disinfected is human or animal tissue (see entire document, particularly p. 1 [0003] – 2nd and 3rd lines from the bottom).

As to Claims 3 and 28, Ressler ('652) discloses that the animal tissue is one of blood or an organ or skin (see entire document, particularly Abstract, p. 1 [0003] – 2nd and 3rd lines from the bottom and [0009], p. 4 [0029] – where the meat and poultry as food products intrinsically comprises blood, organ and skin, such as a whole chicken/turkey).

As to Claim 6, Ressler ('652) discloses that the microorganism is at least one of a bacteria and a virus (see entire document, particularly p. 1 [0011], p. 2 [0013] and [0019], p. 3 [0024]).

As to Claims 12, Ressler ('652) discloses that the step of generating photons comprises activating a lamp (108) (see entire document, particularly p. 3 [0027], p. 4 [0029]).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

8. Claims 7, 13, and 22-23 is/are rejected under 35 U.S.C. 103 as being unpatentable over Ressler (20050173652).

Ressler (20050173652) is relied upon for disclosure described in the rejection of claim 1 under 35 U.S.C. 102(a)(1).

While Ressler (‘652) does not appear to specifically teach that the step of directing is performed for approximately two seconds, or that the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected, or that the step of directing the photons further comprises a step of providing a radiant dose energy of 40 mJ/cm^2 or 60 mJ/cm^2 to the substance or surface to be disinfected, it would have been well within the purview of one of ordinary skill in the art before the effective filing date of the claimed invention to provide irradiation for 2 seconds or to provide 540 kJ/mole

of photon energy or a radiant dose energy of 40 mJ/cm^2 or 60 mJ/cm^2 to the substance or surface to be disinfected in the process of Ressler in order to ensure complete sterilization of microorganism(s) on or in a substance or on a surface. Only the expected results would be attained.

Allowable Subject Matter

9. Claims 8 and 10 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	RY
A23L3/26, 3/28	02/25/2019	RY
A23B7/015	02/25/2019	RY
B08B17/00	02/25/2019	RY
A61N5/0624	02/25/2019	RY

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* 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**

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		
consulted related case 14/254,957, 11/831,667	11/23/2019	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	04/22/2020	RY
EAST and PALM - Inventor Search	04/19/2020	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	04/20/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	06/05/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S25, S30, S32)	11/11/2020	RY
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EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S3,S35-S58;S73-S88)	03/13/2021	RY
EAST and PALM - Inventor Search (S5-S8,S10)	03/13/2021	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout (S14-S23, S25,S27,S29-S30,S33-S34;S60-S64,S67-S72)	03/13/2021	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S3,S5-S16,S18)	06/05/2021	RY

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
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	REGINA M YOO	1799

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A61L	2/0047, 2/0011, 2/10, 9/20	04/22/2020	RY
A23L	3/26, 3/28	04/22/2020	RY
A23B	7/015	04/22/2020	RY
B08B	17/00	04/22/2020	RY
A61N	5/0624	04/22/2020	RY
UPDATED	SEARCH		
A61L	2/0047, 2/0011, 2/10, 9/20	03/13/2021	RY
A23L	3/26, 3/28	03/13/2021	RY
A23B	7/015	03/13/2021	RY
B08B	17/00	03/13/2021	RY
A61N	5/0624	03/13/2021	RY

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

✓	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								
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EAST Search History

EAST Search History (Prior Art)

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S1	1	("8975605").PN.	US-PGPUB; USPAT	OR	OFF	2021/05/07 10:14
S2	179	("far UV" or "far UV-C" or "far UVC") with (human or animal or tissue or skin or body or hand or foot or nail)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/05/07 10:17
S3	1	("6960201").PN.	US-PGPUB; USPAT	OR	OFF	2021/05/07 10:22
S5	7	(("7918229") or ("20060004425") or ("20050173652") or ("20050205206") or ("7381976") or ("20040238344") or ("9700642")).PN.	US-PGPUB; USPAT	OR	OFF	2021/05/09 14:02
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S8	3	(("7306620") or ("6960201") or ("7494502")).PN.	US-PGPUB; USPAT	OR	OFF	2021/06/05 21:22
S9	1	("5843371").PN.	US-PGPUB; USPAT	OR	OFF	2021/06/05 21:28
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S11	1	("20050205206").PN.	US-PGPUB; USPAT	OR	OFF	2021/06/05 22:03
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S13	2	(("8753575") or ("20100028201")).PN.	US-PGPUB; USPAT	OR	OFF	2021/06/05 22:59
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S15	4	WO-2007084145-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/06/05 23:05
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S18	13	((food or meat) with steriliz$) and (wand or "fiber optic") and ("new UV" or "new ultraviolet" or "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/06/05 23:54

EAST Search History (Interference)

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6/5/2021 11:57:25 PM
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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

(Not for submission under 37 CFR 1.99)

Application Number	15645480
Filing Date	2017-07-10
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

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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
/R.M.Y/	1	7918229		2011-04-05	Cumbie	

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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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	Attorney Docket Number	17-093-EN

/R.M.Y/	1	JOHN ANDERSON; NEIL ROWAN; SCOTT MACGREGOR; RICHARD FOURACRE; OWEN FARISH; Inactivation of Food- Borne Enteropathogenic Bacteria and Spoilage Fungi Using Pulsed- Light; John Anderson; Neil Rowan; Scott MacGregor; Richard Fouracre; Owen Farish IEEE Transactions on Plasma Science; February 2000	
	2	S. M. AVDEEV; E. A. SOSNIN; V. S. SKAKUN; V. F. TARASENKO; AND D. V. SCHITZ; Two-Band Emission Source Based on a Three-Barrier KrCl– XeBr Excilamp; Technical Physics Letters; September 2008	
	3	MARCUS CLAUS; Higher effectiveness of photoinactivation of bacterial spores UV resistant vegetative bacteria and mold spores with 222 nm compared to 254 nm wavelength; Acta hydrochim. Hydrobiol; 2006	
	4	MASAYOSHI KITAMURA; KAORU MITSUKA; HIROSHI SATO; A practical high-power excimer lamp excited by a microwave discharge; Applied Surface Science; 1994	
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	6	IAN RAMSAY; JEAN- CHRISTOPHE NIEDZIELA; IAIN OGDEN; The Synergistic Effect of Excimer and Low- Pressure Mercury Lamps on the Disinfection of Flowing Water; Journal of Food Protection; Nov. 11 2000	
	7	JEFFREY REIDMILLER; JEREMIAH BALDECK; GLEN RUTHERFORD; ROBERT MARQUIS; Characterization of UV-Peroxide Killing of Bacterial Spores; Journal of Food Protection; 2003	
	8	SVEN SCHALK; VOLKER ADAM; ERICH ARNOLD; KARL BRIEDEN; ALEX VORONOV; HANS-DIETER WITZKE; UV-Lamps for Disinfection and Advanced Oxidation - Lamp Types Technologies and Applications; Novel Lamps Sleeves and Reactors session at the UV Congress; March 2006	
	9	EDWARD SOSNIN; EVA STOFFELS; MICHAEL EROFEEV; INGRID KIEFT; SERGEY KUNTS; The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria:A Comparative Approach; IEEE Transactions on Plasma Science; August 2004	
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	Attorney Docket Number	17-093-EN

/R.M.Y/	12	A Recommended Standard for Occupational Exposure to Ultraviolet Radiation; National Institute for Occupational Safety and Health; 1992	
	13	IARC Monographs on the Evaluation of Carcinogenic Risks to Humans – Solar and Ultraviolet Radiation; World Health Organization International Agency for Research on Cancer; 1992	
	14	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Plaintiff Healthe's Response to Defendants High Energy Ozone D/B/A Far-UV Sterilray, S. Edward Neister, and Pathogen Path Consulting LLC's Infringement Contentions and Disclosure of Invalidity and Unenforceability Contentions; March 29, 2021	
	15	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-20 - 9,700,642 Patent Invalidity Chart - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans – Solar and Ultraviolet Radiation, by World Health Organization International Agency for Research on Cancer; March 29, 2021	
	16	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-1 - 8,975,605 Patent Invalidity Chart - Inactivation of Food-Borne Enteropathogenic Bacteria and Spoilage Fungi Using Pulsed-Light, by Anderson et al.; March 29, 2021	
	17	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-2 - 8,975,605 Patent Invalidity Chart - Two-Band Emission Source Based on a Three-Barrier KrCl-XeBr Excilamp, by Adveev et al.; March 29, 2021	
	18	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-3 - 8,975,605 Patent Invalidity Chart - U.S. Patent Application Publication No. 2004/0238344 to Benoit et al.; March 29, 2021	
	19	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-4 - 8,975,605 Patent Invalidity Chart - Higher effectiveness of photoinactivation of bacterial spores, UV resistant vegetative bacteria and mold spores with 222 nm compared to 254 nm wavelength, by Claus; March 29, 2021	
	20	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-5 - 8,975,605 Patent Invalidity Chart - U.S. Patent No. 7,381,976 to Coogan, Jr. et al.; March 29, 2021	
	21	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-6 - 8,975,605 Patent Invalidity Chart - U.S. Patent No. 6,960,201 to Cumbie; March 29, 2021	
/R.M.Y/	22	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-7 - 8,975,605 Patent Invalidity Chart - U.S. Patent No. 7,918,229 to Cumbie et al.; March 29, 2021	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Attorney Docket Number	17-093-EN

/R.M.Y/	23	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-8 - 8,975,605 Patent Invalidity Chart - U.S. Patent Application Publication No. 2006/0004425 to Cumbie; March 29, 2021	
	24	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-9 - 8,975,605 Patent Invalidity Chart - A practical high-power excimer lamp excited by a microwave discharge, by Kitamura et al.; March 29, 2021	
	25	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-10 - 8,975,605 Patent Invalidity Chart - U.S. Patent Application Publication No. 2005/0205206 to Lembersky; March 29, 2021	
	26	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-11 - 8,975,605 Patent Invalidity Chart - The Development of Photosensitized Pulsed and Continuous Ultraviolet Decontamination Techniques for Surfaces and Solutions, by McDonald et al.; March 29, 2021	
	27	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-12 - 8,975,605 Patent Invalidity Chart - A Recommended Standard for Occupational Exposure to. . . . Ultraviolet Radiation, by National Institute for Occupational Safety and Health; March 29, 2021	
	28	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-13 - 8,975,605 Patent Invalidity Chart - The Synergistic Effect of Excimer and Low-Pressure Mercury Lamps on the Disinfection of Flowing Water, by Ramsay et al.; March 29, 2021	
	29	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-14 - 8,975,605 Patent Invalidity Chart - Characterization of UV-Peroxide Killing of Bacterial Spores, by Reidmiller et al.; March 29, 2021	
	30	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-15 - 8,975,605 Patent Invalidity Chart - U.S. Patent Application Publication No. 2005/0173652 to Ressler; March 29, 2021	
	31	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-16 - 8,975,605 Patent Invalidity Chart - UV-Lamps for Disinfection and Advanced Oxidation - Lamp Types, Technologies and Applications, by Schalk et al.; March 29, 2021	
	32	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-17 - 8,975,605 Patent Invalidity Chart - The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria: A Comparative Approach, by Sosnin et al.; March 29, 2021	
/R.M.Y/	33	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-18 - 8,975,605 Patent Invalidity Chart - Excilamps as efficient UV-VUV light sources, by Tarasenko; March 29, 2021	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

/R.M.Y/	34	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-19 - 8,975,605 Patent Invalidity Chart - Comparison of Disinfection Effects of UV Light at 172, 222, 254 nm on Bacillus subtilis Spores, by Wang; March 29, 2021	
	35	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit E-20 - 8,975,605 Patent Invalidity Chart - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans – Solar and Ultraviolet Radiation, by World Health Organization International Agency for Research on Cancer; March 29, 2021	
	36	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-1 - 9,700,642 Patent Invalidity Chart - Inactivation of Food-Borne Enteropathogenic Bacteria and Spoilage Fungi Using Pulsed-Light, by Anderson et al.; March 29, 2021	
	37	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-2 -9,700,642 Patent Invalidity Chart - Two-Band Emission Source Based on a Three-Barrier KrCl-XeBr Excilamp, by Adveev et al.; March 29, 2021	
	38	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-3 - 9,700,642 Patent Invalidity Chart - U.S. Patent Application Publication No. 2004/0238344 to Benoit et al.; March 29, 2021	
	39	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-4 - 9,700,642 Patent Invalidity Chart - Higher effectiveness of photoinactivation of bacterial spores, UV resistant vegetative bacteria and mold spores with 222 nm compared to 254 nm wavelength, by Claus; March 29, 2021	
	40	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-5 - 9,700,642 Patent Invalidity Chart - U.S. Patent No. 7,381,976 to Coogan, Jr. et al.; March 29, 2021	
	41	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-6 - 9,700,642 Patent Invalidity Chart - U.S. Patent No. 6,960,201 to Cumbie; March 29, 2021	
	42	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-7 - 9,700,642 Patent Invalidity Chart - U.S. Patent No. 7,918,229 to Cumbie et al.; March 29, 2021	
	43	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-8 - 9,700,642 Patent Invalidity Chart - U.S. Patent Application Publication No. a2006/0004425 to Cumbie; March 29, 2021	
/R.M.Y/	44	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-9 - 9,700,642 Patent Invalidity Chart - A practical high-power excimer lamp excited by a microwave discharge, by Kitamura et al.; March 29, 2021	

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	Application Number	15645480
	Filing Date	2017-07-10
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	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

/R.M.Y/	45	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-10 - 9,700,642 Patent Invalidity Chart - U.S. Patent Application Publication No. 2005/0205206 to Lembersky; March 29, 2021	
	46	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-11 - 9,700,642 Patent Invalidity Chart - The Development of Photosensitized Pulsed and Continuous Ultraviolet Decontamination Techniques for Surfaces and Solutions, by McDonald et al.; March 29, 2021	
	47	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-12 - 9,700,642 Patent Invalidity Chart - A Recommended Standard for Occupational Exposure to. . . . Ultraviolet Radiation, by National Institute for Occupational Safety and Health; March 29, 2021	
	48	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-13 - 9,700,642 Patent Invalidity Chart - The Synergistic Effect of Excimer and Low-Pressure Mercury Lamps on the Disinfection of Flowing Water, by Ramsay et al.; March 29, 2021	
	49	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-14 - 9,700,642 Patent Invalidity Chart - Characterization of UV-Peroxide Killing of Bacterial Spores, by Reidmiller et al.; March 29, 2021	
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Examiner Signature	/REGINA M YOO/	Date Considered	05/06/2021

*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.

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	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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).

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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.

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-04-01
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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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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.

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

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

(Not for submission under 37 CFR 1.99)

Application Number	15645480
Filing Date	2017-07-10
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

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EXAMINER SIGNATURE

Examiner Signature	/REGINA M YOO/	Date Considered	05/06/2021

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Signature	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-04-01
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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Sale Item Reference Number	Effective Date
15645480	04/12/2021

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I202157A36171353	2806	SUBMISSION- INFORMATION DISCLOSURE STMT	$130.00	Deposit Account

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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	15645480	Filing Date	2017-02-24	Docket Number (if applicable)	17-093-EN	Art Unit	1799
First Named Inventor	S. Edward Neister			Examiner Name	Yoo, Regina M.		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☒ Enclosed

☐ Amendment/Reply

☒ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (07-09)
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Signature of Registered U.S. Patent Practitioner			
Signature	/David J. Connaughton, Jr/	Date (YYYY-MM-DD)	2021-04-02
Name	David J. Connaughton, Jr.	Registration Number	67275

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	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
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	15	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-20 - 9,700,642 Patent Invalidity Chart - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans – Solar and Ultraviolet Radiation, by World Health Organization International Agency for Research on Cancer; March 29, 2021	
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Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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PTO/SB/08a (01-10)
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	Attorney Docket Number	17-093-EN

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

	1	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-16 - 9,700,642 Patent Invalidity Chart - UV-Lamps for Disinfection and Advanced Oxidation - Lamp Types, Technologies and Applications, by Schalk et al.; March 29, 2021	
	2	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-17 - 9,700,642 Patent Invalidity Chart - The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria: A Comparative Approach, by Sosnin et al.; March 29, 2021	
	3	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-18 - 9,700,642 Patent Invalidity Chart - Excilamps as efficient UV-VUV light sources, by Tarasenko; March 29, 2021	
	4	ADAM M. KAUFMANN; DAVID S. WOOD; MONICA M. KOVECSES; GARRET A. LEACH; ERIC D. HAYES; Exhibit F-19 - 9,700,642 Patent Invalidity Chart - Comparison of Disinfection Effects of UV Light at 172, 222, 254 nm on Bacillus subtilis Spores, by Wang; March 29, 2021	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15645480
	Filing Date	2017-07-10
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2021-04-01
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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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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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Electronic Patent Application Fee Transmittal

Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
PETITION FEE-37CFR 1.17(H) (GROUP II)	2464	1	70	70
RCE- 2ND AND SUBSEQUENT REQUEST	2820	1	1000	1000
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1070**

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Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Decision Date : April 12, 2021

In re Application of :

S. Neister

DECISION ON PETITION

UNDER CFR 1.313(c)(2)

Application No : 15645480

Filed : 10-Jul-2017

Attorney Docket No : 17-093-EN

This is an electronic decision on the petition under 37 CFR 1.313(c)(2), filed April 12, 2021 , to withdraw the above-identified application from issue after payment of the issue fee.

The petition is **GRANTED.**

The above-identified application is withdrawn from issue for consideration of a submission under 37 CFR 1.114 (request for continued examination). See 37 CFR 1.313(c)(2).

Petitioner is advised that the issue fee paid in this application cannot be refunded. If, however, this application is again allowed, petitioner may request that it be applied towards the issue fee required by the new Notice of Allowance.

Telephone inquiries concerning this decision should be directed to the Patent Electronic Business Center (EBC) at 866-217-9197.

This application file is being referred to Technology Center AU 1799 for processing of the request for continuing examination under 37 CFR 1.114 .

Office of Petitions

Electronic Acknowledgement Receipt	
EFS ID:	42426378
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	12-APR-2021
Filing Date:	10-JUL-2017
Time Stamp:	14:31:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1070
RAM confirmation Number	E20214BE31230450
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

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1	Petition automatically granted by EFS	petition-request.pdf	31688 219c2151f1317fe49c48a00e5e041df01f899b0f	no	2
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3	Request for Continued Examination (RCE)	RCE-17-093-EN-4-2-21.pdf	697673 26eaa86497ad4e900c7dbcacf6bdea4317a037a4	no	3
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6	Non Patent Literature	2021-03-29-Healthe-Contentions-Cover-Document.pdf	5307380 40e44e3d25cd66a599d0a5e69bcaea530a108071	no	176
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7	Non Patent Literature	ExE01.PDF	150494 6ddbf245d7216d00f9cb0a8754c81ef20780cc9b	no	6
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41	Non Patent Literature	ExF15.PDF	123764 483ed1446340604316e54d0ed3b0eeab8e2166e4	no	15
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42	Non Patent Literature	ExF16.PDF	407350 1fa111185d54c2e3909982553a87ec1cfdd43ad9	no	28
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43	Non Patent Literature	ExF17.PDF	268599 76f765f268b2098575b72b7578ab540d4bb1f77a	no	30
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44	Non Patent Literature	ExF18.PDF	248680 905321e33d90b3cec162c260a18017eea59a001c	no	17
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					

45	Non Patent Literature	ExF19.PDF	242652 671ccf310114c6cd4e8835a47e259216ec316701	no	22
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
46	Non Patent Literature	ExF20.PDF	221912 d6e5323d9e99a71aa6b10c486a7a6bcc46c26646	no	37
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
47	Non Patent Literature	HEALTHE00000478.PDF	20616208 5c56e93fb3353dde3841d9133e5706ec96972f7f	no	325
Warnings:					
Information:					
48	Non Patent Literature	HEALTHE00000846.PDF	966585 813a77e98f109f403caf7614e3f153ba1a5d9a27	no	6
Warnings:					
Information:					
49	Non Patent Literature	HEALTHE00000852.PDF	668687 165562444f6e02bcf034b69bbd047376f95e1cc	no	3
Warnings:					
Information:					
50	Non Patent Literature	HEALTHE00000865.PDF	641226 94b4f9a6d8e882bf3670962c71b70473287b9b75	no	8
Warnings:					
Information:					
51	Non Patent Literature	HEALTHE00000901.PDF	385882 b1e9c85674e0b8efb48b56849ce37df3d78d70d3	no	7

Warnings:					
Information:					
52	Non Patent Literature	HEALTHE00000938.PDF	2261973 b8a2776979fa36eef3e239837bd3d41e9d4c8325	no	8
Warnings:					
Information:					
53	Non Patent Literature	HEALTHE00000946.PDF	862059 62f1c2a49d42294645c80217cc1467138a86aaf7	no	5
Warnings:					
Information:					
54	Non Patent Literature	HEALTHE00000959.PDF	768630 78f8783f7f032acdf2f1cb6c40a1f4f7b7194f70	no	8
Warnings:					
Information:					
55	Non Patent Literature	HEALTHE00000967.PDF	5192597 53fba11647ed98d2698e4260f8d386ee2cc53ae3	no	6
Warnings:					
Information:					
56	Non Patent Literature	HEALTHE00000973.PDF	1092115 dbdd4ab6e7d580ddaf7b41c6a651508b67d8cb5d	no	7
Warnings:					
Information:					
57	Non Patent Literature	HEALTHE00000980.PDF	259939 48c9e7a374f8f6bfca6ff894dfa0041522a4d3d0	no	5
Warnings:					
Information:					
58	Non Patent Literature	HEALTHE00000985.PDF	5795535 b8a4ada43b52c4367c3e619a31a3193d21b5d821	no	183
Warnings:					
Information:					

59	Non Patent Literature	HEALTHE00001168.PDF	333946 fe2db10b1f674c8a7dbde6647cb5e5c330e77b45	no	8
Warnings:					
Information:					
60	Fee Worksheet (SB06)	fee-info.pdf	32518 4c8f06a8ba9034ea387af73c7e7e60b54b1de89b	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	54942046	

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.

Doc Code: PET.AUTO Document Description: Petition automatically granted by EFS-Web	PTO/SB/140 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**PETITION TO WITHDRAW AN APPLICATION FROM ISSUE AFTER PAYMENT OF THE ISSUE FEE UNDER 37 CFR 1.313(c)**
Application Number	15645480
Filing Date	10-Jul-2017
First Named Inventor	S. Neister
Art Unit	1799
Examiner Name	REGINA YOO
Attorney Docket Number	17-093-EN
Title	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

An application may be withdrawn from issue for further action upon petition by the applicant. To request that the Office withdraw an application from issue, applicant must file a petition under this section including the fee set forth in § 1.17(h) and a showing of good and sufficient reasons why withdrawal of the application from issue is necessary.

APPLICANT HEREBY PETITIONS TO WITHDRAW THIS APPLICATION FROM ISSUE UNDER 37 CFR 1.313(c).

A grantable petition requires the following items:
(1) Petition fee; and
(2) One of the following reasons:
(a) Unpatentability of one or more claims, which must be accompanied by an unequivocal statement that one or more claims are unpatentable, an amendment to such claim or claims, and an explanation as to how the amendment causes such claim or claims to be patentable;
(b) Consideration of a request for continued examination in compliance with § 1.114 (for a utility or plant application only); or
(c) Express abandonment of the application. Such express abandonment may be in favor of a continuing application, but not a CPA under 37 CFR 1.53(d).

Petition Fee

◉	Small Entity
○	Micro Entity
○	Regular Undiscounted

Reason for withdrawal from issue

◯ One or more claims are unpatentable ◉ Consideration of a request for continued examination (RCE) (List of Required Documents and Fees) ◯ Applicant hereby expressly abandons the instant application (any attorney/agent signing for this reason must have power of attorney pursuant to 37 CFR 1.32(b)).
RCE request,submission, and fee. ☐ I certify, in accordance with 37 CFR 1.4(d)(4) that : The RCE request ,submission, and fee have already been filed in the above-identified application on ☒ Are attached.
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application. ◯ An attorney or agent registered to practice before the Patent and Trademark Office, acting in a representative capacity. ◯ A sole inventor ◯ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ◯ A joint inventor; all of whom are signing this e-petition

Signature	/David Connaughton/
Name	David Connaughton
Registration Number	67275

Doc Code: QPIDS.REQ
Document Description: QuickPath Information Disclosure Statement

PTO/SB/09 (09-18)

CERTIFICATION AND REQUEST FOR CONSIDERATION OF AN INFORMATION DISCLOSURE STATEMENT FILED AFTER PAYMENT OF THE ISSUE FEE UNDER THE QPIDS PROGRAM

Non-Provisional Application Number: 15645480	Filing Date: 2017-02-24
First Named Inventor: S. Edward Neister	Title of Invention: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND P

THE UNDERSIGNED HEREBY CERTIFIES AND REQUESTS THE FOLLOWING FOR THE ABOVE-IDENTIFIED APPLICATION.

1. Consideration is requested of the information disclosure statement (IDS) submitted herewith, which is being filed after payment of the issue fee.
2. Check the box next to the appropriate selection:

   ☐ Each item of information contained in the IDS 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 IDS. See 37 CFR 1.97(e)(1).

   OR

   ☑ No item of information contained in the IDS 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 IDS was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the IDS. See 37 CFR 1.97(e)(2).

   OR

   ☐ See attached certification statement in compliance with 37 CFR 1.97(e).
3. Please charge the IDS fee set forth in 37 CFR 1.17(p) to Deposit Account No. DA120115.
4. A Petition to Withdraw from Issue After Payment of the Issue Fee (37 CFR 1.313(c)(2)), including the petition fee set forth in 37 CFR 1.17(h), is submitted herewith as a **Web-based ePetition**. **WARNING:** Do not submit the petition as a follow-on paper via EFS-Web. Submit the petition as a Web-based ePetition by signing on to EFS-Web as a registered user, selecting the radio button next to "Existing application/patent," and then selecting the radio button next to "ePetition (for automatic processing and immediate grant, if all petitions requirements are met)." Failure to use the Web-based ePetition interface will result in automatic entry of the RCE.
5. A request for continued examination (RCE) under 37 CFR 1.114 and the RCE fee under 37 CFR 1.17(e) are submitted herewith.
6. The RCE will be treated as a "conditional" RCE. In the event the examiner determines that any item of information contained in the IDS necessitates the reopening of prosecution in the application, the undersigned understands that (i) the RCE will be processed and treated as an RCE under 37 CFR 1.114 and therefore (ii) the IDS fee under 37 CFR 1.17(p) will be returned in accordance with 37 CFR 1.97(b)(4). In the event that no item of information in the IDS necessitates reopening prosecution, the undersigned understands that the RCE will not be processed and the RCE fee under 37 CFR 1.17(e) will be returned.
7. This certification and request is being filed as a **Web-based ePetition** and is not accompanied by an amendment to the application. Inclusion of an amendment will result in automatic entry of the RCE.

Signature /David J. Connaughton/	Date 4/2/21
Name (Print/Typed) David J. Connaughton	Practitioner Registration Number (If applicable) 67275

Note: *Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below.**

☐ *Total of _____ forms are submitted.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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.

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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	04/27/2021	10987437	17-093-EN	4718

32118 7590 04/07/2021

LAMBERT SHORTELL & CONNAUGHTON
100 Franklin Street
Suite 903
BOSTON, MA 02110

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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 19 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 Application Information Retrieval (PAIR) WEB site (http://pair.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 Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

S. Edward Neister, Dover, NH;

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.

IR103 (Rev. 10/09)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (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 including the Patent, advance orders and notification of maintenance fees 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.

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

LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

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 facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION:

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	Small	$600	$0	$0	$600	6/22/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS

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/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form 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 Lambert Shortell & Connaughton
2 David J. Connaughton, Jr.
3 Gary E. Lambert

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 has been filed for recordation as set forth in 37 CFR 3.11. 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. The following fee(s) are submitted:

☑ Issue Fee
☑ Publication Fee (No small entity discount permitted)
❑ Advance Order - # of Copies _____

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

❑ A check is enclosed.
☑ Payment by credit card. Form PTO-2038 is attached.
❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /David J. Connaughton, Jr./ Date 3/23/21

Typed or printed name David J. Connaughton, Jr. Registration No. 67275

This collection of information 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 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, 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. 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.

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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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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 Patent Application Fee Transmittal

Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	600	600

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**600**

Electronic Acknowledgement Receipt	
EFS ID:	42256631
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	23-MAR-2021
Filing Date:	10-JUL-2017
Time Stamp:	14:01:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$600
RAM confirmation Number	E20213ME02081852
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	Issue Fee Payment (PTO-85B)	Issue_Fee_Transmittal_Form-Neister-17-093-EN.pdf	73981 704e4dee8313a2e677f8fedc0352329875d22b83	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30943 8744eebec659079b4d6031ebb68ed1621a4e6808	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	104924		

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
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NOTICE OF ALLOWANCE AND FEE(S) DUE

32118 7590 03/22/2021
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER
YOO, REGINA M

ART UNIT	PAPER NUMBER
1799	

DATE MAILED: 03/22/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	06/22/2021

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 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity 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 and an extra copy of the form should be submitted. 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 EFS-Web.

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 including the Patent, advance orders and notification of maintenance fees 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.

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

32118 7590 03/22/2021
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

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 EFS-Web 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.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	06/22/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
YOO, REGINA M	1799	422-121000

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/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 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) ❑Advance Order - # of Copies _____

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

❑ Electronic Payment via EFS-Web ❑ 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

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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.
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.
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. _____

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.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 03/22/2021

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BOSTON, MA 02109-2004

EXAMINER	
YOO, REGINA M	
ART UNIT	PAPER NUMBER
1799	

DATE MAILED: 03/22/2021

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. 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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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.

Notice of Allowability	Application No. 15/645,480	Applicant(s) Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	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 amendment filed 1/19/2021.
   ☐ 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 1,3,6-8,10,12-13,22-23 and 28 . 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 _____.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of Pre-AIA or AIA Status

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

EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

- in line 4 of Claim 1, delete "222nm" and insert --222 nm--.

Reasons for Allowance

3. The following is an examiner's statement of reasons for allowance: the primary reason for allowance of the claims is amendment of the claims to include limitation of now cancelled claim 21 which included allowable subject matter and also due to cancellation of claims 14 and its dependent claims which overcomes the double patenting concerns. While prior art such as Sizer (5843371) discloses a process of destroying a DNA or RNA of a microorganism on or in a substance or on a surface by generating photons of a wavelength corresponding to a peak absorption wavelength of proteins, or DNA, or RNA, the wavelength being 222 nm and directing the photons to a substance or surface to be disinfected, whereby the photons are generated to destroy a plurality of chemical bonds within the proteins, DNA, or RNA of the microorganism (see paragraph 10 on pp 4-5 of Office Action mailed 11/17/2020), Sizer ('371)

does not specifically teach or suggest that the substance or surface to be disinfected is human or animal tissue. In addition, while prior art such as Wilkinson (4909254) teaches irradiating human tissue with UV radiation in the UV-C wavelength range (200 nm - 280 nm) (see Abstract, Description, Summary of the Invention), Wilkinson ('254) does not specifically teach use of 222 nm to generate photons that will destroy a plurality of chemical bonds within proteins, DNA, or RNA of microorganisms. Cumbie (20070255266; 6960201) also discloses treatment of human tissue with UV radiation in UV-C wavelength (i.e. less than 280 nm) (see '266 - Figure 5, Abstract, p. 9 [0106], Claim 2; '201 - Abstract, Claim 1), Cumbie ('266) also does not specifically teach that 222 nm wavelength is utilized to generate photons to destroy a plurality of chemical bonds within proteins, DNA, or RNA of microorganisms. Thus, it would not have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to direct photons of a wavelength 222 nm corresponding to a peak absorption wavelength of proteins, or DNA, or RNA of microorganisms to human or animal tissue in a process for destroying a DNA or RNA comprising steps as set forth in the claims.

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."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of References Cited	Application/Control No. 15/645,480	Applicant(s)/Patent Under Reexamination Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20070255266-A1	11-2007	Cumbie; William E.	A61L2/10	606/9
*	B	US-6960201-B2	11-2005	Cumbie; William Emmett	A61L2/10	128/898
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	RY
A23L3/26, 3/28	02/25/2019	RY
A23B7/015	02/25/2019	RY
B08B17/00	02/25/2019	RY
A61N5/0624	02/25/2019	RY

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

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

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		
consulted related case 14/254,957, 11/831,667	11/23/2019	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	04/22/2020	RY
EAST and PALM - Inventor Search	04/19/2020	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	04/20/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	06/05/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S25, S30, S32)	11/11/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S3,S35-S58;S73-S88)	03/13/2021	RY
EAST and PALM - Inventor Search (S5-S8,S10)	03/13/2021	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout (S14-S23, S25,S27,S29-S30,S33-S34;S60-S64,S67-S72)	03/13/2021	RY

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A61L	2/0047, 2/0011, 2/10, 9/20	04/22/2020	RY
A23L	3/26, 3/28	04/22/2020	RY
A23B	7/015	04/22/2020	RY
B08B	17/00	04/22/2020	RY
A61N	5/0624	04/22/2020	RY
UPDATED	SEARCH		
A61L	2/0047, 2/0011, 2/10, 9/20	03/13/2021	RY
A23L	3/26, 3/28	03/13/2021	RY
A23B	7/015	03/13/2021	RY
B08B	17/00	03/13/2021	RY
A61N	5/0624	03/13/2021	RY

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

CPC						
Symbol					**Type**	**Version**
A61L	/	2	/	0047	F	2013-01-01
A61N	/	5	/	0624	I	2013-01-01
B08B	/	17	/	00	I	2013-01-01
A61L	/	2	/	0011	I	2013-01-01
A23B	/	7	/	015	I	2013-01-01
A61L	/	9	/	20	I	2013-01-01
A23L	/	3	/	28	I	2013-01-01
A61L	/	2	/	10	I	2013-01-01
A23L	/	3	/	26	I	2013-01-01
A61L	/	2202	/	22	A	2013-01-01
A61N	/	2005	/	0661	A	2013-01-01
A61N	/	2005	/	0654	A	2013-01-01
A61N	/	2005	/	063	A	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	11	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	13 March 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20210313

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

INTERNATIONAL CLASSIFICATION				
CLAIMED				
A61L	/	2	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	11	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	13 March 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20210313

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

☐ 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
1	1	6	10		19	11	28								
	2		11		20										
2	3	7	12		21										
	4	8	13	9	22										
	5		14	10	23										
3	6		15		24										
4	7		16		25										
5	8		17		26										
	9		18		27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	11	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	13 March 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office Part of Paper No.: 20210313

Receipt date: 01/19/2021

OK TO ENTER: /R.M.Y/ 03/13/2021

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister | Art Unit: 1799

Filed: July 10, 2017 | Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOVEMBER 17, 2020 OFFICE ACTION

This is a response to the Office Action issued on November 17, 2020 by the U.S. Patent and Trademark Office in connection with the above-identified application. A two-month response is due on January 19, 2021. Entrance of these after-final amendments re respectfully requested because they remove formalities issues and elect allowable subject matter as indicated by the Examiner. Accordingly, this response is being timely filed.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	1	("20180353629").PN.	US-PGPUB; USPAT	OR	OFF	2021/03/13 10:49
S2	1	("20170304472").PN.	US-PGPUB; USPAT	OR	OFF	2021/03/13 10:49
S3	1	S1 and skin	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 10:49
S4	54	neister-s-edward.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 10:53
S5	4	S4 and (photons and (DNA or RNA or protein) and (human or animal)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 10:54
S6	2	S4 and (photons and (DNA or RNA or protein) and ((human or animal) with tissue)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 10:55
S7	2	S4 and (wavelength and "peak absorption" and (DNA or RNA or protein) and ((human or animal) with tissue)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 10:56
S8	3	S4 and (photons and (DNA or RNA or protein) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 10:57
S9	54	neister-s-edward.in.	US-PGPUB; USPAT; USOCR;	OR	ON	2021/03/13 11:01

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S10	3	S9 and (photons and wavelength and "chemical bonds" and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 11:01
S11	46,809	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:22
S12	1,050	S11 and (photons and (DNA or RNA or protein) and (human or animal))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:23
S13	880	S11 and (photons and (DNA or RNA or protein) and (human or animal) and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:24
S14	80	S11 and (photons and wavelength and "peak absorption" and (DNA or RNA or protein) and (human or animal) and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:25
S15	11	S11 and (photons and wavelength and "peak absorption" and (DNA or RNA or protein) and (human or animal) and tissue and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:38
S16	11	S11 and (photons and wavelength and "peak absorption" and (human or animal) and tissue and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:53

S17	12	S11 and (photons and wavelength and "peak absorption" and (human or animal) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:54
S18	12	S11 and (photons and "peak absorption" and (human or animal) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:55
S19	35	S11 and (photons and (human or animal) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 12:57
S20	12	S11 and (photons and "peak absorption" and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 13:06
S21	13	S11 and (wavelength and "peak absorption" and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 13:08
S23	11	S11 and (photons and wavelength and "peak absorption" and "222 nm" and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 13:14
S24	46,809	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 14:35
S25	28	S24 and (photons and "222 nm" and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 14:35

S26	46,809	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 16:23
S27	84	S26 and (photons and wavelength and "peak absorption" and (DNA or RNA or protein) and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 16:23
S28	124	S26 and (wavelength and "peak absorption" and (DNA or RNA or protein) and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 16:55
S29	12	S26 and (wavelength and "peak absorption" and "222 nm" and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 16:56
S30	47	S26 and (wavelength and (animal or human) and "222 nm" and tissue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:01
S31	100	S26 and (wavelength and (animal or human) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:08
S32	85	S26 and ((sterliz$3 or disinfect$3 or decontaminat$3) and wavelength and (animal or human) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:09
S33	13	S26 and ((sterliz$3 or disinfect$3 or decontaminat$3) and "peak absorption" and (animal or human) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:10

S34	20	S26 and ((sterliz$3 or disinfect$3 or decontaminat$3) and "chemical bonds" and (animal or human) and "222 nm")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:13
S35	3	(photons and wavelength and "peak absorption" and (DNA or RNA or protein) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:16
S36	2	(photons and wavelength and "peak absorption" and (animal or human) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:17
S37	2	(photons and wavelength and "chemical bonds" and (animal or human) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:18
S38	7	(photons and wavelength and "chemical bonds" and (DNA or RNA or protein) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:19
S39	10	(photons and wavelength and destroy$3 and (DNA or RNA or protein) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:22
S40	13	(wavelength and (destroy$3 with (DNA or RNA or protein)) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:27
S41	2	(wavelength and (destroy$3 with (DNA or RNA or protein)) and (animal or human) and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:27

S43	2	((destroy$3 with (DNA or RNA or protein)) and (animal or human) and tissue and "222 nm").clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:28
S44	4	(wavelength and (destroy$3 with (DNA or RNA or protein)) and tissue and absorption).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:31
S45	2	((destroy$3 with (DNA or RNA or protein)) and ((animal or human) with tissue) and "222 nm").clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:34
S48	2	((destroy$3 with (DNA or RNA or protein)) and ((animal or human) with tissue) and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:34
S49	2	((destroy$3 with (DNA or RNA or protein)) and ((animal or human) with tissue) and "peak absorption").clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 17:36
S52	1	(microorganism and (surface or substance) and wavelength and ((DNA or RNA or protein) with tissue) and disinfected).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 18:14
S53	1	(microorganism and photons and (surface or substance) and wavelength and ((DNA or RNA or protein) with tissue)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 18:14
S54	1	(microorganism and photons and wavelength and ((DNA or RNA or protein) with tissue)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 18:16

S55	1	(microorganism and "chemical bonds" and (surface or substance) and wavelength and ((DNA or RNA or protein) with tissue)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 18:16
S56	1	("peak absorption" and microorganism and (surface or substance) and wavelength and ((DNA or RNA or protein) with tissue)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 18:17
S57	1	(microorganism and "222 nm" and wavelength and ((DNA or RNA or protein) with tissue) and disinfected).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/03/13 18:17
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EAST Search History (Interference)

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S60	27	S59 and (photons and "222 nm" and tissue)	US-PGPUB; USPAT	OR	ON	2021/03/13 18:18
S61	34	S59 and (photons and "222 nm" and (animal or human))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:20
S62	18	S59 and (photons and "222 nm" and (tissue with (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:25
S63	31	S59 and ("222 nm" and (tissue with (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:26
S64	45	S59 and ("222 nm" and (tissue and (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:36
S65	119	S59 and ("peak absorption" and (tissue and (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:40

S66	118	S59 and (wavelength and "peak absorption" and (tissue and (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:40
S67	82	S59 and (photons and "peak absorption" and (tissue and (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:41
S68	84	S59 and ("peak absorption" and (tissue with (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:42
S69	84	S59 and (wavelength and "peak absorption" and (tissue with (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:42
S70	56	S59 and (photons and "peak absorption" and (tissue with (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 18:43
S71	61	S59 and (wavelength and "peak absorption" and (tissue with (animal or human)) and (DNA or RNA))	US-PGPUB; USPAT	OR	ON	2021/03/13 19:05
S72	84	S59 and ("peak absorption" and (tissue with (animal or human)))	US-PGPUB; USPAT	OR	ON	2021/03/13 19:44
S73	3	(photons and "222 nm" and tissue).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 19:55
S74	4	(photons and "222 nm" and (animal or human)).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 19:56
S75	2	(photons and "222 nm" and (tissue with (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 19:56
S76	2	("222 nm" and (tissue with (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 19:56
S77	2	("222 nm" and (tissue and (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 19:57
S78	10	("peak absorption" and (tissue and (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:00
S79	8	(wavelength and "peak absorption" and (tissue and (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:01
S80	7	("peak absorption" and (tissue with (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:01

S81	2	(photons and "peak absorption" and (tissue with (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:02
S82	2	(wavelength and "peak absorption" and (tissue with (animal or human)) and (DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:03
S83	6	(wavelength and "peak absorption" and (tissue with (animal or human))).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:03
S84	4	("chemical bonds" and photons and destroy$3 and "222 nm" and (animal or human) and (DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:14
S85	3	("chemical bonds" and photons and destroy$3 and "222 nm" and tissue and (DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:14
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S87	5	("chemical bonds" and photons and destroy$3 and "222 nm" and disinfect$3 and (DNA or RNA)).clm.	US-PGPUB; USPAT	OR	ON	2021/03/13 20:15
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3/13/2021 10:47:29 PM
C:\Users\ryoo\Documents\EAST\Workspaces\15645480 on 031321.wsp

Remarks

Applicant thanks the Office for the attention accorded to the present application in the October 28, 2016 Office Action. Claims 1, 3-16, and 18-20 were pending in the subject application.

Without prejudice or disclaimer, Applicant has herein amended claims 1, 3, 12 canceled claims 14-16, 18-19, 21, and 24-27 and added new claim 28. Upon entry of this amendment, claims 1, 3, 6-8, 10, 12-13, 22-23 and 28 will be pending in the present application.

The amendments to the claims are primarily to correct matters of form and/or clarity in response to the Office's recommendation. Applicant asserts that all claims are supported in the specification as originally filed. No new matter has been added.

The claim amendments and cancellations made herein are made solely to expedite prosecution of the instant application, and should not be construed as acquiescence to the Office's rejections. Applicant reserves the right to pursue the cancelled and/or non-elected subject matter in one or more divisional or continuation applications.

Applicant respectfully traverses all rejections and asserts that the claims are now in condition for allowance.

Claim Objections

Applicant has amended the claims to address the Examiner's objections. Accordingly, this objection is now believed to be moot.

Rejections under 35 U.S.C. § 112

The Examiner has rejected claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 as allegedly not having written description support under 35 USC 112(a). Applicant has herein amended claim 1, upon which claims 6-8, 10 and 12-13 depend, 3 and 12 and canceled claims 2, 4-5, 9, 11, 14-21 and 24-27. Therefore, Applicant respectfully asserts that this rejection has been overcome.

The Examiner has rejected claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 as allegedly being indefinite under 35 USC 112(b). Applicant has herein amended claim 1, upon which claims 6-8, 10 and 12-13 depend, 3 and 12 and canceled claims 2, 4-5, 9, 11, 14-21 and 24-27. Therefore, Applicant respectfully asserts that this rejection has been overcome.

35 U.S.C. 102 Rejections

In the present Office Action, the Examiner rejected claims 1, 6, 12, 14, 16, 19, 24 and 27 under 35 U.S.C. 102(b) as being anticipated by Sizer (5843371).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claims 3, 6 and 12 depend, and canceled claims 14, 16, 19, 24 and 27 to elect allowable subject matter of claim 21. Applicant respectfully asserts that these elements are not present in Sizer.

As such, Applicant respectfully asserts that the 35 U.S.C. 102(b) rejection based on Sizer is overcome, and respectfully requests that the Examiner remove this rejection.

Rejections under 35 U.S.C. § 103(a)

In the present Office Action, the Examiner rejected claims 7, 13, 23-24 and 25-26 under 35 U.S.C. 103(a) as being anticipated by Sizer (5843371).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claims 7, 13 and 23 depend, and canceled claims 24 and 25-26 to elect indicated allowable subject matter. Applicant respectfully asserts that these elements are not present in Sizer.

As such, Applicant respectfully asserts that the 35 U.S.C. 103(a) rejection based on Sizer is overcome, and respectfully requests that the Examiner remove this rejection.

Conclusion

Applicant again thanks the Office for the attention accorded to the present Application in the November 17, 2020 office action. Applicant has herein amended claims 1, 3, 12 canceled claims 14-16, 18-19, 21, and 24-27 and added new claim 28. Applicant asserts that based on the amendment and comments presented herein, all of the pending claims are in condition for allowance. Early and favorable action is respectfully requested.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

/David J. Connaughton, Jr./
David J. Connaughton, Jr.
USPTO Reg. #67275
Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109
(617) 720-0091

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on or in a substance or on a surface comprising the steps of:

generating photons of a wavelength corresponding to a peak absorption wavelength of[[,]] proteins, or DNA, or RNA, the wavelength being 222nm;

directing the photons to a substance or surface to be disinfected, whereby the photons are ~~selected~~ generated to destroy a plurality of chemical bonds within the proteins, DNA, or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

2. (Canceled).
3. (Currently Amended) The process of claim [[2]]1 wherein the human or animal tissue is one of blood, an organ, or a wound.
4. (Canceled).
5. (Canceled).
6. (Original) The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. (Original) The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. (Previously Presented) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. (Canceled).
10. (Original) The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
11. (Canceled).
12. (Currently Amended) The process of claim 1 wherein the step of generating photons comprises activating a lamp~~, the lamp producing a non-coherent light positioned within a case~~.

13. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.

14. -21 (Canceled).

22. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 40 mJ/cm^2 to the substance or surface to be disinfected.

23. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 60 mJ/cm^2 to the substance or surface to be disinfected.

24. -27 (Canceled).

28. (New) The process of claim 1 wherein the human or animal tissue is skin.

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister

Art Unit: 1799

Filed: July 10, 2017

Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOVEMBER 17, 2020 OFFICE ACTION

This is a response to the Office Action issued on November 17, 2020 by the U.S. Patent and Trademark Office in connection with the above-identified application. A two-month response is due on January 19, 2021. Entrance of these after-final amendments re respectfully requested because they remove formalities issues and elect allowable subject matter as indicated by the Examiner. Accordingly, this response is being timely filed.

Electronic Acknowledgement Receipt	
EFS ID:	41684937
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	19-JAN-2021
Filing Date:	10-JUL-2017
Time Stamp:	17:12:10
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		Response-FOA-11-17-20.pdf	33935 a335956b589ae56c7c2fc9393d1625c949f44a0c	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	4	6
	Claims	2	3
	Applicant Arguments/Remarks Made in an Amendment	1	1
Warnings:			
Information:			
	Total Files Size (in bytes):	33935	

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.

<u>New Applications Under 35 U.S.C. 111</u>
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.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
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/SB/06 (09-11)
Approved for use through 1/31/2014. 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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/645,480	Filing Date 07/10/2017	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

	(Column 1)	(Column 2)			
FOR	NUMBER FILED	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 $80 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $420 =	
☐ 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	01/19/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 11	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	*** 3	= 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".	/TONI R HAKIM/
*** 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
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 11/17/2020
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

NOTIFICATION DATE	DELIVERY MODE
11/17/2020	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):

info@lambertpatentlaw.com

Office Action Summary	Application No. 15/645,480	Applicant(s) Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	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 09 September 2020.

☐ 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) 1,3,6-8,10,12-16,18-19 and 21-27 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) 1,3,6-8,10,12-16,18-19 and 21-27 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 _____ 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 9/09/2020, 9/09/2020.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

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

FINAL ACTION

Response to Amendment

The amendment filed on 9/09/2020 has been received and claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 are pending.

Claim Objections

2. Claims 24 and 27 are objected to because of the following informalities:

- in line 4 of Claim 24,
  - insert --proteins,-- before "DNA", and
  - insert --,-- after "RNA";
- in line 4 of Claim 27,
  - insert --proteins,-- before "DNA", and
  - insert --,-- after "RNA".

Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention. Specifically, in Claims 1 and 14, there is no written description support for the limitation that the process destroys microorganism "in a…surface" within the Specification. As to Claims 12 and 19 there is no written description support for the limitation "a non-coherent light" within the Specification. As to Claims 24 and 27, there is no written description support for the limitation that the exposure to photons occurs "for less than 0.1 second" within the Specification.

5. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point

out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

7. In Claims 1 and 14, it is not clear what the limitation "proteins, DNA or RNA" is attempting to set forth, whether wavelength is that of proteins or DNA or RNA, or that wavelength is that of proteins in the form of DNA or RNA.

8. In Claims 24 and 27, it is not clear whether the plurality of chemical bonds of "DNA or RNA" or "proteins [and/or] DNA or RNA" are being destroyed in the microorganism.

Claim Rejections - 35 USC § 102

9. 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.

10. Claim(s) 1, 6, 12, 14, 16, 19, 24, and 27 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Sizer (5843371).

As to Claims 1 and 14, Sizer ('371) discloses a process for destroying a DNA or RNA of a microorganism on or in a substance or surface comprising the steps of:

generating (via 20) photons of a single line wavelength corresponding to a peak absorption of proteins, DNA or RNA, the wavelength being 222 nm (see Col. 5 line 53 to Col. 6 line 3, Col. 7 lines 37-39); and

directing the photons (60) to a substance or surface to be disinfected (34) (see Figure 3, Col. 7 lines 57-61, Col. 7 line 66 to Col. 8 line 4), whereby the photons are selected to

intrinsically destroy a plurality of chemical bonds within the proteins, DNA or RNA of the microorganism (see Col. 8 lines 2-5).

As to Claim 6, Sizer ('371) discloses that the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa (see Col. 8 lines 2-5, Col. 10 lines 20 and 42).

As to Claims 12 and 19, Sizer ('371) discloses that the step of generating photons comprises activating a lamp (20), the lamp (20) producing a non-coherent light (see Col. 5 line 53 to Col. 6 line 3).

As to Claim 16, Sizer ('371) discloses that the substance or surface to be disinfected is an inanimate surface (36) (see Figure 2, Col. 5 lines 25-28).

As to Claims 24 and 27, Sizer ('371) discloses that the step of directing the photons further comprises exposing the substance or surface to be disinfected (36) to the generated photons for less than 0.1 seconds to destroy the plurality of chemical bonds within the proteins, DNA or RNA, of the microorganism (see Figure 3, Col. 8 lines 2-5).

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

12. The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

13. Claims 7, 13, 23-24, and 25-26 is/are rejected under 35 U.S.C. 103 as being unpatentable over Sizer (5843371).

Sizer ('371) is relied upon for disclosure described in the rejection of claims 1 and 14 under 35 U.S.C. 102(a)(1).

While Sizer ('371) does not appear to specifically teach that the step of directing is performed for approximately two seconds or that the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected or providing a radiant dose energy of 40 mJ/cm^2 or 60 mJ/cm^2 to the substance or surface to be disinfected, it would have been well within the purview of one of ordinary skill in the art before the effective filing date of the claimed invention to perform the step of directing for approximately two seconds or to provide 540 kJ/mole of photon energy or a radiant dose energy of 40 mJ/cm^2 or 60 mJ/cm^2 to the substance or surface to be disinfected in the process of Sizer as a matter of choice in order to ensure that complete sterilization of the substance or surface. Only the expected results would be attained.

Double Patenting

14. Applicant is advised that should claim 1 (or 14) be found allowable, claim 14 (or 1) will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing,

despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 608.01(m).

Response to Arguments

15. Applicant's arguments with respect to claim(s) 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 have been considered but are moot because the new ground of rejection does not rely on any reference applied in the prior rejection of record for any teaching or matter specifically challenged in the argument.

Conclusion

16. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	
A23L3/26, 3/28	02/25/2019	
A23B7/015	02/25/2019	
B08B17/00	02/25/2019	
A61N5/0624	02/25/2019	

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

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

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		
consulted related case 14/254,957, 11/831,667	11/23/2019	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	04/22/2020	RY
EAST and PALM - Inventor Search	04/19/2020	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	04/20/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	06/05/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout (S1-S25, S30, S32)	11/11/2020	RY

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A61L	2/0047, 2/0011, 2/10, 9/20	04/22/2020	RY
A23L	3/26, 3/28	04/22/2020	RY
A23B	7/015	04/22/2020	RY
B08B	17/00	04/22/2020	RY
A61N	5/0624	04/22/2020	RY

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

✓	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	02/26/2019	11/23/2019	06/05/2020	11/11/2020					
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	3	✓	✓	✓	✓					
	4	✓	✓	✓	-					
	5	✓	✓	✓	-					
	6	✓	✓	✓	✓					
	7	✓	✓	✓	✓					
	8	✓	✓	✓	✓					
	9	✓	✓	✓	-					
	10	✓	✓	✓	✓					
	11	✓	✓	✓	-					
	12	✓	✓	✓	✓					
	13	✓	✓	✓	✓					
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	21				✓					
	22				✓					
	23				✓					
	24				✓					
	25				✓					
	26				✓					
	27				✓					

Receipt date: 09/09/2020

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
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15/645,480 - GAU: 1799
Filing Date	
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

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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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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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]
/R.M.Y/	1	2002316041	JP	A	2002-10-29	Tatsumi Hiramoto		

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NON-PATENT LITERATURE DOCUMENTS Remove

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]

EFS Web 2.1.17

Receipt date: 09/09/2020

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15/645,480 - GAU: 1799
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

/R.M.Y/	1	Ramsay, Ian A. The Synergistic Effect of Excimer and Low Pressure Mercury Lamps on the Disinfection of Flowing Water, Journal of Food Protection, Vol. 63, No. 11, 2000 Pages 1529-1533.	

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Examiner Signature	/REGINA M YOO/	Date Considered	11/10/2020

*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	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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).

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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.

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2020-09-09
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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.

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

PTO/SB/08a (01-10)
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First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

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Examiner Initial*	Cite No	Foreign Document Number[3]	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]
/R.M.Y/	1	2002316041	JP	A	2002-10-29	Tatsumi Hiramoto		

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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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/R.M.Y/	1	Ramsay, Ian A. The Synergistic Effect of Excimer and Low Pressure Mercury Lamps on the Disinfection of Flowing Water, Journal of Food Protection, Vol. 63, No. 11, 2000 Pages 1529-1533.	

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Signature	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2020-09-09
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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S3	0	S1 and ("non coherent light")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/10 20:41
S4	0	S1 and ("non coherent")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/10 20:41
S5	0	S1 and (coherent)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/10 20:41
S6	1	S1 and (light with lamp)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/10 20:41
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S13	0	S11 and ("dose energy")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 11:26
S14	1	S11 and (energy)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 11:26
S15	1	S11 and (dose)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 11:27
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S18	1	S16 and ((substance or surface) with microorganism)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 14:47
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S22	3	S19 and ("222 nanometer" or "222 nm" or "222 nanometers")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 16:24
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S24	3	S23 and ("222 nanometer" or "222 nm" or "222 nanometers")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 18:43
S25	1	S24 and dose	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2020/11/11 18:43

			EPO; JPO; DERWENT; IBM_TDB			
S26	7,921	("packaging material" or container or package) and steriliz$ and "fiber optic"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 20:20
S27	7,145	("packaging material" or container or packaging) and steriliz$ and "fiber optic"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 21:19
S28	6,026	("packaging material" or container) and steriliz$ and "fiber optic"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 21:34
S29	3,237	("packaging material" or container) and steriliz$ and "fiber optic" and (UV or ultraviolet)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 21:35
S30	8	("packaging material" or container) and steriliz$ and "fiber optic" and (UV or ultraviolet) and ("222 nanometer" or "222 nm" or "222 nanometers")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 21:35
S31	2,287	("packaging material" or container) and steriliz$ and "fiber optic" and (UV or ultraviolet) and ("light source" or lamp)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 22:54
S32	264	("packaging material" or container) and steriliz$ and (UV or ultraviolet) and (("light source" or lamp) near "fiber optic")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/11/11 22:55

EAST Search History (Interference)

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11/11/2020 11:34:01 PM
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Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister

Art Unit: 1799

Filed: July 10, 2017

Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO JUNE 10, 2020 OFFICE ACTION

This is a response to the Office Action issued on June 10, 2020 by the U.S. Patent and Trademark Office in connection with the above-identified application. A response is due on September 10, 2020. Accordingly, this response is being timely filed.

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Notice

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DESCRIPTION JP2002316041A

10 BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to a treatment method using a dielectric barrier discharge lamp as a light source for a photochemical reaction, for example, treatment of chlorofluorocarbon gas or various waste gases, clean water, sewage, and various industrial waste water. The present invention relates to an improvement in a method for treating various objects to be treated, such as the treatment or cleaning, or a film forming method for producing a hydrogenated amorphous silicon thin film used for a solar cell or the like.

17 2. Description of the Related Art As a technique related to the present invention, for example, Japanese Patent Laid-Open Publication No. 3-212183 discloses a dielectric barrier discharge (also called an ozonizer discharge). It describes a thin film manufacturing apparatus by a CVD method using ultraviolet rays emitted from a lamp, which uses a revised new edition "Discharge Handbook" issued by The Institute of Electrical Engineers of Japan, June 2001, reprint 7th edition, page 263). Further, Japanese Laid-Open Patent Publication No. 3-122287 describes a method for metallizing a substrate using ultraviolet rays emitted from a lamp using a dielectric barrier discharge. The treatment method using the dielectric barrier discharge lamp as described above has various features that the dielectric barrier discharge lamp does not have in the conventional low-pressure mercury discharge lamp and high-pressure arc discharge lamp, and therefore the characteristic treatment is required. It is useful because it can be obtained. For example, a method of manufacturing a thin film using a dielectric barrier discharge lamp is useful because a thin film for solar cells and various semiconductor elements can be manufactured with high quality.

31 The above-mentioned conventional treatment method employs a method of irradiating the treatment fluid, the object to be treated, or both of them with one kind of ultraviolet ray only once. For example, in a method of manufacturing a thin film using a dielectric barrier discharge lamp, a plurality of process gases that are processing fluids and a substrate that is an object to be processed are housed in one reaction chamber and one type of dielectric barrier discharge is used. A film was formed on a substrate by a method of irradiating the process gas with one type of ultraviolet light emitted from a lamp only once to decompose and

activate the process gas. At this time, the substrate is also irradiated with ultraviolet rays that have not been absorbed by the process gas. In the above-described conventional processing method, even if the irradiation of ultraviolet rays is repeated twice or more, the type of chemical reaction generated on the process gas and the substrate is the same as that of the first irradiation of ultraviolet rays, and only the first time. It only corresponds to the longer irradiation time of the ultraviolet rays.

44 Generally, the optimum conditions for activating, decomposing, ionizing or synthesizing a certain substance by a photochemical reaction, that is, the wavelength and intensity of ultraviolet rays to be irradiated, the temperature of the substance, etc., differ depending on the type of substance. Therefore, in the method of treating an object to be treated by bringing the object to be treated into contact with the treating fluid, at least one of the object to be treated and the treating fluid is irradiated with one kind of ultraviolet ray from the dielectric barrier discharge lamp only once. The method of irradiating and treating has a problem that the treatment is incomplete, or the treatment speed or treatment efficiency is not always sufficient.

53 SUMMARY OF THE INVENTION An object of the present invention is to provide a processing method using a dielectric barrier discharge lamp capable of performing various kinds of processing with high quality and at high speed or with high efficiency. It is to be.

56 SUMMARY OF THE INVENTION It is an object of the present invention to provide an object to be treated and a treatment fluid by means of a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths. It is achieved by providing a processing method using a dielectric barrier discharge lamp in which the contact is performed.

61 That is, in the gas treatment method for treating a gas as an object to be treated, the object to be treated and the treatment fluid are treated by using the first dielectric barrier discharge lamp and the second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp, wherein the treatment fluid comprises a fluid containing oxygen, wherein the treatment fluid is ultraviolet light from the first dielectric barrier discharge lamp. Is irradiated to generate ozone, and ultraviolet rays from the second dielectric barrier discharge lamp are irradiated to generate active oxygen, thereby treating the object to be processed.

69 In a wet cleaning method of immersing an object to be processed in water to clean the outer surface of the object to be processed, a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp radiating ultraviolet rays having different wavelengths. According to the first aspect, a treatment method using a dielectric barrier discharge lamp in which an object to be treated and a treatment fluid are brought into contact with each other, wherein the treatment fluid is a fluid containing oxygen, and the treatment fluid includes the first fluid. Of the dielectric barrier discharge lamp to generate ozone, and to irradiate the ultraviolet ray from the second dielectric barrier discharge lamp to generate active oxygen to mix the treatment fluid with the water. However, it is achieved by treating the object to be treated.

79 In addition, in the ashing method of ashing a photoresist as an object to be treated, the first

and second dielectric barrier discharge lamps that emit ultraviolet rays having different wavelengths are used to treat the object to be treated with the second dielectric barrier discharge lamp. What is claimed is: 1. A treatment method using a dielectric barrier discharge lamp in which a treatment fluid is brought into contact with the treatment fluid, wherein the treatment fluid is a fluid containing oxygen, and the treatment fluid is the first dielectric barrier discharge lamp. From the second dielectric barrier discharge lamp to generate active oxygen and treat the object to be treated. To be done.

87 Further, in the surface reforming method for surface-modifying plastic as an object to be treated, the object to be treated is treated by using a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp for treating in contact with a treatment fluid, wherein the treatment fluid comprises a fluid containing oxygen, and the object to be treated is subjected to the first dielectric treatment in a nitrogen atmosphere. Irradiating ultraviolet rays from a body barrier discharge lamp to bring the processing fluid into contact with the object to be treated, and irradiating ultraviolet rays from the second dielectric barrier discharge lamp to treat the object to be treated. Achieved by featuring.

97 Further, in a film forming method for forming a film on a substrate as an object to be processed, the object to be processed is treated with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp in which a treatment fluid is brought into contact with the treatment fluid, wherein the treatment fluid comprises a gas containing monosilane gas and methane gas, and the treatment fluid includes the first dielectric barrier discharge. The ultraviolet rays from the lamp are irradiated to decompose and activate, the processing fluid and the object to be processed are brought into contact with each other, and the ultraviolet rays from the second dielectric barrier discharge lamp are irradiated to be reactivated. This is achieved by treating the object to be treated.

107 In the sterilization method of sterilizing an object to be processed, the object to be processed and the processing fluid are brought into contact with each other by a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp, wherein the treatment fluid comprises a fluid containing oxygen, and the treatment fluid is irradiated with ultraviolet rays from the first dielectric barrier discharge lamp. To generate ozone, and to irradiate the ultraviolet rays from the second dielectric barrier discharge lamp to generate active oxygen, thereby treating the object to be treated.

115 When a dielectric barrier discharge lamp is used as a light source of ultraviolet rays when at least an object to be treated and a treating fluid are brought into contact with each other by utilizing a photochemical reaction by ultraviolet rays, conventional low pressure mercury is used. Compared with discharge lamps and high-pressure arc discharge lamps, dielectric barrier discharge lamps can generate specific ultraviolet rays with high efficiency, are almost monochromatic light, have low temperature, and have a large degree of freedom in shape. Therefore, high efficiency and high speed processing can be performed with a small device.

Further, according to the present invention, since the first dielectric barrier discharge lamp and the second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths are used, the first ultraviolet irradiation and the second ultraviolet irradiation are performed. Can be carried out under optimum conditions, and thus activation, decomposition, ionization and synthesis are carried out optimally, resulting in high efficiency and high speed processing in a small device.

128 BEST MODE FOR CARRYING OUT THE INVENTION A schematic view of a water treatment method which is a first embodiment of the present invention is shown in FIG. The box-shaped reaction vessel 5 has substantially two reaction space regions by two dielectric barrier discharge lamps 6 and 7 on a flat plate having a structure that radiates ultraviolet rays on both sides. A schematic diagram of a dielectric barrier discharge lamp is shown in FIG. A discharge space 23 is formed by the dielectrics 20 and 21 on the flat plate that transmits ultraviolet rays and the side plate 22, and the discharge space 23 is filled with a luminescent gas. When a voltage is applied to the transparent electrodes 24 and 25 made of metal mesh provided on the surfaces of the dielectrics 20 and 21 by the AC power supply 26, so-called dielectric barrier discharge, which is also called ozonizer discharge or silent discharge, occurs in the discharge space 23. Ultraviolet rays are radiated with high efficiency through the dielectrics 20 and 21 and the transparent electrodes 24 and 25. Although not shown in the drawing, the surfaces of the transparent electrodes 24 and 25 are covered with an ultraviolet-transparent resin, glass or the like to be electrically insulated, if necessary.

142 The first dielectric barrier discharge lamp 6 is filled with xenon gas as a main component of luminescent gas and emits ultraviolet rays in the wavelength range of 120 to 190 nm having a maximum value near 172 nm. The second dielectric barrier discharge lamp 7 is filled with a mixed gas of krypton and chlorine as a main component of luminescent gas, and emits ultraviolet rays in the wavelength range of 200 to 240 nm which has a maximum value near 222 nm. When the air 1 as the processing fluid is supplied to the reaction vessel 5 from the processing fluid supply port 2, the first dielectric barrier discharge lamp 6 emits a maximum value around 172 nm in the range of 120 to 190 nm. Ozone produces ozone in the reaction space region 8 from the oxygen in the air 1 by the ultraviolet rays. The ozone moves to the reaction space region 9 and is irradiated with ultraviolet rays in the wavelength range of 200 to 240 nm which has a maximum value in the vicinity of 222 nm emitted from the second dielectric barrier discharge lamp 7, and activates active oxygen atoms and oxygen. Decomposed into molecules. The active oxygen atoms and oxygen molecules are mixed with water 3, which is the object to be processed supplied from the object supply port 4 to the reaction vessel 5, and the mixed fluid in the reaction space regions 10 and 11 has the second and first parts. Ultraviolet rays from the dielectric barrier discharge lamps 7 and 6 are irradiated.

159 As a result, methanol, isopropylalcoid, etc. contained as impurities in water are decomposed and converted into harmless carbon dioxide gas, water, etc. The treated water is discharged from the outlet 12 together with the treating air.

162 As an advantage of this embodiment, firstly, since the wavelength range of ultraviolet rays for ozone generation and the wavelength range of ultraviolet rays for ozone decomposition are

made different, therefore, highly efficient treatment is possible, and secondly, In addition to the ultraviolet rays from the second dielectric barrier discharge lamp, the first derivative, methyl ethyl ketone, trichloroethylene, dodecylbenzene sulfonic acid, polyoxyethylene was added to the mixture of the object to be treated and the pretreated processing fluid. Octyl phenyl ether, trimethylamine, and tetramethylammonium hydroxide electric barrier discharge lamps can irradiate short-wavelength ultraviolet rays that cannot be generated by conventional low-pressure mercury discharge lamps or high-pressure arc lamps with high efficiency. It is difficult to decompose trimethylamine, tetramethylammonium hydroxide, etc., and thirdly, the light output characteristics of the first and second dielectric barrier discharge lamps do not change with ambient temperature, so relatively low temperature Moreover, the treatment of water, which requires a large amount of energy to keep the temperature constant, can be stably performed. Fourth, there is a great degree of freedom in changing the shapes of the first and second dielectric barrier discharge lamps. Therefore, it becomes possible to perform the first step, the second step and the subsequent steps in the immediate vicinity, so that highly efficient processing can be performed.

179 The second embodiment of the present invention is the same as the first embodiment except that the object supply port 4 is closed and the mixture of the object 3 and the processing fluid 1 is mixed and supplied from the processing fluid supply port 2. Is the way. This method has the advantage of simplifying the device.

183 The third embodiment of the present invention uses hydrogen peroxide as the processing fluid in the first or second embodiment. Hydrogen peroxide is supplied as hydrogen peroxide solution. The supplied hydrogen peroxide solution generates hydroxy radicals in the reaction space regions 8 and 9 by irradiation with ultraviolet rays. The mixture of the object to be treated and the pretreated hydrogen peroxide solution is irradiated with ultraviolet rays in the reaction space regions 10 and 11 to treat the object to be treated.

189 The fourth embodiment of the present invention is the same as the first and second embodiments, except that the material to be treated is industrial wastewater or sewage. In this embodiment as well, a pretreatment step such as separation of solid matter contained in the object to be treated may be required, but the object to be treated is treated by the same mechanism as in the first to third examples. To be done.

194 In the first to fourth examples, the object to be processed was liquid, but in the fifth example, the object to be processed in the first to fifth examples was replaced with gas. For example, when the object to be treated is a CFC-11, CFC-12, CFC-114, CFC-112, or other CFC gas that destroys the stratospheric ozone layer, and oxygen is used as the treatment fluid, it is a compound of carbon, chlorine, or fluorine. CFC can be converted into harmless lower fluororesin, carbon dioxide gas, or hydrogen chloride by the treatment method. The hydrogen chloride gas is treated as a sodium compound or the like in a separate process. Various waste gases such as industrial waste gases containing carbon tetrachloride and methyl chloroform can also be treated by the method of the sixth embodiment.

203 FIG. 3 shows a schematic diagram of a wet cleaning method which is a sixth embodiment. In the box-shaped cleaning tank 30, two flat plate-shaped dielectric barrier discharge lamps 6 and 7 having a structure that radiates ultraviolet rays on both sides are installed. The

structure of the dielectric barrier discharge lamp is substantially the same as that shown in FIG. The first dielectric barrier discharge lamp 6 is filled with xenon gas as a main component of luminescent gas and emits ultraviolet rays in the wavelength range of 120 to 190 nm having a maximum value near 172 nm. Further, the second dielectric barrier discharge lamp 7 is filled with a mixed gas of krypton and fluorine as a main component of luminescent gas, and emits ultraviolet rays in the wavelength range of 240 to 255 nm having a maximum value near 249 nm. When the air 1 as the processing fluid is supplied from the processing fluid supply port 2, the air 1 is emitted by the ultraviolet rays in the range of 120 to 190 nm having the maximum value near 172 nm emitted from the first dielectric barrier discharge lamp 6. Ozone is generated in the reaction space region 8 from the oxygen contained therein. The ozone moves to the reaction space region 9 and is irradiated with ultraviolet rays in the wavelength range of 240 to 255 nm which has a maximum value in the vicinity of 249 nm emitted from the second dielectric barrier discharge lamp 7, and activates active oxygen atoms and oxygen. Decomposed into molecules. The active oxygen atoms and oxygen molecules are mixed into the water 32 in the cleaning tank 30 through the whisk 31 provided at the bottom of the cleaning tank 30.

222 An object to be treated, for example, a plastic bottle 33 is submerged in water 32 containing ozone by a support 34, and its outer surface is cleaned by irradiation with ultraviolet rays from the first and second dielectric barrier discharge lamps. By the cleaning, printing on the outer surface of the bottle 33 can be performed with high quality. A method of rotating the plastic bottle 33, which is the object to be processed, by rotating the support tool 34, and a method of rotating the third and fourth dielectric barrier discharge lamps facing the first and second dielectric barrier discharge lamps. The processing speed can be increased by sandwiching 33.

230 FIG. 4 shows a schematic view of a method of ashing a photoresist which is a seventh embodiment. The processing fluid oxygen 1 injected into the ashing duct 40 is converted into ozone by the ultraviolet rays emitted from the first dielectric barrier discharge lamp group 41 provided in the ashing duct 40. The first dielectric barrier discharge lamp group 41 is formed by bundling a plurality of hollow coaxial cylindrical dielectric barrier discharge lamps 41a as shown in FIG. 5 on a pedestal 44. The structure of each dielectric barrier discharge lamp 41a is as follows. An aluminum foil 52 that also serves as an ultraviolet reflector and an electrode is provided inside the inner dielectric 51, and an ultraviolet-transmitting electrode 54 is provided outside an outer dielectric 53 provided coaxially with the inner dielectric 51. Is provided. The hollow cylindrical portion 55 formed by the inner dielectric 51 and the outer dielectric 53 is filled with a gas for light emission. When a voltage is applied between the electrodes 52 and 54 by the power source 26, ozonizer discharge is generated in the hollow cylindrical portion 55, and ultraviolet rays are emitted from the outer dielectric body 54.

244 Ozone generated by the ultraviolet rays emitted from the first dielectric barrier discharge lamp group 41 is converted into activated oxygen atoms by the ultraviolet rays emitted from the second dielectric barrier discharge lamp. The photoresist applied to the semiconductor substrate 43, which is the object to be processed, reacts with activated oxygen atoms under

the irradiation of ultraviolet rays from the second dielectric barrier discharge lamp group 42, and is ashed. The structure of each discharge lamp 42 a is the same as that of the discharge lamp 41 a and is attached to the pedestal 44. The distance between the lamp group 41 and the lamp group 42 can be adjusted by adjusting the positions of the two pedestals 44.

252 When the second dielectric barrier discharge lamp group 42 selects the luminescent material so as to emit ultraviolet rays having relatively long wavelengths in the range of 240 to 255 nm, 200 to 240 nm, 300 to 320 nm, the photons irradiated on the substrate 43. Is small, the substrate 43 is less likely to be damaged. Further, when the second dielectric barrier discharge lamp group 42 selects the light-emitting substance so as to emit the ultraviolet rays having a relatively short wavelength in the range of 180 to 200 nm and 160 to 190 nm, the ultraviolet rays will not absorb oxygen molecules. Since the area is large, it is possible to generate extremely high density of oxygen atoms having high chemical activity near the surface of the substrate, and since the photon energy with which the substrate 43 is irradiated is large, ions are injected and ashed. The hardened photoresist can be ashed.

262 FIG. 6 shows a schematic view of the surface modification method of the eighth embodiment. The plastic 60 as the object to be processed is installed in the first processing duct 61 filled with the atmosphere of nitrogen 62 supplied from above, and the wavelength range of 120 to 190 nm from the first dielectric barrier discharge lamp group 63. Is exposed to the ultraviolet rays of, the bonds of molecules existing on the surface are broken. After that, the plastic 60 is carried to the second processing duct 65 by the carrier device 64, and the second dielectric barrier discharge lamp group 66 in the atmosphere of oxygen or air 1 supplied from the processing fluid supply port 2. When irradiated with ultraviolet rays from - , -COOH groups and -OH groups are generated on the surface. By the above-mentioned treatment, printing and adhesion on the plastic surface can be performed with high quality. In this embodiment, since the object to be processed is in the atmosphere of atmospheric pressure or higher, there is an advantage that the object to be processed can be easily moved. When the first dielectric barrier discharge lamp group 63 radiates ultraviolet rays in the wavelength range of 107 to 165 nm from the first dielectric barrier discharge lamp group 63, it becomes possible to modify the surface of a very stable resin such as a fluororesin. ..

278 FIG. 7 shows a schematic view of the film forming method of the ninth embodiment. A first dielectric barrier discharge lamp group 63 having no window member is provided in the vicinity of the light emission gas supply port 75 provided in the upper portion of the reaction vessel 70. When the emission gas argon 74 is supplied from the emission gas supply port 75, ultraviolet rays in the wavelength range of 107 to 165 nm emitted from the excimer molecules of argon are emitted from the first dielectric barrier discharge lamp group 63. The mixed gas 1 of the processing fluid monosilane gas and methane gas supplied from the processing fluid supply port 2 is decomposed and activated by the ultraviolet rays in the wavelength range of 107 to 165 nm emitted from the first dielectric barrier discharge lamp group 63, A thin film of hydrogenated amorphous silicon carbide is formed on the surface of the substrate 71, which is the object to be processed, by being reactivated by the ultraviolet rays from the second dielectric barrier discharge lamp group 66. When a lamp that emits

ultraviolet rays having a relatively long wavelength is used as the second dielectric barrier discharge lamp group 66, the energy of photons applied to the film is small, so that the film is less damaged and a high-quality film is obtained. can get. By decomposing and activating the processing fluid with the ultraviolet rays of the first dielectric barrier discharge lamp and irradiating it with the second ultraviolet rays during the film formation, it becomes possible to form a good quality film. A mechanism for adjusting the temperature of the object to be processed is installed in the object support device 72 to adjust the temperature of the object to be processed, and the distance between the object to be processed and the first dielectric barrier discharge lamp group 63 is increased by the support tool 73. It is possible to form a higher quality film by adjusting Reference numeral 76 is an outlet for the discharge gas and the processing gas.

301 FIG. 8 shows a schematic diagram of the sterilization method of the tenth embodiment. As shown in FIG. 8, the dielectric barrier discharge lamp is configured by arranging three tubular dielectrics coaxially, and includes an inner dielectric 51, an intermediate dielectric 88 and an outer dielectric 53. A transparent electrode 82 and an outer dielectric material provided on the inner surface of an intermediate electrode 89 and an inner dielectric material 51 which are coaxially arranged to form an independent inner discharge chamber 87 and an outer discharge chamber 86 and are embedded in an intermediate dielectric material 88. This is a type of lamp in which a voltage is applied between the transparent outer electrodes 54 provided on the outer surface of 53 by AC power supplies 26a and 26b, respectively, and dielectric barrier discharge is performed in the inner discharge chamber 87 and the outer discharge chamber 86. Xenon gas is used as the light emitting gas in the inner discharge chamber 87 to radiate ultraviolet rays in the wavelength range of 120 to 190 nm, and a mixed gas of krypton and fluorine is used as the light emitting gas in the outer discharge chamber 86. Emit UV light in the wavelength range.

315 Oxygen gas 1, which is a processing fluid, is flown from one end 81 of the tubular inner dielectric 51 to generate ozone generated by ultraviolet rays in the wavelength range of 120 to 190 nm emitted from the inner discharge chamber 87 in the first reaction space 83. It is ejected from the other end 84 of the inner dielectric 51. The ozone is decomposed by ultraviolet rays in the wavelength range of 240 to 255 nm emitted from the outer discharge chamber 86 in the reaction space 85 to generate active oxygen atoms, and the active oxygen atoms are the food cup 90. Sterilize the inner surface of. Further, the ultraviolet rays in the wavelength range of 240 to 255 nm radiated from the outer discharge chamber 86 that irradiates the inner surface of the food cup 90 directly contact the inner surface of the food cup 90 because the ultraviolet light in this wavelength range has the optimum sterilizing action. Sterilization, and therefore, sterilization and disinfection can be performed in a short time.

327 As described above, according to the present invention, since the first dielectric barrier discharge lamp and the second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths are used, various treatments can be performed with high efficiency. It is possible to provide a processing method which can be performed with quality, high efficiency, and sufficient speed.

(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2002－316041
（P2002－316041A）
(43)公開日　平成14年10月29日(2002.10.29)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード*（参考）
Ｂ０１Ｊ　19/12		Ｂ０１Ｊ　19/12	Ｃ	２Ｈ０９６
Ｂ０１Ｄ　53/34	ＺＡＢ	Ｃ０１Ｂ　13/10	Ｚ	４Ｃ０５８
53/70		Ｃ０２Ｆ　1/32		４Ｄ００２
Ｃ０１Ｂ　13/10		Ｇ０３Ｆ　7/42		４Ｄ０３７
Ｃ０２Ｆ　1/32		Ｇ２１Ｋ　5/00	Ｚ	４Ｇ０４２

審査請求　有　　請求項の数６　ＯＬ　（全　８　頁）　最終頁に続く

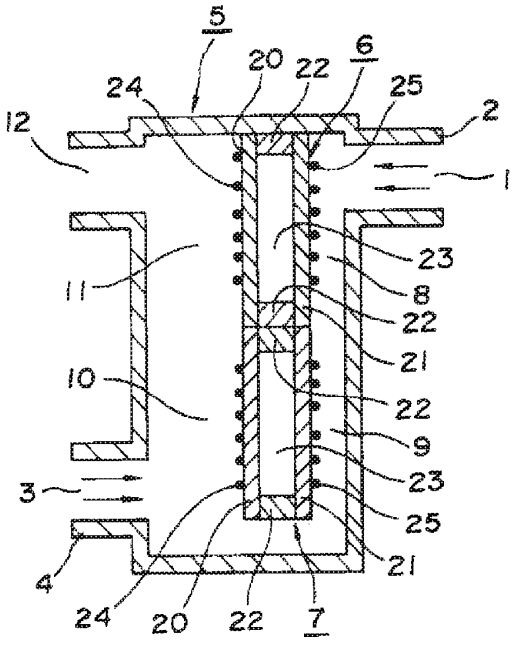
(21)出願番号　特願2002－15150(P2002－15150)
(62)分割の表示　特願平5－23534の分割
(22)出願日　平成５年１月20日(1993.1.20)

(71)出願人　000102212
ウシオ電機株式会社
東京都千代田区大手町２丁目６番１号　朝日東海ビル19階
(72)発明者　松野　博光
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内

最終頁に続く

(54)【発明の名称】　誘電体バリヤ放電ランプを使用した処理方法

(57)【要約】
【課題】　各種の処理を高品位で行い、かつ、高速度であるいは高効率で行うことが出来る誘電体バリヤ放電ランプを利用した処理方法を提供すること
【解決手段】　上記本発明の目的は、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と少なくとも酸素を含む処理用流体とを接触させ第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させる。また、第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、処理用流体と被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射し再活性化させて、前記被処理物を処理する。



1

【特許請求の範囲】

【請求項１】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としてのガスを処理するガス処理方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項２】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物を水に浸して当該被処理物の外表面を洗浄する湿式洗浄方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、該処理用流体を前記水に混入し、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項３】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としてのフォトレジストを灰化処理する灰化方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項４】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としてのプラスチックを表面改質する表面改質方法であり、

前記処理用流体は酸素を含む流体からなり、

窒素雰囲気中で前記第１の誘電体バリヤ放電ランプからの紫外線を前記被処理物に照射し、

前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

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【請求項５】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としての基板に膜を形成する成膜方法であり、

前記処理用流体はモノシランガス及びメタンガスを含むガスからなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、

前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して再活性化させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項６】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物を殺菌処理する殺菌方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、光化学反応用の光源として誘電体バリヤ放電ランプを使用した処理方法に関し、例えば、フロンガスまたは各種の廃ガスの処理、あるいは上水、下水、各種の工場廃水の処理、あるいは洗浄、あるいは太陽電池などに使用される水素化アモルファスシリコン薄膜等を製造する成膜方法など、各種被処理体を処理する方法の改良に関する。

【０００２】

【従来の技術】本発明に関連した技術としては、例えば、日本国公開特許公報平３－２１１２８３号には、誘電体バリヤ放電（別名オゾナイザ放電。電気学会発行改定新版「放電ハンドブック」平成１年６月再版７刷発行第２６３ページ参照）を使用したランプから放射される紫外線を利用したＣＶＤ法による薄膜の製造装置について記載されている。また、日本国公開特許公報平３－１２２２８７号には、誘電体バリヤ放電を使用したランプから放射される紫外線を利用した基板の金属化方法について記載されている。上記のような誘電体バリヤ放電ラ

ンプを利用した処理方法は、誘電体バリヤ放電ランプが従来の低圧水銀放電ランプや高圧アーク放電ランプには無い種々の特長を有しており、従って特長ある処理が得られるため有用である。例えば、誘電体バリヤ放電ランプを利用した薄膜の製造方法は、太陽電池、各種半導体素子用の薄膜を高品質で作製出来るため有用である。

【０００３】上記した従来の処理方法は、処理用流体あるいは被処理物又は前記両者に１種類の紫外線を１回だけ照射する方法を採用していた。例えば、誘電体バリヤ放電ランプを利用した薄膜の製造方法においては、処理用流体である複数のプロセスガスと被処理物である基板を１個の反応室内に収納し、１種類の誘電体バリヤ放電ランプから放射される１種類の紫外線を１回だけプロセスガスに照射してプロセスガスを分解、活性化する方法によって、基板上に成膜していた。なおこの時、基板にも、プロセスガスによって吸収されなかった紫外線が照射される。上記した従来の処理方法において、紫外線の照射を２回以上繰り返したとしても、プロセスガスおよび基板上に発生する化学反応の種類は１回目の紫外線を照射した時と同一であり、単に、１回目の紫外線の照射時間を長くしたことに相当するだけである。

【０００４】一般的に、ある物質を光化学反応によって活性化、分解、イオン化あるいは合成するのに最適な条件、すなわち照射する紫外線の波長と強度、物質の温度などは、物質の種類によって異なる。従って、被処理物と処理用流体を接触させて該被処理物を処理する方法において、被処理物あるいは処理用流体の少なくとも一方に誘電体バリヤ放電ランプからの１種の紫外線照射を１回だけ照射して処理する方法は、処理が不完全であったり、あるいは処理の速度あるいは処理効率が必ずしも十分ではないという問題があった。

【０００５】

【本発明が解決しようとする課題】本発明の課題は、各種の処理を高品位で行い、かつ、高速度であるいは高効率で行うことが出来る誘電体バリヤ放電ランプを利用した処理方法を提供することである。

【０００６】

【問題を解決するための手段】上記本発明の目的は、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法とすることによって達成される。

【０００７】すなわち、被処理物としてのガスを処理するガス処理方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【０００８】また、被処理物を水に浸して当該被処理物の外表面を洗浄する湿式洗浄方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、該処理用流体を前記水に混入し、前記被処理物を処理することを特徴とすることによって達成される。

【０００９】また、被処理物としてのフォトレジストを灰化処理する灰化方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１０】また、被処理物としてのプラスチックを表面改質する表面改質方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記被処理物を窒素雰囲気中で前記第１の誘電体バリヤ放電ランプからの紫外線を照射し、前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して前記被処理物を処理することを特徴とすることによって達成される。

【００１１】また、被処理物としての基板に膜を形成する成膜方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体はモノシランガス及びメタンガスを含むガスからなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して再活性化させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１２】また、被処理物を殺菌処理する殺菌方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１３】

【作用】少なくとも紫外線による光化学反応を利用しかつ被処理物と処理用流体を接触させて該被処理物を処理する際に、紫外線の光源として誘電体バリヤ放電ランプを使用すると、従来の低圧水銀放電ランプや高圧アーク放電ランプに比較して、誘電体バリヤ放電ランプが、特定の紫外線を高効率で発生できる、ほぼ単色光である、ランプの温度が低い、形状の自由度が大きいなどの特長があるので、小型の装置で高効率、高速の処理が可能になる。そして、本願発明によれば、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプを使用するので、１回目の紫外線照射、および、２回目の紫外線照射を最適な条件で行うことが可能になり、したがって、活性化、分解、イオン化および合成が最適に行われ、その結果、小型の装置で高効率、高速の処理が可能になる。

【００１４】

【発明の実施の形態】本発明の第１の実施例である水処理方法の概略図を図１に示す。箱形の反応容器５は、両面に紫外線を放射する構造の平板上の２個の誘電体バリヤ放電ランプ６，７によって実質的に２箇の反応空間領域を有している。誘電体バリヤ放電ランプの概略図を図２に示す。紫外線を透過する平板上の誘電体２０，２１と側板２２によって放電空間２３が形成されており、該放電空間２３内に発光ガスが充填されている。誘電体２０，２１の表面に設けられた金属網からなる透明電極２４，２５に交流電源２６によって電圧を印加すると、放電空間２３内にいわゆる誘電体バリヤ放電、別名オゾナイザ放電あるいは無声放電が発生して、誘電体２０，２１，透明電極２４，２５を通して、高効率で紫外線が放射される。図には示していないが、必要に応じて、透明電極２４，２５の表面を紫外線透過性の樹脂、ガラスなどで覆い電気的に絶縁する。

【００１５】第１の誘電体バリヤ放電ランプ６は、発光ガスの主成分としてキセノンガスが封入されており、１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの波長範囲の紫外線を放出する。また、第２の誘電体バリヤ放電ランプ７は、発光ガスの主成分としてクリプトンと塩素の混合ガスが封入されており、２２２ｎｍ付近で最大値を有する２００から２４０ｎｍの波長範囲の紫外線を放出する。処理用流体である空気１が処理用流体供給口２から反応容器５に供給されると、第１の誘電体バリヤ放電ランプ６から放射される１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの範囲の紫外線によって空気１中の酸素から反応空間領域８においてオゾンが生成される。該オゾンは、反応空間領域９に移動して、第２の誘電体バリヤ放電ランプ７から放射される２２２ｎｍ付近で最大値を有する２００から２４０ｎｍの波長範囲の紫外線を照射され、活性酸素原子と酸素分子に分解される。該活性酸素原子と酸素分子と、被処理物供給口４から反応容器５に供給された被処理物である水３が混合され、反応空間領域１０，１１における該混合流体に第２および第１の誘電体バリヤ放電ランプ７および６からの紫外線が照射される。

【００１６】その結果、水に不純物として含まれているメタノール、イソプロピルアルコイド等が分解され、無害な炭酸ガス、水等に変換される。処理された水は、処理用空気とともに、出口１２から排出される。

【００１７】本実施例の利点として、第１に、オゾンの生成用の紫外線の波長範囲とオゾンの分解用の紫外線の波長範囲を異ならせたので、従って高効率の処理が可能になり、第２に、被処理物と前処理された処理用流体の混合物に、第２の誘電体バリヤ放電ランプからの紫外線に加えて、第１の誘ールル、メチルエチルケトン、トリクロルエチレン、ドデシルベンゼンスルフォン酸、ポリオキシエチレンオクチルフェニルエーテル、トリメチルアミン、テトラメチルアンモニウムハイドロオキサ電体バリヤ放電ランプによって従来の低圧水銀放電ランプや高圧アークランプでは発生できない短波長の紫外線を高効率で照射することが出来るので、従来の方法では分解が困難であったトリメチルアミン、テトラメチルアンモニウムハイドロオキサイド等が分解可能になり、第３に、第１および第２の誘電体バリヤ放電ランプの光出力特性が周囲温度によって変化しないので、比較的低温度でしかも温度の一定化には多大のエネルギーが必要である水の処理を安定に行うことが出来、第４に、第１および第２の誘電体バリヤ放電ランプの形状の変更に大きな自由度があるので、第１の工程と第２の工程およびそれに続く工程を直近して行うことが可能になり、従って高効率の処理が出来るようになる。

【００１８】本発明の第２の実施例は、第１の実施例において、被処理物供給口４を閉じてしまい、被処理物３と処理用流体１の混合物を処理用流体供給口２から混合供給する方法である。この方法は装置が簡単になる利点がある。

【００１９】本発明の第３の実施例は、第１あるいは第２の実施例において、処理用流体として過酸化水素を使用したものである。過酸化水素は、過酸化水素水として供給される。供給された過酸化水素水は、反応空間領域

８，９において紫外線の照射によってヒドロキシラジカルを生成する。被処理物と該前処理された過酸化水素水の混合物に、反応空間領域１０，１１において紫外線が照射され、被処理物が処理される。

【００２０】本発明の第４の実施例は、第１から第２の実施例において、被処理物を工業廃水や、下水としたものである。この実施例においても、被処理物に含まれている固形物の分離などの前処理工程が必要になる場合があるが、第１から第３の実施例と同様の機構で被処理物が処理される。

【００２１】第１から第４までの実施例は被処理物が液体であったが、第５の実施例は第１から第５の実施例における被処理物を、ガスに置き換えたものである。例えば、被処理物を成層圏オゾン層を破壊するＣＦＣ－１１，ＣＦＣ－１２，ＣＦＣ－１１４およびＣＦＣ－１１２等のフロンガスとし、処理用流体として酸素を使用すると、炭素、塩素、フッ素の化合物であるフロンを、該処理方法によって無害な低級フッ素樹脂、炭酸ガス、或いは塩化水素に変換する事が可能になる。なお、塩化水素ガスは、別工程でナトリウム化合物等にして処理する。四塩化炭素やメチルクロロホルムなどを含む工業廃ガスなど各種の廃ガスも第６の実施例の方法で処理することが出来る。

【００２２】第６の実施例である湿式洗浄方法の概略図を図３に示す。箱形の洗浄槽３０内に、両面に紫外線を放射する構造の平板状の２個の誘電体バリヤ放電ランプ６，７が設置されている。誘電体バリヤ放電ランプの構造は、図２に示すものと実質的に同一である。第１の誘電体バリヤ放電ランプ６は、発光ガスの主成分としてキセノンガスが封入されており、１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの波長範囲の紫外線を放出する。また、第２の誘電体バリヤ放電ランプ７は、発光ガスの主成分としてクリプトンとフッ素の混合ガスが封入されており、２４９ｎｍ付近で最大値を有する２４０から２５５ｎｍの波長範囲の紫外線を放出する。処理用流体である空気１が処理用流体供給口２から供給されると、第１の誘電体バリヤ放電ランプ６から放出される１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの範囲の紫外線によって空気１中の酸素から反応空間領域８においてオゾンが生成される。該オゾンは、反応空間領域９に移動して、第２の誘電体バリヤ放電ランプ７から放射される２４９ｎｍ付近で最大値を有する２４０から２５５ｎｍの波長範囲の紫外線を照射され、活性酸素原子と酸素分子に分解される。該活性酸素原子と酸素分子は、洗浄槽３０の底に設けられた泡立て器３１を通して洗浄槽３０内の水３２のなかに混入される。

【００２３】被処理物、例えばプラスチックの瓶３３は、支持具３４によってオゾンの混入した水３２に沈められ、第１および第２の誘電体バリヤ放電ランプからの紫外線の照射によって外表面が洗浄される。該洗浄によって、瓶３３の外表面への印刷などが高品位で行えるようになる。支持具３４を回転させることにより被処理物であるプラスチックの瓶３３を回転させる方法や、第１、第２の誘電体バリヤ放電ランプに対向して第３，４の誘電体バリヤ放電ランプを瓶３３を挟むように設けることにより、処理速度を大きくすることが出来る。

【００２４】第７の実施例であるフォトレジストの灰化方法の概略図を図４に示す。灰化ダクト４０内に注入された処理用流体酸素１は、灰化ダクト４０内に設けられた第１の誘電体バリヤ放電ランプ群４１から放射される紫外線によってオゾンに変換される。第１の誘電体バリヤ放電ランプ群４１は、図５に示したような中空同軸円筒形の誘電体バリヤ放電ランプ４１ａを台座４４に複数束ねたもので、各誘電体バリヤ放電ランプ４１ａの構造は、内側誘電体５１の内側に紫外線の反射板と電極を兼ねたアルミニウム箔５２が設けてあり、該内側誘電体５１と同軸に設けられた外側誘電体５３の外側には紫外線を透過する電極５４が設けられた構造である。該内側誘電体５１と外側誘電体５３によって形成された中空円筒部５５に、発光用ガスが充填されている。電極５２，５４間に電源２６によって電圧を印加すると、中空円筒部５５にオゾナイザ放電が発生し、外側誘電体５４から紫外線が放射される。

【００２５】第１の誘電体バリヤ放電ランプ群４１から放射される紫外線によって生成されたオゾンは第２の誘電体バリヤ放電ランプからの紫外線によって活性化酸素原子に変換される。被処理物である半導体基板４３に塗布されたフォトレジストは、第２の誘電体バリヤ放電ランプ群４２からの紫外線の照射のもとに活性化酸素原子と反応し、灰化する。個々の放電ランプ４２ａの構造は、放電ランプ４１ａと同一であって、かつ台座４４に取り付けられている。２箇の台座４４の位置調節をすれば、ランプ群４１とランプ群４２の距離は調節できる。

【００２６】第２の誘電体バリヤ放電ランプ群４２が、比較的波長の長い２４０から２５５ｎｍ，２００から２４０ｎｍ，３００から３２０ｎｍの範囲の紫外線を放射するように発光物質を選択すると、基板４３に照射される光子のエネルギーが小さいので、基板４３を損傷することが少ない。また、第２の誘電体バリヤ放電ランプ群４２が、比較的波長の短い１８０から２００ｎｍ，１６０から１９０ｎｍの範囲の紫外線を放射するように発光物質を選択すると、該紫外線は、酸素分子の吸収断面積が大きいので基板表面近くにおいて化学活性の高い酸素原子の密度を極めて高く生成することが出来ることになり、かつ、基板４３に照射される光子のエネルギーが大きいので、イオンが注入されて灰化しにくくなったフォトレジストも灰化することが出来る。

【００２７】第８の実施例である表面改質方法の概略図を図６に示す。被処理物であるプラスチック６０は、上部から供給された窒素６２の雰囲気で満たされた第１の

処理ダクト６１に設置され、第１の誘電体バリヤ放電ランプ群６３からの１２０から１９０ｎｍの波長範囲の紫外線の照射をうけ、表面に存在する分子の結合が切断される。しかるのちに、プラスチック６０は、搬送装置６４によって第２の処理ダクト６５に運ばれ、処理用流体供給口２から供給された酸素もしくは空気１の雰囲気中で第２の誘電体バリヤ放電ランプ群６６からの紫外線の照射を受け、表面に－ＣＯＯＨ基、－ＯＨ基が生成される。上記のような処理によって、プラスチック表面への印刷、接着などが高品位で出来るようになる。この実施例では被処理物は大気圧以上の雰囲気にあるので、被処理物の移動が簡単であるという利点が生じる。また、第１の誘電体バリヤ放電ランプ群６３から１０７から１６５ｎｍの波長範囲の紫外線が放射されると、フッ素樹脂のような非常に安定な樹脂の表面の改質を行うことが出来るようになる。

【００２８】第９の実施例である成膜方法の概略図を図７に示す。反応容器７０の上部に設けられた発光用ガス供給口７５に近接して、窓部材を有さない第１の誘電体バリヤ放電ランプ群６３が設けられている。発光用ガス供給口７５から発光用ガスアルゴン７４が供給されると、第１の誘電体バリヤ放電ランプ群６３からアルゴンのエキシマ分子から放射される１０７から１６５ｎｍの波長範囲の紫外線が放射される。処理用流体供給口２から供給された処理用流体モノシランガスとメタンガスの混合ガス１は第１の誘電体バリヤ放電ランプ群６３から放射される１０７から１６５ｎｍの波長範囲の紫外線によって分解、活性化され、被処理物である基板７１の表面において第２の誘電体バリヤ放電ランプ群６６からの紫外線によって再活性化され水素化アモルファス炭化シリコンの薄膜を形成する。第２の誘電体バリヤ放電ランプ群６６として比較的長い波長の紫外線を放射するランプを採用すると、膜に照射される光子のエネルギーが小さいので、膜を損傷することが少なく、高品質の膜が得られる。処理用流体を第１の誘電体バリヤ放電ランプの紫外線で分解、活性化し、さらに成膜時に第２の紫外線を照射することにより、良質な膜の形成が可能になった。被処理物の支持装置７２に被処理物の温度を調整する機構を組み込み被処理物の温度を調整したり、支持具７３によって被処理物と第１の誘電体バリヤ放電ランプ群６３との距離を調整したりすることにより、さらに良質の膜を形成することが可能になる。尚、７６は放電用ガスや処理用ガスの排出口である。

【００２９】第１０の実施例である殺菌方法の概略図を図８に示す。誘電体バリヤ放電ランプは、図８に示したように、３本の管状の誘電体を同軸的に配置してなるものであって、内側誘電体５１、中間誘電体８８および外側誘電体５３を同軸に配置して独立した内側放電室８７と外側放電室８６を形成し、中間誘電体８８内に埋め込まれた中間電極８９と内側誘電体５１の内面に設けられた透明電極８２および外側誘電体５３の外面に設けられた透明外側電極５４の間にそれぞれ交流電源２６ａおよび２６ｂによって電圧を印加して、内側放電室８７と外側放電室８６で誘電体バリヤ放電を行う方式のランプである。内側放電室８７の発光用ガスとしてキセノンガスを使用して１２０から１９０ｎｍの波長範囲の紫外線を放射させ、外側放電室８６の発光用ガスとしてクリプトンとフッ素の混合ガスを使用し、２４０から２５５ｎｍの波長範囲の紫外線を放射させる。

【００３０】処理用流体である酸素ガス１を管状の内側誘電体５１の一端８１から流し込み、第１の反応空間８３内で内側放電室８７から放射された１２０から１９０ｎｍの波長範囲の紫外線によって生成したオゾンを内側誘電体５１の他の一端８４から噴出させる。該オゾンは反応空間８５内で外側放電室８６から放射された２４０から２５５ｎｍの波長範囲の紫外線によって分解され、活性な酸素原子を生成し、活性な酸素原子が被処理物である食品用カップ９０の内面を殺菌する。さらに、食品用カップ９０の内面を照射した外側放電室８６から放射された２４０から２５５ｎｍの波長範囲の紫外線は、この波長領域の紫外線は殺菌作用が最適であるため食品用カップ９０の内面を直接殺菌し、従って、短時間で殺菌、消毒を行うことが出来る。

【００３１】

【発明の効果】上記したように、本発明によれば、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプを使用したので、各種の処理を高品質で、高効率で、十分な速度で行うことができる処理方法を提供できる。

【図面の簡単な説明】

【図１】本発明を使用した水処理方法の説明図である。

【図２】誘電体バリヤ放電ランプの概略図である。

【図３】本発明を使用した湿式洗浄方法の説明図である。

【図４】本発明を使用したフォトレジストの灰化方法の説明図である。

【図５】他の構造の誘電体バリヤ放電ランプの概略図である。

【図６】本発明を使用したプラスチックの表面改質方法の説明図である。

【図７】本発明を使用した成膜方法の説明図である。

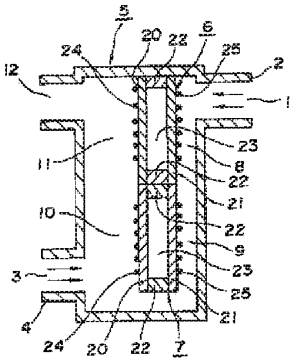
【図８】本発明を使用した殺菌方法の説明図である。

【符号の説明】

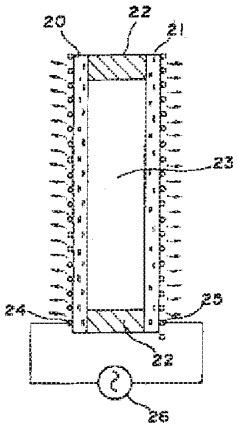
１　処理用流体
３　被処理物
６，７　誘電体バリヤ放電ランプ
８，９，１０，１１　反応空間領域
２０，２１　誘電体
２３　放電空間
２４，２５　透明電極

２６　交流電源

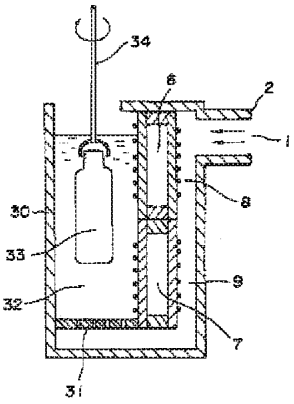
【図１】



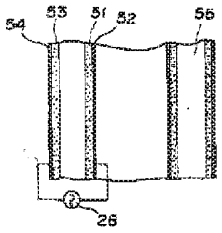
【図２】



【図３】

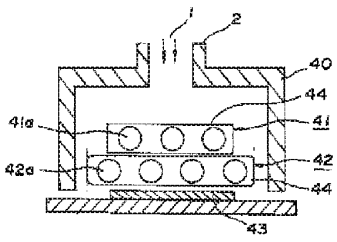


【図５】

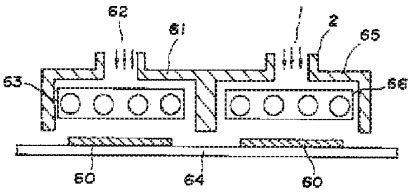


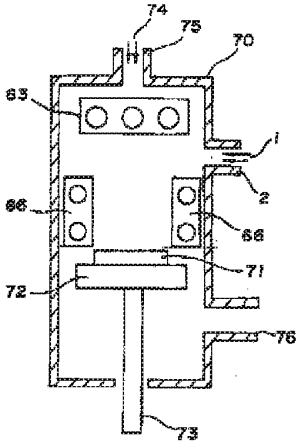
【図７】

【図４】

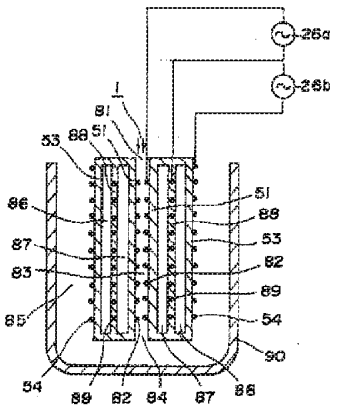


【図６】





【図８】



フロントページの続き

(51)Int.Cl.[7]	識別記号	FI		テーマコード゛(参考)
Ｇ０３Ｆ	7/42	Ｈ０１Ｊ	65/00	Ｂ　４Ｃ０７５
Ｇ２１Ｋ	5/00	Ａ６１Ｌ	2/10	
Ｈ０１Ｊ	65/00		2/20	Ｊ
// Ａ６１Ｌ	2/10	Ｂ０１Ｄ	53/34	１３４Ｅ
	2/20			ＺＡＢ

(72)発明者　五十嵐　龍志
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内
(72)発明者　平本　立躬
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内

Ｆターム(参考)　2H096 LA02 LA03
4C058 AA06 BB06 BB07 CC02 CC04 JJ14 JJ28 KK02 KK42
4D002 AA21 AA22 BA05 BA09 EA06
4D037 AA11 AB11 BA18 BB09
4G042 CA03 CE04
4G075 AA02 AA30 AA37 BA06 CA33 CA51 CA57 DA02 EB01 EB31 EC21

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Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Total in USD ($)				

Electronic Acknowledgement Receipt	
EFS ID:	40507308
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	09-SEP-2020
Filing Date:	10-JUL-2017
Time Stamp:	15:03:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$120
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2	Non Patent Literature	Ramsay.pdf	1010322 7c753b463cc7ef6651c984090af420290dadfa29	no	5
Warnings:					
Information:					
3		Response-NFOA-9-9-20.pdf	50102 37e0168f7972b0bf7795b4a1d49a87e87447354e	yes	11

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Applicant Arguments/Remarks Made in an Amendment	5	11
Claims	2	4
Amendment/Req. Reconsideration-After Non-Final Reject	1	1

Warnings:					
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4	Foreign Reference	JP2002316041-Eng2.pdf	127342 48ce4d2e901e45a0b5efd05ce0d48592f7d377ac	no	8
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5	Foreign Reference	JPA2002316041-0000002.pdf	483831 3db57653ab25e31651bbdf13104e98c0573668c9	no	8
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6	Fee Worksheet (SB06)	fee-info.pdf	30061 769380a49c92bc8e06d1c1dfb5959d2273810ce5	no	2
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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.

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

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	1	2002316041	JP	A	2002-10-29	Tatsumi Hiramoto		
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

	1	Ramsay, Ian A. The Synergistic Effect of Excimer and Low Pressure Mercury Lamps on the Disinfection of Flowing Water, Journal of Food Protection, Vol. 63, No. 11, 2000 Pages 1529-1533.	

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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	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2020-09-09
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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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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.

Remarks

Applicant thanks the Office for the attention accorded to the present application in the October 28, 2016 Office Action. Claims 1, 3-16, and 18-20 were pending in the subject application.

Without prejudice or disclaimer, Applicant has herein amended claims 1, 3, 8, 12, 14, and 19, canceled claims 4, 5, 9, 11, and 20, and has added claims 21-27. Upon entry of this amendment, claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 will be pending in the present application.

The amendments to the claims are primarily to correct matters of form and/or clarity in response to the Office's recommendation. Applicant asserts that all claims are supported in the specification as originally filed and the amendments find explicit support in the original parent case. Regarding the non-coherent light amendment, this is at least implied because the light source is described as a lamp, and the specification makes no reference to a coherent (laser) light. The use of reflectors demonstrates the non-coherence of the light, as do the details of the lamp construction as well as multi-directional use options around the lamp, such that a POSITA would understand that the written description contemplated a non-coherent light source. No new matter has been added.

The claim amendments and cancellations made herein are made solely to expedite prosecution of the instant application, and should not be construed as acquiescence to the Office's rejections. Applicant reserves the right to pursue the cancelled and/or non-elected subject matter in one or more divisional or continuation applications.

Applicant respectfully traverses all rejections and asserts that the claims are now in condition for allowance.

Information Disclosure Statement

Applicant notes that at the time of filing of the IDS, it did not have possession of any of the omitted documents, only knowledge of these documents' existence, which are behind a paywall. Therefore, applicant has satisfied its duty of disclosure. However, in the interests of complete disclosure, additional research was performed to obtain the most information readily accessible to the Applicant. This supplemental information was filed with the USPTO on June 20, 2020.

Claim Objections

Applicant has amended the claims to address the examiner's objections. Accordingly, this objection is now believed to be moot.

Rejections under 35 U.S.C. § 112

The Examiner has rejected claims 5 and 15-16 as allegedly being indefinite under 35 USC 112(b) second paragraph. Applicant has herein amended claims 15 and 16 to clarify the claims, and has canceled claim 5. Therefore, Applicant respectfully asserts that this rejection has been overcome.

35 U.S.C. 102 Rejections

In the present Office Action, the Examiner rejected claims 1, 3-6, 12, and 20 under 35 U.S.C. 102(b) as being anticipated by Coogan (7381976).

Without prejudice or disclaimer, Applicant has amended independent claims 1 and 14 upon which claims 3-6, and 12 depend to clarify the inventions contemplated therein, and has canceled claim 20. Applicant respectfully asserts that these elements are not present in Coogan. Specifically, claims 1 and 14 require only a wavelength of 222 nm. Among other distinctions, Coogan makes no teaching or suggestion of the use of 222 nm, and in fact does not even teach wavelengths close to 222 nm. Therefore, Applicant respectfully asserts that Coogan does not teach each and every element of claims 1 and 14.

As such, Applicant respectfully asserts that the 35 U.S.C. 102(b) rejection based on Coogan is overcome, and respectfully requests that the Examiner remove this rejection.

Rejections under 35 U.S.C. § 103(a)

The Examiner has rejected claims 5 and 8 under 35 U.S.C. 103(a) as being unpatentable over Coogan (7381976) as applied to claim 1 above, and further in view of Eckhardt (6730113).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claims 5 and 8 depend, to clarify the inventions contemplated therein. Among other shortcomings, Eckhardt does not teach the claim limitations of claim 1 that are missing from Coogan. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claims 5 and 8 are now patentably distinguished from Coogan in view of Eckhardt. Applicant further asserts that this claim is now in condition for allowance.

In the present Office Action, the Examiner rejected claims 7, 9, 11, and 13 under 35 U.S.C. 103(a) as being anticipated by Coogan (7381976).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claims 7, 9, 11, and 13 depend, to clarify the inventions contemplated therein. Applicant respectfully asserts that these elements are not present in Coogan.

As such, Applicant respectfully asserts that the 35 U.S.C. 103(a) rejection based on Coogan is overcome, and respectfully requests that the Examiner remove this rejection.

The Examiner has rejected claim 10 under 35 U.S.C. 103(a) as being unpatentable over Coogan (7381976) as applied to claim 1 above, and further in view of Tribelsky (8088289).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claim 10 depends, to clarify the inventions contemplated therein. Among other distinctions, Tribelsky does not teach the elements of claim 1 that are missing from Coogan. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claim 10 is now patentably distinguished from Coogan in view of Tribelsky. Applicant further asserts that this claim is now in condition for allowance.

The Examiner has rejected claims 14-16 and 18 under 35 U.S.C. 103(a) as being unpatentable over Tribelsky (WO2004011038) as applied to claim 1 above, and further in view of Coogan (7381976).

Without prejudice or disclaimer, Applicant has amended claim 14, upon which claims 15-16 and 18 depend, to clarify the inventions contemplated therein. Among other distinctions, none of Tribelsky or Coogan teach a wavelength of 222nm as required by claim 14. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claims 14-16 and 18 are now patentably distinguished from Tribelsky in view of Coogan. Applicant further asserts that this claim is now in condition for allowance.

The Examiner has rejected claim 19 under 35 U.S.C. 103(a) as being unpatentable over Tribelsky (WO2004011038) in view of Coogan (7381976) as applied to claim 14 above, and further in view of Eckhardt (6730113).

Without prejudice or disclaimer, Applicant has amended claim 14, upon which claim 19 depends, to clarify the inventions contemplated therein. Among other distinctions, Eckhardt does not teach the elements of claim 14 missing from Tribelsky and Coogan. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claim 19 is now patentably distinguished from Tribelsky in view of Coogan and Eckhardt. Applicant further asserts that this claim is now in condition for allowance.

Comments on Newly Added Claims

Applicant has added new claims 21-27. These claims further clarify and distinguish from the prior art. The claimed energy levels and time frames for disinfection are not possible using prior art disinfection technology, which is drastically less efficient compared to the claimed invention.

Comments on the Ressler Reference

Applicant wishes to address the Ressler reference (US 2005/0173652), which was cited as prior art in a parent patent case. However, with respect to claims directed to the 222nm wavelength, Applicant has previously submitted an affidavit under 37 C.F.R. 1.31 successfully antedating this reference in parent case 11/831,667. To the extent the Examiner may seek to use Ressler as a prior art reference with respect to the amended claims, her attention is directed to the parent case 11/831,667. Specifically, Examiner is directed to the 4 April 2011 affidavit and evidence antedating Ressler with respect to 222nm technology, and the 6 May 2011 Advisory Action confirming the successful antedating affidavit and evidence with respect to 222 nm. In summary, Ressler is not prior art to independent claims 1 and 14 and the claims depending therefrom.

Conclusion

Applicant again thanks the Office for the attention accorded to the present Application in the June 10, 2020 office action. Applicant has herein amended claims 1, 3, 8, 12, 14, and 19, canceled claims 4, 5, 9, 11, and 20, and has added claims 21-27. Applicant asserts that based on the amendment and comments presented herein, all of the pending claims are in condition for allowance. Early and favorable action is respectfully requested.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

/David J. Connaughton, Jr./
David J. Connaughton, Jr.
USPTO Reg. #67275
Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109
(617) 720-0091

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on or in a substance or surface comprising the steps of:

generating photons of ~~at least one~~ a wavelength corresponding to a peak absorption wavelength of , proteins, DNA or RNA, the ~~at least one~~ wavelength being ~~at least one of 207nm,~~ 222nm~~, 280nm, 282nm, and 308nm~~;

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the proteins, DNA or RNA of the microorganisms~~; and~~

~~wherein the substance or surface to be disinfected is human or animal tissue~~.

2. (Canceled).
3. (Currently Amended) The process of claim 21 wherein the human or animal tissue is one of blood, an organ, or a wound.
4. (Canceled).
5. (Canceled).
6. (Original) The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. (Original) The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. (Previously Presented) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. (Canceled).
10. (Original) The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
11. (Canceled).

12. (Currently Amended) The process of claim 1 wherein the step of generating photons comprises activating a lamp, the lamp producing a non-coherent light ~~positioned within a case~~.

13. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.

14. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on or in a substance or surface comprising the steps of:

generating photons of ~~at least two~~ a single line wavelength[[s]] corresponding to a peak absorption wavelength of proteins, DNA or RNA, the ~~at least two~~ single line wavelength[[s]] being ~~at least two of 207nm,~~ 222nm~~, 254nm, 280nm, 282nm, and 308nm~~; and

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the proteins, DNA or RNA of the microorganism~~s~~.

15. (Currently Amended) The process of claim 14 wherein the substance or surface to be disinfected is a human or animal tissue.

16. (Currently Amended) The process of claim 14 wherein the substance or surface to be disinfected is an inanimate surface.

17. (Canceled).

18. (Original) The process of claim 14 wherein the step of directing comprises passing the generated photons through a fiber optic cable.

19. (Currently Amended) The process of claim 14 wherein the step of generating photons comprises activating a lamp, the lamp producing a non-coherent light ~~positioned within a wand, and wherein the step of directing comprises positioning of the wand~~.

20. (Canceled).

21. (New) The process of claim 1 wherein the substance or surface to be disinfected is human or animal tissue.

22. (New) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 40 mJ/cm^2 to the substance or surface to be disinfected.
23. (New) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 60 mJ/cm^2 to the substance or surface to be disinfected.
24. (New) The process of claim 1 wherein the step of directing the photons further comprises exposing the substance or surface to be disinfected to the generated photons for less than 0.1 second to destroy the plurality of chemical bonds within the DNA or RNA of the microorganism.
25. (New) The process of claim 14 wherein the step of directing the photons further comprises providing a radiant dose energy of 40 mJ/cm^2 to the substance or surface to be disinfected.
26. (New) The process of claim 14 wherein the step of directing the photons further comprises providing a radiant dose energy of 60 mJ/cm^2 to the substance or surface to be disinfected.
27. (New) The process of claim 14 wherein the step of directing the photons further comprises exposing the substance or surface to be disinfected to the generated photons for less than 0.1 second to destroy the plurality of chemical bonds within the DNA or RNA of the microorganism.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/645,480	Filing Date 07/10/2017	☐ 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 $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ 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	09/09/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	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".	/TAMMY ACREE/
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

	1	Ramsay, Ian A. The Synergistic Effect of Excimer and Low Pressure Mercury Lamps on the Disinfection of Flowing Water, Journal of Food Protection, Vol. 63, No. 11, 2000 Pages 1529-1533.	

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	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2020-09-09
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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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Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister

Art Unit: 1799

Filed: July 10, 2017

Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO JUNE 10, 2020 OFFICE ACTION

This is a response to the Office Action issued on June 10, 2020 by the U.S. Patent and Trademark Office in connection with the above-identified application. A response is due on September 10, 2020. Accordingly, this response is being timely filed.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on or in a substance or surface comprising the steps of:

generating photons of ~~at least one~~ a wavelength corresponding to a peak absorption wavelength of , proteins, DNA or RNA, the ~~at least one~~ wavelength being ~~at least one of 207nm,~~ 222nm~~, 280nm, 282nm, and 308nm~~;

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the proteins, DNA or RNA of the microorganisms~~; and~~

~~wherein the substance or surface to be disinfected is human or animal tissue~~.

2. (Canceled).
3. (Currently Amended) The process of claim 21 wherein the human or animal tissue is one of blood, an organ, or a wound.
4. (Canceled).
5. (Canceled).
6. (Original) The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. (Original) The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. (Previously Presented) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. (Canceled).
10. (Original) The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
11. (Canceled).

12. (Currently Amended) The process of claim 1 wherein the step of generating photons comprises activating a lamp, the lamp producing a non-coherent light ~~positioned within a case~~.

13. (Previously Presented) The process of claim 1 wherein the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.

14. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on or in a substance or surface comprising the steps of:

generating photons of ~~at least two~~ a single line wavelength[[s]] corresponding to a peak absorption wavelength of proteins, DNA or RNA, the ~~at least two~~ single line wavelength[[s]] being ~~at least two of 207nm,~~ 222nm~~, 254nm, 280nm, 282nm, and 308nm~~; and

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the proteins, DNA or RNA of the microorganism~~s~~.

15. (Currently Amended) The process of claim 14 wherein the substance or surface to be disinfected is a human or animal tissue.

16. (Currently Amended) The process of claim 14 wherein the substance or surface to be disinfected is an inanimate surface.

17. (Canceled).

18. (Original) The process of claim 14 wherein the step of directing comprises passing the generated photons through a fiber optic cable.

19. (Currently Amended) The process of claim 14 wherein the step of generating photons comprises activating a lamp, the lamp producing a non-coherent light ~~positioned within a wand, and wherein the step of directing comprises positioning of the wand~~.

20. (Canceled).

21. (New) The process of claim 1 wherein the substance or surface to be disinfected is human or animal tissue.

22. (New) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 40 mJ/cm^2 to the substance or surface to be disinfected.
23. (New) The process of claim 1 wherein the step of directing the photons further comprises providing a radiant dose energy of 60 mJ/cm^2 to the substance or surface to be disinfected.
24. (New) The process of claim 1 wherein the step of directing the photons further comprises exposing the substance or surface to be disinfected to the generated photons for less than 0.1 second to destroy the plurality of chemical bonds within the DNA or RNA of the microorganism.
25. (New) The process of claim 14 wherein the step of directing the photons further comprises providing a radiant dose energy of 40 mJ/cm^2 to the substance or surface to be disinfected.
26. (New) The process of claim 14 wherein the step of directing the photons further comprises providing a radiant dose energy of 60 mJ/cm^2 to the substance or surface to be disinfected.
27. (New) The process of claim 14 wherein the step of directing the photons further comprises exposing the substance or surface to be disinfected to the generated photons for less than 0.1 second to destroy the plurality of chemical bonds within the DNA or RNA of the microorganism.

Remarks

Applicant thanks the Office for the attention accorded to the present application in the October 28, 2016 Office Action. Claims 1, 3-16, and 18-20 were pending in the subject application.

Without prejudice or disclaimer, Applicant has herein amended claims 1, 3, 8, 12, 14, and 19, canceled claims 4, 5, 9, 11, and 20, and has added claims 21-27. Upon entry of this amendment, claims 1, 3, 6-8, 10, 12-16, 18-19, and 21-27 will be pending in the present application.

The amendments to the claims are primarily to correct matters of form and/or clarity in response to the Office's recommendation. Applicant asserts that all claims are supported in the specification as originally filed and the amendments find explicit support in the original parent case. Regarding the non-coherent light amendment, this is at least implied because the light source is described as a lamp, and the specification makes no reference to a coherent (laser) light. The use of reflectors demonstrates the non-coherence of the light, as do the details of the lamp construction as well as multi-directional use options around the lamp, such that a POSITA would understand that the written description contemplated a non-coherent light source. No new matter has been added.

The claim amendments and cancellations made herein are made solely to expedite prosecution of the instant application, and should not be construed as acquiescence to the Office's rejections. Applicant reserves the right to pursue the cancelled and/or non-elected subject matter in one or more divisional or continuation applications.

Applicant respectfully traverses all rejections and asserts that the claims are now in condition for allowance.

Information Disclosure Statement

Applicant notes that at the time of filing of the IDS, it did not have possession of any of the omitted documents, only knowledge of these documents' existence, which are behind a paywall. Therefore, applicant has satisfied its duty of disclosure. However, in the interests of complete disclosure, additional research was performed to obtain the most information readily accessible to the Applicant. This supplemental information was filed with the USPTO on June 20, 2020.

Claim Objections

Applicant has amended the claims to address the examiner's objections. Accordingly, this objection is now believed to be moot.

Rejections under 35 U.S.C. § 112

The Examiner has rejected claims 5 and 15-16 as allegedly being indefinite under 35 USC 112(b) second paragraph. Applicant has herein amended claims 15 and 16 to clarify the claims, and has canceled claim 5. Therefore, Applicant respectfully asserts that this rejection has been overcome.

35 U.S.C. 102 Rejections

In the present Office Action, the Examiner rejected claims 1, 3-6, 12, and 20 under 35 U.S.C. 102(b) as being anticipated by Coogan (7381976).

Without prejudice or disclaimer, Applicant has amended independent claims 1 and 14 upon which claims 3-6, and 12 depend to clarify the inventions contemplated therein, and has canceled claim 20. Applicant respectfully asserts that these elements are not present in Coogan. Specifically, claims 1 and 14 require only a wavelength of 222 nm. Among other distinctions, Coogan makes no teaching or suggestion of the use of 222 nm, and in fact does not even teach wavelengths close to 222 nm. Therefore, Applicant respectfully asserts that Coogan does not teach each and every element of claims 1 and 14.

As such, Applicant respectfully asserts that the 35 U.S.C. 102(b) rejection based on Coogan is overcome, and respectfully requests that the Examiner remove this rejection.

Rejections under 35 U.S.C. § 103(a)

The Examiner has rejected claims 5 and 8 under 35 U.S.C. 103(a) as being unpatentable over Coogan (7381976) as applied to claim 1 above, and further in view of Eckhardt (6730113).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claims 5 and 8 depend, to clarify the inventions contemplated therein. Among other shortcomings, Eckhardt does not teach the claim limitations of claim 1 that are missing from Coogan. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claims 5 and 8 are now patentably distinguished from Coogan in view of Eckhardt. Applicant further asserts that this claim is now in condition for allowance.

In the present Office Action, the Examiner rejected claims 7, 9, 11, and 13 under 35 U.S.C. 103(a) as being anticipated by Coogan (7381976).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claims 7, 9, 11, and 13 depend, to clarify the inventions contemplated therein. Applicant respectfully asserts that these elements are not present in Coogan.

As such, Applicant respectfully asserts that the 35 U.S.C. 103(a) rejection based on Coogan is overcome, and respectfully requests that the Examiner remove this rejection.

The Examiner has rejected claim 10 under 35 U.S.C. 103(a) as being unpatentable over Coogan (7381976) as applied to claim 1 above, and further in view of Tribelsky (8088289).

Without prejudice or disclaimer, Applicant has amended claim 1, upon which claim 10 depends, to clarify the inventions contemplated therein. Among other distinctions, Tribelsky does not teach the elements of claim 1 that are missing from Coogan. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claim 10 is now patentably distinguished from Coogan in view of Tribelsky. Applicant further asserts that this claim is now in condition for allowance.

The Examiner has rejected claims 14-16 and 18 under 35 U.S.C. 103(a) as being unpatentable over Tribelsky (WO2004011038) as applied to claim 1 above, and further in view of Coogan (7381976).

Without prejudice or disclaimer, Applicant has amended claim 14, upon which claims 15-16 and 18 depend, to clarify the inventions contemplated therein. Among other distinctions, none of Tribelsky or Coogan teach a wavelength of 222nm as required by claim 14. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claims 14-16 and 18 are now patentably distinguished from Tribelsky in view of Coogan. Applicant further asserts that this claim is now in condition for allowance.

The Examiner has rejected claim 19 under 35 U.S.C. 103(a) as being unpatentable over Tribelsky (WO2004011038) in view of Coogan (7381976) as applied to claim 14 above, and further in view of Eckhardt (6730113).

Without prejudice or disclaimer, Applicant has amended claim 14, upon which claim 19 depends, to clarify the inventions contemplated therein. Among other distinctions, Eckhardt does not teach the elements of claim 14 missing from Tribelsky and Coogan. Therefore, the combination of references does not establish a prima facie case of obviousness under 35 U.S.C. 103(a).

Thus, Applicant respectfully asserts that claim 19 is now patentably distinguished from Tribelsky in view of Coogan and Eckhardt. Applicant further asserts that this claim is now in condition for allowance.

Comments on Newly Added Claims

Applicant has added new claims 21-27. These claims further clarify and distinguish from the prior art. The claimed energy levels and time frames for disinfection are not possible using prior art disinfection technology, which is drastically less efficient compared to the claimed invention.

Comments on the Ressler Reference

Applicant wishes to address the Ressler reference (US 2005/0173652), which was cited as prior art in a parent patent case. However, with respect to claims directed to the 222nm wavelength, Applicant has previously submitted an affidavit under 37 C.F.R. 1.31 successfully antedating this reference in parent case 11/831,667. To the extent the Examiner may seek to use Ressler as a prior art reference with respect to the amended claims, her attention is directed to the parent case 11/831,667. Specifically, Examiner is directed to the 4 April 2011 affidavit and evidence antedating Ressler with respect to 222nm technology, and the 6 May 2011 Advisory Action confirming the successful antedating affidavit and evidence with respect to 222 nm. In summary, Ressler is not prior art to independent claims 1 and 14 and the claims depending therefrom.

Conclusion

Applicant again thanks the Office for the attention accorded to the present Application in the June 10, 2020 office action. Applicant has herein amended claims 1, 3, 8, 12, 14, and 19, canceled claims 4, 5, 9, 11, and 20, and has added claims 21-27. Applicant asserts that based on the amendment and comments presented herein, all of the pending claims are in condition for allowance. Early and favorable action is respectfully requested.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

/David J. Connaughton, Jr./
David J. Connaughton, Jr.
USPTO Reg. #67275
Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109
(617) 720-0091

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DESCRIPTION JP2002316041A

10 BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to a treatment method using a dielectric barrier discharge lamp as a light source for a photochemical reaction, for example, treatment of chlorofluorocarbon gas or various waste gases, clean water, sewage, and various industrial waste water. The present invention relates to an improvement in a method for treating various objects to be treated, such as the treatment or cleaning, or a film forming method for producing a hydrogenated amorphous silicon thin film used for a solar cell or the like.

17 2. Description of the Related Art As a technique related to the present invention, for example, Japanese Patent Laid-Open Publication No. 3-212183 discloses a dielectric barrier discharge (also called an ozonizer discharge). It describes a thin film manufacturing apparatus by a CVD method using ultraviolet rays emitted from a lamp, which uses a revised new edition "Discharge Handbook" issued by The Institute of Electrical Engineers of Japan, June 2001, reprint 7th edition, page 263). Further, Japanese Laid-Open Patent Publication No. 3-122287 describes a method for metallizing a substrate using ultraviolet rays emitted from a lamp using a dielectric barrier discharge. The treatment method using the dielectric barrier discharge lamp as described above has various features that the dielectric barrier discharge lamp does not have in the conventional low-pressure mercury discharge lamp and high-pressure arc discharge lamp, and therefore the characteristic treatment is required. It is useful because it can be obtained. For example, a method of manufacturing a thin film using a dielectric barrier discharge lamp is useful because a thin film for solar cells and various semiconductor elements can be manufactured with high quality.

31 The above-mentioned conventional treatment method employs a method of irradiating the treatment fluid, the object to be treated, or both of them with one kind of ultraviolet ray only once. For example, in a method of manufacturing a thin film using a dielectric barrier discharge lamp, a plurality of process gases that are processing fluids and a substrate that is an object to be processed are housed in one reaction chamber and one type of dielectric barrier discharge is used. A film was formed on a substrate by a method of irradiating the process gas with one type of ultraviolet light emitted from a lamp only once to decompose and

activate the process gas. At this time, the substrate is also irradiated with ultraviolet rays that have not been absorbed by the process gas. In the above-described conventional processing method, even if the irradiation of ultraviolet rays is repeated twice or more, the type of chemical reaction generated on the process gas and the substrate is the same as that of the first irradiation of ultraviolet rays, and only the first time. It only corresponds to the longer irradiation time of the ultraviolet rays.

44 Generally, the optimum conditions for activating, decomposing, ionizing or synthesizing a certain substance by a photochemical reaction, that is, the wavelength and intensity of ultraviolet rays to be irradiated, the temperature of the substance, etc., differ depending on the type of substance. Therefore, in the method of treating an object to be treated by bringing the object to be treated into contact with the treating fluid, at least one of the object to be treated and the treating fluid is irradiated with one kind of ultraviolet ray from the dielectric barrier discharge lamp only once. The method of irradiating and treating has a problem that the treatment is incomplete, or the treatment speed or treatment efficiency is not always sufficient.

53 SUMMARY OF THE INVENTION An object of the present invention is to provide a processing method using a dielectric barrier discharge lamp capable of performing various kinds of processing with high quality and at high speed or with high efficiency. It is to be.

56 SUMMARY OF THE INVENTION It is an object of the present invention to provide an object to be treated and a treatment fluid by means of a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths. It is achieved by providing a processing method using a dielectric barrier discharge lamp in which the contact is performed.

61 That is, in the gas treatment method for treating a gas as an object to be treated, the object to be treated and the treatment fluid are treated by using the first dielectric barrier discharge lamp and the second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp, wherein the treatment fluid comprises a fluid containing oxygen, wherein the treatment fluid is ultraviolet light from the first dielectric barrier discharge lamp. Is irradiated to generate ozone, and ultraviolet rays from the second dielectric barrier discharge lamp are irradiated to generate active oxygen, thereby treating the object to be processed.

69 In a wet cleaning method of immersing an object to be processed in water to clean the outer surface of the object to be processed, a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp radiating ultraviolet rays having different wavelengths. According to the first aspect, a treatment method using a dielectric barrier discharge lamp in which an object to be treated and a treatment fluid are brought into contact with each other, wherein the treatment fluid is a fluid containing oxygen, and the treatment fluid includes the first fluid. Of the dielectric barrier discharge lamp to generate ozone, and to irradiate the ultraviolet ray from the second dielectric barrier discharge lamp to generate active oxygen to mix the treatment fluid with the water. However, it is achieved by treating the object to be treated.

79 In addition, in the ashing method of ashing a photoresist as an object to be treated, the first

and second dielectric barrier discharge lamps that emit ultraviolet rays having different wavelengths are used to treat the object to be treated with the second dielectric barrier discharge lamp. What is claimed is: 1. A treatment method using a dielectric barrier discharge lamp in which a treatment fluid is brought into contact with the treatment fluid, wherein the treatment fluid is a fluid containing oxygen, and the treatment fluid is the first dielectric barrier discharge lamp. From the second dielectric barrier discharge lamp to generate active oxygen and treat the object to be treated. To be done.

87 Further, in the surface reforming method for surface-modifying plastic as an object to be treated, the object to be treated is treated by using a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp for treating in contact with a treatment fluid, wherein the treatment fluid comprises a fluid containing oxygen, and the object to be treated is subjected to the first dielectric treatment in a nitrogen atmosphere. Irradiating ultraviolet rays from a body barrier discharge lamp to bring the processing fluid into contact with the object to be treated, and irradiating ultraviolet rays from the second dielectric barrier discharge lamp to treat the object to be treated. Achieved by featuring.

97 Further, in a film forming method for forming a film on a substrate as an object to be processed, the object to be processed is treated with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp in which a treatment fluid is brought into contact with the treatment fluid, wherein the treatment fluid comprises a gas containing monosilane gas and methane gas, and the treatment fluid includes the first dielectric barrier discharge. The ultraviolet rays from the lamp are irradiated to decompose and activate, the processing fluid and the object to be processed are brought into contact with each other, and the ultraviolet rays from the second dielectric barrier discharge lamp are irradiated to be reactivated. This is achieved by treating the object to be treated.

107 In the sterilization method of sterilizing an object to be processed, the object to be processed and the processing fluid are brought into contact with each other by a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths. A treatment method using a dielectric barrier discharge lamp, wherein the treatment fluid comprises a fluid containing oxygen, and the treatment fluid is irradiated with ultraviolet rays from the first dielectric barrier discharge lamp. To generate ozone, and to irradiate the ultraviolet rays from the second dielectric barrier discharge lamp to generate active oxygen, thereby treating the object to be treated.

115 When a dielectric barrier discharge lamp is used as a light source of ultraviolet rays when at least an object to be treated and a treating fluid are brought into contact with each other by utilizing a photochemical reaction by ultraviolet rays, conventional low pressure mercury is used. Compared with discharge lamps and high-pressure arc discharge lamps, dielectric barrier discharge lamps can generate specific ultraviolet rays with high efficiency, are almost monochromatic light, have low temperature, and have a large degree of freedom in shape. Therefore, high efficiency and high speed processing can be performed with a small device.

Further, according to the present invention, since the first dielectric barrier discharge lamp and the second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths are used, the first ultraviolet irradiation and the second ultraviolet irradiation are performed. Can be carried out under optimum conditions, and thus activation, decomposition, ionization and synthesis are carried out optimally, resulting in high efficiency and high speed processing in a small device.

128 BEST MODE FOR CARRYING OUT THE INVENTION A schematic view of a water treatment method which is a first embodiment of the present invention is shown in FIG. The box-shaped reaction vessel 5 has substantially two reaction space regions by two dielectric barrier discharge lamps 6 and 7 on a flat plate having a structure that radiates ultraviolet rays on both sides. A schematic diagram of a dielectric barrier discharge lamp is shown in FIG. A discharge space 23 is formed by the dielectrics 20 and 21 on the flat plate that transmits ultraviolet rays and the side plate 22, and the discharge space 23 is filled with a luminescent gas. When a voltage is applied to the transparent electrodes 24 and 25 made of metal mesh provided on the surfaces of the dielectrics 20 and 21 by the AC power supply 26, so-called dielectric barrier discharge, which is also called ozonizer discharge or silent discharge, occurs in the discharge space 23. Ultraviolet rays are radiated with high efficiency through the dielectrics 20 and 21 and the transparent electrodes 24 and 25. Although not shown in the drawing, the surfaces of the transparent electrodes 24 and 25 are covered with an ultraviolet-transparent resin, glass or the like to be electrically insulated, if necessary.

142 The first dielectric barrier discharge lamp 6 is filled with xenon gas as a main component of luminescent gas and emits ultraviolet rays in the wavelength range of 120 to 190 nm having a maximum value near 172 nm. The second dielectric barrier discharge lamp 7 is filled with a mixed gas of krypton and chlorine as a main component of luminescent gas, and emits ultraviolet rays in the wavelength range of 200 to 240 nm which has a maximum value near 222 nm. When the air 1 as the processing fluid is supplied to the reaction vessel 5 from the processing fluid supply port 2, the first dielectric barrier discharge lamp 6 emits a maximum value around 172 nm in the range of 120 to 190 nm. Ozone produces ozone in the reaction space region 8 from the oxygen in the air 1 by the ultraviolet rays. The ozone moves to the reaction space region 9 and is irradiated with ultraviolet rays in the wavelength range of 200 to 240 nm which has a maximum value in the vicinity of 222 nm emitted from the second dielectric barrier discharge lamp 7, and activates active oxygen atoms and oxygen. Decomposed into molecules. The active oxygen atoms and oxygen molecules are mixed with water 3, which is the object to be processed supplied from the object supply port 4 to the reaction vessel 5, and the mixed fluid in the reaction space regions 10 and 11 has the second and first parts. Ultraviolet rays from the dielectric barrier discharge lamps 7 and 6 are irradiated.

159 As a result, methanol, isopropylalcoid, etc. contained as impurities in water are decomposed and converted into harmless carbon dioxide gas, water, etc. The treated water is discharged from the outlet 12 together with the treating air.

162 As an advantage of this embodiment, firstly, since the wavelength range of ultraviolet rays for ozone generation and the wavelength range of ultraviolet rays for ozone decomposition are

made different, therefore, highly efficient treatment is possible, and secondly, In addition to the ultraviolet rays from the second dielectric barrier discharge lamp, the first derivative, methyl ethyl ketone, trichloroethylene, dodecylbenzene sulfonic acid, polyoxyethylene was added to the mixture of the object to be treated and the pretreated processing fluid. Octyl phenyl ether, trimethylamine, and tetramethylammonium hydroxide electric barrier discharge lamps can irradiate short-wavelength ultraviolet rays that cannot be generated by conventional low-pressure mercury discharge lamps or high-pressure arc lamps with high efficiency. It is difficult to decompose trimethylamine, tetramethylammonium hydroxide, etc., and thirdly, the light output characteristics of the first and second dielectric barrier discharge lamps do not change with ambient temperature, so relatively low temperature Moreover, the treatment of water, which requires a large amount of energy to keep the temperature constant, can be stably performed. Fourth, there is a great degree of freedom in changing the shapes of the first and second dielectric barrier discharge lamps. Therefore, it becomes possible to perform the first step, the second step and the subsequent steps in the immediate vicinity, so that highly efficient processing can be performed.

179 The second embodiment of the present invention is the same as the first embodiment except that the object supply port 4 is closed and the mixture of the object 3 and the processing fluid 1 is mixed and supplied from the processing fluid supply port 2. Is the way. This method has the advantage of simplifying the device.

183 The third embodiment of the present invention uses hydrogen peroxide as the processing fluid in the first or second embodiment. Hydrogen peroxide is supplied as hydrogen peroxide solution. The supplied hydrogen peroxide solution generates hydroxy radicals in the reaction space regions 8 and 9 by irradiation with ultraviolet rays. The mixture of the object to be treated and the pretreated hydrogen peroxide solution is irradiated with ultraviolet rays in the reaction space regions 10 and 11 to treat the object to be treated.

189 The fourth embodiment of the present invention is the same as the first and second embodiments, except that the material to be treated is industrial wastewater or sewage. In this embodiment as well, a pretreatment step such as separation of solid matter contained in the object to be treated may be required, but the object to be treated is treated by the same mechanism as in the first to third examples. To be done.

194 In the first to fourth examples, the object to be processed was liquid, but in the fifth example, the object to be processed in the first to fifth examples was replaced with gas. For example, when the object to be treated is a CFC-11, CFC-12, CFC-114, CFC-112, or other CFC gas that destroys the stratospheric ozone layer, and oxygen is used as the treatment fluid, it is a compound of carbon, chlorine, or fluorine. CFC can be converted into harmless lower fluororesin, carbon dioxide gas, or hydrogen chloride by the treatment method. The hydrogen chloride gas is treated as a sodium compound or the like in a separate process. Various waste gases such as industrial waste gases containing carbon tetrachloride and methyl chloroform can also be treated by the method of the sixth embodiment.

203 FIG. 3 shows a schematic diagram of a wet cleaning method which is a sixth embodiment. In the box-shaped cleaning tank 30, two flat plate-shaped dielectric barrier discharge lamps 6 and 7 having a structure that radiates ultraviolet rays on both sides are installed. The

structure of the dielectric barrier discharge lamp is substantially the same as that shown in FIG. The first dielectric barrier discharge lamp 6 is filled with xenon gas as a main component of luminescent gas and emits ultraviolet rays in the wavelength range of 120 to 190 nm having a maximum value near 172 nm. Further, the second dielectric barrier discharge lamp 7 is filled with a mixed gas of krypton and fluorine as a main component of luminescent gas, and emits ultraviolet rays in the wavelength range of 240 to 255 nm having a maximum value near 249 nm. When the air 1 as the processing fluid is supplied from the processing fluid supply port 2, the air 1 is emitted by the ultraviolet rays in the range of 120 to 190 nm having the maximum value near 172 nm emitted from the first dielectric barrier discharge lamp 6. Ozone is generated in the reaction space region 8 from the oxygen contained therein. The ozone moves to the reaction space region 9 and is irradiated with ultraviolet rays in the wavelength range of 240 to 255 nm which has a maximum value in the vicinity of 249 nm emitted from the second dielectric barrier discharge lamp 7, and activates active oxygen atoms and oxygen. Decomposed into molecules. The active oxygen atoms and oxygen molecules are mixed into the water 32 in the cleaning tank 30 through the whisk 31 provided at the bottom of the cleaning tank 30.

222 An object to be treated, for example, a plastic bottle 33 is submerged in water 32 containing ozone by a support 34, and its outer surface is cleaned by irradiation with ultraviolet rays from the first and second dielectric barrier discharge lamps. By the cleaning, printing on the outer surface of the bottle 33 can be performed with high quality. A method of rotating the plastic bottle 33, which is the object to be processed, by rotating the support tool 34, and a method of rotating the third and fourth dielectric barrier discharge lamps facing the first and second dielectric barrier discharge lamps. The processing speed can be increased by sandwiching 33.

230 FIG. 4 shows a schematic view of a method of ashing a photoresist which is a seventh embodiment. The processing fluid oxygen 1 injected into the ashing duct 40 is converted into ozone by the ultraviolet rays emitted from the first dielectric barrier discharge lamp group 41 provided in the ashing duct 40. The first dielectric barrier discharge lamp group 41 is formed by bundling a plurality of hollow coaxial cylindrical dielectric barrier discharge lamps 41a as shown in FIG. 5 on a pedestal 44. The structure of each dielectric barrier discharge lamp 41a is as follows. An aluminum foil 52 that also serves as an ultraviolet reflector and an electrode is provided inside the inner dielectric 51, and an ultraviolet-transmitting electrode 54 is provided outside an outer dielectric 53 provided coaxially with the inner dielectric 51. Is provided. The hollow cylindrical portion 55 formed by the inner dielectric 51 and the outer dielectric 53 is filled with a gas for light emission. When a voltage is applied between the electrodes 52 and 54 by the power source 26, ozonizer discharge is generated in the hollow cylindrical portion 55, and ultraviolet rays are emitted from the outer dielectric body 54.

244 Ozone generated by the ultraviolet rays emitted from the first dielectric barrier discharge lamp group 41 is converted into activated oxygen atoms by the ultraviolet rays emitted from the second dielectric barrier discharge lamp. The photoresist applied to the semiconductor substrate 43, which is the object to be processed, reacts with activated oxygen atoms under

the irradiation of ultraviolet rays from the second dielectric barrier discharge lamp group 42, and is ashed. The structure of each discharge lamp 42 a is the same as that of the discharge lamp 41 a and is attached to the pedestal 44. The distance between the lamp group 41 and the lamp group 42 can be adjusted by adjusting the positions of the two pedestals 44.

252 When the second dielectric barrier discharge lamp group 42 selects the luminescent material so as to emit ultraviolet rays having relatively long wavelengths in the range of 240 to 255 nm, 200 to 240 nm, 300 to 320 nm, the photons irradiated on the substrate 43. Is small, the substrate 43 is less likely to be damaged. Further, when the second dielectric barrier discharge lamp group 42 selects the light-emitting substance so as to emit the ultraviolet rays having a relatively short wavelength in the range of 180 to 200 nm and 160 to 190 nm, the ultraviolet rays will not absorb oxygen molecules. Since the area is large, it is possible to generate extremely high density of oxygen atoms having high chemical activity near the surface of the substrate, and since the photon energy with which the substrate 43 is irradiated is large, ions are injected and ashed. The hardened photoresist can be ashed.

262 FIG. 6 shows a schematic view of the surface modification method of the eighth embodiment. The plastic 60 as the object to be processed is installed in the first processing duct 61 filled with the atmosphere of nitrogen 62 supplied from above, and the wavelength range of 120 to 190 nm from the first dielectric barrier discharge lamp group 63. Is exposed to the ultraviolet rays of, the bonds of molecules existing on the surface are broken. After that, the plastic 60 is carried to the second processing duct 65 by the carrier device 64, and the second dielectric barrier discharge lamp group 66 in the atmosphere of oxygen or air 1 supplied from the processing fluid supply port 2. When irradiated with ultraviolet rays from - , -COOH groups and -OH groups are generated on the surface. By the above-mentioned treatment, printing and adhesion on the plastic surface can be performed with high quality. In this embodiment, since the object to be processed is in the atmosphere of atmospheric pressure or higher, there is an advantage that the object to be processed can be easily moved. When the first dielectric barrier discharge lamp group 63 radiates ultraviolet rays in the wavelength range of 107 to 165 nm from the first dielectric barrier discharge lamp group 63, it becomes possible to modify the surface of a very stable resin such as a fluororesin. ..

278 FIG. 7 shows a schematic view of the film forming method of the ninth embodiment. A first dielectric barrier discharge lamp group 63 having no window member is provided in the vicinity of the light emission gas supply port 75 provided in the upper portion of the reaction vessel 70. When the emission gas argon 74 is supplied from the emission gas supply port 75, ultraviolet rays in the wavelength range of 107 to 165 nm emitted from the excimer molecules of argon are emitted from the first dielectric barrier discharge lamp group 63. The mixed gas 1 of the processing fluid monosilane gas and methane gas supplied from the processing fluid supply port 2 is decomposed and activated by the ultraviolet rays in the wavelength range of 107 to 165 nm emitted from the first dielectric barrier discharge lamp group 63, A thin film of hydrogenated amorphous silicon carbide is formed on the surface of the substrate 71, which is the object to be processed, by being reactivated by the ultraviolet rays from the second dielectric barrier discharge lamp group 66. When a lamp that emits

ultraviolet rays having a relatively long wavelength is used as the second dielectric barrier discharge lamp group 66, the energy of photons applied to the film is small, so that the film is less damaged and a high-quality film is obtained. can get. By decomposing and activating the processing fluid with the ultraviolet rays of the first dielectric barrier discharge lamp and irradiating it with the second ultraviolet rays during the film formation, it becomes possible to form a good quality film. A mechanism for adjusting the temperature of the object to be processed is installed in the object support device 72 to adjust the temperature of the object to be processed, and the distance between the object to be processed and the first dielectric barrier discharge lamp group 63 is increased by the support tool 73. It is possible to form a higher quality film by adjusting Reference numeral 76 is an outlet for the discharge gas and the processing gas.

301 FIG. 8 shows a schematic diagram of the sterilization method of the tenth embodiment. As shown in FIG. 8, the dielectric barrier discharge lamp is configured by arranging three tubular dielectrics coaxially, and includes an inner dielectric 51, an intermediate dielectric 88 and an outer dielectric 53. A transparent electrode 82 and an outer dielectric material provided on the inner surface of an intermediate electrode 89 and an inner dielectric material 51 which are coaxially arranged to form an independent inner discharge chamber 87 and an outer discharge chamber 86 and are embedded in an intermediate dielectric material 88. This is a type of lamp in which a voltage is applied between the transparent outer electrodes 54 provided on the outer surface of 53 by AC power supplies 26a and 26b, respectively, and dielectric barrier discharge is performed in the inner discharge chamber 87 and the outer discharge chamber 86. Xenon gas is used as the light emitting gas in the inner discharge chamber 87 to radiate ultraviolet rays in the wavelength range of 120 to 190 nm, and a mixed gas of krypton and fluorine is used as the light emitting gas in the outer discharge chamber 86. Emit UV light in the wavelength range.

315 Oxygen gas 1, which is a processing fluid, is flown from one end 81 of the tubular inner dielectric 51 to generate ozone generated by ultraviolet rays in the wavelength range of 120 to 190 nm emitted from the inner discharge chamber 87 in the first reaction space 83. It is ejected from the other end 84 of the inner dielectric 51. The ozone is decomposed by ultraviolet rays in the wavelength range of 240 to 255 nm emitted from the outer discharge chamber 86 in the reaction space 85 to generate active oxygen atoms, and the active oxygen atoms are the food cup 90. Sterilize the inner surface of. Further, the ultraviolet rays in the wavelength range of 240 to 255 nm radiated from the outer discharge chamber 86 that irradiates the inner surface of the food cup 90 directly contact the inner surface of the food cup 90 because the ultraviolet light in this wavelength range has the optimum sterilizing action. Sterilization, and therefore, sterilization and disinfection can be performed in a short time.

327 As described above, according to the present invention, since the first dielectric barrier discharge lamp and the second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths are used, various treatments can be performed with high efficiency. It is possible to provide a processing method which can be performed with quality, high efficiency, and sufficient speed.

(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2002－316041
（P2002－316041A）
(43)公開日　平成14年10月29日(2002.10.29)

(51)Int.Cl.⁷		識別記号	ＦＩ		テーマコード*（参考）
Ｂ０１Ｊ	19/12		Ｂ０１Ｊ	19/12	Ｃ　２Ｈ０９６
Ｂ０１Ｄ	53/34	ＺＡＢ	Ｃ０１Ｂ	13/10	Ｚ　４Ｃ０５８
	53/70		Ｃ０２Ｆ	1/32	４Ｄ００２
Ｃ０１Ｂ	13/10		Ｇ０３Ｆ	7/42	４Ｄ０３７
Ｃ０２Ｆ	1/32		Ｇ２１Ｋ	5/00	Ｚ　４Ｇ０４２

審査請求　有　　請求項の数６　ＯＬ　（全　８　頁）　最終頁に続く

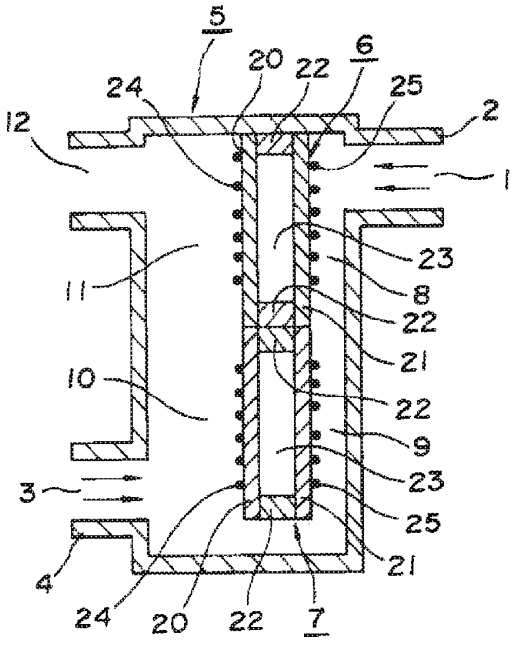
(21)出願番号　特願2002－15150(P2002－15150)
(62)分割の表示　特願平5－23534の分割
(22)出願日　平成５年１月20日(1993.1.20)

(71)出願人　000102212
ウシオ電機株式会社
東京都千代田区大手町２丁目６番１号　朝日東海ビル19階
(72)発明者　松野　博光
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内

最終頁に続く

(54)【発明の名称】　誘電体バリヤ放電ランプを使用した処理方法

(57)【要約】
【課題】　各種の処理を高品位で行い、かつ、高速度であるいは高効率で行うことが出来る誘電体バリヤ放電ランプを利用した処理方法を提供すること
【解決手段】　上記本発明の目的は、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と少なくとも酸素を含む処理用流体とを接触させ第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させる。また、第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、処理用流体と被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射し再活性化させて、前記被処理物を処理する。



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【特許請求の範囲】

【請求項１】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としてのガスを処理するガス処理方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項２】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物を水に浸して当該被処理物の外表面を洗浄する湿式洗浄方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、該処理用流体を前記水に混入し、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項３】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としてのフォトレジストを灰化処理する灰化方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項４】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としてのプラスチックを表面改質する表面改質方法であり、

前記処理用流体は酸素を含む流体からなり、

窒素雰囲気中で前記第１の誘電体バリヤ放電ランプからの紫外線を前記被処理物に照射し、

前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

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【請求項５】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物としての基板に膜を形成する成膜方法であり、

前記処理用流体はモノシランガス及びメタンガスを含むガスからなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、

前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して再活性化させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【請求項６】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記被処理物を殺菌処理する殺菌方法であり、

前記処理用流体は酸素を含む流体からなり、

前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、

前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、光化学反応用の光源として誘電体バリヤ放電ランプを使用した処理方法に関し、例えば、フロンガスまたは各種の廃ガスの処理、あるいは上水、下水、各種の工場廃水の処理、あるいは洗浄、あるいは太陽電池などに使用される水素化アモルファスシリコン薄膜等を製造する成膜方法など、各種被処理体を処理する方法の改良に関する。

【０００２】

【従来の技術】本発明に関連した技術としては、例えば、日本国公開特許公報平３－２１１２８３号には、誘電体バリヤ放電（別名オゾナイザ放電。電気学会発行改定新版「放電ハンドブック」平成１年６月再版７刷発行第２６３ページ参照）を使用したランプから放射される紫外線を利用したＣＶＤ法による薄膜の製造装置について記載されている。また、日本国公開特許公報平３－１２２２８７号には、誘電体バリヤ放電を使用したランプから放射される紫外線を利用した基板の金属化方法について記載されている。上記のような誘電体バリヤ放電ラ

ンプを利用した処理方法は、誘電体バリヤ放電ランプが従来の低圧水銀放電ランプや高圧アーク放電ランプには無い種々の特長を有しており、従って特長ある処理が得られるため有用である。例えば、誘電体バリヤ放電ランプを利用した薄膜の製造方法は、太陽電池、各種半導体素子用の薄膜を高品質で作製出来るため有用である。

【０００３】上記した従来の処理方法は、処理用流体あるいは被処理物又は前記両者に１種類の紫外線を１回だけ照射する方法を採用していた。例えば、誘電体バリヤ放電ランプを利用した薄膜の製造方法においては、処理用流体である複数のプロセスガスと被処理物である基板を１個の反応室内に収納し、１種類の誘電体バリヤ放電ランプから放射される１種類の紫外線を１回だけプロセスガスに照射してプロセスガスを分解、活性化する方法によって、基板上に成膜していた。なおこの時、基板にも、プロセスガスによって吸収されなかった紫外線が照射される。上記した従来の処理方法において、紫外線の照射を２回以上繰り返したとしても、プロセスガスおよび基板上に発生する化学反応の種類は１回目の紫外線を照射した時と同一であり、単に、１回目の紫外線の照射時間を長くしたことに相当するだけである。

【０００４】一般的に、ある物質を光化学反応によって活性化、分解、イオン化あるいは合成するのに最適な条件、すなわち照射する紫外線の波長と強度、物質の温度などは、物質の種類によって異なる。従って、被処理物と処理用流体を接触させて該被処理物を処理する方法において、被処理物あるいは処理用流体の少なくとも一方に誘電体バリヤ放電ランプからの１種の紫外線照射を１回だけ照射して処理する方法は、処理が不完全であったり、あるいは処理の速度あるいは処理効率が必ずしも十分ではないという問題があった。

【０００５】

【本発明が解決しようとする課題】本発明の課題は、各種の処理を高品位で行い、かつ、高速度であるいは高効率で行うことが出来る誘電体バリヤ放電ランプを利用した処理方法を提供することである。

【０００６】

【問題を解決するための手段】上記本発明の目的は、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法とすることによって達成される。

【０００７】すなわち、被処理物としてのガスを処理するガス処理方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【０００８】また、被処理物を水に浸して当該被処理物の外表面を洗浄する湿式洗浄方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、該処理用流体を前記水に混入し、前記被処理物を処理することを特徴とすることによって達成される。

【０００９】また、被処理物としてのフォトレジストを灰化処理する灰化方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１０】また、被処理物としてのプラスチックを表面改質する表面改質方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記被処理物を窒素雰囲気中で前記第１の誘電体バリヤ放電ランプからの紫外線を照射し、前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して前記被処理物を処理することを特徴とすることによって達成される。

【００１１】また、被処理物としての基板に膜を形成する成膜方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体はモノシランガス及びメタンガスを含むガスからなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して再活性化させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１２】また、被処理物を殺菌処理する殺菌方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１３】

【作用】少なくとも紫外線による光化学反応を利用しかつ被処理物と処理用流体を接触させて該被処理物を処理する際に、紫外線の光源として誘電体バリヤ放電ランプを使用すると、従来の低圧水銀放電ランプや高圧アーク放電ランプに比較して、誘電体バリヤ放電ランプが、特定の紫外線を高効率で発生できる、ほぼ単色光である、ランプの温度が低い、形状の自由度が大きいなどの特長があるので、小型の装置で高効率、高速の処理が可能になる。そして、本願発明によれば、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプを使用するので、１回目の紫外線照射、および、２回目の紫外線照射を最適な条件で行うことが可能になり、したがって、活性化、分解、イオン化および合成が最適に行われ、その結果、小型の装置で高効率、高速の処理が可能になる。

【００１４】

【発明の実施の形態】本発明の第１の実施例である水処理方法の概略図を図１に示す。箱形の反応容器５は、両面に紫外線を放射する構造の平板上の２個の誘電体バリヤ放電ランプ６，７によって実質的に２箇の反応空間領域を有している。誘電体バリヤ放電ランプの概略図を図２に示す。紫外線を透過する平板上の誘電体２０，２１と側板２２によって放電空間２３が形成されており、該放電空間２３内に発光ガスが充填されている。誘電体２０，２１の表面に設けられた金属網からなる透明電極２４，２５に交流電源２６によって電圧を印加すると、放電空間２３内にいわゆる誘電体バリヤ放電、別名オゾナイザ放電あるいは無声放電が発生して、誘電体２０，２１，透明電極２４，２５を通して、高効率で紫外線が放射される。図には示していないが、必要に応じて、透明電極２４，２５の表面を紫外線透過性の樹脂、ガラスなどで覆い電気的に絶縁する。

【００１５】第１の誘電体バリヤ放電ランプ６は、発光ガスの主成分としてキセノンガスが封入されており、１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの波長範囲の紫外線を放出する。また、第２の誘電体バリヤ放電ランプ７は、発光ガスの主成分としてクリプトンと塩素の混合ガスが封入されており、２２２ｎｍ付近で最大値を有する２００から２４０ｎｍの波長範囲の紫外線を放出する。処理用流体である空気１が処理用流体供給口２から反応容器５に供給されると、第１の誘電体バリヤ放電ランプ６から放射される１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの範囲の紫外線によって空気１中の酸素から反応空間領域８においてオゾンが生成される。該オゾンは、反応空間領域９に移動して、第２の誘電体バリヤ放電ランプ７から放射される２２２ｎｍ付近で最大値を有する２００から２４０ｎｍの波長範囲の紫外線を照射され、活性酸素原子と酸素分子に分解される。該活性酸素原子と酸素分子と、被処理物供給口４から反応容器５に供給された被処理物である水３が混合され、反応空間領域１０，１１における該混合流体に第２および第１の誘電体バリヤ放電ランプ７および６からの紫外線が照射される。

【００１６】その結果、水に不純物として含まれているメタノール、イソプロピルアルコイド等が分解され、無害な炭酸ガス、水等に変換される。処理された水は、処理用空気とともに、出口１２から排出される。

【００１７】本実施例の利点として、第１に、オゾンの生成用の紫外線の波長範囲とオゾンの分解用の紫外線の波長範囲を異ならせたので、従って高効率の処理が可能になり、第２に、被処理物と前処理された処理用流体の混合物に、第２の誘電体バリヤ放電ランプからの紫外線に加えて、第１の誘ールル、メチルエチルケトン、トリクロルエチレン、ドデシルベンゼンスルフォン酸、ポリオキシエチレンオクチルフェニルエーテル、トリメチルアミン、テトラメチルアンモニウムハイドロオキサ電体バリヤ放電ランプによって従来の低圧水銀放電ランプや高圧アークランプでは発生できない短波長の紫外線を高効率で照射することが出来るので、従来の方法では分解が困難であったトリメチルアミン、テトラメチルアンモニウムハイドロオキサイド等が分解可能になり、第３に、第１および第２の誘電体バリヤ放電ランプの光出力特性が周囲温度によって変化しないので、比較的低温度でしかも温度の一定化には多大のエネルギーが必要である水の処理を安定に行うことが出来、第４に、第１および第２の誘電体バリヤ放電ランプの形状の変更に大きな自由度があるので、第１の工程と第２の工程およびそれに続く工程を直近して行うことが可能になり、従って高効率の処理が出来るようになる。

【００１８】本発明の第２の実施例は、第１の実施例において、被処理物供給口４を閉じてしまい、被処理物３と処理用流体１の混合物を処理用流体供給口２から混合供給する方法である。この方法は装置が簡単になる利点がある。

【００１９】本発明の第３の実施例は、第１あるいは第２の実施例において、処理用流体として過酸化水素を使用したものである。過酸化水素は、過酸化水素水として供給される。供給された過酸化水素水は、反応空間領域

８，９において紫外線の照射によってヒドロキシラジカルを生成する。被処理物と該前処理された過酸化水素水の混合物に、反応空間領域１０，１１において紫外線が照射され、被処理物が処理される。

【００２０】本発明の第４の実施例は、第１から第２の実施例において、被処理物を工業廃水や、下水としたものである。この実施例においても、被処理物に含まれている固形物の分離などの前処理工程が必要になる場合があるが、第１から第３の実施例と同様の機構で被処理物が処理される。

【００２１】第１から第４までの実施例は被処理物が液体であったが、第５の実施例は第１から第５の実施例における被処理物を、ガスに置き換えたものである。例えば、被処理物を成層圏オゾン層を破壊するＣＦＣ－１１，ＣＦＣ－１２，ＣＦＣ－１１４およびＣＦＣ－１１２等のフロンガスとし、処理用流体として酸素を使用すると、炭素、塩素、フッ素の化合物であるフロンを、該処理方法によって無害な低級フッ素樹脂、炭酸ガス、或いは塩化水素に変換する事が可能になる。なお、塩化水素ガスは、別工程でナトリウム化合物等にして処理する。四塩化炭素やメチルクロロホルムなどを含む工業廃ガスなど各種の廃ガスも第６の実施例の方法で処理することが出来る。

【００２２】第６の実施例である湿式洗浄方法の概略図を図３に示す。箱形の洗浄槽３０内に、両面に紫外線を放射する構造の平板状の２個の誘電体バリヤ放電ランプ６，７が設置されている。誘電体バリヤ放電ランプの構造は、図２に示すものと実質的に同一である。第１の誘電体バリヤ放電ランプ６は、発光ガスの主成分としてキセノンガスが封入されており、１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの波長範囲の紫外線を放出する。また、第２の誘電体バリヤ放電ランプ７は、発光ガスの主成分としてクリプトンとフッ素の混合ガスが封入されており、２４９ｎｍ付近で最大値を有する２４０から２５５ｎｍの波長範囲の紫外線を放出する。処理用流体である空気１が処理用流体供給口２から供給されると、第１の誘電体バリヤ放電ランプ６から放出される１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの範囲の紫外線によって空気１中の酸素から反応空間領域８においてオゾンが生成される。該オゾンは、反応空間領域９に移動して、第２の誘電体バリヤ放電ランプ７から放射される２４９ｎｍ付近で最大値を有する２４０から２５５ｎｍの波長範囲の紫外線を照射され、活性酸素原子と酸素分子に分解される。該活性酸素原子と酸素分子は、洗浄槽３０の底に設けられた泡立て器３１を通して洗浄槽３０内の水３２のなかに混入される。

【００２３】被処理物、例えばプラスチックの瓶３３は、支持具３４によってオゾンの混入した水３２に沈められ、第１および第２の誘電体バリヤ放電ランプからの紫外線の照射によって外表面が洗浄される。該洗浄によって、瓶３３の外表面への印刷などが高品位で行えるようになる。支持具３４を回転させることにより被処理物であるプラスチックの瓶３３を回転させる方法や、第１、第２の誘電体バリヤ放電ランプに対向して第３，４の誘電体バリヤ放電ランプを瓶３３を挟むように設けることにより、処理速度を大きくすることが出来る。

【００２４】第７の実施例であるフォトレジストの灰化方法の概略図を図４に示す。灰化ダクト４０内に注入された処理用流体酸素１は、灰化ダクト４０内に設けられた第１の誘電体バリヤ放電ランプ群４１から放射される紫外線によってオゾンに変換される。第１の誘電体バリヤ放電ランプ群４１は、図５に示したような中空同軸円筒形の誘電体バリヤ放電ランプ４１ａを台座４４に複数束ねたもので、各誘電体バリヤ放電ランプ４１ａの構造は、内側誘電体５１の内側に紫外線の反射板と電極を兼ねたアルミニウム箔５２が設けてあり、該内側誘電体５１と同軸に設けられた外側誘電体５３の外側には紫外線を透過する電極５４が設けられた構造である。該内側誘電体５１と外側誘電体５３によって形成された中空円筒部５５に、発光用ガスが充填されている。電極５２，５４間に電源２６によって電圧を印加すると、中空円筒部５５にオゾナイザ放電が発生し、外側誘電体５４から紫外線が放射される。

【００２５】第１の誘電体バリヤ放電ランプ群４１から放射される紫外線によって生成されたオゾンは第２の誘電体バリヤ放電ランプからの紫外線によって活性化酸素原子に変換される。被処理物である半導体基板４３に塗布されたフォトレジストは、第２の誘電体バリヤ放電ランプ群４２からの紫外線の照射のもとに活性化酸素原子と反応し、灰化する。個々の放電ランプ４２ａの構造は、放電ランプ４１ａと同一であって、かつ台座４４に取り付けられている。２箇の台座４４の位置調節をすれば、ランプ群４１とランプ群４２の距離は調節できる。

【００２６】第２の誘電体バリヤ放電ランプ群４２が、比較的波長の長い２４０から２５５ｎｍ，２００から２４０ｎｍ，３００から３２０ｎｍの範囲の紫外線を放射するように発光物質を選択すると、基板４３に照射される光子のエネルギーが小さいので、基板４３を損傷することが少ない。また、第２の誘電体バリヤ放電ランプ群４２が、比較的波長の短い１８０から２００ｎｍ，１６０から１９０ｎｍの範囲の紫外線を放射するように発光物質を選択すると、該紫外線は、酸素分子の吸収断面積が大きいので基板表面近くにおいて化学活性の高い酸素原子の密度を極めて高く生成することが出来ることになり、かつ、基板４３に照射される光子のエネルギーが大きいので、イオンが注入されて灰化しにくくなったフォトレジストも灰化することが出来る。

【００２７】第８の実施例である表面改質方法の概略図を図６に示す。被処理物であるプラスチック６０は、上部から供給された窒素６２の雰囲気で満たされた第１の

処理ダクト６１に設置され、第１の誘電体バリヤ放電ランプ群６３からの１２０から１９０ｎｍの波長範囲の紫外線の照射をうけ、表面に存在する分子の結合が切断される。しかるのちに、プラスチック６０は、搬送装置６４によって第２の処理ダクト６５に運ばれ、処理用流体供給口２から供給された酸素もしくは空気１の雰囲気中で第２の誘電体バリヤ放電ランプ群６６からの紫外線の照射を受け、表面に－ＣＯＯＨ基、－ＯＨ基が生成される。上記のような処理によって、プラスチック表面への印刷、接着などが高品位で出来るようになる。この実施例では被処理物は大気圧以上の雰囲気にあるので、被処理物の移動が簡単であるという利点が生じる。また、第１の誘電体バリヤ放電ランプ群６３から１０７から１６５ｎｍの波長範囲の紫外線が放射されると、フッ素樹脂のような非常に安定な樹脂の表面の改質を行うことが出来るようになる。

【００２８】第９の実施例である成膜方法の概略図を図７に示す。反応容器７０の上部に設けられた発光用ガス供給口７５に近接して、窓部材を有さない第１の誘電体バリヤ放電ランプ群６３が設けられている。発光用ガス供給口７５から発光用ガスアルゴン７４が供給されると、第１の誘電体バリヤ放電ランプ群６３からアルゴンのエキシマ分子から放射される１０７から１６５ｎｍの波長範囲の紫外線が放射される。処理用流体供給口２から供給された処理用流体モノシランガスとメタンガスの混合ガス１は第１の誘電体バリヤ放電ランプ群６３から放射される１０７から１６５ｎｍの波長範囲の紫外線によって分解、活性化され、被処理物である基板７１の表面において第２の誘電体バリヤ放電ランプ群６６からの紫外線によって再活性化され水素化アモルファス炭化シリコンの薄膜を形成する。第２の誘電体バリヤ放電ランプ群６６として比較的長い波長の紫外線を放射するランプを採用すると、膜に照射される光子のエネルギーが小さいので、膜を損傷することが少なく、高品質の膜が得られる。処理用流体を第１の誘電体バリヤ放電ランプの紫外線で分解、活性化し、さらに成膜時に第２の紫外線を照射することにより、良質な膜の形成が可能になった。被処理物の支持装置７２に被処理物の温度を調整する機構を組み込み被処理物の温度を調整したり、支持具７３によって被処理物と第１の誘電体バリヤ放電ランプ群６３との距離を調整したりすることにより、さらに良質の膜を形成することが可能になる。尚、７６は放電用ガスや処理用ガスの排出口である。

【００２９】第１０の実施例である殺菌方法の概略図を図８に示す。誘電体バリヤ放電ランプは、図８に示したように、３本の管状の誘電体を同軸的に配置してなるものであって、内側誘電体５１、中間誘電体８８および外側誘電体５３を同軸に配置して独立した内側放電室８７と外側放電室８６を形成し、中間誘電体８８内に埋め込まれた中間電極８９と内側誘電体５１の内面に設けられた透明電極８２および外側誘電体５３の外面に設けられた透明外側電極５４の間にそれぞれ交流電源２６ａおよび２６ｂによって電圧を印加して、内側放電室８７と外側放電室８６で誘電体バリヤ放電を行う方式のランプである。内側放電室８７の発光用ガスとしてキセノンガスを使用して１２０から１９０ｎｍの波長範囲の紫外線を放射させ、外側放電室８６の発光用ガスとしてクリプトンとフッ素の混合ガスを使用し、２４０から２５５ｎｍの波長範囲の紫外線を放射させる。

【００３０】処理用流体である酸素ガス１を管状の内側誘電体５１の一端８１から流し込み、第１の反応空間８３内で内側放電室８７から放射された１２０から１９０ｎｍの波長範囲の紫外線によって生成したオゾンを内側誘電体５１の他の一端８４から噴出させる。該オゾンは反応空間８５内で外側放電室８６から放射された２４０から２５５ｎｍの波長範囲の紫外線によって分解され、活性な酸素原子を生成し、活性な酸素原子が被処理物である食品用カップ９０の内面を殺菌する。さらに、食品用カップ９０の内面を照射した外側放電室８６から放射された２４０から２５５ｎｍの波長範囲の紫外線は、この波長領域の紫外線は殺菌作用が最適であるため食品用カップ９０の内面を直接殺菌し、従って、短時間で殺菌、消毒を行うことが出来る。

【００３１】

【発明の効果】上記したように、本発明によれば、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプを使用したので、各種の処理を高品質で、高効率で、十分な速度で行うことができる処理方法を提供できる。

【図面の簡単な説明】

【図１】本発明を使用した水処理方法の説明図である。

【図２】誘電体バリヤ放電ランプの概略図である。

【図３】本発明を使用した湿式洗浄方法の説明図である。

【図４】本発明を使用したフォトレジストの灰化方法の説明図である。

【図５】他の構造の誘電体バリヤ放電ランプの概略図である。

【図６】本発明を使用したプラスチックの表面改質方法の説明図である。

【図７】本発明を使用した成膜方法の説明図である。

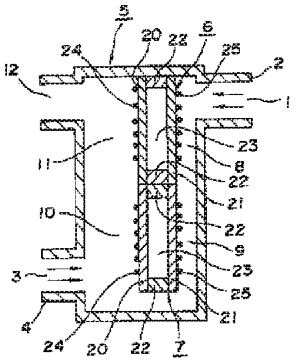
【図８】本発明を使用した殺菌方法の説明図である。

【符号の説明】

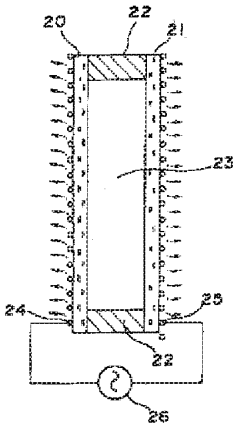
１　処理用流体
３　被処理物
６，７　誘電体バリヤ放電ランプ
８，９，１０，１１　反応空間領域
２０，２１　誘電体
２３　放電空間
２４，２５　透明電極

２６　交流電源

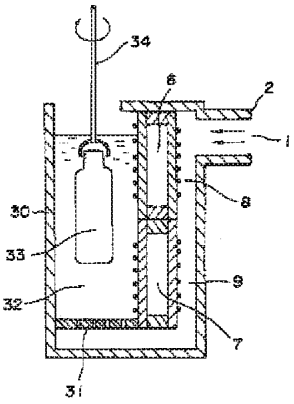
【図１】



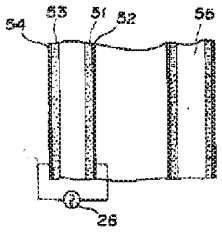
【図２】



【図３】

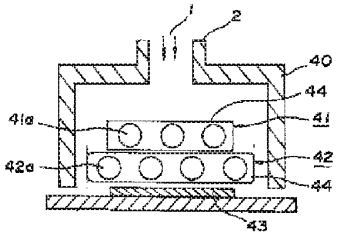


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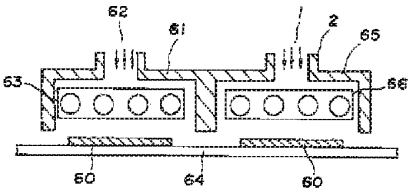


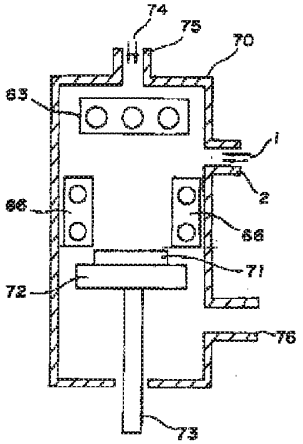
【図７】

【図４】

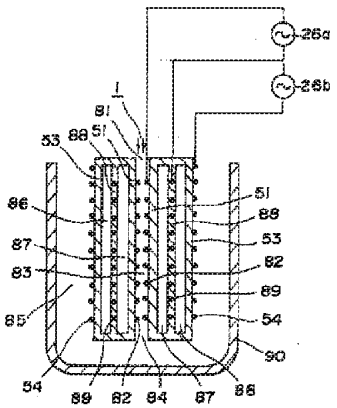


【図６】





【図８】



フロントページの続き

(51)Int.Cl.[7]	識別記号	FI		テーマコード（参考）
Ｇ０３Ｆ	7/42	Ｈ０１Ｊ	65/00	Ｂ　４Ｃ０７５
Ｇ２１Ｋ	5/00	Ａ６１Ｌ	2/10	
Ｈ０１Ｊ	65/00		2/20	Ｊ
// Ａ６１Ｌ	2/10	Ｂ０１Ｄ	53/34	１３４Ｅ
	2/20			ＺＡＢ

(72)発明者　五十嵐　龍志
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内
(72)発明者　平本　立躬
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内

Ｆターム(参考)　2H096 LA02 LA03
4C058 AA06 BB06 BB07 CC02 CC04 JJ14 JJ28 KK02 KK42
4D002 AA21 AA22 BA05 BA09 EA06
4D037 AA11 AB11 BA18 BB09
4G042 CA03 CE04
4G075 AA02 AA30 AA37 BA06 CA33 CA51 CA57 DA02 EB01 EB31 EC21

Electronic Patent Application Fee Transmittal	
Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	120	120
		Total in USD ($)		**120**

Electronic Acknowledgement Receipt	
EFS ID:	40507308
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	09-SEP-2020
Filing Date:	10-JUL-2017
Time Stamp:	15:03:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$120
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1	Information Disclosure Statement (IDS) Form (SB08)	IDS3.pdf	612157 9384ca8617d4b1a143f7167051a0c748117246d8	no	4
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Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
2	Non Patent Literature	Ramsay.pdf	1010322 7c753b463cc7ef6651c984090af420290dadfa29	no	5
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3		Response-NFOA-9-9-20.pdf	50102 37e0168f7972b0bf7795b4a1d49a87e87447354e	yes	11

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Applicant Arguments/Remarks Made in an Amendment	5	11
Claims	2	4
Amendment/Req. Reconsideration-After Non-Final Reject	1	1

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<u>National Stage of an International Application under 35 U.S.C. 371</u>
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<u>New International Application Filed with the USPTO as a Receiving Office</u>
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Electronic Acknowledgement Receipt	
EFS ID:	39780226
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	20-JUN-2020
Filing Date:	10-JUL-2017
Time Stamp:	15:13:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

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Information:					
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 06/10/2020
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

NOTIFICATION DATE	DELIVERY MODE
06/10/2020	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):

info@lambertpatentlaw.com

Office Action Summary	Application No. 15/645,480	Applicant(s) Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	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 02 June 2020.

☐ 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) 1,3-16 and 18-20 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) 1,3-16 and 18-20 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 _____ 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 6/02/2020.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 6/02/2020 has been entered.

Information Disclosure Statement

3. The information disclosure statement filed 6/02/2020 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered.

Claim Objections

4. Claims 1, 3-16, and 18-20 are objected to because of the following informalities:

- in line 8 of Claim 1, delete “microorganisms” and insert --microorganism--;

- in line 3 of Claim 8, delete "of";
- in line 1 of Claim 11, insert --step of-- before "directing";
- in line 9 of Claim 14, delete "microorganisms" and insert --microorganism--;
- in line 8 of Claim 20, delete "microorganisms" and insert --microorganism--.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 5 and 15-16 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

7. In Claim 5, it is not clear whether "a wound" is a human or animal tissue or an optional feature on a human or animal tissue rather than a tissue.

8. In Claim 15, it is not clear whether "the substance or surface" in line 1 is referring to "the substance or surface" or "the substance or surface to be disinfected".

9. In Claim 16, it is not clear whether "the substance or surface" in line 1 is referring to "the substance or surface" or "the substance or surface to be disinfected".

Claim Rejections - 35 USC § 102

10. 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.

11. Claim(s) 1, 3-6, 12, and 20 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Coogan (7381976).

Coogan ('976) discloses a process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 282nm and 308nm (see entire document, particularly Col. 3 lines 49-51, Col. 7 lines 36-42, Col. 8 lines 48-51, Col. 12 lines 18-28, Col. 19 lines 29-30, Col. 20 lines 9-10), comprising:

activating a lamp positioned within a case (see entire document, particularly Figures 1-3 – case 100, lamp 200 within 110 – see Col. 11 lines 14-15; Figure 7 – case: 708, lamp: 702a, 702b; Col. 9 lines 27-30);

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganism is a at least one of bacteria and a virus, as well as pathogens capable of being a fungus, an amoeba, and a protozoa (see entire document, particularly Col. 3 lines 49-51, Col. 6 lines 2-4, Col. 7 lines 27-36, Col. 8 lines 48-51, Col. 9 lines 50-65, Col. 12 lines 18-28, Col. 13 lines 9-10, Col. 19 line 28 to Col. 21 line 20); and

wherein the substance or surface to be disinfected is human or animal tissue in the form of blood and organ (i.e. skin capable of having a wound) (see entire document, particularly Col. 1 lines 9-10, Col. 3 lines 46 and 55-56, Col. 7 lines 17-21 and 33-36, Col. 9 lines 22-30, Col. 14 lines 6-8, Col. 15 lines 33-36 and 64-66, Col. 17 lines 55-60, Col. 19 lines 28-67).

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

13. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

14. Claims 5 and 8 is/are rejected under 35 U.S.C. 103 as being unpatentable over Coogan (7381976) as applied to claim 1 above, and further in view of Eckhardt (6730113).

Coogan (‘976) is relied upon for disclosure described in the rejection of claim 1 under 35 U.S.C. 102(a)(1).

Coogan (‘976) does not appear to specifically teach that the step of generating photons comprises activating a lamp positioned within a wand, wherein the step of directing comprises positioning the wand.

It was known in the art before the effective filing date of the claimed invention to provide/position a wand in a process for destroying a DNA or RNA of a microorganism. Eckhardt (‘113) discloses a process for disinfection of a substance or surface by destroying a DNA or RNA (see entire document, particularly Col. 3 lines 13-41) comprising: activating a lamp (7a, 7b) positioned within a wand (16a, 16b) (see entire document, particularly Figures 1-2, 5B, 6B); and positioning the wand (16a; 16b) and directing photons to a substance or surface to be disinfected being human or animal tissue (3, 5) in the form of a wound (1) (see entire document, particularly Figures 1-3, 5A-5B, 6B, 7A, 7C, 12-14A, and 14C, Col. 3 lines 35-36, Col. 4 lines 26-39), in order to sterilize/disinfect human tissue (see entire document, particularly Col. 3 lines 12-36). It would have been obvious to one of ordinary skill in this art before the effective filing date of the claimed invention to provide and position a wand in the process of Coogan as known alternate configuration in order to sterilize/disinfect a substance or surface such as human or animal tissue and/or wound as shown by Eckhardt.

Thus, Claims 5 and 8 would have been obvious within the meaning of 35 U.S.C. 103 over the combined teachings of Coogan (‘976) and Eckhardt (‘113).

15. Claims 7, 9, 11, and 13 is/are rejected under 35 U.S.C. 103 as being unpatentable over Coogan (7381976).

Coogan (‘976) is relied upon for disclosure described in the rejection of claim 1 under 35 U.S.C. 102(a)(1).

As to Claim 7, while Coogan ('976) does not appear to specifically teach that the step of directing is performed for approximately two seconds, it would have been obvious to and well within the purview of one of ordinary skill in this art before the effective filing date of the claimed invention to provide the step of directing for approximately two seconds in the method of Coogan in order to provide necessary/required amount of photon irradiation so as to effect disinfection of the substance or surface. Only the expected results would be attained.

As to Claim 9, while Coogan ('976) discloses a step of activating a lamp positioned within a blood flow path (300, 390) (see Col. 15 lines 57-62, Col. 17 lines 50-60), Coogan ('976) does not appear to specifically teach that the blood flow path (300, 390) is located in a dialysis machine. However, as Coogan ('976) discloses that the treatment takes place in real time (see entire document, particularly Col. 17 lines 50-63), it would have been obvious to and well within the purview of one of ordinary skill in this art before the effective filing date of the claimed invention to provide the blood flow path/apparatus (390, 300) of Coogan in a dialysis machine in order to provide blood treatment in real time. Only the expected results would be attained.

As to Claim 11, while Coogan ('976) discloses that the process comprises a step of positioning a lamp (702a, 702b; 802) close to the substance or surface to be disinfected (720, 722; 808, 810) (see Figures 7-8). Coogan ('976) does not appear to specifically teach that the distance between the lamp and the substance or surface to be disinfected is approximately two centimeters away. However, it would have been obvious to and well within the purview of one of ordinary skill in this art before the effective filing date of the claimed invention to provide the lamp approximately two centimeters away in the method of Coogan as a matter of choice in order to deliver necessary amount of photon to the substance or surface to be disinfected in a

given amount of processing time so as to effect disinfection. Only the expected results would be attained.

As to Claim 13, while Coogan ('976) does not appear to specifically teach that the step of directing the photons further comprises a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected, it would have been obvious to and well within the purview of one of ordinary skill in this art before the effective filing date of the claimed invention to provide a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected in the method of Coogan in order to provide adequate/necessary amount of photon energy so as to effect disinfection of the substance or surface. Only the expected results would be attained.

16. Claim 10 is/are rejected under 35 U.S.C. 103 as being unpatentable over Coogan (7381976) as applied to claim 1 above, and further in view of Tribelsky (8088289).

Coogan ('976) is relied upon for disclosure described in the rejection of claim 1 under 35 U.S.C. 102(a)(1).

Coogan ('976) does not appear to specifically teach that the step of directing comprises passing the generated photons through a fiber optic cable.

It was known in the art before the effective filing date of the claimed invention to provide a fiber optic cable to pass generated photons in a process of disinfection/sterilization. Tribelsky ('289) discloses a process of disinfection comprising providing a fiber optic cable (73a-73e) in order to provide and direct photons to a desired location for treatment/disinfection/sterilization (see entire document, particularly Figure 3A, Col. 34 lines 53-63, Col. 36 lines 66-67). It would have been obvious to one of ordinary skill in this art before the effective filing date of the

claimed invention to provide a step of passing generated photons through a fiber optic cable in the process of Coogan in order to provide and direct photons to a desired site/location as shown by Tribelsky.

Thus, Claim 10 would have been obvious within the meaning of 35 U.S.C. 103 over the combined teachings of Coogan ('976) and Tribelsky ('289).

17. Claims 14-16 and 18 is/are rejected under 35 U.S.C. 103 as being unpatentable over Tribelsky (WO2004011038) in view of ().

Tribelsky ('038) discloses a process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least two single line wavelengths capable of corresponding to a peak absorption wavelength of DNA or RNA (see entire document, particularly p.11 lines 7-12, p.14 lines 1-11, p.15 lines 24-26, p.21 lines 23-26, p. 39 last 5 lines, p.41 lines 16-20); and

directing photons (103) to the substance or surface to be disinfected (109) (see Figure 5), whereby the photons destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms (see entire document, p.16 lines 14-19, p.21 lines 23-26, p. 39 last 5 lines),

wherein the substance or surface to be disinfected is human tissue (see entire document, particularly p.16 lines 14-19, p.21 lines 23-26 and 32-33, p. 48 – 6th – 7th lines from the bottom) or an inanimate surface (see p. 16 lines 1-2 and 15-16, p. 21 line 33, p. 50 lines 16-18); and

wherein the step of directing comprises passing the generated photons through a fiber optic cable (73a-73e) (see Figures 1, 3A, and 5, p. 48 line 9, p. 51 line 9).

While Tribelsky appears to teach a wavelength range of 220 nm-357 nm (see entire document, particularly p.28 lines 12-16) and 266 nm to about 1000 nm (see entire document,

particularly p.47 lines 27-28), use of a laser with wavelength in the range from about 193 nm to about 308 and 351 nm (see entire document, particularly p.39 lines 24-27), operating the laser at wavelength of about 266 nm (see entire document, particularly p.35 line 16, p.40 line 2, p.41 lines 6-9, p47 lines 31-32), Tribelsky does not teach that the at least two single line wavelengths are at least two of 207nm, 222nm, 254nm, 280nm, 282nm, and 308nm corresponding to a peak absorption wavelength of DNA or RNA.

It was known in the art before the effective filing date of the claimed invention to provide wavelengths selected from 207nm, 222nm, 254nm, 280nm, 282nm, and 308nm in a process for disinfection/sterilization. Coogan ('976) discloses a process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 282nm and 308nm (see entire document, particularly Col. 3 lines 49-51, Col. 7 lines 36-42, Col. 8 lines 48-51, Col. 12 lines 18-28, Col. 19 lines 29-30, Col. 20 lines 9-10), comprising:

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganism is a at least one of bacteria and a virus, as well as pathogens capable of being a fungus, an amoeba, and a protozoa (see entire document, particularly Col. 3 lines 49-51, Col. 6 lines 2-4, Col. 7 lines 27-36, Col. 8 lines 48-51, Col. 9 lines 50-65, Col. 12 lines 18-28, Col. 13 lines 9-10, Col. 19 line 28 to Col. 21 line 20); and

wherein the substance or surface to be disinfected is human or animal tissue in the form of blood and organ (i.e. skin capable of having a wound) (see entire document, particularly Col.

1 lines 9-10, Col. 3 lines 46 and 55-56, Col. 7 lines 17-21 and 33-36, Col. 9 lines 22-30, Col. 14 lines 6-8, Col. 15 lines 33-36 and 64-66, Col. 17 lines 55-60, Col. 19 lines 28-67),

in order to inactivate pathogens/microorganisms (see entire document, particularly Abstract).

It would have been obvious to one of ordinary skill in this art before the effective filing date of the claimed invention to provide wavelengths of 282nm and 308nm in the method of Tribelsky ('038) in order to provide wavelengths effective for inactivation of pathogens as shown by Coogan.

Thus, Claims 14-16 and 18 would have been obvious within the meaning of 35 U.S.C. 103 over the combined teachings of Tribelsky ('038) and Coogan ('976).

18. Claim 19 is/are rejected under 35 U.S.C. 103 as being unpatentable over Tribelsky (WO2004011038) in view of Coogan (7381976) as applied to claim 14 above, and further in view of Eckhardt (6730113).

Tribelsky ('038) and Coogan ('976) are relied upon for disclosure described in the rejection of claim 14 under 35 U.S.C. 103.

Neither Tribelsky ('038) nor Coogan ('976) appears to specifically teach that the step of generating photons comprises activating a lamp positioned within a wand, wherein the step of directing comprises positioning the wand.

It was known in the art before the effective filing date of the claimed invention to provide/position a wand in a process for destroying a DNA or RNA of a microorganism. Eckhardt ('113) discloses a process for disinfection of a substance or surface by destroying a DNA or RNA (see entire document, particularly Col. 3 lines 13-41) comprising: activating a

lamp (7a, 7b) positioned within a wand (16a, 16b) (see entire document, particularly Figures 1-2, 5B, 6B); and positioning the wand (16a; 16b) and directing photons to a substance or surface to be disinfected being human or animal tissue (3, 5) in the form of a wound (1) (see entire document, particularly Figures 1-3, 5A-5B, 6B, 7A, 7C, 12-14A, and 14C, Col. 3 lines 35-36, Col. 4 lines 26-39), in order to sterilize/disinfect human tissue (see entire document, particularly Col. 3 lines 12-36). It would have been obvious to one of ordinary skill in this art before the effective filing date of the claimed invention to provide and position a wand in the process of Tribelsky as modified by Coogan as known alternate configuration in order to sterilize/disinfect a substance or surface such as human or animal tissue and/or wound as shown by Eckhardt.

Thus, Claim 19 would have been obvious within the meaning of 35 U.S.C. 103 over the combined teachings of Tribelsky (‘038), Coogan (‘976), and Eckhardt (‘113).

Conclusion

19. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following references relate either to the field of the invention or subject matter of the invention, but are not relied upon in the rejection of record: WO8702256.

20. Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of References Cited	Application/Control No. 15/645,480	Applicant(s)/Patent Under Reexamination Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
	A					
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N	WO-8702256-A1	04-1987	WO	WILKINSON FRANK JOHN	A61N5/0616
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	
A23L3/26, 3/28	02/25/2019	
A23B7/015	02/25/2019	
B08B17/00	02/25/2019	
A61N5/0624	02/25/2019	

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

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

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		
consulted related case 14/254,957, 11/831,667	11/23/2019	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	04/22/2020	RY
EAST and PALM - Inventor Search	04/19/2020	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	04/20/2020	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	06/05/2020	RY

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A61L	2/0047, 2/0011, 2/10, 9/20	04/22/2020	RY
A23L	3/26, 3/28	04/22/2020	RY
A23B	7/015	04/22/2020	RY
B08B	17/00	04/22/2020	RY
A61N	5/0624	04/22/2020	RY

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

✓	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	02/26/2019	11/23/2019	06/05/2020						
	1	✓	✓	✓						
	2	✓	-	-						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	✓	✓	✓						
	6	✓	✓	✓						
	7	✓	✓	✓						
	8	✓	✓	✓						
	9	✓	✓	✓						
	10	✓	✓	✓						
	11	✓	✓	✓						
	12	✓	✓	✓						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	✓						
	16	✓	✓	✓						
	17	✓	-	-						
	18	✓	✓	✓						
	19	✓	✓	✓						
	20	✓	✓	✓						

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	
Filing Date	
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

U.S.PATENTS Remove

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
/R.M.Y/	1	7381976		2008-06-03	Coogan et al.	
	2	4909254		1990-03-20	Wilkinson	
	3	8088289		1996-06-04	Tribelsky	
	4	6730113		2004-05-04	Eckhardt et al.	
/R.M.Y/	5	7217936		2007-05-15	Ressler	

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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
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

Examiner Initial*	Cite No	Foreign Document Number[3]	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							

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/R.M.Y/	2	Heering, UV SOURCES – Basics, Properties and Applications, IUVA NEWS, Vol. 6, No. 4, p. 7 (Dec. 2004)	
	3	Sosnin, et al., The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria: A Comparative Approach, IEEE Transactions On Plasma Science, Vol. 32, No. 4, p. 1544 (2004)	
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	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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Signature	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2020-06-02
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	5	(("4909254") or ("6730113") or ("7217936") or ("7381976") or ("8088289")).PN.	US-PGPUB; USPAT	OR	OFF	2020/06/03 22:43
S2	5	(("4909254") or ("6730113") or ("7217936") or ("7381976") or ("8088289")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/04 11:42
S3	2	WO-8702256-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/04 11:43
S4	1	("20080255498").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/04 14:41
S5	5	(("4909254") or ("6730113") or ("7217936") or ("7381976") or ("8088289")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/04 17:02
S6	3	S5 and insert$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/04 17:03
S7	4	S5 and (tube or tubing or vessel)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/04 17:22
S8	0	S5 and (blood near transfer$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/04 17:31
S9	2	S5 and (blood and transfer$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/04 17:31

S10	5	(("4909254") or ("6730113") or ("7217936") or ("7381976") or ("8088289")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/04 22:59
S11	1	S10 and "fiber optic"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/04 22:59
S12	2	(("8481985") or ("20080255498")).PN.	US-PGPUB; USPAT	OR	OFF	2020/06/05 11:28
S13	3	WO-2004011038-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 11:45
S14	5	(("4909254") or ("6730113") or ("7217936") or ("7381976") or ("8088289")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/05 15:56
S15	1	S14 and ("XeCl" and "XeBr" or "KrCl")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 15:56
S16	1	S14 and ("XeCl" or "XeBr" or "KrCl")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 15:58
S17	3	S14 and laser	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 16:11
S18	4,509	wand and (lamp or "light source") and wavelengths	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 20:55
S19	4,314	wand and (lamp or "light source") and wavelengths and (skin or tissue or surfaces)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2020/06/05 20:55

			DERWENT; IBM_TDB			
S20	4,318	wand and (lamp or "light source") and wavelengths and (skin or tissue or surfaces or wound)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 20:55
S21	21,538,154	wand and (lamp or "light source") and wavelengths and (skin or tissue or surfaces or wound) an d(UVC or "UV-C")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 20:55
S22	206	wand and (lamp or "light source") and wavelengths and (skin or tissue or surfaces or wound) and(UVC or "UV-C")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 20:56
S23	128	wand and (lamp or "light source") and wavelengths and (body or "body part" or skin or tissue or surfaces or wound) and(UVC or "UV-C") and (DNA or RNA)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/06/05 21:50

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 4 :		(11) International Publication Number: WO 87/ 02256
A61N 5/08	A1	(43) International Publication Date: 23 April 1987 (23.04.87)

(21) International Application Number: PCT/AU86/00297

(22) International Filing Date: 9 October 1986 (09.10.86)

(31) Priority Application Number: PH 2828

(32) Priority Date: 9 October 1985 (09.10.85)

(33) Priority Country: AU

(71) Applicant *(for all designated States except US):* COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION [AU/AU]; Limestone Avenue, Canberra, ACT 2602 (AU).

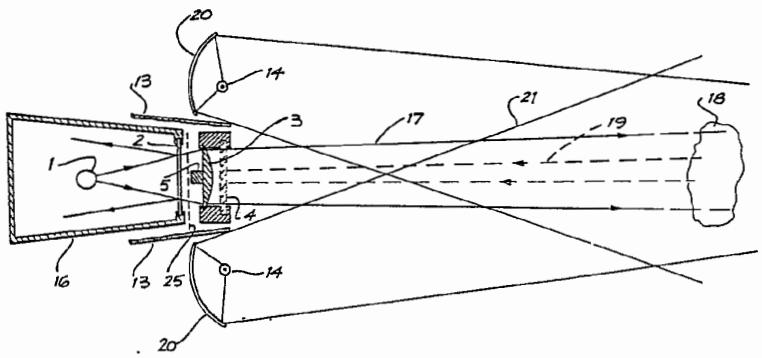
(72) Inventor; and
(75) Inventor/Applicant *(for US only) :* WILKINSON, Frank, John [AU/AU]; Lot 38, Fairlight Road, Mulgoa, NSW 2750 (AU).

(74) Agent: SPRUSON & FERGUSON; G.P.O. Box 3898, Sydney, NSW 2001 (AU).

(81) Designated States: AT (European patent), AU, BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.

(54) Title: PHOTOTHERAPY OF SKIN WOUNDS



(57) Abstract

A method and apparatus for irradiating wounds with UV radiation from which the UVB component is substantially removed or attenuated. UV light from a mercury vapour lamp (1) is passed through a filter (2) and thence through a lens (3) which focuses the radiation onto a target region (18). The filter (2) is formed from a number of alternating layers of dielectric material of different refractive indexes.

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PHOTOTHERAPY OF SKIN WOUNDS

The present invention relates to the phototherapy of skin wounds and, in particular, to the phototherapy of skin wounds with ultra violet light from which the UVB component (wavelengths of 280nm to 315nm) has been substantially removed or attenuated so that the wound is irradiated with UVC (wavelengths of 200 to 280nm) and UVA (315 to 400nm). Preferably the wound is also irradiated with visible and infra-red radiation.

BACKGROUND ART

Prior to the advent of modern antibiotics, it was known that beneficial effects could be obtained in the treatment of skin wounds in mammals by the irradiation of the wounds by sunlight and by carbon-arc radiation. In addition, the germicidal action of significant levels of UVC radiation is well known. Furthermore, the beneficial properties of UVA radiation have also been reported.

Such ultraviolet radiation fell into a decline with the advent of antibiotics since it suffers from the problem that the ultraviolet radiation used included excessive emissions of damaging erythemal UVB radiation which readily causes burning and blistering and is generally regarded as being carcinogenic. Since the UVB radiation was itself harmful, it was necessary to maintain the radiation level overall at a fairly low level thereby preventing the beneficial properties of the UVC and UVA components from being applied at



an effective dosage level.

Whilst antibotics were initially spectacularly successful, many organisms have now developed resistance to antibotics and therefore higher doses and longer periods of treatment are required. In addition, in some applications, such as the treatment of racehorses, there are objections to the use of antibiotics and it is often difficult to apply bandages and other surface treatments to the legs of racehorses in particular.

It is therefore an object of the present invention to overcome the disadvantages inherent with antibiotic treatment and provide a method and apparatus whereby the germicidal and other beneficial properties of UV radiation can be utilized without the unnecessary, short-term damage and possible carcinogenic problems inherent with UVB radiation by the reduction or substantial elimination of the UVB component.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is disclosed a method of phototherapy of skin wounds of mammals, said method comprising the step of irradiating the wound area with ultraviolet light from which the UVB component has been substantally removed or attenuated whereby the wound is irradiated with substantially UVA and UVC radiation. Preferably the wound is also irradiated with visible light and/or infra-red radiation.

In accordance with another aspect of the present

invention there is disclosed apparatus for carrying out the above method and comprising a source of UV radiation, focusing means to focus the UV radiation onto a target area, and a filter placed in said radiation to substantially remove or attenuate any UVB component in said radiation. Preferably a monitor device is provided in order to monitor the radiation dosage.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the present invention will now be described with reference to the drawings in which:-

Fig. 1 is a horizontal cross-sectional view through the apparatus of the preferred embodiment,

Fig. 2 is a centrally located vertical cross-section through the apparatus of Fig. 1,

Fig. 3 is an enlarged view of the vertical section through the monitor optics illustrated in Fig. 2, and

Fig. 4 is a front elevational view of the monitor optics arrangement of Fig. 3.

As seen in the drawings, the apparatus of the preferred embodiment comprises a high-pressure mercury-vapor gas-discharge lamp 1, with a quartz envelope, preferably having a power of approximately 100 W which is mounted vertically within a lamp enclosure 16 formed from UV stable material. The enclosure 16 is provided with light baffles 13 and a cooling fan 15. At one end of the lamp enclosure 16 is a selective-UV filter 2 (to be described hereafter) which substantially prevents

the passage of UVB radiation.

The UV and visible radiation which passes through the filter 2 is allowed to fall onto a plano-convex fused silica lens 3 which focuses the radiation into a beam 17 which falls upon a target region 18. Mounted in front of the lens 3 is a removeable UV-absorbing lens-cover filter 4 which, as best seen in Fig. 2, is pivoted or slidable as indicated by arrows 12 into, and out of, the beam 17. This filter is used during initial target selection and to control the UV exposure time.

Centrally positioned on the lens 3 is a prism 5 which is shielded on its surface facing the mercury discharge lamp 1 and gathers reflected light 19 from the target region. A monitor-imaging lens 6 is secured to the lower surface of the prism 5 in order to focus the reflected beam 19 through a monitor-cell aperture 8 and onto a monitor photoelectric cell 10, via a monitor-cell filter 9. As best seen in Figs. 3 and 4, the monitor imaging-lens 6, aperture 8, filter 9, and photoelectric cell 10 are all located within a tubular light-tight monitor housing 7.

A pair of infra-red heaters 14, each with an associated reflector 20, are mounted one to either side of the light baffles 13 as illustrated in Fig. 1. The infra-red heaters 14 preferably comprise the ballast for the mercury vapor lamp 1 and can also separately be energized if only infra-red radiation 21 is desired.

The filter 2 is of special construction and

comprises at least 2, and preferably upto 21 layers of dielectric material which are non-absorbing in the UV region and which have different refractive indexes.

Thus if the filter 2 is regarded as a series of layers ABABAB and so on then the material A can be selected from the group consisting of hafnium dioxide (HfO_2), magnesium oxide (MgO), and yittrium oxide (Y_2O_3) and the material B of the alternate layers can be selected from the group consisting of aluminium oxide (Al_2O_3), magnesium fluoride (MgF_2) and silicon dioxide (SiO_2). It will be apparent that the stack of dieletric layers constitutes an interference filter and for the materials mentioned above the filter is operable so as to reject radiation in the UVB band thereby allowing UVA and UVC to pass through the filter 2 and hence through the lens 3. Preferably the spectral transmittance for a beam normal by incidence on the filter 2 in the UVC and UVA regions is not less than 0.5 and preferably is approximately 0.8 to 0.9 whereas the spectral transmittance in the UVB region does not exceed 0.05. More layers than 21 provides an even smaller transmittance.

It will be apparent that the monitor optics enable the dosage actually received by the target area to be monitored. The choice of the monitor-cell filter 9 enables a selection to be made as to whether the UV, visible, or infra-red radiation is monitored. The monitor is focused at infinity and views directly along the main beam axis. The photo-cell aperture 8

determines the divergence of the accepted beam 19 away from the lens 3. Preferably the arrangement is such that the diameter of the beam 19 is approximately 3 cm at a distance of 50 cm from the lens 3. This gives reasonable results for a target distance of from 20 to 100 cm.

It will be apparent that by monitoring the reflected radiation, the correct dose is delivered irrespective of beam dimensions in the target plane, provided that the beam cross-section is at least as big as the monitor beam cross-section. The monitor also allows accurate dose delivery independent of the loss of radiant output of the lamp with time, which typically is approximately 50% over its useful life.

Preferably, a small disc-shaped piece (not illustrated) of retro-reflective sheeting such as that sold under the trade mark SCOTCHLITE by 3M and used for reflecting motor vehicle head lamp light, is positioned in the target plane and illuminated by the beam 17. This can be accomplished by swivelling the apparatus to locate the centre of the beam 17 on the disc-shaped piece, taking a reading and then swivelling the apparatus back again, the wound 18 and the disc-shaped piece being equidistant from the UV source 1. This measurement is used to determine the time of exposure required to give the desired dose and overcomes the problems of low wound reflectivity and variation between wounds.

The lens 3 is approximately 40 - 60 mm in diameter

and has a focal length of approximately 50 - 100 mm. As illustrated in Fig. 2 the lens 3 is preferably reciprocable as indicated by arrows 11 to permit a degree of focussing, giving a beam area from approximately 25 mm^2 to approximately 200 m^2 at a distance from the lens of from 10 cm to 50 cm.

Preferably, an additional shutter 25 which is reciprocable in a vertical plane as indicated by arrows 26 in Fig. 2 can be added between the filter 2 and the monitor housing 7. The shutter 25 is illustrated by broken lines in Figs. 1 and 2 and allows a background signal level from the monitor to be established in the absence of the UV radiation. This enables corrections to be made for the photo-cell darkcurrent, circuit bias, any detected ambient radiation, and the like.

The above described arrangement results in the treatment beam 17 from the mercury lamp having intensities in the following wavelength regions in the following proportions: UVC: UVB: UVA plus visible plus near infra-red being approximately equal to 1:0.05:2. The desired level for UVC radiation for a beam area of approximately 50 cm^2 is an average of approximately 1 to 2 mW/cm^2. The IR radiation delivered from the infra-red heaters 14 preferably has an intensity of approximately 100 mW/cm^2 at a distance of approximately 30 cm and thus is approximately the same as the total irradiance from sunlight.

Experimental results to date show indications

of a reduction in scarring (which is important with pedigree show animals). Also preliminary work with racehorses indicates that wounds are healed more quickly than without the radiation and, as a consequence, the racehorse suffers less loss of condition than previously.

The foregoing describes only one embodiment of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

CLAIMS

1. A method of phototherapy of skin wounds of mammals, said method comprising the step of irradiating the wound area with ultraviolet light from which the UVB component has been substantially removed or attenuated whereby the wound is irradiated with substantially UVA and UVC radiation.

2. A mehtod as claimed in claim 1 including the step of substantially removing or attenuating said UVB component by passing said ultraviolet light through an interference filter comprising a plurality of layers of dielectric material which are non-absorbing in the UV region, alternate ones of said layers having different refractive indexes.

3. A method as claimed in claim 2 wherein said filter comprises a stack formed from a plurality of layers of said dielectric material, the even numbered layers of said stack being a material selected from the group consisting of hafnium dioxide, magnesium oxide, and yittrium oxide; and the odd number layers of said stack being a material selected from the group consisting of aluminium oxide, magnesium fluoride and silicon dioxide.

4. A method as claimed in any one of claims 1 to 3 including the step of monitoring the radiation reflected by said wound to determine the dose received by said wound.

5. A method as claimed in claim 4 including the step

of simultaneously irradiating said wound with infra-red radiation and/or visible light.

6. Apparatus for phototherapy of skin wounds of mammals, said apparatus comprising a source of UV radiation, focusing means to focus the UV radiation onto a target area, and a filter placed in said radiation to substantially remove or attenuate any UVB component in said radiation.

7. Apparatus as claimed in claim 6 including an interference filter through which said UV radiation passes and which comprises a plurality of layers dielectric material which are non-absorbing in the UV region, alternate ones of said layers having different refractive indexes.

8. Apparatus as claimed in claim 6 wherein said filter comprises a stack formed from a plurality of layers of said dielectric material, the odd numbered layers of said stack being a material selected from the group consisting of hafnium dioxide, magnesium oxide, and yittrium oxide; and the even numbered layers of said stack being a material selected from the group consisting of aluminium oxide, magnesium fluoride and silicon dioxide.

9. Apparatus as claimed in any one of claims 6 to 8 wherein a prism is located in the path of said radiation focused on said target area, the side of said prism adjacent said source of UV radiation is rendered opaque, radiation reflected from the target plane is

incident on said prism and directed thereby through a lens to focus said reflected radiation onto a light sensitive device which is shielded from direct radiation from said UV source.

10. Apparatus as claimed in claim 9 wherein a first shutter is moveable into and out of the path of said radiation to shield said target from said radiation and a second shutter is moveable into and out of the path of said radiation at a location between said prism and said UV source to shield said prism and target from radiation from said UV source whereby substantially only background radiation from said target plane or wound is received by said light sensitive device.

ORIGINAL
2 SHEETS, SHEET 1

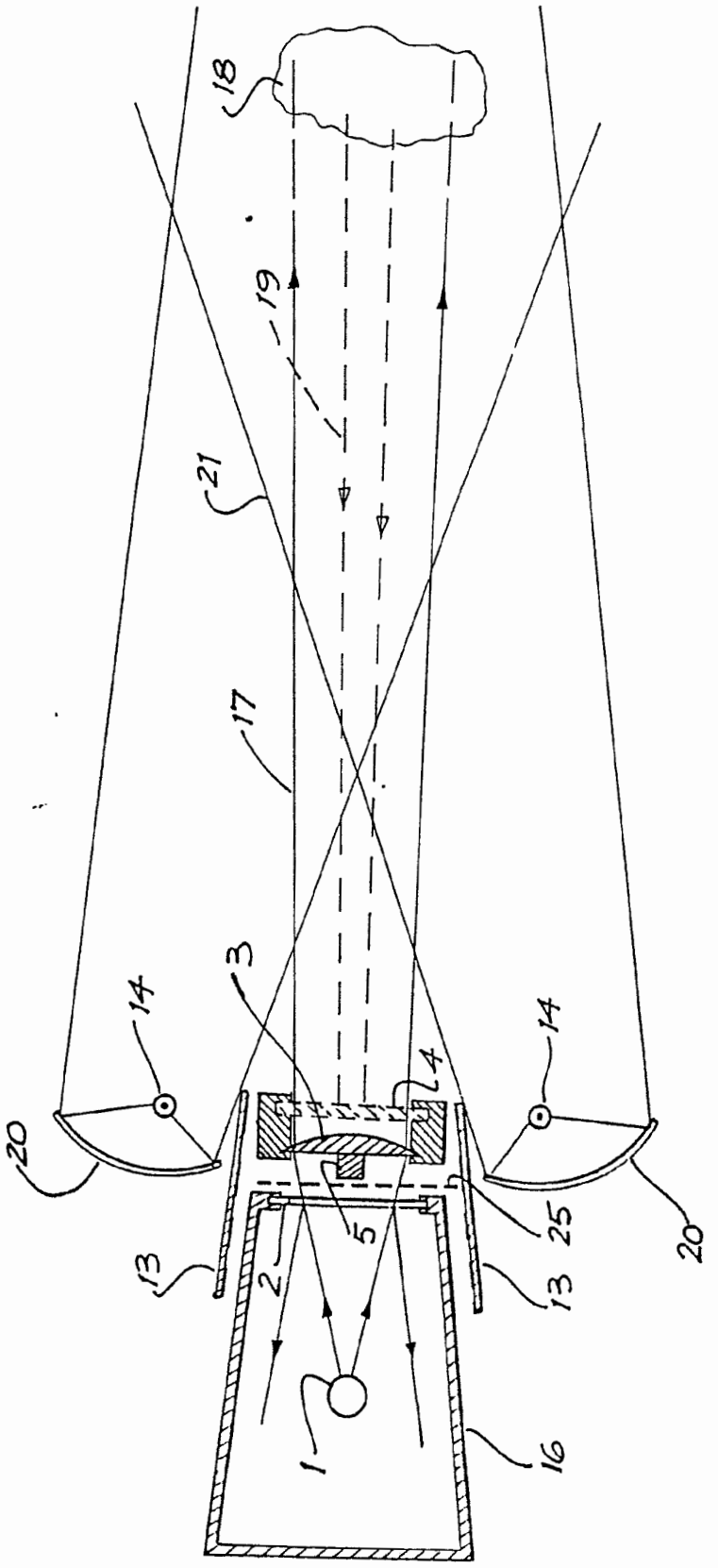


FIG. 1

ORIGINAL
2 SHEETS, SHEET 2

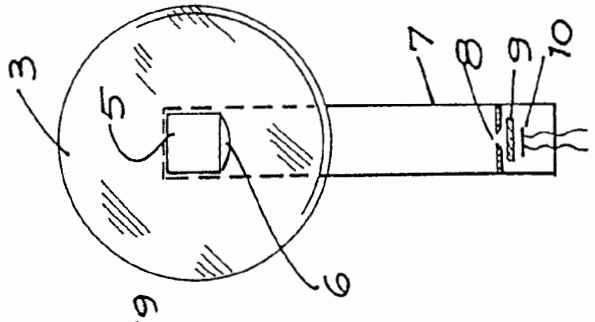


FIG. 4

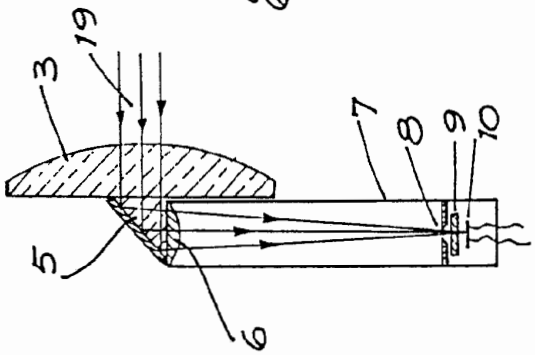


FIG. 3

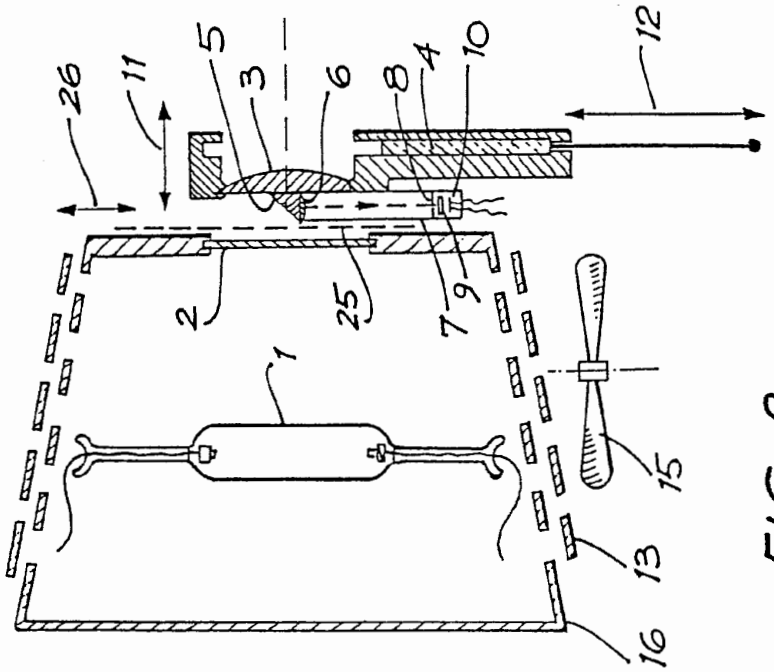


FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 86/00297

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] A61N 5/08

II. FIELDS SEARCHED

Minimum Documentation Searched

Classification System	Classification Symbols
IPC	A61N 5/06, A61N 5/08

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched

AU : IPC as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	US,A, 1856969 (REITER et al) 3 May 1932 (03.05.32)	1,6
X	AU,B, 17021/76 (505720) (WOLFF) 23 February 1978 (23.02.78)	6
X	DE,A, 2906512 (HUBNER) 21 August 1980 (21.08.80)	6
X	GB,B, 813118 (23294/55) (QUARZLAMPEN GESELLSCHAFT) 6 May 1959 (06.05.59)	6
X	DE,A, 2804228 (WOLFF) 2 August 1979 (02.08.79)	6
A	AU,A, 87776/82 (MARTA FENYO et al) 10 March 1983 (10.03.83)	

* 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

"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

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
15 December 1986 (15.12.86)	(13.01.87) 13 JANUARY 1987
International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	J.I. WELSH

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 86/00297

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
AU 17021/76	AT 5907/76	AT 5908/76	AU 16924/76
	BE 845554	BE 845555	CA 1074382
	CA 1100168	CA 1100169	CH 604746
	CH 619143	DE 2537855	DK 3824/76
	DK 3823/76	FI 762425	FI 762426
	FR 2321908	FR 2322329	GB 1540488
	GB 154089	GB 1540866	IT 1069671
	IT 1078636	JP 52028337	JP 52034587
	LU 75652	LU 75653	NL 7609410
	NL 7609465	NO 762886	NO 762887
	SE 7609401	SE 7609402	US 4095113
	US 4106083	US 4196354	US 4309616
	CA 1079782	DE 2603460	DE 2605487
	DE 2624297	US 4177384	DE 2707920
	FR 2381530	GB 1554702	JP 53111690
AU 87776/82	BE 894290	BR 8205145	CA 1197563
	CH 657991	DD 204850	DE 3220218
	DK 3879/82	ES 515325	FI 822940
	FR 2511877	GB 2105195	IL 66643
	JP 58073375	LU 84349	MX 152363
	NL 8203377	NO 822871	SE 8202568
	ZA 8206320		

END OF ANNEX

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)
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.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	15645480	Filing Date	2017-02-24	Docket Number (if applicable)	17-093-EN	Art Unit	1799
First Named Inventor	S. Edward Neister			Examiner Name	Yoo, Regina M.		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☐ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (07-09)
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.

Signature of Registered U.S. Patent Practitioner			
Signature	/David J. Connaughton, Jr/	Date (YYYY-MM-DD)	2020-05-02
Name	David J. Connaughton, Jr.	Registration Number	67275

This collection of information is required by 37 CFR 1.114. 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.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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 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.

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	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

U.S.PATENTS Remove

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	7381976		2008-06-03	Coogan et al.	
	2	4909254		1990-03-20	Wilkinson	
	3	8088289		1996-06-04	Tribelsky	
	4	6730113		2004-05-04	Eckhardt et al.	
	5	7217936		2007-05-15	Ressler	

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

U.S.PATENT APPLICATION PUBLICATIONS Remove

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. Add

FOREIGN PATENT DOCUMENTS Remove

EFS Web 2.1.17

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

Examiner Initial*	Cite No	Foreign Document Number[3]	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							

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

NON-PATENT LITERATURE DOCUMENTS Remove

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	Sosnin, et al., A Bactericidal Barrier-Discharge KrBr Excilamp, Instruments and Experimental Techniques, Vol. 48, No. 5, p. 663 (2005)	
	2	Heering, UV SOURCES – Basics, Properties and Applications, IUVA NEWS, Vol. 6, No. 4, p. 7 (Dec. 2004)	
	3	Sosnin, et al., The Effects of UV Irradiation and Gas Plasma Treatment on Living Mammalian Cells and Bacteria: A Comparative Approach, IEEE Transactions On Plasma Science, Vol. 32, No. 4, p. 1544 (2004)	
	4	Sosnin, et al., New bactericidal UV Light Sources: Excilamps, Proceedings of SPIE, Volume 5483, Atomic and Molecular Pulsed Lasers V, p. 317 (2004)	

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

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	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	17-093-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2020-06-02
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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

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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).

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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 Patent Application Fee Transmittal	
Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 1ST REQUEST	2801	1	650	650
		Total in USD ($)		**650**

Electronic Acknowledgement Receipt	
EFS ID:	39602170
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	02-JUN-2020
Filing Date:	10-JUL-2017
Time Stamp:	15:03:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$650
RAM confirmation Number	E202062F03490103
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	Request for Continued Examination (RCE)	RCE-17-093-EN.pdf	697611 59b73a58bb2ed8ce148cba3c02cfede9ffb0b129	no	3
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	IDS2.pdf	612581 47ba4ca13108fd02d1bebbd7e570a6bf2bd547a0	no	4
Warnings:					
Information:					
3	Non Patent Literature	060401Heering_2004-2.pdf	715218 1c36f6313429b550bbe2cd4362b517d72660ac76	no	7
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30966 e2d31b4c27b995b33a0bfc7d6d194f0da7003359	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2056376		

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

32118 7590 04/27/2020
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER
YOO, REGINA M

ART UNIT	PAPER NUMBER
1799	

DATE MAILED: 04/27/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	07/27/2020

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 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity 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 and an extra copy of the form should be submitted. 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 EFS-Web.

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 including the Patent, advance orders and notification of maintenance fees 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.

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

32118 7590 04/27/2020
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

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 EFS-Web 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.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

TITLE OF INVENTION: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	07/27/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
YOO, REGINA M	1799	422-121000

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/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 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) ❑Advance Order - # of Copies _____

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

❑ Electronic Payment via EFS-Web ❑ 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

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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.
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.
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. _____

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.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 04/27/2020

LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER	
YOO, REGINA M	
ART UNIT	PAPER NUMBER
1799	

DATE MAILED: 04/27/2020

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. 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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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.

Notice of Allowability	Application No. 15/645,480	Applicant(s) Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	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 terminal disclaimer 3/26/2020.
   ☐ 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 1,3-16 and 18-20 . 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 _____.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of Pre-AIA or AIA Status

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

Terminal Disclaimer

2. The terminal disclaimer filed on 3/26/2020 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of Pat. No. 9,700,642 has been reviewed and is accepted. The terminal disclaimer has been recorded.

EXAMINER'S AMENDMENT

3. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

The application has been amended as follows:

- in line 8 of Claim 1, delete "microorganisms" and insert --microorganism--;
- in line 1 of Claim 11, insert --step of-- before "directing";
- in line 9 of Claim 14, delete "microorganisms" and insert --microorganism--;
- in line 1 of Claim 15, insert --to be disinfected-- after "surface";
- in line 1 of Claim 16, insert --to be disinfected-- after "surface";
- in line 8 of Claim 20, delete "microorganisms" and insert --microorganism--.

REASONS FOR ALLOWANCE

4. The following is an examiner's statement of reasons for allowance: the primary reason for allowance of the claims is due to acceptance of the terminal disclaimer filed on 3/26/2020 which overcomes the last remaining rejection (i.e. nonstatutory double patenting rejection) remaining in the application (see paragraph 2 above). While prior art such as Neister (8481985) discloses generating photons of at least two single line wavelengths corresponding to a peak absorption wavelength of DNA or RNA, the at least two single line wavelengths being at least two of 222nm and 282nm (see Col. 3 lines 61-65, Col. 7 lines 54-57) and directing the photons to a substance or a surface (see Col. 8 lines 12-21 and 60-67), whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms, wherein the substance or surface is a human or animal tissue (see Col. 5 lines 35-38, Col. 8 lines 12-13), or an inanimate surface (see Col. 1 lines 8-10, Col. 5 lines 17-67, Col. 6 lines 1-16), the disclosure by Neister ('985) is not an applicable prior art since the effective filing date of Neister ('985) (i.e. 1/29/2009) is not prior to the effective filing date of the claimed invention (7/31/2007). In addition, while prior art of Houle (20080255498) appears to teach a process of destroying a microorganism on a substance or a surface comprising the steps of generating light with at least one or more wavelengths being at least one of 282nm and 308 nm (see p. 8 [0156], p. 9 [0159], p. 22 [0254] – lines 43-44 and 58-59) and directing the light (see Figure 12-18, 21-27, 36, 38-47, 55-62, and 68-82) with the at least one or more wavelengths to a substance or surface in the form of human tissue (see p. 4 [0025], [0029]-[0032], p. 5 [0035], p. 8 [0156], p. 10 [0163]) or an inanimate surface (see p. 4 [0033]-[0034]), Houle ('498) does not specifically teach that photons are generated or that the method comprises a step of directing said photons to the substance or surface to be disinfected where the photons are selected to destroy a plurality of

chemical bonds within DNA or RNA of the microorganism since Houle ('498) teaches utilizing one or more sensitizers in solution to generate reactive chemical species which provides the disinfection (see p. 1 [0003], [0006]-[0008], p. 3 [0020]-[0023], p. 8 [0154], p. 10 [0171]) rather than via photons to destroy chemical bonds of DNA or RNA. It would not have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to provide a process for destroying a DNA or RNA of a microorganism on a substance or surface as claimed.

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."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of References Cited	Application/Control No. 15/645,480	Applicant(s)/Patent Under Reexamination Neister, S. Edward	
	Examiner REGINA M YOO	Art Unit 1799	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20080255498-A1	10-2008	Houle; Philip R.	A61C17/0211	604/20
*	B	US-8481985-B2	07-2013	Neister; S. Edward	A61L2/10	210/748.1
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

CPC						
Symbol					**Type**	**Version**
A61L	/	2	/	0047	F	2013-01-01
A61N	/	5	/	0624	I	2013-01-01
B08B	/	17	/	00	I	2013-01-01
A61L	/	2	/	0011	I	2013-01-01
A23B	/	7	/	015	I	2013-01-01
A61L	/	9	/	20	I	2013-01-01
A23L	/	3	/	28	I	2013-01-01
A61L	/	2	/	10	I	2013-01-01
A23L	/	3	/	26	I	2013-01-01
A61L	/	2202	/	22	A	2013-01-01
A61N	/	2005	/	0661	A	2013-01-01
A61N	/	2005	/	0654	A	2013-01-01
A61N	/	2005	/	063	A	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	22 April 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20200405

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

INTERNATIONAL CLASSIFICATION				
CLAIMED				
A61L	/	2	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/REGINA M YOO/ Primary Examiner, Art Unit 1799	22 April 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20200405

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	**Art Unit**
	REGINA M YOO	1799

☐ 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
1	1	9	10	18	19										
	2	10	11	13	20										
2	3	11	12												
3	4	12	13												
4	5	14	14												
5	6	15	15												
6	7	16	16												
7	8		17												
8	9	17	18												

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 18	
/REGINA M YOO/ Primary Examiner, Art Unit 1799 (Primary Examiner)	22 April 2020 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office Part of Paper No.: 20200405

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	
A23L3/26, 3/28	02/25/2019	
A23B7/015	02/25/2019	
B08B17/00	02/25/2019	
A61N5/0624	02/25/2019	

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

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

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister, S. Edward
	Examiner	Art Unit
	REGINA M YOO	1799

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		
consulted related case 14/254,957, 11/831,667	11/23/2019	RY
UPDATED SEARCH		
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	04/22/2020	RY
EAST and PALM - Inventor Search	04/19/2020	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	04/20/2020	RY

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
A61L	2/0047, 2/0011, 2/10, 9/20	04/22/2020	RY
A23L	3/26, 3/28	04/22/2020	RY
A23B	7/015	04/22/2020	RY
B08B	17/00	04/22/2020	RY
A61N	5/0624	04/22/2020	RY

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	2	(("20170304472") or ("20180353629")).PN.	US-PGPUB; USPAT	OR	OFF	2020/04/19 15:16
S2	54	neister-s-edward.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:17
S3	3	S2 and (photons and human and animal and (DNA or RNA)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:18
S4	3	S2 and (photons and human and animal and (DNA or RNA) and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:18
S5	9934	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT	OR	ON	2020/04/19 15:44
S6	3	S5 and (photons and human and animal and (DNA or RNA)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:45
S7	606	S5 and (photons and human and animal and (DNA or RNA))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2020/04/19 15:45

			DERWENT; IBM_TDB			
S8	584	S5 and (photons and human and animal and (DNA or RNA) and wavelength)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:46
S9	523	S5 and (photons and human and animal and (DNA or RNA) and wavelength and absorption)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:51
S10	72	S5 and (photons and human and animal and (DNA or RNA) and wavelength and "peak absorption")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 15:53
S11	0	S5 and (photons and human and animal and (DNA or RNA) and wavelength and "peak absorption" and dsinfect$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 16:05
S12	14	S5 and (photons and human and animal and (DNA or RNA) and wavelength and "peak absorption" and disinfect$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 16:05
S13	30	S5 and (photons and human and animal and (DNA or RNA) and "chemical bonds" and disinfect$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 17:06
S14	26	("20050173652" | "5364645" | "5843374" | "20070045561" | "5753106" | "6099799" | "6235090" | "3672126" | "4458153" | "4524079" | "20060188835" | "4317041" |	US-PGPUB; USPAT	OR	ON	2020/04/19 18:51

		"20040120850" | "20040166018" | "20070102280" | "6149717" | "7326387" | "20040120846" | "5750072" | "20040131497" | "20050186108" | "5492676" | "5505904" | "5993738" | "20100222852" | "6165170").PN.				
S15	3	S6 and (human and animal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/19 19:14
S16	54	neister-s-edward.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:04
S17	16	S16 and (human or animal or patient or wound)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:04
S18	0	WO-07084145-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:11
S19	0	WO-070084145-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:11
S20	4	WO-2007\084145-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:12

S21	4	WO-2007084145-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:12
S22	0	S21 and (human or animal or patient or wound)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:12
S23	9934	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT	OR	ON	2020/04/20 12:39
S24	38	S23 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "chemical bonds" and disinfect$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 12:39
S25	9934	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT	OR	ON	2020/04/20 13:29
S26	28	S25 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "chemical bonds" and disinfect$ and (wavelength with ("222" or "207" or "254" or "280" or "282" or "308")))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/20 13:29
S27	1	("20080255498").PN.	US-PGPUB; USPAT	OR	OFF	2020/04/20 16:38
S28	1	S27 and (UV or ultraviolet)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2020/04/20 16:39

			DERWENT; IBM_TDB			
S31	1	("20080255498").PN.	US-PGPUB; USPAT	OR	OFF	2020/04/21 08:13
S32	1	S31 and ("light source")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 08:13
S33	5	WO-2007025244-$.did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 14:14
S34	5	(photons and (human or animal or tissue) and (DNA or RNA) and "chemical bonds" and (wavelength with ("222" or "207" or "254" or "280" or "282" or "308"))).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:30
S35	3	(photons and human and animal and DNA and RNA and "chemical bonds" and wavelength and ("222" or "207" or "254" or "280" or "282" or "308")).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:35
S36	2	(photons and human and animal and DNA and RNA and "chemical bonds" and wavelength and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:36
S37	3	(destroying and photons and DNA and RNA and "chemical bonds" and wavelength and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:36

S41	3	(photons and DNA and RNA and "peak absorption" and wavelength and tissue).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:38
S42	6	(photons and DNA and RNA and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:39
S43	12	((substance or surface) and (DNA or RNA) and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 15:39
S44	18	((substance or surface) and photons and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 18:14
S45	7	((substance or surface) and photons and destroy and microorganism and "single line" and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 19:37
S46	7	(disinfected and (substance or surface) and photons and destroy and microorganism and "single line" and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 19:41
S47	10	(disinfected and photons and destroy and microorganism and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/04/21 19:41

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S52	9939	(A61L2/0047 or B08B17/00 or A61L2/0011 or A23B7/015 or A61L9/20 or A23L3/28 or A61L2/10 or A23L3/26 or A61N5/0624 or A61L2202/22 or A61N2005/0661 or A61N2005/0654 or A61N2005/063).cpc.	US-PGPUB; USPAT	OR	ON	2020/04/22 09:15
S53	38	S52 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "chemical bonds" and disinfect$)	US-PGPUB; USPAT	OR	ON	2020/04/22 09:16
S54	38	S52 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "chemical bonds" and disinfect$ and wavelengths)	US-PGPUB; USPAT	OR	ON	2020/04/22 09:17
S55	68	S52 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "peak absorption" and destroy and wavelengths)	US-PGPUB; USPAT	OR	ON	2020/04/22 11:01
S56	13	S52 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "peak absorption" and destroy and wavelengths and disinfect)	US-PGPUB; USPAT	OR	ON	2020/04/22 11:02
S57	13	S52 and (photons and (human or animal or tissue or wound) and (DNA or RNA) and "peak absorption" and wavelengths and disinfect)	US-PGPUB; USPAT	OR	ON	2020/04/22 11:04
S58	16	S52 and (photons and (human or animal or tissue or wound) and "peak absorption" and wavelengths and disinfect)	US-PGPUB; USPAT	OR	ON	2020/04/22 11:05
S59	15	S52 and ((DNA or RNA) and (human or animal or tissue or wound) and "peak absorption" and wavelengths and disinfect)	US-PGPUB; USPAT	OR	ON	2020/04/22 12:37
S60	32	S52 and ((DNA or RNA) and (human or animal or tissue or wound) and "peak absorption" and wavelengths and generat$3 and directing)	US-PGPUB; USPAT	OR	ON	2020/04/22 12:53
S61	84	S52 and ((DNA or RNA) and (human or animal) and "peak absorption" and wavelengths and generat$3)	US-PGPUB; USPAT	OR	ON	2020/04/22 13:39

S62	72	S52 and ((DNA or RNA) and (human or animal) and "peak absorption" and wavelengths and generat$3 and photons)	US-PGPUB; USPAT	OR	ON	2020/04/22 13:40
S63	5	(photons and (human or animal or tissue) and (DNA or RNA) and "chemical bonds" and disinfect$).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 13:49
S64	6	(photons and (human or animal or tissue) and (DNA or RNA) and "chemical bonds" and direct$3).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 13:50
S65	6	(photons and (human or animal or tissue) and (DNA or RNA) and "chemical bonds" and generat$3).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 13:51
S66	5	(photons and (human or animal or tissue) and (DNA or RNA) and "chemical bonds" and disinfected).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 13:51
S67	5	(photons and (human or animal or tissue) and (DNA or RNA) and "peak absorption" and disinfected).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 13:52
S68	5	(photons and (human or animal or tissue) and (DNA or RNA) and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 14:58
S69	4	(photons and (human or animal) and (DNA or RNA) and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 15:01
S70	6	(photons and (substance or surface) and (DNA or RNA) and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 15:02
S71	6	(photons and (DNA or RNA) and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 15:06
S72	6	(photons and microorganism and "peak absorption" and wavelength).clm.	US-PGPUB; USPAT	OR	ON	2020/04/22 15:07

4/22/2020 3:17:47 PM
C:\Users\ryoo\Documents\EAST\Workspaces\15645480 on 041920.wsp

Receipt date: 03/26/2020

OK TO ENTER: /R.M.Y/ 04/21/2020

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister | Art Unit: 1799

Filed: July 10, 2017 | Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOVEMBER 27, 2019 OFFICE ACTION

This is a response to the Office Action issued on November 27, 2019 by the U.S. Patent and Trademark Office in connection with the above-identified application. With a one month extension of time, a response is due on March 27, 2020. Accordingly, this response is being timely filed.

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
15/645,480	07/10/2017	1799	800	17-093-EN	20	3

CONFIRMATION NO. 4718

UPDATED FILING RECEIPT

32118
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

OC000000115841775

Date Mailed: 04/01/2020

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)

S. Edward Neister, Dover, NH;

Applicant(s)

S. Edward Neister, Dover, NH;

Power of Attorney: The patent practitioners associated with Customer Number 32118

Domestic Priority data as claimed by applicant

This application is a CIP of 14/254,957 04/17/2014 PAT 9700642
which is a CIP of 11/831,667 07/31/2007 PAT 8753575
which is a CIP of PCT/US06/03393 01/31/2006
which claims benefit of 60/593,626 01/31/2005

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: No

Permission to Access Search Results: No

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

Preliminary Class

422

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: Yes

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

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/645,480	07/10/2017	S. Edward Neister	17-093-EN

CONFIRMATION NO. 4718

32118
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

37 CFR 1.48 ACKNOWLEDGEMENT LETTER

OC00000011584177 6

Date Mailed: 04/01/2020

NOTICE OF ACCEPTANCE OF REQUEST UNDER 37 CFR 1.48(a)

This is in response to the applicant's request under 37 CFR 1.48(a) submitted on 03/26/2020.

The request under 37 CFR 1.48(a) to correct the inventorship, to correct or update the name of an inventor, or to correct the order of names of joint inventors is accepted.

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**.

/rmohamed/

Application Number * 15/645,480 *	Application/Control No. 15/645,480	Applicant(s)/Patent under Reexamination Neister et al.	
	Examiner YOO, REGINA M	Art Unit 1799	

Document Code - DISQ	Internal Document - DO NOT MAIL

TERMINAL DISCLAIMER	☑ APPROVED	☐ DISAPPROVED
Date Filed: 26 March 2020	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
/LAWANA R HIXON/ **Technology Center: OPLC** **Telephone: (571)272-6074**

Doc Code: R48.REQ
Document Description: Request under Rule 48 correcting inventorship

PTO/AIA/40 (04-18)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

REQUEST FOR CORRECTION IN A PATENT APPLICATION RELATING TO INVENTORSHIP OR AN INVENTOR NAME, OR ORDER OF NAMES, OTHER THAN IN A REISSUE APPLICATION (37 CFR 1.48)

Application Number	15/645,480
Filing Date	July 10, 2017
First Named Inventor	S. Edward Neister
Art Unit	1799
Examiner Name	Yoo, Regina M
Practitioner Docket Number	17-093-EN

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby **requests that the inventorship be corrected or changed, or that the name of the inventor or a joint inventor, or the order of the names of joint inventors, be changed,** in the above-identified application. **Note**: 37 CFR 1.48 applies to any request to correct inventorship filed on or after September 16, 2012, regardless of the application filing date. **Do not submit this form after payment of the issue fee or if the application has been patented.** See 37 CFR 1.324 for correction of inventorship in a patent.

Please check the applicable box(es) below.

For a nonprovisional application:

☒ 1. This request is to correct or change the inventorship in a **nonprovisional** application (**under 37 CFR 1.48(a)**) and includes:

☒ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). See the Manual of Patent Examining Procedure (MPEP) section 601.05(a) for information about filing an ADS in an application filed on/after September 16, 2012. For information about filing a Supplemental ADS in an application filed before September 16, 2012, see MPEP 601.05(b).

☒ The processing fee set forth in 37 CFR 1.17(i). $ $70

☐ An inventor is being added. An inventor's oath or declaration by any actual inventor who has not yet executed an oath or declaration is required (see 37 CFR 1.48(b)). See MPEP 602.01(a) for information about an inventor's oath or declaration for an application filed on/after September 16, 2012 (*e.g.*, form **PTO/AIA/01**). For information about an inventor's oath or declaration for an application filed before September 16, 2012 (*e.g.*, form **PTO/SB/01**), see MPEP 602.01(b).

☒ This request is being filed after the first Office action on the merits has been given or mailed (see 37 CFR 1.48(c) and 1.17(d)). Check one of the following:

☒ This request to correct or change the inventorship is due solely to the cancellation of claims in the application.

OR

☐ The fee set forth in 37 CFR 1.17(d) is due (in addition to the fee set forth in 37 CFR 1.17(i)). $ _____

This collection of information is required by 37 CFR 1.48. 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 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.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/40 (04-18)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

REQUEST FOR CORRECTION IN A PATENT APPLICATION RELATING TO INVENTORSHIP OR AN INVENTOR NAME, OR ORDER OF NAMES, OTHER THAN IN A REISSUE APPLICATION (37 CFR 1.48)

☐ 2. This request is to correct or update the name of the inventor or a joint inventor, or the order of names of joint inventors, in a **nonprovisional** application (**under 37 CFR 1.48(f)**) and includes:

☐ An application data sheet in accordance with 37 CFR 1.76(c) identifying the complete inventive entity, including the corrected or updated name of the inventor, or the new order of names shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). See the MPEP 601.05(a) for information about filing an ADS in an application filed on/after September 16, 2012. For information about filing a Supplemental ADS in an application filed before September 16, 2012, see MPEP 601.05(b).

☐ The processing fee set forth in 37 CFR 1.17(i). $ _____

For a provisional application:

☐ This request is to change or correct the inventorship, or correct or update the name of the inventor or a joint inventor, in a **provisional** application (**under 37 CFR 1.48(d)**) and includes:

☐ **Attached hereto** is a document that is signed by a party set forth in 37 CFR 1.33(b) and identifies each inventor by his or her legal name, in the preferred order. Note: the document may be an application data sheet in accordance with 37 CFR 1.76(c) that identifies the changes with markings (underlining for insertions, strikethrough for deletions).

☐ The processing fee set forth in 37 CFR 1.17(q). $ _____

Fee Payment Information:

☒ 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

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. _____.

☒ Payment made via EFS-Web.

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.

I am the

☐ Applicant*

☒ attorney or agent of record
Registration number 67275

☐ attorney or agent acting under 37 CFR 1.34
Registration number _____

Signature /David J. Connaughton, Jr./

Typed or printed name David J. Connaughton, Jr.

Date 3/26/2020

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

☐ ** Total of _____ forms are submitted.

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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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 Patent Application Fee Transmittal

Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Extension - 1 month with $0 paid	2251	1	100	100
Miscellaneous:				
		Total in USD ($)		**170**

Electronic Acknowledgement Receipt	
EFS ID:	38973696
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	26-MAR-2020
Filing Date:	10-JUL-2017
Time Stamp:	10:55:51
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E20203PA58345560
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	Application Data Sheet	ADS3.pdf	9410146 a73455723725c8c883a00ad3468618d2a74c5937	no	7
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
2		Response-FOA-3-20-20.pdf	35008 3254d31a54e9e20d377a7b2f73fab9f18a2f910c	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	7

Warnings:					
Information:					
3	Request under Rule 48 correcting inventorship	AIA0040-2.pdf	171620 117f58d8cc6fc15cc17ab5fe069d4daacd9e383a	no	3
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	32841 c66664f3f85293916beb977e6012165993b04607	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	9649615		

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/14 (03-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

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
	S	Edward	Neister	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Dover	State/Province	NH	Country of Residence	US

Mailing Address of Inventor:

Address 1	273-B Locust Street		
Address 2			
City	Dover	State/Province	NH
Postal Code	03820	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	~~John~~	~~James~~	~~Rowsey~~	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	~~Belleair~~	State/Province	~~FL~~	Country of Residence	~~US~~

Mailing Address of Inventor:

Address 1	~~150 Belleview Blvd~~		
Address 2	~~#102~~		
City	~~Belleair~~	State/Province	~~FL~~
Postal Code	~~33756~~	Country	~~US~~

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).

PTO/AIA/14 (03-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
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Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	32118
Email Address	Add Email / Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION		
Attorney Docket Number	17-093-EN	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

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.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	32118		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(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.

Prior Application Status: Patented — Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15645480	Continuation in part of	14254957	2014-04-18	9700642	2017-07-11

Prior Application Status: Patented — Remove

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14254957	Continuation in part of	11831667	2007-07-31	8753575	2014-06-17

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11831667	Continuation in part of	PCT/US2006/003393	2006-01-31

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
PCT/US/2006/03393	non provisional of	60593626	2005-01-31

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

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(d). 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(h)(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[j] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

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 Remove

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.

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Mailing Address Information For Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section 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), as the patent application publication will include the name of the applicant(s).

Remove

If the Assignee is an Organization check here.

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the Add button. Add

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Signature:

Remove

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

Signature	/David J. Connaughton, Jr./			Date (YYYY-MM-DD)	2017-06-22
First Name	David	Last Name	Connaughton	Registration Number	67275

Additional Signature may be generated within this form by selecting the Add button. Add

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 Co o p eration 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.

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister

Art Unit: 1799

Filed: July 10, 2017

Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOVEMBER 27, 2019 OFFICE ACTION

This is a response to the Office Action issued on November 27, 2019 by the U.S. Patent and Trademark Office in connection with the above-identified application. With a one month extension of time, a response is due on March 27, 2020. Accordingly, this response is being timely filed.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Previously Presented) A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 207nm, 222nm, 280nm, 282nm, and 308nm;

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

2. (Canceled).
3. (Original) The process of claim 1 wherein the human or animal tissue is blood.
4. (Original) The process of claim 1 wherein the human or animal tissue is an organ.
5. (Original) The process of claim 1 wherein the human or animal tissue is a wound.
6. (Original) The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. (Original) The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. (Original) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. (Original) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a blood flow path in a dialysis machine.
10. (Original) The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.

11. (Previously Presented) The process of claim 1 wherein the directing comprises positioning a lamp approximately two centimeters away from the substance or surface to be disinfected.
12. (Original) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a case.
13. (Currently Amended) The process of claim 1 wherein the step of directing the photons further comprises [[the]] a step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.
14. (Previously Presented) A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least two single line wavelengths corresponding to a peak absorption wavelength of DNA or RNA, the at least two single line wavelengths being at least two of 207nm, 222nm, 254nm, 280nm, 282nm, and 308nm; and

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms.
15. (Original) The process of claim 14 wherein the substance or surface is a human or animal tissue.
16. (Original) The process of claim 14 wherein the substance or surface is an inanimate surface.
17. (Canceled).
18. (Original) The process of claim 14 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
19. (Original) The process of claim 14 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
20. (Previously Presented) A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 222nm and 282nm;

directing the photons to a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

Remarks

Applicant thanks the Office for the attention accorded to the present application in the October 28, 2016 Office Action. Claims 1, 3-16, and 18-20 were pending in the subject application.

Without prejudice or disclaimer, Applicant has herein amended claim 13. Upon entry of this amendment, claims 1, 3-16, and 18-20 will be pending in the present application.

The amendments to the claims are primarily to correct matters of form and/or clarity in response to the Office's recommendation. Applicant asserts that all claims are supported in the specification as originally filed. No new matter has been added.

The claim amendments and cancellations made herein are made solely to expedite prosecution of the instant application, and should not be construed as acquiescence to the Office's rejections. Applicant reserves the right to pursue the cancelled and/or non-elected subject matter in one or more divisional or continuation applications.

Applicant respectfully traverses all rejections and asserts that the claims are now in condition for allowance.

Notice of Change in Inventorship

Applicant herein respectfully requests a correction of inventorship due solely to the cancellation of claims 2 and 17 in this application. In compliance with 37 CFR 1.48(a)-(c), Applicant herein submits an updated application data sheet, form AIA 40, and the required fee. No oath or declaration is believed to be required.

Rejections under 35 U.S.C. § 112

The Examiner has rejected claims 1-20 as allegedly being indefinite under 35 USC 112(b)/ second paragraph. Applicant has herein amended claim 13 to clarify the claims. Therefore, Applicant respectfully asserts that this rejection has been overcome.

Double Patenting

Claims 1-20 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of US Patent No. 9,700,642. Without acceding to the propriety of this rejection, Applicant herein submits an updated terminal disclaimer, thereby overcoming this rejection.

Conclusion

Applicant again thanks the Office for the attention accorded to the present Application in the November 27, 2020 office action. Applicant has herein amended claim 13. Applicant asserts that based on the amendment and comments presented herein, all of the pending claims are in condition for allowance. Early and favorable action is respectfully requested.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

/David J. Connaughton, Jr./
David J. Connaughton, Jr.

USPTO Reg. #67275
Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109
(617) 720-0091

PTO/SB/26 (08-08)
Approved for use through 09/30/2008. OMB 0651-0031
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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) 17-093-EN

In re Application of: S. Edward Neister

Application No.: 15/645,480

Filed: 7/10/17

For: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

The owner*, S. Edward Neister, of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term **prior patent** No. 9,700,642 as the term of said prior patent is defined in 35 U.S.C. 154 and 173, and as the term of said **prior patent** is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

expires for failure to pay a maintenance fee;
is held unenforceable;
is found invalid by a court of competent jurisdiction;
is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
has all claims canceled by a reexamination certificate;
is reissued; or
is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2. ☑ The undersigned is an attorney or agent of record. Reg. No. 67275

/David J. Connaughton, Jr./ — Signature
9/4/19 — Date

David J. Connaughton, Jr. — Typed or printed name

617-742-8714 — Telephone Number

☐ Terminal disclaimer fee under 37 CFR 1.20(d) included.

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.

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

This collection of information is required by 37 CFR 1.321. 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.**

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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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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:	38974065
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	26-MAR-2020
Filing Date:	10-JUL-2017
Time Stamp:	11:16:47
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	Terminal Disclaimer Filed	sb0026.pdf	80998 99a0e32cc12dc3d2b28bdc7bbf449b171f6a5ef3	no	2

Warnings:

Information:	
Total Files Size (in bytes):	80998

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/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/645,480	Filing Date 07/10/2017	☐ 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 $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ 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	03/26/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $230 =	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".	/SHAREILL A COLES/
*** 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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LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

Courtesy Reminder for
Application Serial No: 15/645,480

Attorney Docket No: 17-093-EN
Customer Number: 32118
Date of Electronic Notification: 11/27/2019

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
info@lambertpatentlaw.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 11/27/2019

LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

NOTIFICATION DATE	DELIVERY MODE
11/27/2019	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):

info@lambertpatentlaw.com

Office Action Summary	**Application No.** 15/645,480	**Applicant(s)** Neister et al.	
	Examiner REGINA M YOO	**Art Unit** 1799	**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 04 September 2019.

☐ 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) 1,3-16 and 18-20 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) 1,3-16 and 18-20 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 _____ 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: _____.

Notice of Pre-AIA or AIA Status

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

FINAL ACTION

Response to Amendment

The amendment filed on 9/04/2019 has been received and claims 1, 3-16, and 18-20 are pending.

Claim Rejections - 35 USC § 112

2. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 13 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

4. Claim 13 recites the limitation "the step" in in line 2. There is insufficient antecedent basis for this limitation in the claim.

Double Patenting

5. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the

form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

6. Claims 1, 3-16, and 18-20 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,700,642. Although the claims at issue are not identical, they are not patentably distinct from each other because skin is a tissue.

Terminal Disclaimer

7. The terminal disclaimer filed on 9/04/2019 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of Patent Number 9,700,642 has been reviewed and is NOT accepted.

8. The assignee has not established, via a statement under 37 CFR 3.73(c), its ownership interest in the patent, in order to support the terminal disclaimer. There is no submission in the record establishing the ownership interest by either: (a) providing documentary evidence of a chain of title from the original inventor(s) to the assignee/new applicant and a statement affirming that the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11; or (b) specifying (by reel and frame number) where such documentary evidence is recorded in the Office (37 CFR 3.73).

9. The following is a statement of 37 CFR 3.73 as applicable to applications filed on or after September 16, 2012:

37 CFR 3.73 Establishing right of assignee to take action.

(a) The original applicant is presumed to be the owner of an application for an original patent, and any patent that may issue therefrom, unless there is an assignment. The original applicant is presumed to be the owner of a trademark application or registration, unless there is an assignment.

(b) In order to request or take action in a trademark matter, the assignee must establish its ownership of the trademark property of paragraph (a) of this section to the satisfaction of the Director. The establishment of ownership by the assignee may be combined with the paper that requests or takes the action. Ownership is established by submitting to the Office a signed statement identifying the assignee, accompanied by either:

(1) Documentary evidence of a chain of title from the original owner to the assignee (e.g., copy of an executed assignment). The documents submitted to establish ownership may be required to be recorded pursuant to § 3.11 in the assignment records of the Office as a condition to permitting the assignee to take action in a matter pending before the Office; or

(2) A statement specifying where documentary evidence of a chain of title from the original owner to the assignee is recorded in the assignment records of the Office (e.g., reel and frame number).

(c)(1) In order to request or take action in a patent matter, an assignee who is not the original applicant must establish its ownership of the patent property of paragraph (a) of this section to the satisfaction of the Director. The establishment of ownership by the assignee may

be combined with the paper that requests or takes the action. Ownership is established by submitting a signed statement identifying the assignee, accompanied by either:

(i) Documentary evidence of a chain of title from the original owner to the assignee (e.g., copy of an executed assignment). The submission of the documentary evidence must be accompanied by a statement affirming that the documentary evidence of the chain of title from the original owner to the assignee was or concurrently is being submitted for recordation pursuant to § 3.11; or

(ii) A statement specifying where documentary evidence of a chain of title from the original owner to the assignee is recorded in the assignment records of the Office (e.g., reel and frame number).

(2) If the submission is by an assignee of less than the entire right, title and interest (e.g., more than one assignee exists) the Office may refuse to accept the submission as an establishment of ownership unless:

(i) Each assignee establishes the extent (by percentage) of its ownership interest, so as to account for the entire right, title and interest in the application or patent by all parties including inventors; or

(ii) Each assignee submits a statement identifying the parties including inventors who together own the entire right, title and interest and stating that all the identified parties owns the entire right, title and interest.

(3) If two or more purported assignees file conflicting statements under paragraph (c)(1) of this section, the Director will determine while, if any, purported assignees will be permitted to control prosecution of the application.

(d) The submission establishing ownership under paragraph (b) or (c) of this section must show that the person signing the submission is a person authorized to act on behalf of the assignee by:

(1) Including a statement that the person is authorized to act on behalf of the assignee;

(2) Being signed by a person having apparent authority to sign on behalf of the assignee; or

(3) For patent matters only, being signed by a practitioner of record.

The following is a statement of pre-AIA 37 CFR 3.73 as applicable to applications filed before September 16, 2012:

Pre-AIA 37 CFR 3.73 Establishing right of assignee to take action.

(a) The inventor is presumed to be the owner of a patent application, and any patent that may issue therefrom, unless there is an assignment. The original applicant is presumed to be the owner of a trademark application or registration, unless there is an assignment.

(b)(1) In order to request or take action in a patent or trademark matter, the assignee must establish its ownership of the patent or trademark property of paragraph (a) of this section to the satisfaction of the Director. The establishment of ownership by the assignee may be combined with the paper that requests or takes the action. Ownership is established by submitting to the Office a signed statement identifying the assignee, accompanied by either:

(i) Documentary evidence of a chain of title from the original owner to the assignee (e.g., copy of an executed assignment). For trademark matters only, the documents submitted to establish ownership may be required to be recorded pursuant to § 3.11 in the assignment records of the Office as a condition to permitting the assignee to take action in a matter pending before the Office. For patent matters only, the submission of the documentary evidence must be

accompanied by a statement affirming that the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to § 3.11; or

(ii) A statement specifying where documentary evidence of a chain of title from the original owner to the assignee is recorded in the assignment records of the Office (e.g., reel and frame number).

(2) The submission establishing ownership must show that the person signing the submission is a person authorized to act on behalf of the assignee by:

(i) Including a statement that the person signing the submission is authorized to act on behalf of the assignee; or

(ii) Being signed by a person having apparent authority to sign on behalf of the assignee, e.g., an officer of the assignee.

(c) For patent matters only:

(1) Establishment of ownership by the assignee must be submitted prior to, or at the same time as, the paper requesting or taking action is submitted.

(2) If the submission under this section is by an assignee of less than the entire right, title and interest, such assignee must indicate the extent (by percentage) of its ownership interest, or the Office may refuse to accept the submission as an establishment of ownership.

10. It should be noted that applicant is not required to pay another disclaimer fee as set forth in 37 CFR 1.20(d) when submitting a replacement or supplemental terminal disclaimer.

Response to Arguments

11. Applicant's arguments filed 9/04/2019 have been fully considered but they are not persuasive. Specifically, the terminal disclaimer filed was not approved/accepted (see paragraph 7 above) and thus it does not overcome the double patenting rejection for the reason set forth in the paragraphs 8-9. In this instance, it is noted that a request to change the applicant needs to be filed, which is (1) a request, signed by a 1.33(b) party, (2) a corrected ADS (37 CFR 1.76(c)) that identifies the "new" applicant in the applicant information, and is underlined since it is new, and (3) a 3.73(c) statement showing chain of title to the new applicant. Along with the § 1.46(c) request we need a POA that gives power to the attorney who is signing the TD, along with another copy of the TD, unless they file a TD that is signed by the applicant. In particular, examiner indicates that the applicant is lacking a 3.73(c) statement showing chain of title to the new applicant.

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister et al.
	Examiner	Art Unit
	REGINA M YOO	1799

✓	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	02/26/2019	11/23/2019							
	1	✓	✓							
	2	✓	-							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	✓							
	11	✓	✓							
	12	✓	✓							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	✓	-							
	18	✓	✓							
	19	✓	✓							
	20	✓	✓							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister et al.
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	
A23L3/26, 3/28	02/25/2019	
A23B7/015	02/25/2019	
B08B17/00	02/25/2019	
A61N5/0624	02/25/2019	

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

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

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister et al.
	Examiner	Art Unit
	REGINA M YOO	1799

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT , IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY
UPDATED SEARCH		
consulted related case 14/254,957, 11/831,667	11/23/2019	RY

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

Application Number * 15/645,480 *	Application/Control No. 15/645,480	Applicant(s)/Patent under Reexamination Neister et al.	
	Examiner YOO, REGINA M	Art Unit 1799	

Document Code - DISQ	Internal Document - DO NOT MAIL

TERMINAL DISCLAIMER	☐ APPROVED	☑ DISAPPROVED
Date Filed: 04 September 2019	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
/FELICIA D ROBERTS/ **Technology Center: OPLC** **Telephone: (571)272-0550** See Continuation Sheet

Continuation of Approved/Disapproved Comments: The terminal disclaimer identifies a party who is not the applicant (only for applications filed on or after September 16, 2012; See FP 14.26.10):

For cases filed on/after 9/16/12, 37 CFR 1.321 specifies that the applicant can disclaim, and the terminal disclaimer must specify the extent of the applicant's ownership.

To remedy this:

A request under 37 CFR 1.46(c) to change the applicant needs to be filed, which is (1) a request, signed by a 1.33(b) party, (2) a corrected ADS (37 CFR 1.76(c)) that identifies the "new" applicant in the applicant information, and is underlined since it is new, and (3) a 3.73(c) statement showing chain of title to the new applicant. Along with the § 1.46(c) request we need a POA that gives power to the attorney who is signing the TD, along with another copy of the TD, unless they file a TD that is signed by the applicant.

Please make corrections as suggested above and also resubmit the TD. (No new fee required)

Electronic Patent Application Fee Transmittal	
Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN
Filed as Small Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	2253	1	700	700
Miscellaneous:				
			Total in USD ($)	**700**

Electronic Acknowledgement Receipt	
EFS ID:	37059180
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	04-SEP-2019
Filing Date:	10-JUL-2017
Time Stamp:	11:37:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$700
RAM confirmation Number	E201994B38226750
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	Application Data Sheet	ADS3.pdf	9410146 a73455723725c8c883a00ad3468618d2a74c5937	no	7
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
2	Amendment/Req. Reconsideration-After Non-Final Reject	Response-NFOA-9-3-19.pdf	35380 17115cdebe4c1f4d01c004449fc16b0b6ab7d404	no	7
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	31187 0bc865282e7aea10c537194093a9f7a1c5c18c87	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	9476713		

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/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

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
	S	Edward	Neister	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Dover	State/Province	NH	Country of Residence	US

Mailing Address of Inventor:

Address 1	273-B Locust Street		
Address 2			
City	Dover	State/Province	NH
Postal Code	03820	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	~~John~~	~~James~~	~~Rowsey~~	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	~~Belleair~~	State/Province	~~FL~~	Country of Residence	~~US~~

Mailing Address of Inventor:

Address 1	~~150 Belleview Blvd~~		
Address 2	~~#102~~		
City	~~Belleair~~	State/Province	~~FL~~
Postal Code	~~33756~~	Country	~~US~~

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).

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
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	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	32118		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION		
Attorney Docket Number	17-093-EN	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

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.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	32118		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(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.

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15645480	Continuation in part of	14254957	2014-04-18	9700642	2017-07-11
Prior Application Status	Patented				Remove

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14254957	Continuation in part of	11831667	2007-07-31	8753575	2014-06-17

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11831667	Continuation in part of	PCT/US2006/003393	2006-01-31

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
PCT/US/2006/03393	non provisional of	60593626	2005-01-31

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

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(d). 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(h)(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[j] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

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 Remove

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.

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

PTO/AIA/14 (03-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
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Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Mailing Address Information For Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Non-Applicant Assignee Information:

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Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section 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), as the patent application publication will include the name of the applicant(s).

Remove

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Mailing Address Information For Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

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PTO/AIA/14 (03-13)
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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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Signature:

Remove

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

Signature	/David J. Connaughton, Jr./			Date (YYYY-MM-DD)	2017-06-22
First Name	David	Last Name	Connaughton	Registration Number	67275

Additional Signature may be generated within this form by selecting the Add button. Add

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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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 Co o p eration 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.

PTO/SB/26 (08-08)
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TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) 17-093-EN

In re Application of: S. Edward Neister

Application No.: 15/645,480

Filed: 7/10/17

For: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

The owner*, S. Edward Neister, of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term **prior patent** No. 9,700,642 as the term of said prior patent is defined in 35 U.S.C. 154 and 173, and as the term of said **prior patent** is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

expires for failure to pay a maintenance fee;
is held unenforceable;
is found invalid by a court of competent jurisdiction;
is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
has all claims canceled by a reexamination certificate;
is reissued; or
is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ For submissions on behalf of a business/organization (e.g., corporation, partnership, university, government agency, etc.), the undersigned is empowered to act on behalf of the business/organization.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

2. ☑ The undersigned is an attorney or agent of record. Reg. No. 67275

/David J. Connaughton, Jr./ — Signature
9/4/19 — Date

David J. Connaughton, Jr. — Typed or printed name

617-742-8714 — Telephone Number

☐ Terminal disclaimer fee under 37 CFR 1.20(d) included.

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.

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

This collection of information is required by 37 CFR 1.321. 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.**

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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 disclosure of these records is required by the Freedom of Information Act.
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).
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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)).
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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 inspection 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 Patent Application Fee Transmittal	
Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert/David Connaughton
Attorney Docket Number:	17-093-EN
Filed as Large Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
		Total in USD ($)		**160**

Electronic Acknowledgement Receipt	
EFS ID:	37060006
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert/David Connaughton
Filer Authorized By:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN
Receipt Date:	04-SEP-2019
Filing Date:	10-JUL-2017
Time Stamp:	12:20:01
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$160
RAM confirmation Number	E201994C20517446
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	Terminal Disclaimer Filed	sb0026.pdf	80998 99a0e32cc12dc3d2b28bdc7bbf449b171f6a5ef3	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30945 4a53ab12d8abb9796092cb1aaee22b582a1a16cf	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	111943		

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.

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480

First Named Inventor: S. Edward Neister

Art Unit: 1799

Filed: July 10, 2017

Examiner: Yoo, Regina M.

Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO MARCH 4, 2019 OFFICE ACTION

This is a response to the Office Action issued on March 4, 2019 by the U.S. Patent and Trademark Office in connection with the above-identified application. With a three month extension of time, a response is due on September 4, 2019. Accordingly, this response is being timely filed.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 207nm, 222nm, 280nm, 282nm, and 308nm;

directing the photons to [[the]] a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

2. (Canceled).
3. (Original) The process of claim 1 wherein the human or animal tissue is blood.
4. (Original) The process of claim 1 wherein the human or animal tissue is an organ.
5. (Original) The process of claim 1 wherein the human or animal tissue is a wound.
6. (Original) The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. (Original) The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. (Original) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. (Original) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a blood flow path in a dialysis machine.
10. (Original) The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.

11. (Currently Amended) The process of claim 1 wherein the ~~step of~~ directing comprises positioning a lamp approximately two centimeters away from the substance or surface to be disinfected.
12. (Original) The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a case.
13. (Original) The process of claim 1 wherein the step of directing the photons further comprises the step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.
14. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

    generating photons of at least two single line wavelengths corresponding to a peak absorption wavelength of DNA or RNA, the at least two single line wavelengths being at least two of 207nm, 222nm, 254nm, 280nm, 282nm, and 308nm; and

    directing the photons to [[the]] a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms.
15. (Original) The process of claim 14 wherein the substance or surface is a human or animal tissue.
16. (Original) The process of claim 14 wherein the substance or surface is an inanimate surface.
17. (Canceled).
18. (Original) The process of claim 14 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
19. (Original) The process of claim 14 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
20. (Currently Amended) A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 222nm and 282nm;

directing the photons to [[the]] a substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

Remarks

Applicant thanks the Office for the attention accorded to the present application in the October 28, 2016 Office Action. Claims 1-20 were pending in the subject application.

Without prejudice or disclaimer, Applicant has herein amended claims 1, 11, 14, and 20, and canceled claims 2 and 17. Upon entry of this amendment, claims 1, 3-16, and 18-20 will be pending in the present application.

The amendments to the claims are primarily to correct matters of form and/or clarity in response to the Office's recommendation. Applicant asserts that all claims are supported in the specification as originally filed. No new matter has been added.

The claim amendments and cancellations made herein are made solely to expedite prosecution of the instant application, and should not be construed as acquiescence to the Office's rejections. Applicant reserves the right to pursue the cancelled and/or non-elected subject matter in one or more divisional or continuation applications.

Applicant respectfully traverses all rejections and asserts that the claims are now in condition for allowance.

Notice of Change in Inventorship

Applicant herein respectfully requests a correction of inventorship due solely to the cancellation of claims 2 and 17 in this application. In compliance with 37 CFR 1.48(a)-(c), Applicant herein submits an updated application data sheet. No oath or declaration is believed to be required. No fee is believed to be required because this request to change

inventorship is due solely to the cancellation of claims in the application, according to 37 CFR 1.48(c).

Rejections under 35 U.S.C. § 112

The Examiner has rejected claims 1-20 as allegedly being indefinite under 35 USC 112(b)/ second paragraph. Applicant has herein amended claims 1, 10, 14, and 20 to clarify the claims. Therefore, Applicant respectfully asserts that this rejection has been overcome.

Double Patenting

Claims 1-20 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of US Patent No. 9,700,642. Without acceding to the propriety of this rejection, Applicant herein submits a terminal disclaimer, thereby overcoming this rejection.

Conclusion

Applicant again thanks the Office for the attention accorded to the present Application in the March 4, 2019 office action. Applicant has herein amended claims 1, 11, 14, and 20, and canceled claims 2 and 17. Applicant asserts that based on the amendment and comments presented herein, all of the pending claims are in condition for allowance. Early and favorable action is respectfully requested.

The Examiner is invited to telephone the undersigned, Applicant's attorney of record, to facilitate advancement of the present application.

Respectfully submitted,

/David J. Connaughton, Jr./
David J. Connaughton, Jr.
USPTO Reg. #67275
Lambert Shortell & Connaughton
92 State Street
Boston, MA 02109
(617) 720-0091

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/645,480	Filing Date 07/10/2017	☐ 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 $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $210 =	
☐ 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	09/04/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	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".	/FELICIA R FARMER/
*** 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.

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UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/645,480	07/10/2017	S. Edward Neister	17-093-EN	4718

32118 7590 03/04/2019
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

EXAMINER	
YOO, REGINA M	

ART UNIT	PAPER NUMBER
1799	

NOTIFICATION DATE	DELIVERY MODE
03/04/2019	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):

info@lambertpatentlaw.com

Office Action Summary	**Application No.** 15/645,480	**Applicant(s)** Neister et al.	
	Examiner REGINA M YOO	**Art Unit** 1799	**AIA 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 _____.

☐ 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) 1-20 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) 1-20 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 _____ 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 7/19/2017.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Claim Rejections - 35 USC § 112

2. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-20 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

4. Claim 1 recites the limitation "the substance or surface to be disinfected" in lines 6 and 9. There is insufficient antecedent basis for this limitation in the claim.

5. Claim 13 recites the limitation "the step" at the end of line 1. There is insufficient antecedent basis for this limitation in the claim.

6. Claim 14 recites the limitation "the substance or surface to be disinfected" in line 6. There is insufficient antecedent basis for this limitation in the claim.

7. Claim 20 recites the limitation "the substance or surface to be disinfected" in lines 6 and 9. There is insufficient antecedent basis for this limitation in the claim.

Double Patenting

8. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the

form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

9. Claims 1-20 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-18 of U.S. Patent No. 9,700,642. Although the claims at issue are not identical, they are not patentably distinct from each other because skin is a tissue.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following references relate either to the field of the invention or subject matter of the invention, but are not relied upon in the rejection of record: 6165170, 20100222852, 20040131497.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to REGINA M YOO whose telephone number is (571)272-6690. The examiner can normally be reached on Monday - Friday, 10:30 am - 7 pm EST.

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, Michael Marcheschi can be reached on (571)272-1374. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/REGINA M YOO/
Primary Examiner, Art Unit 1799

Notice of References Cited	Application/Control No. 15/645,480	Applicant(s)/Patent Under Reexamination Neister et al.	
	Examiner REGINA M YOO	Art Unit 1799	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-6165170-A	12-2000	Wynne; James Jeffrey	A61B18/203	606/10
*	B	US-20040131497-A1	07-2004	Lengsfeld, Thomas	A61K47/10	422/22
*	C	US-20100222852-A1	09-2010	Vasily; David B.	A61N5/0603	607/89
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister et al.
	Examiner	Art Unit
	REGINA M YOO	1799

✓	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	02/26/2019								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister et al.
	Examiner	Art Unit
	REGINA M YOO	1799

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61L2/0047, 2/0011, 2/10, 9/20	02/25/2019	
A23L3/26, 3/28	02/25/2019	
A23B7/015	02/25/2019	
B08B17/00	02/25/2019	
A61N5/0624	02/25/2019	

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* 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**
EAST (US-PGPUB, USPAT, USOCR, FPRS, EPO, JPO, DERWENT, IBM_TDB) - See Search History Printout	02/26/2019	RY
EAST - Inventor Search neister-s-edward, rowsey-john-james	02/25/2019	RY
PALM - Inventor Search	02/25/2019	RY
A61L2/0047, 2/0011, 2/10, 9/20; A23L3/26, 3/28; A23B7/015; B08B17/00; A61N5/0624 - see Search History Printout	02/26/2019	RY
consulted search from related case 14/254,957	02/26/2019	RY

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/645,480	Neister et al.
	Examiner	Art Unit
	REGINA M YOO	1799

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Receipt date: 07/19/2017

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	15/645,480 - GAU: 1799
Filing Date	
First Named Inventor	S. Edward Neister
Art Unit	
Examiner Name	
Attorney Docket Number	14-016-EN

U.S.PATENTS Remove

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
/R.M.Y/	1	4317041		1982-02-23	Schenck	
	2	5843374		1998-12-01	Sizer et al.	
	3	6099799		2000-08-08	Anderson	
	4	7326387		2008-02-05	Arts et al.	
	5	5364645		1994-11-15	Lagunas-Solar, et al.	
	6	5753106		1998-05-19	Schenck	
	7	4458153		1984-07-03	Wesley	
/R.M.Y/	8	4524079		1985-06-18	Hofmann	

EFS Web 2.1.17

Receipt date: 07/19/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

/R.M.Y/	9	5750072		1998-05-12	Sangster et al.	
	10	6235090		2001-05-22	Bernstein et al.	
	11	5492676		1996-02-20	Katatani et al.	
	12	3672126		1972-06-27	Goettle	
	13	5505904		1996-04-09	Haidinger et al.	
	14	5993738		1999-11-30	Goswani	
/R.M.Y/	15	6149717		2000-11-21	Satyapal et al.	

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

U.S.PATENT APPLICATION PUBLICATIONS Remove

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
/R.M.Y/	1	20060188835		2006-08-24	Nagel et al.	
/R.M.Y/	2	20040166018		2004-08-26	Clark et al.	

Receipt date: 07/19/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

/R.M.Y/	3	20070045561		2007-03-01	Cooper	
	4	20040120846		2004-06-24	Bates et al.	
	5	20040120850		2004-06-24	Kaiser	
	6	20050173652		2005-08-11	Ressler	
	7	20050186108		2005-08-25	Fields	
/R.M.Y/	8	20070102280		2007-05-10	Hunter et al.	

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

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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]
/R.M.Y/	1	2139811Y	CN		1993-08-11	HONG YONGFENG		
/R.M.Y/	2	2604181Y	CN		2004-02-25	LIU GANG		
/R.M.Y/	3	2662909Y	CN		2004-12-15	UNIV JILIN		

Receipt date: 07/19/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

/R.M.Y/	4	2005061396	WO		2005-07-07	Marine Environmental Partners, Inc. et al.		
/R.M.Y/	5	2003207165	JP		2003-07-25	Sanyo Electric Co. Ltd.		
/R.M.Y/	6	20040097758	KR		2004-11-18	Modine Korea, LLC		
/R.M.Y/	7	0023552	WO		2000-05-10	Clean Earth Technologies, LLC		
/R.M.Y/	8	0238447	WO		2002-05-16	Tribelsky et al.		
/R.M.Y/	9	0245756	WO		2002-06-13	Tribelsky et al.		
/R.M.Y/	10	02078754	WO		2002-10-10	L2B Environmental Systems, Inc.		
/R.M.Y/	11	10-071192	JP		1998-03-17	Takashi et al		
/R.M.Y/	12	2002-316041	JP		2002-10-29	Hiromitsu et al		
/R.M.Y/	13	2005/081338 A1	WO		2005-09-01	BORMET		
/R.M.Y/	14	2007/084145 A2	WO		2007-07-26	Neister		

Receipt date: 07/19/2017

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15/645,480 - GAU: 1799
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

/R.M.Y/	15	2007-522843	JP		2007-08-16			

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

NON-PATENT LITERATURE DOCUMENTS [Remove]

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]
/R.M.Y/	1	Demethoxycurcumin in combination with ultraviolet radiation B induces apoptosis through the mitochondrial pathway and caspase activation in A431 and HaCaT cells, Yong Xin et al., Tumor Biology June 2017: 1–11	
/R.M.Y/	2	Corneal Collagen Cross-Linking, Mirko R. Jankov II et al., Middle East Afr J Ophthalmol. 2010 Jan-Mar; 17(1): 21–27.	

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

EXAMINER SIGNATURE

Examiner Signature	/REGINA M YOO/	Date Considered	02/25/2019

*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	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2014-04-03
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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.

Bibliographic Data

Application No: 15/645,480

Foreign Priority claimed: ○ Yes ◉ No

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

Verified and Acknowledged: /REGINA M YOO/ Examiner's Signature | Initials

Title: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/10/2017	422	1799	
RULE			

APPLICANTS

INVENTORS

S. Edward Neister Dover, NH, UNITED STATES

John James Rowsey Belleair, FL, UNITED STATES

CONTINUING DATA

This application is a CIP of 14254957 04/17/2014 PAT 9700642

14254957 is a CIP of 11831667 07/31/2007 PAT 8753575

11831667 is a CIP of PCT/US06/03393 01/31/2006

PCT/US06/03393 has PRO of 60593626 01/31/2005

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

07/18/2017

** SMALL ENTITY **

STATE OR COUNTRY

UNITED STATES

ADDRESS

FILING FEE RECEIVED

$730

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	53	neister-s-edward.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:02
S2	9	S1 and ((DNA or RNA) and (substance or surface) and photons and wavelength).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:03
S3	4	S1 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "chemical bonds" and microorganism).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:04
S4	4	S1 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "chemical bonds" and microorganism and generat$3 and direct$3).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:04
S5	3	rowsey-john-james.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:10
S6	6	S1 and ((DNA or RNA) and (substance or surface) and photons and wavelength and disinfect).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:37
S7	5	S1 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "peak absorption").clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 18:37
S8	28860	(A61L2/0047 or A23L3/26 or A23B7/015	US-PGPUB;	OR	ON	2019/02/25

		or A61L2/0011 or A61L2/10 or A23L3/28 or A61L9/20 or B08B17/00 or A61N5/0624).cpc.	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			19:15
S9	23	("20040120846" | "20040120850" | "20040166018" | "20050173652" | "20050186108" | "20060188835" | "20070045561" | "20070102280" | "3672126" | "4317041" | "4458153" | "4524079" | "5364645" | "5492676" | "5505904" | "5750072" | "5753106" | "5843374" | "5993738" | "6099799" | "6149717" | "6235090" | "7326387").PN.	US-PGPUB; USPAT	OR	ON	2019/02/25 19:53
S10	28860	(A61L2/0047 or A23L3/26 or A23B7/015 or A61L2/0011 or A61L2/10 or A23L3/28 or A61L9/20 or B08B17/00 or A61N5/0624).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 22:39
S11	62	S10 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "peak absorption")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 22:39
S12	50	S10 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "peak absorption" and skin)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/25 22:40
S13	28865	(A61L2/0047 or A23L3/26 or A23B7/015 or A61L2/0011 or A61L2/10 or A23L3/28 or A61L9/20 or B08B17/00 or A61N5/0624).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 11:57
S14	50	S13 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "peak absorption" and skin and (UV or UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 11:58
S15	14	S13 and ((DNA or RNA) and (substance or surface) and photons and wavelength and "peak absorption" and skin and (UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 11:58
S16	47	S13 and ((DNA or RNA) and microorganism and photons and wavelength and "peak absorption" and skin and (UV or UVC or "UV-C" or "UV	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2019/02/26 12:31

		C"))	EPO; JPO; DERWENT; IBM_TDB			
S17	11	S13 and ((DNA or RNA) and microorganism and photons and wavelength and "peak absorption" and skin and (UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 12:31
S18	126	S13 and ((DNA or RNA) and microorganism and photons and wavelength and skin and (UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 12:32
S19	33	S13 and ((DNA or RNA) and microorganism and photons and wavelength and (tissue with (animal or human)) and (UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 12:32
S20	74	((DNA or RNA) and microorganism and photons and wavelength and (tissue with (animal or human)) and (UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 14:18
S21	74	((DNA or RNA) and microorganism and photons and wavelength and (tissue with (animal or human or organic)) and (UVC or "UV-C" or "UV C"))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2019/02/26 14:48
S22	37	("20050173652" | "5364645" | "5933702" | "5843374" | "20030170151" | "5843374" | "6165170" | "20070045561" | "5753106" | "6099799" | "6235090" | "20020177118" | "5647890" | "6770069" | "3672126" | "4458153" | "4524079" | "6063170" | "20060188835" | "4317041" | "20040238344" | "20040120850" | "20040166018" | "6149717" | "7326387" | "20020089275" | "20050118078" | "6673137" | "20070102280" | "20040120846" | "5750072" | "20030188740" | "20050173652" | "6160835" | "20050186108" | "5492676" | "5505904" | "5993738" | "20050205206").PN.	US-PGPUB; USPAT	OR	ON	2019/02/26 19:00

EAST Search History (Interference)

< This search history is empty>

2/26/2019 10:47:48 PM
C:\Users\ryoo\Documents\EAST\Workspaces\15645480 on 022519.wsp

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/645,480	07/10/2017	S. Edward Neister	17-093-EN

CONFIRMATION NO. 4718

32118
LAMBERT SHORTELL & CONNAUGHTON
92 STATE STREET
BOSTON, MA 02109-2004

PUBLICATION NOTICE



Title:METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

Publication No.US-2018-0353629-A9
Publication Date:12/13/2018

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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LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON, MA 02109-2004

Courtesy Reminder for
Application Serial No: 15/645,480

Attorney Docket No: 17-093-EN
Customer Number: 32118
Date of Electronic Notification: 09/07/2018

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
info@lambertpatentlaw.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://sportal.uspto.gov/secure/myportal/privatepair.** If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/645,480	07/10/2017	S. Edward Neister	17-093-EN

CONFIRMATION NO. 4718

32118
LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON, MA 02109-2004

PUB REQUEST ACCEPTANCE LETTER

OC000000102135955

Date Mailed: 09/07/2018

NOTICE OF ACCEPTANCE OF PUBLICATION REQUEST

The request for voluntary publication, amended publication, early publication, redacted publication, republication, corrected publication or revised publication has been received for this application. The request, including payment of any necessary fee(s), is in compliance with 37 CFR 1.215, 1.217, 1.219 or 1.221.

The projected publication date is 12/13/2018.

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**.

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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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
15/645,480	07/10/2017	1799	800	17-093-EN	20	3

CONFIRMATION NO. 4718

CORRECTED FILING RECEIPT

32118
LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON, MA 02109-2004

OC000000102024698

Date Mailed: 09/04/2018

Receipt is acknowledged of this non-provisional 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 APPLICANT, 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 Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections 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**

Inventor(s)

S. Edward Neister, Dover, NH;
John James Rowsey, Belleair, FL;

Applicant(s)

S. Edward Neister, Dover, NH;
John James Rowsey, Belleair, FL;

Power of Attorney: The patent practitioners associated with Customer Number 32118

Domestic Priority data as claimed by applicant

This application is a CIP of 14/254,957 04/17/2014 PAT 9700642
which is a CIP of 11/831,667 07/31/2007 PAT 8753575
which is a CIP of PCT/US06/03393 01/31/2006
which claims benefit of 60/593,626 01/31/2005

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: No

Permission to Access Search Results: No

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: 07/18/2017
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/645,480**
Projected Publication Date: Not Applicable
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

Preliminary Class

422

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: Yes

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).

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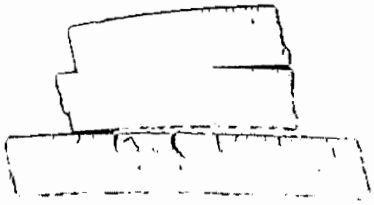
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LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON MA 02109-2004

In re Application of
S. Edward Neister, et al.
Application No.: 15/645,480
Filing Date: July 10, 2017
Attorney Docket No.: 01-16-2018

DECISION ON PETITION
UNDER 37 CFR 1.78(c)
AND 1.78(e)

This is a decision on the renewed petition under 37 CFR 1.78(c) and (e), filed August 07, 2018, to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for the benefit of priority to one or more prior-filed provisional and nonprovisional/international applications.

Under 37 CFR 1.78(c) and (e), a petition to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for the benefit of a prior-filed application must be accompanied by:

(i) the reference required by 35 U.S.C. 119(e) and 120 and 37 CFR 1.78(a)(3) and 1.78(d)(2) to the prior-filed applications, unless previously submitted;

(ii) the petition fee set forth in 37 CFR 1.17(m); and

(iii) a statement that the entire delay between the date the claim was due under 37 CFR 1.78(a)(4) and (d)(3) and the date the claim was filed was unintentional. The Director may require additional information where there is a question whether the delay was unintentional.

With regard to item (i), a proper reference to the prior-filed applications has been included in an application data sheet as required by 37 CFR 1.78(a)(3) and (d)(2).

With regard to item (ii), the petition fee set forth in 37 CFR 1.17(m) has been submitted.

With regard to item (iii), the statement of unintentional delay contained in the petition differs slightly from the language contained in 37 CFR 1.78(c)(3) and (e)(3) and is hereby construed as a statement that the entire delay between the date the claim was due under 1.78(a)(4) and (d)(3) and the date the claim was filed was unintentional. If this interpretation is incorrect, applicant is required to immediately notify the Office. As construed, the provided statement of unintentional delay is acceptable.

For the reasons above, the petition under 37 CFR 1.78(c) and (e) is **GRANTED**.

Applicant is advised that the inclusion of a prior-filed application on any filing receipt should not be construed as meaning that the application is necessarily entitled to the benefit of the prior-filed application. In order for an application to be entitled to the benefit of the prior-filed application, all other requirements under 35 U.S.C. 119(e) and 120 and 37 CFR 1.78 must be met. The examiner will, in due course, determine whether this application is entitled to the benefit of an earlier filing date.

This matter is being referred to Technology Center Art Unit 1799 for appropriate action, including consideration by the examiner of applicant's entitlement to the benefit of priority under 35 U.S.C. 119(e) and 120 to any prior-filed applications.

/Anish Gupta/
Anish Gupta
PCT Legal Examiner
International Patent Legal Administration
571-272-0965

ATTACHMENT: corrected filing receipt

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480
Applicant: S. Edward Neister Art Unit: 2884

Filed: July 10, 2017 Examiner: Not Yet Known

Lambert & Associates
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Request for Reconsideration

Applicant has filed a petition to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for benefit of priority to one or more prior-filed provisional and non-provisional/international applications. In the petition decision issued by the USPTO on May 1, 2018, it was determined that all requirements were met, except that an intermediate application (US 11/831,667) did not contain a proper reference to application no. PCT/US2006/003393 and 60/593,626. In response, petitioner has amended application no. 11/831,667 to include the appropriate references by filing a petition under 37 CFR 1.78. This petition was granted, as demonstrated in the attached petition decision.

Accordingly, Petitioner herein submits this request for reconsideration in light of the corrections made. All conditions for granting the petition are now believed to have been met.

Respectfully submitted,
/David J. Connaughton, Jr./
David J. Connaughton, Jr., Esq.
Registration No. 67,275
LAMBERT & ASSOCIATES
92 State Street
Boston, MA 02109
(617) 720-0091

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

LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON MA 02109-2004

MAILED

JUN 22 2018

INTERNATIONAL PATENT LEGAL ADM.

In re Application of
NEISTE, S. Edward
Application No.: 11/831,667
Filing Date: July 31, 2007
Attorney Docket No.: 11-044-EN

DECISION ON PETITION
UNDER 37 CFR 1.78(c)
AND 1.78(e)

This is a decision on the petition under 37 CFR 1.78(c) and (e), filed June 13, 2018, to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for the benefit of priority to one or more prior-filed provisional and nonprovisional/international applications.

Under 37 CFR 1.78(c) and (e), a petition to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for the benefit of a prior-filed application must be accompanied by:

(i) the reference required by 35 U.S.C. 119(e) and 120 and 37 CFR 1.78(a)(3) and 1.78(d)(2) to the prior-filed applications, unless previously submitted;

(ii) the petition fee set forth in 37 CFR 1.17(m); and

(iii) a statement that the entire delay between the date the claim was due under 37 CFR 1.78(a)(4) and (d)(3) and the date the claim was filed was unintentional. The Director may require additional information where there is a question whether the delay was unintentional.

With regard to item (i), a proper reference to the prior-filed applications has been included in an application data sheet as required by 37 CFR 1.78(a)(3) and (d)(2).

With regard to item (ii), the petition fee set forth in 37 CFR 1.17(m) has been submitted.

With regard to item (iii), the petition contains a proper statement of unintentional delay.

For the reasons above, the petition under 37 CFR 1.78(c) and (c) is **GRANTED**.

Applicant is advised that the inclusion of a prior-filed application on any filing receipt should not be construed as meaning that the present application is necessarily entitled to the benefit of the prior-filed application. In order for an application to be entitled to the benefit of the prior-filed application, all other requirements under 35 U.S.C. 119(e) and 120 and 37 CFR 1.78 must be met.

This matter is being referred to the Office of Publications for appropriate action.

/AnthonySmith/
Anthony Smith
Attorney Advisor
International Patent Legal Administration
571-272-3298

Electronic Acknowledgement Receipt

EFS ID:	33400215
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert
Filer Authorized By:	
Attorney Docket Number:	17-093-EN
Receipt Date:	07-AUG-2018
Filing Date:	10-JUL-2017
Time Stamp:	16:11:54
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	Petition for review by the Office of Petitions	Petition-Request-Reconsideration.pdf	18079 9f81e79ca9a1174ddfbae601741cc82f76a8ebb1	no	1

Warnings:

Information:					
2	Miscellaneous Incoming Letter	Petitiondecision11831667.pdf	59470 f01d17938e5df72052e50b4701b74007f7ea5a84	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	77549	

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

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

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MAY 01 2018

INTERNATIONAL PATENT LEGAL ADM.

LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON MA 02109-2004

In re Application of	:	
S. Edward Neister, et al.	:	
Application No.: 15/645,480	:	DECISION ON PETITION
Filing Date: July 10, 2017	:	UNDER 37 CFR 1.78(c)
Attorney Docket No.: 01-16-2018	:	AND 1.78(e)
	:	

This is a decision on the petition under 37 CFR 1.78(c) and (e), filed February 23, 2018, to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for the benefit of priority to one or more prior-filed provisional and nonprovisional/international applications.

Under 37 CFR 1.78(c) and (e), a petition to accept an unintentionally delayed claim under 35 U.S.C. 119(e) and 120 for the benefit of a prior-filed application must be accompanied by:

(i) the reference required by 35 U.S.C. 119(e) and 120 and 37 CFR 1.78(a)(3) and 1.78(d)(2) to the prior-filed applications, unless previously submitted;

(ii) the petition fee set forth in 37 CFR 1.17(m); and

(iii) a statement that the entire delay between the date the claim was due under 37 CFR 1.78(a)(4) and (d)(3) and the date the claim was filed was unintentional. The Director may require additional information where there is a question whether the delay was unintentional.

With regard to item (i), intermediate application number 118/831,667 does not contain a proper reference to application number PCT/US2006/003393 and 60/593,626. As set forth in MPEP 211.01(b), Section II., "Benefit Claims to Multiple Prior Applications", "Sometimes a pending application is one of a series of applications wherein the pending application is not copending with the first filed application but is copending with an intermediate application entitled to the benefit of the filing date of the first application. . . . Appropriate references must be made in

each intermediate application in the chain of prior applications." Before the petition can be granted, intermediate application number 11/831,667 must be amended to include an appropriate reference to application number PCT/US2006/003393 and 60/593,626. This requires the submission of a petition under 37 CFR 1.78 in the intermediate application along with the appropriate reference as required by 37 CFR 1.78.

It is noted that applicant filed a request for a Certificate of Correction in 11/831,667 but did not file the accompanying petition under 37 C.F.R. §1.78. Filing of a Certificate of Correction alone to correct the benefit claim is not sufficient. Where priority is based on 35 U.S.C. 120 to a national application, a grantable petition to accept an unintentional delayed claim for benefit of the prior application must also be filed in 11/831,667 as required by 37 C.F.R. §1.78. See MPEP 1481.03.

With regard to item (ii), the petition fee set forth in 37 CFR 1.17(m) has been submitted.

With regard to item (iii), the statement of unintentional delay contained in the petition differs slightly from the language contained in 37 CFR 1.78(c)(3) and (e)(3) and is hereby construed as a statement that the entire delay between the date the claim was due under 1.78(a)(4) and (d)(3) and the date the claim was filed was unintentional. If this interpretation is incorrect, applicant is required to immediately notify the Office. As construed, the provided statement of unintentional delay is acceptable.

For the reasons above, the petition under 37 CFR 1.78(c) and (e) is **DISMISSED** without prejudice.

Any further correspondence with respect to this matter may be filed electronically via EFS-Web selecting the document description "Petition for review and processing by the PCT Legal Office" or by mail addressed to Mail Stop PCT, Commissioner for Patents, International Patent Legal Administration, P.O. Box 1450, Alexandria, Virginia 22313-1450, with the contents of the letter marked to the attention of the International Patent Legal Administration.

/Anish Gupta/
Anish Gupta
PCT Legal Examiner
International Patent Legal Administration
571-272-0965

Docket No. 17-093-EN

UNITED STATES PATENT AND TRADEMARK OFFICE

Serial No.: 15/645,480
Applicant: S. Edward Neister Art Unit: 2884

Filed: July 10, 2017 Examiner: Not Yet Known

Lambert & Associates
92 State Street
Boston, MA 02109

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Petition to Accept Unintentionally Delayed Domestic Benefit Claim and Statement That the Entire Delay was Unintentional

Applicant's failure to properly claim the domestic benefit claims in the above referenced application was due to an unintentional clerical error and the delay between the date the claim was due and the date of this Petition was unintentional. For that the Applicant apologizes and submits this Petition to Accept Unintentionally Delayed Domestic Benefit Claim including the corrected reference required by 35 U.S.C. 120 and 37 CFR 1.78(d)(2)(i) and (iii) to the prior-filed application (unless previously submitted); the surcharge set forth in 37 CFR 1.17(m); and (3) a statement that the entire delay between the date the claim was due under 37 CFR 1.78(d)(2)(ii) and the date the claim was filed was unintentional.

To correct the reference required by 35 U.S.C. 120 and 37 CFR 1.78(d)(2)(i) and (iii) to the prior-filed application, Applicant herein submits a clean ADS form and a marked corrected form.

Applicant believes that all proper fees have been filed. However, in the event that this is not the case, the USPTO is hereby authorized to charge or credit Deposit Account Number 32118.

Respectfully submitted,
/David J. Connaughton, Jr./
David J. Connaughton, Jr., Esq.
Registration No. 67,275
LAMBERT & ASSOCIATES
92 State Street
Boston, MA 02109
(617) 720-0091

Electronic Patent Application Fee Transmittal

Application Number:	15645480
Filing Date:	10-Jul-2017
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
PET. DELAY SUB OR RESTORE PRIORITY-CLAIM	2454	1	1000	1000
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1000**

Electronic Acknowledgement Receipt	
EFS ID:	31868128
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert
Filer Authorized By:	
Attorney Docket Number:	17-093-EN
Receipt Date:	23-FEB-2018
Filing Date:	10-JUL-2017
Time Stamp:	10:30:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	022318INTEFSW10313000
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	Application Data Sheet	ADS2.pdf	1503761 8eee9260e32cafe61af4f5fe8029bf1f7de89b05	no	7
Warnings:					
Information:					
2	Application Data Sheet	Corrected-ADS-2-22-18.pdf	106685 5b04a6d73fd23a5404fba07e7cc97743beeb9c3c	no	6
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3	Petition for review by the Office of Petitions	Statement-Delay-Unintentional.pdf	19452 7b7e66c05f7c3530f1be2bd3e148cad8e2613641	no	1
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30553 fdce0ca945bfdc40c3c2510c150aac5a07bc5bc8	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1660451		

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/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

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
	S.	Edward	Neister	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	Dover	State/Province	NH	Country of Residence	US

Mailing Address of Inventor:

Address 1	273-B Locust Street
Address 2	

City	Dover	State/Province	NH
Postal Code	03820	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	John	James	Rowsey	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	Belleair	State/Province	FL	Country of Residence	US

Mailing Address of Inventor:

Address 1	150 Belleview Blvd
Address 2	#102

City	Belleair	State/Province	FL
Postal Code	33756	Country	US

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).

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	32118		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION		
Attorney Docket Number	17-093-EN	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

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.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	32118		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(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.

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15645480	Continuation in part of	14254957	2014-04-18	9700642	2017-07-11
Prior Application Status	Patented				Remove

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14254957	Continuation in part of	11831667	2007-07-31	8753575	2014-06-17

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11831667	Continuation in part of	PCT/US2006/003393	2006-01-31

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
PCT/US/2006/03393	non provisional of	60593626	2005-01-31

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

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(d). 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(h)(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. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

X 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.

Authorization to Permit Access:

Authorization to Permit Access to the Instant Application by the Participating Offices

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

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 Remove

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. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Mailing Address Information For Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Country[i]		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section 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), as the patent application publication will include the name of the applicant(s).

Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country[i]		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the Add button. Add

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Signature:

Remove

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

Signature	/David J. Connaughton, Jr./			Date (YYYY-MM-DD)	2017-06-22
First Name	David	Last Name	Connaughton	Registration Number	67275

Additional Signature may be generated within this form by selecting the Add button. Add

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 Co o p eration 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.

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

CORRECTED ADS FORM

Application Number	15645480
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

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		

Corrected ADS 1.0

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Application Information

	Data of Record	Updated Data
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	
Attorney Docket Number	17-093-EN	
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	patented	
	Application Number	15645480	
	Continuity Type	CIP	
	Prior Application Number	14254957	
	Filing Date (YYYY-MM-DD)	2014-04-17	
	Patent Number	9700642	
	Issue Date (YYYY-MM-DD)	2017-07-11	

		Data of Record	Updated Data
	Prior Application Status		patented
	Application Number	14254957	
	Continuity Type	CIP	
	Prior Application Number	~~PCT/US2006/003393~~	11831667
	Filing Date (YYYY-MM-DD)	2007-07-31	
	Patent Number		8753575
	Issue Date (YYYY-MM-DD)		2014-06-17

		Data of Record	Updated Data
	Prior Application Status		expired
	Application Number		11831667
	Continuity Type		CIP
	Prior Application Number		PCTUS2006003393
	Filing Date (YYYY-MM-DD)		2006-01-31
	Patent Number		
	Issue Date (YYYY-MM-DD)		

		Data of Record	Updated Data
	Prior Application Status		expired
	Application Number		PCTUS2006003393
	Continuity Type		PRO
	Prior Application Number		60593626
	Filing Date (YYYY-MM-DD)		2005-01-31
	Patent Number		
	Issue Date (YYYY-MM-DD)		

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

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).

		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		

Corrected ADS 1.0

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.

Signature	/David Connaughton/	Registration Number	67275
First Name	David	Last Name	Connaughton

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
15/645,480	07/10/2017	S. Edward Neister	17-093-EN

CONFIRMATION NO. 4718

32118
LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON, MA 02109-2004

IMPROPER CFR REQUEST

OC000000097432184

Date Mailed: 02/15/2018

RESPONSE TO REQUEST FOR CORRECTED FILING RECEIPT

Continuity, Priority Claims, Petitions, and Non-Publication Requests

In response to your request for a corrected Filing Receipt, the Office is unable to comply with your request because:

- The priority or continuity claim has not been entered because it was not filed during the required time period. Applicant may wish to consider filing a petition to accept an unintentionally delayed claim for priority. See 37 CFR 1.55 or 1.78.

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**.

/hsarwari/

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

CORRECTED ADS FORM

Application Number	15645480
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

Inventor Information

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	Data of Record	Updated Data
Order Number		
Name		
Residence Information		
Residency		
City		
State		
Country of Residence		
Mailing Address of Inventor		
Address 1		
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City,State/Province, Postal Code		
Country		

Corrected ADS 1.0

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

Application Information

	Data of Record	Updated Data
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	
Attorney Docket Number	17-093-EN	
Entity Type	Small	

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		Data of Record	Updated Data
	Prior Application Status	patented	
	Application Number	15645480	
	Continuity Type	CIP	
	Prior Application Number	14254957	
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	Patent Number	9700642	
	Issue Date (YYYY-MM-DD)	2017-07-11	

		Data of Record	Updated Data
	Prior Application Status		patented
	Application Number	14254957	
	Continuity Type	CIP	
	Prior Application Number	~~PCT/US2006/003393~~	11831667
	Filing Date (YYYY-MM-DD)	2007-07-31	
	Patent Number		8753575
	Issue Date (YYYY-MM-DD)		2014-06-17

		Data of Record	Updated Data
	Prior Application Status		expired
	Application Number		11831667
	Continuity Type		CIP
	Prior Application Number		PCTUS2006003393
	Filing Date (YYYY-MM-DD)		2006-01-31
	Patent Number		
	Issue Date (YYYY-MM-DD)		

		Data of Record	Updated Data
	Prior Application Status		expired
	Application Number		PCTUS2006003393
	Continuity Type		PRO
	Prior Application Number		60593626
	Filing Date (YYYY-MM-DD)		2005-01-31
	Patent Number		
	Issue Date (YYYY-MM-DD)		

Document Description: Application Data Sheet to update/correct info
Doc Code: ADS.CORR

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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****
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	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		

Corrected ADS 1.0

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.

Signature	/David Connaughton/	Registration Number	67275
First Name	David	Last Name	Connaughton

Electronic Acknowledgement Receipt

EFS ID:	31781542
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	
Customer Number:	32118
Filer:	Gary Ervery Lambert
Filer Authorized By:	
Attorney Docket Number:	17-093-EN
Receipt Date:	13-FEB-2018
Filing Date:	10-JUL-2017
Time Stamp:	17:01:02
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	82405 a69495a29e4489540637e4a5395def4456328880	no	6
Warnings:					

Information:	
Total Files Size (in bytes):	82405

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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/645,480	07/10/2017	S. Edward Neister	17-093-EN

CONFIRMATION NO. 4718

32118
LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON, MA 02109-2004

PUBLICATION NOTICE



Title:METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

Publication No.US-2017-0304472-A1
Publication Date:10/26/2017

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

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/645,480

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	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 210 =	0.00			
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	730		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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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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
15/645,480	07/10/2017	2884	800	17-093-EN	20	3

CONFIRMATION NO. 4718

32118
LAMBERT & ASSOCIATES
92 STATE STREET
BOSTON, MA 02109-2004

FILING RECEIPT



Date Mailed: 07/20/2017

Receipt is acknowledged of this non-provisional 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 APPLICANT, 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 Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections 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**

Inventor(s)

S. Edward Neister, Dover, NH;
John James Rowsey, Belleair, FL;

Applicant(s)

S. Edward Neister, Dover, NH;
John James Rowsey, Belleair, FL;

Power of Attorney: The patent practitioners associated with Customer Number 32118

Domestic Priority data as claimed by applicant

This application is a CIP of 14/254,957 04/17/2014 PAT 9700642
which is a CIP of PCT/US2006/003393 07/31/2007

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.

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/645,480**

Projected Publication Date: 10/26/2017

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

Preliminary Class

250

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: Yes

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

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	
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	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

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	2	5843374		1998-12-01	Sizer et al.	
	3	6099799		2000-08-08	Anderson	
	4	7326387		2008-02-05	Arts et al.	
	5	5364645		1994-11-15	Lagunas-Solar, et al.	
	6	5753106		1998-05-19	Schenck	
	7	4458153		1984-07-03	Wesley	
	8	4524079		1985-06-18	Hofmann	

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	9	5750072		1998-05-12	Sangster et al.	
	10	6235090		2001-05-22	Bernstein et al.	
	11	5492676		1996-02-20	Katatani et al.	
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	13	5505904		1996-04-09	Haidinger et al.	
	14	5993738		1999-11-30	Goswani	
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	2	20040166018		2004-08-26	Clark et al.	

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	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

	3	20070045561		2007-03-01	Cooper	
	4	20040120846		2004-06-24	Bates et al.	
	5	20040120850		2004-06-24	Kaiser	
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	7	20050186108		2005-08-25	Fields	
	8	20070102280		2007-05-10	Hunter et al.	

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	1	2139811Y	CN		1993-08-11	HONG YONGFENG		
	2	2604181Y	CN		2004-02-25	LIU GANG		
	3	2662909Y	CN		2004-12-15	UNIV JILIN		

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	Application Number	
	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

	4	2005061396	WO		2005-07-07	Marine Environmental Partners, Inc. et al.		
	5	2003207165	JP		2003-07-25	Sanyo Electric Co. Ltd.		
	6	20040097758	KR		2004-11-18	Modine Korea, LLC		
	7	0023552	WO		2000-05-10	Clean Earth Technologies, LLC		
	8	0238447	WO		2002-05-16	Tribelsky et al.		
	9	0245756	WO		2002-06-13	Tribelsky et al.		
	10	02078754	WO		2002-10-10	L2B Environmental Systems, Inc.		
	11	10-071192	JP		1998-03-17	Takashi et al		
	12	2002-316041	JP		2002-10-29	Hiromitsu et al		
	13	2005/081338 A1	WO		2005-09-01	BORMET		
	14	2007/084145 A2	WO		2007-07-26	Neister		

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	15	2007-522843	JP		2007-08-16			

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	1	Demethoxycurcumin in combination with ultraviolet radiation B induces apoptosis through the mitochondrial pathway and caspase activation in A431 and HaCaT cells, Yong Xin et al., Tumor Biology June 2017: 1–11	
	2	Corneal Collagen Cross-Linking, Mirko R. Jankov II et al., Middle East Afr J Ophthalmol. 2010 Jan-Mar; 17(1): 21–27.	

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	Filing Date	
	First Named Inventor	S. Edward Neister
	Art Unit	
	Examiner Name	
	Attorney Docket Number	14-016-EN

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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.

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	/David J. Connaughton, Jr./	Date (YYYY-MM-DD)	2014-04-03
Name/Print	David J. Connaughton, Jr.	Registration Number	67275

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[19]中华人民共和国专利局

[11] 授权公告号 CN 2139811Y

[12]实用新型专利说明书

[21] ZL 专利号 92239349.4

[51]Int.Cl[5]
A47L 7/04

[45]授权公告日 1993 年 8 月 11 日

[22]申请日 92.11.10 [24]颁证日 93.6.20

[73]专利权人 洪永丰

地址 100036北京市海淀区太平路22院11楼西门一楼东

[72]设计人 洪永丰

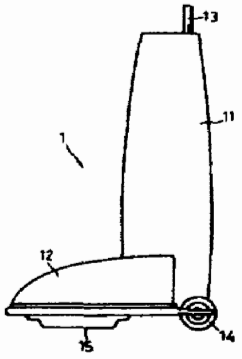
[21]申请号 92239349.4

说明书页数: 1 附图页数: 2

[54]实用新型名称 紫外线杀菌吸尘器

[57]摘要

一种紫外线杀菌吸尘器，在吸尘器底部朝向地板表面的吸入口前方设置一灯座，灯座上可装设紫外线杀菌灯，使吸尘器在进行吸尘工作时，同时可使杀菌灯照射地板表面，对细菌、微生物、病毒等起到杀菌消毒作用，使吸尘器兼具杀菌及吸尘功能。



(BJ)第 1452 号

权　利　要　求　书

1、一种紫外线杀菌吸尘器，包括：直立部分和水平部分以及水平部分底部朝向地板表面的吸入口，其特征在于：吸尘器吸入口的前方设有一长凹槽状的灯座，该灯座可供装设紫外线杀菌灯。

说　　明　　书

紫外线杀菌吸尘器

本实用新型涉及一种具有杀菌作用的吸尘器。

一般医务室为降低病菌的传播途径，确实地减少疾病传染因素，都要定期予以清洁、消毒、杀菌工作。通常是在地板表面进行吸尘处理后再采取紫外线杀菌处理，即用紫外线照射在地板表面，借以使细菌、微生物及病毒等暴露在紫外线中，达到消毒杀菌的目的。所以传统的吸尘和杀菌操作，需分别进行，较为费时费力，实施上也比较麻烦。

本实用新型的目的在于避免上述不足之处提供一种紫外线杀菌吸尘器。

本实用新型的上述目的是通过以下措施达到的：在吸尘器吸入口的前方设置一长凹槽状的灯座。该灯座可供装设紫外线杀菌灯。

附图的图面说明如下：

图1为本实用新型实施例的侧视图(外观)。

图2为本实用新型实施例的底视图。

图3为本实用新型实施例的侧视局部放大剖视图。

如图1，本实用新型以一直立式吸尘器为实施例，该吸尘器(1) 和一般吸尘器结构相同，它包括有直立部分(11)及水平部分(12)，直立部分(11)与水平部分(12)以铰接方式结合，直立部分(11)可调整倾斜角度，直立部分(11)上端为一握把(13)，直立部分(11)的底部后端设有后轮(14)，水平部分(12)底部设有一开口朝向地板表面的吸入口(15)，在吸尘器(1)底部吸入口(15)的前方设计有一长凹槽状的灯座(16)，该灯座(16)可供装设紫外线杀菌灯(17)，在吸尘工作进行时，也点亮紫外线杀菌灯(17)，对地板表面照射紫外光线，使吸尘器兼具杀菌与吸尘的功能，使吸尘操作与杀菌操作同时进行。为了便于使用者了解吸尘器底部紫外线杀菌灯状况，可设置警报器电路，以便紫外线灯坏时，使用者可立即得知。

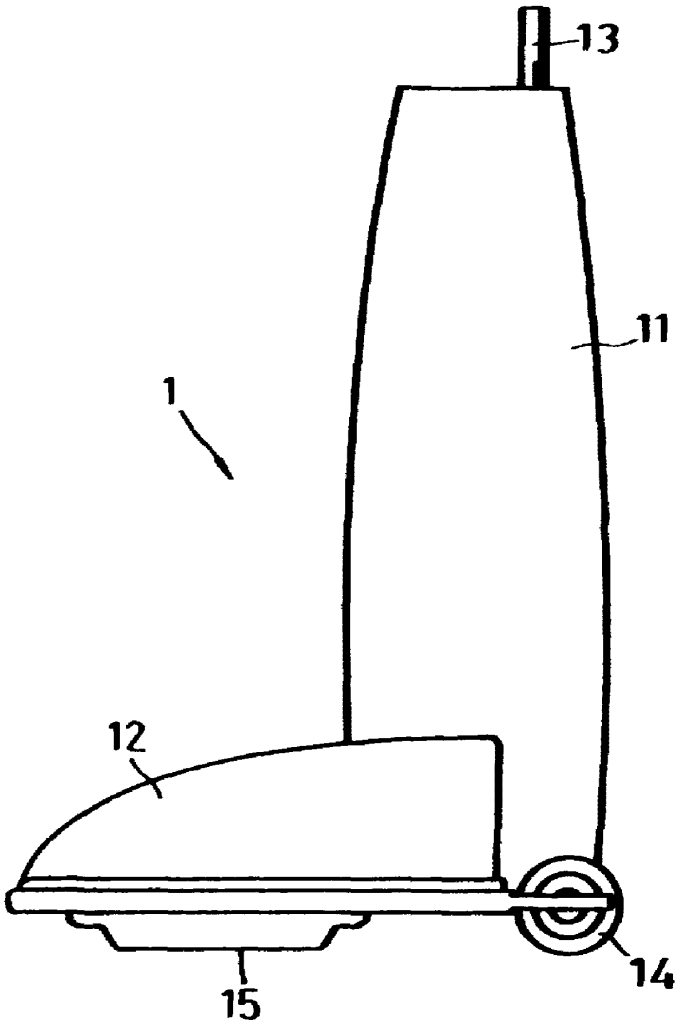


图　1

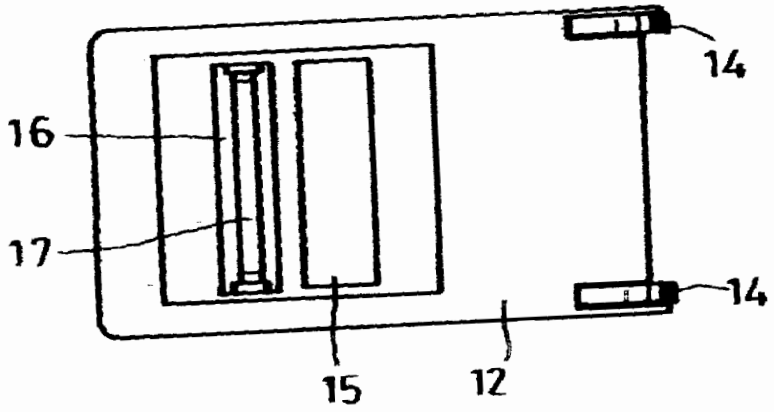


图 2

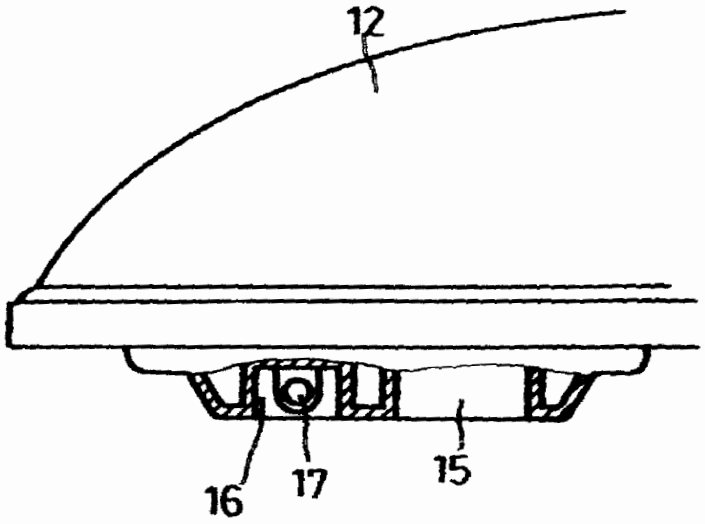


图 3

5

CN2139811Y

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Ultraviolet disinfect dust collector

CN 2139811 Y

Publication number	CN2139811 Y
Publication type	Grant
Application number	CN 92239349
Publication date	Aug 11, 1993
Filing date	Nov 10, 1992
Priority date	Nov 10, 1992
Inventors	张永丰
Applicant	张永丰
Export Citation	BiBTeX, EndNote, RefMan

Referenced by (3), Classifications (1), Legal Events (2)

External Links: SIPO, Espacenet

ABSTRACT

The utility model relates to an ultraviolet sterilization dust collector. A lamp holder is arranged on the bottom of the dust collector facing the front side of the suction mouth of the floor surface; the lamp holder can be provided with an ultraviolet sterilization lamp; when the ultraviolet sterilization dust collector conducts the dust collecting operation, the sterilization lamp can irradiate the floor surface; the sterilizing functions to the bacteria, the micro organism, the viruses, etc. can be obtained, and the ultraviolet sterilization dust collector can simultaneously have the sterilizing and dust collecting functions.

DESCRIPTION translated from Chinese

The utility model relates to a vacuum cleaner has a bactericidal effect.

To reduce the transmission of general infirmary germs indeed reduce the spread of disease factors, should be cleaned on a regular basis, disinfection and sterilization work. Usually the floor surface of the vacuum treatment before taking ultraviolet sterilization, i.e., irradiated with ultraviolet rays in the floor surface, whereby the bacteria, viruses and other micro-organisms and exposure to ultraviolet light, to achieve the purpose of disinfection. Therefore, the traditional vacuuming and sterilization operations were required, more time-consuming, the implementation of more trouble.

The utility model aims to avoid these shortcomings to provide a UV germicidal cleaner.

The utility model of the object is achieved by the following measures: setting a long groove-shaped lamp holder in front of the vacuum cleaner suction inlet. The lamp base for the installation of UV germicidal lamp.

Brief Description of the Drawings: Figure 1 is a schematic side view of a new type of practical embodiment (appearance).

Figure 2 an embodiment of the present utility model bottom view.

Figure 3 is a side view of an embodiment of the utility model a partially enlarged cross-sectional view.

Figure 1, the present utility model is to always upright cleaners embodiment, the vacuum cleaner (1) and the same general structure of the vacuum cleaner, which includes an upright portion (11) and the horizontal portion (12), the upright portion (11) and the horizontal portion (12) in an articulated way, the combination (11) to adjust the inclination angle of the upright portion, (11) the upper end of the upright portion of a grip (13), the upright portion (11) is provided at the bottom of the rear end of the rear wheel (14), the level of portion (12) provided with an opening facing the bottom surface of the floor suction port (15), the vacuum cleaner (1) in front of the bottom of the suction port (15) is designed with an elongated groove-shaped lamp holder (16), the lamp holder (16) for the installation of UV germicidal lamp (17), at work when vacuuming, also lit UV germicidal lamp (17), on the floor surface is irradiated with ultraviolet light, so that both the sterilization and vacuum cleaner features that make vacuuming operation simultaneously with sterilization process. In order to facilitate users to understand the bottom cleaner UV germicidal lamp status, you can set the alarm circuit so bad when the UV lamp, the user can know immediately.

CLAIMS (1) translated from Chinese

An ultraviolet sterilization vacuum cleaner, comprising: an upright portion and a horizontal portion and a bottom horizontal portion of the suction port toward the floor surface, wherein: the front of the cleaner suction port is provided with an elongated groove-shaped lamp holder, the lamp holder for installation of UV germicidal lamp.

REFERENCED BY

Citing Patent	Filing date	Publication date	Applicant	Title
US7251853	Apr 13, 2004	Aug 7, 2007	Samsung Gwangju Electronics Co., Ltd.	Robot cleaner having floor-disinfecting function

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Citing Patent	Filing date	Publication date	Applicant	Title
US9700642	Apr 17, 2014	Jul 11, 2017	S. Edward Neister	Method and apparatus for sterilizing and disinfecting air and surfaces and protecting a zone from external microbial contamination

CLASSIFICATIONS

International Classification	A47L7/04

LEGAL EVENTS

Date	Code	Event	Description
Aug 11, 1993	C14	Granted	
Jul 8, 1998	C17	Cessation of patent right	

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[19] 中华人民共和国国家知识产权局

[51] Int. Cl[7]
A61L 2/02
A61L 2/10 F24F 7/00
B01D 35/00 B01D 37/00

[12] 实用新型专利说明书

[21] ZL 专利号 02267186.2

[45] 授权公告日 2004 年 2 月 25 日

[11] 授权公告号 CN 2604181Y

[22] 申请日 2002.9.16 [21] 申请号 02267186.2

[73] 专利权人 刘 刚

地址 200051 上海市金钟路 255 弄 24 号 501 室

共同专利权人 何永德 张鸿飞

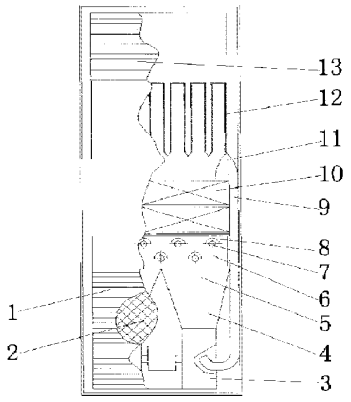
[72] 设计人 刘 刚 何永德 张鸿飞

权利要求书 1 页 说明书 2 页 附图 1 页

[54] 实用新型名称 医院空气消毒器

[57] 摘要

一种医院空气消毒器，它主要是由消毒系统、过滤系统、空气内循环系统与风机组成。其中消毒系统是由紫外线消毒装置与静电吸附式空气消毒装置组成；过滤系统是由预过滤器与活性炭纤维过滤器组成；而空气内循环系统由回风罩、回风道与倒钩管组成。本消毒器能够有效地杀灭微生物与吸附空气中带菌的尘埃，为医院二类环境提供一个卫生消毒的场所。



ISSN1008-4274

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1、 本实用新型提供一种医院空气消毒器，它主要由消毒系统、过滤系统、空气内循环系统与风机组成，其特征在于：消毒系统是由静电吸附式消毒装置与紫外线空气消毒装置上下相叠组成；而前者是由 1～2 组高压静电场组成；后者又由 2～3 排带反射罩的紫外线灭菌灯组成。

2、 根据权利要求 1 所述的医院空气消毒器，其特征在于：过滤系统由预过滤器与活性炭纤维过滤器组成，而后者结构呈方槽形。

3、 根据权利要求 1 所述的医院空气消毒器，其特征在于：空气内循环系统是由两组回风罩、回风道与倒钩管组成。

医院空气消毒器

本实用新型涉及一种空气卫生消毒装置，具体地说是一种用于医院二类环境及其场所的空气消毒器。

随着科学的发展，社会的进步，人民生活的改善，为人民健康服务的各类医院正不断地改进设施，其中包括院内二类环境。这些环境如普通手术室、产房、婴儿室、早产儿室、普通保护性隔离室、供应室、无菌区、烧伤病房与重症监护病房，关系着千千万万人的生命与健康。

然而目前社会上各种消毒、净化类装置不少，但真正能用于医院并达到医院二类环境的空气消毒装置却不多，为了解决问题，相当医院花大钱进口国外产品或采用昂贵的层流洁净装置。

本实用新型的目的就是为了解决上述问题，提供一种医院空气消毒器，它能有效地过滤或杀死空气中的微生物，并有效地滤除空气中的尘埃。为病人提供一个卫生而健康的环境。

本实用新型的技术方案是，它含有由静电吸附式空气消毒装置与紫外线空气消毒装置上下叠加组成的消毒系统，并在消毒系统两侧设置一套空气内循环系统，使得部分空气二次通过消毒系统，为此能为医院二类环境提供消毒品质良好的空气。

如上述，本实用新型的医院空气消毒器主要由消毒系统、过滤系统、空气内循环系统与风机组成。其中消毒系统是由紫外线空气消毒装置 6 与静电吸附式空气消毒器 10 组成；过滤系统由预过滤器 2 与活性炭纤维过滤器 12 组成，空气内循环系统由回风罩 11、回风道 9 与倒钩管 4 组成。风机 3 布置在器体的下部，其前面有栅格状的进风口 1。在进风口 1 内布置了预过滤器 2。而在风机 3 的出风罩 5 上方布置紫外线消毒装置 6。它是由 2～3 排多根排列带有反射罩 8 的紫外线灭菌灯 7 组成，再上面布置了静电吸附式空气消毒装置 10，它由 1～2 组高压静电场组成，紧挨着该装置的上方两侧各布置了回风罩 11，其剖面呈下抛物线。在回风罩 11 内有一不封顶的隔板，其外侧下部的回风道 9 与风机蜗壳内的倒钩管 4 相连通。在两个回风罩 11 上方布置活性炭纤维过滤器 12，其截面呈方

槽形，在活性炭纤维过滤器 12 的上方为栅格状的出风口 13。

图 1 为本实用新型结构示意图。

图中标号说明

1、进风口	2、预过滤器	3、风机	4、倒钩管
5、出风罩	6、紫外线消毒装置	7、紫外线灭菌灯	
8、反射罩	9、回风道	10、静电吸附式空气消毒器	
11、回风罩	12、活性炭纤维过滤器	13、出风口	

参阅附图，接通电源、启动风机 3，紫外线消毒装置 6 与静电吸附式空气消毒装置 10 进入工作。空气从进风口 1 吸入，其中较大颗粒尘埃被预过滤器 2 吸附，空气接着进入风机 3，在其蜗壳内与空气内循环系统下部的倒钩管 4 中出来的空气相混合，两者一起进入紫外线消毒装置 6。在高强度的紫外线灭菌灯 7 的直接辐射下，空气中相当的微生物被杀死，随后空气又进入静电吸附式空气消毒装置 10，在高压静电场作用下，该消毒装置 10 吸附并过滤了空气中带菌的尘埃，同时也吸附剩余微生物，离开静电吸附式空气消毒装置 10 的空气，其内含细菌菌落总数已完全≤200cfu/m^3,此时中间大部分空气进入活性炭纤维过滤器 12，而两侧的部分空气则被吸入到回风罩内，随即拐弯进入回风道 9，接着又进入风机蜗壳内的倒钩管 4，被风机 3 的负压抽引出来与主流气流混合，共同通过风机 3。又，进入活性炭纤维过滤器 12 的空气，其极少量异味与有害气体被活性纤维吸附与过滤掉；消毒后的空气随即离开过滤器 12，从出风口 13 送出，重新参与医院二类场所的外循环。

本实用新型设计新颖，结构合理，其灭菌除尘效果特佳，是用于医院二类环境的专业产品。

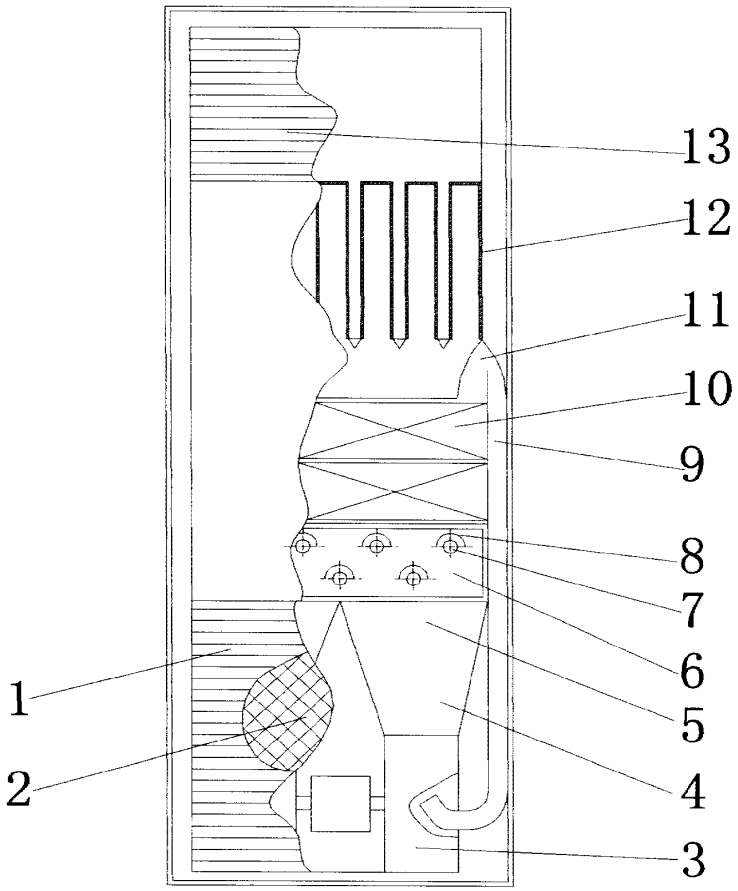


图1

CN2604181Y

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Hospital air sterilizer

CN 2604181 Y

Publication number	CN2604181 Y
Publication type	Grant
Application number	CN 02267186
Publication date	Feb 25, 2004
Filing date	Sep 16, 2002
Priority date	Sep 16, 2002
Inventors	刘刚, 何永德, 张鸿飞
Applicant	刘刚, 何永德, 张鸿飞
Export Citation	BiBTeX, EndNote, RefMan

Referenced by (1), Classifications (5), Legal Events (2)

External Links: SIPO, Espacenet

ABSTRACT

A hospital air disinfector mainly consists of a disinfection system, a filter system, an air internal circulatory system and a fan. The disinfection system consists of an ultraviolet disinfection device and an electrostatic absorption-type air disinfection device. The filter system consists of a pre-filter and an activated carbon fiber filter. The air internal circulatory system consists of a wind returning cover, a wind returning channel and a barb tube. The disinfector can effectively kill microorganism and absorb bacteria carrying dust as well as provide a clean and disinfectant place for hospital class-two environment.

DESCRIPTION translated from Chinese

Hospital air disinfection

The utility model relates to an air sanitizing device, particularly a second-class environment for hospital and air disinfection sites.

With the development of science, social progress and improving people's lives, all kinds of hospital services for the people's health is constantly improving facilities, including second-class hospital environment. These environments such as ordinary operating room, delivery room, nursery, premature children room, general protective isolation room, supply room, sterile area, burn ward and intensive care unit, related to the life and health of millions of people.

However, in today's society a variety of disinfection, purification class means a lot, but really for the hospital and the hospital achieve air disinfection device does not have much second-class environment, in order to solve the problem, a considerable import of foreign products or hospital to spend big money for expensive layer stream clean means.

The utility model aims to solve the above problems and provide a hospital air disinfection, can effectively filter or kill microorganisms in the air, and effectively filter dust in the air. Provides patients with a health and healthy environment.

The utility model of technical solution, it contains disinfection system consists of upper and lower electrostatic adsorption air disinfection device with UV air disinfection device composed of superimposed, and circulatory system within an air sterilization system set up on both sides, so that part of the air through the secondary disinfection system, for which can provide good air quality for the hospital disinfection II environment.

As described above, the utility model consists of hospital air disinfection sterilization system, filtration system, circulatory system components and fan inside the air. Which is composed of an ultraviolet disinfection system air disinfection device 6 and the electrostatic adsorption air sterilizer 10 composition; filtration system consists of 2 pre-filter and activated carbon fiber filter 12 composed in the air circulation system consists of the return air cover 11 return air duct 9 Barb tube 4 components. Fan 3 is arranged in the lower body, which is in front of a grid-like inlet 1. 1 is arranged in the inlet pre-filter 2. And at the top of the fan out of three of the hood 5 is arranged ultraviolet disinfection unit 6. It is composed of 2 to 3 rows are arranged with a plurality of reflectors UV sterilization lamp 8 7 composition, and then arranged above the electrostatic adsorption air disinfection device 10, which consists of 1 to 2 groups composed of high voltage electrostatic field, next to the on both sides of the upper unit of the layout of the return air cover 11, which was under the parabolic cross-section. In the return air cover 11 has an uncapped partition, the outside of the lower part of return duct 9 and the inner tube 4 barbs fan volute in communication. In the above arrangement of the two return air cover 11 Activated carbon fiber filter 12, which was square cross-section groove, the outlet 13 at the top of the activated carbon fiber filter 12 is lattice-shaped.

CLAIMS (3) translated from Chinese

1. The utility model provides a hospital air disinfection, it is mainly by disinfection systems, filtration systems, internal air circulation system and the fans, and is characterized in that: disinfection system is composed of the upper and lower electrostatic adsorption and UV air disinfection device disinfection device with fold composition; while the former is composed of 1 to 2 groups composed of high voltage electrostatic field; UV sterilization lamp which in turn consists of two to three rows with the reflector components.

The hospital air disinfection device according to claim 1, characterized in that: the filter system consists of a pre-filter and activated carbon fiber filter composition, while the latter structure was square groove.

3. The hospital air disinfection 1, characterized in that the claim: in the air circulation system is composed of two return air cover, return air duct and barbed tube.

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FIG. Symbols 1, inlet 2, a pre-filter 3, fan 4, barb tube 5, the hood 6, ultraviolet disinfection device 7, 8 UV germicidal lamp, reflector 9, 10, electrostatic adsorption return air duct air sterilizer 11, return air cover 12, the activated carbon fiber filter 13, the outlet to the drawings, power, start the fan 3, an ultraviolet disinfection unit 6 and the electrostatic adsorption air disinfection device 10 into operation. Air is sucked from the inlet 1, wherein the larger dust particles are adsorbed by the pre-filter 2, the air and then into the fan 3, in which the volute air circulation system within the lower portion of the barb out of the air tube 4 is mixed, both They went into the ultraviolet disinfection device 6. In the high-intensity UV sterilization lamp direct radiation 7, the air fairly microbes are killed, and then the air and into the electrostatic adsorption air disinfection device 10 under high pressure electrostatic field, 10 adsorption and filtration of the sterilizing apparatus dust contaminated air, but also microorganisms remaining adsorption, electrostatic adsorption air leaving the air sterilization device 10, the total number of bacterial colonies containing fully ≤200cfu / m3, this time most of the air into the middle of the activated carbon fiber filter 12, and both sides were part of the air sucked into the return air cover, then turning into the return air duct 9, and then they entered the barbed tube fan volute 4, the fan was pumping leads to negative 3 is mixed with the main stream, together 3 by the fan. Also, enter the activated carbon fiber filters Air 12, very little odor and harmful gases are adsorbed active fiber and filtered; air disinfection immediately after leaving the filter 12, fed from the outlet 13, to re-engage outside hospital premises II cycle.

The utility model design, reasonable structure, excellent special effects sterilizing dust, second-class environment for hospital professional products.

REFERENCED BY

Citing Patent	Filing date	Publication date	Applicant	Title
US8753575	Jul 31, 2007	Jun 17, 2014	S. Edward Neister	Method and apparatus for sterilizing and disinfecting air and surfaces and protecting a zone from external microbial contamination

CLASSIFICATIONS

International Classification	F24F7/00, A61L2/10, A61L2/02, B01D37/00, B01D35/00

LEGAL EVENTS

Date	Code	Event	Description
Feb 25, 2004	C14	Granted	
Nov 16, 2005	C19	Lapse of patent right due to non-payment of the annual fee	

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CLASSIFICATIONS

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[19] 中华人民共和国国家知识产权局

[51] Int. Cl[7]
A61L 9/20
A61L 9/014

[12] 实用新型专利说明书

[21] ZL 专利号 03251990.7

[45] 授权公告日 2004 年 12 月 15 日

[11] 授权公告号 CN 2662909Y

[22] 申请日 2003.7.16 [21] 申请号 03251990.7

[73] 专利权人 吉林大学
地址 130012 吉林省长春市前卫路 10 号
[72] 设计人 王 君 林 君 凌振宝 谭笑平

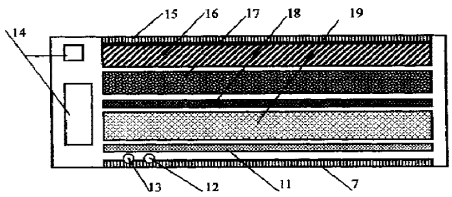
[74] 专利代理机构 长春吉大专利代理有限责任公司
代理人 王立文

权利要求书 1 页 说明书 3 页 附图 2 页

[54] 实用新型名称 室内空气净化装置

[57] 摘要

本实用新型涉及一种用于室内空气净化装置，是在壳体内按顺序依次装有进风口，活性炭过滤网，风速检测器，湿度检测器，远紫外线灯，光触媒空气净化网，负离子发生器，排风扇，出风口。在壳体的内左端装有检测控制电路，在壳体的外表面装有紫外线工作指示灯，键盘，风速调节旋钮，状态显示指示灯，显示器，活性炭过滤网更换口以及加湿器控制接口。达到强力除尘、消毒、灭菌等多重净化功能，对室内空气中的各种污染物的净化达到全方位、高效率、多功能的效果，净化彻底，不会发生二次污染，且使空气清新。



ISSN1008-4274

1.一种主要用于室内空气净化装置，是由在壳体上设有进风口、出风口，壳体表面装有显示器和键盘，壳体内装有排风扇等构成，其特征在于，壳体（1）表面设有活性炭过滤网更换口（10），装有状态显示指示灯（8）、远紫外线工作指示灯（2）、风速调节旋扭（6），壳体（1）内从进风口（7）向内依次装有活性炭过滤网（11），远紫外线灯（19）、光触媒空气净化网（18）、负离子发生器（17），并通过螺丝固定在壳体（1）的内底面上，左端装有检测控制电路（14）。

2 按照权利要求 1 所述的室内空气净化装置，其特征在于，在壳体（1）右端设有外接加湿器控制接口（4），在进风口（7）与活性炭过滤网（11）之间并排装有风速传感器（12）和湿度传感器（13）。

室内空气净化装置

所属技术领域

本实用新型涉及一种利用活性炭空气过滤网、远紫外线灯、光触媒空气净化网及负离子发生器综合在一起的室内空气净化装置。

背景技术

空气是生物赖以生存的必要条件,对人类生活环境中的空气净化，越来越受到重视。不良的室内空气加重人体免疫系统许多额外负担，造成体力耗损，降低生产力及工作效率。对于儿童、成人中有呼吸及免疫系统疾病，如气喘、肺气肿及过敏的人，不良的室内空气质量更是发病的高危险因素。根据调查，目前中国有近 4 亿 2 千万人患有气喘及过敏性鼻炎，不良的室内空气质量是主要原因。

现有的室内空气净化装置种类较多，大致有：过滤、吸附、采用风扇强制换气、静电集尘式、磁化处理等，每种方法都有各自的特点，尚未见到将活性炭空气过滤网、远紫外线灯、光触媒空气净化网、负离子发生器等空气净化方法集成在一起的室内空气净化器。

发明内容

本实用新型的目的就在于提供一种将活性炭过滤网、远紫外线灯、光触媒空气净化网、负离子发生器等多种空气净化方法合理组合，达到对室内空气进行多种功能净化的目的。

本实用新型是通过以下方式实现的，壳体 1 表面设有活性炭过滤网更换口 10，装有状态显示指示灯 8、远紫外线工作指示灯 2、风速调节旋扭 6，壳体 1 内从进风口 7 向内依次装有活性炭过滤网 11，远紫外线灯 19、光触媒空气净化网 18、负离子发生器 17，并通过螺丝固定在壳体 1 的内底面上，左端装有检测控制电路 14；壳体 1 右端设有外接加湿器控制接口 4，在进风口 7 与活性炭过滤网 11 之间并排装有风速检测传感器 12 湿度传感器 13。

本实用新型和现有技术相比可对空气中的尘埃、病菌、碳氢化物、氮氧化物、醛类、苯类等有害,有毒气体进行净化。具有强力除尘、消毒、灭菌等多重净化功能，对室内空气中的各种污染物的净化能达到全方位、高效率、多功能的效果，净化彻底，不会发生二次污染，且使空气清新。

附图说明

图1是室内空气净化装置外型示意图

图2是室内空气净化装置俯视结构图

图3是室内空气净化装置测控电路原理图

1.壳体，2.紫外线工作指示灯，3.电源线，4.加湿器控制接口，5.键盘，6.风速调节旋扭，7.进风口，8.状态显示指示灯，9.显示器，10.活性炭过滤网更换口，11. 活性炭过滤网，12.风速传感器，13.湿度传感器，14.检测控制电路，15. 出风口，16.排风扇，17.负离子发生器 18. 光触媒空气净化网，19.远紫外线灯。

具体实施方式

下面结合附图和实施例对本实用新型进一步说明。

用本装置进行空气净化时，是将需要净化的空气由进风口导入本净化器内，其动力来源于出风口 15 内的排风扇 16；进入净化器内部的空气，首先通过可更换的活性炭空气过滤网 11，利用活性炭空气过滤网 11 的孔表双重吸附、物质吸附容量大的特点，以滤除空气中的粉尘、烟雾、臭味、异味、甲苯、甲醇、细菌等有害颗粒物。活性炭空气过滤网 11 可通过活性炭过滤网更换口 10 随时更换。

经过活性炭空气过滤网 11 的空气，到达远紫外线灯 19 照射区域，远紫外线灯 19 使用杀菌能力强的远紫外线波段，通过紫外线对微生物的照射，以改变及破坏微生物的组织结构（DNA-核酸），导致核酸结构突变，生物体丧失复制、繁殖能力，功能遭受破坏，从而达到消毒、杀菌的目的。

经过远紫外线灯 19 照射区后的空气，到达光触媒空气净化网 18，再次过滤空气，直接将空气中的有机污染物，完全氧化成无毒无害的物质，对某些有机物如三氯甲烷、四氯化炭、六氯苯、都能有效地加以分解，光触媒对从烃到羧酸的种类众多有机物都有效，即使对原子有机物如卤代烃、染料、含氮有机物、有机磷杀虫剂也有很好的去除效果，一般经过持续反应可达到完全净化的效果。

为使输出的空气清新，装置中加入了负离子发生器 17，负离子发生器 17 产生高压使空气电离，产生负离子，利用负离子来吸附灰尘、杀灭细菌。

为达到将活性炭空气过滤网 11、远紫外线灯 19、光触媒空气净化网 18、负离子发生器 17 等多种空气净化方法的工作合理组合，本装置中设有风速传感器 12、湿度传感器 13、检测控制电路 14。

检测控制电路在装置中完成风速检测、环境湿度检测和空气净化时间、环境湿度、风量循环显示以及内部控制紫外线灯、负离子发生器 17 和本装置相连的外设加湿器的工作。

在壳体1表面设有远紫外线工作指示灯2，活性炭过滤网更换口10，正面装有键盘5，风速调节旋扭6，进风口7，状态显示指示灯8，显示器9，侧面装有外接加湿器控制接口4和电源线3，壳体1内紧靠进风口7与活性炭过滤网11之间并排装有风速传感器12和湿度传感器13，从进风口7向内依次装有活性炭过滤网11，远紫外线灯19、光触媒空气净化网18、

负离子发生器17、排风扇16、，它们都是独立部件，是通过螺丝固定在壳体1的内底面上，排风扇16为圆筒状轴流风扇，紧靠壳体1背面的出风口15，在壳体1内的左端装有检测控制电路（14），在壳体1的内顶面和远紫外线灯19的下面贴有用于反光的锡箔。

单片机是检测控制电路部分的核心，单片机通过比较器电路，接收风速传感器 12 的脉冲信号，计算出风量，送给显示器 9 显示，以便根据室内容积的大小，确定所需的净化时间；单片机通过 VCO（压控振荡器）和放大器接收湿度传感器 13 的信号，得出室内空气的湿度数值，送显示器 9 显示，并按设定数值，通过三极管 T2 和继电器 J2 控制加湿器电源，以便于根据设定值开闭外接空气加湿器；单片机内部程序控制接收键盘 5 的输入，其输入的数据为净化时间、湿度设定值；单片机内部程序还控制远紫外线灯 19 和排风扇 16 电机的工作。

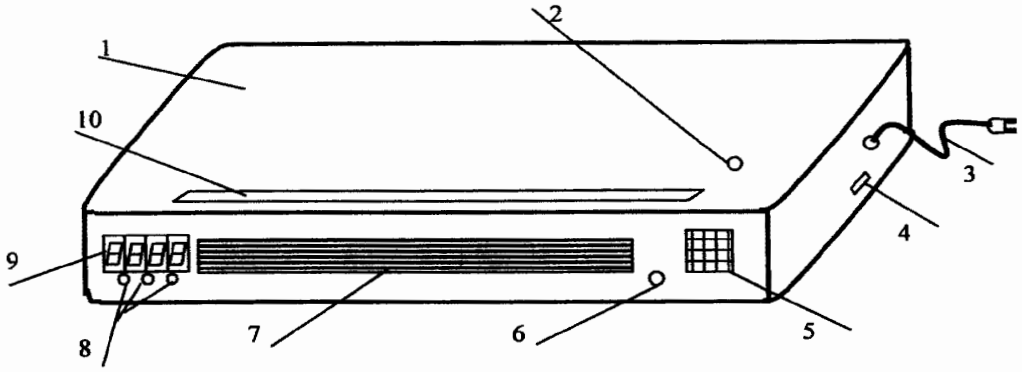


图 1

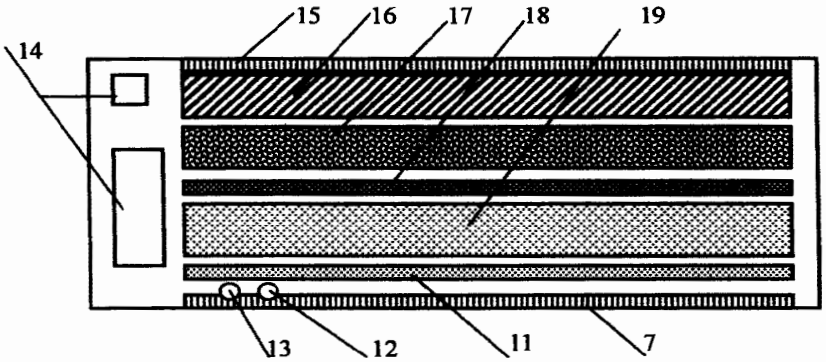


图 2

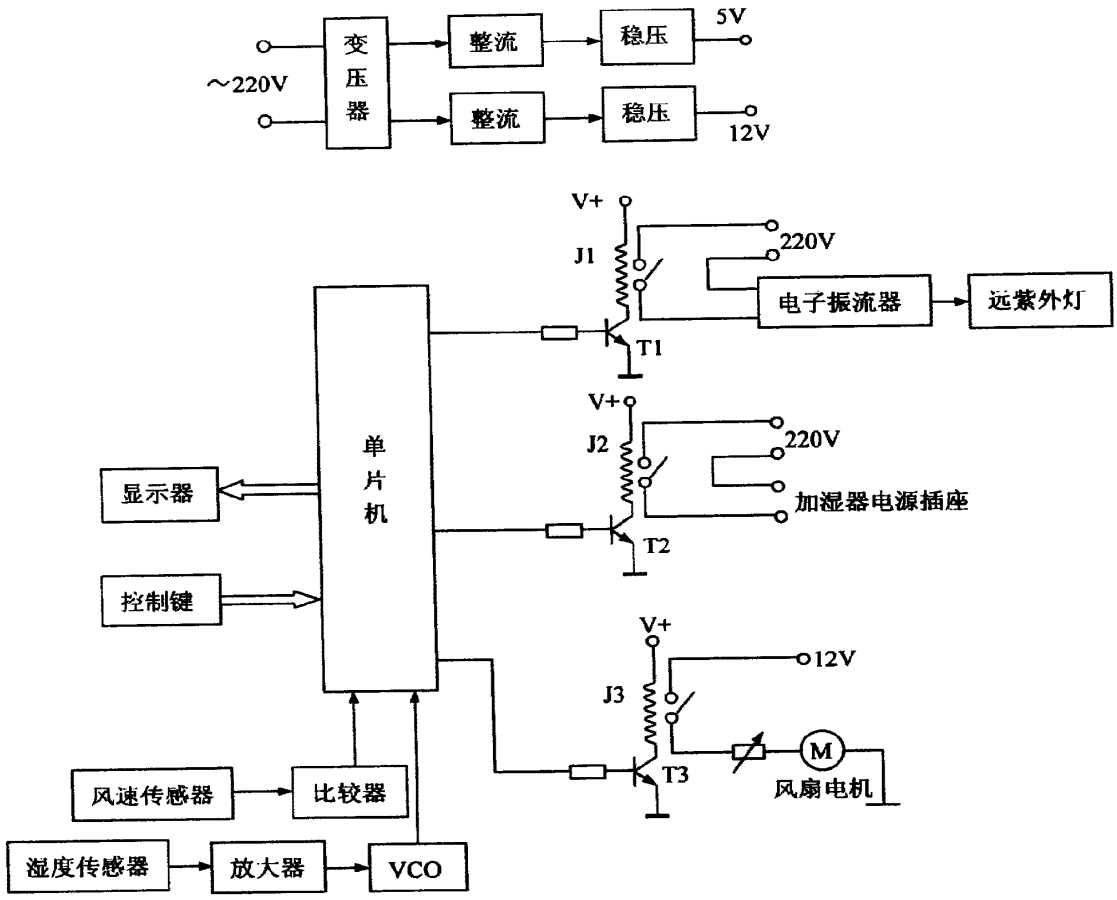

~220V
变压器
整流
稳压
5V
整流
稳压
12V
V+
J1
220V
电子振流器
远紫外灯
T1
V+
J2
220V
加湿器电源插座
T2
单片机
显示器
控制键
V+
J3
12V
T3
M
风扇电机
风速传感器
比较器
湿度传感器
放大器
VCO

图 3

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Room air cleaner

CN 2662909 Y

Publication number	CN2662909 Y
Publication type	Grant
Application number	CN 03251990
Publication date	Dec 15, 2004
Filing date	Jul 16, 2003
Priority date	Jul 16, 2003
Inventors	王君, 林君, 凌振宝, 谭笑平
Applicant	吉林大学
Export Citation	BiBTeX, EndNote, RefMan

Referenced by (8), Classifications (2), Legal Events (2)

External Links: SIPO, Espacenet

ABSTRACT

The utility model relates to an indoor air purifying device. The technical proposal of the utility model is that the shell is internally provided in serial with an air inlet, an active carbon filtering net, a wind speed detector, a moisture detector, a remote ultraviolet radiation lamp, a photocatalyst air purifying net, a negative ion generator, an air exhaust fan and an air outlet. The inner left end of the shell is provided with a detecting control circuit. The external surface of the shell is provided with the ultraviolet radiation operating pilot lamp, a keypad, a wind speed adjusting knob, a state displaying pilot lamp, a display, an active carbon filtering net exchanging out and a humidifier control interface. The utility model has the advantages of achieving multiple purifying functions of heavy dust eliminating, disinfecting and sterilizing, achieving the efficiency of full direction, high efficiency and multifunction for the purifying of various pollutants in the indoor air, no secondary pollution and being capable of freshening air.

DESCRIPTION translated from Chinese

Indoor air cleaning devices

Those skilled in the utility model relates to a carbon air filter, far ultraviolet light, photocatalyst air purifier negative ion generator network and integrated with the indoor air cleaning devices.

BACKGROUND

Air is a necessary condition for the survival of organisms, the human living environment of air purification, more and more attention. Poor indoor air heavier burden on many additional immune system, causing physical wear and tear, loss of productivity and efficiency. For children, adults with respiratory and immune system diseases, such as asthma, emphysema and allergies, poor indoor air quality is a high risk factor for disease. According to the survey, China has nearly 420 million people suffer from asthma and allergic rhinitis, poor indoor air quality is the main reason.

Existing indoor air cleaning devices more categories, roughly: filtration, adsorption, using forced ventilation fan, electrostatic precipitators type, magnetic treatment, each method has its own characteristics, has yet to see the carbon air filter , far ultraviolet light, photocatalyst air purifier net negative ion generator air purification method that integrates indoor air purifier.

SUMMARY

The utility model purpose is to provide a variety of air purification methods activated carbon filter, far ultraviolet light, photocatalytic air purification network, negative ion generators and other reasonable combination, to achieve the purpose of the multiple functions of indoor air purification.

The utility model is implemented in the following manner, a surface of the housing has a charcoal filter replacement port 10, equipped with status display indicator 8, far ultraviolet light 2 work, speed adjustment knob 6, the casing 1 from the intake outlet 7 provided with inwardly activated carbon filter 11 sequentially, far ultraviolet lamp 19, photocatalyst air purification web 18, negative ion generator 17, and fixed by screws on the inner bottom surface of the casing 1, the control circuit 14 detects the left end fitted; shell an external body has the right humidifier control interface 4, 7 and activated carbon air intake side wind speed sensor mounted humidity sensor 12 11 13 between screens.

CLAIMS (2) translated from Chinese

1. A mainly used for indoor air purification device, is provided in the housing inlet, the outlet, the housing containing both the display and the keyboard surface, an exhaust fan installed in the housing, and the like, characterized in that the housing (1) surface has a charcoal filter replacement port (10), equipped with a status display LED (8), the work is far ultraviolet light (2), wind speed adjustment knob (6), housing () from within an inlet (7) is equipped with an inward turn activated carbon filter (11), far ultraviolet light (19), photocatalytic air purification network (18), negative ion generator (17), and fixed by screws in the inner bottom surface of the housing (1) on the left is equipped with detection control circuit (14).

2 in accordance with the indoor air cleaning apparatus of claim 1, characterized in that the control interface between an external humidifier (4), the air inlet (7) and the activated carbon filter (11) in the housing (1) provided with the right end side-mounted wind speed sensor (12) and a humidity sensor (13).

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The utility model and compared to the prior art can be in the air dust, bacteria, hydrocarbons, nitrogen oxides, aldehydes, benzene and other harmful, toxic gas purification. With a strong dust, disinfection, sterilization and other multiple purification, the purification of various pollutants in indoor air can reach the full range, high efficiency, multi-effect, clean thoroughly without secondary pollution, and air fresh.

Brief Description

Figure 1 is a schematic diagram of indoor air cleaning devices appearance Figure 2 is a plan view of the structure of indoor air cleaning devices Figure 3 is an indoor air cleaning devices and control circuit diagram of the housing 1., 2. UV work lights, three power cord, 4. humidifier control interface, 5 keyboards, 6 speed adjustment knob, 7 inlet, 8. Status display LED, 9 display, 10 activated carbon filter replacement mouth, 11 activated carbon filter, 12 wind sensor 13 Humidity sensor, 14 detection control circuit 15. outlet, 16 exhaust fans, 17 negative ion generator 18. The photocatalyst air purifier net, 19 far-ultraviolet light.

DETAILED DESCRIPTION

Below in conjunction with the accompanying drawings and examples further illustrate the utility model implementation.

When the present air purification apparatus is to be purified is introduced into the air from the inlet of the purifier, its power from the exhaust fan 16 within outlet 15; enters inside the air purifier, first by means of replaceable activated carbon air filter net 11, the use of activated carbon air filter double suction holes in Table 11, the material characteristics of large capacity adsorption to filter the air of dust, smoke, odor, smell, toluene, methanol, bacteria and other harmful particles. Activated carbon air filter 11 through the activated carbon filter replacement port 10 change at any time.

After activated carbon air filter 11 air, far-ultraviolet lamp 19 reaches the irradiation zone, far-ultraviolet germicidal lamp 19 using the ability of the far-ultraviolet radiation range, by ultraviolet irradiation of the microorganism to vary, and destroying microbes organizational structure (DNA- nucleic acid) resulting mutant nucleic acid structure, organisms lose reproduce, reproductive capacity, functional destroyed, so as to achieve disinfection, sterilization purposes.

19 through the air far ultraviolet light irradiation area after arriving photocatalyst air purifier net 18, again filtered air directly organic pollutants in the air, completely oxidized to non-toxic substances, some organic compounds such as chloroform, carbon tetrachloride, hexachlorobenzene, can be effectively decomposed photocatalyst for many types of organic compounds from hydrocarbons to carboxylic acids are effective, even for atoms such as halogenated organic compounds, dyes, nitrogen-containing organic compounds, organophosphorus pesticides also have a good removal, usually after a sustained response effect can be completely cleaned.

To make the output of fresh air, the device 17 is added to the negative ion generator, negative ion generator 17 generates high pressure air ionization, producing negative ions, the use of negative ions to attract dust, kill bacteria.

To achieve the activated carbon air filter 11, far ultraviolet lamp 19, web 18 photocatalyst air purification, air purification methods work more rational combination of anion generator 17 or the like, the present apparatus is provided with a wind speed sensor 12, humidity sensor 13, the detection control circuit 14.

Detection control circuit is completed in the device detects wind speed, humidity and air purification detection time, humidity, air flow cycle and internal control UV lamps, negative ion generator 17 and the unit is connected to a peripheral humidifier work.

In a work surface of the housing has far-ultraviolet light 2, activated carbon filter replacement port 10, the front fitted with a keyboard 5, 6 speed adjustment knob, air inlet 7, the status display indicator 8, 9 display, side mounted external humidifier control interface and power cord 4 3, the shell a close inlet 7 side by side with the activated carbon filter 11 is provided between the wind speed sensor 12 and the humidity sensor 13 from the inlet 7 inward turn 11 is equipped with activated carbon filter far ultraviolet lamp 19, net 18 photocatalyst air purifier, negative ion generator 17, the exhaust fan 16, they are independent components, fixed by screws in the bottom surface of the housing 1, the exhaust fan 16 is cylindrical axial fans, tight against a rear surface of the housing to the outlet 15, the left end in the housing 1 is provided with detection control circuit (14), below the top surface of the housing 1 and the far ultraviolet lamp 19 for reflective foil affixed.

SCM is the detection and control core circuit section, the microcontroller through the comparator circuit receives the pulse signal wind speed sensor 12 to calculate the amount of wind, gave a display 9 shows, according to the size of the interior volume to determine the time required for purification; microcontroller through the VCO (voltage controlled oscillator) and an amplifier receiving signals of the humidity sensor 13, the indoor air humidity values obtained, send display 9 displays, press set value, through the transistor T2 and the power supply relay J2 control humidifier, according to the set in order to the value of opening and closing the external air humidifier; internal microcontroller programmed to receive input keyboard 5, the data input for the purification of the time, the humidity setpoint; MCU internal control procedures also work far ultraviolet lamp 19 and the exhaust fan motor 16.

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Citing Patent	Filing date	Publication date	Applicant	Title
CN100520249C	Mar 25, 2005	Jul 29, 2009	海尔集团公司;青岛海尔股份有限公司	Energy-saving refrigerator with air purification function
CN101496995B	Jan 15, 2009	Mar 2, 2011	武汉科技大学	Malodorous gas processing system and processing method thereof
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CN103170240A *	Feb 27, 2013	Jun 26, 2013	西安交通大学	Air quality monitoring and purifying device in closed space
US8753575	Jul 31, 2007	Jun 17, 2014	S. Edward Neister	Method and apparatus for sterilizing and disinfecting air and surfaces and protecting a zone from external microbial contamination

* Cited by examiner

CLASSIFICATIONS

International Classification	A61L9/20, A61L9/014

LEGAL EVENTS

Date	Code	Event	Description
Dec 15, 2004	C14	Granted	
Oct 29, 2008	C19	Lapse of patent right due to non-payment of the annual fee	

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(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2002－316041
（P2002－316041A）
(43)公開日　平成14年10月29日(2002.10.29)

(51)Int.Cl.[7]		識別記号	Ｆ Ｉ		テーマコード（参考）
Ｂ０１Ｊ	19/12		Ｂ０１Ｊ 19/12	Ｃ	２Ｈ０９６
Ｂ０１Ｄ	53/34	ＺＡＢ	Ｃ０１Ｂ 13/10	Ｚ	４Ｃ０５８
	53/70		Ｃ０２Ｆ 1/32		４Ｄ００２
Ｃ０１Ｂ	13/10		Ｇ０３Ｆ 7/42		４Ｄ０３７
Ｃ０２Ｆ	1/32		Ｃ２１Ｋ 5/00	Ｚ	４Ｇ０４２

審査請求　有　　請求項の数６　ＯＬ　（全　８　頁）　最終頁に続く

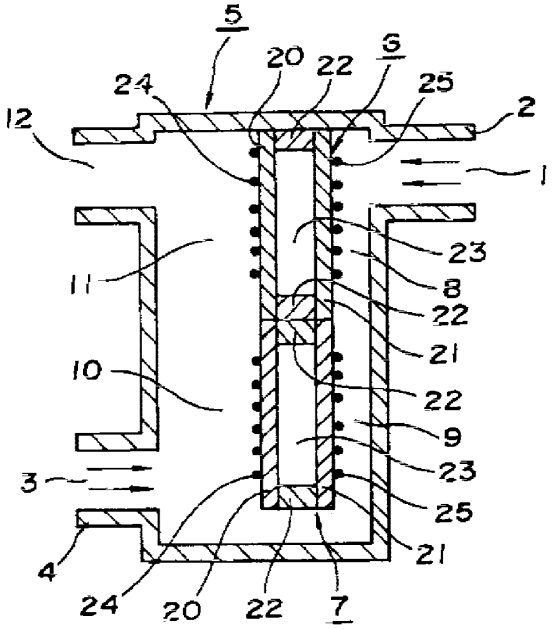
(21)出願番号　特願2002－15150(P2002－15150)
(62)分割の表示　特願平5－23534の分割
(22)出願日　平成５年１月20日(1993.1.20)

(71)出願人　000102212
ウシオ電機株式会社
東京都千代田区大手町２丁目６番１号　朝日東海ビル19階
(72)発明者　松野　博光
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内

最終頁に続く

(54)【発明の名称】　誘電体バリヤ放電ランプを使用した処理方法

(57)【要約】
【課題】　各種の処理を高品位で行い、かつ、高速度であるいは高効率で行うことが出来る誘電体バリヤ放電ランプを利用した処理方法を提供すること
【解決手段】　上記本発明の目的は、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と少なくとも酸素を含む処理用流体とを接触させ第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させる。また、第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、処理用流体と被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射し再活性化させて、前記被処理物を処理する。



【特許請求の範囲】
【請求項１】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、
前記被処理物としてのガスを処理するガス処理方法であり、
前記処理用流体は酸素を含む流体からなり、
前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、
前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。
【請求項２】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、
前記被処理物を水に浸して当該被処理物の外表面を洗浄する湿式洗浄方法であり、
前記処理用流体は酸素を含む流体からなり、
前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、該処理用流体を前記水に混入し、
前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。
【請求項３】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、
前記被処理物としてのフォトレジストを灰化処理する灰化方法であり、
前記処理用流体は酸素を含む流体からなり、
前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、
前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。
【請求項４】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、
前記被処理物としてのプラスチックを表面改質する表面改質方法であり、
前記処理用流体は酸素を含む流体からなり、
窒素雰囲気中で前記第１の誘電体バリヤ放電ランプからの紫外線を前記被処理物に照射し、
前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。
【請求項５】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、
前記被処理物としての基板に膜を形成する成膜方法であり、
前記処理用流体はモノシランガス及びメタンガスを含むガスからなり、
前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、
前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して再活性化させて、
前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。
【請求項６】　波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、
前記被処理物を殺菌処理する殺菌方法であり、
前記処理用流体は酸素を含む流体からなり、
前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、
前記被処理物を処理することを特徴とする誘電体バリヤ放電ランプを使用した処理方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、光化学反応用の光源として誘電体バリヤ放電ランプを使用した処理方法に関し、例えば、フロンガスまたは各種の廃ガスの処理、あるいは上水、下水、各種の工場廃水の処理、あるいは洗浄、あるいは太陽電池などに使用される水素化アモルファスシリコン薄膜等を製造する成膜方法など、各種被処理体を処理する方法の改良に関する。
【０００２】
【従来の技術】本発明に関連した技術としては、例えば、日本国公開特許公報平３－２１１２８３号には、誘電体バリヤ放電（別名オゾナイザ放電。電気学会発行改定新版「放電ハンドブック」平成１年６月再版７刷発行第２６３ページ参照）を使用したランプから放射される紫外線を利用したＣＶＤ法による薄膜の製造装置について記載されている。また、日本国公開特許公報平３－１２２２８７号には、誘電体バリヤ放電を使用したランプから放射される紫外線を利用した基板の金属化方法について記載されている。上記のような誘電体バリヤ放電ラ

ンプを利用した処理方法は、誘電体バリヤ放電ランプが従来の低圧水銀放電ランプや高圧アーク放電ランプには無い種々の特長を有しており、従って特長ある処理が得られるため有用である。例えば、誘電体バリヤ放電ランプを利用した薄膜の製造方法は、太陽電池、各種半導体素子用の薄膜を高品質で作製出来るため有用である。

【０００３】上記した従来の処理方法は、処理用流体あるいは被処理物又は前記両者に１種類の紫外線を１回だけ照射する方法を採用していた。例えば、誘電体バリヤ放電ランプを利用した薄膜の製造方法においては、処理用流体である複数のプロセスガスと被処理物である基板を１個の反応室内に収納し、１種類の誘電体バリヤ放電ランプから放射される１種類の紫外線を１回だけプロセスガスに照射してプロセスガスを分解、活性化する方法によって、基板上に成膜していた。なおこの時、基板にも、プロセスガスによって吸収されなかった紫外線が照射される。上記した従来の処理方法において、紫外線の照射を２回以上繰り返したとしても、プロセスガスおよび基板上に発生する化学反応の種類は１回目の紫外線を照射した時と同一であり、単に、１回目の紫外線の照射時間を長くしたことに相当するだけである。

【０００４】一般的に、ある物質を光化学反応によって活性化、分解、イオン化あるいは合成するのに最適な条件、すなわち照射する紫外線の波長と強度、物質の温度などは、物質の種類によって異なる。従って、被処理物と処理用流体を接触させて該被処理物を処理する方法において、被処理物あるいは処理用流体の少なくとも一方に誘電体バリヤ放電ランプからの１種の紫外線照射を１回だけ照射して処理する方法は、処理が不完全であったり、あるいは処理の速度あるいは処理効率が必ずしも十分ではないという問題があった。

【０００５】

【本発明が解決しようとする課題】本発明の課題は、各種の処理を高品位で行い、かつ、高速度であるいは高効率で行うことが出来る誘電体バリヤ放電ランプを利用した処理方法を提供することである。

【０００６】

【問題を解決するための手段】上記本発明の目的は、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法とすることによって達成される。

【０００７】すなわち、被処理物としてのガスを処理するガス処理方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【０００８】また、被処理物を水に浸して当該被処理物の外表面を洗浄する湿式洗浄方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、該処理用流体を前記水に混入し、前記被処理物を処理することを特徴とすることによって達成される。

【０００９】また、被処理物としてのフォトレジストを灰化処理する灰化方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１０】また、被処理物としてのプラスチックを表面改質する表面改質方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記被処理物を窒素雰囲気中で前記第１の誘電体バリヤ放電ランプからの紫外線を照射し、前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して前記被処理物を処理することを特徴とすることによって達成される。

【００１１】また、被処理物としての基板に膜を形成する成膜方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体はモノシランガス及びメタンガスを含むガスからなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射して分解、活性化させ、前記処理用流体と前記被処理物とを接触させて前記第２の誘電体バリヤ放電ランプからの紫外線を照射して再活性化させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１２】また、被処理物を殺菌処理する殺菌方法においては、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプにより、被処理物と処理用流体とを接触させて処理する誘電体バリヤ放電ランプを使用した処理方法であって、前記処理用流体は酸素を含む流体からなり、前記処理用流体に前記第１の誘電体バリヤ放電ランプからの紫外線を照射してオゾンを生成させ、前記第２の誘電体バリヤ放電ランプからの紫外線を照射して活性酸素を生成させて、前記被処理物を処理することを特徴とすることによって達成される。

【００１３】

【作用】少なくとも紫外線による光化学反応を利用しかつ被処理物と処理用流体を接触させて該被処理物を処理する際に、紫外線の光源として誘電体バリヤ放電ランプを使用すると、従来の低圧水銀放電ランプや高圧アーク放電ランプに比較して、誘電体バリヤ放電ランプが、特定の紫外線を高効率で発生できる、ほぼ単色光である、ランプの温度が低い、形状の自由度が大きいなどの特長があるので、小型の装置で高効率、高速の処理が可能になる。そして、本願発明によれば、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプを使用するので、１回目の紫外線照射、および、２回目の紫外線照射を最適な条件で行うことが可能になり、したがって、活性化、分解、イオン化および合成が最適に行われ、その結果、小型の装置で高効率、高速の処理が可能になる。

【００１４】

【発明の実施の形態】本発明の第１の実施例である水処理方法の概略図を図１に示す。箱形の反応容器５は、両面に紫外線を放射する構造の平板上の２個の誘電体バリヤ放電ランプ６，７によって実質的に２箇の反応空間領域を有している。誘電体バリヤ放電ランプの概略図を図２に示す。紫外線を透過する平板上の誘電体２０，２１と側板２２によって放電空間２３が形成されており、該放電空間２３内に発光ガスが充填されている。誘電体２０，２１の表面に設けられた金属網からなる透明電極２４，２５に交流電源２６によって電圧を印加すると、放電空間２３内にいわゆる誘電体バリヤ放電、別名オゾナイザ放電あるいは無声放電が発生して、誘電体２０，２１，透明電極２４，２５を通して、高効率で紫外線が放射される。図には示していないが、必要に応じて、透明電極２４，２５の表面を紫外線透過性の樹脂、ガラスなどで覆い電気的に絶縁する。

【００１５】第１の誘電体バリヤ放電ランプ６は、発光ガスの主成分としてキセノンガスが封入されており、１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの波長範囲の紫外線を放出する。また、第２の誘電体バリヤ放電ランプ７は、発光ガスの主成分としてクリプトンと塩素の混合ガスが封入されており、２２２ｎｍ付近で最大値を有する２００から２４０ｎｍの波長範囲の紫外線を放出する。処理用流体である空気１が処理用流体供給口２から反応容器５に供給されると、第１の誘電体バリヤ放電ランプ６から放射される１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの範囲の紫外線によって空気１中の酸素から反応空間領域８においてオゾンが生成される。該オゾンは、反応空間領域９に移動して、第２の誘電体バリヤ放電ランプ７から放射される２２２ｎｍ付近で最大値を有する２００から２４０ｎｍの波長範囲の紫外線を照射され、活性酸素原子と酸素分子に分解される。該活性酸素原子と酸素分子と、被処理物供給口４から反応容器５に供給された被処理物である水３が混合され、反応空間領域１０，１１における該混合流体に第２および第１の誘電体バリヤ放電ランプ７および６からの紫外線が照射される。

【００１６】その結果、水に不純物として含まれているメタノール、イソプロピルアルコイド等が分解され、無害な炭酸ガス、水等に変換される。処理された水は、処理用空気とともに、出口１２から排出される。

【００１７】本実施例の利点として、第１に、オゾンの生成用の紫外線の波長範囲とオゾンの分解用の紫外線の波長範囲を異ならせたので、従って高効率の処理が可能になり、第２に、被処理物と前処理された処理用流体の混合物に、第２の誘電体バリヤ放電ランプからの紫外線に加えて、第１の誘ール、メチルエチルケトン、トリクロルエチレン、ドデシルベンゼンスルフォン酸、ポリオキシエチレンオクチルフェニルエーテル、トリメチルアミン、テトラメチルアンモニウムハイドロオキサ電体バリヤ放電ランプによって従来の低圧水銀放電ランプや高圧アークランプでは発生できない短波長の紫外線を高効率で照射することが出来るので、従来の方法では分解が困難であったトリメチルアミン、テトラメチルアンモニウムハイドロオキサイド等が分解可能になり、第３に、第１および第２の誘電体バリヤ放電ランプの光出力特性が周囲温度によって変化しないので、比較的低温度でしかも温度の一定化には多大のエネルギーが必要である水の処理を安定に行うことが出来、第４に、第１および第２の誘電体バリヤ放電ランプの形状の変更に大きな自由度があるので、第１の工程と第２の工程およびそれに続く工程を直近して行うことが可能になり、従って高効率の処理が出来るようになる。

【００１８】本発明の第２の実施例は、第１の実施例において、被処理物供給口４を閉じてしまい、被処理物３と処理用流体１の混合物を処理用流体供給口２から混合供給する方法である。この方法は装置が簡単になる利点がある。

【００１９】本発明の第３の実施例は、第１あるいは第２の実施例において、処理用流体として過酸化水素を使用したものである。過酸化水素は、過酸化水素水として供給される。供給された過酸化水素水は、反応空間領域

８，９において紫外線の照射によってヒドロキシラジカルを生成する。被処理物と該前処理された過酸化水素水の混合物に、反応空間領域１０，１１において紫外線が照射され、被処理物が処理される。

【００２０】本発明の第４の実施例は、第１から第２の実施例において、被処理物を工業廃水や、下水としたものである。この実施例においても、被処理物に含まれている固形物の分離などの前処理工程が必要になる場合があるが、第１から第３の実施例と同様の機構で被処理物が処理される。

【００２１】第１から第４までの実施例は被処理物が液体であったが、第５の実施例は第１から第５の実施例における被処理物を、ガスに置き換えたものである。例えば、被処理物を成層圏オゾン層を破壊するＣＦＣ－１１，ＣＦＣ－１２，ＣＦＣ－１１４およびＣＦＣ－１１２等のフロンガスとし、処理用流体として酸素を使用すると、炭素、塩素、フッ素の化合物であるフロンを、該処理方法によって無害な低級フッ素樹脂、炭酸ガス、或いは塩化水素に変換する事が可能になる。なお、塩化水素ガスは、別工程でナトリウム化合物等にして処理する。四塩化炭素やメチルクロロホルムなどを含む工業廃ガスなど各種の廃ガスも第６の実施例の方法で処理することが出来る。

【００２２】第６の実施例である湿式洗浄方法の概略図を図３に示す。箱形の洗浄槽３０内に、両面に紫外線を放射する構造の平板状の２個の誘電体バリヤ放電ランプ６，７が設置されている。誘電体バリヤ放電ランプの構造は、図２に示すものと実質的に同一である。第１の誘電体バリヤ放電ランプ６は、発光ガスの主成分としてキセノンガスが封入されており、１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの波長範囲の紫外線を放出する。また、第２の誘電体バリヤ放電ランプ７は、発光ガスの主成分としてクリプトンとフッ素の混合ガスが封入されており、２４９ｎｍ付近で最大値を有する２４０から２５５ｎｍの波長範囲の紫外線を放出する。処理用流体である空気１が処理用流体供給口２から供給されると、第１の誘電体バリヤ放電ランプ６から放出される１７２ｎｍ付近で最大値を有する１２０から１９０ｎｍの範囲の紫外線によって空気１中の酸素から反応空間領域８においてオゾンが生成される。該オゾンは、反応空間領域９に移動して、第２の誘電体バリヤ放電ランプ７から放射される２４９ｎｍ付近で最大値を有する２４０から２５５ｎｍの波長範囲の紫外線を照射され、活性酸素原子と酸素分子に分解される。該活性酸素原子と酸素分子は、洗浄槽３０の底に設けられた泡立て器３１を通して洗浄槽３０内の水３２のなかに混入される。

【００２３】被処理物、例えばプラスチックの瓶３３は、支持具３４によってオゾンの混入した水３２に沈められ、第１および第２の誘電体バリヤ放電ランプからの紫外線の照射によって外表面が洗浄される。該洗浄によって、瓶３３の外表面への印刷などが高品位で行えるようになる。支持具３４を回転させることにより被処理物であるプラスチックの瓶３３を回転させる方法や、第１、第２の誘電体バリヤ放電ランプに対向して第３，４の誘電体バリヤ放電ランプを瓶３３を挟むように設けることにより、処理速度を大きくすることが出来る。

【００２４】第７の実施例であるフォトレジストの灰化方法の概略図を図４に示す。灰化ダクト４０内に注入された処理用流体酸素１は、灰化ダクト４０内に設けられた第１の誘電体バリヤ放電ランプ群４１から放射される紫外線によってオゾンに変換される。第１の誘電体バリヤ放電ランプ群４１は、図５に示したような中空同軸円筒形の誘電体バリヤ放電ランプ４１ａを台座４４に複数束ねたもので、各誘電体バリヤ放電ランプ４１ａの構造は、内側誘電体５１の内側に紫外線の反射板と電極を兼ねたアルミニウム箔５２が設けてあり、該内側誘電体５１と同軸に設けられた外側誘電体５３の外側には紫外線を透過する電極５４が設けられた構造である。該内側誘電体５１と外側誘電体５３によって形成された中空円筒部５５に、発光用ガスが充填されている。電極５２，５４間に電源２６によって電圧を印加すると、中空円筒部５５にオゾナイザ放電が発生し、外側誘電体５４から紫外線が放射される。

【００２５】第１の誘電体バリヤ放電ランプ群４１から放射される紫外線によって生成されたオゾンは第２の誘電体バリヤ放電ランプからの紫外線によって活性化酸素原子に変換される。被処理物である半導体基板４３に塗布されたフォトレジストは、第２の誘電体バリヤ放電ランプ群４２からの紫外線の照射のもとに活性化酸素原子と反応し、灰化する。個々の放電ランプ４２ａの構造は、放電ランプ４１ａと同一であって、かつ台座４４に取り付けられている。２箇の台座４４の位置調節をすれば、ランプ群４１とランプ群４２の距離は調節できる。

【００２６】第２の誘電体バリヤ放電ランプ群４２が、比較的波長の長い２４０から２５５ｎｍ，２００から２４０ｎｍ，３００から３２０ｎｍの範囲の紫外線を放射するように発光物質を選択すると、基板４３に照射される光子のエネルギーが小さいので、基板４３を損傷することが少ない。また、第２の誘電体バリヤ放電ランプ群４２が、比較的波長の短い１８０から２００ｎｍ，１６０から１９０ｎｍの範囲の紫外線を放射するように発光物質を選択すると、該紫外線は、酸素分子の吸収断面積が大きいので基板表面近くにおいて化学活性の高い酸素原子の密度を極めて高く生成することが出来ることになり、かつ、基板４３に照射される光子のエネルギーが大きいので、イオンが注入されて灰化しにくくなったフォトレジストも灰化することが出来る。

【００２７】第８の実施例である表面改質方法の概略図を図６に示す。被処理物であるプラスチック６０は、上部から供給された窒素６２の雰囲気で満たされた第１の

処理ダクト６１に設置され、第１の誘電体バリヤ放電ランプ群６３からの１２０から１９０ｎｍの波長範囲の紫外線の照射をうけ、表面に存在する分子の結合が切断される。しかるのちに、プラスチック６０は、搬送装置６４によって第２の処理ダクト６５に運ばれ、処理用流体供給口２から供給された酸素もしくは空気１の雰囲気中で第２の誘電体バリヤ放電ランプ群６６からの紫外線の照射を受け、表面に－ＣＯＯＨ基、－ＯＨ基が生成される。上記のような処理によって、プラスチック表面への印刷、接着などが高品位で出来るようになる。この実施例では被処理物は大気圧以上の雰囲気にあるので、被処理物の移動が簡単であるという利点が生じる。また、第１の誘電体バリヤ放電ランプ群６３から１０７から１６５ｎｍの波長範囲の紫外線が放射されると、フッ素樹脂のような非常に安定な樹脂の表面の改質を行うことが出来るようになる。

【００２８】第９の実施例である成膜方法の概略図を図７に示す。反応容器７０の上部に設けられた発光用ガス供給口７５に近接して、窓部材を有さない第１の誘電体バリヤ放電ランプ群６３が設けられている。発光用ガス供給口７５から発光用ガスアルゴン７４が供給されると、第１の誘電体バリヤ放電ランプ群６３からアルゴンのエキシマ分子から放射される１０７から１６５ｎｍの波長範囲の紫外線が放射される。処理用流体供給口２から供給された処理用流体モノシランガスとメタンガスの混合ガス１は第１の誘電体バリヤ放電ランプ群６３から放射される１０７から１６５ｎｍの波長範囲の紫外線によって分解、活性化され、被処理物である基板７１の表面において第２の誘電体バリヤ放電ランプ群６６からの紫外線によって再活性化され水素化アモルファス炭化シリコンの薄膜を形成する。第２の誘電体バリヤ放電ランプ群６６として比較的長い波長の紫外線を放射するランプを採用すると、膜に照射される光子のエネルギーが小さいので、膜を損傷することが少なく、高品質の膜が得られる。処理用流体を第１の誘電体バリヤ放電ランプの紫外線で分解、活性化し、さらに成膜時に第２の紫外線を照射することにより、良質な膜の形成が可能になった。被処理物の支持装置７２に被処理物の温度を調整する機構を組み込み被処理物の温度を調整したり、支持具７３によって被処理物と第１の誘電体バリヤ放電ランプ群６３との距離を調整したりすることにより、さらに良質の膜を形成することが可能になる。尚、７６は放電用ガスや処理用ガスの排出口である。

【００２９】第１０の実施例である殺菌方法の概略図を図８に示す。誘電体バリヤ放電ランプは、図８に示したように、３本の管状の誘電体を同軸的に配置してなるものであって、内側誘電体５１、中間誘電体８８および外側誘電体５３を同軸に配置して独立した内側放電室８７と外側放電室８６を形成し、中間誘電体８８内に埋め込まれた中間電極８９と内側誘電体５１の内面に設けられた透明電極８２および外側誘電体５３の外面に設けられた透明外側電極５４の間にそれぞれ交流電源２６ａおよび２６ｂによって電圧を印加して、内側放電室８７と外側放電室８６で誘電体バリヤ放電を行う方式のランプである。内側放電室８７の発光用ガスとしてキセノンガスを使用して１２０から１９０ｎｍの波長範囲の紫外線を放射させ、外側放電室８６の発光用ガスとしてクリプトンとフッ素の混合ガスを使用し、２４０から２５５ｎｍの波長範囲の紫外線を放射させる。

【００３０】処理用流体である酸素ガス１を管状の内側誘電体５１の一端８１から流し込み、第１の反応空間８３内で内側放電室８７から放射された１２０から１９０ｎｍの波長範囲の紫外線によって生成したオゾンを内側誘電体５１の他の一端８４から噴出させる。該オゾンは反応空間８５内で外側放電室８６から放射された２４０から２５５ｎｍの波長範囲の紫外線によって分解され、活性な酸素原子を生成し、活性な酸素原子が被処理物である食品用カップ９０の内面を殺菌する。さらに、食品用カップ９０の内面を照射した外側放電室８６から放射された２４０から２５５ｎｍの波長範囲の紫外線は、この波長領域の紫外線は殺菌作用が最適であるため食品用カップ９０の内面を直接殺菌し、従って、短時間で殺菌、消毒を行うことが出来る。

【００３１】

【発明の効果】上記したように、本発明によれば、波長が異なる紫外線を放射する第１の誘電体バリヤ放電ランプと第２の誘電体バリヤ放電ランプを使用したので、各種の処理を高品質で、高効率で、十分な速度で行うことができる処理方法を提供できる。

【図面の簡単な説明】

【図１】本発明を使用した水処理方法の説明図である。

【図２】誘電体バリヤ放電ランプの概略図である。

【図３】本発明を使用した湿式洗浄方法の説明図である。

【図４】本発明を使用したフォトレジストの灰化方法の説明図である。

【図５】他の構造の誘電体バリヤ放電ランプの概略図である。

【図６】本発明を使用したプラスチックの表面改質方法の説明図である。

【図７】本発明を使用した成膜方法の説明図である。

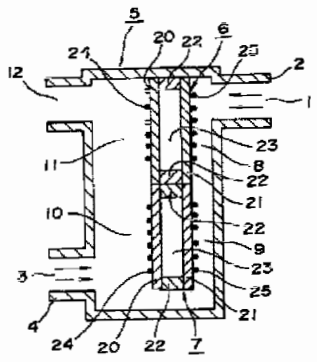
【図８】本発明を使用した殺菌方法の説明図である。

【符号の説明】

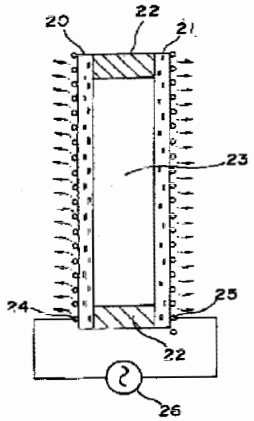
１　処理用流体
３　被処理物
６，７　誘電体バリヤ放電ランプ
８，９，１０，１１　反応空間領域
２０，２１　誘電体
２３　放電空間
２４，２５　透明電極

26　交流電源

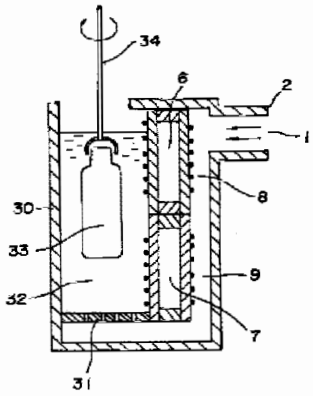
【図1】



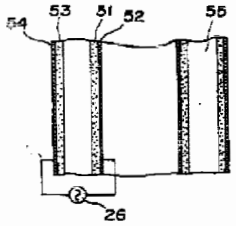
【図2】



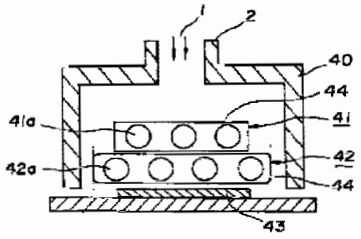
【図3】



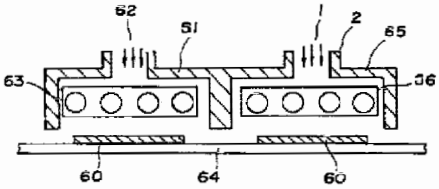
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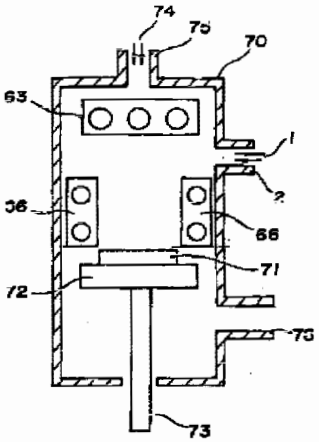
【図4】



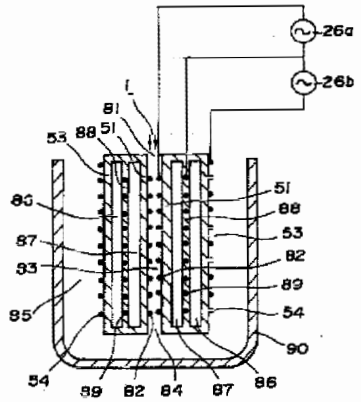
【図6】



【図7】



【図8】



フロントページの続き

(51)Int.Cl.[7]	識別記号	ＦＩ		(参考)
Ｇ０３Ｆ	7/42	Ｈ０１Ｊ	65/00	Ｂ　４Ｇ０７５
Ｇ２１Ｋ	5/00	Ａ６１Ｌ	2/10	
Ｈ０１Ｊ	65/00		2/20	Ｊ
// Ａ６１Ｌ	2/10	Ｂ０１Ｄ	53/34	１３４Ｅ
	2/20			ＺＡＢ

(72)発明者　五十嵐　龍志
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内
(72)発明者　平本　立躬
兵庫県姫路市別所町佐土1194番地　ウシオ電機株式会社内

Ｆターム(参考)　2H096 LA02 LA03
4C058 AA06 BB06 BB07 CC02 CC04 JJ14 JJ28 KK02 KK42
4D002 AA21 AA22 BA05 BA09 EA06
4D037 AA11 AB11 BA18 BB09
4G042 CA03 CE04
4G075 AA02 AA30 AA37 BA06 CA33 CA51 CA57 DA02 EB01 EB31 EC21

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CLAIMS JP2002316041

1.

A processing method using a dielectric barrier discharge lamp for processing an object to be processed and a processing fluid by bringing it into contact with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths , Wherein the processing fluid is a fluid containing oxygen and the processing fluid is irradiated with ultraviolet light from the first dielectric barrier discharge lamp Using a dielectric barrier discharge lamp characterized in that it irradiates ozone to generate active oxygen by irradiating ultraviolet light from the second dielectric barrier discharge lamp to treat the workpiece Processing method done.

2.

A processing method using a dielectric barrier discharge lamp for processing an object to be processed and a processing fluid by bringing it into contact with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths , Wherein the object to be treated is immersed in water to wash the outer surface of the object to be treated, the processing fluid is composed of a fluid containing oxygen, and the first Irradiating ultraviolet rays from a dielectric barrier discharge lamp to generate ozone, irradiating ultraviolet rays from the second dielectric barrier discharge lamp to generate

active oxygen, mixing the processing fluid into the water , And processing the object to be processed by using the dielectric barrier discharge lamp.

3.

A processing method using a dielectric barrier discharge lamp for processing an object to be processed and a processing fluid by bringing it into contact with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths , Wherein the processing fluid is a fluid containing oxygen and the processing fluid is supplied from the first dielectric barrier discharge lamp to the processing fluid, And irradiating ultraviolet rays from the second dielectric barrier discharge lamp to generate active oxygen to treat the object to be processed, characterized in that the dielectric barrier discharge Processing method using a lamp.

4.

A processing method using a dielectric barrier discharge lamp for processing an object to be processed and a processing fluid by bringing it into contact with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths Wherein the processing fluid is made of a fluid containing oxygen and the surface of the plastic as the object to be treated is surface modified, Irradiating ultraviolet rays to the object to be processed, bringing the processing fluid into contact with the object to be processed, and irradiating ultraviolet rays from the second dielectric barrier discharge lamp to treat the object to be processed A dielectric barrier discharge lamp is used.

5.

A processing method using a dielectric barrier discharge lamp for processing an object to be processed and a processing fluid by bringing it into contact with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp which emit ultraviolet rays having different wavelengths Wherein the processing fluid is composed of a gas containing monosilane gas and methane gas and the processing fluid is supplied with the first dielectric barrier discharge lamp And irradiating ultraviolet rays from the second dielectric barrier discharge lamp to reactivate the processing fluid and the object to be processed so that the processing fluid and the object to be processed are brought into contact with each other, And processing the object to

be treated by using the dielectric barrier discharge lamp.

6.

A processing method using a dielectric barrier discharge lamp for processing an object to be processed and a processing fluid by bringing it into contact with a first dielectric barrier discharge lamp and a second dielectric barrier discharge lamp that emit ultraviolet rays having different wavelengths , Wherein the processing fluid is a fluid containing oxygen and the processing fluid is irradiated with ultraviolet rays from the first dielectric barrier discharge lamp so as to sterilize the object to be processed Wherein the treatment is carried out by generating ozone and irradiating ultraviolet rays from the second dielectric barrier discharge lamp to generate active oxygen to treat the object to be treated .

(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2003－207165
（P2003－207165A）
(43)公開日　平成15年７月25日(2003.7.25)

(51)Int.Cl.[7]	識別記号	Ｆ Ｉ		ﾃｰﾏｺｰﾄﾞ(参考)
Ｆ２４Ｆ　1/02		Ｆ２４Ｆ　1/02	３７１Ｊ	３Ｌ０５０
	３７１		４１１Ｂ	３Ｌ０５１
	４１１		４５１	
	４５１		３８１Ｂ	

審査請求　未請求　請求項の数15　ＯＬ　（全 14 頁）

(21)出願番号　特願2002－8886(P2002－8886)

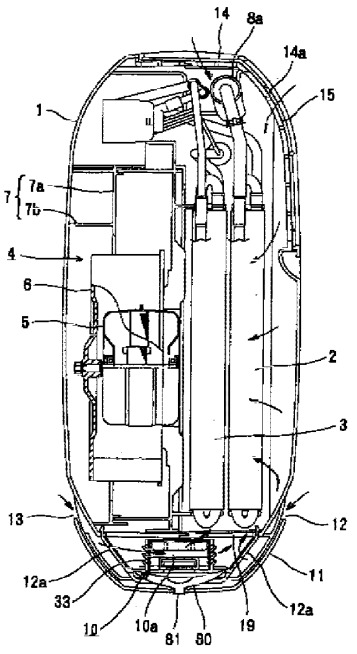
(22)出願日　平成14年１月17日(2002.1.17)

(71)出願人　000001889
三洋電機株式会社
大阪府守口市京阪本通２丁目５番５号
(72)発明者　岡田　広和
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内
(72)発明者　高馬　一豊
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内
(74)代理人　100087985
弁理士　福井　宏司

最終頁に続く

(54)【発明の名称】　空気調和機

(57)【要約】
【課題】　殺菌を行うための紫外線ランプの発光を利用して、紫外線ランプ自身の運転表示及び本体ケース外観のデザイン向上を行う。
【解決手段】　機械本体の本体ケースの内面近傍に、一面から可視光を発光し、他面から紫外線を発光する平板状紫外線ランプを、前面側が可視光発光面となるように配置し、その前面に前面カバーを設け、この前面カバーを光らせる。前面カバーを、光輝性顔料を配合した半透明性又は透明性材料から作る。



【特許請求の範囲】
【請求項１】　機械本体の本体ケースの内面近傍に配置された紫外線ランプと、紫外線ランプ前面側の本体ケースの一部に形成された前面カバーとを有し、
この前面カバーは、光輝性顔料を配合した透明又は半透明性樹脂材料から形成され、
前記紫外線ランプは、前面カバー側の面を可視光発光面とし、機械本体内側の面を紫外線発光面とする平板状紫外線ランプであり、前記紫外線発光面が機内空気通路に面するように、かつ、前記可視光発光面から放射される可視光が前記前面カバーに投射されるように本体ケース内に設けられている空気調和機。
【請求項２】　前記前面カバーは、本体ケースの前面側から本体ケースの側面側に跨る形状に形成されている請求項１記載の空気調和機。
【請求項３】　前記前面カバーは、本体ケースの前面側を構成する部分に配合される光輝性顔料の配合量が本体ケースの側面側を構成する部分に含有される光輝性顔料の配合量より多い請求項２記載の空気調和機。
【請求項４】　請求項１～３記載の何れか１項に記載の空気調和機において、前記紫外線ランプと前記前面カバーとの間に可視光を側方に拡散させるためのレンズを設けた空気調和機。
【請求項５】　前記レンズは、左右方向の中心部から側方に向かって機械本体内側に湾曲する形状に形成され、かつ、側方に行くに従い厚さが薄くなるように形成されている請求項４記載の空気調和機。
【請求項６】　前記レンズは、機械本体内側の表面が粗面に形成されている請求項５記載の空気調和機。
【請求項７】　前記レンズは、ポリスチレンを原材料とする請求項６記載の空気調和機。
【請求項８】　前記レンズは、左右方向の中心部位に所定幅で直線的に機械本体の高さ方向に延びる突出部が形成され、前記前面カバーは、この突出部を貫通させるための開口部を備えている請求項４～７の何れか１項記載の空気調和機。
【請求項９】　前記空気調和機は、機内に吸入した空気を冷却除湿する蒸発器と、この蒸発器で除湿した水を貯留する排水タンクとを備え、この排水タンクは、その一部が機械本体の前部において前面及び左右両側面に露出されているとともに、水位透視可能な透明又は半透明材料から形成されている請求項１～８の何れか１項記載の空気調和機。
【請求項１０】　前記機械本体の前部において、前面及び左右両側面に露出されている排水タンクの一部は、前記前面カバーに連続するような形状とされるとともに、光輝性顔料が配合された水位透視可能な透明又は半透明材料から形成されている請求項９記載の空気調和機。
【請求項１１】　前記排水タンクは、機械本体の外部から透視することのできる水位表示部を備えている請求項１０記載の空気調和機。
【請求項１２】　前記水位表示部は、排水タンクにおける平面形状の変形部分に配置された水平の補強リブにより形成されている請求項１１記載の空気調和機。
【請求項１３】　前記補強リブは、高さ方向に均等間隔で複数配置されている請求項１２記載の空気調和機。
【請求項１４】　前記補強リブは、最上位のものが排水タンクの満杯を表示する請求項１３記載の空気調和機。
【請求項１５】　前記光輝性顔料は、ガラスフレーク又は塊状フレークを母材とし、この母材表面に金属又は金属酸化物をコートしたものである請求項１～１４の何れか１項記載の空気調和機。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、空気調和機に係わり、特に紫外線ランプを備えた除湿機等の空気調和機に関するものである。
【０００２】
【従来の技術】従来のこの種の空気調和機においては、例えば特開平１－２３４７２９号公報や特公平６－７２７０３号公報に開示されているように、殺菌や脱臭のための紫外線ランプが用いられている。これら空気調和機では、紫外線ランプが機内の中央部に配置されていた。なお、このような空気調和機では、紫外線ランプの運転中に機械内部を開放すると、紫外線が放射され人体に危険を及ぼすので、紫外線ランプの運転表示ランプを必要としていた。
【０００３】
【発明が解決しようとする課題】しかしながら、このような運転表示ランプは、面発光させるものではなかった。また、面発光をデザイン的に取り入れる場合には、構造、コスト面で不都合が多かった。また、紫外線ランプと表示ランプとは別部品となるので、表示灯回路の故障に対する保証回路や安全回路を必要としていた。なお、紫外線ランプによる発光をデザイン効果に利用することについては、従来全く検討されていなかった。
【０００４】本発明は、このような課題を解決するためになされたものであり、殺菌を行うための紫外線ランプの発光を利用して、紫外線ランプ自身の運転表示及び本体ケース外観のデザイン向上を行うことを目的とする。
【０００５】
【課題を解決するための手段】上記のような目的を達成するため、本発明に係る空気調和機は、機械本体の本体ケースの内面近傍に配置された紫外線ランプと、紫外線ランプ前面側の本体ケースの一部に形成された前面カバーとを有し、この前面カバーは、光輝性顔料を配合した透明又は半透明性樹脂材料から形成され、前記紫外線ランプは、前面カバー側の面を可視光発光面とし、機械本体内側の面を紫外線発光面とする平板状紫外線ランプであり、前記紫外線発光面が機内空気通路に面するよう

に、かつ、前記可視光発光面から放射される可視光が前記前面カバーに投射されるように本体ケース内に設けられているものである。

【０００６】このように構成すると、紫外線ランプを使用して空気通路内を通過する空気の殺菌を行っている時間帯においては、常に、紫外線ランプから可視光が面発光され、前面カバーが広範囲で明るくなる。これにより、使用者は紫外線ランプの運転を容易かつ確実に知ることができる。また、紫外線ランプの運転表示のために別光源の運転表示ランプを使用しないので、別光源の故障に対する保証回路や安全回路を必要としない。さらに、前面カバーを構成する樹脂材料には光輝性顔料が配合されているので、可視光が拡散され視認性及びデザイン効果が良好となる。また、紫外線ランプは一面が可視光発光面であり他方の面が紫外線発光面となる平板状紫外線ランプであるので、紫外線ランプを組み込む場合の配置場所や保持方法の選択性が拡がり、取付構造を簡略化することができる。

【０００７】また、前記前面カバーは、本体ケースの前面側から本体ケースの側面側に跨る形状に形成してもよい。このように構成すると、前面カバー内における可視光の伝搬により紫外線ランプから放射される可視光が側方にも放射される。したがって、紫外線ランプの運転表示を正面ばかりでなく側方からも視認することができる。

【０００８】また、前記前面カバーは、本体ケースの前面側を構成する部分に配合される光輝性顔料の配合量が本体ケースの側面側を構成する部分に含有される光輝性顔料の配合量より多いものとしてもよい。なお、この場合、製作を容易にするために、本体ケースの前面側を構成する部分と本体ケースの側面側を構成する部分とを別体として形成し接合するようにしてもよい。このように構成すると、本体ケースの側面側を構成する部分における光の拡散性が向上し、側面部への光の拡散性が向上する。

【０００９】また、前記紫外線ランプと前記前面カバーとの間に可視光を側方に拡散させるためのレンズを設けてもよい。このように構成すると、レンズにより紫外線ランプから放射された可視光を側方に拡散することができ、側面部からの視認性が向上する。

【００１０】また、前記レンズは、左右方向の中心部から側方に向かって機械本体内側に湾曲する形状に形成され、かつ、側方に行くに従い厚さが薄くなるように形成されたものとしてもよい。このように構成すると、レンズ内の側方部における反射光が増加し、可視光の側方への拡散性がさらに改善される。

【００１１】また、前記レンズは、機械本体内側の表面が粗面に形成されているものとしてもよい。このように構成すると、機械本体内側のレンズの表面部において、レンズ内を伝搬する可視光が反射する場合及び紫外線ランプからの可視光がレンズ内に入射する場合に、可視光が乱反射されるので、光輝感が向上し、デザイン効果を向上させることができる。

【００１２】また、前記レンズは、ポリスチレンを原材料とするのが好ましい。このように構成すると、レンズの透明性が良好となるとともに、レンズ内部での表面反射が良好となり、可視光の側方への拡散性が向上する。

【００１３】また、前記レンズは、左右方向の中心部位に所定幅で直線的に機械本体の高さ方向に延びる突出部が形成され、前記前面カバーは、この突出部を貫通させるための開口部を備えているものとしてもよい。このように構成すると、突出部から機外へ直接可視光が放射されるので、突出部分は突出部分の周囲に対し明るくなる。この結果、この突出部と突出部の左右部分との間に照度差を生じさせることができ、デザイン効果を向上させることができる。

【００１４】また、前記空気調和機は、機内に吸入した空気を冷却除湿する蒸発器と、この蒸発器で除湿した水を貯留する排水タンクとを備え、この排水タンクは、その一部が機械本体の前部において前面及び左右両側面に露出されているとともに、水位透視可能な透明又は半透明材料から形成されているものとしてもよい。このように構成すると、排水タンクの一部が機械本体前部において、前面及び両側面に露出しているので、前、左、右の３方向から排水タンクの貯水量を確認することができる。

【００１５】また、前記機械本体の前部において、前面及び左右両側面に露出されている排水タンクの一部は、前記前面カバーに連続するような形状とされるとともに、光輝性顔料が配合された水位透視可能な透明又は半透明材料から形成されているものとしてもよい。このように構成すると、前面カバーと排水タンクの露出部との形状の連続性により、可視光の伝搬性が期待できる。これにより排水タンクも光らせることができ、デザイン効果を向上させることができる。

【００１６】また、前記排水タンクは、機械本体の外部から透視することのできる水位表示部を備えているものとしてもよい。これにより、使用者は、排水タンクに貯水されている量を把握し易くなる。

【００１７】また、前記水位表示部は、排水タンクにおける平面形状の変形部分に配置された水平の補強リブにより形成されているものとしてもよい。このように構成すると、特別の水位表示部を設ける必要が無く、部品の構成を簡略化することができる。

【００１８】また、前記補強リブは、高さ方向に均等間隔で複数配置されているものとしてもよい。このように構成すると、貯水されている水の量をより把握し易くなる。

【００１９】また、前記補強リブは、最上位のものが排水タンクの満杯を表示するものとしてもよい。このよう

に構成すると、使用者は、排水タンクの満水時期を予測することが可能となり、使用者の便宜を図ることができる。

【００２０】また、前記光輝性顔料は、ガラスフレーク又は塊状フレークを母材とし、この母材表面を金属又は金属酸化物をコートしたものとすることが好ましい。金属又は金属酸化物のコート方法としては、ガラスフレーク又は塊状フレークの母材上に金属を無電解メッキする方法、ガラスフレーク又は塊状フレークの母材上にルチル形二酸化チタンを液相法によって均一に被覆する方法などがある。このように構成すると、光輝性顔料母材の表面での可視光の高反射を得ることができ、前面カバーの光輝感が良好となる。すなわち、従来の光輝性顔料を配合した樹脂としては、樹脂材料に銀、ニッケル等の金属箔、金属粉末を配合したものがあるが、これらのものに比べ、上記のガラスフレーク又は塊状フレークに金属又は金属酸化物をコートしたものは、軽量であるため樹脂材料中にランダムに配合され易く、広範囲の光輝感が得られる。また、本発明に係る光輝性顔料を配合した樹脂は、樹脂成型品のそり、収縮防止効果があり、成型作業が容易になる。

【００２１】

【発明の実施の形態】以下、本発明を除湿機に具体化した実施の形態について、図面を参照して詳細に説明する。

【００２２】本実施の形態に係る除湿機は、図４の外観斜視図に示すように、機械本体の本体ケース１が前後方向に長い形状とされ前部上面に操作部１ａが形成されている。本体ケース１内の上部側には、図１の上面側から見た要部構成図に示すように、幅方向に空気調和手段として冷凍サイクルの熱交換器を構成する蒸発器２、凝縮器３、送風機４が機内空気流れの方向に順次配列されている。送風機４は、モータ５、羽根車６、上下吹出形ファンハウジング７等から構成され、上下に吹出可能に構成されている。

【００２３】また、本体ケース１内の下部側には、図２の正面側から見た要部構成図及び図３の左側面側から見た要部構成図に示すように、本体ケース１内の後側（図３の下部左側）に蒸発器２や凝縮器３と共に冷凍サイクルを構成する圧縮機８、アキュムレータ８ａが取り付けられ、本体ケース１内の前側（図３の下部右側）に、蒸発器２で結露して滴下する除湿水を貯留する排水タンク９が配置されている。排水タンク９は、機械本体の前面から引き出し式に本体ケース１内に着脱自在に収納され、収納状態において前面側部分が本体ケース１外に露出している。そして、この露出部分は、機械本体の外側輪郭の一部を形成している。

【００２４】また、本体ケース１上部の前面部分の内面側には、紫外線ランプユニット１０が組み込まれている。さらに、本体ケース１における紫外線ランプユニット１０の前面側には、前面カバー１１が着脱可能に取り付けられている。前面カバー１１は、機械本体の外側輪郭の一部を形成するが、両側端部において本体ケース１との間に隙間が形成され、この隙間が空気を吸い込む幅狭の吸気口１２、１３として形成されている（図１参照）。なお、前面カバー１１の内面側と紫外線ランプユニット１０との間には、平面視略山形のエアーフィルター１２ａが介在されており、吸気口１２、１３から吸入される空気は、このエアーフィルター１２ａを介して機内に吸い込むように構成されている。

【００２５】本実施の形態に係る除湿機の吸気口は、上記吸気口１２、１３以外に、本体ケース１の後面及び右側面の後部にグリル構造の吸気口１４、１５が形成されている（図１参照）。このように機械本体の前部両側面や機械本体の後部背面及び右側面に吸気口１２、１３、１４、１５を設ける理由は、吸気口を多数個所に設けることにより、押し入れの側壁と蒲団との隙間や家具と家具との隙間等、幅の狭いスペースに設置した場合に、一部の吸気口が塞がれても他の吸気口が開放されたまま残るようにしたものである。例えば、押し入れの側壁や蒲団、家具等により右側面の吸気口１２及び１５が塞がれても、左側面の吸気口１３及び後面の吸気口１４が開放されたまま残るようにしたものであって、このように構成することにより、吸気量の減少による除湿能力の低下を防ぐことができるようにしたものである。

【００２６】一方、この除湿機の吹出口として、本体ケース１の上面部に上部吹出口１７が形成され、左側面の下部に下部吹出口１８が形成されている（図２参照）。そして、上部吹出口１７には、右端を支軸として回転式に開閉される蓋１７ａが、また、下部吹出口１８には上下スライド式に開閉される蓋１８ａが取り付けられている（図２、図４参照）。なお、本体ケース１の上面中央部には、上部吹出口１７の反対側に倒して収納される取手１ｂが取り付けられている。

【００２７】前記送風機４は、図２及び図３に示すように、羽根車６の図２における右側部分のファンハウジング７ａ部分が上吹出用ハウジングに形成され、羽根車６の図２における左側部分のファンハウジング７ｂ部分が下吹出用ハウジングに形成されて機械本体内に収納されている。そして、前記上部吹出口１７が送風機４の上吹出用ハウジング７ａに連通され、前記下部吹出口１８が送風機４の下吹出用ハウジング７ｂに連通されている。

【００２８】機内空気通路は、吸気口１２、１３、１４、１５→エアーフィルター１２ａ、１４ａ→蒸発器２→凝縮器３→送風機４→上部吹出口１７及び下部吹出口１８の経路を経るように形成されているが、吸気口１３から吸入された空気は、蒸発器２へ行く前に紫外線ランプユニット１０内の空気通路１０ａを通過するように構成されている。

【００２９】そして、紫外線ランプユニット１０内の空

気通路１０ａを通過した空気は、紫外線ランプユニット１０の背面側に形成された格子状吸気孔１９から蒸発器２側に吸い込まれるようになっている。なお、格子状吸気孔１９は、前面カバー１１を外した図５の斜視図に一部が見えるように、紫外線ランプユニット１０の背両側略全体に対し形成されているが、送風機４側は上下吹出形ファンハウジング７等により遮られているので、吸気口１３から吸い込まれた空気は、全て紫外線ランプユニット１０内の空気通路１０ａを通って前面カバー１１の反対側の格子状吸気孔１９から蒸発器２側に流通する。

【００３０】紫外線ランプユニット１０は、図６の機械本体上面から見た詳細構成図、図７の機械本体左側面側から見た詳細構成図、図８の機械本体内側から見た詳細構成図などから分かるように、平板状紫外線ランプ２０、収納ケースを構成する樹脂製ケース３０、エラストマー製パッキン４０、樹脂製ケース３０と協働して収納ケースを構成するアルミ製ケース５０、光触媒フィルター６０、制御基板７０、機器カバー７１、ビス７２、光センサー７３等から構成されている。なお、この紫外線ランプユニット１０の前面には可視光を側方に分散させるレンズ８０が取り付けられている。

【００３１】上記平板状紫外線ランプ２０は、平面発光ランプで、本体ケース１側（前面側）からは４５２ｎｍの波長の可視光を放射できるように、また、機械本体内側（光触媒フィルター６０側）からは殺菌効果が最大となる２５３．７ｎｍの波長の紫外線を放射できるように構成されている。

【００３２】図１０に上記平板状紫外線ランプ２０の基本的構成と原理を示す。平板状紫外線ランプ２０は、一面側（機械本体内側）が紫外線を透過するＵＶ透過ガラス（バリューム－ソーダーガラス）２１で形成され、他面側が上記紫外線を透過させずに可視光を透過させる通常のソーダーガラス２３で形成されている。なお、ソーダーガラス２３の内面側には蛍光体２２が塗布されている。平板状紫外線ランプ２０は、ＵＶ透過ガラス２１、通常のソーダーガラス２３等で形成された容器内に、水銀蒸気とアルゴンガスが封入され、両側に放電電極２４ａ、２４ｂが配置されている。放電電極２４ａ、２４ｂ間にグロー放電が生じると、放電電極２４ａ、２４ｂ間を流れる電子２５がアルゴン原子２６や水銀原子２７と衝突する。水銀原子２７と衝突することにより発生した紫外線２８は、一面側のＵＶ透過ガラス２１を透過し、他面側（ソーダーガラス２３側）では蛍光体２２に当たって可視光２９を発生させる。

【００３３】可視光２９は、蛍光体２２の発光色となるので、所望の色で発光する蛍光体２２を用いることもできる。なお、通常の蛍光灯などに用いられる白色蛍光体を用い、上記レンズ８０を例えば一般に殺菌中をイメージさせる青色に着色すれば、紫外線ランプユニット１０及びレンズ８０を安価にすることができる。

【００３４】このように構成された平板状紫外線ランプ２０は、ＵＶ透過ガラス（バリューム－ソーダーガラス）２１側が紫外線発光面２０ａとなり、ソーダーガラス２３側が可視光発光面２０ｂとなる。また、平板状紫外線ランプ２０は、可視光発光面２０ｂが機械本体前面側（前面カバー１１側）を向き、紫外線発光面２０ａが機械本体内側、すなわち、樹脂製ケース３０内の空気通路１０ａに晒されるように取り付けられている。

【００３５】平板状紫外線ランプ２０を収納するための収納ケースは、上述のように樹脂製ケース３０とアルミ製ケース５０とから構成されている。樹脂製ケース３０は、樹脂成形された中空基材からなるものであって、上方部が浅い皿状の機器取付部３１、下方部が平断面形状を略コの字形としたランプ取付部３２として形成されている。ランプ取付部３２は、図６から良く分かるように、機械本体内側に開放したコの字形をなしている。このランプ取付部３２は、図１１に示すように、当初平面的な形状で樹脂成形され、コの字形のコーナ部分を薄肉部３２ａとされている。そして、その後に薄肉部３２ａで図１２のように折り曲げられて、コの字形に形成されている。

【００３６】ランプ取付部３２のコの字形の側壁には、吸気口１３から吸入された空気をこの紫外線ランプユニット１０内の空気通路１０ａに流通させるための通風口が設けられている。この通風口は、平板状紫外線ランプ２０から放射される紫外線２８の漏洩を防止しつつ吸気口１３から吸入された空気をこの紫外線ランプユニット１０内の空気通路１０ａに流通させるために、後方外側に向かって（図９における下方向に向かって）傾斜する鎧格子３３により形成されている。

【００３７】このように通風可能に構成されたランプ取付部３２の中央面部（断面コの字形部分の機械本体前面側にある中央面部）には、可視光放出穴３４が形成され、その内側が平板状紫外線ランプ２０を収納する収納スペースとされている。この収納スペースには、平板状紫外線ランプ２０の可視光発光面２０ｂが可視光放出穴３４に面するように平板状紫外線ランプ２０が収納されている。なお、平板状紫外線ランプ２０は、可視光放出穴３４を備えた面に対し、紫外線２８の漏れ防止用シール材としてのエラストマー製パッキン４０を介して取り付けられている。

【００３８】樹脂製ケース３０のランプ取付部３２の内面は、紫外線２８が照射され、樹脂製ケース３０を形成する樹脂そのものが劣化する可能性があるので、真空蒸着によりアルミ層が施されている。このアルミ層は、アルミテープを貼り付けることにより形成することもできるが、真空蒸着により形成すれば、樹脂製ケース３０をデザイン上の都合などから複雑な形状、構造に形成した場合でも、表面全体に渡り均一な厚みのアルミ層を形成することができる。したがって、前記アルミ層を真空蒸

着により形成する場合は、前記通風口を鎧格子３３により形成しても容易にアルミ層を形成することができる。

【００３９】樹脂製ケース３０のランプ取付部３２内には、収納ケースを構成するもう一方のアルミ製ケース５０が挿入されている。アルミ製ケース５０は、紫外線２８が紫外線ランプユニット１０の外部に漏れないようにするために、樹脂製ケース３０のランプ取付部３２の機械本体内側に取り付けられるリフレクターである。アルミ製ケース５０は、アルミ材料により、一面開放の箱型に形成されている。そして、コの字形のランプ取付部３２の開放部と、アルミ製ケース５０の箱形の開放部とが互いに向き合うように、アルミ製ケース５０が樹脂製ケース３０内に挿入されている。

【００４０】また、アルミ製ケース５０は、箱形の底面部と、樹脂製ケース３０の側面部に重なる側面部とに、紫外線２８の漏れを防止しながら空気を紫外線ランプユニット１０内に流通させるように鎧格子５１、５２が形成されている。なお、この側面の鎧格子５２は、アルミ製ケース５０を樹脂製ケース３０のランプ取付部３２内に収納することが可能となり、かつ、ランプ取付部３２との協働による紫外線２８の漏れ防止効果を向上させるために、ランプ取付部３２内の内側方向かつ機械本体内側（背面側）に向かって傾斜させている。また、アルミ製ケース５０の底面（機械本体背面側）の鎧格子５１は、紫外線ランプユニット１０の外側に突出しないようにし、紫外線ランプユニット１０を格子状吸気孔１９に密着させて取り付けることが可能となるように形成されている。

【００４１】アルミ製ケース５０の底面部の内面（後面側）には、光触媒フィルター６０が配置されている。したがって、平板状紫外線ランプ２０と光触媒フィルター６０とは対向する位置に平行に配置されている。光触媒フィルター６０は、図１３のような多数の通風孔６１を有する平板状の触媒担持体に、アナタース形結晶構造をもつ二酸化チタン（TiO_2）を担持させたものである。また、通風孔６１は、図１４の断面図に示すように、平板状の平面部に対し傾斜した孔として形成されている。このような光触媒フィルター６０に対し、バンドキャップ約３．５ｅＶを超える値、波長でいうならば波長約４００ｎｍ以下の紫外線２８を当てると、主に一般的な臭いの源であるアンモニア等の臭気成分が紫外線２８の光エネルギーで励起され、酸化分解されて脱臭される。このように、光触媒フィルター６０は、吸着された臭気成分が酸化分解されて再生（リフレッシュ）されるので、交換せずに半永久的に使用することができる。

【００４２】機器取付部３１には、機器カバー７１により制御基板７０が固定されている。また、機器取付部の下方部に光センサー７３が取り付けられ、機器カバー７１によりカバーされている。そして、この機器カバー７１が取り付けられることにより、光シールドされた構造物内に光センサー７３を取り付ける光センサー取付部７４が構成されている。なお、機器カバー７１に対し、機器取付部３１及びレンズ８０を介しビス７２をビス穴７１ａにねじ込むことにより、機器取付部３１に機器カバー７１が固定され、紫外線ランプユニット１０に対しレンズ８０が固定されている。

【００４３】レンズ８０は、平板状紫外線ランプ２０の可視光発光面２０ｂから放射される可視光２９を側方に拡がらせるためのものであり、さらには、幅方向の中心部を前面カバー１１の外部に露出させてデザイン効果を演出するためのものである。レンズ８０は、透明性を良好とするとともに、レンズ８０内部での表面反射を良好とするためにポリスチレンから形成されている。レンズ８０は、縦長で正面から見た形状は長方形をなしているが、上方から見た形状は、機械本体内側に湾曲した円弧状をなし、側方に行くに従い薄肉となるように形成されている。

【００４４】レンズ８０の幅方向の中心線部分における外側には、一定幅で高さ方向に延び、かつ、機械本体前面側に突出する突出部８１が形成されている。一方、本体ケース１の前面カバー１１には、この突出部８１と対向する位置に縦長の開口部１１ａが形成されている（図１５参照）。そして、突出部８１が開口部１１ａから機械本体前面側に突出するように、レンズ８０が紫外線ランプユニット１０に取り付けられている。

【００４５】また、レンズ８０の幅方向の中心線部分における内側には、前記突出部８１に対向するように平断面円弧状の凹部８２が形成されている。この凹部８２によりレンズ８０内に可視光２９が入りやすいようにし、レンズ８０から機械外部に投射される可視光量を増大させるようにしている。

【００４６】なお、レンズ８０は、上記のように紫外線ランプユニット１０に装着しているが、特にこのような構造に限定されるものではなく、前面カバー１１に取り付けるようにしてもよい。

【００４７】排水タンク９は、前面カバー１１と同様の半透明又は透明樹脂材料により成型されたものであって、機械本体前部において、前面及び左右両側面に露出されるように機械本体前部の下方部に配置される。また、排水タンク９の前部９１は、前面カバー１１の形状が延長されるような前面形状とされている。また、排水タンク９の後部９２は、本体ケース１内に収納されるように、前部に比し幅が狭く形成されている（図１６～図１８参照）。そしてこの平面形状の変形部分に水平方向の補強リブ９３、９４、９５が形成されている。補強リブ９３、９４、９５は、高さ方向に均等間隔に形成されており（図１７参照）、機械本体側方から透視できるように形成されている。最上段の補強リブ９３は、排水タンク９の満杯位置に形成されており、満杯表示を兼ねている。

【００４８】以上の構成において、この除湿機を押し入れの側壁と蒲団の間等の狭いスペースに設置して運転すると、押し入れ内の湿気を多く含んだ空気は送風機４の回転によって、図１に矢印で示すように吸気口１２、１３、１４、１５から吸い込まれる。吸気口１３から吸入された空気は、紫外線ランプユニット１０で殺菌され、少なくともその一部は光触媒フィルター６０を通過して脱臭される。また、吸気口１２、１３、１４、１５から吸入された空気は、蒸発器２を通過することで冷却除湿される。蒸発器２で冷却除湿された空気は、凝縮器３を通過することによりその熱で加熱され、乾燥空気となって、送風機４の作用により上部吹出口１７及び下部吹出口１８から室内に吹き出される。

【００４９】蒸発器２において除湿された空気中の水分は、蒸発器２の下方に設けられた排水タンク９内に溜まる。この排水タンク９に溜まった水は、排水タンク９を前方に引き出して取り出すことにより、排出することができる。また、排水タンク９貯水量は、排水タンク９の前部９１が機械本体前部の前面及び左右両側面に露出しているので、前、左、右の３方向から確認することができる。また、この貯水量が満杯に対しどの程度になっているかは、補給リブ９３、９４、９５が水位目印となるので容易に知ることができる。このように、補給リブ９３、９４、９５は、排水タンク９の水位表示を兼ねるので、他に特別の水位表示部を設ける必要がない。なお、排水タンク９の水位が最上位の目印表示である補強リブ９３の位置近辺まで到達したときは、他に搭載されている満水検知装置が作動し、除湿機の運転が停止される。

【００５０】平板状紫外線ランプ２０は、除湿機運転中において紫外線ランプスイッチ（図示しない）が投入されているときのみ通電される。平板状紫外線ランプ２０は、通電により紫外線発光面２０ａから紫外線２８を放射し、可視光発光面２０ｂから可視光２９を放射する。

【００５１】可視光２９は、一部は突出部８１から直接機外に放射され、他の一部は前面カバー１１を通過して機外に放射される。可視光２９が前面カバー１１を透過することにより前面カバー１１が面発光する。これにより、使用者は平板状紫外線ランプ２０の運転を確実、かつ、簡単に知ることができる。また、前面カバー１１は、機械本体前面から機械本体側面に跨る形状とされているので、前面カバー１１内の可視光２９の伝搬により、機械本体側方からも平板状紫外線ランプ２０の運転を知ることができる。また、前面カバー１１は、光輝性顔料が含まれているので、可視光２９が拡散され視認性及び光輝感が良好となり、デザイン効果も優れたものとなる。また、この光輝性顔料は、ガラスフレーク又は塊状フレークを母材とし、この母材表面に金属又は金属酸化物をコートしたものであるので、光輝性顔料の母材表面における反射が大きくなり、前面カバー１１の光輝感が良好となる。すなわち、従来の光輝性顔料を配合した樹脂としては、樹脂材料に銀、ニッケル等の金属箔、金属粉末を配合したものがあるが、これらのものに比べ、上記のガラスフレーク又は塊状フレークに金属又は金属酸化物をコートしたものは、軽量であるため樹脂材料中にランダムに配合され易く、広範囲の光輝感が得られる。また、本発明に係る光輝性顔料を配合した樹脂は、樹脂成型品のそり、収縮防止効果があり、成型作業が容易になる。

【００５２】また、可視光２９は、前述のように、機械本体の前面側に放射されるに際し、一部は突出部８１から直接放射され、また、他部は光を側方に拡散させるためのレンズ８０を通過し、前面カバー１１を介して機外に放出されるので、突出部８１の部分はその周囲に対し明るくなり、照度に変化を持たせることが可能となり、デザインに多様性を持たせることができる。なお、レンズ８０により、前面カバー１１の側方部の照度が高く維持される。

【００５３】また、紫外線ランプ２０からレンズ８０の中央部へ放射される可視光２９は、レンズ８０に入射する際、レンズ８０の中央部に凹部８２が形成されていることにより、表面での反射光が減少し、レンズ８０の側方部への入射光が増加する。また、レンズ８０に入射した可視光２９は、レンズ８０が湾曲状をなし、側方が薄く形成されていることにより、レンズ８０内の側方における反射光が増加し、可視光２９の側方への拡散が良好となり、機械本体側方からの視認性がより良好となる。

【００５４】前面カバー１１で拡散された光の一部は、前記排水タンク９の前部９１の形状が前面カバー１１の形状と連続性を持たせるように形成されているので、排水タンク９の前部にも伝搬され、排水タンク９を光らせることができる。

【００５５】一方、紫外線発光面２０ａから放射された紫外線２８は、紫外線ランプユニット１０内の空気通路１０ａを通過する空気を殺菌する。このとき、紫外線ランプ２０を収納する収納ケースの内面がアルミで形成されていることにより、紫外線は乱反射され、殺菌効果が向上する。また、紫外線２８が光触媒フィルター６０に照射されることにより、光触媒が活性化し、この光触媒フィルター６０を通過する空気中の臭気成分が酸化分解され、機内循環される空気が脱臭される。なお、平板状紫外線ランプ２０がエラストマー製パッキン４０を介して樹脂製ケース３０に取り付けられていること、樹脂製ケース３０側面の通風口として鎧格子３３が設けられていること、さらには、アルミ製ケース５０の空気流通口に鎧格子５１、５２が設けられていることにより、紫外線発光面２０ａから放射された紫外線２８が紫外線ランプユニット１０の外側に漏れることが防止されている。なお、エラストマー製パッキン４０は、弾性に富み、紫外線２８にも侵されないので、良好な紫外線シールパッキンを得ることができる。

【００５６】また、以上の本実施の形態による場合は、別光源の紫外線ランプ運転表示ランプを使用する必要がないので、別光源の紫外線ランプ運転表示ランプの故障に対する保証回路や安全回路を設ける必要はない。また、レンズ８０は、ポリスチレンを原材料として構成しているので、レンズ８０の透明性が良好となり、さらに、レンズ８０内表面での反射が良好になり、可視光２９の側方への拡散が良好になる。また、平板状紫外線ランプ２０は、平板状として形成されているため、平板状紫外線ランプ２０の取付構造、紫外線２８の照射構造、可視光２９利用の構造などを簡略化し易くなる。

【００５７】また、紫外線ランプユニット１０の収納ケースは、樹脂製ケース３０とアルミ製ケース５０とから構成されているので、複雑な形状部分を樹脂製ケース３０とすることにより、空気調和機との構成上の調整を容易に行うことができる。また、紫外線ランプユニット１０の樹脂製ケース３０は、内表面にアルミ層が形成されているため、紫外線ランプ２０から発生される熱が放出され易くなる、また、この内表面のアルミ層により、紫外線２８による樹脂の劣化が防止される。また、このアルミ層は真空蒸着により形成されるので、樹脂製ケース３０が鎧格子３３などを備えた複雑な形状、構造であっても、全表面に渡り均一な厚みのアルミ層が形成される。

【００５８】また、紫外線ランプユニット１０は、機内空気流路における上流側に配置されているので、下流側の蒸発器２、凝縮器３及び送風機４等に雑菌や臭気成分が付着するのが抑制され、衛生的で、メンテナンスも容易になる。

【００５９】変形例

以下に、上記実施の形態に対する変形例を記載する。

（１）　前面カバー１１は、中央部の光輝性顔料の配合量を側方部の光輝性顔料の配合量に比し大きくしてもよい。このように形成すると、前面カバー１１の側方への可視光２９の伝搬が良好となる。なお、この場合において、前面カバー１１を一体成型することが困難な場合は、機械本体前面側の部分と機械本体側面側の部分とを別体で成型し成型後に結合するようにしてもよい。

（２）　紫外線ランプユニット１０の樹脂製ケース３０は、上記実施の形態では内面のみアルミ蒸着で被覆していたが、外表面をもアルミ蒸着で被覆してもよい。このように構成すれば、レンズ８０側への光の反射量が増加し、前面カバー１１の照度を向上させることができる。

（３）　上記実施の形態では、脱臭機能を持たせるために光触媒フィルター６０を備えたものについて示したが、殺菌機能のみであれば光触媒フィルター６０を除いた構成とすることができる。なお、このように構成しても、機械前面側からの運転表示及びデザイン効果に影響がないことは勿論のこと、紫外線ランプユニット１０の殺菌機能に関しても前記実施の形態と同様な作用効果が得られる。

（４）　レンズ８０の機械本体内側の表面を粗面としてもよい。このように構成すると、機械本体内側のレンズ８０の表面部において、レンズ８０内を伝搬する可視光２９が反射する場合及び紫外線ランプ２０からの可視光２９がレンズ８０内に入射する場合に、可視光２９が乱反射されるので、光輝感が向上し、デザイン効果を向上させることができる。

（５）　上記実施の形態では、本発明を除湿機に適用した場合について説明したが、エアコンなどの空気調和機にも適用可能である。

【００６０】

【発明の効果】本発明は、次のような効果を奏することができる。請求項１記載の発明によれば、紫外線ランプから面発光される可視光により前面カバーが広範囲で明るくなるので、紫外線ランプの運転を容易かつ確実に知ることができる。したがって、別光源の運転表示ランプを使用する必要がない。また、前面カバーを構成する樹脂材料に光輝性顔料が配合されているので、可視光が拡散され視認性及び光輝感が良好となる。また、紫外線ランプは一面が可視光発光面であり他方の面が紫外線発光面となる平板状紫外線ランプであるので、紫外線ランプを組み込む場合の配置場所や保持方法の選択性が拡がり、取付構造を簡略化することができる。

【００６１】また、請求項２記載の発明によれば、前面カバーが本体ケースの前面側から本体ケースの側面側に跨る形状に形成されているので、前面カバー内における可視光の伝搬により紫外線ランプから放射される可視光が側方にも放射される。したがって、紫外線ランプの運転表示を正面ばかりでなく側方からも視認することができる。

【００６２】また、請求項３記載の発明によれば、前面カバーは、本体ケースの前面側を構成する部分に配合される光輝性顔料の配合量が本体ケースの側面側を構成する部分に含有される光輝性顔料の配合量より多いので、本体ケースの側面側を構成する部分における光の拡散性が向上し、側面部への光の拡散性が向上させることができる

【００６３】また、請求項４記載の発明によれば、紫外線ランプと前記前面カバーとの間に可視光を側方に拡散させるためのレンズが設けられているので、紫外線ランプから放射された可視光がレンズにより側方に拡散することができ、機械本体側面部からの視認性が向上する。

【００６４】また、請求項５記載の発明によれば、レンズが機械本体内側に湾曲する形状に形成され、かつ、側方に行くに従い厚さが薄くなるように形成されているので、レンズ内の側方部における反射光が増加し、可視光の側方への拡散性がさらに改善される。

【００６５】また、請求項６記載の発明によれば、レンズの機械本体内側の表面が粗面に形成されているので、

機械本体内側のレンズの表面部において、レンズ内を伝搬する可視光が反射する場合及び紫外線ランプからの可視光がレンズ内に入射する場合に、可視光が乱反射されるので、光輝感が向上し、デザイン効果を向上させることができる。

【００６６】また、請求項７記載の発明によれば、ポリスチレンを原材料としてレンズが形成されているので、レンズの透明性が良好となるとともに、レンズ内部での表面反射が良好となり、可視光の側方への拡散性が向上する。

【００６７】また、請求項８記載の発明によれば、レンズ中央部の突出部がレンズカバーを貫通しているので、この突出部から機外へ直接可視光が放射され、突出部分が突出部分の周囲より明るくなる。この結果、この突出部と突出部の左右部分との間に照度差を生じさせることができ、デザイン効果を向上させることができる。

【００６８】また、請求項９記載の発明によれば、空気調和機は、一部が機械本体の前部において前面及び左右両側面に露出されているとともに、透明又は半透明材料から形成されている排水タンクを備えているので、前、左、右の３方向から排水タンクの貯水量を確認することができる。

【００６９】また、請求項１０記載の発明によれば、上記のように、機械本体の前部に露出する排水タンクの一部分が、前面カバーから連続するような形状とされているので、前面カバーから排水タンクへの可視光の伝搬性が期待できる。これにより排水タンクも光らせることができ、デザイン効果を向上させることができる。

【００７０】また、請求項１１記載の発明によれば、排水タンクに機械本体の外部から透視することのできる水位表示部が設けられているので、貯水されている水の量を容易に把握することができる。

【００７１】また、請求項１２記載の発明によれば、排水タンクにおける平面形状の変形部分に配置された水平の補強リブにより水位表示部が形成されているので、特別の水位表示部を形成する必要が無く、部品の構成簡略化を図ることができる。

【００７２】また、請求項１３記載の発明によれば、水位表示部を兼ねる補強リブが高さ方向に均等間隔で複数配置されているので、使用者は貯水されている水の量をより把握し易くなる。

【００７３】また、請求項１４記載の発明によれば、最上位の補強リブが排水タンクの満杯を表示するので、使用者は、排水タンクの満水時期を予測することが可能となり、使用者の便宜を図ることができる。

【００７４】また、請求項１５記載の発明によれば、前面カバーの樹脂材料に配合される光輝性顔料が、ガラスフレーク又は塊状フレークを母材とし、この母材表面に金属又は金属酸化物をコートしたものであるので、光輝性顔料母材の表面での可視光の高反射を得ることができ、前面カバーの光輝感が良好となる。

【図面の簡単な説明】

【図1】本発明の実施の形態係る空気調和機の内部構成を上面側から見た要部構成図。

【図２】上記空気調和機の内部構成を正面側から見た要部構成図。

【図３】上記空気調和機の内部構成を左側面側から見た要部構成図。

【図４】上記空気調和機の外観斜視図。

【図５】上記空気調和機の、前面カバー及びエアーフィルターを取り外した状態の外観斜視図。

【図６】上記空気調和機における紫外線ランプユニットを機械本体上面側からから見た詳細構成図。

【図７】上記空気調和機における紫外線ランプユニットを機械本体左側面側から見た詳細構成図。

【図８】上記空気調和機における紫外線ランプユニットを機械本体内側から見た詳細構成図。

【図９】上記紫外線ランプユニットにおける基板ホルダーの斜視図。

【図１０】上記紫外線ランプユニットにおける平板状紫外線ランプの発光原理説明図。

【図１１】上記紫外線ランプユニットにおけるランプ取付部の樹脂成形直後の状態図。

【図１２】上記ランプ取付部の折り曲げ工程説明図。

【図１３】上記紫外線ランプユニットにおける光触媒フィルターの平面図。

【図１４】上記光触媒フィルターのＸＩＶ－ＸＩＶ断面図。

【図１５】上記紫外線ランプユニットにおける前面カバーの斜視図。

【図１６】上記空気調和機における排水タンクの斜視図。

【図１７】上記排水タンクの左側面図。

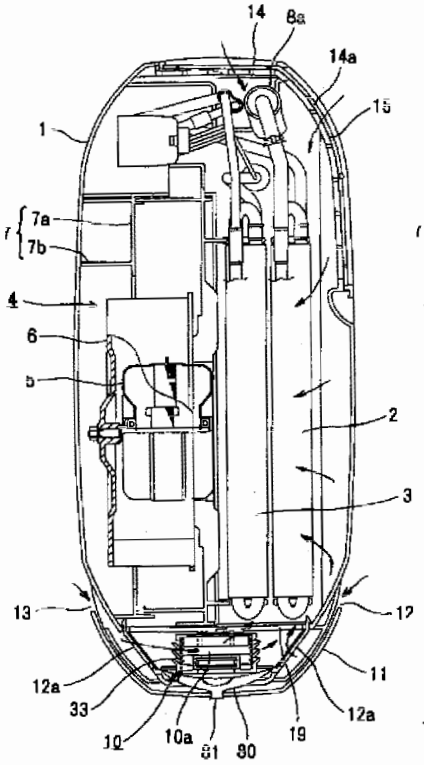
【図１８】上記排水タンクの平面図。

【符号の説明】

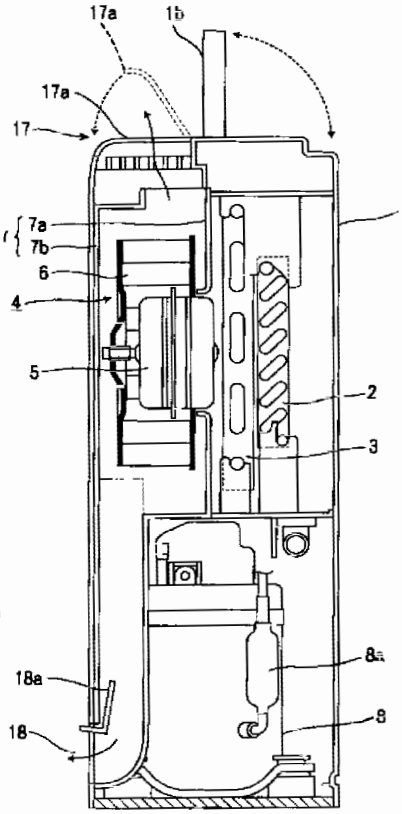
１　本体ケース
１０　紫外線ランプユニット
１０ａ（紫外線ランプユニット内の）空気通路
１１　前面カバー
１１ａ 開口部
１２　吸気口
１２ａ エアーフィルター
１３　吸気口
１４　吸気口
１５　吸気口
１７　上部吹出口
１８　下部吹出口
２０　平板状紫外線ランプ
２０ａ 紫外線発光面
２０ｂ 可視光発光面

２８　紫外線
２９　可視光
８０　レンズ
８１　突出部
８２　凹部
９３　（最上段の）補強リブ
９４　補強リブ
９５　補給リブ

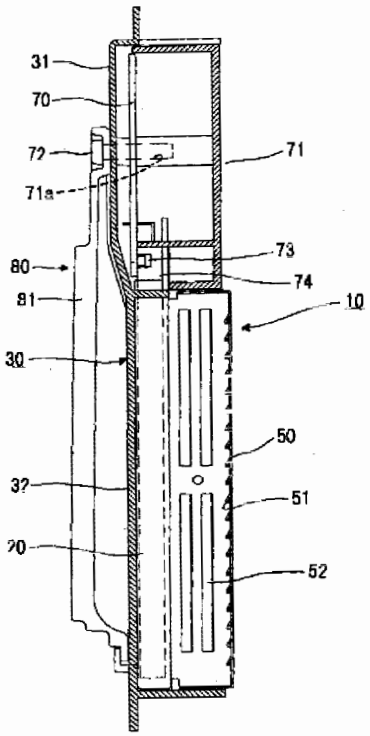
【図１】



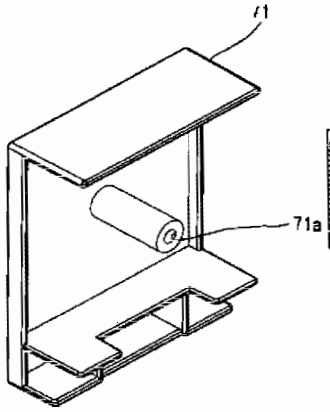
【図２】



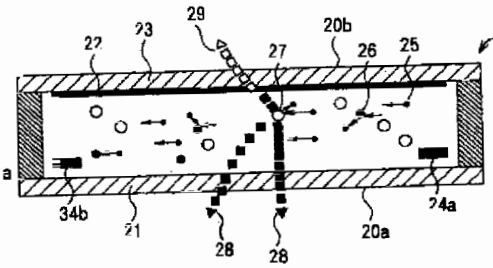
【図７】



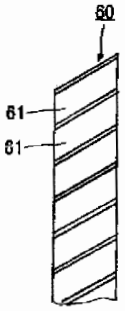
【図９】



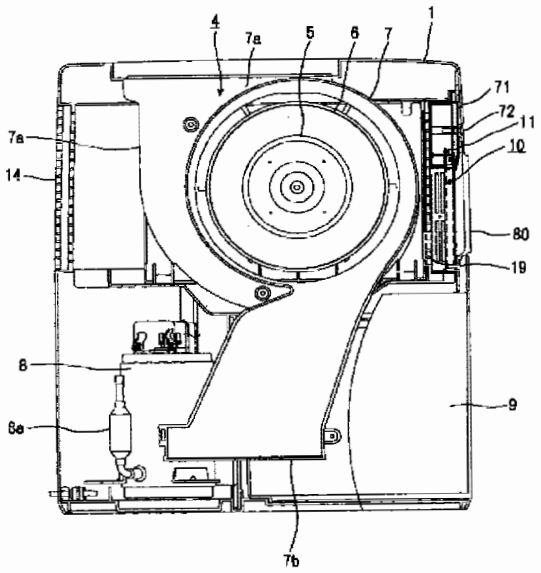
【図１０】



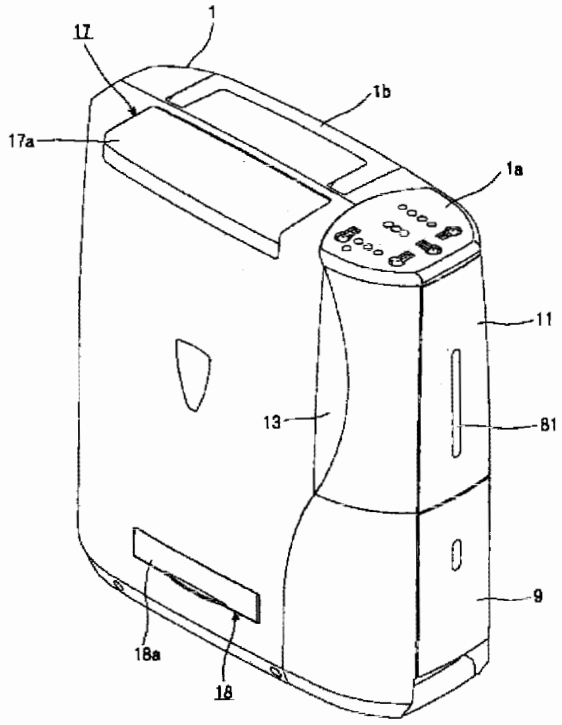
【図１４】



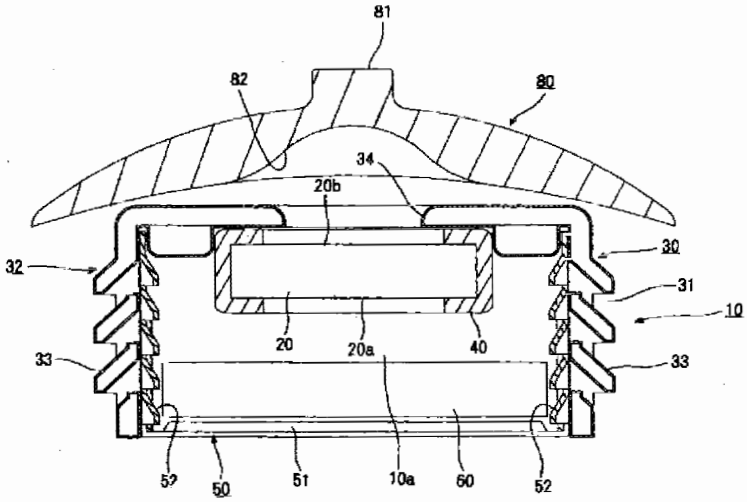
【図3】



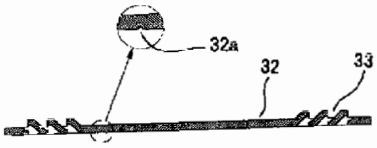
【図4】



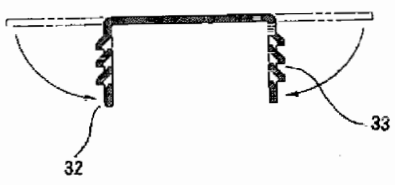
【図6】



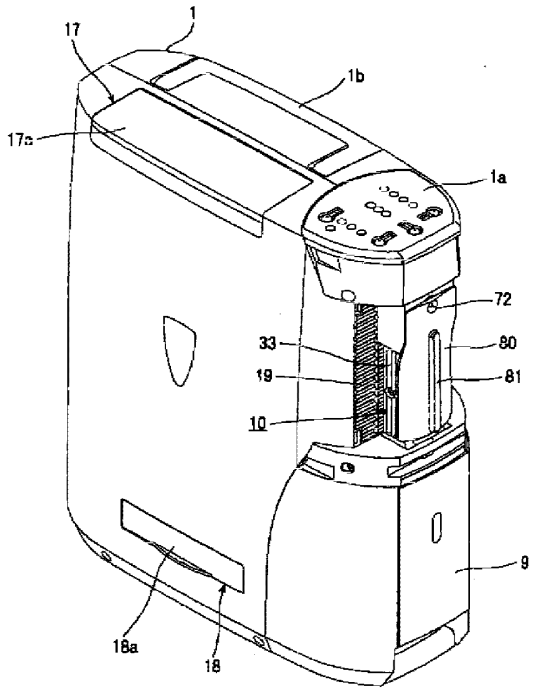
【図11】



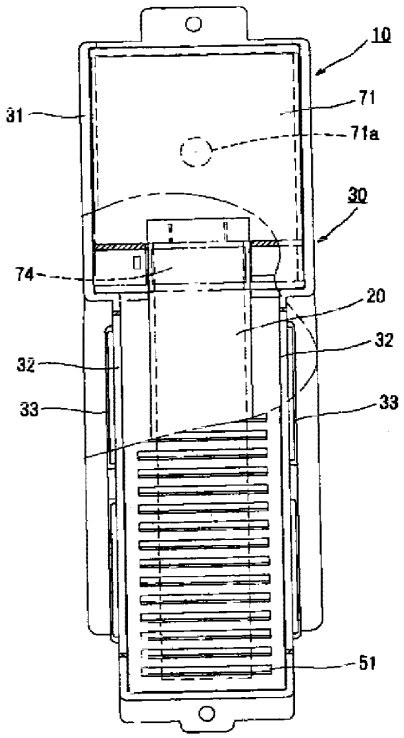
【図12】



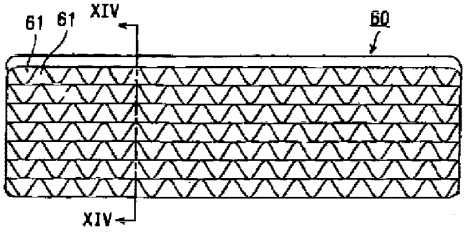
【図5】


17
1
1b
17a
1a
72
33
80
19
81
10
9
18a
18

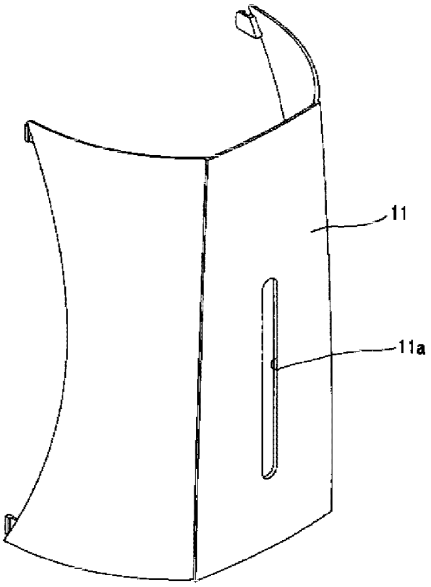
【図8】


10
71
31
71a
30
74
20
32
32
33
33
51

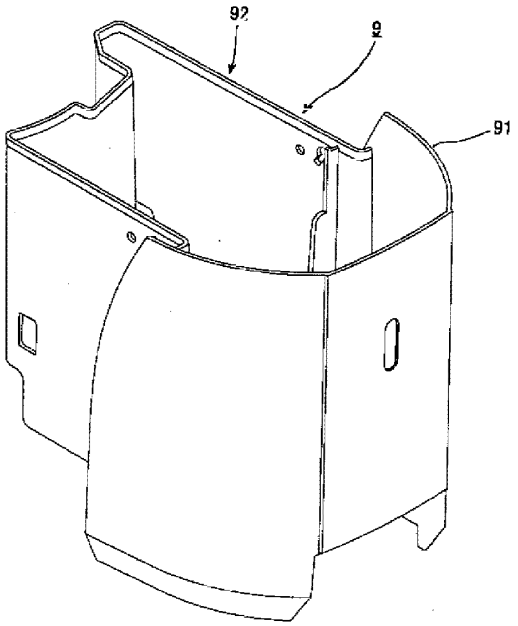
【図13】


61
61
XIV
60
XIV

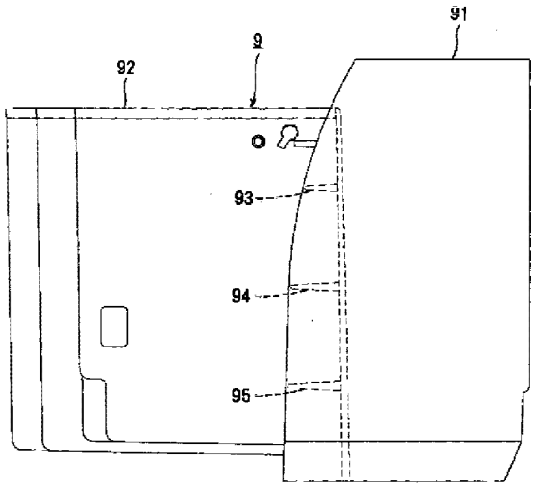
【図15】


11
11a

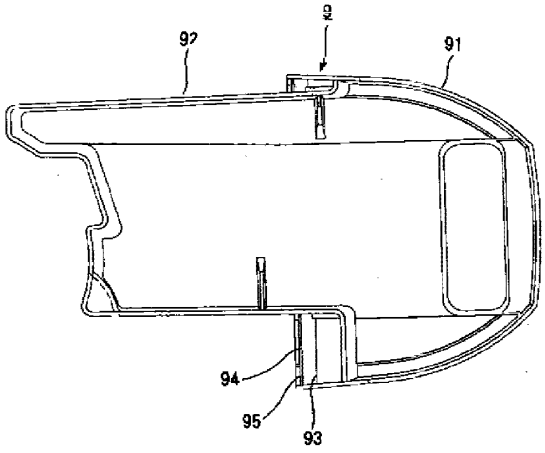
【図16】



【図17】



【図18】



フロントページの続き

(72)発明者　上堂薗　敏郎
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内
(72)発明者　森　好弘
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内
(72)発明者　秋山　真一
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内
(72)発明者　福田　知治
大阪府守口市京阪本通２丁目５番５号　三洋電機株式会社内

Fターム(参考) 3L050 BD05 BE00
3L051 BC03 BG06 BJ10

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CLAIMS JP2003207165

1.

An ultraviolet lamp disposed in the vicinity of the inner surface of the main body case of the machine body and a front cover formed on a part of the main body case on the front side of the ultraviolet lamp. The front cover is made of transparent or Wherein the ultraviolet lamp is a flat plate ultraviolet lamp having a surface on the front cover side as a visible light emitting surface and a surface on the inner side of the machine body as an ultraviolet light emitting surface, Wherein the front cover is provided inside the main body case so that the visible light emitted from the visible light emitting surface faces the air passage and is projected to the front cover.

2.

2. The air conditioner according to claim 1, wherein the front cover is formed in a shape extending from a front side of the main body case to a side of the main body case.

3.

The front cover according to claim 2, wherein the blending amount of the bright pigment

blended in the portion constituting the front side of the main body case is larger than the blending amount of the bright pigment contained in the portion constituting the side surface side of the main body case An air conditioner.

4.

The air conditioner according to any one of claims 1 to 3, wherein a lens for diffusing visible light laterally is provided between the ultraviolet lamp and the front cover.

5.

5. The air conditioner according to claim 4, wherein the lens is formed in a shape curved toward the inside of the machine body from the central portion in the left-right direction toward the side, and the thickness is made thinner as going to the side Harmony machine.

6.

6. The air conditioner according to claim 5, wherein the inner surface of the lens of the lens is formed as a rough surface.

7.

7. The air conditioner according to claim 6, wherein the lens uses polystyrene as a raw material.

8.

The lens has a projecting portion linearly extending in the height direction of the machine main body with a predetermined width at the central portion in the left and right direction, and the front cover has an opening for allowing the projecting portion to pass therethrough The air conditioner according to any one of items 4 to 7.

9.

The air conditioner comprises an evaporator for cooling and dehumidifying the air sucked into the airplane and a drainage tank for storing water dehumidified by the evaporator. Part of the drainage tank is provided at a front portion of the machine body The air conditioner according to any one of claims 1 to 8, wherein the air conditioner is exposed on a front surface and both left and right side surfaces, and is formed of a transparent or translucent material that is visible in water level.

[10]

10. Wherein a part of the drainage tank exposed at the front face and the left and right side faces at the front portion of the machine main body is formed to be continuous with the front face cover and has a water level transparent 10. The air conditioner according to claim 9, wherein the air conditioner is formed of a transparent or translucent material.

[11]

11.11. The air conditioner according to claim 10, wherein the drainage tank is provided with a water level indicator which can be seen through from the exterior of the machine body.

[12]

12.12. The air conditioner according to claim 11, wherein said water level indicator is formed by horizontal reinforcing ribs arranged in a deformed portion of a planar shape in a drain tank.

[13]

13.13. The air conditioner according to claim 12, wherein a plurality of said reinforcing ribs are arranged at even intervals in a height direction.

[14]

14.15. The air conditioner according to claim 13, wherein the uppermost one of said reinforcing ribs indicates that the drain tank is full.

[15]

15.15. The air conditioner according to claim 1, wherein the bright pigment is a glass flake or a bulk flake as a base material, and the surface of the base material is coated with a metal or a metal oxide.

(19)日本国特許庁(JP)　(12)公表特許公報(A)　(11)特許出願公表番号
特表2007-522843
(P2007-522843A)
(43)公表日　平成19年8月16日(2007.8.16)

(51)Int.Cl.			F I			テーマコード（参考）
A61L	2/10	(2006.01)	A61L	2/10		4C058
A61N	5/06	(2006.01)	A61N	5/06	B	4C082

審査請求 未請求　予備審査請求 未請求　（全 10 頁）

(21)出願番号　特願2006-553231 (P2006-553231)
(86)(22)出願日　平成17年2月11日 (2005.2.11)
(85)翻訳文提出日　平成18年10月11日 (2006.10.11)
(86)国際出願番号　PCT/US2005/004246
(87)国際公開番号　WO2005/077076
(87)国際公開日　平成17年8月25日 (2005.8.25)
(31)優先権主張番号　60/543,710
(32)優先日　平成16年2月11日 (2004.2.11)
(33)優先権主張国　米国 (US)

(71)出願人　506276192
レスラー，バリー
アメリカ合衆国，コネチカット　０６８１０，ダンバリー，レイク　プレイス　サウス　１３７
(74)代理人　100099759
弁理士　青木　篤
(74)代理人　100092624
弁理士　鶴田　準一
(74)代理人　100102819
弁理士　島田　哲郎
(74)代理人　100090309
弁理士　今枝　久美

最終頁に続く

(54)【発明の名称】紫外線光源を使用した製品滅菌システム並びに方法

(57)【要約】
単一及び/又は複数の光源の単色連続波形の高強度非干渉性光を用いて、パッケージの内外のいずれに位置するポリマーベースの製品等を、滅菌するシステムと方法。この処理システム及び方法は、獣・鳥肉等の食品を含む別の製品、腸用及び/又非腸用液とシステム等の滅菌に使用され得る。

【特許請求の範囲】
【請求項1】
製品滅菌用の非レーザ光源であって、a）少なくとも一つの外壁によって画定されたハウジングと、b)前記ハウジング内に入れられた所定量の光子発生ガスとを含み、前記外壁の少なくとも一部が、前記所定量のガスによって生成された光子に対して実質的透過性である光源。
【請求項2】
包装され、或いは包装されていない眼科用装置及びその他の製品を含む基板に対して、例えば１９３，２２２，２４８，２８２，３０８又は３４４nmの波長の単色光を所定の滅菌量で付与する方法。
【発明の詳細な説明】
【技術分野】
【0001】
本開示は、製品滅菌システム及び方法、並びに/又は紫外線光源を使用するシステムに関する。更に詳しくは、本開示は、単一及び/又は複数の光源における単色光で連続する波形を有する高強度の非干渉性光を使用して、包装の内側或いは外側に置かれたポリマーをベースとする製品を滅菌するためのシステムと方法に関する。開示された処理システム並びに方法は、所望の滅菌レベルを保持しつつ、製品/システムの物理的性質及び性能を保存することが望ましい。開示された処理システム及び方法は、獣・鳥肉等の食品を含む別の製品、腸用及び/又非腸用液とシステム等の滅菌に使用されてよい。
【背景技術】
【0002】
一般に、殺菌もしくは滅菌（sterilization）とは、多数の抵抗性の高い細菌内生胞子を含むすべての有機体を完全に破壊することと定義されている。滅菌技術の多くは、特定の滅菌の必要性をめざして開発された。代表的な滅菌技術は、オートクレーブ（高圧蒸気滅菌装置）からの湿熱、酸化エチレンガス滅菌技術、乾熱技術及び新規な化学滅菌剤の使用を含む。
【0003】
蒸気滅菌は広く使用され、一般的に原価効率の高い技術であると考えられている。オートクレーブを使用した蒸気滅菌技術は、すべての関連生物を破壊するための効率的で、簡単、かつ比較的低コストのアプローチであると認められている。しかし、特定の構成部分(例えば、医療装置/器具の部品やアクセサリ)は、高い熱と圧力に耐えられない。例えば、蒸気と圧力は、ゴム、Ｌｅｘａｎ（登録商標）プラスチック部品、その他の合成材料を損傷することが知られており、麻酔器具のために蒸気を使用することは、その処理方法が製造業者によって特に推奨されない限りは好ましくない。
【0004】
酸化エチレンは、麻酔装置、換気装置、モニタの再使用可能な構成部品を含む医療装置等を製造するのに使用される多くの材料に受け入れ可能である。しかし、これらのシステムの全体を酸化エチレン室に入れることは一般的に不適当である。更に、ポリスチレン成分の部品は、酸化エチレンガスに露出できない。酸化エチレンによる滅菌は、強力な毒性の燻蒸ガスを使用するので、残存ガスのすべての痕跡を除去するための適宜な通気手段が必要である。酸化エチレンに触れる作業者は、ＯＳＨＡ及びＥＰＡによって決められたすべての処方に従う必要がある。別の化学処理技術は、過酸化水素とペルオキシ酢酸を緩衝剤と低熱と共に使用する。
【0005】
最近、「広いスペクトルの非干渉性多色光の高強度短時間パルスを使用したパッケージとその内容物の滅菌」と称する表題でＣｌａｒｋ他に付与された米国特許５，７８６，５９６には、滅菌技術が開示されている。この表題に記載されているように、Ｃｌａｒｋの‘５９８特許は、広いスペクトルの非干渉性多色光の高強度短時間パルスを使用して、製品容器を滅菌し、その中の微生物を非活性化させるものである。Ｃｌａｒｋの‘５９８特

許は、「非腸用及び/又は腸用液とパッケージ内、コンタクトレンズ液とパッケージ内、及び/又は眼用液とパッケージ内の微生物の非活性化」を提案している（１欄、１１～２０行参照）。Ｃｌａｒｋの‘５９８特許に開示されているように、広いスペクトルの非干渉性多色光の短いパルスを使用することは、提案されている用途の少なくとも幾つかの態様に対して非効率的及び/又は受入れ不能であると信じられている。

【0006】

今日までの努力にも拘わらず、パッケージの内外のいずれに位置していても、ポリマーをベースとする製品を滅菌するのに使用されるシステム及び/又は方法であって、その処理によって、対象のポリマーをベースとする製品の物性及び/又は効能に悪影響を与えることなく、所望の滅菌レベルを達成できるものに対する必要性が存在する。同じく、パッケージの内外のいずれに位置していても、別の製品（例えば、獣肉や鳥肉等の食品、腸用及び/又は非腸用液とそのシステム等）を滅菌するのに使用されるシステム及び/又は方法であって、対象製品の物性及び/又は有効性に悪影響を与えることなく、所望の滅菌レベルを達成できるものに対する必要性が存在する。

【0007】

上述及びその他の目的は本発明によって達成され、そこでは滅菌は、単一及び/又は複数の光源における単色光で連続する波形を有する高強度の非干渉性光を使用して得られる。本発明の処理システムと方法は、対象製品の物性及び/又は有効性に悪影響を与えることなく、所望の滅菌レベルを有利に得ることができる。これら及びその他の特長/機能性は、以下に述べる詳細な説明から当業者には自明であろう。

【発明の開示】

【0008】

（発明の概要）

感熱性材料を含む製品を、それがパッケージ及び/又は包装容器の内或いは外のいずれに位置していても、滅菌するための有利な手段がここに開示されている。開示された滅菌システム及び方法は、処理される製品或いはパッケージに対して物理的又は性能的に損傷を与えることなく、ウイルス及びバクテリア微生物を不活性化するのに有効である。単一或いは複数列の光源は、単色殺菌性周囲温度光を少なくとも２００～６００mw/cm^{2}の光輝レベルで、多数の微生物を不活性化するために発射する。本発明の実施形態によれば、製品は１９３，２２２，２４８，２８２，３０８，３５４ｎｍ（±5nm）のそれぞれの異なる波長で、少なくとも10^{-5}ｃfu/mlの滅菌保証レベル（SALs）まで滅菌される。

【0009】

開示された滅菌処理法はバッチ式、半バッチ式或いは連続モードで行われる。本発明の一実施形態において、目標製品及び/又は容器入りの製品は、一つ以上の光源の上、下又は間を移動する移動要素（例えば、ベルト）の上に位置決めして連続的に処理される。製品/容器が光源を通過する速度は、所望エネルギ処理レベルが得られるように調整される。バッチ式/半バッチ式の実施形態では、処理時間は所望処理レベルが得られるように変更される。以下に述べるように、補助的な処理パラメータが滅菌処理に影響を与え、（単独で或いは速度/滞留時間との組合せで）調節/選択されて所望の滅菌結果を達成する。

【0010】

こうして、本発明の滅菌システム及び/又は方法に採用されている単色光源の強度は、所望の滅菌結果が得られるように調節される。例えば、複数の光源が採用されている処理システムでは、個々の光源は異なる強度で作動して、所望の滅菌結果を得る。光源の強度は、一般的に一個の微生物或いは一組（パネル）の生物/微生物のための処理アルゴリズムに基づいて選ばれる。代表的な処理法において、生物パネルはバチルスプミラス菌（胞子形成菌）、カンジダアルビカン菌（イースト）、脂質及び非脂質ウイルス、クロスチヂウムスポロゲネス菌（嫌気性胞子形成菌）、スタフィロコカスアウレウス菌（植物性グラム陽性菌）、プソイドモナスアエルギノサ菌（植物性グラム陰性菌）、黒色アスペルギルス菌（糸状真菌）、マイコバクテリウムテラエ菌、豚のパルボウイルス（PPV及びB19）、リステリア菌、及びサルモネラ菌を含んでいるが、これらに限定されない。ここに開示さ

れた滅菌法は種々の形状の製品/パッケージを処理するのに有効である。したがって、例えば、製品及び/又は製品パッケージは平らでも、出っ張っていても、凹んでいても、或いは別の形状でもよく、例えば、前述の形状の組合せでもよい。光源は所望の結果が得られるように修正されてよい。例えば、部分的に被覆された光学面を採用してもよく、この被覆された面は、所望の単色波長に同調するように調整されている。部分的に被覆された面の使用は、５００mw/cm²を超えるスペクトル強度を満足させる光を発生するのに有利である。

【0011】

開示された滅菌システムと方法に伴う付加的な特長と機能は、添付の図面を参照して以下に述べる詳細な説明から明らかになるであろう。

【発明を実施するための最良の形態】

【0012】

当業者の理解を助けるために、添付図面を参照して本発明による滅菌システムおよび方法を説明する。

【0013】

本発明によれば、パッケージ及び/又は包装容器の内或いは外のいずれかに位置する感熱性材料を含む製品を滅菌するシステムと方法が提供される。このシステム/方法は、処理される製品或いはそのパッケージに物理的又は性能的損傷を与えることなく、ウイルス及びバクテリア微生物を不活性化する効果がある。単一又は複数列の光源が、少なくとも２００mw/cm²～６００mw/cm²の光輝レベルの単色の殺菌性周囲温度光を発射して、多数の微生物を不活性化する。本発明の実施形態によれば、製品（例えば包装されたコンタクトレンズ）は、１９３，２２２，２４８，２８２，３０８，３５４nm（±５nm）の明らかに異なる波長で、少なくとも10^{-5}cfu/ml（コロニ形成単位/ミリメータ）の滅菌保証レベル（SALs）まで滅菌される。ポリマー製コンタクトレンズ製品（包装されていてもいなくても）の滅菌処理に使用される最近の好ましい波長は、２８２と３０８nmである。

【0014】

本発明による滅菌処理法は、バッチ式、半バッチ式或いは連続モードで行われる。コンタクトレンズの滅菌において、開示された光源を用いて単色光の紫外線を付与してウイルス及びバクテリア微生物を不活性化することは、最近行われている蒸気滅菌等の滅菌方法の代わりに特に魅力的である。なぜならば、この紫外線処理は滅菌が一秒以下で行われるインライン（即ち、連続的或いは実質的に連続的な）プロセスに容易に組込み可能だからである。更に、開示された単色光の紫外線は、感熱性材料の物性及び/又は性能に悪影響を与えることなく、感熱性材料の滅菌に有効である。（例えば蒸気滅菌が特長/機能を損傷し又は破壊するので）従来の蒸気滅菌に適さないポリマーをベースにした製品（例えばコンタクトレンズ）に関する付加的な性能/機能は、この開示された単色紫外線滅菌技術を用いるのに潜在的に適している。

【0015】

この開示された実施形態において、目標製品及び/又は容器に収納された製品は、一つ以上の光源の上、下又は間を移動する移動要素の上に位置決めして連続的に処理される。例えば、図２を参照すると、上下の光源が中間領域を形成し、そこに製品（例えば包装されたコンタクトレンズ）が滅菌処理のために搬送される。種々の設計と構成のコンベヤベルトや軌道等の構造と機構が、滅菌の目的のために紫外線放射を製品まで到達させると共に、製品を中間領域を介して搬送するために使用される。適当なコンベヤ/搬送システムの選択と設置は当業者に可能である。種々の搬送システムが図１に描かれたタイプの滅菌システムの単一光源に組み込まれてよい。

【0016】

連続或いは半連続式の実施形態において製品/容器が光源を通過する速度は、所望のエネルギ処理レベルが得られるように調節される。同様に、バッチ式/半バッチ式の実施形態において、処理時間は所望エネルギ処理レベルが得られるように変更できる。以下に述べるように、補助的な処理パラメータが滅菌処理に影響を与え、（単独で或いは速度/滞

留時間及び/又はその他の処理パラメータと組合わせて）調節/選択され、所望エネルギ供給とその結果としての滅菌効果を達成する。

【0017】

即ち、本発明の滅菌システム及び/又は方法に採用される単色光源は、所望の滅菌結果が得られるように調節される。例えば、複数の光源が採用される処理システムにおいて、個々の光源は異なる強度及び/又は異なる時間で作動して、所望の滅菌結果を得る。好ましくは、制御システムが光源に連携して、それの作業パラメータを制御する。典型的な制御システムは、光源を所望の強度と所望の時間で作動させるようにプログラムされたプロセッサを含む。連続処理法の場合には、制御システムは、例えば、コンベヤ/搬送システムの速度に基づいて、製品が処理領域を通過する速度を制御することが望ましい。作業者が必要に応じて処理パラメータを調節/修正できるように、手動のオーバーライド（over-ride）が設けられることが多い。

【0018】

光源強度等の処理パラメータは、一般的に一つの微生物或いは一組（パネル）の生物/微生物のための処理アルゴリズムに基づいて選択される。典型的な処理法において、生物のパネルはバチルスプミラス菌（胞子形成菌）、カンジダアルビカン菌（イースト）、脂質及び非脂質ウイルス、クロスチヂウムスポロゲネス菌（嫌気性胞子形成菌）、スタフィロコカスアウレウス菌（植物性グラム陽性菌）、プソイドモナスアエルギノサ菌（植物性グラム陰性菌）、黒色アスペルギルス菌（糸状真菌）、マイコバクテリウムテラエ菌、豚のパルボウイルス（PPV及びB19）、リステリア菌、及びサルモネラ菌を含むが、これらに限定されない。当業者に自明のように、付加的な及び/又は別の生物を、全体としてあるいは部分的に、適宜な処理法を開発し、実行するのに利用できる。単色殺菌性周囲温度光を利用した滅菌処理法は、ここに開示されているように、種々の形状の製品/パッケージを処理するのに有効である。したがって、例えば、製品及び/又は製品パッケージは平らでも、出っ張っていても、凹んでいても、或いは別の形状でもよく、例えば、前述の形状の組合せでもよい。光源は所望の結果が得られるように修正されてよい。例えば、部分的に被覆された光学面を採用してよく、この被覆された面は、所望の単色波長に同調するように調整されるのが望ましい。部分的に被覆された面の使用は、５００mw/cm^{2}を超えるスペクトル強度要求を満足させる光を発生するのに効果的である。

【0019】

実施形態による光源システムは、大きな活動領域にわたって光を発射し、周囲温度で作動するように構成されることが好ましい。光源からの実質的単色の光の出力は、プロセス活動スペクトルのピーク内の高スペクトル光輝（ワット/nm）を発生するように調整でき、必要とされる生物的対象の関数として殺菌効果（或いはその他の所望のプロセス/用途）を最大化する。利用可能な形状（内方或いは外方を照射する同心の複数の光源、及び片側或いは両側から発射する平坦な光源を含む）の範囲、及び光輝及び全力を別々に調節する能力は、システムの設計に大きな融通性を与え、更に効率的な光供給システムを可能にする。

【0020】

図１と１Ａを参照すると、例示された処理システム１００はベース構造１０２とカバー構造１０４を具えている。カバー構造１０４はベース構造１０２に対して枢支され、ハンドル１０６を具えて再位置決め（即ち開閉）を容易にしている。図1は「開放」位置にあるカバー構造１０４を示し、図１Ａは「閉鎖」位置にあるカバー構造を示している。代表的なカバー構造１０４は、光源により発生する光線を沪過/遮蔽し、処理システム１００の近くの作業者その他を保護する材料で作られる。即ち、カバー構造１０４の寸法と形状は、製品を光源に対して好適な処理位置に位置決めし、且つ発射された光線がそれによって沪過/遮蔽されるように選択される。

【0021】

処理システム１００は、ベース構造１０２の中に位置決めされた光源１０８を具え、これは単色殺菌性周囲温度光を発生し、処理窓１１０ａ、１１０ｂを通って発光するように

設計される。光源１０８は、使用される稀ガス及び/又はハロゲンガスを変化させることによって、ＶＵＶ，ＵＶ－Ａ，ＵＶ－Ｂ及びＵＶ－Ｃにわたって区別できるように調節可能な１０㎚以内でその出力の９０％を発生するエキシマ光源である。効率はガスの混合と形態によって、実施された入力力が１ワットを超え１０キロワット未満の場合に１０から３０％を超えるまで変化する。この開示されたシステムで使用される例示の光源の全体的構成と作用は、共に譲渡された特許出願０９/８０５，６１０（２００１年３月１３日出願、米国出願２００－０１７７１１８Ａ１として発行）及び特許出願１０/６６１，２６２（２００３年９月１２日出願）（先願）に開示、記載、図示され、これらの内容は全体が参考としてここに組み込まれる。例えば、これらの先願は冷却用流体の導入と排出のための流れのパターン/配列（例えば図１，１Ａのチューブ/ホースを参照）処理窓の構成等を開示し記載している。それぞれは図１及び/又は図１Ａに示されている。

【0022】

この開示された実施形態によれば、光源を所望の温度及び/又は所望の温度範囲内に維持するのに、適当な流体が使用されている。光源の作用を通じて発生した熱を消散/吸収するための好ましい媒体は、水である。しかし、当業者には、別の冷却流体を採用することも自明であろう。適当な冷却流体を選ぶ場合、使用の際に殺菌性放射線に対して実質的に透過性であって、これを透過させる流体を選ぶことが好ましい。泡の存在/形成は、殺菌性放射線を散乱させ、開示されたシステムの滅菌効率及び/又は有効性に悪影響を与えるので、泡の発生及び/又は伝播が生じ難い流体を選択することが望ましいことに留意すべきである。適宜な添加剤等を使用して冷却流体を使う場合に、泡の形成/伝播を少なくし且つ/又は防ぐように予め注意することが好ましい。

【0023】

使用の際に、滅菌対象の製品、例えばコンタクトレンズ、医療製品及び/又は部品、食品等は（包装されていてもいなくても）窓１１０ａ、１１０ｂの上に載せられ、カバー構造１０６が「閉鎖」されて処理領域が遮蔽され、光源１０８が作動して単色殺菌周囲温度光を製品に運ぶようにする。先願に記載されているように、光源は熱伝達/熱交換手段を介して実質的に制御された温度に維持されていることが望ましい。上述のように、先願はその全体が参考として組み込まれる。

【0024】

図２を参照すると、別の例の処理システム２００が示されている。このシステム２００は第一（上部）光源ハウジング２０２と第二（下部）光源ハウジング２０４を具えている。光源（図示いない）はハウジング２０２，２０４内に位置決めされ、先願に記載されているように、熱伝達/熱交換手段を用いて実質的に一定の温度に維持されていることが好ましい。処理領域２０６はハウジング２０２と２０４との間に画定されている。処理窓（図示しない）は第一及び第二ハウジング２０２，２０４に画定され、各光源からの単色の殺菌性光が処理領域内の製品に到達するようになっている。

【0025】

コンベヤ/搬送システム（図示しない）は、製品を処理領域２０６へ、即ち、ハウジング２０２と２０４との間に搬送するように設けられていることが好ましい。この開示の実施形態によれば、コンベヤは製品を光源に対して固定配向で、処理領域２０６へ進行させる。別の例では、製品が処理領域を通過する際に光源に対して製品の再位置決めを行うのに効果的な構造及び/又は機構を具えることが望ましい。例えば、厚く且つ/又は不規則な形状の製品の場合には、処理領域内の一つ以上の地点において製品を回転させることが望ましい。処理領域内で製品の向きを変えるために有効な構造及び/又は機構は、コンベヤ、上部及び/又は下部ハウジング、或いはそれらの組合せに関連する。製品の再位置きめは、例えば転換壁等を設けたり、制御ロボット等を使って制御する等、実質的にランダムに行われる。いずれの場合にも、再位置決め機構を組み込んで、種々の寸法と形状の製品に対して効果的で信頼性のある滅菌処理を行うことが望ましい。

【0026】

上部ハウジング２０２と下部ハウジング２０４との間の距離は、一般的に最小の間隙で

所望の製品を両者の間を通過させるように選ばれる。この開示の実施形態によれば、ハウジング２０２と２０４との間の間隔は、例えばハウジング２０２，２０４の少なくとも一方を他方のハウジングに対して位置決めし直すことによって調節される。即ち、例えば、上部ハウジング２０４は、下部ハウジング２０２に対して（上部ハウジング２０４を手動或いは動力によって再位置決めすることによって）垂直方向の再位置決めが可能/容易となるフレーム構造によって支持されてよい。上述したように、上部ハウジング２０４内の光源は、下部ハウジング２０２内の光源に対して異なる特性を有する単色光を放射するように設計/構成されてよい。したがって、図２の二光源機構は、更にこの開示の滅菌手段の融通性/多用性を増大させる。

【0027】

この開示によれば、（限定されてはいないが）バチルスプミラス菌（胞子形成菌）、カンジダアルビカン菌（イースト）、脂質及び非脂質ウイルス、クロスチヂウムスポロゲネス菌（嫌気性胞子形成菌）、スタフィロコカスアウレウス菌（植物性グラム陽性菌）、プソイドモナスアエルギノサ菌（植物性グラム陰性菌）、黒色アスペルギルス菌（糸状真菌）、マイコバクテリウムテラエ菌、豚のパルボウイルス（PPV及びB19）、リステリア菌、及びサルモネラ菌を含むパネルを含む接種されていない製品とパッケージに対して、10^{-6}の滅菌保証レベル（SAL）が得られる。このSALを得る際に、コンタクトレンズ等の滅菌された製品の全体的性能は、（これが包装されているか否かに関係なく）本質的には影響を受けない。

【0028】

開示された滅菌処理システムを作動させる際には、多くの処理変数及び/又は製品特性が滅菌処理有効性及び/又は関連する製品の生存率基準（即ち、滅菌後の製品性能及び/又は有効性）に影響する。例えば、コンタクトレンズに対する好適/最適処理パラメータの開発を考える際に考慮すべき処理変数と製品の性質は、次の通りである。

・　光源に供給される力（力は製品に付与される紫外線放射量に直接関係する。）
・　処理時間（処理時間は製品に付与される紫外線放射量に直接関係する。）
・　処理対象のコンタクトレンズの基本曲線（基本曲線の半径は所望の/最適な紫外線放射量に影響を与える。）
・　処理対象のコンタクトレンズの直径（直径は所望/最適な紫外線放射量に影響を与える。）
・　コンタクトレンズの酸素透過率（酸素透過率は所望/最適な紫外線放射量に影響を与える。）
・　コンタクトレンズの平衡含水量（平衡含水量は所望/最適な紫外線放射量に影響を与える。）
・　コンタクトレンズの弾性率（弾性率は所望/最適な紫外線放射量に影響を与える。）
・　コンタクトレンズの破断伸度（破断伸度は所望/最適な紫外線放射量に影響を与える。）
・　コンタクトレンズの引張強度（引張強度は所望/最適紫外線放射量に影響を与える。）
・　コンタクトレンズの靭性（靭性は所望/最適紫外線放射量に影響を与える。）

【0029】

本発明はその実施形態を参照して説明されたが、これに限定されるものではないことを理解するべきである。ここに開示されたシステムと方法は、当業者であれば参考として全体がここに組み込まれる先願を含むこの開示に基づいて自明な修正、改善及び/又は変更を包含している。

【図面の簡単な説明】

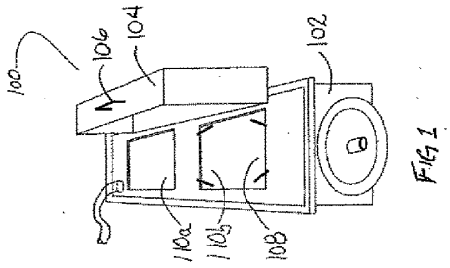
【0030】

【図1】単色光で連続する波形を有する高強度の非干渉性光を、高分子をベースにした製品等に単一光源を使用して供給するための滅菌システム/アセンブリの（上面）斜視図。

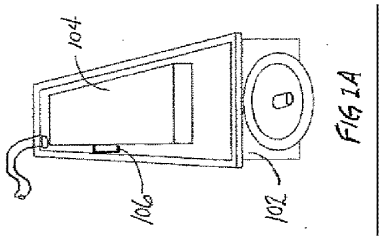
【図1A】カバー構造が閉鎖位置にある図１の滅菌システム/アセンブリの（側面）斜視図
。

【図2】単色光で連続する波形を有する高強度の非干渉性光を、高分子をベースにした製品等に複数の光源を使用して供給するための滅菌システム/アセンブリの（側面）斜視図
。

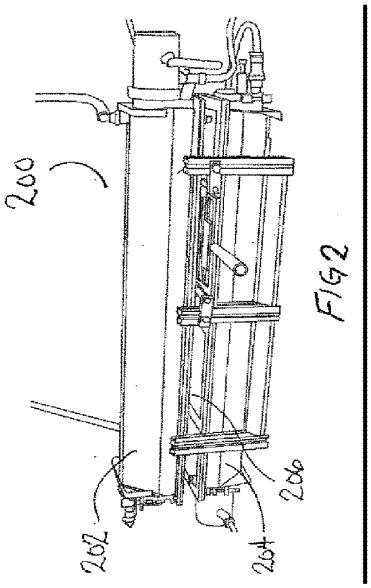
【図1】



【図1A】



【図2】



60700260083

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/04246

A. CLASSIFICATION OF SUBJECT MATTER
IPC: G01N 23/00(2007.01)

USPC: 250/455.11
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)
U.S. : 250/455.11

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,586,749 B2 (CIMINO et al.) 01 July 2003 (01.07.2003), see entire document.	1-2
A	US 5,468,803 A (TAKAHASHI et al.) 21 November 1995 (21.11.1995), see entire document.	1-2
A	US-2003/0062483 A1 (CIMINO et al) 03 April 2003 (03.04.2003), see entire document.	1-2

☐ 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 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
17 November 2006 (17.11.2006)

Date of mailing of the international search report
06 DEC 2006

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) 273-3201

Authorized officer
Jose Dees
Telephone No. 571-272-1569

Form PCT/ISA/210 (second sheet) (April 2005)

07. 5. 2007

(81)指定国　　AP(BW,GH,GM,KE,LS,MW,MZ,NA,SD,SL,SZ,TZ,UG,ZM,ZW),EA(AM,AZ,BY,KG,KZ,MD,RU,TJ,TM),EP(AT,BE,BG,CH,CY,CZ,DE,DK,EE,ES,FI,FR,GB,GR,HU,IE,IS,IT,LT,LU,MC,NL,PL,PT,RO,SE,SI,SK,TR),OA(BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,ML,MR,NE,SN,TD,TG),AE,AG,AL,AM,AT,AU,AZ,BA,BB,BG,BR,BW,BY,BZ,CA,CH,CN,CO,CR,CU,CZ,DE,DK,DM,DZ,EC,EE,EG,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KP,KR,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,MZ,NA,NI,NO,NZ,OM,PG,PH,PL,PT,RO,RU,SC,SD,SE,SG,SK,SL,SY,TJ,TM,TN,TR,TT,TZ,UA,UG,US,UZ,VC,VN,YU,ZA,ZM,ZW

(72)発明者　レスラー，バリー
アメリカ合衆国，コネチカット　０６８１０，ダンバリー，レイク　プレイス　サウス　１３７

Ｆターム(参考) 4C058 AA06 AA09 AA12 BB06 KK02 KK12 KK21
4C082 PA03 PC10 PG16 PJ01

Patents

Product sterilization system and method using a UV light source

Abstract

translated from Japanese

Single and / or using a high intensity incoherent light monochromatic continuous waveform of a plurality of light sources, the polymer-based products, etc. which is located inside or outside of the package, a system and method for sterilizing. The processing system and method can be used for different products, sterilization of the system such as the enteric and / or non-enteric solution containing foods such beasts, poultry meat.

Classifications

A61L2/10 Ultra-violet radiation

View 5 more classifications

JP2007522843A

JP Application

Application number: JP2006553231A

Other languages: Japanese

Inventor: レスラー, バリー

Original Assignee: レスラー, バリー

Priority date: 2004-02-11

Filing date: 2005-02-11

Publication date: 2007-08-16

Info: Patent citations (3), Cited by (3), Also published as (9), Legal events, Similar documents

External links: Espacenet, Global Dossier, Discuss

Claims (2)

translated from Japanese

1. A non-laser light source for product sterilization, a) comprising a housing defined by at least one outer wall, b) a photon generation gas of a predetermined amount that is placed within the housing, at least a portion of the outer wall , the light source is substantially transparent to the photons generated by said predetermined amount of gas.

2. Packaged, or a method of imparting to a substrate comprising a packaged ophthalmic devices do not, and other products, for example, 193,222,248,282,308 or monochromatic light having a wavelength of 344nm in a given sterile amount.

Description

translated from Japanese

The present disclosure relates to a system for using the product sterilization system and method, and / or ultraviolet light source,. More particularly, the present disclosure includes a base using incoherent light of high

intensity having a waveform continuous with monochromatic light, the inner or placed on the outside polymer packing in a single and / or multiple light sources system and method for sterilizing products that related to. The disclosed processing system and method, while retaining the desired sterilization level, it is desirable to store the physical properties and performance of the product / system. The disclosed processing system and method, another product, may be used to sterilize the system such as the enteric and / or non-enteric solution containing foods such beasts, poultry meat.

In general, a disinfection or sterilization (sterilization), has been defined as the complete destruction of all organic material, including a large number of resistant high bacterial endospores. Many of the sterilization technology, has been developed with the aim of the needs of the particular sterilization. Typical sterilization techniques include heat and humidity from the autoclave (high-pressure steam sterilization equipment), ethylene oxide gas sterilization techniques, the use of dry heat technology and novel chemical sterilant.

Steam sterilization is widely used, it is believed to be generally high cost efficient technologies. Steam sterilization techniques using autoclave, efficient for destroying all relevant organisms, are recognized as simple, and relatively low cost approach. However, the specific component (for example, medical devices / equipment parts and accessories) are not withstand the high heat and pressure. For example, steam and pressure, rubber, Lexan (registered trademark) plastic parts are known to damage the other synthetic materials, the use of steam for anesthesia instruments according to the processing method by the manufacturer in particular, it is not preferable as long as it is not recommended.

Ethylene oxide, anesthesia equipment, ventilation equipment, is acceptable for many materials used to manufacture the medical device or the like including a reusable component of the monitor. However, it is generally inappropriate to place the whole of these systems to ethylene oxide chamber. Furthermore, parts of the polystyrene component can not be exposed to ethylene oxide gas. Sterilization by ethylene oxide, because it uses fumigant gas strong toxicity, there is a need for appropriate venting means for removing all traces of residual gas. Worker touching the ethylene oxide, there is a need to follow all of the prescription that is determined by OSHA and EPA. Another chemical treatment techniques use hydrogen peroxide and peroxyacetic acid together with buffers and low heat.

Recently, the "broad spectrum incoherent polychromatic light high-intensity short time sterilization of pulse package and its contents using of" the title in the granted US patent to Clark other referred to 5,786,596, the sterilization technique There has been disclosed. As described in the title, Clark of '598 patent, using a high intensity short pulse of incoherent polychromatic light in a broad spectrum, and sterilize the product container, deactivate microorganisms therein it is intended to. Clark's' 598 patent proposes a "non-enteric and / or intestinal liquid for the package, the contact lens solution and the package, and / or deactivation of microorganisms in the ophthalmic solution and the package" (1 column, see 11 to 20 lines). As disclosed in Clark's' 598 patent, the use of short pulses of incoherent polychromatic light in a broad spectrum, for at least some aspects of the proposed applications inefficiently and / or it is believed to be unacceptable.

Despite efforts to date, be positioned inside or outside of the package, a system and / or methods used to sterilize the product to a polymer-based, by this processing, the target without adversely affecting the physical properties and / or efficacy of the product that the polymer-based, there is a need for it can achieve the desired sterilization level. Similarly, be positioned inside or outside of the package, is used different product (e.g., foods such as meat and poultry, and the system such as enteric and / or non-enteric solution) to sterilize a system and / or method, without adversely affecting the physical properties and / or efficacy of the subject products, there is a need for it can achieve the desired sterilization level.

The foregoing and other objects are achieved by the present invention, wherein the sterilization is obtained using a single and / or incoherent light of high intensity having a waveform continuous with monochromatic light at a plurality of light sources. Processing system and method of the present invention, without adversely

affecting the physical properties and / or efficacy of the subject product can be obtained advantageously a desired sterilization level. These and other features / functionalities will be apparent to those skilled in the art from the detailed description set forth below.

(Summary of the Invention)
Products containing heat-sensitive material, it be positioned either within or outside of the package and / or packaging containers, it is advantageous means for sterilizing disclosed herein. The disclosed sterilization system and method, without giving physical or performance to damage to the product or package is processed, it is effective to inactivate viruses and bacteria microbes. Light source of a single or multi-column, at least $^{200\sim600mw}$ / cm 2 of the bright level monochromatic bactericidal ambient temperature light, to fire in order to inactivate a large number of microorganisms. According to an embodiment of the present invention, the product in each of the different wavelengths of 193,222,248,282,308,354nm (± 5nm), are sterile at least until ^{10} -5 cfu / ml of sterility assurance level (SALS) that.

The disclosed sterilization treatment method batchwise carried out in semi-batch or continuous mode. In one embodiment of the present invention, the target product and / or containers of the products, on the one or more light sources, a mobile element that moves between below or (for example, a belt) successively processed is positioned on the It is. Speed product / container passes through the light source is adjusted so that the desired energy treatment level is obtained. In an embodiment of the batch / semi-batch, the processing time is changed such that the desired treatment level is obtained. As described below, auxiliary processing parameters affect the sterilization to achieve the desired sterilization result (either alone or in combination with the speed / residence time) adjusted / selected by.

Thus, the intensity of the monochromatic light source which is adopted in the sterilization system and / or method of the present invention is adjusted such that the desired sterilization results. For example, in the processing system in which a plurality of light sources are employed, the individual light sources operating at different intensities to obtain the desired sterilization results. Intensity of the light source is generally chosen based on the processing algorithms for biological / microbial single microorganism or a set (panel). In a typical treatment, biological panel Bacillus Pumira skins (spore-forming bacteria), Candida Albi Kang bacteria (East), lipid and non-lipid viruses, cross Chidji Umm sports Rogge Ness bacteria (anaerobic spore-forming bacteria), Sutafi Rocco dregs aureus bacteria (vegetable gram-positive bacteria), pseudoisocytosine Monas AER Guinot support bacteria (vegetable gram-negative bacteria), Aspergillus niger fungus (filamentous fungi), Mycobacterium Terra et fungus, porcine parvovirus (PPV and B19) , Listeria monocytogenes, and contains Salmonella, but not limited to. Sterilization method disclosed herein is effective to treat the various shape of the product / package. Thus, for example, also be flat products and / or product packaging, even if bulging, also recessed, or may be another shape, for example, may be a combination of the aforementioned shapes. The light source may be modified to achieve the desired result. For example, may be adopted partially coated optical surfaces, the coated surfaces are adjusted to tune to a desired monochromatic wavelength. The use of a partially coated surface is advantageous for generating light that satisfies spectral intensity above a ^{500mw} / cm 2.

Additional features and functions associated with the disclosed sterilization system and method will become apparent from the detailed described below with reference to the accompanying drawings described below.

To aid in understanding of those skilled in the art, with reference to the accompanying drawings illustrating the sterilization system and method according to the present invention.

According to the present invention, a system and method for sterilizing a product comprising a heat-sensitive material located either within or outside of the package and / or packaging container is provided. The system / method, without giving physical or performance damage to the product or its packaging be processed, there is

an effect of inactivating viruses and bacteria microbes. Light source of a single or multiple columns, and fired at least ^{200mw} / cm 2 ~600mw / cm monochromatic of ^{two} of the bright level bactericidal ambient temperature light, to inactivate a large number of microorganisms. According to an embodiment of the present invention, product (eg packaged contact lenses) are obviously different wavelengths of 193,222,248,282,308,354nm (± 5nm), at least ^{10} -5 cfu / ml (colony forming units / millimeter) of the sterility assurance level up to (SALs) is sterilized. Currently preferred wavelength used for sterilization of polymeric contact lens products (or may not be packaged) is 282 and 308 nm.

Sterilization method according to the present invention, batch, carried out in semi-batch or continuous mode. In sterilization of contact lenses, particularly attractive in place of the disclosed to inactivate viruses and bacteria microbe to impart ultraviolet monochromatic light using a light source, recent in which sterilization methods such as steam sterilization it is. This is because, this in-line ultraviolet treatment is that sterilization is performed in the following one second is easy because it can be built-in (ie, continuous or substantially continuous) process. Furthermore, ultraviolet rays of the disclosed monochromatic light, without adversely affecting the physical properties and / or performance of the heat-sensitive material, which is effective for sterilization of heat sensitive materials. (For example, since steam sterilization it is damaged or destroyed the features / functions) is an additional performance / features for products in which the polymer that is not suitable for conventional steam sterilization in the base (for example, contact lenses), the disclosed monochromatic ultraviolet sterilization It is potentially suitable for use technology.

In the disclosed embodiment, products that are accommodated in the target product and / or container, on the one or more light sources, is continuously processed is positioned on a moving element that moves between under or. For example, referring to FIG. 2, the upper and lower light source to form an intermediate region, where the product (eg packaged contact lenses) are transported for sterilization treatment. A variety of design and construction of the conveyor belt and the structure of the track or the like and the mechanism, along with the to reach the ultraviolet radiation until the product for the purpose of sterilization, is using the product to carry through the intermediate region. Selection and installation of the appropriate conveyor / transport system can to those skilled in the art. Various transport systems may be incorporated into a single light source depicted type of sterilization system in FIG.

Speed product / container in a continuous or embodiment of the semi-continuous passes of the light source is adjusted so that the desired energy treatment level is obtained. Similarly, in the embodiment of a batch / semi-batch, processing time can be modified to obtain the desired energy treatment level. As described below, auxiliary processing parameters affect the sterilization, (alone or velocity / residence time and / or in combination with other processing parameters) regulatory / are selected, the desired energy supply and results to achieve sterilization effect as.

That is, monochromatic light source employed in sterilization systems and / or methods of the present invention is adjusted such that the desired sterilization results. For example, in a processing system in which a plurality of light sources are employed, the individual light sources operating at different intensity and / or at different times to obtain the desired sterilization results. Preferably, the control system work together to the light source, to control it of operating parameters. Typical control system includes a programmed processor to actuate the light source at a desired time and a desired intensity. In the case of a continuous treatment method, the control system may, for example, based on the speed of the conveyor / transport system, it is desirable to control the velocity through the product processing area. As can adjust / modify treatment parameters as required by the operator, often manual override (over-ride) are provided.

Processing parameters such as source intensity is selected based on the processing algorithms for biological / microbial generally a microorganism or a set (panel). In a typical procedure, the organism of the panel Bacillus Pumira skins (spore-forming bacteria), Candida Albi Kang bacteria (East), lipid and non-lipid viruses, cross

Chidji Umm sports Rogge Ness bacteria (anaerobic spore-forming bacteria), Staphylococcus Coca Sua Ureusu bacteria (vegetable gram-positive bacteria), pseudoisocytosine Monas AER Guinot support bacteria (vegetable gram-negative bacteria), Aspergillus niger fungus (filamentous fungi), Mycobacterium Terra et fungus, porcine parvovirus (PPV and B19), Listeria monocytogenes, and including Salmonella, but not limited to. As obvious to those skilled in the art, the additional and / or another organism, in whole or in part, to develop an appropriate treatment method, can be used to run. Sterilization method utilizing monochromatic germicidal ambient temperature light, as disclosed herein, are effective in treating a variety of shape of the product / package. Thus, for example, also be flat products and / or product packaging, even if bulging, also recessed, or may be another shape, for example, may be a combination of the aforementioned shapes. The light source may be modified to achieve the desired result. For example, may employ a partially coated optical surfaces, the coated surfaces are desirably adjusted so as to tune to a desired monochromatic wavelength. The use of a partially coated surface is effective in generating light that satisfies spectral intensity requirements in excess of ^{500mw} / cm 2.

A light source system according to embodiments, the light emits over a large active area is preferably configured to operate at ambient temperatures. The output of the substantially monochromatic light from the light source, can be adjusted so as to generate a high spectral brilliance in the peak of the process activity spectrum (Watts / nm), bactericidal effect as a biological function of the subject being required (or other to maximize the desired process / application). (Concentric plurality of light sources to illuminate the inside or the outside, and one side or including a flat light source to fire from both sides) available shape the scope of, and ability to regulate bright and everything separately, the design of the system giving greater flexibility to, to enable a more efficient light supply system.

Referring to FIG. 1 and 1A, the illustrated processing system 100 comprises a base structure 102 and the cover structure 104. Cover structure 104 is pivoted to the base structure 102, to facilitate the repositioning (i.e. open) comprises a handle 106. Figure 1 shows a cover structure 104 in the "open" position, FIG. 1A shows a cover structure in the "closed" position. Typical cover structure 104, a light beam generated by the light source is filtered / shielding, it is made of a material to protect the other close to the workers of the processing system 100. That is, the size and shape of the cover structure 104 is positioned at a suitable treatment position the product with respect to the light source, and the emitted light is selected so that as filtered / shielded.

Processing system 100 comprises a light source 108 positioned within base structure 102, which generates a monochromatic germicidal ambient temperature light, processing window 110a, it is designed to emit light through 110b. Light source 108, by varying the rare gas and / or halogen gas are used, VUV, UV-A, 90% of its output within adjustable 10nm to distinguish over UV-B and UV-C it is an excimer light source that generates. Efficiency changes to more than 30 percent from 10 in the case by the mixing and the form of gas, implementation has been the input power is less than 10 kilowatts more than 1 watt. The overall construction and operation of exemplary light sources for use in the disclosed system, commonly assigned patent application 09 / 805,610 (March 13, 2001 filed, published as US Application 200-0177118A1) and patents disclosed in application Ser. No. 10 / 661,262 (September 12, 2003 filed) (prior application), described, illustrated, entire contents of which are incorporated herein by reference. For example, these prior application has been disclosed and described cooling for introduction and flow of pattern / sequence for the discharge of fluid (see, for example, the tube / hose of Figure 1,1A) configuration of the processing window and the like. Each are shown in FIGS. 1 and / or FIG. 1A.

According to the disclosed embodiment, to maintain the light source in a desired temperature and / or the desired temperature range, a suitable fluid is used. Preferred medium for dissipating / absorbing heat generated through the action of the light source is water. However, to one skilled in the art, it will be obvious to employ a different cooling fluid. When choosing a suitable cooling fluid, a substantially transparent to germicidal radiation in use, it is preferable to select a fluid that transmits it. Presence / formation of bubbles

bactericidal radiation is scattered, so adversely affect the sterilization efficiency and / or effectiveness of the disclosed system, it is desirable to select a hard fluid occur generation of bubbles and / or propagation it should be noted. If you are using the appropriate additives and the like using the cooling fluid, it is preferable to note in advance so little to and / or prevent the formation / propagation of foam.

In use, sterilized products, eg contact lenses, medical products and / or components, food or the like is (or may not be packaged) windows 110a, placed on the 110 b, the cover structure 106 is "closed "has been processing region is shielded, light source 108 is to carry the product of a single color sterilization ambient temperature light working. As described in the prior application, the light source is preferably is maintained at a substantially controlled temperature through heat transfer / heat exchange means. As noted above, earlier application is entirely incorporated by reference.

Referring to Figure 2, processing system 200 of another embodiment is shown. The system 200 is comprises a first (upper) light source housing 202 and the second (lower) light source housing 204. A light source (not shown) is positioned within the housing 202, 204, as described in the prior application, which is preferably maintained at a substantially constant temperature using a heat transfer / heat exchange means. Processing area 206 is defined between the housing 202 and 204. Processing window (not shown) is adapted to reach the first and is defined in the second housing 202, a monochromatic products germicidal light processing region from the light sources.

Conveyor / transport system (not shown), the product to the processing area 206, i.e., is preferably provided to transfer between the housing 202 and 204. According to embodiments of the disclosure, the conveyor has a fixed orientation of the product relative to the light source is allowed to proceed to the processing region 206. In another example, it is desirable comprising an effective structure and / or mechanism for performing the re-positioning of the product with respect to the light source when the product passes through the processing region. For example, thick and in the case of / or irregularly shaped products, by rotating the product in one or more points in the processing area is desirable. Valid structures and / or mechanisms to alter the product orientation within the processing region, conveyors, upper and / or lower housing, or associated with these combinations. Texture re-position of the product, for example, may be provided to shift the wall, etc., etc. to be controlled using a control robot or the like, are substantially carried out at random. In any case, incorporating the repositioning mechanism, it is desirable to perform sterilization treatment which is effective and reliable for products of various sizes and shapes.

The distance between the upper housing 202 and lower housing 204 is generally selected the desired product with minimal clearance so as to pass between the two. According to embodiments of the disclosure, the spacing between the housing 202 and 204, for example, is adjusted by at least one housing 202, 204 re-positioned relative to the other housing. Thus, for example, upper housing 204 may be supported by frame structure repositioning vertical (by the upper housing 204 to re-positioned by manual or power) can be / facilitated relative to the lower housing 202. As noted above, light source within upper housing 204 may be designed / configured to emit monochromatic light having different characteristics with respect to the light source within lower housing 202. Thus, two light source mechanism of FIG. 2, to further increase the flexibility / versatility of sterilizing means of this disclosure.

According to this disclosure, (but it is not limited to being) Bacillus Pumira skins (spore-forming bacteria), Candida Albi Kang bacteria (East), lipid and non-lipid viruses, cross Chidji Umm sports Rogge Ness bacteria (anaerobic spore-forming bacteria), Staphylococcus Coca Sua Ureusu bacteria (vegetable gram-positive bacteria), pseudoisocytosine Monas AER Guinot support bacteria (vegetable gram-negative bacteria), Aspergillus niger fungus (filamentous fungi), Mycobacterium Terra et fungus, porcine parvovirus (PPV and B19), Listeria monocytogenes, and to products and packages that have not been inoculated, including the panel, including salmonella, 10^{-6} sterility assurance level (SAL) is obtained. In obtaining this SALs, the overall

performance of sterile products such as contact lenses, (which is irrespective of whether or not packaged) is essentially unaffected.

When operating the disclosed sterilization treatment systems, numerous processing variables and / or product characteristics sterilization efficacy and / or related products survival criteria (i.e., product performance and / or efficacy after sterilization affect). For example, the nature of the process variables and the product should be taken into account when considering the development of suitable / optimal processing parameters for the contact lens is as follows.
· Force to be supplied to the light source (force is directly related to the ultraviolet radiation amount to be applied to the product.)
And processing time (processing time is directly related to the ultraviolet radiation amount to be applied to the product.)
Basic curve of and processing the subject of contact lenses (the radius of the base curve affect the desired / optimum ultraviolet radiation amount.)
And processing the subject of the contact lens diameter (diameter affect the desired / optimum ultraviolet radiation amount.)
Contact lens oxygen transmission rate of (oxygen transmission rate has an impact on the desired / optimum ultraviolet radiation amount.)
- Equilibrium moisture content of the contact lens (equilibrium water content will affect the desired / optimum ultraviolet radiation amount.)
- Modulus of elasticity of the contact lens (modulus of elasticity affects the desired / optimum ultraviolet radiation amount.)
- Elongation at break of the contact lens (elongation at break will affect the desired / optimum ultraviolet radiation amount.)
Tensile strength of the contact lens (tensile strength has an impact on the desired / optimum ultraviolet radiation amount.)
And toughness of the contact lens (toughness affect the desired / optimum ultraviolet radiation amount.)

The present invention has been described with reference to embodiments thereof, it should be understood that the invention is not limited thereto. The disclosed systems and methods herein, obvious modifications based on this disclosure, including the prior application as a whole by reference those skilled in the art are incorporated herein encompasses the improvement and / or change.

The incoherent light of high intensity having a waveform continuous with monochromatic light, (top) perspective view of a sterilization system / assembly for supplying with a single light source to a product or the like based on the polymer. (Side) perspective view of a sterilization system / assembly of Figure 1 with the cover structure is in the closed position. The incoherent light of high intensity having a waveform continuous with monochromatic light, (side) perspective view of a sterilization system / assembly for supplied using a plurality of light sources in the product or the like based on the polymer.

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* Cited by examiner, † Cited by third party

Cited By (3)

Search Within Citing Patents

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JP2013532004A *	2010-05-19	2013-08-15	ジョンソン・アンド・ジョンソン・ビジョン・ケア・インコーポレイテッド Ｊｏｈｎｓｏｎ＆Ｊｏｈｎｓｏｎ Ｖｉｓｉｏｎ Ｃａｒｅ，Ｉｎｃ．	Ophthalmic lens disinfection base portion
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* Cited by examiner, † Cited by third party

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Moore et al.	2000	Bactericidal properties of ozone and its potential application as a terminal disinfectant

Legal Events

Date	Code	Title	Description
2008-02-13	A621	Written request for application examination	**Free format text**: JAPANESE INTERMEDIATE CODE: A621 **Effective date**: 20080212
2009-09-02	A977	Report on retrieval	**Effective date**: 20090902 **Free format text**: JAPANESE INTERMEDIATE CODE: A971007
2009-09-16	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20090915
2009-12-15	A601	Written request for extension of time	**Effective date**: 20091214 **Free format text**: JAPANESE INTERMEDIATE CODE: A601
2009-12-22	A602	Written permission of extension of time	**Effective date**: 20091221 **Free format text**: JAPANESE INTERMEDIATE CODE: A602
2010-03-16	A521	Written amendment	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20100315
2010-05-12	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20100511
2010-08-11	A601	Written request for extension of time	**Free format text**: JAPANESE INTERMEDIATE CODE: A601 **Effective date**: 20100810

2010-08-18	A602	Written permission of extension of time	**Effective date**: 20100817 **Free format text**: JAPANESE INTERMEDIATE CODE: A602
2011-02-02	A02	Decision of refusal	**Effective date**: 20110201 **Free format text**: JAPANESE INTERMEDIATE CODE: A02

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(19) KOREAN INDUSTRIAL PROPERTY OFFICE

KOREAN PATENT ABSTRACTS

(11) Publication number: **1020040097758 A**
(44) Date of publication of specification: **18.11.04**

(21) Application number: **1020030030187**
(22) Date of filing: **13.05.03**

(71) Applicant: **MODINE KOREA, LLC**
(72) Inventor: **JANG, MYEONG JUN**
OH, SEUNG TAEK

(51) Int. Cl **B60H 3/06**

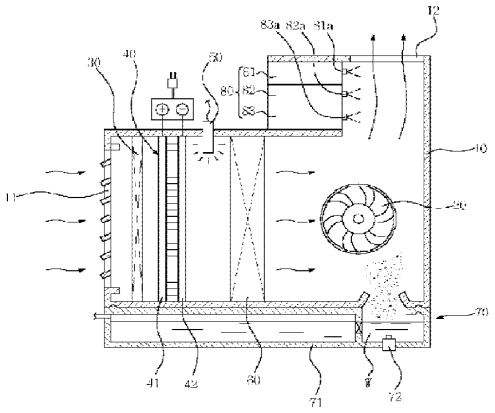
(54) AIR CLEANER WITH A FRAGRANCE EMISSION PART JETTING A FRAGRANT AGENT TOWARD AN EXHAUST PORT FOR VEHICLE

(57) Abstract:

PURPOSE: An air cleaner for a vehicle is provided to supply clean air to the room of the vehicle and to properly maintain the humidity of the room, by effectively getting rid of such pollutants as dust and microorganism of the room.

CONSTITUTION: An air cleaner for a vehicle cleans air sucked from a suction port(11) and exhausts the air through an exhaust port(12) by the operation of a fan(20). The air cleaner comprises a first filter(30) collecting dust in the air sucked from the suction port; an electrostatic dust collector(40) removing fine dust in the air filtered by the first filter; an ultraviolet lamp(50) sterilizing microorganism in the air passing through the electrostatic dust collector; a second filter(60) activated by ultraviolet energy of the ultraviolet lamp; a humidifying device(70) having a water tank(71) in which humidifying water is stored, and an ultrasonic vibration part(72) spraying the humidifying water toward the exhaust port by ultrasonic waves; and a fragrance emission part(80) jetting a fragrant agent toward the exhaust port. The second filter is coated with a photocatalyst sterilizing and deodorizing the air passing through the electrostatic dust collector.

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CLAIMS KR20040097758

1.

1. A vehicle air cleaner for purifying air sucked from a suction port by operation of a fan and discharging the air through a discharge port, comprising: a first filter for collecting dust in the air sucked from the suction port; An electrostatic precipitator for removing fine dust in the air filtered by the first filter; An ultraviolet lamp that sterilizes microorganisms in the air that has passed through the electrostatic dust collector; A second filter coated with a photocatalyst that is activated by ultraviolet energy of the ultraviolet lamp and sterilizes and deodorizes air that has passed through the electrostatic dust collector; A humidifier having a water tank storing humidifying water and an ultrasonic vibrating unit for spraying the humidifying water toward the discharge port by ultrasonic waves; And a fragrance dispenser for spraying a fragrance toward the discharge port.

2.

The air cleaner for a vehicle according to claim 1, wherein the first filter is coated with a phosphoric acid catalyst.

3.

The air cleaner for a vehicle according to claim 1, wherein a wavelength of an ultraviolet ray emitted from the ultraviolet lamp is 200 to 390 nm.

4.

The air cleaner for a vehicle according to claim 1, wherein the photocatalyst of the second filter is titanium dioxide anatase.

5.

The air cleaner for a vehicle according to claim 1, wherein the ultrasonic vibration part of the humidifier is a piezoelectric element.

6.

The air cleaner for a vehicle according to claim 1, wherein the fragrance dispensing portion includes a plurality of fragrance storage portions including a refreshing fragrance, a drowziness inhibitor, and an antibacterial deodorant.

7.

7. The air cleaner for a vehicle according to claim 6, wherein the drowsiness preventing agent is a natural aromatic agent including a herbal medicine and a herb flavor.

8.

7. The air cleaner for a vehicle according to claim 6, wherein the antibacterial deodorant

includes a Manuka liquid and a canoe liquid.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
1 September 2005 (01.09.2005)

PCT

(10) International Publication Number
WO 2005/081338 A1

(51) International Patent Classification[7]: H01M 4/50, C01G 45/02, H01M 10/40

(21) International Application Number: PCT/EP2005/000600

(22) International Filing Date: 21 January 2005 (21.01.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2004 008 397.5
20 February 2004 (20.02.2004) DE

(71) Applicant *(for all designated States except US)*: **FERRO GMBH** [DE/DE]; Gutleutstrasse 215, 60327 Frankfurt (DE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **BORMET, Steffen** [DE/DE]; In den Niederwiesen 22, 64291 Darmstadt (DE). **REIM, Jörg** [DE/DE]; Altmühlweg 3a, 63456 Hanau (DE). **RENTSCH, Harald** [DE/DE]; Spessartstr. 9, 63457 Hanau (DE). **SCHELLING, Volker** [DE/DE]; Ringstrasse 80, 63589 Linsengericht (DE).

(74) Agent: **REINHARDT, Markus**; Reinhardt & Söllner, Postfach 12 26, 85542 Kirchheim b. München (DE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2005/081338 A1

(54) Title: POSITIVE ACTIVE ELECTRODE MATERIAL WITH IMPROVED CYCLING STABILITY

(57) Abstract: The invention relates to a positive active electrode material for use in rechargeable lithium ion batteries, to a lithium secondary cell having the electrode material according to the invention, and to a method for the production of the latter.

Positive active electrode material with improved cycling stability

The invention relates to a positive active electrode material for use in rechargeable lithium ion batteries, to a lithium secondary cell having the electrode material according to the invention, and to a method for the production of the latter.

There is increasingly a need for rechargeable lithium batteries as a source of electricity for portable electronic devices, for example laptops or mobile telephones. Lithium batteries have very large volume- and weight-specific energy densities (respectively about 300 Wh/l and 120 Wh/kg at present), have high cell voltages (about 4 V) and relatively low self-discharge rates.

Batteries with metallic lithium are generally less suitable since the cycle life is generally insufficient, and there are furthermore safety questions regarding the use of metallic lithium.

For this reason, the focus of attention is currently on lithium ion batteries. The positive electrode of a lithium battery may consist of $LiCoO_2$, $LiNiO_2$ or $LiMn_2O_4$, the negative electrode of graphite or coke and the separator of a porous plastic. The lithium ions are reversibly absorbed and released at these electrodes. The ions migrate from the positive electrode to the negative electrode during the charging process, and then in the opposite direction during discharge.

In the future, batteries will be employed to a greater extent with respect to their use in electrical vehicles and as energy stores. For this, the cathode material plays an important part in determining the performance and safety of lithium ion batteries.

$LiCoO_2$ is almost exclusively used at present as the active positive electrode material in lithium ion batteries. Yet there is a need for alternative materials which can be produced from starting materials that are less expensive as well as less toxic, while having the same or even a better performance, particularly for large batteries.

$LiCoO_2$ is the cathode material of choice for rechargeable lithium ion batteries. It has a layer structure with the space group R-3m, presents a good initial capacity and a good cycle stability. But $LiCoO_2$ is relatively expensive, and there are furthermore safety questions regarding the use of $LiCoO_2$ in large batteries.

Many alternatives may be considered instead of $LiCoO_2$.

On the one hand, $LiNiO_2$ may be used as an alternative material. It has a layer structure with the space group R-3m like $LiCoO_2$, is relatively inexpensive and has a higher capacity. The production of $LiNiO_2$ on an industrial scale entails difficulties, however, and there are furthermore safety questions.

Another possibility is to use $LiMn_2O_4$ as a cathode material. $LiMn_2O_4$ has the spinel form, is cheaper than $LiCoO_2$ and also safer. The disadvantage of using $LiMn_2O_4$ is the low capacity, however, and there are also stability problems at elevated temperatures.

A further possibility is to use $Li(Ni,Mn,Co)O_2$ materials. These materials each have layer structures and crystallise in the space group R-3m. The use of Ni and Mn leads to a cost reduction and increases safety, which is attributable to the involvement of Mn. Such materials have a high

initial capacity, but the disadvantage is the insufficient cycle stability.

The latter cathode materials are extremely promising and are currently at the focus of interest in research and development worldwide. In our experience, these materials present high initial capacities but only a low cycle stability, especially materials which have a low Co content.

It is known that the electrochemical performance of positive electrode materials can be improved by doping. The choice and applicability of the dopants depends to a large extent on the type of positive electrode material. Doping with B, Al and Mg is known.

For instance WO 01/41238 describes an electrode material for positive electrodes of rechargeable batteries, which is based on a lithium-transition metal mixed oxide with at least two transition metals (for example nickel and/or manganese), has a layer structure and is doped, for example, with aluminium and/or boron. This electrode material is distinguished by a high cycle stability but is nevertheless inexpensive to produce. It has proved particularly advantageous for the electrode material to have the composition $LiMn_{0.5}Ni_{0.4}Al_{0.1}O_2$. This electrode material is stable with respect to the specific charge (Ah/kg) over 200 cycles as a positive electrode.

The article by R. Alcantara, P. Lavela, J.L. Tirado, R. Stoyanova, E. Zhecheva, J. Solid State Chem., vol. 134, 1997, pp 265-273 describes that a significant improvement, while maintaining the capacity, has been observed when $LiCoO_2$ is doped with boron.

The article by Jaephil Cho, Chem. Mater., vol. 12, 2000, pp 3089-3094, describes that a reduced capacity loss is observed for $LiNiO_2$ when it is doped with magnesium.

The article by C. Delmas, L. Croguennec, MRS Bulletin, August 2002, pp 608-612 describes that Mg-doped $Li(Ni,Co)O_2$ compounds have an improved cycle performance compared with undoped materials.

EP 1 130 665 A1 describes an active material for a positive electrode for a secondary battery with a non-aqueous electrolyte, the active material comprising a manganese composite oxide containing lithium with a layered crystal structure, which is represented by the general formula $Li_{1-x}Mn_{1-y}M_yO_{2-\delta}$. With this electrode material, an improved cycle stability can be observed when M is selected from Co, Ni, Fe, Al, Ga, In, V, Nb, Ta, Ti, Zr, Ce or Cr.

EP 944 125 A1 describes an improved cycle stability for $Li_aCo_bM_cNi_{1-b-c}O_2$ ($0.02 \leq b+c \leq 0.5$) compared with the unsubstituted compound, when M is selected from B, Mg, Al, Si, Ca, Sc, Ti, V, Cr, Mn, Fe, Cu, Zn, Ga, Ge, Y, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In and Sn.

It is an object of the present invention to provide doped electrode materials which increase the cycle stability considerably compared with undoped materials. This object is achieved by the characterising part of Claim 1.

A positive active electrode material for use in rechargeable lithium ion batteries is provided, which is characterised in that the positive active electrode material has the general formula

$Li_aNi_{1-x-y-z}Mn_xCo_yM_zO_2$,

where M = Nb and/or Ta, and

$1.00 \leq a \leq 1.15$

$0.5 < x+y+z < 1.0$

$0.1 < x < 0.5$

$0.01 < y < 0.3$

$0 < z < 0.10$.

Surprisingly, it has been found that the cycle stability can be improved considerably compared with undoped materials by doping compounds of the formula $Li_aNi_{1-x-y}Mn_xCo_yO_2$ ($1.00 \leq a \leq 1.15$, $0.5 < x+y < 1.0$, $0.1 < x < 0.5$) with small amounts of about 1 mol% Nb and/or Ta. It has furthermore been found that when doping with Nb and/or Ta, the cycle stability is even better than when doping with B, Al or Mg.

It has been found to be preferable that $0 < z < 0.05$ and even more preferable that $0 < z < 0.03$.

It is also an object of the invention to provide a method by which the materials according to the invention can be produced.

This object is achieved by mixing together a mixture of a lithium compound, a nickel compound, manganese oxide, cobalt oxide and niobium and/or tantalum oxide in a suitable ratio, subjecting this mixture to a heat treatment and subsequently comminuting it and grinding it to a powder.

Lithium carbonate or lithium hydroxide may be used as the lithium compound here.

Nickel carbonate or nickel hydroxide may be used as the nickel compound here.

The lithium complex oxides according to the invention, the properties of which will be described in more detail in the examples together with the comparison compounds, are produced by solid-state methods. Commercial oxides, hydroxides and carbonates of the corresponding elements are used. Lithium carbonate, nickel carbonate, manganese oxide, cobalt oxide and a compound of the dopant (boric acid, aluminium hydroxide, magnesium hydroxide, niobium(V) oxide or tantalum(V) oxide) are mixed together in a suitable ratio.

The term suitable ratio is intended to mean a ratio which is used in order to produce the materials according to the invention.

After the materials have been mixed together, they are heat treated at a temperature of 800°C - 1200°C.

It is preferable for the heat treatment to be carried out at a temperature of 900°C - 1000°C.

The heat treatment is preferably carried out in an oxidising atmosphere, i.e. in an air atmosphere or in an air atmosphere which has been supplemented with oxygen. The time period for this is between 4 and 20 h. It is preferable for the heat treatment to be carried out for a period of 8 - 12 h.

The mixture is subsequently ground to a powder with a defined particle size. A grinding device, which is known to the person skilled in the art, may be used for this. For example, a ball mill may be used for the grinding.

The powder obtained in this way has a particle size of $d90 < 20\ \mu m$.

The phase identity and the purity of the products was checked by using X-ray diffractometry (XRD).

It is also an object of the invention to provide a lithium secondary cell in which the materials according to the invention are used.

This object is achieved by providing a lithium secondary cell having a positive electrode, which reversibly absorbs and releases lithium ions, a negative electrode which contains lithium or a lithium compound, and a non-aqueous electrolyte, which is characterised in that the positive active electrode material has the general formula

$Li_aNi_{1-x-y-z}Mn_xCo_yM_zO_2$,

where M = Nb and/or Ta, and

$1.00 \leq a \leq 1.15$

$0.5 < x+y+z < 1.0$

$0.1 < x < 0.5$

$0.01 < y < 0.3$

$0 < z < 0.10$.

It is preferable that $0 < z < 0.05$ and even more preferable that $0 < z < 0.03$.

The invention will be described below with reference to the examples, which do not restrict the invention.

Examples

The following lithium complex oxides were produced:

$LiNi_{0.45}Mn_{0.45}Co_{0.10}O_2$ **(1)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.99}B_{0.01}O_2$ **(2a)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.99}Al_{0.01}O_2$ **(3a)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.95}Al_{0.05}O_2$ **(3b)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.99}Mg_{0.01}O_2$ **(4a)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.95}Mg_{0.05}O_2$ **(4b)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.99}Nb_{0.01}O_2$ **(5a)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.95}Nb_{0.05}O_2$ **(5b)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.99}Ta_{0.01}O_2$ **(6a)**

$Li[Ni_{0.45}Mn_{0.45}Co_{0.10}]_{0.95}Ta_{0.05}O_2$ **(6b)**

Compound 1 is the undoped starting compound, and is used as a comparison compound. Compounds **3a**, **3b**, **4a**, **4b**, **5a**, **5b**, **6a** and **6b** contain 1 or 5 mol% of Al, Mg, Nb and Ta. In the case of B, only the 1% doped material could be produced (compound **2a**). When attempting to dope with higher proportions of boron, Li_3BO_3 was observed by means of X-ray diffraction (XRD) as a secondary phase. For the other compounds, X-ray diffraction (XRD) confirmed the phase purity.

For the electrochemical testing method, electrodes were produced by using a standard method comprising the steps of mixing the oxides with a binder system, carbon black and graphite and an organic solvent, spreading the mixture over an aluminium foil and drying. A round electrode was punched out. An electrochemical cell was set up with this electrode, a separator, an electrolyte and a lithium foil which functions as the other electrode.

The cell was subsequently operated between 3.0 and 4.4 V vs. Li/Li^+. 30 cycles were generally carried out by using the following programme: a specific current of 10 mA/g was used for cycles 1-2 or 1-3, and 30 mA/g were applied for the next cycles. A current of 75 mA/g was used between cycles 21-24 or 21-25.

Compounds **1**, **2a**, **3a**, **3b**, **4a**, **4b**, **5a**, **5b**, **6a** were electrochemically tested by using the method as described above. Table 1 shows the discharge capacities measured in the 4th and 30th cycles. The undoped material 1 starts at 146 mAh/g and presents only a moderate cycle stability with a loss of 9 mAh/g by the 30th cycle. The doped compounds **2a**, **3a**, **4a**, **5a** and **6a** have about the same initial values in the 4th cycle. The doping with 1% B shows a good positive effect on the cycle stability, whereas the doping with 1% Al shows virtually no effect and the doping with 1% Mg actually shows a negative effect. On the other hand, the doping with 1% Nb increases the cycle stability considerably: a loss of only 2 mAh/g is observed from the 4th cycle to the 30th cycle. The effect of doping with 1% Ta is not as great as that of Nb, but this compound still performs better than the comparative examples. The doping with 5% Al and Mg impairs the electrochemical performance considerably.

Table 1 shows the discharge capacities after the 4th and 30th cycles

Table 1: Discharge capacities after the 4th and 30th cycles

Compound	Doping	Discharge capacity, 4th cycle [mAh/g]	Discharge capacity, 30th cycle [mAh/g]
Comparative example **1**	-	146	137
Comparative example **2a**	1% B	146	140
Comparative example **3a**	1% Al	147	138
Comparative example **3b**	5% Al	136	127
Comparative example **4a**	1% Mg	141	134
Comparative example **4b**	5% Mg	118	113
Example **5a**	1% Nb	148	146

according to the invention			
Example **6a** according to the invention	1% Ta	147	143

Figure 1 shows the cycle curves for the undoped compound and the 1% doped materials **2a**, **3a**, **4a** and **5a**.

Patent Claims

1. Positive active electrode material for use in rechargeable lithium ion batteries, characterised in that the positive active electrode material has the general formula
$Li_aNi_{1-x-y-z}Mn_xCo_yM_zO_2$,
where M = Nb and/or Ta, and
$1.00 \leq a \leq 1.15$
$0.5 < x+y+z < 1.0$
$0.1 < x < 0.5$
$0.01 < y < 0.3$
$0 < z < 0.10$.

2. Positive active electrode material according to Claim 1, characterised in that
$0 < z < 0.05$.

3. Positive active electrode material according to Claim 1, characterised in that
$0 < z < 0.03$.

4. Method for the production of a positive active electrode material according to one of the preceding claims, characterised in that a mixture of a lithium compound, a nickel compound, manganese oxide, cobalt oxide and niobium and/or tantalum oxide is mixed together in a suitable ratio, this mixture is subjected to a heat treatment and subsequently comminuted and ground to a powder.

5. Method according to Claim 4, characterised in that the heat treatment is carried out at a temperature of 800°C - 1200°C.

6. Method according to Claim 5, characterised in that the heat treatment is carried out at a temperature of 900°C - 1000°C.

7. Method according to Claims 4 - 6, characterised in that the heat treatment is carried out in an oxidising atmosphere.

8. Method according to Claims 4 - 7, characterised in that the heat treatment is carried out for a period of 4 - 20 h.

9. Method according to Claim 8, characterised in that the heat treatment is carried out for a period of 8 - 12 h.

10. Method according to Claims 4 - 9, characterised in that the mixture is ground in a grinding device.

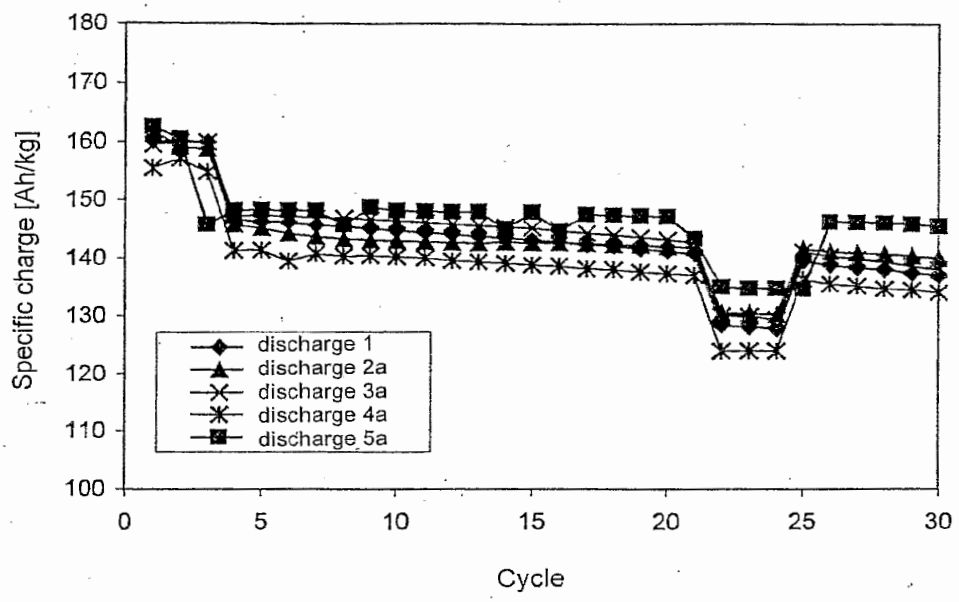
11. Method according to Claim 10, characterised in that the mixture is ground in a ball mill.

12. Lithium secondary cell having a positive electrode, which reversibly absorbs and releases lithium ions, a negative electrode which contains lithium or a lithium compound, and a non-aqueous electrolyte,
characterised in that
the positive active electrode material has the general formula
$Li_aNi_{1-x-y-z}Mn_xCo_yM_zO_2$,
where M = Nb and/or Ta, and
$1.00 \leq a \leq 1.15$
$0.5 < x+y+z < 1.0$
$0.1 < x < 0.5$
$0.01 < y < 0.3$
$0 < z < 0.10$.

13. Lithium secondary cell according to Claim 12, characterised in that
$0 < z < 0.05$.

14. Lithium secondary cell according to Claim 12, characterised in that
$0 < z < 0.03$.

Figure 1: cycle performance of compounds **1, 2a, 3a, 4a, 5a**



INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/000600

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M4/50 C01G45/02 H01M10/40

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 7 H01M

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 practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	US 2004/214086 A1 (BRUCE PETER GEORGE ET AL) 28 October 2004 (2004-10-28) the whole document	1-14
A	US 2003/027048 A1 (LU ZHONGHUA ET AL) 6 February 2003 (2003-02-06)	1-14
A	EP 1 130 665 A (NISSAN MOTOR COMPANY, LIMITED) 5 September 2001 (2001-09-05) cited in the application	1-14
A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 04, 30 April 1999 (1999-04-30) & JP 11 001323 A (SAKAI CHEM IND CO LTD), 6 January 1999 (1999-01-06) abstract	1-14

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[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2005	09/05/2005

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A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 08, 30 June 1998 (1998-06-30) & JP 10 059725 A (SAKAI CHEM IND CO LTD), 3 March 1998 (1998-03-03) abstract	1-14

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP2005/000600

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **C11D 3/06**	**A1**	**(11) International Publication Number:**	**WO 00/23552**
		(43) International Publication Date:	27 April 2000 (27.04.00)

(21) International Application Number: PCT/US99/24512

(22) International Filing Date: 19 October 1999 (19.10.99)

(30) Priority Data:
09/176,351 21 October 1998 (21.10.98) US

(71) Applicant: DONLAR CORPORATION [US/US]; 6502 South Archer Road, Bedford Park, IL 60501 (US).

(72) Inventors: FAN, Lai–Duien, Grace; 1165 Berkley Road, Lake Zurich, IL 60047 (US). FAN, Joseph, C.; 1165 Berkley Road, Lake Zurich, IL 60047 (US).

(74) Agents: CEPURITIS, Talivaldis et al.; Olson & Hierl, Ltd., 20 North Wacker Drive, 36th Floor, Chicago, IL 60606 (US).

(81) Designated States: AU, BR, CA, JP, MX, NO, ZA, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: INHIBITION OF METAL CORROSION

(57) Abstract

A composition and method is disclosed for inhibiting the corrosion of metals in contact with an aqueous system capable of corroding the metal. The inventive composition contains a substantially water–soluble polymer of an acidic amino acid and at least one water–soluble salt of molybdenum or zinc. The composition is substantially non–toxic and environmentally acceptable and is supplied in a corrosion–inhibition amount to the otherwise metal–corrosive aqueous system.

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INHIBITION OF METAL CORROSION

Technical Field

This invention relates to a composition and method for inhibiting the corrosion of metals in an aqueous system. More particularly, the invention is directed to the use of a substantially water-soluble, polymer of an acidic amino acid and at least one water-soluble salt of molybdenum or zinc.

Background of the Invention

The corrosion of metal equipment is a widespread and expensive problem in many industrial settings such as open recirculating cooling towers and in the agricultural industry in fertilizer storage and irrigation systems. Expenses arise due to corrosion from lost production time and from costly repairs and replacement of metal equipment parts that have been weakened or destroyed by the action of water and oxygen at the metal surface.

Many environmental factors can accelerate the corrosion rate of metals, and ferrous metals in particular, in aqueous systems. For example, a high content of dissolved oxygen in an aqueous system has a significant oxidative influence on the corrosion rate of many metals. Inert gas purging or blanketing of aqueous systems can minimize the oxygen content of the aqueous solution to decrease the rate of corrosion, but this approach is limited to closed systems. Another factor is the temperature of the aqueous system. A reduction in the temperature of the aqueous system can decrease the rate of corrosion providing the reduced temperature can be tolerated and controlled. Similarly, a reduction in the velocity or movement of the aqueous system through the equipment can also reduce the rate of corrosion. However, some flow is essential to maintain corrosion protection when utilizing corrosion inhibitors. Finally, maintaining a pH value of about 7 units or greater in the aqueous system can lessen the corrosion rate of metals caused by acid attack.

Another important means of retarding corrosion in aqueous systems is the use of various chemical additives as "corrosion inhibitors." It is believed that these additives inhibit the rate of corrosion by forming surface films which physically block the diffusion of ions to and from the surface of the metal. Some of these corrosion inhibitors are organic polymers, others are salts of toxic metals such as chromium, still others are phosphorous-containing complexes. See, for example, Little et. al., "Corrosion Inhibition by Thermal Polyaspartate," Surface Reactive Peptides and

Polymers: Discovery and Commercialization, Sikes, C.S. and Wheeler, A.P. (Eds.), ACS Symposium Series No. 444 (1990). However, many of these chemical additives have a negative environmental impact given their toxicity and persistence.

In industrial water treatment applications, such as open recirculating cooling systems, and boilers, the formation of scale and corrosion is a major problem. The growth of mineral crystals (scale formation) on heat transfer surfaces leads to decreased heat transfer efficiency and increases corrosion of heat transfer components. Corrosion of the heat transfer components can lead to costly replacements and failures. The addition of chemicals to reduce scale is well known. In many cases, phosphorus-containing materials are used to inhibit scale. However, when released into the environment, many of these materials can have a negative environmental impact. Polymeric organic inhibitors of scale are also known, such as polyacrylic acid, polymaleic acid, copolymers of acrylic and maleic acid, copolymers of acrylic acid and acrylamide, and the like. These polymeric materials, while being good scale inhibitors, are not known to have corrosion inhibition activity. Moreover, these materials are also not readily biodegradable, and thus can contribute to the overall chemical burden on the environment for long periods of time.

The performance of polymers as mineral scale inhibitors is dependent on the ability of the polymers to interact with growth sites on the surface of growing mineral crystals to retard mineral formation and reduce the adherence of the mineral to heat transfer surfaces by changing the crystal morphology.

Therefore, a need exists for an effective and environmentally tolerable polymeric corrosion inhibitor that can be used to inhibit corrosion and mineral scale on metal in contact with a metal-corrosive aqueous systems. Some previous attempts to fulfill this need employed a solution containing aspartic acid homopolymers to inhibit the corrosion of metals in aqueous systems of basic pH (U.S. Patent No. 4,971,724 to Kalota et al.); an aqueous detergent solution combined with homopolymers of aspartic acid or glutamic acid (U.S. Patent No. 5,531,934 to Freeman et al.); and polyaspartate salts having alkali or alkaline earth metal counterions as corrosion inhibitors in an aqueous saline environment (U.S. Patent No. 5,607,623 to Benton et al.). However, corrosion inhibition has met with limited success.

The present invention provides for both scale and corrosion inhibition benefits in a single, substantially non-toxic, environmentally acceptable polymer-containing composition.

Summary of the Invention

A composition and method for inhibiting corrosion of metals in contact with an aqueous system capable of corroding the metal is provided. The inventive method comprises supplying to the aqueous system a metal corrosion-inhibiting amount of a composition comprising a substantially water-soluble polymer of at least one acidic amino acid and at least one water-soluble salt of molybdenum or zinc.

The present inventive composition and method surprisingly is effective in inhibiting both corrosion and mineral scale on metal, particularly ferrous metal, in contact with an otherwise metal corrosive aqueous systems.

The acidic amino acid polymers useful in the compositions and methods of the present invention are biodegradable, have low toxicity, have low calcium sensitivity, provide scale control, and provide corrosion control. Acidic amino acid polymers, in combination with water-soluble molybdate salts, zinc salts, and mixtures thereof, beneficially provide unexpectedly improved corrosion control without sacrificing the beneficial attributes of the polymers. Surprisingly, the corrosion inhibiting effect of the inventive composition is significantly greater than the mere additive corrosion inhibiting effect of the individual components.

The compositions and methods of the present invention beneficially inhibit mineral scale and in particular, provide both scale and corrosion inhibiting functionality in a single composition. It is very common for both mineral scale and corrosion to be problems in the same application or system and conventionally require the use of multiple compositions to alleviate both scale and corrosion.

The inventive compositions and method are particularly suitable for use in metal corrosive aqueous systems encountered in such industrial water treatment applications as open recirculating cooling towers, boilers and the like and in such agricultural applications as agricultural fertilizer systems, agricultural irrigation systems and the like.

In the agriculture industry, in particular, the storage and application of fertilizer solutions can be problematic due to the corrosive nature of such fertilizer solutions to metals such as mild steel. The present invention provides effective and

environmentally acceptable compositions and methods for the inhibition of corrosion of metals in contact with known metal-corrosive aqueous fertilizer solutions. Particular preferred compositions comprising a substantially water-soluble acidic amino acid polymer, particularly polyaspartate, and at least one water-soluble molybdate or zinc salt, were found to inhibit the corrosion of mild steel in the presence of an aqueous solution of a fertilizer, such as urea and ammonium nitrate.

An additional benefit of the inventive compositions can be realized in the agriculture industry since they can concurrently supply acidic amino acid polymers, which can also enhance plant productivity, as disclosed in U.S. Patent No. 5,350,735 to Kinnersley, et al., and the micro nutrient plant minerals, molybdenum or zinc or both.

Detailed Description of the Preferred Embodiments

The terms "acidic amino acid polymer," or any grammatical variations thereof, and "poly(aminoacids) are used interchangeably and shall include the homopolymer and copolymers of the acid form of the amino acid as well as their salts. The salts of the acidic amino acid polymers may be alkali metal salts, alkaline earth metal salts, ammonium salts C_1-C_{20}, alkyl ammonium salts or aryl ammonium salts. The term "polymer" as used herein includes homopolymers and copolymers of acidic amino acid. The term "copolymer" as used herein includes random and block copolymers of acidic amino acid and their salts.

The inventive compositions contain a biodegradable and substantially non-toxic corrosion inhibiting amount of at least one substantially water-soluble polymer of an acidic amino acid together with at least one substantially water-soluble molybdate or zinc metal salt. The term "molybdate salt" as used herein defines a substantially non-toxic, water-soluble inorganic metal salt of molybdenum having the general formula (I): $(X)_n(MoO_4)_m$, wherein X is a cation, n and m are integers and the cationic charge on X times n is equal to 2m. The term "zinc salt" as used herein defines a substantially non-toxic water-soluble inorganic metal salt of zinc having the general formula (II): $(Zn)_p(Y)_q$, wherein Y is an anion, p and q are integers and the anionic charge on Y times q is equal to 2p. For convenience, the term "metal salt" is used herein to refer to molybdate and zinc salts.

Preferably, the molybdate salt has an alkali metal cation and most preferably is sodium molybdate (Na_2MoO_4). Preferably, the zinc salt has an anion derived from

an inorganic mineral acid and most preferably is zinc chloride ($ZnCl_2$) or a hydrate thereof.

Surprisingly, the corrosion inhibiting effect of the inventive compositions is considerably greater than the additive corrosion inhibiting effect, if any, attributable to the individual components.

Particularly preferred acidic amino acid polymers are synthesized from acidic amino acids, such as aspartic acid, in either α form, β form, or optionally containing a cyclic imide (succinimide), as well as glutamic acid in either α form, or γ form, or a derivative thereof. Preferably, the molecular size of the acidic amino acid polymer is in the range of about 1,000 to about 100,000 daltons, more preferably in the range of about 1,000 to about 20,000 daltons. The acidic amino acid residue content of the polymer is preferably in the range of about 20 mole percent to about 100 mole percent.

Preferably, the acidic amino acid polymer is a homopolymer of polyaspartic acid, or polyglutamic acid or is a block or random copolymer containing:

a) at least one amino acid derived moiety selected from the group consisting of aspartic acid and glutamic acid; and

b) one or more co-monomers selected from the group consisting of polybasic carboxylic acids and anhydrides, fatty acids, polybasic hydroxycarboxylic acids, monobasic polyhydroxycarboxylic acids, aliphatic amines, diamines and triamines, polyamines, carbohydrates, sugar carboxylic acids, amino acids, non-protein forming aminocarboxylic acids, lactams, lactones, diols, triols, polyols, unsaturated monocarboxylic, dicarboxylic and tricarboxylic acids, derivatized aspartic acid residues, derivatized glutamic acid residues; and the sum of the residues of aspartic acid, glutamic acid or mixture thereof comprises at least about 20% of the total number of residues in the polymer.

Acidic amino acid polymers useful in the compositions and methods of the present invention can be synthesized by any of numerous methods known in the chemical arts. See, for example, Koskan et al.; U.S. Patent Nos. 5,057,597; No. 5,116,513; No. 5,219,952, and No. 5,221,733, the disclosures of which are incorporated by reference, which describe methods for the manufacture of polysuccinimide and polyaspartic acid. Other methods can be found in U.S. Patent No. 5,142,062 which describes the use of phosphoric anhydride to facilitate the

polymerization of aspartic acid to polysuccinimide. Polyaspartic acid salts are obtained by the alkaline hydrolysis of polysuccinimide.

Fujimoto et al. in U.S. Patent No. 3,846,380 describe the formation of modified polypeptides having hydrophobic and hydrophilic substituents as side chains obtained by reacting polysuccinimide with at least one primary or secondary aliphatic amine in a polar aprotic solvent and hydrolyzing the resulting polyamide derivative with alkali to produce polypeptides that are useful as surface active agents.

Reactions of polysuccinimide in an aqueous medium with aqueous ammonia or aqueous primary or secondary amines produces copolymers of aspartic acid ammonium salts and aspartamide units. For example, hydrolysis of polysuccinimide with aqueous ammonia affords a copolymer of aspartamide (a.k.a. asparagine) and ammonium aspartate units in a ratio of about 40:60 to about 60:40.

Acidic amino acid copolymers containing co-monomers such as polybasic carboxylic acids and anhydrides, fatty acids, polybasic hydroxycarboxylic acids, monobasic polyhydroxycarboxylic acids, aliphatic amines, diamines and triamines, polyamines, carbohydrates, sugar carboxylic acids, amino acids, non-protein forming aminocarboxylic acids, lactams, lactones, diols, triols, polyols, unsaturated monocarboxylic, dicarboxylic and tricarboxylic acids, can be made by any number of methods described in the literature.

See, for example, U.S. Patent No. 5,478,919, to Koskan et al., incorporated herein by reference, which describes a method of preparation of copolymers of polysuccinimide or polyaspartic acid by copolymerization of maleic or fumaric acid, ammonia and one or more amino, hydroxyl or carboxyl containing monomers; U.S. Patents to Wood, No. 5,510,427 which describes a method of preparing polyaspartate copolymers by polymerization of maleic acid, and ammonia with a diamine or triamine, followed by hydrolysis with base; No. 5,494,995 which describes a method of preparing polysuccinimide copolymers by polymerization of maleic acid, ammonia and a polycarboxylic acid, and optionally with a diamine or triamine; and No. 5,484,860 which describes a method of preparing polyaspartate copolymers by polymerization of maleic acid, ammonia and a polycarboxylic acid, and optionally with a diamine or triamine, followed by hydrolysis with base.

Also, U.S. Patent Nos. 4,696,981 to Harada describes the copolymerization maleic or fumaric acid, ammonia and one or more amino acids using microwave

heating, to form polysuccinimide copolymers; No. 4,892,733, to Bichon et al. describes copolymers of aspartic or glutamic acid with other natural amino acids; No. 5,747,635, to Kroner et al., describes a method of preparing copolymers of polysuccinimide and polyaspartic acid by copolymerization of aspartic acid with 99 to 0.1 mole % of one or more polybasic carboxylic acids, polybasic carboxylic acid anhydrides, fatty acids, polybasic hydroxycarboxylic acids, monobasic polyhydroxycarboxylic acids, diamines and triamines, polyamines, carbohydrates, sugar carboxylic acids, amino acids, non-protein forming aminocarboxylic acids, or by radically initiated graft polymerization of monoethylenically unsaturated carboxylic acids in the presence of polyaspartic acid; and No. 5,679,761 to Heuer et al. which describes copolymers of polyaspartate or polysuccinimide with iminodisuccinate units. The relevant portions of each of the foregoing patents are incorporated herein by reference.

Examples of co-monomers useful in the acidic amino acid co-polymers of the present invention include, but are not limited to, lactic acid, citric acid, glycolic acid, malic acid, tartaric acid, succinic acid, adipic acid, butanetetracarboxylic acid, gluconic acid, glucuronic acid, glucaric acid, aconitic acid, sulfosuccinic acid, phosphinicosuccinic acid, phosphonosuccinic acid, iminodiacetic acid, iminodisuccinic acid, nitrilotriacetic acid, stearic acid, palmitic acid, cyclohexanedicarboxylic acid and anhydride, terephthalic acid, phthalic acid and anhydride, crotonic acid, sorbitol, glycerol, glucose, fructose, sucrose, maltose, glycine, alanine, serine, threonine, cystine, cysteine, ethylenediamine, diethylenetriamine, triethylenetetramine, polyamines, 1,6-diaminohexane, octadecylamine, 6-aminocaproic acid, 4-aminobutyric acid, diaminocyclohexane, urea, melamine, carbohydrazide, hydrazine, ascorbic and isoascorbic acid, sorbic acid, maleuric acid, cyanuric acid, alkyldiamines, alkyltriamines, acrylic acid, methacrylic acid, maleic acid, maleic anhydride, alkylmaleic acids, alkenylsuccinic acids and anhydrides thereof, and methylenemalonic acid. The term "alkyl" and "alkanyl" as used herein means that the alkyl of alkanyl group has 1 to 7 carbon atoms.

Examples of derivatized aspartic acid and derivatized glutamic acid residues include materials in which the free carboxyl group of the aspartic acid or glutamic acid residue has been chemically bonded with an amino, hydroxyl or mercapto containing moiety to form an amide, ester or thioester bond.

Non-limiting examples of acidic amino acid polymers containing derivatized aspartic acid or glutamic acid residues useful in the compositions and methods of the present invention are found in U.S. Patents to Uhr et al., Nos. 5,506,335 and 5,726,280 which describe polyaspartate alkyl and aryl amide derivatives with sulfonic acid group-containing side chains on the alkyl or aryl moieties; U.S. Patents to Jacquet et al., No. 4,363,797 which describes derivatized polyaspartates bearing amide, mercapto and sulfoalkylamide functional group bearing moieties attached to the polyaspartate by amide bonds to the free carboxyl groups of the polymer; and No. 4,314,808 which describes derivatized polyaspartates wherein alkyl substituents, functionalized alkyl substituents, dyes and dye precursors that are attached to the polyaspartate by amide bonds to the free carboxyl groups of the polymer; U.S. Patent No. 3,846,380 to Fujimoto, which describes derivatized polyaspartates wherein C_1 to C_{20} alkyl groups, in proportions from 0.005 to 1 substituents per monomer unit, are attached to the polyaspartate by amide bonds to the free carboxyl groups of the polymer. The relevant portions of each of the foregoing patents are incorporated by reference.

Also, U.S. Patent No. 5,639,832, to Kroner et al, describes a method of derivatizing polysuccinimide with amino acids by reaction of polysuccinimide with amino acids in aqueous medium at pH values wherein at least 5 % of the amino acids are in the free amine (non-protonated) form; and PCT Application No. WO 96/04332, to Greindl et al., describes derivatives of polyaspartic acid having hydroxamic acid, hydroxamic ether and/or hydrazide groups in the side chain, formed by reaction of polysuccinimide with hydroxylamine, hydroxylamine alkyl ethers with 1 to 18 C atoms in the alkyl group, N-mono-hydroxylamines with 1 to 18 C atoms in the alkyl group, and/or hydrazine in aqueous or alcohol media at pH values of at least 7. The relevant portions of each of the foregoing patents are incorporated by reference.

Examples of amino, hydroxyl or mercapto containing moieties that may be bonded with aspartic acid or glutamic acid residues to form derivatized aspartic acid or derivatized glutamic acid residues include, but are not limited to: hydrazine, C_1-C_{20} alkyl or aryl substituted hydrazines, hydroxyl amine, C_1-C_{20} alkyl O-substituted hydroxylamines, natural amino acids such as alanine, glycine, leucine, phenylalanine, lysine, non-natural amino acids such as 6-aminocaproic acid, 4-aminobutyric acid, 2-

aminobenzoic acid, 4-aminobenzoic acid, or iminodiacetic acid, C_1-C_{20} alkyl amines, aryl amines such as aniline, secondary alkyl amines such as dimethylamine, morpholine, diethylamine, or N-methylstearylamine, substituted alkyl or aryl amines such as taurine, 3-phosphinopropyl amine, or 4-aminobenzenesulfonic acid, heterocyclic amines such as 2-aminopyridine, 2-aminopyrazine, 2-aminothiazole, or 2-aminoimidazole, diamines such as ethylenediamine, hexamethylenediamine, or alkoxylated diamines such as triethyleneglycol diamine, alkoxylated amines such as amine capped polyethylene oxides or amine capped polypropylene oxides, polyols such as ethylene glycol, propylene glycol, glycerin, polyethylene oxides, polypropylene oxides, sugars, or amino sugars, thiols such as butanethiol, 2-hydroxyethanethiol, or 2-aminoethanethiol, and hydoxycarboxylic acids such as glycolic acid, lactic acid, 2-hydroxybutyric acid, citric acid, tartaric acid, or salicylic acid.

Preferred amino acids for preparing acidic amino acid polymers useful in the present invention are aspartic acid, glutamic acid or mixtures thereof and the sum of the residues of aspartic acid or glutamic acid or both is at least about 20%, more preferably, at least about 30%, most preferably at least about 50% of the total number of polymeric residues.

The starting materials, i.e., the amino acids and other co-monomers, for the polymerization to form the acidic amino acid polymers of the present invention can exist as optical isomers, depending upon their respective structures, and can be polymerized either as a racemic mixture or as segregated optical isomers.

The aspartic acid moieties of the acidic amino acid polymers of the present invention may be synthesized by any of several methods known in the art, such as from the thermal polymerization of aspartic acid or of precursors of aspartic acid such as maleamic acid, fumaramic acid, ammonium salts of maleic acid, ammonium salts of fumaric acid and ammonium salts of malic acid. The acidic amino acid polymers can also be synthesized by microbial fermentation.

In agricultural applications to inhibit corrosion of metal equipment in contact with fertilizer solutions, the inventive composition containing at least one molybdate or zinc salt and the acidic amino acid polymers can be supplied in the form of an aqueous solution or a substantially solid form. The weight ratio of the acidic amino

acid polymer to molybdate and zinc salts can be in the range of about 0.1:1 to about 1,000,000:1, preferably in the range of about 20:1 to about 100,000:1.

When supplied as an aqueous composition, the content, on a total composition basis, of acidic amino acid polymer preferably is in the range of about 0.001% (10 ppm) to about 10% (100,000 ppm) by weight and the content of the metal salt is in the range of at least about 0.00001% (0.1 ppm) to about 0.01% (100 ppm) by weight. More preferably, the inventive aqueous composition to be supplied has an acidic amino acid polymer content in the range of about 0.001% (10 ppm) to about 10% (100,000 ppm) by weight, a molybdate salt content of at least about 0.00001% (0.1 ppm) to about 0.001% (10 ppm) by weight or a zinc salt concentration of at least about 0.00001% (0.1 ppm) to about 0.0005% (5 ppm) by weight or a combined molybdate and zinc salt concentration of at least about 0.00001% (0.1 ppm) by weight. A most preferred composition has an acidic amino acid polymer content of about 0.5% (5000 ppm) to about 5% (50,000 ppm) by weight and at least one molybdate or zinc salt in about 0.0001% (1 ppm) to about 0.001% (10 ppm) by weight, i.e., a weight ratio range of about 500:1 to about 50,000:1. Preferably, the pH of the composition is in the range of about 6 to about 14 pH units.

Fertilizer solutions containing the inventive composition can also contain plant nutrients, such as potassium, phosphorus, nitrogen and sulfur. Most preferably, the fertilizer solution contains urea and ammonium nitrate (referred to as UAN). Such plant nutrients can be supplied together with the acidic amino acid polymer and at least one molybdate or zinc salt for agricultural uses. Advantageously, the molybdate salts and zinc salts useful in the inventive composition can provide, respectively, the plant micro nutrients, molybdenum and zinc. Preferably the the pH of the composition is in the range of about 6 to about 14 units, more preferably in the range of about 7 to about 9 units.

The compositions and method of the present invention are particularly useful in industrial water treatment applications such as open recirculating cooling towers, boilers and the like, where both scale and corrosion problems, particularly of ferrous metals, occur in the same system, simultaneously.

In an industrial aqueous system, the weight ratio of the acidic amino acid polymer to the at least one molybdate or zinc salt can be in the range of abut 0.01:1 to about 1,000:1, preferably in the range of about 1:1 to about 500:1, more

preferably in the range of about 2:1 to about 25:1. Preferably, an industrial aqueous system will contain an acidic amino acid polymer content in the range of about 0.00001% (0.1 ppm) to about 0.01% (100 ppm) by weight and at least one molybdate or zinc salt in the range of about 0.00001% (0.1 ppm) to about 0.001% (10 ppm) by weight. A preferred composition contains, on a total composition weight basis, an acidic amino acid polymer content of about 0.0001% (1 ppm) to about 0.005% (50 ppm) by weight and molybdate or zinc salt content of about 0.00002% (0.2 ppm) to about 0.0005% (5 ppm) by weight, i.e., a weight ratio of polymer to salt of about 250:1 to about 0.2:1. A preferred pH range of the composition is about 6 to about 14 units.

Other common water treatment components, such as biocides, dispersants, sequestrants, other scale inhibitors or other corrosion inhibitors, and mixtures thereof may be supplied along with the acidic amino acid polymer and the molybdate or zinc salt in the inventive composition. Useful formulations, for examples, can contain polyaspartate, metal salts and phosphonate sequestrants, wherein the added phosphonate sequestrants may further enhance either the scale inhibition or corrosion activity of the formulation.

The scale inhibiting activity of poly(amino acids) is well known. One other useful feature of such amino acid polymers is low calcium sensitivity. Calcium sensitivity is the tendency of an inhibitor to precipitate as a calcium salt in waters having a high calcium hardness. Such precipitation is undesirable in that the precipitated inhibitor can no longer perform its intended function.

Calcium sensitivity may be measured in a relatively simple test wherein a known amount of inhibitor (typically enough to attain 50 ppm concentration in solution) is added to a water composition containing about 500 ppm of calcium (as calcium carbonate), 0.005M borate buffer at a temperature of about 70°C (about 158°F), pH 8.3 for an incubation time of about 18 hours. The turbidity of the solution is monitored using a nephelometer. Turbidity is measured in Nephelometric Turbidity Units (NTU). Turbidity is an indication of precipitation. Higher turbidity indicates high calcium sensitivity. In such a test, an amino acid polymer of polyaspartic acid, showed no measurable turbidity, whereas common non-amino acid based scale inhibitors such as polyacrylic acid and polymaleic acid had measureable

turbidities of 8 and 13 NTU, respectively, indicating low calcium sensitivity for polyaspartate and high calcium sensitivity for the polyacrylate and polymaleates.

The activity of corrosion inhibitors toward metal corrosion is commonly assayed by the Polarization Resistance Method, ASTM G-59, found in "Standard Practice for Conducting Potentiodynamic Polarization Resistance Measurements," American Society For Testing And Materials, Philadelphia, Pennsylvania, the disclosures of which are incorporated herein by reference. Linear Polarization Resistance is an electrochemical technique that measures the DC current (i_{meas}) through the metal/fluid interface under study by applying a small electric potential difference (ΔE) from the corrosion potential (E_{corr}). I_{meas} is related to corrosion current density (i_{corr}) by the Stern-Geary equation:

$$\frac{\Delta E}{i_{meas}} = \frac{\beta_a \beta_c}{(2.303 i_{corr})(\beta_a + \beta_c)}$$

where: β_a = Anodic Tafel Slope and β_c = Cathodic Tafel Slope.

The corrosion rate is directly proportional to the corrosion current density, and can be calculated using the ASTM G-102 standard method, found in "Calculation of Corrosion Rates and Related Information From Electrochemical Measurements," American Society For Testing And Materials, Philadelphia, Pennsylvania, the disclosures of which are incorporated herein by reference.

The following examples illustrate composition embodiments and the method of the present invention in agricultural fertilizer solutions and in industrial aqueous systems. The compositions and methods presented are illustrations of preferred embodiments and are not intended as limitations.

Example 1: Inhibition of Steel Corrosion in an Aqueous Fertilizer Solution by Acidic Amino Acid Polymer and Zinc Salt.

The corrosion rate of C1010 mild steel coupons submerged in an aqueous fertilizer solution was monitored using the Polarization Resistance Method. The analytical instrument contained a two-electrode probe which provided the corrosion rates as milli-inches per year (mpy).

The control sample was a 28% by weight aqueous solution of the commercial fertilizer, urea and ammonium nitrate (UAN), commonly employed in the agriculture

industry and is known to be metal corrosive, especially to ferrous metals. The corrosion rate of separate steel coupons was measured following immersion contact in a series of tests performed with the UAN fertilizer solution containing either thermal polyaspartate, (TPA), as the acidic amino acid polymer (5000 molecular weight, sodium salt form), or zinc chloride or TPA and zinc chloride and the results were compared to corrosion in contact with the control sample.

The concentration of the aspartic acid polymer in the test aqueous solutions ranged from about 1% (10,000 ppm) to about 0.001% (10 ppm) by weight and the concentration of zinc chloride was about 0.0002% (2 ppm) by weight as shown in Table 1 below. All compositions had a pH of about 8.4. Measurements were made at ambient room temperature over an immersion period of 4 to 28 days. The results are summarized in Table 1.

Table 1. Corrosion Inhibition of Mild Steel

	Treatment									
	Corrosion rate (mpy)									
Day	UAN alone (28%)	1% TPA (10000 ppm)	2 ppm $ZnCl_2$	1%TPA + 2ppm $ZnCl_2$	5000ppm TPA + 2ppm $ZnCl_2$	1000 ppm TPA + 2ppm $ZnCl_2$	50 ppm TPA + 2 ppm $ZnCl_2$	25 ppm TPA + 2 ppm $ZnCl_2$	10 ppm TPA + 2 ppm $ZnCl_2$
1	0.3	0.7	0	0.1	0	0	0	0.1	0.1
2	0.1	0							
3	0.1	0							
4	80.4	0	0.1	0	0	0	0	0.1	0
5		0.1			0	0	0	0.1	0.1
6			0.1	0.1	0	0	0	0.1	0
7			0	0	0	0	0	0.1	0.1
8		2.4	0.1	0.1	0	0	0	0.1	0
9		2.8							
10		2.4							
11			0	0		0			
12		2.6	0.1	0.1	0	0	0	0.1	0
13			90.8	0	0	0	0	0.1	0.1
14					0	0	0	0.1	0.1
15					0	0	0	0.1	0
16									
17									
18				0	0	0	0	0.1	0.1
19									
20					0	0	0	0.1	0.1
21					0.1	0	0	0.1	0

Table 1. Corrosion Inhibition of Mild Steel

	Treatment									
	Corrosion rate (mpy)									
Day	UAN alone (28%)	1% TPA (10000 ppm)	2 ppm $ZnCl_2$	1%TPA + 2ppm $ZnCl_2$	5000ppm TPA + 2ppm $ZnCl_2$	1000 ppm TPA + 2ppm $ZnCl_2$	50 ppm TPA + 2 ppm $ZnCl_2$	25 ppm TPA + 2 ppm $ZnCl_2$	10 ppm TPA + 2 ppm $ZnCl_2$
22				0.1		0	0	0.1	0.1
23									
24									
25				0.2	0.2	0.1	0	0	
26				0.2	0.2	0.1	0.1	0.1	0.1
27				0.2	0.2	0.2	0.1	0	
28				0.1	0.2	0.2	0.1	0.1	0.1
29				0.2	0.2	0.2	0	0	

The data in Table 1 clearly showed that corrosion inhibition by the combination of the polyaspartate with zinc salt was considerably more effective than that achieved with either the polymer alone or the zinc salt alone. The UAN control produced massive corrosion within 4 days (80.4 mpy). Polyaspartate (1%) alone decreased the corrosion rate during the first 7 days and produced "slight corrosion" (mpy value of 2.4-2.6) over 8-14 days, whereas massive corrosion (90.8 mpy) was produced with zinc salt (2 ppm) alone after by 13 days. With all the inventive compositions containing the combination of polyaspartate and zinc chloride, however, the corrosion rates surprisingly ranged from none (0 mpy) to at most about 0.2 mpy over the entire 29 day test period.

Similarly effective inhibition was achieved in similar tests conducted over a test period of 30 days, with 1 ppm zinc salt in combination with 10 ppm, 25 ppm, 50 ppm or 100 ppm polyaspartate.

Example 2. Corrosion Inhibition by Acidic Amino Acid Polymer and Molybdate Salt in a Fertilizer Solution.

The procedure of Example 1 was repeated, except that the UAN fertilizer (28 % by weight) compositions contained either 1% by weight of sodium polyaspartate, (5000 Mw), or 0.0005% by weight sodium molybdate (5 ppm) or a combination of 1% by weight sodium polyaspartate and 0.0005% by weight sodium molybdate at a pH of about 8.4. After 12 days of immersion contact, no corrosion (0 mpy) of the C1010 mild steel coupons was evident when the inventive composition containing the polymer and molybdate salt was used. In contrast, severe corrosion of the coupons was evident after 4 days immersion contact with the control sample (UAN only, 80 mpy) and after 7 days immersion contact with the sodium molybdate sample (87 mpy), whereas the aspartic acid polymer sample had only slight corrosion after 8-12 days (2.4-2.6 mpy).

Example 3. Corrosion Inhibition by Acidic Amino Acid Polymer with Molybdate and Zinc Salt in a Cooling Water Application.

Water used for cooling applications is typically described as scale forming or corrosive, primarily depending on the concentration of hardness ions in the water and the

alkalinity. Low hardness waters (low LSI), are usually significantly more corrosive than higher hardness waters (high LSI).

This example demonstrates corrosion inhibition by acidic amino acid polymer with molbydate and zinc salt in an aggressive soft water (substantially low LSI) containing about 35 ppm Ca^{+2} as $CaCO_3$, about 10 ppm Mg^{+2} as $CaCO_3$ and about 25 ppm total alkalinity to simulate the cooling water used in open recirculatory cooling towers (hereafter, "cooling water"). Total alkalinity was determined as M-alkalinity (i.e., titration with acid to a Methyl Orange indicator endpoint). The cooling water had a pH of about 8.0 and a temperature of about 27°C (about 81°F). The cooling water was constantly purged with air to ensure oxygen saturation to simulate open recirculation tower conditions.

A series of separate tests were performed over a test run period of about 18 hours employing either cooling water (blank), or cooling water containing (0.001%) 10 ppm polyaspartate with and without zinc chloride or sodium molybdate salt in the amounts shown in Table 2. All tests were performed on C1010 mild steel coupons that had been pre-corroded in 1 N hydrochloric acid for about 10 minutes and then rinsed with deionized water to simulate tower metal use conditions. The flow rate during pre-corrosion and each test was about 1 m/s (3.3 ft/s).

The corrosion rate was determined by the Polarization Resistance Method as in Example 1 and by visually observing the appearance of the metal surface for pitting and general corrosion (rust). The results are presented in Table 2.

Table 2. The Corrosion Rate Of C1010 Mild Steel In Cooling Water With Various Treatments.

Treatment	Corrosion Rate (mpy)	Appearance, Observed Pitting
Blank	52	large amount of general corrosion (rust), pitting
10 ppm polyaspartate	2.5	large pits, reduced rust
10 ppm polyaspartate + 1 ppm Zn^{+2}	2.0	small pits, greatly reduced rust
10 ppm polyaspartate + 0.4 ppm Zn^{+2}	2.0	small pits, greatly reduced rust
10 ppm polyaspartate + 5 ppm MoO_4^{-2}	1.5	small pits, little rust
10 ppm polyaspartate + 0.4 ppm Zn^{+2} + 5 ppm MoO_4^{-2}	1.6	small pits, very little surface rust
2 ppm Zn^{+2}	8.4	large pits

The data in Table 2 illustrate the efficacy of polyaspartate as a corrosion inhibitor and provides an indication of potential synergistic effects with molybdate in lowering corrosion rates and with zinc in reducing pitting corrosion. The advantages of combining polyaspartate with molybdate salts, zinc salt or both were depicted by comparing the surface morphologies of the treated coupons. The data in Table 2 clearly show that combinations of polyaspartate and zinc salt, for example, unexpectedly reduced corrosion attack and pitting was minimized relative to that of the zinc salt treatment. It is well known that at a low level of 1 ppm or less the corrosion rate of Zn^{+2} is greater than that at 2 ppm (i.e., 8.4 mpy). Thus, the combination of polyaspartate and Zn^{+2} advantageously achieved a low corrosion rate employing a

fraction of the zinc which would be needed if zinc were used alone to reduce the corrosion rate to the same level.

The combination of polyaspartate with molybdate salt or with a combination of zinc and molybdate salts resulted in a high level of inhibition of both general corrosion and pitting attack. It is well known that 5 ppm MoO_4^{-2} is not an effective corrosion inhibitor.

The potential Polarization data indicates that polyaspartate acts as an anodic inhibitor. Thus, the anodic Tafel slope of the mild steel coupon doubles when treated with 10 ppm of polyaspartate.

WE CLAIM:

1. A method for inhibiting the corrosion of metals in contact with a metal corrosive aqueous system which comprises supplying to the aqueous system a corrosion-inhibiting amount of a composition comprising a substantially water-soluble polymer of at least one acidic amino acid and at least one water-soluble metal salt selected from the group consisting of molybdate salts and zinc salts.

2. The method of claim 1 wherein the acidic amino acid is selected from the group consisting of aspartic acid, glutamic acid and mixtures thereof.

3. The method of claim 1 wherein the molecular size of the acidic amino acid polymer is in the range of about 1,000 to about 100,000 daltons.

4. The method of claim 1 wherein the acidic amino acid content comprises at least about 20% by weight of the polymer.

5. The method of claim 1 wherein the metal salt is sodium molybdate.

6. The method of claim 1 wherein the metal salt is zinc chloride.

7. The method of claim 1 wherein the metal salt comprises sodium molybdate, zinc chloride and mixtures thereof.

8. The method of claim 1, wherein, on a total composition weight basis, the supplied composition contains about 0.001% to about 10% by weight acidic amino acid polymer, and at least about 0.00001% by weight of the metal salt.

9. The method of claim 1 wherein the composition is supplied to an aqueous fertilizer system.

10. The method of claim 9 wherein the acidic amino acid polymer is an aspartic acid polymer.

11. The method of claim 9 wherein, on a total composition weight basis, the composition contains about 0.5% to about 5% by weight acidic amino acid polymer and about 0.00001% to about 0.001% by weight molybdate salt.

12. The method of claim 1 wherein the aqueous system has a pH in the range of about 6 to about 14.

13. The method of claim 1 wherein the aqueous system is useful for agricultural applications and the composition further includes plant nutrients.

14. The method of claim 1 wherein the aqueous system is a water treatment application.

15. The method of claim 1 wherein the composition supplied contains, on a total composition weight basis, about 0.00001% to about 0.01% by weight acidic amino acid polymer and at least about 0.00001% of the metal salt.

16. The method of claim 1 wherein the composition contains, on a total composition weight basis, about 0.0001% to about 0.005% by weight acidic amino acid polymer and at least about 0.00001% of the metal salt.

17. A method of claim 1 wherein the composition comprises an acidic amino acid copolymer comprising: (a) at least one amino acid derived moiety selected from the group consisting of aspartic acid, glutamic acid and mixtures thereof; and (b) one or more co-monomers selected from the group consisting of polybasic carboxylic acids and anhydrides, fatty acids, polybasic hydroxycarboxylic acids, monobasic polyhydroxycarboxylic acids, diphatic amines, diamines, triamines, polyamines, carbohydrates, sugar carboxylic acids, amino acids, non-protein forming aminocarboxylic acids, lactams, lactones, diols, triols, polyols, unsaturated dicarboxylic and tricarboxylic acids, unsaturated monocarboxylic acids, derivatized aspartic acid residues, and derivatized glutamic acid residues; wherein the sum of the residues of aspartic acid, glutamic acid or mixture thereof comprises at least about 20% of the total number of residues in the polymer.

18. A composition suitable for use in the inhibition of corrosion of metal in contact with a metal corrosive aqueous system comprising a corrosion-inhibiting amount of a substantially water-soluble polymer of an acidic amino acid, and at least one water-soluble metal salt selected from the group consisting of molybdate salts and zinc salts.

19. The composition of claim 18 wherein the weight ratio of the acidic amino acid polymer to the metal salt is in the range of about 0.1:1 to about 1,000,000:1.

20. The composition of claim 18 wherein the weight ratio of the acidic amino acid polymer to the metal salt is in the range of 0.01:1 to about 1,000:1.

21. The composition of claim 18 wherein the composition is suitable for agricultural applications and includes fertilizer.

22. The composition of claim 18 wherein the acidic amino acid polymer is a copolymer comprising: (a) at least one amino acid derived moiety selected from the group consisting of aspartic acid, glutamic acid and mixtures thereof; and (b) one or more co-monomers selected from the group consisting of polybasic carboxylic acids and anhydrides, fatty acids, polybasic hydroxycarboxylic acids, monobasic polyhydroxycarboxylic acids, aliphatic amines, diamines and triamines, polyamines, carbohydrates, sugar carboxylic acids, amino acids, non-protein forming aminocarboxylic acids, lactams, lactones, diols, triols, polyols, unsaturated dicarboxylic and tricarboxylic acids, unsaturated monocarboxylic acids, derivatized aspartic acid residues, and derivatized glutamic acid residues; wherein the sum of the residues of aspartic acid, glutamic acid or mixture thereof comprises at least about 20% of the total number of residues in the polymer.

23. The composition of claim 18 wherein the acidic amino acid polymer is polyaspartate.

24. The composition of claim 18 wherein the metal salt is sodium molybdate.

25. The composition of claim 18 wherein the metal salt is zinc chloride.

26. The composition of claim 18 in a substantially solid form.

27. The composition of claim 18 in an aqueous solution form.

28. The composition of claim 18 further including water treatment components selected from the group consisting of biocides, dispersants, sequestrants and mixtures thereof.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/24512

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :C 11D 3/06
US CL :252/389.52, 389.54; 210/701
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)

U.S. : 252/389.52, 389.54; 210/701

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, 5,531,934 (FREEMAN et al) 02 July 1996. See col. 1, lines 6-10; col. 2, lines 12-20, 45-57; col. 5, lines 13-23; col. 6, lines 5-68; col. 7, lines 60-65; col. 8, lines 58-61; claims 5-7.	1-28

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"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
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Date of the actual completion of the international search 22 DECEMBER 1999	Date of mailing of the international search report 10 FEB 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer CEPHIA D. TOOMER DEBORAH THOMAS PARALEGAL SPECIALIST Telephone No. (703) 308-0661

Form PCT/ISA/210 (second sheet)(July 1992)★

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2002 (16.05.2002)

PCT

(10) International Publication Number
WO 02/38447 A2

(51) International Patent Classification[7]: B65B 55/08, 55/16

(21) International Application Number: PCT/IL01/00995

(22) International Filing Date: 26 October 2001 (26.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
139287 26 October 2000 (26.10.2000) IL

(71) Applicants and
(72) Inventors: **TRIBELSKY, Zamir** [IL/IL]; 37 Hadvor st., 90805 Mevaseret Tzion (IL). **ENDE, Michael** [IL/IL]; 90855 Moshav Shoeva (IL).

(74) Agent: **NOAM, Meir**; P.O. Box 34335, 91342 Jerusalem (IL).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DISINFECTION THROUGH PACKAGING

(57) Abstract: Method and system for disinfection and sterilization through packaging (DTP) are disclosed. The method and system are usfull for the treatment of solids, liquids, gases or a combination thereof without damaging said packaging, or their content using high peak power pulsed radiation unit having a high intensity source of light. Said method and system present invention are especially beneficial for disinfecting and sterelizing water-based packaged products, and for granting biosecurity to modern agro-food production lines, biomedical preparation processes such as used for the production of vaccination, and for the production through packaging of opto-pro-biotic or OPB compounds for the enhancement of the human immune system (acquired immune system, or MHC type I, II, III). The methodology of the present invention is especially beneficial for agro-food production, for biomedical fields, and for bottled water or flavored water and beverages. More specifically, the present invention facilitate the disinfection or photo-treatment of liquids and gases after they have been filled into the packaging, and the packaging is closed already, or the packaging will be closed prior or after treatment. The evolutionary step of the method according to the present invention facilitate final polishing, or processing (by light) for increasing the safety, bio-security, and chemical purity of bottled water or packaged liquids or gases or combination. The methodology of the present invention eliminates the need to transfer the liquid or gas, or solids, or combination through a plurality of stages, or through cumbersome distribution systems requiring substantial attention to bio-compatbility, and biological, and chemical cleanliness and purity of origin of components therein (in the packaging). Furthermore, the methodology of the present invention facilitates the provision of a single step for purification, disinfection, sterilization, oxygenation, dissociation, or reduction, elimination, or equalization of unwanted species of biological, or chemical origin without the need to open the package and treat the content separately. More specifically, the present invention discloses a novel methodology for photo-treatment through packaging without causing molecular migration or damaging to said packaging or their content therein. The competitive advantages of the methodology of the present invention, as well as instruments, or devices using the method, is the capability to ensure purity, freshness, integrity, and naturally of single and multi-components compounds, liquids, gases or solids or any combination thereof by transferring light through packaging for photo-treatment through packaging enhancing the quality levels through out the life of processed products by the method of the present invention for disinfection and sterilization, oxidation, and reduction, dissociation and photo-treatment through packaging DTP (disinfection Through Packaging). Especially beneficial for bottling industries and for the biomedical filed.

WO 02/38447 A2

DISINFECTION THROUGH PACKAGING

FIELD OF THE INVENTION

The present invention relates to a method and a system for disinfection and sterilization through packaging (DTP) containing solids, liquids, gases or a combination thereof without damaging said packaging, or their content using high peak power pulsed radiation unit having a high intensity source of light. The present invention is especially beneficial for disinfecting and sterilizing water-based packaged products, and for granting biosecurity to modern agro-food production lines, biomedical preparation processes such as used for the production of vaccination , and for the production through packaging of opto-pro-biotic or OPB compounds for the enhancement of the human immune system (acquired immune system, or MHC type I, II, III). The methodology of the present invention is especially beneficial for agro-food production, for biomedical fields, and for bottled water or flavored water and beverages. More specifically, the present invention facilitate the disinfection or photo-treatment of liquids and gases after they have been filled into the packaging, and the packaging is closed already, or the packaging will be closed prior or after treatment. The evolutionary step of the method according to the present invention facilitate final polishing, or processing (by light) for increasing the safety, bio-security, and chemical purity of bottled water or packaged liquids or gases or combination. The methodology of the present invention eliminates the need to transfer the liquid or gas, or solids, or combination through a plurality of stages, or through cumbersome distribution systems requiring substantial attention to bio-compatibility, and biological, and chemical cleanliness and purity of origin of components therein (in the packaging). Further more, the methodology of the present invention facilitates the provision of a single step for purification, disinfection, sterilization, oxygenation, dissociation, or reduction, elimination, or equalization of unwanted species of biological, or chemical origin without the need to open the package and treat the content separately. More specifically, the present invention discloses a novel methodology for photo-treatment through packaging without causing molecular migration or damaging to said packaging or their content therein. The competitive advantages of the methodology of the present invention, as well as instruments, or devices using the method, is the capability to ensure purity, freshness, integrity, and naturally of single and multi-components compounds, liquids, gases or solids or any combination thereof by transferring light through packaging for photo-treatment through packaging enhancing the quality levels through out the life of processed products by the method of the present invention for disinfection and sterilization, oxidation, and reduction, dissociation and photo-treatment through packaging DTP (disinfection Through Packaging). Especially beneficial for bottling industries and for the biomedical filed.

BACKGROUND OF THE INVENTION

In industry, especially in food production, sterilization of the end product is a must.

Conventional chemical disinfectants inflict strict limitations on producers and end users as there is always the need to remove the harmful chemical from the water, or agro-food product being packaged. Furthermore, chemical treatment methodologies are being phased out by regulatory legislation limiting the concentration of disinfectant in products DBPs. Public awareness has already focused on threatening volumes of toxic compounds created using chemical disinfectants, and the residual toxic by-products created when chemical residues gets mixed with widely available materials in the environment. Use of electromagnetic radiation and radiation chemistry techniques for sterilization, is documented. These methods use ionizing radiation which can be absorbed by the packaging materials (for example PET does not transmit below 312nm), altering the composition of the packaging and causing molecular migration which induces sensory effects. Furthermore, Gamma rays, X-Rays, Y-Rays and electron beam technologies have failed to provide safe working environments, often producing unstable molecules and compromising the safety of the operators. Furthermore, machines producing ionizing radiation have being limited by regulatory affairs and are cumbersome, requiring high periodical maintenance and replacements. While ionizing radiation is able to treat some forms of packaging (such as glass bottles, for instance,) their use is being limited as spatial control and manipulation of these lower wavelengths is considerably more difficult then stirring UVA pulsed laser beams).

Temperature and heating treatment currently in use through aseptic filling machines and other agro-food production lines is prohibitively expensive, requiring high periodical maintenance and replacements. Currently used heat treatments are performed on the liquid (water for example) before it is packaged, in order to prevent damage to temperature-sensitive polymers used in packaging (PET for example). Increasing the temperature of water-based products to be packaged can result in changes to its taste, flavoring and the integrity of the components can be compromised. The wholesomeness, freshness, the flavor and quality parameters of products treated by high temperature deteriorates rapidly. This decreases the quality while increasing the overhead. No known thermal treatment can offer a solution to water based products after packaging in PET packaging materials, as the PET molecules migrate into the packaged products (as results of the heat generated) and may cause dangerous sensory effects which threaten the health of the consumers. Sterilization using heat substantially increases the production time and expenditure, often leading to machinery and devices which are cumbersome, large in dimensions, and require specialized engineering support and operation.

The principles of disinfection and sterilization techniques which utilize photo-treatment and oxidation processes that involve ultraviolet light, are well known and documented. Use of an effective Wavelength Range (EWR) of 220nm to about 360nm for sterilization, using a variety of conventional continuous wave (CW) type light sources has being documented. Should pathogens be present within

a product, these wavelengths are considered to inactivate their DNA and RNA, thus preventing the replication of microbes. This ultraviolet (UV) technology is preferred compared to other disinfection technologies, due to its non-residual, non-chemical nature. However such UV technology only provide a partial solution to the familiar problem of hygiene and biosecurity: this conventional UV technology can only provide disinfection capabilities when a predetermined volume of liquid and gas has to be disinfected, or when the surface area is of particular parameters, having a specific surface curvature. Conventional ultraviolet technologies have failed to provide the ability to disinfect through packaging without inflicting damage or molecular migration within the product or within the packaging, which may cause sensory effects and health threats for the consumers and the producers. An effective disinfection technique which can penetrate through packaging has not being found till now. This is due to the strict limitations imposed by the polychromatic nature of current conventional UV mercury based lamp light sources, the most common being Continuous Wave (CW) / Pulsed Wave (PW) low pressure, medium pressure, or LPHO types of mercury based lamps, which are used, for example, for the disinfection of potable and drinking waters.

Currently used sterilization and disinfection methodologies are hindered by strict limitations such as polychromatic emission, continuos wave operation, non directive optical distribution of the light, and radial, and often wasteful, optical performance of currently used light sources. Further more, low geometrical utilization and lack of appropriate beam management systems have reduced coupling efficiencies, causing alarming head-loss. These limitations reduce the efficiency and increase the costs associated with these conventional sterilization techniques (i.e. mercury based lamps) thus further reducing their use and marketability.

It is the object of the present invention to disclose a method and a system capable of disinfecting a liquid, a gas or a solid through the respective packaging material of said liquid, gas or solid. Thus, the product and its packaging need not be sterilized separately in a two-step process, and should the product need sterilization after it is already packaged, it need not be removed from the packaging. The safety of the product is thus increased, and its quality parameters remain high for consumption after it is packaged or filled.

The present invention discloses a novel disinfection method and system, using a light source which penetrates the products' packaging. The invention utilizes high peak power, a light source such as a solid state laser, high repetition rates, and advanced geometrical utilization techniques. This leads to an evolutionary sterilization method and system, which do not slow down the rate of production lines, filling lines and packaging lines, yet grant them biosecurity.

These and other objects of the present invention will become more apparent from the summary of the invention and the detailed description of the drawings that follow.

Strict limitation of medical, and biomedical production processes for vaccination and medical preparation, is prohibited by the expense, cumbersome and large systems, and often time consuming

research and production activities. Further more, very often, in the sophisticated electronic, hydraulic, and pneumatic transport, mixing, and stirring mechanism and processes environment, the need to transport samples, and to deliver and distribute different compound from several often remotely connected or interfaced cambers or conduits is a necessity and limits the ability to safeguard against cross contamination, biocompatibility and biosecurity, often toxic chemicals or sensitive agents are transferred from containers for the sake of a single often simple processing therein (in the container, camber, or conduit), the methodology of the present invention is not so limited, that why the present invention could be utilized for wide variety of application in various industries saving substantial expenditure, featuring small foot print (as no need for additional processing stages, dishes, and transfers of liquids or gases or solids throughout networks of pipes and interfaces). More specifically, the evolutionary step is that once the ingredients, or components, of a multi components and/or (or single components) compounding volumes could be processed according to the methodology of the present invention, and thus surpass current limitation (which necessitate transfer of liquids and gases or solids or combination for multi stage processing, thus increasing the safety expenditure in order to ensure biocompatibility or bio security or chemical and toxic contamination transfer. The present invention is especially beneficial for producing opto-pro-biotic compounds for enhancing the immune system of human, animal or plants. Once compounds which have being processed throi8gh the methodology of the present invention are consumed, the MHCC type I, II, III, is triggered and upon performing traceable recognition, or marking or adjustments of biological or chemical origins acknowledged, rehearsed, and educate the immune system positive response portfolio and thus is better equipped for tackling, and dealing with potential threatening antigens, and toxic, biological noxious and chemical threatening eventualities (i.e. cross contamination occurring as the need to transfer compounds from different location through a distribution systems, which in turn needs to be disinfected for example). More specifically and in contradistinction to existing technologies in the field of medical preparation, the ability of the methodology of the present invention to process in the final packaging the content or volume facilitate safer, rapid, and economical aseptic production processes, especially beneficial for the bottling industries, biomedical fields, and for the production of immunifying and optoprobiotic compounds embedded in drinking water, mineral water, flavored water, spring water, treated water, air for breathing, and carbonated, oxygenated or enhanced or supplemented beverages or any combination thereof. Especially beneficial for the agro-food industries, bottling and water industries and for progress in immunological production processes eliminating the need to use expensive and often reactive species and noxious chemicals.

DEFINITIONS

Optronic in the context of the present invention means optical and electronic manipulation of the light sources according to the present invention, and wherein said optic or electronic manipulation are linked

or synchronized or operating autonomously for smooth efficient operation of devices using method of the present invention.

Biodosimetric curve means in the context of the present invention a predetermined dose of the rendering harmless of specific microbiological (and chemical) compounds or species which otherwise will be noxious and can threaten health or human, animal or plants.

Chemodosimetric curve means in the context of the present invention a predetermined dose of energy for the rendering harmless of specific chemical (and biological) compounds or species which otherwise will be noxious and can threaten health or human, animal or plants.

Thermal Dynamic curve means in the context of the present invention a threshold which above the molecular structure of the polymer, compounds or resin becomes unstable such that molecular migration may occur (i.e. from packaging to content therein) , or visible or sensory damage may pursue upon consumption.

Recurrent means in he context of the present invention reaching its original settings, or dosimetric value, or sequence start, or beginning of exposure time, or time and energy intervals, or energy intensity, or machine control command protocol, thus performance is repeated back to the original level or starting point.

Non recurrent means in he context of the present invention means that performance of devices using the method of the present invention does not reach its original point, level or time and intensity starting point.

Cyclic means in the context of the present invention reaching its original starting point, beginning, or dose or energy density or intensity or sequence start, or time interval, or machine control command protocol cyclically progressing with spectral distribution over predetermined space over a predetermined period of time, thus performance reaching its starting point.

Continuum means in he context of the present invention a continuos flow of strings, events, performances, or machine command protocol, or operation, intensity or activity which does not stop continuously.

Optronic means for the context of the present invention a process or interface wherein optical signals control electrical signals for the objective purpose of the production of electronic or optical or electro-optical output or combinations at a given range and spatial characteristics. Such characteristics as triggering lasers and supplement light sources in a continues string of electro-optic modulation or parameter changes received on a network via machine control protocols for the sake of adjusting or enhancing the interoperability or interconnectivity for maximizing efficiencies or system performance.

Deflecting, refracting, reflecting, refractive index, and spatial uniformity and characteristics of light means in the context of the present invention optical processing and beam management of light produced by radiation units according to the methodology of the present invention having a high intensity source of light, such optical processing and/or beam management caould be applied on CW or PW, or Quasi CW beams generated by a plurality of light sources operating in synchronicity or according to preplanned operation.

In the context of the present invention, spectral ranges of interest in Photochemistry mean:

Range Name	Wavelength
Near Infrared	700-10000
Visible	400 - 700
Ultraviolet	
UVA	315 -400
UVB	280-315
UVC	100-280

Little photochemistry occurs in the Near Infrared. Except for some photosynthetic bacteria. Which are capable of storing solar energy at wavelengths out to 980 nm. The Visible range is completely active for photosynthesis in green plants and algae. Also many dyes can undergo photochemical transformations themselves or sensitize reactions in other molecules. Most studies in photochemistry involve the Ultraviolet range. The UVC range is extremely dangerous since it is absorbed by proteins, RNA and DNA and can lead to cell mutations and/or cell death. The UVC range is sometimes called the germicidal range, since it is very effective in inactivating bacteria and viruses. The Vacuum Ultraviolet range is absorbed by almost all substances (including water and air).

In the context of the present invention Coherent and incoherent light means Light sources used in photochemistry can either be coherent (all emitted photons are in phase with each other as they propagate) or incoherent (all emitted photons have random phases). All lasers emit coherent radiation and usually at one wavelength. The dispersion is very small so that a laser beam remains at or near its original diameter as it propagates; the light emitted by all other light sources is almost always incoherent. Most of these sources are either "hot element" sources (e.g., the incandescent light bulb) or "plasma" sources (e.g., a fluorescent light tube).

The appropriate term for UV disinfection is "UV fluence rate" because a Microorganism can receive UV power from any direction, especially when there is more than one UV lamp in the vicinity. In general usage, the irradiance or fluence rate may be expressed as MW cm^(-2). The irradiance is often incorrectly termed "light intensity" see the proper definition of "radiant intensity" above.

Light dose or fluence means: The light dose or fluence (symbol H. units J m~2) is the total radiant energy of all wavelengths passing from all directions through an infinitesimally small sphere of cross-sectional area dA, divided by dA It is given by the average fluence rate times the exposure tune

in seconds. The term UV dose is often used in UV disinfection literature. It represents the UV exposure of a given organism in the germicidal range.

When atoms are raised to an excited state, they emit only in very narrow lines with virtually no emission between the lines. The low-pressure mercury lamp is a very common lamp of this type. For example, The emission lines of a mercury lamp are only sharp when the pressure of the gas is low (<10 tore). If the pressure is increased, the lamp can carry much more power, but the emission lines broaden. For the same length of lamp (about 120cm), a medium pressure lamp (pressure about 1000 tore) can carry up to 30,000W. These lamps are very common in commercial Systems utilizing ultraviolet light. Figure 5 shows a comparison of the emission of low pressure and medium pressure lamps in the ultraviolet region.

Certain radiation units and associated light sources, (lasers) and lamps emit at longer wavelengths, This is the basis of the very popular fluorescent lamp.

Excimer lamps means: Excimer lamps are unique in that they emit in a narrow band of wavelengths. An excimer is an atomic dimmer that is stable only in the excited state and dissociates on decaying to the ground state. Table 4 gives the wavelengths of sonic of the common excimer lamps. Examples: Emission wavelengths (or some common excimer lamps:

Excimer	Wavelength (nm)	Excimer	Wavelength (nm)
Xe2	172	XeCl	308
KrCl	222	I2	342
Cl2	259		

Flash lamps:

Flash lamps are similar to continuous wave (CW), but could also operate in (PW), pulsed mode operation, and are lamps that consist of a cylindrical quartz tube with electrodes at each end and filled with a ga.½ (e.g.. xenon). A power supply "fires' the lamps by discharging a large amount of electrical energy in a very short period of time (several us) by applying a very high voltage (10 - 30 kV}. The resulting plasma reaches temperatures of 10,000 - 13,000 K and the emission is essentially that of a blackbody (see Fig. 4). In commercial flash lamp Systems the lamp , a typical "flashed" about 30 times per s, but given a special electronic pulsing circuitry is added, repetition rates could reach Khz regime.

Biologically enhanced or photo-chemically polished drinking water or breathing air means any liquid or gas which have been passed through or processed by the method of the present invention such as water and/or air), more specifically such processes involved in the polishing and enhancing may

include; Optical inactivation, disinfection, inactivation of DNA and/or RNA replication sequences, Photocatalysis, electro catalysis, a hybrid of photo and electro-catalysis, optical dissociation, physiological dissociation, biomass expansion, filtration (pre/post), physical separation and sorting, reactivation, activation, sonication, acoustics, electroacoustics, electro-optical treatment (by photons of light), transgressing, or transversing said liquids and gasses through a photonic band gaped wave guides having an aerobic, non toxic passage for light and liquids or gasses or combination together, synchronously and or separately.

Peak power means, the energy generated when squeezing (i.e. such as when pulsing) electromagnetic energy in short duration of time, for example: a pulse of a given average energy and power – lasting, or having a pulse width of around 1 second (1s) will generate several watts in peak power, a pulse lasting or having width of microseconds (ms) will generate peak powers reaching the kilo-watts scale, while a pulse lasting nano (ns) seconds will generate peak powers reaching into the hundreds of million of watts which is especially beneficial for purposes such as optical dissociation, optical inactivation, optical polishing, and optical secretion and spectroscopy for control and diagnostics, so in short the shorter the pulse duration the higher its respective peak power.

A hybrid of light sources means a plurality of light sources and wherein their total spectral emitence, or total spectral distribution, or their total irradiance will cause multiphotonic absorption processes by means of super imposing their time domain (example: 1 light source is slow = 1s pulse duration, and additional light sources are very fast =5ns laser for example), their total irradiance is great and beneficial for the processes of the method of the present invention to occur efficiently, further more, such hybridization could includes, lamps and lasers, lasers and flash lamps, or any combination of CW, or PW type of light source working together, in synchronisity, and or sequentially or link or resolved by time domain manipulation for maximizing photonic interaction in matter, especially beneficial for triggering the catalytic scintillating elemental compound according to the present invention.

Photo catalysis means: The use of energy of a photon of light to catalyze chemical reactions. More specifically, such reaction may include the decomposition of water into hydrogen, and oxygen, and the complete oxidation of organic contaminants in aqueous environments. More specifically, the first step in Photocatalysis is for the catalyst material to absorb photon of light in order to excite an electron from the velance band (VB), to the conduction band (CB), thus creating electron-hole-pairs. Each Species must then migrate to the surface before recombination occurs. If this condition is met, the electron can be transferred to a surface adsorbed molecule, reducing it. The overall process is illustrated , it is important to note that for the processes to occur efficiently (preventing pre-matured recombination of the said electron-hole pairs), the rates of reduction, and the oxidation must be comperable .The position of the band edges is critical for each step of the process, a photocatalyst material which is stable in water is tio2, (or known as Titanium Oxide).

Absorbence in the context of the present invention means the ability of a medium to absorb radiation depending on temperature and wavelength. expressed as the negative common logarithm of the transmittance.

Active medium in the context of the present invention means a medium in which lasing will take place, rather than absorption, at a given wavelength.

Air-cooled laser in the context of the present invention means a laser using fans to force air over the laser tube and through the power supply. air-cooled lasers have the benefit of needing no water supply, although the fan noise can sometimes be a disadvantage. usually only small and medium power lasers are air-cooled. very small lasers, typically helium-neon, need no fans. although technically they are "air cooled" via convection, the term is usually applied only to fan-forced cooling.

Average Power in the context of the present invention means the sums of the energy of all single discrete pulses, in one second, of a pulsed laser.

Beam Expander in the context of the present invention means optical device increasing beam diameter and reducing divergence.

Beam Splitting in the context of the present invention means optically splitting a laser beam into two or more beams, of various or identical energies.

CW in the context of the present invention means an abbreviation of continuous wave of a laser as opposed to pulsed operation.

D.T.P means disinfection through packaging .

Duty Cycle in the context of the present invention means the length of time the laser beam is actually cutting, drilling, welding, or heat-treating, as compared to the entire work cycle time.

Flashlamp in the context of the present invention means source of powerful light; often in the form of a helical coil and used to excite photon emission in a solid-state laser.

OPB in the context of the present invention means Opto-Pro-Biotic such that after processing of photo-treatment through packaging (DTP) by the methodology of the present invention contributes to the opulent, or positive immune responses such as generated by MHC type I II III (Major Hysto Compatibility Complex) or positive immune responses of the acquired immune system driven by traceable recognition of the dissociated components of noxious species therein (i.e. in the packaging) without damage to the geometrical integrity of said components.

Packaging in the context of the present invention reffers to any type of material which may hold liquides, gasses or solids, or a combination thereof permanently or temporarily, such as bottled water package or capsoule for bio-medical utilization, or an envelope.

Package in the context of the present invention means the same as packaging.

Mode in the context of the present invention means a particular functioning arrangement, setup, or condition for laser operation, such as continuous emission, pulses, or grouped pulses. "mode" also describes the cross-sectional shape of the beam. (see "tem.")

Modulation in the context of the present invention means the ability to superimpose an external signal on the output beam of the laser as a control.

nd:glass laser in the context of the present invention means a solid-state laser of neodymium:glass offering high power or short pulses, or both, for specific industrial applications.

nd:yag laser in the context of the present invention means a solid-state laser of neodymium:yttrium-aluminum garnet, similar to the nd:glass laser. both are pumped by flash lamps, or diode lasers.

Optical Pumping in the context of the present invention means exciting the lasing medium by the application of light rather than electrical discharge from anode and cathode.

Peak Power in the context of the present invention means the power of an individual pulse in a pulsed laser. it is obtained by dividing the pulse energy in joules to the pulse width in seconds. typical values can be reach mega and giga watts.

Power Density: the amount of radiant power concentrated on a surface. units watts per square meters or square centimeters

Pulse Energy in the context of the present invention means the energy of a single, brief emission from a laser programmed for pulsed behavior rather than continuous operation. pulse power can be several times greater than cw emission.

Refraction in the context of the present invention means the change of direction of propagation of any wave, such as an electromagnetic wave, when it passes from one medium to another in which the wave velocity is different. simply put, the bending of incident rays as they pass from one medium to another, such as air to water.

Solid-state Laser in the context of the present invention means a laser where the lasing medium is a solid material such as a ruby rod. these can be optically pumped by a flashlamp or diodes. solid state lasers also include diode lasers as they use electrically pumped solids to produce light. currently, solid-state lasers are too expensive for most light show uses. this may change over the next few years. the most promising solid-state laser uses a material called nd:yag, which produces infrared light. this can be frequency doubled (second harmonic generation) to produce up to 60 watts of green light at 532 nm. the green light can again frequency doubled (fourth harmonic generation) to produce uv light at 266 nm, up to several watts.

Opt-pro-biotic or optoprobiotic means in the context of the present invention that the sterilization, or disinfection, or dissociation, or oxygenation, or reduction, or equalization, or acoustic-optical action of processes according to the methodology of the present invention is aiding or facilitating water content and products beneficial for the human immune system enhancements and strengthening and that this photochemical effects are achieved through the packaging without damaging said packaging or content therein (*i.e. in the packaging*).

Instrument means in the context of the present invention the radiation unit, light source or laser, optics, and the beam management or combination optronics used to direct the light spatially at the appropriate angular orientation or coupling of the delivered light form said radiation unit or light source through the packaging without causing damage throughout.

DEPTH OF FIELD In the context of the present invention means The working range of the beam, a function of wavelength, diameter of the unfocused beam and focal length of the lens. To achieve a small diameter spot size, and thus a high power density, a short depth of field must be accepted.

Dichroic filters and mirrors In the context of the present invention means A piece of glass with an optical thindim coating that transmits certain colours (wavelengths), and reflects the remaining colours.

Dichroic filters are used to combine or eliminate specific colours as needed in a laser projector. Dichroic mirrors are used to maximise the amount of light reflected from a laser of a particular wavelength. Dichroics should be handled with care to prevent damage to the coating. [see Also: Colour box]

DIODE LASER In the context of the present invention means A semiconductor similar to an LED (light-emitting diode) but which produces coherent light. Diode lasers are small and efficient, which has led to their use in compact disc players and pen-type laser pointers. Currently, diode lasers are too dim or expensive for most light show uses. This is likely to change over the next few years. [see also: Solid-state laser]

DIVERGENCE In the context of the present invention means The angle at which the laser beam spreads in the far field; the bending of rays away from each other, as by a concave lens or convex mirror.

DRIFT, ANGULAR In the context of the present invention means All undesirable variations in output (either amplitude or frequency); angular drift of the beam, measured in milliradians before, during, and after warm-up.

DUTY CYCLE In the context of the present invention means The length of time the laser beam is actually cuffing, drilling, welding, or heat-treating, as compared to the entire work cycle time

ELECTROMAGNETIC WAVE In the context of the present invention means A disturbance which propagates outward from an electric charge which oscillates or is accelerated. Includes radio waves; X-rays; gamma rays; and infrared, ultraviolet, and visible light.

EMISSIVITY, EMITTANCE In the context of the present invention means Rate at which emission takes place; the ratio of the radiant energy emitted by a source or surface to that emitted by a blackbody at the same temperature.

EXPOSURE In the context of the present invention means A measure of the total radiant energy incident on a surface per unit area; radiant exposure.

FAR-FIELD IMAGING In the context of the present invention means An imaging technique with solid-state lasers that has several limitations: non-uniform energy distribution, very short working distances, and poor control of hole geometry.

FIBER OPTIC CABLE In the context of the present invention means Flexible glass or plastic strands made into a cable, used to carry light from one place to another. There are two main types; Step index and Graded index fiber. Within these two main types there are two further subgroups:

Transmission fibers carry the beam with as little loss as possible. They are used to transmit the laser's light to remotely located projection devices.

Display fibers [known as side glow fibers] have no cable jacket, so some light scatters out the side of the strands. The strands themselves look like microscopic neon tubing and become a special effect such as laser-lit "whip" or a glowing "rope" wrapped around objects.

FLASHLAMP In the context of the present invention means Source of powerful light; often in the form of a helical coil and used to excite photon emission in a solid-state laser

FLUORESCENCE In the context of the present invention means The glow induced in a material when bombarded by light. Brewster windows of fused silica fluoresce in UV light, increasing absorption of laser radiation and degrading laser mode and output.

FLUX In the context of the present invention means The radiant, or luminous, power of a light beam; the time rate of the flow of radiant energy across a given surface.

FOCUS In the context of the present Invention means Noun: The point where rays of light meet which have been Converged by a lens. Verb: To adjust focal length for the clearest image.

FOCAL POINT In the context of the present invention means (Same as first definition under "focus" in laser work,) the focal point of the beam relative to the work surface has a critical effect, such as the depth and shape of drilled holes. When the focal point is at the surface, holes are of uniform diameter, When the focus is below the surface, Conical holes are drilled.

FOLDED RESONATOR in the context of the present invention means Construction in which the interior optical path is bent by mirrors mounted on corner blocks bolted into pre-aligned position, permitting compact packaging of a long laser cavity

FREQUENCY In the context of the present invention means The number of light waves passing a fixed point unit of time, or the number of complete vibrations in that period of time.

GAIN In the context of the present invention means Another term for amplification, usually referring to the efficiency of a lasing medium in attaining a population inversion. High gain is typically more than 50% per pass of the light wave between cavity mirrors

GAS DISCHARGE LASER In the context of the present invention means A laser containing a gaseous lasing medium in a glass tube in which a constant flow of gas replenishes the molecules depleted by the electricity or chemicals used for excitation. The discharged gas can be filtered and 90% recycled for economy.

GAS JET ASSIST In the context of the present invention means An assisting coaxial gas, such as oxygen, argon, or nitrogen, which may be used to achieve very high power levels for cutting certain metals.

GAS TRANSPORT In the context of the present invention means A laser design, which generates Very high beam power within a fairly small resonator structure. Long electrodes parallel the axis and gas is circulated across the resonator cavity.

GAUSSIAN In the context at the present invention means The "normal curve" or normal distribution, an example of which is the symmetrical bell shape of the holes created by the uncorrected, unfocused laser beam in its optimum mode. A Gaussian laser beam has most of its energy in the center

HAZ In the context of the present invention means Heat-Affected Zone, or the area where laser beam and metal (or other) surface are in contact.

HELIUM-NEON LASER In the context of the present invention means ("HeNe"), Laser in which the active medium is a mixture of helium and neon, which is in the visible range. Used widely in industry for alignment, recording, printing, and measuring, it is also valuable as a pointer or aligner of invisible C02 laser light.

HEAT SINK In the context of the present Invention means A substance or device used to dissipate or absorb unwanted heat, as from a manufacturing process (or with lasers, from reflected rays).

HERTZ In the context of the present invention means The approved international term, abbreviated Hz, which replaces CPS for cycles per second.

IMAGE In the context of the present Invention means The optical reproduction of an object, produced by a lens or mirror. A typical positive lens converges rays to form a "real" image which can be photographed. A negative lens spreads rays to form a "virtual" image which can't be projected.

INCIDENT LIGHT In the context of the present invention means A ray of light that falls on the surface of a lens - or any other object. The "angle of incidence" is the angle made by the ray with a perpendicular to the surface.

INTENSITY In the context of the present invention means The magnitude of radiant energy (light) per unit, such as time or reflecting surface.

ION LASER In the context of the present Invention means A type of laser employing a very high discharge current, passing down a small bore to ionize a noble gas such as argon or krypton. The ionization process creates a population inversion for lasing to occur. A research laser useful for some industrial applications.

IONIZATION In the context of the present invention means The process by which ions are formed.

IRRADIATION In the context of the present invention means Exposure to radiant energy, such as heat, X-rays, or light; the product of irradiance and time.

JOULE In the context of the present invention means One watt per second; a measurement frequently given for laser output in pulsed operation.

KRYPTON LASER In the context of the present invention means A laser filled primarily with krypton gas. When used with "all-line' or 'white" optics, it produces red, yellow, green and blue light. A "red-only" krypton laser uses with specially tailored optics to output a very strong red line at 647 nm. Kryptons are similar to argons (the same tube design can be used for both). However krypton gas produce less light (output power) than an equivalent volume of argon gas. Krypton lasers are primarily used when a powerful red light is needed.

LASER In the context of the present invention means "Laser" is an acronym derived from "Light Amplification by Stimulated Emission of Radiation"

A device which produces a coherent beam of light. The beam remains parallel for long distances and contains one or more extremely pure colours.

Light show lasers are usually gas-filled tubes using high voltage current to ionise the gas (cause the gas to glow). Mirrors at each end of the tube help amplify a process called "stimulated emission". Most of the stimulated emission light travels between the two mirrors; between 1% and 4% comes out of one of the mirrors to create the beam of light that we see.

The gas used determines the colour (or colours) of the beam. Gas lasers remain the overwhelming choice for display applications. The four main types used are a helium neon mixture, argon, krypton; and an argon-krypton "mixed gas" mixture.

LASIER OSCILLATION In the context of the present invention means The buildup of the coherent wave between laser cavity end mirrors. In CW mode, the wave bounding back and forth between mirrors transmits a fraction of its energy on each trip; in pulsed operation, emission happens instantaneously.

LASER ROD In the context of the present invention means A solid-state, rod-shaped lasing medium in which ion excitation is caused by a source of intense light, such as a flashlamp Various materials are used for the rod, the earliest of which was synthetic ruby crystal.

LIGHT In the context of the present invention means The range of visible electromagnetic radiation frequencies detected by the eye, or the wavelength range from about 400 to 750 nanometers It is sometimes extended to include photovoltaic effects and radiation beyond visible limits.

LIGHT REGULATION In the context of the present invention means A form of power regulation in which output power is maintained at a constant level by controlling discharge current.

LUMINANCE In the context of the present invention means Commonly called illumination; the luminous or visible flux per unit area on a receiving surface at any given point.

MENISCUS LENS In the context of the present invention means The lens used primarily in C02 lasers by Coherent Inc. It has one side convex, the other concave.

METASTABLE, METASTABLE STATE In the context of the present invention means Unstable condition in which the energy of a molecule is at some discrete level above the lowest or ground state. It is this condition which is necessary for emission of photons in a laser. (From quantum theory.)

MILLIJOULE: One thousandth of a Joule

MILLIWATT In the context of the present invention means One thousand milliwatts equal one watt. Small lasers' beam powers are measured in milliwatts. For example, a 50 mW laser is one-twentieth of a watt; a 500 mW laser is one-half watt

MODE In the context of the present invention means A particular functioning arrangement, setup. or condition for laser operation, such as continuous emission, pulses7 or grouped pulses. "Mode" also describes the cross-sectional shape of the beam. (See "TEM.")

MODULATION In the context of the present invention means The ability to superimpose an external signal on the output beam of the laser as a control.

MONOCHROMATIC LIGHT In the context of the present invention means Theoretically, light consisting of just one wavelength. Since no light is completely monochromatic, it usually consists of a very narrow band of wavelengths. Lasers provide the narrowest bands.

NANOMETER In the context of the present invention means A unit of length in the International System of Units (SI) equal to one billionth of a meter (10-9 meter). Once called a millimicron, it is used to represent wavelength. Abbreviated "nm."

NEAR FIELD IMAGING In the context of the present invention means A solid-state Laser imaging technique offering control of spot size and hole geometry, adjustable working distance, uniform energy distribution, and easily produced range of spot sizes.

Nd:GLASS LASER In the context of the present invention means A solid-state laser of Neodymium: glass offering high power or short pulses, or both, for specific industrial applications.

Nd:YAG LASER In the context of the present invention means A solid-state laser of Neodymium:Yttrium-Aluminum Garnet, similar to the Nd:glass laser. Both are pumped by flash lamps, or diode lasers.

NEMA In the context of the present invention means National Electrical Manufacturers' Association, a group which defines and recommends safety standards for electrical equipment.

NOISE In the context of the present invention means Unwanted, minor currents or voltages in an electrical system.

OBJECT In the context of the present Invention means The subject matter or figure imaged by, or seen through, an optical system.

OPTICAL DENSITY In the Context of the present invention means Protection factor provided by a filter (such as used in eyewear, viewing windows, etc.) at a specific wavelength Each unit of CD represents a 1Ox increase in protection.

OPTICAL PUMPING In the context of the present Invention means Exciting the lasing medium by the application of light rather than electrical discharge from anode and cathode.

OUTPUT COUPLER In the context of the present invention means The resonator mirror which transmits light; the one at the Opposite end is totally reflective.

OUTPUT POWER In the Context of the present invention means The energy per second emitted from the laser in the form of coherent light, usually measured in watts for continuous-wave operation and joules for pulsed operation

PEEK POWER In the context of the present invention means The power of an individual pulse n a pulsed laser. it is obtained by dividing the pulse energy in Joules to the pulse width in seconds. Typical values can be reach Mega and Giga Watts.

PHOTOACOUSTIC EFFECTS In the context of the present invention means Arises with the use of very short-duration high-energy laser pulses, at pulse durations typically below 10 microseconds. Significant amounts of energy are absorbed and a rapid expansion occurs in the tissue generating an acoustic shock wave that causes mechanical disruption to cellular structures.

PHOTOCHEMICAL EFFECTS In the context of the present invention means Effects that occur from long exposure durations at incident power levels insufficient to cause damaging Photothermal effects. It is an energy dependent process (a function of the total quantity of radiation absorbed rather than its rate of absorption).

PHOTOMETER In the context of the present invention means An instrument which measures luminous intensity.

PHOTON In the context of the present invention means In quantum theory, the elemental unit of light, having both wave and particle behavior. It has motion, but no mass or charge.

PHOTOTHERMAL EFFECTS In the context of the present invention means The damage mechanism for acute laser injury (i.e. for injury immediately following exposure). The radiation incident at the surface is absorbed in the underlying tissue, increasing the temperature of the tissue to the level at which damage can occur, and laser burns result. It is a power dependent process (a function of the RATE at which energy is absorbed rather than the total quantity of energy involved).

PLASMA In the context of the present invention means In laser welding, a metal vapor that forms above the spot where the beam reacts with the metal surface. Also used to describe the laser tube (plasma tube, discharge tube) which contains the completely ionized gas in certain lasers.

POLARIZATION In the context of the present invention means Restriction of the vibrations of the electromagnetic field to a single plane, rather than the innumerable planes rotating about the vector axis. This prevents optical losses at interfaces between the lasing medium and optical elements. Various forms of polarization include random, linear (plane), vertical, horizontal, elliptical, and circular. Of two polarization components (so-called), S and P, the P component has zero losses at Brewster's angle.

POPULATION INVERSION In the context of the present invention means When more molecules (atoms, ions) in a laser are in a metastable state than in the ground state (a situation needed for sustaining a high rate of stimulated emissions), a "population inversion" is said to exist. Without a population inversion, there can be no lasing action.

POWER DENSITY: The amount of radiant power concentrated on a surface. Units Watts per square meters or square centimeters.

PULSE ENERGY In the context of the present invention means The energy of a single, brief emission from a laser programmed for pulsed behavior rather than continuous operation. Pulse power can be several times greater than CW emission.

PULSE TAIL In the context of the present invention means Pulse decay time, which can be shortened (by using a special mixture of gases) to allow for fast repetition of laser pulses within a given length of time.

Q-SWITCH In the context of the present invention means A device that has the effect of a shutter moving rapidly in and out of the beam to "spoil" the resonator's normal Q, keeping it low to prevent lasing action until a high level of energy is stored. Result: a giant pulse of power when normal Q is restored.

QUASI CW In the context of the present invention means The pulsating of a continious light into pulsed light by acusto optic, electrooptic, electronic, or mechano optical means, so peak powers are reduced, by number of pulses (see rep. Rate) are increased

RADIANCE In the context of the present invention means Brightness; the radiant energy per unit solid angle and per unit projected area of a radiating surface.

RADIANT ENERGY In the context of the present invention means Energy traveling as wave motion; specifically, the energy of electromagnetic waves (light, X-rays, radio, gamma rays).

RADIANT FLUX: The rate of emission or transmission of radiant energy.

RADIANT INTENSITY In the context of the present invention means Radiant power, or flux, expressed as emission per unit solid angle about the direction of the light in a given length of time

RADIANT POWER In the context of the present invention means The amount of radiant energy available per unit; the radiant flux.

REFLECTANCE In the context of the present invention means The ratio of the reflected flux to the incident flux, or the ratio of reflected light to light falling on the object.

Reflection In the context of the present invention means the return of radiant energy (incident light) by a surface, with no change in wavelength.

REFRACTION In the context of the present invention means The change of direction of propagation of any wave, such as an electromagnetic wave, when it passes from one medium to another in which the

wave velocity is different. Simply put, the bending of incident rays as they pass from one medium to another, such as air to water.

RESOLUTION In the context of the present invention means Resolving power, or the quantitative measure of the ability of an optical instrument to produce separable images of different points on an object; the capability of making distinguishable the individual parts of an object, closely adjacent images, or sources of light.

RESONATOR In the context of the present invention means The mirrors (or reflectors) making up the laser cavity containing the laser rod or tube. The mirrors reflect light back and forth to build up amplification under an external stimulus. Emission is through one of them, called a coupler, which is partially transmissive.

ROCKWELL C In the context of the present invention means A scale or test used to define hardness in metals, particularly steel and titanium.

SOLID-STATE LASER In the context of the present invention means A laser where the lasing medium is a solid material such as a ruby rod. These can be optically pumped by a flashlamp or diodes. Solid state lasers also include diode lasers as they use electrically pumped solids to produce light. Currently, solid-state lasers are too expensive for most light show uses. This may change over the next few years. The most promising solid-state laser uses a material called Nd:YAG, which produces infrared light. This can be frequency doubled (Second Harmonic Generation) to produce up to 60 watts of green light at 532 nm The green light can again frequency doubled (Fourth Harmonic Generation) to produce UV light at 266 nm, up to several watts.

SPECTRAL RESPONSE In the context of the present invention means The response of a device or material to monochromatic light as a function of wavelength.

STIMULATED EMISSION In the context of the present invention means When an atom, ion, or molecule capable of lasing is excited to a higher energy level by an electric charge or other means, it will Spontaneously emit a photon as it decays to the normal ground state. If that photon passes near another atom of the same frequency which is also at some metastable energy level, the second atom will be stimulated to emit a photon. Both photons will be of the same wavelength, phase, and spatial coherence. Light amplified in this manner is intense, coherent (collimated or parallel), and monochromatic. In short, laser light.

TEM In the context of the present invention means Abbreviation for Transverse

Electromagnetic Mode, the cross-sectional shape of the working laser beam. An infinite number of shapes can be produced, but only a relatively small number are needed for industrial applications. In general, "the higher the TEM, the coarser the focusing"

TEMOO: A Gaussian-curve mode that is the best collimated and produces the smallest spot of high power density for druling, welding and cutting.

TEMOI Divided into two equal beams for special applications.

THRESHOLD In the context of the present invention means During excitation of the laser medium, this is the point where lasing begins.

TRANSMISSION In the context of the present invention means In optics, the passage of radiant energy (light) through a medium.

TRANSMITTANCE In the context of the present invention means The ratio of transmitted radiant energy to incident radiant energy, or the fraction of light that passes through a medium.

VIGNETTING In the context of the present invention means The loss of light through an optical element when the entire bundle does not pass through; an image or picture that shades off gradually into the background.

VISIBLE LIGHT TRANSMISSION/TRANSMITTANCE In the context of the present invention means The amount of visible light usable to the eye that passes through a filter. As a rule of thumb, as optical density increases, visible light transmission decreases - but not always.

WATT In the context of the present invention means An objective measure of power; in lasers usually refers to the optical output power, or strength, of a laser beam. Watts are also used in a more conventional sense, to measure electrical power used by a laser. For example, a 10 W (optical) argon laser consumes around 10,000 W of electrical power.

WAVE In the context of the present invention means An undulation or vibration a form of movement by which all radiant energy of the electromagnetic spectrum is thought to travel.

WAVELENGTH In the context of the present invention means The fundamental property of light-the length of the light wave, which determines its color Common units of measurement (which is usually from crest to crest) are the micron, the nanometer, and (earlier) the angstrom. Visible light has wavelengths extending from about 700 nanometers (red) through orange (~600 nm), yellow (~580 nm), green (~550 nm), blue (~450 nm) and violet (~400 nm).

WHITE-LIGHT BEAM In the context of the present invention means Broadly, a laser beam which contains a number of different wavelengths (colours) so the beam appears white. If the beam is passed through a prism or diffraction grating, it is separated into individual laser beams, each of a single specific wavelength. More specifically, a white-light beam ideally contains twice as much red as green and blue light for correct colour balance (see appendix). It can be from a single white-light laser or from two or three lasers whose beams have been combined into a single beam. White-light beams are

primarily used in RGB laser projectors See the definition of white-light laser for more information on what constitutes an "equal mixture" of light.

WHITE-LIGHT LASER In the context of the present invention means Many lasers can produce a number of wavelengths (colours) simultaneously. A white-light laser is designed to give a good balance of red, green and blue wavelengths. Usually the laser is intended for an RGB laser projector. (Some models also deliberately add yellow light for specialised 4-colour projectors.) Most white-light lasers use an anrgon/krypton gas mixture. It is somewhat difficult to produce an equal balance of desired colours, and to keep this balance consistent during the lifetime of the laser tube. At present, there are no standards defining the exact wavelengths and colour proportions for a laser to be called "white-light" In addition, the sought-after colour balance can be defined either as equal amounts on a photometer, or as visually equal amounts. Since the eye is much more sensitive to green, a visually equal or "photopically balanced" laser has roughly five times more power in red and blue than in green. Most white-light lasers today are not photopically balanced.

WINDOW In the context of the present invention means A piece of glass with plane parallel sides which admits light into or through an optical system and excludes dirt and moisture.

In the context of the present invention Acquired immunodeficiency Syndrome means A life threatening disease caused by virus and characterized by breakdown of the body's immune defenses, specie specific calibration standards mean in the context of the present invention the efficient reduction of viruses which causing immunodeficiency syndromes without interfering with the body external surfaces.

In the context of the present invention Active immunity means that the immunity produced by the body in response to stimulation by a disease causing organism or vaccine, or treatment according to the present invention wherein blood is circulated in the body, or in loop to/from the body through optronic dialysis according to the methodology of the present invention and therapeutic responses are following as a result of the treatment according to the methodology of the present invention.

In the context of the present invention Agamaglobulinemia means An almost total lack of immunoglobulines, and/or antibodies.

In the context of the present invention Allergen means any substance that causes an Allergy, and/or allergic reaction by the misfunctioning of the MHC type 1, 2, 3, and/or any combination thereof.

In the context of the present invention Allergy means An inappropriate and harmful response of the immune system to normally harmless substances (i.e. see Alergic reaction as an example)

In the context of the present invention Anaphylactic Shoch a life threatening Alergic reaction characterized by swelling of the body tissues including the throat, difficulties in breathing, and a sudden fall in blood pressure.

In the context of the present invention Anergy means A state of unresponsiveness, induced when the T cell antigen receptor is stimulated, that effectively freezes T cell responses, pending a 2ND Signal from the Antigen presenting cell.

In the context of the present invention Antibody means a soluble protein molecule produced and secreted by B cell in the response to an antigen, which is capable of binding to the specific antigen.

In the context of the present invention Antibody-dependent Cell - mediated Citotoxicity (ADCC) means in the context of the present invention An immune response in which antibody, by coating target cells makes them vandurable to attack by immune cell (see coating and marking cells)

In the context of the present invention Antigen means any substance that, when in traduced into the body is recognized by the immune system.

In the context of the present invention Antigen presenting cells means B cells of the monocyt lineage (including macrophages as s dantritic cells), and various other body cells that present antigen in a form that T cells can recognize.

In the context of the present invention Anti nuclear antibody (ANA) means an autoantibody directed against a substance in the cell nucleus.

In the context of the present invention Antiserum means a Serum that contains antibodies.

In the con text of the present invention the refractiv index of water is 1.3, and the refractive index of air is 1.00, thus when light is coupled to a real time flowing liquid wave guide it getslocked, and relected by T.I.R (Total Internal Reflections) thus creating a lighjet (uvjet) according to the methodology of the present invention.

In the context of the present invention Antitoxins mean Antibodies that in terlockk with and inactivate toxins produced by certain bacteria.

In the context of the present invention Appendix means a lymphoid organ in the intestine.

In the context of the present invention Attenuated means a weakened; no longer infectious (innocuous form)

In the context of the present invention Autoantibody an antibody that reacts against persons own tissue.

In the context of the present invention Auoto immune desease a desease that result when the immune system mistakenly attacked the bodies own tissues. For example the Rheumatoid arthritis and systemic lupus erythematosus aree auto immune diseases.

In the context of the present invention Bacterium means a microscopic noxious microorganism composed of a single cell. Mant but not all bacteria cause desease.

In the context of the present invention Bassophile means A white blood cell that contributes to inflammatory reactions. A long with mast cells, Basophiles are responsible for the symptoms of Allergy. (and/or Alergic reactions).

In the context of the present invention B cells means small white blood cells crucial to the immune defenses. Also known as B lymphocites, they are derived from bon Marrow and develop into plasma cells that are the source of antibodies.

In the context of the present invention Biological response modifiers means a substances, either natural or synthesized, that boost, direct, or restore normal immune defenses. BRMs include interferons, interleukins, thymus hormones and monoclonal antibodies.

In the context of the present invention Biotechnology means the use of living organisms or their products to make or modify a substance. Biotechnology includes recombinant DNA technique (such as genetic engineering), and hybridoma technology.

In the context of the present invention Bon-marrow means soft tissue located in the cavities of the bones. The bone marrow is the source of all blood cells.

In the context of the present invention Cellular immunity means immune protection provided by the direct action of the immune cells (as distinct from soluble molecules such as antibodies).

In the context of the present invention Chromosomes mean physical structures in the cell's nucleus that have the genes. Each Human cell has 23 pares of chromosomes.

In the context of the present invention Clone A group of genetically identical cells or organisms descended from a single common ancestor., (v) to reproduce multiple identical copies.

In the context of the present invention Complement means a complex series of blood proteins whose action complements the work of antibodies. Complement destroys bacteria produces inflammation, and regulates the immune reactions.

In the context of the present invention Complement cascade means a precise sequence of events usually triggered by an antigen/antibody complex in which each component of the complement system is activated in turns.

In the context of the present invention Constant region means that part of an Antibody structure that is characteristic for each antibody class.

In the context of the present invention Co stimulation means the delivery of a 2nd signal from an antigen-presenting cell to a T cell. The 2nd signal rescues the activated T cell from Anergy, allowing it to produce the lymphokinds necessary for the growth of additional T cells.

In the context of the present invention Cytikines means powerful chemical substances secreted by Cells. Cytokines include lymphokines produced by lymphocytes and monokines produced by monycites and macrophages.

In the context of the present invention Dandritic cells means] white blood cells found in the spleen and other lymphoid organs. Dandritic cells typically use thread like tentacles to enmesh antigen, which they present to T cells.

In the context of the present invention DNA (deoxyribonucleic acid) means a nucleic acid that is found in the cell nucleus and that is the carrier or co. represents genetic information. (I.e. see RNA, Ribonucleic Acid or any combination thereof)

In the context of the present invention Enzyme means a protein; produced by living cells that promotes the chemical processes of life without itself being altered.

In the context of the present invention Eosinophil means a white blood cell that contains granules filled with chemicals damaging to parasites, and enzymes that damp down inflammatory reactions.

In the context of the present invention Epitop means a unique shape or marker carried on antigen's surface, which triggers a corresponding antibody response.

In the context of the present invention Fungus means a member of a class of relatively primitive vegetable organism. Fungi include mushrooms, yeast, rusts, molds and smuts.

In the context of the present invention Gene means a unit of genetic material (DNA) that carries the directions a cell uses to perform a specific function, such as making a given protein.

In the context of the present invention Graft-versus-host disease (GVHD) means a life threatening reaction in which transplanted immunocompetent cells attack the tissues of the recipient (such as in transplant medical procedures).

In the context of the present invention Granulocytes means A white blood cell file with granules containing potent chemicals that allow the cell to digest micro organisms (noxious types and non noxious types) or to produce inflammatory reactions. Neutrophiles eosinophiles and basophiles are examples of granulocytes.

In the context of the present invention Helper T cells means A subset of T cells that tipically carry the T4 marker and are essential for turning on the antibody production, activating cytotoxic T cells, and initiating many other immune responses.

In the context of the present invention Hematopoiesis means the formation and development of blood cells, usually takes place in the bone marrow.

In the context of the present invention Histo Compatibility Testing means A method of matching the self-antigens (HLA) on the tissues of a transplant doner with those of the recipient. The closer the natch, the better the chance that the transplant procedure will be successful "and will take"

In the context of the present invention HIV means (Human Immunodificiancy virus) it is the virus that causes AIDS.

In the context of the present invention Human lococyte antigens (HLA) means a protein in markers of self use in histocompatibility testing. Soma HLA types also correlate with certain autoimmune diseases.

In the context of the present invention Humoral immunity means an immune protection provided by the soluble factors such as antobodies, which circulate in the body fluids or Humors, primarily Serum and lymph.

In the context of the present invention Hybridoma means A Hybrid cell created by fusing B lymphocytes with as long lived neoplastic plasma cell or T lymphocyte with a lymphoma cell. B cell Hybridoma secretes a signal specific antibody.

In the context of the present invention VOCs reduction means reduction of volatile organic compounds by the use of a flowing liquid wave guide (could be used also for TOC reduction in the same principle)

In the context of the present invention Hypogammmaglobuilinemia means is an abnormally low level of immunoglobuline.

In the context of the present invention Ideotypes means a unique and characteristic part of an antibody variable region, which can dam cells serve as antigens.

In the context of the present invention Immune Complex (IC) means a Cluster of interleukines, antigens and antibodies.

In the context of the present invention Immune response means the reactions of the immune system to foreign substances.

In the context of the present invention Immunoassay means A test using antibodies to identify and quantify substances. Often the antibody is link to a marker such as a fluorescent molecule, a radio active molecule or an enzyme type, or combination of the above

In the context of the present invention Immunocompetent means the capability of developing an immune response.

In the context of the present invention Immunoglobulines means a family of large protein molecules also known as antibodies.

In the context of the present invention Immunosupression means A reduction of the immunresponses for instance by giving drugs to prevent transplant rejection/s.

In the context of the present invention Immunotoxines A monoclonal antibody linked to a natural toxins, a toxic drugs or radioactive substance or combination.

In the context of the present invention Inflammatory response means A redness, warmth, swelling, pain, and/or loss of function produced in response to infection as the result of increased flood flow and an influx of immune cells and secretions.

In the context of the present invention I8nterleukines means A major group of lymphokines and monokines.

In the context of the present invention Kupffer cells means specialized macrophages in the liver.

In the context of the present invention LAK cells means lymphocytes transformed in the laboratory into lymphokines activated Killer cells, which attack tumor cells.

In the context of the present invention Langerhans cells means A drandritic cells in the skin that pick up antigen and transport it to lymph nodes.

In the context of the present invention Leukocytes and all white blood cells.

In the context of the present invention Lymph means a transparent, slightly yellow fluid that carries lymphocytes, bathes the body tissues, and drains into the lymphatic vessels.

In the context of the present invention In the context of the present invention Lymphatic vessels mean a body-wide network of channels, similar to the blood vessels, which transport lymph to the immune organs and into the bloodstream.

In the context of the present invention Lymph nodes mean small bean-shaped organs of the immune system, distributed widely throughout the body and linked by lymphatic vessels. Lymph nodes are garrisons of B, T, and other immune cells.

In the context of the present invention Lymphocyte means small white blood cells produced in the lymphoid organs and paramount in the immune defenses.

In the context of the present invention Lymphoid organs mean the organs of the immune system, where lymphocytes develop and congregate. They include the bone marrow, thymus, lymph nodes, spleen, and various other clusters of lymphoid tissue. The blood vessel and lymphatic vessels can also be considered lymphoid organs.

In the context of the present invention Lymphokines means powerful chemical substances secreted by lymphocytes. These soluble molecules help direct and regulate the immune responses.

In the context of the present invention Macrophages mean a large and versatile immune cell that acts as a microbe-devouring phagocyte, an antigen-presenting cell, and an important source of immune secretions.

In the context of the present invention Major histocompatibility complex (MHS) means a group of genes that controls several aspects of the immune response. MHC genes code for self-markers on all body cells.

In the context of the present invention Mast cells means a granule-containing cell found in tissue. The contents of mast cells, along with those of basophils, are responsible for the symptoms of allergy.

In the context of the present invention Microbes means minute living organisms, including bacteria, viruses, fungi and protozoa.

In the context of the present invention Microorganisms means microscopic plants or animals.

In the context of the present invention Molecule means the smallest amount of a specific chemical substance that can exist alone. (The break a molecule down into its constituent atoms is to change its character. A molecule of water, for instance, reverts to oxygen and hydrogen).

In the context of the present invention Monoclonal antibodies mean antibodies produced by a single cell or its identical progeny, specific for a given antigen. As a tool for binding to specific protein molecules, monoclonal antibodies are invaluable in research, medicine and industry.

Monocyte means a large phagocytic white blood cell which, when it enters tissue, develops into a macrophage.

In the context of the present invention Monokines means powerful chemical substances secreted by monocytes and macrophages. These soluble molecules help direct and regulate the immune responses.

In the context of the present invention Natural killer (NK) cells mean large granule-filled lymphocytes that take on tumor cells and infected body cells. They are known as natural killers because they attack without first having to recognize specific antigens.

In the context of the present invention Neutrophil means a white blood cell that is an abundant and important phagocyte.

In the context of the present invention Nucleic acids means large, naturally occurring molecules composed of chemical building blocks known as nucleotides. There are two kinds of nucleic acids, DNA and RNA.

In the context of the present invention OKT3 means a monoclonal antibody that targets mature T cells.

In the context of the present invention Opportunistic infection means an infection in an immunosuppressed person caused by an organism that does not usually trouble people with healthy immune systems.

In the context of the present invention Opsonize means to coat an organism with antibodies or complement protein so as to make it palatable to phagocytes.

In the context of the present invention Organism means an individual living thing.

In the context of the present invention Parasite means a plant or animal that lives, grows, and feeds on or within another living organism.

In the context of the present invention Passive immunity means immunity resulting from the transfer of antibodies or antiserum produced by another individual.

In the context of the present invention Peyer's patches means a collection of lymphoides tissues in the intestinal tract.

In the context of the present invention Phagosites means a large white blood cells that contribute to the immune defenses by ingesting microbes or other cells and/or forign particles.

In the context of the present invention Plasma cells means a large antibody producing cell that develops from B cell.

In the context of the present invention Platelets mean A granule containing cellular fragments critical for blood clotting and sealing of wounds. Platelets also contribute to the immune response.

In the context of the present invention Plymorphes means short for Poly Morpho Neuclear locosytes or granulocytes.

In the context of the present invention Proteins means an organic compound made up of aminoacids. Proteins are one of the major constituents of plants and animals and human cells.

In the context of the present invention Protozoa means a group of one-celled animals few of, which can cause Human desease (including maleria and sleepoing sickness types)

In the context of the present invention Rheumatoid factor means an auto antibody found in the serum of most persons with rheumatoid arthritis.

In the context of the present invention RNA (Ribonucleic Acid) a nucleic acid that is found in the cytoplasm and also in the nucleus of some cells. One function of RNA is to direct the synthesis of proteins.

In the context of the present invention Scavenger cells means any of the diverse groups of cells that have the capability to engulf and destroy foreign materials, dead tissues, or other cells.

In the context of the present invention SCID mouse a laboratory animal that, lacking enzyme necessary to fashion an immune system of its own, can be turned into a model of the human immune system when injected with human cells or tissues.

In the context of the present invention Serum means a clear liquid that separates from the blood when it is allowed to clot these fluids retains any antibodies that were present in the whole blood.

In the context of the present invention Severe combined immunodefficency desease (SCID) means A life threatening condition in which infants are born lacking all major immune defenses.

In the context of the present invention Splin means a lymphoid organ in the abdominal cavity that is important center for immune system activities.

In the context of the present invention Stem cells mean Cells from which all blood cells are derived. The bone marrow is rich in stem cells.

In the context of the present invention Suunit vaccine means a vaccine that uses marely one component of an infectious agent rather then the whole to stimulate an immune response.

In the context of the present invention Supeantigens means a class of antigens, including certain bacterial toxins that unleash a massive and damaging immune response.

In the context of the present invention Suppresser T cells means a subset of T cells that turn off antibody production and other immune response.

In the context of the present invention T cells means small white blood cells that orchestrate and/or directly participate in the immune defenses. Also known as T lymphocytes, they are processed in the thymus and secret lymphokines.

In the context of the present invention Thymus means a primary lymphoides organ, high in the chest where T lymphocyte proliferate and mature.

In the context of the present invention TIL means a tumor Infiltrating Lymphocytes. These immune cells are extracted from a tumor tissue, treated in laboratory and re-injected into the cancer patient.

In the context of the present invention Tissue typing means (see MHC, Major Histocompatibility Testing HCT).

In the context of the present invention Tolerance a state of nonresponsivnes to a particular antigen or group of antigens.

In the context of the present invention Tonsils and adenoids means are a prominent oval massive of lymphoid tissues on either side of the throat.

In the context of the present invention Toxins means agents produced by plants and bacteria, normally very damaging to mammalian cells, that can be delivered directly to target cells by lionkiun gthenm to monoclonal antibodies or lymphokines.

In the context of the present invention Vaccine means a substance that contains antigenic components from an infectious organism by stimulating an immune response (but not disease) it protect against subsequent infection by that organism.

In the context of the present invention Variable region means that part of an antibody structure that differs from one antibody to another.

In the context of the present invention Virus means a sub-microscopic microbe that causes infectious disease. A virus can reproduce only in living cells.

In the context of the present invention Libido- pranic a state of increased vitality (i.e. the word prana, pranic means vitality, or states of ample vitality), or such states in which the body is tuned, and the immune system is at rest, empowered by biological traces of specific origin, and nature. Libido is the

sensual drive induced as a result of the body being tuned, and/or referenced, and systems in the body aren't over loaded, and thus a state of improved feelings is induced, i.e. a libido-pranic state.

In the context of the present invention Resonativistic means a state of resonance created when energy of high peak powers is being applied, projected into, coupled to, or are being generated into biomass, such resonance is subject to the expansion In the context of the present invention ration, or density of the holding media, or medium, the term represent a state in which light and sound, ultrasound and mechanical, and physiological process are occurring and causing resonance which when said resonance utilizes the individual resonance of elements, organs, or cells of the noxious species, and could identify, or recognize, separate, sort and inactivate, dissociate, or vibrate said biomass,

In the context of the present invention The following terms included to improve the understanding of photochemistry the specific context have been selected for benefits of clarity and familiarization.

Physical Constants of interest in Ultraviolet and Photochemistry means

Constant	Symbol	Value	Units
Speed of light	c	2.99792458x108	M s (-1)
Charge on electron	e	1.60217733x10(-19)	C
Planck constant	h	6.6260755 x10 (-34)	J s
Boltzmann constant	k	k 1.380658x10 (-23)	J K (-1)
Avogadro number	NA	6.0221367 x 1023	mol (-1)
Gas constant	R	8.31451	J mol (-1) K (-1)

Further Characteristics of light and context explanatory notes are herewith included:

In the context of the present invention Planck Law of Radiation means in the context of the present invention:

Light which has both particle and wave properties. It is transmitted in discrete packets of energy (photons) and yet has a frequency and wavelength. The connection between these two properties is embodied in the Planck flaw of Radiation

In the context of the present invention Photochemical wave changes means in the context of the present invention:

In the context of the present invention The usual wavelength range in Photochemistry is 100 - 1000 nm. Light photons with wavelengths longer than 1000 nm have a photon energy too Small to cause chemical change when absorbed, and photons with wavelengths shorter than 100 nm have so much energy that ionization and molecular disruptions characteristic of radiation chemistry prevail. The total In the context of the present invention photochemical wavelength range is divided up into bands with specific names as given below.

In the context of the present invention Spectral ranges or interest in Photochemistry means in the context of the present invention:

Range Name	Wavelength
Near Infrared	700-10000
Visible	400 - 700
Ultraviolet	
UVA	315 -400
UVB	280-315
UVC	100-280

Little photochemistry occurs in the Near Infrared. Except for some photosynthetic bacteria. Which are capable of storing solar energy at wavelengths out to 980 nm. The Visible range is completely active for photosynthesis in green plants and algae. Also many dyes can undergo photochemical transformations themselves or sensitize reactions in other molecules. Most studies in photochemistry involve the Ultraviolet range. The division into three sub-ranges [UVA, UVB, UVC] is connected with the human skin's sensitivity to ultraviolet light. The UVA range causes changes in the skin that lead to sun tanning. The UVB range can cause sun burning and is known to eventually induce skin cancer. The UVC range is extremely dangerous since it is absorbed by proteins, RNA and DNA and can lead to cell mutations and/or cell death. The UVC range is sometimes called the germicidal range, since it is very effective in inactivating bacteria and viruses. The Vacuum Ultraviolet range is absorbed by almost all substances (including water and air). Thus it can only be transmitted in a vacuum. The absorption of a VUV photon causes one or more bond

Breaks. However, even though photons with wavelengths less than 561.6 nm are capable of splitting the H202 molecule, no photolysis, or proteolysis occurs in this wavelength region because H202 does not begin to absorb ultraviolet light until below 300 nm. This illustrates the first Law of Photochemistry; namely that no photochemical reaction can occur unless a photon/s of light is absorbed.

In the context of the present invention Coherent and incoherent light means Light sources used in photochemistry can either be coherent (all emitted photons are in phase with each other as they propagate) or incoherent (all emitted photons have random phases). All lasers emit coherent radiation and usually at one wavelength. The dispersion is very small so that a laser beam remains at or near its original diameter as it propagates; the light emitted by all other light sources is almost always incoherent. Most of these sources are,either "hot element" sources (e.g., the incandescent light bulb) or "plasma" sources (e.g., a fluorescent light tube).

In the context of the present invention Point sources, means Light sources have finite dimensions (e.g., often a cylindrical shape). Emission from such a source is difficult to treat mathematically. It is convenient to mode] these sources as a collection of point sources, in which all light is emitted from the point equally in all directions. The optics treatment for point sources is especially simple.

In the context of the present invention The Terms and concepts associated with the emission of tight, are herewith included for clarity of explanation and to simplify the understanding of the method of the present invention, especially wherein photochemistry is involved, or photochemical polishing is active in the processing according to the present invention:

The light emitted from a source can be viewed in many different ways. In this Section, the various terms that may be used to describe this emission are defined and explained.

In the context of the present invention Radiant energy means:

Radiant energy (Q) is a total amount of radiant emission (J) from a source over a given period of time,

In the context of the present invention Radiant power means:

The radiant power (P) of a source is the rate of radiant energy or total radiant power (W) emitted in all directions by a light source. For example, the radiant power of the Sun is 3-842 x 1026 w. in theory, P, should include all wavelengths emitted by the source; however, ~ is usually restricted to the wavelength range of interest to photochemistry. For example, if a light source were being used for ultraviolet photochemistry, P would be specified for emission in the 200 - 400 nm ultraviolet ranges.

In the context of the present invention Radiant power efficiency means:

The radiant power efficiency (q) is defined as

$$Q = P/e$$

Where e is the input electrical power (W) supply.

Radiant emittance or excitance means:

The r Radiant emittance or excitance of a source is the radiant power emitted from an infinitesimal area on the surface of the source.

In the context of the present invention Radiant Intensity means:

The radiant intensity (I) (W sr^(-1)) is the total radiant power P emitted by a source in a given direction about an infinitesimal solid angle.

Radiance means:

Radiance (L) is defined as the radiant power d^2P, emitted from an infinitesimal area dA of the source surface in a given direction about the solid angle di, divided both by the solid angle di) and the orthogonal projected area.

The emittance M from an infinitesimal surface element dA is obtained by integrating L in spherical polar coordinates over the hemisphere of all outward-bound directions above dA.

An isotropic light source is defined as one in which the radiance L is uniform over all

Outward directions. Terms and concepts associated with the receipt of light When light is emitted from a source, it radiates outward at the speed of light, when it impinges on an object, it may be reflected, transmitted or absorbed. There are several terms that relate to the receipt of light.

Fluence Rate means:

Fluence Rate (E) (W m^(-2) is the radiant power of all wavelengths passing from all

Directions through an infinitesimally small sphere of cross-sectional area d, divided by CM

Irradiance means:

Irradiance (symbol E; units W m^(-2) is defined as the total radiant power of wavelengths incident on an infinitesimal element of surface of area as containing the point under consideration divided by as. The following are some important points regarding characteristics and differences between "irradiance" and "fluence rate":

Examples: For a parallel and perpendicularly incident beam, not scattered or reflected, irradiance and fluence rate becomes identical. For any UV source within a three-dimensional volume, the integration of UV irradiance over the interior surface of the volume yields the UV power of the lamp., This is not true for UV fluence rate.

The appropriate term for UV disinfection is "UV fluence rate" because a

Microorganism can receive UV power from any direction, especially when there is more than one UV lamp in the vicinity. In general usage, the irradiance or fluence rate may be expressed as MW cm^(-2). The irradiance is often incorrectly termed "light intensity" see the proper definition of "radiant intensity" above.

Light dose or fluence means:

The light dose or fluence (symbol H. units J m~2) is the total radiant energy of all

Wavelengths passing from all directions through an infinitesimally small sphere of cross-sectional area dA, divided by dA It is given by the average fluence rate times the exposure tune in seconds. The term UV dose is often used in UV disinfection literature. It represents the UV exposure of a given organism in the germicidal range.

Spectral units means:

All of the terms for tight emission or incidence refer to all relevant wavelengths. One can define spectral derivatives for each of these terms. For example. the light power emission of a LIV lamp is often expressed as the spectral power (W nm^(-1), defined as the power output in a narrow wavelength band divided by the width of the band. The solar spectrum received at the Earth's surface is described in terms of the solar spectrum irradiance. Also the spectral distribution of a lamp emission is often given an a plot of spectral power versus wavelength.

Photon based units means:

Photochemistry involves the interaction of photons of light with molecules and means: the definitions units that are based on photons.

Photon irradiance, photon fluence rate and photon flow means:

Each of the spectral terms can be convened to a corresponding equivalent photon flow and fluence rate ' by dividing the term by the average photon energy in the narrow wavelength band.

Quantum yield means:

The quantum yield (unites) Q is a measure of the photon efficiency of a photochemical reaction. e Is defined as the number of moles of product formed or reactant removed (P) per Einstein of photons absorbed

Line sources means:

When atoms are raised to an excited state, they emit only in very narrow lines with

Virtually no emission between the lines. The low-pressure mercury lamp is a very

Common lamp of this type. Table 3 gives the wavelengths and relative emittance for the emission lines of a low-pressure mercury vapor lamp.

Certain radiation units and associated light sources, (lasers) and lamps emit at longer wavelengths, This is the basis of the very popular fluorescent lamp.

For example, The emission lines of a mercury lamp are only sharp when the pressure of the gas is low (<10 tore). If the pressure is increased, the lamp can carry much more power, but the emission lines broaden. For the same length of lamp (about 120cm), a medium pressure lamp (pressure about 1000 tore) can carry up to 30,000W. These lamps are very common in commercial Systems utilizing ultraviolet light. Figure 5 shows a comparison of the emission of low pressure and medium pressure lamps in the ultraviolet region.

Excimer lamps means:

Excimer lamps arc unique in that they emit in a narrow band of wavelengths. An excimer is an atomic dimmer that is stable only in the excited state and dissociates on decaying to the ground state. Table 4 gives the wavelengths of sonic of the common excimer lamps.

Examples: Emission wavelengths (or some common excimer lamps

Excimer	Wavelength (nm)	Excimer	Wavelength (nm)
Xe2	172	XeCl	308
KrCl	222	I2	342
Cl2	259		

Flash lamps

Flash lamps are similar to continuous wave (CW), but could also operate in (PW), pulsed mode operation, and are lamps that consist of a cylindrical quartz tube with electrodes at each end and filled with a ga.½ (e.g.. xenon). A power supply "fires' the lamps by discharging a large amount of electrical energy in a very short period of time (several us) by applying a very high voltage (10 - 30 kV}. The resulting plasma reaches temperatures of 10,000 - 13,000 K and the emission is essentially that of a blackbody (see Fig. 4). In commercial flash lamp Systems the lamp , a typical "flashed" about 30 times per s, but given a special electronic pulsing circuitry is added, repetition rates could reach Khz regime.

FEL means Free Electron Laser and its derivatives, wherein space charged technologies (such as the Electrostatically Accelerated Free Electron Laser) include an electronic pulsing circuits, charging, or an accelerator (Such as R.F. Linac) is involved in the production of photons (around 100, 000,000 photons per electrons, in contradistinction of a conventional crystal based laser having around 1 photon per electron, it is a laser which have less maintenance associated with its operation and its wall plug efficiency is reaching around the 40-51% respectively, and respectfully of the exact pumping geometry used.

The term EAFEL means Electrostaticely Accelerated Free Electron Laser and is an extremely efficient laser pumping geometry wherein recycling of the Accelerated electrons is being performed by utilizing deceleration techniques and its wall plug efficiency is estimated to reach in access of the 55% (amount of light being produced or converted from the electricity being consumed for its operation.

Biologically enhanced or photo-chemically polished drinking water or breathing air means any liquid or gas which have been passed through or processed by the method of the present invention such as water and/or air), more specifically such processes involved in the polishing and enhancing may include; Optical inactivation, disinfection, inactivation of DNA and/or RNA replication sequences, Photocatalysis, electro catalysis, a hybrid of photo and electro-catalysis, optical dissociation, physiological dissociation, biomass expansion, filtration (pre/post), physical separation and sorting, reactivation, activation, sonication, acoustics, electroacoustics, electro-optical treatment (by photons of light), transgressing, or transversing said liquids and gasses through a photonic band gaped wave guides having an aerobic, non toxic passage for light and liquids or gasses or combination together, synchronously and or separately.

Peak power means, the energy generated when squeezing (i.e. such as when pulsing) electromagnetic energy in short duration of time, for example: a pulse of a given average energy and power – lasting, or having a pulse width of around 1 second (1s) will generate several watts in peak power, a pulse lasting or having width of microseconds (ms) will generate peak powers reaching the kilo-watts scale, while a pulse lasting nano (ns) seconds will generate peak powers reaching into the hundreds of million of watts which is especially beneficial for purposes such as optical dissociation, optical inactivation, optical polishing, and optical secretion and spectroscopy for control and diagnostics, so in short the shorter the pulse duration the higher its respective peak power.

Multi-photon – absorption - processes means a processes which when harnessed could be very beneficial for the photochemistry involved in the processing according to the present invention, for example when 10mj of energy (250,000 photons) are projected into a liquid or gas, the time it takes this projection is very important, if these photons will be furnished over 1 second time domain, then it leaves sufficient time for the electrons in said liquid or gasses, to relax back to the relaxed state, but if we apply these photons in a time domain of 5 nano seconds, then we do not leave time for the electrons to

relaxed and the processes is called Multiphoton absorption processes, this processes are non linear in nature and yield much higher quantum yield , or efficiencies, or speed of the reactivation, or a more efficient methodology for optical treatment, processing and polishing

A hybrid of light sources means plurality of light sources and wherein their total spectral emitence, or total spectral distribution, or their total irradiance will cause multiphotonic absorption processes by means of super imposing their time domain (example: 1 light source is slow = 1s pulse duration, and additional light sources are very fast =5ns laser for example), their total irradiance is great and beneficial for the processes of the method of the present invention to occur efficiently, further more, such hybridization could includes, lamps and lasers, lasers and flash lamps, or any combination of CW, or PW type of light source working together, in synchronisity, and or sequentially or link or resolved by time domain manipulation for maximizing photonic interaction in matter, especially beneficial for triggering th catalytic scentiliting elemental compound according to the present onvention.

Photo catalysis means: The use of energy of a photon of light to catalyze chemical reactions. More specifically, such reaction may include the decomposition of water into hydrogen, and oxygen, and the complete oxidation of organic contaminants in aqueous environments. More specifically, the first step in Photocatalysis is for the catalyst material to absorb photon of light in order to excite an electron from the velance band (VB), to the conduction band (CB), thus creating electron-hole-pairs. Each Species must then migrate to the surface before recombination occurs. If this condition is met, the electron can be transferred to a surface adsorbed molecule, reducing it. The overall process is illustrated , it is important to note that for the processes to occur efficiently (preventing pre-matured recombination of the said electron-hole pairs), the rates of reduction, and the oxidation must be comperable.The position of the band edges is critical for each step of the process, a photocatalyst material which is stable in water is tio2, (or known as Titanium Oxide).

Electrocatalysis, similar to that explained in photo-catalysis, but instead of photons, an electrical charge is used, through the use of semiconductor material which has been specially selected (its band gap) for the charge applied, for the context of the present invention an electrocatalysis, stable in water is I.T.O, or known in its chemical name and signature Indium Tinoxide). Further more, it is especially beneficial to combine, and operate both electrocatalysis, and photo-catalysis simultaneously, or serially, or sequentially or in unison, or each separate catalytic is triggered separately in order to maximize the collective efficiencies, thus harnessing and improving the performance of current and future catalytic technologcal evolution according to the methodology of the present invention.

<TBODY>ablation in the context of the present invention means the removal of material or tissue by melting, evaporation, or vaporization.

absorb in the context of the present invention means to transform radiant energy into a different form, usually with a resultant rise in temperature.

absorbance in the context of the present invention means the ability of a medium to absorb radiation depending on temperature and wavelength. expressed as the negative common logarithm of the transmittance.

absorption coefficient in the context of the present invention means the amount of radiant energy absorbed per unit or path-length.

active medium in the context of the present invention means a medium in which lasing will take place, rather than absorption, at a given wavelength.

afocal in the context of the present invention means literally, "without a focal length"; an optical system with its object and image point at infinity.

air-cooled laser in the context of the present invention means a laser using fans to force air over the laser tube and through the power supply. air-cooled lasers have the benefit of needing no water supply, although the fan noise can sometimes be a disadvantage. usually only small and medium power lasers are air-cooled. very small lasers, typically helium-neon, need no fans. although technically they are "air cooled" via convection, the term is usually applied only to fan-forced cooling.

amplification in the context of the present invention means the growth of the radiation field in the laser resonator cavity. as the light wave bounces back and forth between the cavity mirrors, it is amp stimulated emission on each pass through the active medium.

amplitude in the context of the present invention means the maximum value of the electromagnetic wave, measured from the mean to the extreme; put simply, the height of the wave.

angstrom unit in the context of the present invention means a unit of measurement for a wavelength of light (written å), equal to one ten billionth of a meter (10-10 meter). occasionally still used.

anode in the context of the present invention means an electrical element in laser excitation which attracts electrons from a cathode. an anode can be cooled directly by water or by radiation.

ar coatings in the context of the present invention means anti-reflection coatings, used on the backs of laser output mirrors to suppress unwanted multiple reflections which reduce power.

argon laser in the context of the present invention means a laser filled with argon gas. it gives off green and blue light. the strongest lines are at 514 nm (green) and 488 nm (blue). argons range from small 15

milliwatt 110 volt air-cooled models to large 50 watt 440 volt water-cooled systems. argon lasers are the most common type of light show lasers since they provide unable brightness at a reasonable cost.

average power in the context of the present invention means the sums of the energy of all single discrete pulses, in one second, of a pulsed laser.

autocollimator in the context of the present invention means a single instrument combining the functions of a telescope and a collimator to detect small angular displacements of a mirror by means of its own collimated light.

axial-flow laser in the context of the present invention means the simplest and most efficient of the gas lasers. an axial flow of gas is maintained through the tube to replace those gas molecules depleted by the electrical discharge used to excite the gas molecules to the lasing state.

axis, optical axis in the context of the present invention means the optical center-line for a lens system; the line passing through the centers of curvature of the optical surfaces of a lens.

beam diameter in the context of the present invention means the diameter of that portion of the beam which contains 86% of the output power.

beam expander in the context of the present invention means optical device increasing beam diameter and reducing divergence.

beam splitting in the context of the present invention means optically splitting a laser beam into two or more beams, of various or identical energys.

brewster windows in the context of the present invention means the transmissive end (or both ends) of the laser tube, made of transparent optical material and set at brewster's angle in gas lasers to achieve zero reflective loss of vertically polarized light. non-standard on industrial lasers, but a must if polarization is desired.

brightness in the context of the present invention means the visual sensation of the luminous power of a light beam, as opposed to scientifically measured power of the beam.

calorimeter in the context of the present invention means an instrument which measures the heat generated by absorption of the laser beam—another way to measure laser power.

cathode in the context of the present invention means the element providing the electrons for the electrical discharge used to excite the lasing medium.

co2 laser in the context of the present invention means a laser largely used in industry in which the primary lasing medium is carbon dioxide.

coaxial gas in the context of the present invention means most laser welding is done with a shield of inert gas flowing over the work surface to prevent plasma oxidation and absorption, to blow away debris, and to control heat reaction. the gas jet has the same axis as the beam so the two can be aimed together.

coherent light, coherent radiation in the context of the present invention means radiation composed of wave trains vibrating in phase with each other. coherent light waves all travel the same direction (spatial coherence) at the same frequency and in phase (temporal coherence). a laser produces coherent light, conventional light sources produce incoherent light.

collimated light in the context of the present invention means beam light rays traveling parallel to each other.

collimation in the context of the present invention means the process by which divergent rays are converted into parallel rays.

convergence in the context of the present invention means the bending of light rays toward each other, as by a positive (convex) lens.

current saturation in the context of the present invention means maximum flow of electric force in a conductor; in a laser, the point at which further electrical charge will not increase lasing action.

cw in the context of the present invention means an abbreviation of continuous wave of a laser as opposed to pulsed operation.

depth of field in the context of the present invention means the working range of the beam, a function of wavelength, diameter of the unfocused beam, and focal length of the lens. to achieve a small diameter spot size, and thus a high power density, a short depth of field must be accepted.

Water laser in the context of the present invention means the creation of lasing in the water (i.e. while flowing), thus harnessing the flowing liquid wave guide for the formation of a flowing light guiding cavity whicg could be utilized to create a water laser.

dichroic filters and mirrors in the context of the present invention means a piece of glass with an optical thin-film coating that transmits certain colours (wavelengths), and reflects the remaining colours. dichroic filters are used to combine or eliminate specific colours as needed in a laser projector. dichroic mirrors are used to maximise the amount of light reflected from a laser of a particular wavelength. dichroics should be handled with care to prevent damage to the coating. [see also: colour box]

diode laser in the context of the present invention means a semiconductor similar to an led (light-emitting diode) but which produces coherent light. diode lasers are small and efficient, which has led to their use in compact disc players and pen-type laser pointers. currently, diode lasers are too dim or expensive for most light show uses. this is likely to change over the next few years. [see also: solid-state laser]

divergence in the context of the present invention means the angle at which the laser beam spreads in the far field; the bending of rays away from each other, as by a concave lens or convex mirror.

drift, angular in the context of the present invention means all undesirable variations in output (either amplitude or frequency); angular drift of the beam, measured in milliradians before, during, and after warm-up.

duty cycle in the context of the present invention means the length of time the laser beam is actually cutting, drilling, welding, or heat-treating, as compared to the entire work cycle time.

electromagnetic wave in the context of the present invention means a disturbance which propagates outward from an electric charge which oscillates or is accelerated. includes radio waves; x-rays; gamma rays; and infrared, ultraviolet, and visible light.

emissivity, emittance in the context of the present invention means rate at which emission takes place; the ratio of the radiant energy emitted by a source or surface to that emitted by a blackbody at the same temperature.

exposure in the context of the present invention means a measure of the total radiant energy incident on a surface per unit area; radiant exposure.

far-field imaging in the context of the present invention means an imaging technique with solid-state lasers that has several limitations: non-uniform energy distribution, very short working distances, and poor control of hole geometry.

fiber optic cable in the context of the present invention means flexible glass or plastic strands made into a cable, used to carry light from one place to another. there are two main types; step index and graded index fiber. within these two main types there are two further subgroups:

transmission fibers carry the beam with as little loss as possible. they are used to transmit the laser's light to remotely located projection devices.

display fibers [also knows as side glow fibers] have no cable jacket, so some light scatters out the side of the strands. the strands themselves look like microscopic neon tubing and become a special effect, such as a laser-lit "whip" or a glowing "rope" wrapped around objects.

flashlamp in the context of the present invention means source of powerful light; often in the form of a helical coil and used to excite photon emission in a solid-state laser.

fluorescence in the context of the present invention means the glow induced in a material when bombarded by light. brewster windows of fused silica fluoresce in uv light, increasing absorption of laser radiation and degrading laser mode and output.

flux in the context of the present invention means the radiant, or luminous, power of a light beam; the time rate of the flow of radiant energy across a given surface.

focus in the context of the present invention means noun: the point where rays of light meet which have been converged by a lens. verb: to adjust focal length for the clearest image.

focal point in the context of the present invention means (same as first definition under "focus;" in laser work,) the focal point of the beam relative to the work surface has a critical effect, such as the depth and shape of drilled holes. when the focal point is at the surface, holes are of uniform diameter. when the focus is below the surface, conical holes are drilled.

folded resonator in the context of the present invention means construction in which the interior optical path is bent by mirrors mounted on corner blocks bolted into pre-aligned position, permitting compact packaging of a long laser cavity.

frequency in the context of the present invention means the number of light waves passing a fixed point unit of time, or the number of complete vibrations in that period of time.

gain in the context of the present invention means another term for amplification, usually referring to the efficiency of a lasing medium in attaining a population inversion. high gain is typically more than 50% per pass of the light wave between cavity mirrors.

gas discharge laser in the context of the present invention means a laser containing a gaseous lasing medium in a glass tube in which a constant flow of gas replenishes the molecules depleted by the electricity or chemicals used for excitation. the discharged gas can be filtered and 90% recycled for economy.

gas jet assist in the context of the present invention means an assisting coaxial gas, such as oxygen, argon, or nitrogen, which may be used to achieve very high power levels for cutting certain metals.

gas transport in the context of the present invention means a laser design, which generates very high beam power within a fairly small resonator structure. long electrodes parallel the axis and gas is circulated across the resonator cavity.

gaussian in the context of the present invention means the "normal curve," or normal distribution, an example of which is the symmetrical bell shape of the holes created by the uncorrected, unfocused laser beam in its optimum mode. a gaussian laser beam has most of its energy in the center.

haz in the context of the present invention means heat-affected zone, or the area where laser beam and metal (or other) surface are in contact.

helium-neon laser in the context of the present invention means ("hene"), laser in which the active medium is a mixture of helium and neon, which is in the visible range. used widely in industry for alignment, recording, printing, and measuring, it is also valuable as a pointer or aligner of invisible co2 laser light.

heat sink in the context of the present invention means a substance or device used to dissipate or absorb unwanted heat, as from a manufacturing process (or, with lasers, from reflected rays).

hertz in the context of the present invention means the approved international term, abbreviated hz, which replaces cps for cycles per second.

image in the context of the present invention means the optical reproduction of an object, produced by a lens or mirror. a typical positive lens converges rays to form a "real" image which can be photographed. a negative lens spreads rays to form a "virtual" image which can't be projected.

incident light in the context of the present invention means a ray of light that falls on the surface of a lens — or any other object. the "angle of incidence" is the angle made by the ray with a perpendicular to the surface.

intensity in the context of the present invention means the magnitude of radiant energy (light) per unit, such as time or reflecting surface.

ion laser in the context of the present invention means a type of laser employing a very high discharge current, passing down a small bore to ionize a noble gas such as argon or krypton. the ionization process creates a population inversion for lasing to occur. a research laser useful for some industrial applications.

ionization in the context of the present invention means the process by which ions are formed.

irradiation in the context of the present invention means exposure to radiant energy, such as heat, x-rays, or light; the product of irradiance and time.

joule in the context of the present invention means one watt per second; a measurement frequently given for laser output in pulsed operation.

krypton laser in the context of the present invention means a laser filled primarily with krypton gas. when used with "all-line" or "white" optics, it produces red, yellow, green and blue light. a "red-only" krypton laser uses with specially tailored optics to output a very strong red line at 647 nm. kryptons are similar to argons (the same tube design can be used for both). however, krypton gas produce less light (output power) than an equivalent volume of argon gas.

krypton lasers are primarily used when a powerful red light is needed.

laser in the context of the present invention means "laser" is an acronym derived from "light amplification by stimulated emission of radiation".

a device which produces a coherent beam of light. the beam remains parallel for long distances and contains one or more extremely pure colours. light show lasers are usually gas-filled tubes using high voltage current to ionise the gas (cause the gas to glow). mirrors at each end of the tube help amplify a process called "stimulated emission". most of the stimulated emission light travels between the two mirrors; between 1%

and 4% comes out of one of the mirrors to create the beam of light that we see. the gas used determines the colour (or colours) of the beam. gas lasers remain the overwhelming choice for display applications. the four main types used are a helium-neon mixture, argon, krypton, and an argon-krypton "mixed gas" mixture.

aser oscillation in the context of the present invention means the buildup of the coherent wave between laser cavity end mirrors. in cw mode, the wave bounding back and forth between mirrors transmits a fraction of its energy on each trip; in pulsed operation, emission happens instantaneously.

laser rod in the context of the present invention means a solid-state, rod-shaped lasing medium in which ion excitation is caused by a source of intense light, such as a flashlamp. various materials are used for the rod, the earliest of which was synthetic ruby crystal.

light in the context of the present invention means the range of visable electromagnetic radiation frequencies detected by the eye, or the wavelength range from about 400 to 750 nanometers. it is sometimes extended to include photovoltaic effects and radiation beyond visible limits.

light regulation in the context of the present invention means a form of power regulation in which output power is maintained at a constant level by controlling discharge current.

luminance in the context of the present invention means commonly called illumination; the luminous or visible flux per unit area on a receiving surface at any given point.

meniscus lens in the context of the present invention means the lens used primarily in co2 lasers by coherent, inc. it has one side convex, the other concave.

metastable, metastable state in the context of the present invention means unstable condition in which the energy of a molecule is at some discrete level above the lowest, or ground state. it is this condition which is necessary for emission of photons in a laser. (from quantum theory.)

millijoule: one thousandth of a joule.

milliwatt in the context of the present invention means one thousand milliwatts equal one watt. small lasers' beam powers are measured in milliwatts. for example, a 50 mw laser is one-twentieth of a watt; a 500 mw laser is one-half watt.

mode in the context of the present invention means a particular functioning arrangement, setup, or condition for laser operation, such as continuous emission, pulses, or grouped pulses. "mode" also describes the cross-sectional shape of the beam. (see "tem.")

modulation in the context of the present invention means the ability to superimpose an external signal on the output beam of the laser as a control.

monochromatic light in the context of the present invention means theoretically, light consisting of just one wavelength. since no light is completely monochromatic, it usually consists of a very narrow band of wavelengths. lasers provide the narrowest bands.

nanometer in the context of the present invention means a unit of length in the international system of units (si) equal to one billionth of a meter (10-9 meter). once called a millimicron, it is used to represent wavelength. abbreviated "nm."

near field imaging in the context of the present invention means a solid-state laser imaging technique offering control of spot size and hole geometry, adjustable working distance, uniform energy distribution, and easily produced range of spot sizes.

nd:glass laser in the context of the present invention means a solid-state laser of neodymium:glass offering high power or short pulses, or both, for specific industrial applications.

nd:yag laser in the context of the present invention means a solid-state laser of neodymium:yttrium-aluminum garnet, similar to the nd:glass laser. both are pumped by flash lamps, or diode lasers.

nema in the context of the present invention means national electrical manufacturers' association, a group which defines and recommends safety standards for electrical equipment.

noise in the context of the present invention means unwanted, minor currents or voltages in an electrical system.

object in the context of the present invention means the subject matter or figure imaged by, or seen through, an optical system.

optical density in the context of the present invention means protection factor provided by a filter (such as used in eyewear, viewing windows, etc.) at a specific wavelength. each unit of od represents a 10x increase in protection.

optical pumping in the context of the present invention means exciting the lasing medium by the application of light rather than electrical discharge from anode and cathode.

output coupler in the context of the present invention means the resonator mirror which transmits light; the one at the opposite end is totally reflective.

output power in the context of the present invention means the energy per second emitted from the laser in the form of coherent light, usually measured in watts for continuous-wave operation and joules for pulsed operation.

peek power in the context of the present invention means the power of an individual pulse in a pulsed laser. it is obtained by dividing the pulse energy in joules to the pulse width in seconds. typical values can be reach mega and giga watts.

photoacoustic effects in the context of the present invention means arises with the use of very short-duration high-energy laser pulses, at pulse durations typically below 10 microseconds. significant amounts of energy are absorbed and a rapid expansion occurs in the tissue, generating an acoustic shock wave that causes mechanical disruption to cellular structures.

photochemical effects in the context of the present invention means effects that occur from long exposure durations at incident power levels insufficient to cause damaging photothermal effects. it is an energy dependent process (a function of the total quantity of radiation absorbed rather than its rate of absorption).

photometer in the context of the present invention means an instrument which measures luminous intensity.

photon in the context of the present invention means in quantum theory, the elemental unit of light, having both wave and particle behavior. it has motion, but no mass or charge.

photothermal effects in the context of the present invention means the damage mechanism for acute laser injury (i.e. for injury immediately following exposure). the radiation incident at the surface is absorbed in the underlying tissue, increasing the temperature of the tissue to the level at which damage

can occur, and laser burns result. it is a power dependent process (a function of the rate at which energy is absorbed rather than the total quantity of energy involved).

plasma in the context of the present invention means in laser welding, a metal vapor that forms above the spot where the beam reacts with the metal surface. also used to describe the laser tube (plasma tube, discharge tube) which contains the completely ionized gas in certain lasers.

polarization in the context of the present invention means restriction of the vibrations of the electromagnetic field to a single plane, rather than the innumerable planes rotating about the vector axis. this prevents optical losses at interfaces between the lasing medium and optical elements. various forms of polarization include random, linear (plane), vertical, horizontal, elliptical, and circular. of two polarization components (so-called), s and p, the p component has zero losses at brewster's angle.

population inversion in the context of the present invention means when more molecules (atoms, ions) in a laser are in a metastable state than in the ground state (a situation needed for sustaining a high rate of stimulated emissions), a "population inversion" is said to exist. without a population inversion, there can be no lasing action.

power density: the amount of radiant power concentrated on a surface. units watts per square meters or square centimeters

pulse energy in the context of the present invention means the energy of a single, brief emission from a laser programmed for pulsed behavior rather than continuous operation. pulse power can be several times greater than cw emission.

pulse tail in the context of the present invention means pulse decay time, which can be shortened (by using a special mixture of gases) to allow for fast repetition of laser pulses within a given length of time.

q-switch in the context of the present invention means a device that has the effect of a shutter moving rapidly in and out of the beam to "spoil" the resonator's normal q, keeping it low to prevent lasing action until a high level of energy is stored. result: a giant pulse of power when normal q is restored.

quasi cw in the context of the present invention means the pulsating of a continious light into pulsed light by acusto optic, electrooptic, electronic, or mechano optical means, so peak powers are reduced, by number of pulses (see rep. rate) are increased.

radiance in the context of the present invention means brightness; the radiant energy per unit solid angle and per unit projected area of a radiating surface.

radiant energy in the context of the present invention means energy traveling as wave motion; specifically, the energy of electromagnetic waves (light, x-rays, radio, gamma rays).

radiant flux: the rate of emission or transmission of radiant energy.

radiant intensity in the context of the present invention means radiant power, or flux, expressed as emission per unit solid angle about the direction of the light in a given length of time.

radiant power in the context of the present invention means the amount of radiant energy available per unit; the radiant flux.

reflectance in the context of the present invention means the ratio of the reflected flux to the incident flux, or the ratio of reflected light to light falling on the object.

reflection in the context of the present invention means the return of radiant energy (incident light) by a surface, with no change in wavelength.

refraction in the context of the present invention means the change of direction of propagation of any wave, such as an electromagnetic wave, when it passes from one medium to another in which the wave velocity is different. simply put, the bending of incident rays as they pass from one medium to another, such as air to water.

resolution in the context of the present invention means resolving power, or the quantitative measure of the ability of an optical instrument to produce separable images of different points on an object; the capability of making distinguishable the individual parts of an object, closely adjacent images, or sources of light.

resonator in the context of the present invention means the mirrors (or reflectors) making up the laser cavity containing the laser rod or tube. the mirrors reflect light back and forth to build up amplification under an external stimulus. emission is through one of them, called a coupler, which is partially transmissive.

rockwell c in the context of the present invention means a scale or test used to define hardness in metals, particularly steel and titanium.

solid-state laser in the context of the present invention means a laser where the lasing medium is a solid material such as a ruby rod. these can be optically pumped by a flashlamp or diodes. solid state lasers also include diode lasers as they use electrically pumped solids to produce light. currently, solid-state lasers are too expensive for most light show uses. this may change over the next few years. the most promising solid-state laser uses a material called nd:yag, which produces infrared light. this can be frequency doubled (second harmonic generation) to produce up to 60 watts of green light at 532 nm. the green light can again frequency doubled (fourth harmonic generation) to produce uv light at 266 nm, up to several watts.

spectral response in the context of the present invention means the response of a device or material to monochromatic light as a function of wavelength.

stimulated emission in the context of the present invention means when an atom, ion, or molecule capable of lasing is excited to a higher energy level by an electric charge or other means, it will spontaneously emit a photon as it decays to the normal ground state. if that photon passes near another atom of the same frequency which is also at some metastable energy level, the second atom will be stimulated to emit a photon. both photons will be of the same wavelength, phase, and spatial coherence. light amplified in this manner is intense, coherent (collimated or parallel), and monochromatic. in short, laser light.

tem in the context of the present invention means abbreviation for transverse electromagnetic mode, the cross-sectional shape of the working laser beam. an infinite number of shapes can be produced, but only a relatively small number are needed for industrial applications. in general, "the higher the tem, the coarser the focusing."

• tem00: a gaussian-curve mode that is the best collimated and produces the smallest spot of high power density for drilling, welding and cutting.

• tem01: divided into two equal beams for special applications.

threshold in the context of the present invention means during excitation of the laser medium, this is the point where lasing begins.

transmission in the context of the present invention means in optics, the passage of radiant energy (light) through a medium.

transmittance in the context of the present invention means the ratio of transmitted radiant energy to incident radiant energy, or the fraction of light that passes through a medium.

vignetting in the context of the present invention means the loss of light through an optical element when the entire bundle does not pass through; an image or picture that shades off gradually into the background.

visible light transmission/transmittance in the context of the present invention means the amount of visible light usable to the eye that passes through a filter. as a rule of thumb, as optical density increases, visible light transmission decreases — but not always.

watt in the context of the present invention means an objective measure of power; in lasers, usually refers to the optical output power, or strength, of a laser beam. watts are also used in a more conventional sense, to measure electrical power used by a laser. for example, a 10 w (optical) argon laser consumes around 10,000 w of electrical power.

wave in the context of the present invention means an undulation or vibration, a form of movement by which all radiant energy of the electromagnetic spectrum is thought to travel.

wavelength in the context of the present invention means the fundamental property of light—the length of the light wave, which determines its color. common units of measurement (which is usually from crest to crest) are the micron, the nanometer, and (earlier) the angstrom. visible light has wavelengths extending from about 700 nanometers (red) through orange (~600 nm), yellow (~580 nm), green (~550 nm), blue (~450 nm) and violet (~400 nm).

white-light beam in the context of the present invention means broadly, a laser beam which contains a number of different wavelengths (colours) so the beam appears white. if the beam is passed through a prism or diffraction grating, it is separated into individual laser beams, each of a single specific wavelength.
more specifically, a white-light beam ideally contains twice as much red as green and blue light for correct colour balance (see appendix). it can be from a single white-light laser or from two or three lasers whose beams have been combined into a single beam. white-light beams are primarily used in rgb laser projectors.
see the definition of white-light laser for more information on what constitutes an "equal mixture" of light.

white-light laser In the context of the present invention means Many lasers can produce a number of wavelengths (colours) simultaneously. A white-light laser is designed to give a good balance of red, green and blue wavelengths. Usually the laser is intended for an RGB laser projector. (Some models also deliberately add yellow light for specialised 4-colour projectors.) Most white-light lasers use an anrgon/krypton gas mixture. It is somewhat

difficult to produce an equal balance of desired colours, and to keep this balance consistent during the lifetime of the laser tube. At present, there are no standards defining the exact wavelengths and colour proportions for a laser to be called"white-light".
In addition, the sought-after colour balance can be defined either as equal amounts on a photometer, or as visually equal amounts. Since the eye is much more sensitive to green, a visually equal or "photopically balanced" laser has roughly five times more power in red and blue than in green. Most white-light lasers today are not photopically balanced.

window In the context of the present invention means A piece of glass with plane parallel sides which admits light into or through an optical system and excludes dirt and moisture.

DETAILED DESCRIPTION OF THE INVENTION

It is appreciated that the detailed description that follows is intended only to illustrate certain preferred embodiments of the present invention. It is in no way intended to limit the scope of the invention, as set out in the claims.

Problems that exist in prior art methods for disinfecting products (solids, liquids or gasses) after they have been packaged are as follows: Often the wavelength used does not allow effective transmission through the packaging material. The presence of the packaging thus requires use of higher levels of energy, which then tend to be absorbed by the packaging material, which then releases toxic molecules into the liquid or gas within. As an example, the majority of the optical output of a conventional mercury UV light is at a wavelength of 254.3nm. This wavelength cannot penetrate PET, the major polymer currently used in the packaging industry.

The inventors of the present invention have noted that PET absorbs almost 100% of energy having a wavelength shorter than 312nm, however PET transmits close to 90% of light energy when the wavelength is 355nm. The present invention proposes using a short sub-microsecond pulse width at 355nm to grant effective disinfection with an appropriate dose of energy. Thus brief, high energy pulses, at a novel wavelength, can be used to penetrate and sterilize packaging materials which were previously thought to be impenetrable using sterilizing light-energy sources. Brief pulses are used to prevent heat build-up, which would result in damage to the packaging and migration of harmful molecules from the packaging to within the contents of the packaged material. The method of the present invention can be applied to many packaging materials (described below), such as materials used for packaging water and water-based products.

The methodology according to the method of the present invention discloses a simple creative and step to form high energy density zones which disinfect. These high energy zones are preferably created using sub-microsecond pulses of UV laser (though other light sources can be used as well). The high energy pulses are hydro-optically distributed uniformly and spatially equalized to deliver the appropriate bio dosimetric energy threshold for inactivation through a predetermined space or within a predetermined volume over a predetermined period of time. The method of the present invention facilitates disinfection by reduction, oxygenation, photocatalysis, photo-electro-catalysis, sterilization, photolysis, dissociation, advanced Oxidation Technology (AOT), photo-excitation or equalizing or controlling the concentration of biological or chemical contaminants. The method can be used to reduce toxic organic compounds and to inactivate bacteria, cysts, germs, spores, viruses, pathogens, moulds and many other noxious species, which threaten human health.

The method of the present invention proposes using a pulsed light source, selected from: lasers having sub-microsecond pulse width time duration (such as a UVA laser), a continuous wave type of light source, or a hybrid combination platform thereof.

According to a preferred embodiment of the present invention, a high repetition rate, high peak power laser of the Nd:Yag, or Nd:Glass, or Nd: YLF, type or any combination thereof is used; driving the uvjet, or a spatially processing pulsed laser light therein, or throughout. The laser can operate in the Fourth Harmonic generation mode (i.e. FHG), or in another embodiment, the solid state (e.g. Nd: Yag type) laser can operate in the Third Harmonic Generation mode (i.e. THG). Additionally, in another embodiment, an electrical discharge laser such as an excimer laser, is used. In such case, the

wavelength should be from about 193nm to 308nm, or 351nm. In another embodiment, a hybrid laser system is used for driving the uvjet, thus operating wherein (a) a solid state laser operating at THG (355nm), is attached, or aligned to the transparent area of the product undergoing sterilization. An electrical discharge laser is also operating together in the hybrid format, to maximize the efficiency of the disinfection. In other embodiments the laser light source is selected from (a) Gas discharge laser, (b) diode pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e) semi conductor lasers, (f) crystal type of lasers, (g), X-rays pumped lasers, (h) E-beam pumped gas lasers types, (I) FEL (Free Electron Laser amplifier), (j) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

In another preferred embodiment, the packaging acts as a waveguide, or a concentrator.

Preferably, the laser light source is tunable from about 1nm to about 3000nm, most preferably from about 333nm to about 360nm. Preferably the peak power density of individual pulses reaches from about 1nJ/Cm2, to about 50Js/Cm2, and preferably the pulsed laser emits pulses at repetition rates from about 1 Hz to about 300MHz. Thus the preferred embodiment of the present invention is suitable for a wide range of applications involving different packaging materials. The species- specific optical calibration standards can be calculated (to sterilize against a specific species of pathogen), to give a specific biodosimetric value or curve which corresponds to (is lower than) the damage threshold of the packaging material used.

The light source is harmonized so as to fit the action spectrum (i.e. absorption, transmittance, reflectance or optical properties of packaging) of the packaging material used at specific manufacturing sites. The present invention utilizes 2nd order interactions, and multiphoton absorption processes harnessed and hydro-optically distributed uniformly. A refractive index profile vortex diffuser is created to deliver the required biodosimetric curve or threshold in line with the specific inactivation objective of a given noxious species or microorganism.

The method of the present invention is especially beneficial for sterilization of water-based products, flavored water, mineral and spring water, bottled water and treated water products to be treated in their packaging, oxygenated water, supplemented water, magnetized water, enhanced water, reconstructed water, or any combination thereof. Also useful for beverages, wine, juice, or alcohol. In addition, a wide variety of bio-medical applications include blood and blood products, medical preparations (e.g. insulin products, blood products, plasma products), and liquids and gases used for medical procedures. Also useful for drug delivery using water based, and/or expanded or flavored water drinks containing vitamins or nutrients; for air products, gases for propelling medications, for sprays, or any solids, liquid or gasses or hybrid combination thereof. In all applications of the present invention, calibration must be performed for the action-spectrum, the absorption, transmittance, transparency, refractive index, or refractive index profiles of the packaging, (and the packaged liquid or gas interface) with the laser wavelength, energy, pulse width, and spectral and spatial characteristics. This will guarantee effective and economical disinfection and sterilization through packaging occurs. The present invention allows

high flow rates to be maintained, and does not effect sensitive natural or wholesome components in the product (such as sugar or natural flavorings in beverages). The method does not alter the taste and flavor of products treated, and does not cause sensory effects.

An additional application is for surface treatment to improve the hygiene of the mouth. Preferably, this includes: (a) harnessing the illumination or irradiation of a waveguiding dielectric brush [WDB] having a delivery capacity from about one quarter of a million of photons per Cm2/Second, to about 999 trillion photons per Cm2. This light source is applied to the mouth for 1 picosecond, or 1 Femtosecond, or 1 Atosecond. This swiftly sterilizes the complexly curved inner surfaces. Optionally, a new generation tooth paste is applied prior to the treatment to control the depth of penetration of the disaffection. The toothpaste comprises one of the following as an active ingredient: a Catalytic scintillated compound [CCC], a multi-component compound yielding Oxygen Charge (SYOCH) in a U.P.W, pH stabilized, held temporarily or permanently in a 3D polymeric frame work of biodegradable biocompatible carbomer or BI-polymers expanded to contain photo-catalytic, and/or scintillating conversion elements, each having predetermined electron charge transfer co.-efficiencies and absorption, refractive index profile, and acoustic properties, selected for their quantum objective efficiencies (from super-conductive, to dielectric, or semi conducting), wherein the flexibility of water may provide generic structurally yielding Oxygen Charge, accommodating into manageable forms the decomposed species inactivated radically (SYOCH1), within water, liquid, gas or air suspension, bodily fluids, or inside the mouth.

In another medical application, a light source is used to penetrate the surface of the skin in human, and animals and swiftly inactivate DNA & RNA sequences in blood therein (in the blood, i.e. under the skin, non invasively). Preferably a Nd:Yag laser is used, having a third Harmonic generator producing a 355nm wavelength. One or more laser units can be used, which have a beam of pulsed UVA light split, and distributed to a plurality of locations, waveguided through HGFS optical fibers, photonic band gap waveguides, or polymer waveguides, or hybrid combinations. The tip of each of these waveguides is attached, supported, or threaded, in proximity to areas in the body where blood vessels are relatively exposed, and are conveniently positioned around the surface (i.e. improving transmission, and coupling conditions). A further embodiment of the present invention is wherein several lasers are used, each having high repetition rates, or high peak powers, and pulse durations from about 1 ms, to about 1 fs, or Atosecond. Their respective beams are collected, deflected, diverted or stirred to form a three dimension element of UVA light at high energy density. This high energy density is below the damage threshold of blood components, nutrients, conditioners, compliment systems, MHC type 1,2,3, and any vital cell present in blood or blood products, yet they are efficient for inactivation of noxious species therein, i.e. within the blood, or blood products.

The method of the present invention is also beneficial for disinfection and inactivation of DNA and RNA sequences (i.e. disinfection) on articles having problematic surfaces, such as surfaces having complex curvature of the packaging materials. Other problematic surfaces are caps, lids, corks, jugs, bottles,

and other conduits or chamber type packaging. Preferably, packaging bottles to be sterilized according to the present invention include transparent caps, lids, bottles, top/bottom or sides in order to facilitate optical delivery of the appropriate dose of energy (light) throughput the volume of the packaged product therein. The methodology of the present invention can nevertheless overcome limitations imposed by standard techniques of manufacturing packagings, and can creatively penetrate and diffuse light in packages having various types of geometry. The packaging can contain liquids, gases, solids, or a combination, to be disinfected, or the packaging may be sterilized according to the present invention, in a separate sterilization step than that performed on the contents.

The methodology according to the present invention discloses the technological know-how to safely penetrate and sterilize by light, packaging materials selected from: PET, Polyolefin, Polyamide, Polycarbonate, Polyeteramid, Polyester or PE/HD or any polymer resin combination thereof. Further more, the method of the present invention can also penetrate effectively and economically glass bottles, and a wide variety of additional polymers used for packaging water, liquids and gases and agro-food products.

A further preferred mode of operation for devices or instruments using the method of the present invention for use in a production line or filling line or a packaging line for bottled water, would be as follows. The production lines are synchronized or resolved to a central workstation networking interface, and include at least one radiation unit. The radiation unit has at least one pulsed laser unit with a high intensity source of light, able to emit from about 0.1mJ Cm2 to about one thousand Joules Cm2. This predetermined energy emission is angled to spatially or dimensionally transcend the surface of the packaging, penetrate it and become diffused uniformly within it. The energy emitted must be calibrated so that it is sufficient to be distributed through the inner volume of liquids or gases within the packaging or bottles. The method proposes synchronization of the optronic, mechanical, hydraulic, and optic and electro-optics platforms (i.e. lasers and light sources, mechanical transport, and ultrasound angular sources) to maximize the efficiency of a device according to the present invention. This will ensure that high flow rates in commercial installation be accommodated. In a preferred mode of operation, a hybrid platform made of a plurality of light sources, is used. In such case, each of the light sources is synchronized to its counterpart in an interactive network so as to increase energy utilization, flexibility of design and interconnectivity and interoperability resolution, to maximize the efficiency of the disinfectionprocess.

Preferably, the volume of the packaging undergoing sterilization is about 10ml to 1 cubic meter. The packaging material or polymers need have an adequate action spectrum, absorption, transmission, refractive index, or transparency so that the high intensity source of light, will penetrate the packaging. As mentioned above, the wavelength and frequency of light appropriate for penetration of the most common types of packaging polymers, is from about 100nm to 400nm; most preferably is at 355nm.

In view of the possible refractive index profiles of the products undergoing sterilization, and that of their packaging, optical manipulation or beam management need be selected. Any of the following beam

management techniques can be used: diffusing, scattering, reflecting, refracting, focusing, defocusing, diffracting, stirring, collimating, splitting or combining, confining, super-imposing, interfering or alternating, zooming, or pointing amplifying, directing or targeting beams of light from said radiation unit throughout the packaging and throughout the content of the packaging. Preferably, a biodosimetric curve is drawn according to species-specific calibration standards such that a particular biological pathogen or a chemically toxic species (organic compound) will be reduced, oxidized, or photolyzed, or disinfected or sterilized by Disinfecton Through Packaging [DTP]. The methodology of the present invention may utilize optical fibers or wave guides selected from solid state guides, photonic band gap trajectories, closed non toxic, non aerobic liquid waveguides, or aerobic flowing liquid waveguides to deliver the light from the high intensity light source to the boundaries of the packaged product (or to the packaging alone). This facilitates network distribution of pulsed UVA light to a plurality of exposed packaging surfaces which may have angular positioning. Thus appropriate biodosimetric curves need be established according to the method of the present invention for particular noxious biological or chemical (organic) species of concern. The methodology of the present invention may us hydraulic, mechanic, pneumatic, or magnetic, acoustic, super sonic, or ultrasonic means in order to mix, stir, move or position the product before or during sterilization to achieve optimal delivery and dispersal of the light energy to all areas of the product.

Preferably, energy dosimetric values are calculated for devices used, by ignoring the overall number of photons delivered. Rather, what is relevant is the actual number of photons delivered within a predetermined space over a predetermined period of time, opening interactive non linear 2nd and 3rd order interactions.

Preferably, a solid state laser is used, wherein frequency doubling and harmonic conversion have been performed efficiently in order to achieve the desired wavelength of 355nm. In devices operated using the methodology of the present invention, the time domain, pulse width, pulse intensity, pulse repetition rates or pulsed laser light energy parameters can be amplified, compressed, expanded, modulated or coded, or recorded for later reply as sequential data strings, recurrent data strings, in presets, or as a real time non recurrent operation. Preferably, the pulse duration (or pulse width) of the pulsed UVA laser is between about 1 microsecond to several femtoseconds (fs), or from about 7nano seconds (ns) to about 11 Pico-seconds (Ps). Said time domain can be adjusted or calibrated to species- specific calibration standards, according to inactivation or disinfection objectives or quality standards.

The optical energy necessary for disinfection must be distributed to reach the entire contents of the packaging, after the packaging material has being penetrated. The inventors propose utilizing the refractive index profile variation created, to guide and diffuse light uniformly throughout the entire volume of the packaging (i.e. the liquid or gas inside the packaging) to be disinfected. The dispersion technique hereby disclosed, involves creating a vortex in a packaged liquid product, then directing the light beam towards the air present in the center of the vortex (parallel to the vortex center). For example: The water inside a PET or polymeric packaged type mineral water bottle or jug has a

refraction index of 1.3, [N1]. The air capsule at the top of the bottle has a refractive index of 1.00, [N2] and the refractive index of the polymeric packaging material is around 1.45 [N3]. Thus creative refractive index sculpturing (N1/N2/N3) is made possible using the methodology of the present invention. The refractive index profiles thus created facilitate the uniform distribution of light therein (inside the packaging). More specifically, the refractive index profile of the air/water interface in a typical mineral water bottle is thus N1=Water, N2=Air, N3=PET. The volume of the water in the bottle is spun at an appropriate speed to create a vortex inside the bottle (between about 18- 1800 RPM). The highest refractive index value is then external to the path-length or direction of light entering the bottle from the outside, and the lower refractive index value (air at 1.00) is at the center of the bottle, forming an efficient diffuser. (This is reminiscent of an optical fiber refractive index profile, however taken inside-out). This facilitates uniform distribution of the laser pulsed UVA light throughout the entirety of the volume and facilitate calibration of the dosimetric values over wide range of energies (for example 1 big pulse for transparent water, and many micro-pulses for flavored water having lower transparency). Many thresholds thus could be created according to the method of the present invention to fit requirement of producers, and end users proficiently.

The vortex within the liquid is formed by applying acoustic energy at a predetermined angle, to stir the liquid therein, without damaging the structure of the polymer packaging from without. This hydro-optical aspect is original in the sense that no other method of photo-sterilization utilizes the air capsule normally present at the top of the bottle. This air capsule also tends to contain 21% of free available oxygen, which suggests pathways for interactive photochemistry therein (in the bottle conduit or chamber packaging interface). Utilization of a vortex to distribute the light energy allows reduction of the power and energy required to reach and disinfect the entire package.

Flash lamps of different types have been produced to try and mimic the intensity effects achieved with the methodology of the present invention, but these trials have failed as a result of the relatively long time duration it takes to ignite and spark or pump the mercury. More specifically, conventional pulsed mercury based flash-lamps cannot offer disinfection at sub-microseconds time domain or pulse width. In effect, often the shortest time duration, or pulse width, achieved with a conventional flashlamp is 10-30 microseconds, thus still remaining within the 1st order interaction of CW type of lamps. The only flash-lamps reaching short pulse durations are the quasi-CW type of flash-lamps wherein the continuos wave operation of this lamp is modulated electronically.

The figures according to the method of the present invention illustrate preferred embodiments of the present invention, and of devices using the methodology of the present invention, and are not intended to limit the scope of the present invention whatsoever. Figures 1-3, together with scientific support data herewith disclosed, are presented for clarity and for illustration purposes.

A preferred embodiment of the present invention illustrating a preferred mode for devices using the method of the present invention wherein sterilizing and disinfecting of water based products in their packaging without causing damage or migration or photochemical damage products or by products from said packaging or its content according to the present invention is being disinfected or sterilized throughout wherein the packaging material having a volume capacity of between about 1ml to about 10,000 liters and wherein said packaging is selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, silicon, paper or silk cellulite or composite combination, or glass or any polymer resins combination thereof and containing sugar or flavoring or food additives or vitamins or minerals or supplements or nutritional additives and wherein each of said proportional components in the content of said packaging contains sugar in said water is from about 1Gram per liter to about 987Gram Liter per volume concentration to about 99% per volume concentration thus flavored water with up to 100 Gram of sugar per liter and Glucose packages having higher concentration are an example of the scope and diversity of the present invention. A further environmental protection embodiment of the present invention is wherein a warehouse, or storage or filling or packaging, or delivery lines are equipped with devices according to the method of the present invention and wherein bottled water products at volumes from about 100ml to about 100 liters are being disinfected or sterilized through the packaging and thus made safe for drinking or consumption increasing its quality standards.

A preferred embodiment of the present invention wherein a solid state pulsed UVA laser light source operating at about 355nm is projecting light through an optical channeling and amplification system having at least one liquid flowing waveguide such that high energy density is coupled to a predetermined packaging material containing bottled water, treated water, flavored water, or carbonated water and wherein sparkling or still combination is enclosed within said packaging and being sterilized or disinfected according to the methodology of the present invention and wherein the volumes of the packaging to be disinfected throughout is selected from 100ml, or half liter, or 1 liter, or 1.5 liters or from about half a gallon to about 20 Gallon, and wherein said light is bouncing or reflecting, deflecting or diffusing, scattering or being absorb in a predetermined statistical portion of predetermined concentration of noxious biological or chemical components therein (I.e. in the content within the packaging), and wherein the components of the packaging, or the components in the content inside the packaging remain stable and unharmed while disinfection, sterilization or oxidation occurs cumuli attentively in a pre-calibrated dose response curve of said laser energy characteristic and the packaging, multi components therein (in the liquid or gas in the packaging) and adequate inactivation of DNA/RNA replication sequences, or mineralization of toxic organic compounds therein (in the liquids or gases in the packaging). A further preferred embodiment of the present invention is wherein the laser pulses repetitoon rate is between about 1 Hz to about 1 T Hz, and wherein its energy density reach from about 1 nJ to about 1000Js Cm2 .

A preferred mode for operation is when lasers or light sources operate at about 355nm, and if pulsed have a pulse width or pulse duration at sub-microsecond, however it may be that additional

evolutionary steps in packaging material fabrication techniques may facilitate additional materials for packaging of liquids or gases not yet utilized by industry, agricultural or medical fields, such materials may have additional transmission windows (so that packaging will not be damaged) other then the 355nm, that why the methodology of the present invention facilitate an evolutionary step by utilizing a faster light transposing, or pumping, shifting or optronically or spatially manipulating, or delivering or targeting or diffusing or absorbing then the molecular thermal dynamic of the packaging material thus no damage to packaging occurs while disinfection or sterilization performance is engaged.

A preferred embodiment of the methodology of the present invention for a preferred mode of operation for devices using the method of the present invention for disinfection through packaging (DTP) is wherein the packaging for water based products is selected from ½, 1 liter, 1.5 liter, or 2 liter bottles or 1,2, 5,10 or 20 gallons, or wherein a conduit or camber shape pipe is interconnected or inter-operated for the delivery throughout of liquids or gases thereunto the packaging, or to/from said packaging aseptically or untreated, flavored or carbonated, oxygenated or enriched, supplemented or expanded with components or multi-components chemically and or biologically harmonious to the global optronic qualities and optival characteristics therein (in the packaging)

An especially beneficial environmental embodiment of the present invention is wherein the packaging is selected from a capsule, or pill, bottle or jug, container of tank, shaped as conduit or chamber or combinations or it may be made out of paper such as mail items or envelopes for letters, the addition of oxygenated water vapor at predetermined pressure throughout the process according to the present invention may be beneficial for making Advance Oxidation Technologies (AOT) therein and throughout the packaging using light and oxygen enriched water (H2O2). An improved embodiment of the present invention is having preferred mode for operating devices using the method of the present invention for disinfection or sterilization through packaging (DTP) without causing damage to said packaging material or causing molecular migration into said packaging from their liquid or gas content; a preferred mode for operating devices using the methodology of the present invention is wherein סוכ

A preferred embodiment of the present invention is wherein the packaging item is a bottle or jug, or container, or a conduit or chamber type shape made from selection of monomers, carbomer, polymers, resins, or combination, and for example; any biocompatible packaging having ability of holding temporarily, or permanently water, air, liquids or gases for later consumption by end users, producers, industrialists, technologists, medical personnel, patients, and agro-food production market destination, and scientists and engineers. An additional preferred embodiment for disinfection through packaging is wherein the packaging is selected from a pill, or a capsule, or a bag, or combination, or perforated sausage like bags, or the packaging material could be selected from polymer or plastic or combination. An environmental protection preferred embodiment is wherein the packaging material is used for containing or transferring, holding or channeling water for drinking, flavored water, carbonated water, beverages, Juices, agro-food products, sweets, or confectionery products. A preferred embodiment of the methodology of the present invention is wherein the packaging is holding glucose, biomedical

preparation, vaccination agents, or preparation for vaccination or medical optoprobiotic compounds according to the method of the present invention.

A preferred embodiment of the present invention is wherein the packaging is exposed to at least one radiation unit or light source selected from solid state lasers, electrical discharge lasers, plasma driven lasers, semiconductor lasers, organic lasers, electron beam pumped lasers, free electron lasers, , fiber lasers doped, or SASE/EA/FEL lasers, fiber lasers, diode pumped lasers, crystal based lasers, doped glass based lasers, FELs lasers, polymer lasers, PW/CW type lasers, quantum dote lasers, laser arrays, flush lamp pumped lasers, water lasers, photonic bandgap lasers, seeded or amplified lasers, time compressed or expanded lasers, q-switch type lasers, interactive harmonic lasers, acoustic-optical lasers, ultrasonic lasers, X-ray pumped lasers, Y pumped lasers, E-beam pumped lasers, catalytic lasers, photoelectrocatalytic lasers, air lasers, ground stationary lasers, mobile and sub-miniaturized lasers, thin film type lasers, vapor lasers, water lasers, photonic bandgapped lasers, CW lamps, PW lamps, Quasi CW lamps, LPHO lamps, Medium pressure UV lamps, Low pressure UV lamps, hybrid combination of CW, PW, Quasi CW lamps and lasers or combinations, and wherein light from said radiation unit or light sources is coupled to waveguides extending from said light units to reaching the proximity of said packaging, and wherein the high intensity light is reaching to cover the entirety of the packaging and content therein for disinfection and sterilization of said content or volume or packaging surfaces within a predetermined space, over a predetermined period of time.

A preferred embodiment of the methodology of the present invention is wherein the light from the radiation units or light sources or hybrid combination of lasers and lamps is delivered through optical processing units able to control aspects of the delivered or distributed light such as to manipulate their optical or spatial properties so as to maximize the distribution, or uniformity, or to adjust the cumulative, or immediate biodosimetric curves adequate for the inactivation, sterilization or disinfection or dissociation or oxidation of noxious species present inside the packaging, in the content of said packaging or on the surfaces of said packaging.

A preferred embodiment especially beneficial for the provision and facilitation of vaccination production methodologies and techniques are being enhanced by using the methodology of the present invention wherein the remains, and the residual, or the bio-mass or chemical-mass within said content, or packaging surfaces, or liquids or gasses, or solids therein are being processed and exposed according to the methodology of the present invention such that opto biotic beneficial effects are facilitated to the agro-food, or bio-medical domains production.

A further preferred embodiment of the present invention is wherein opto-pro-biotic products are being produced according to the method of the present invention wherein noxious species within the packaging and content to be disinfected are exposed and traceable recognition will occur upon consumption, or preceding treatment of the methodology of the present invention. A preferred mode for devices operating according to the method of the present ibvehntion is wherein the radiation unit or

laser or light source is a pulsed, or continuos wave light source, or a further preferred mode is wherein the light radiation instrument includes a sub-microsecond pulsed source.

A preferred embodiment of the present invention is wherein the optical processing unit, which delivers the light to the packaging or content or space or volume or combination, is selected from diffractive optical elements, lenses or cubes, splitting or recombining optics and electro-optical elements, diffusers, reflectors, prisms, telescopic zooms, and zoom expanders, refractive optics, conversion or harmonic generators, pumping or amplified signals, amplifiers, converters, spatial processors, scanners, stirrers, beam positioning, location equation and transport interfaces, robotic arms with optical support means, optical bread boards, waveguids (HGFS, SFS,), photonic band gap, crystals, liquid waveguides, flowing liquid waveguides, or any combination thereof

A preferred embodiment of the present invention wherein the lasers or lamps operating is CW, PW, quasi CW, hybrid, liquid or gas based lasers, or the radiation unit or light sources combined or integrated include diamond based lasers, fiber lasers, TSA/SE/EA/FELs lasers, or electrical discharge lasers, or water lasers, or diod pumped or organic type lasers, or plasma lasers, or semi-conductor lasers, or amplified or harmonically generated lasers, or CW, PW lamps, or combination

A preferred embodiment of the present invention wherein the instrument or device is optically synchronized, or electronically linked or referenced, triggered or resolved to a particular machine control protocol for enhancing delivery and distribution of optical energy through packaging, and for the calibration and adjustment of the biodosimetric or chemical dosimetric curve adequate for sterilization or disinfection, dissociation or oxygenation of noxious species through the packaging without damaging said packaging or multi-components therein (in the packaging content or volume).

A preferred embodiment of the present invention wherein the packaging to be disinfected is an envelope or a mail item containing spores, bacteria or harmful compounds of biological or chemical origin. A Further beneficial biomedical preferred embodiment is wherein the effective range of the phototreatment effects according to the methodology of the present invention wherein opto-biotic, and/or opto probiotic water are produces according to the methodology of the present invention, such water may be beneficial for the immune system of consumers as the noxious species will be dissociated by the photochemical action or effects of processes according to the present invention, however, while the parent compound (example: before treatment, while liquids or gases or solids are in the packaging) before, or during, or after being treated, does not need to be transferred, or poured to, or transported via additional steps (i.e. additional chambers or conduits, bottles or jugs, containers or pipes for example), thus the methodology of the present invention is beneficial for the production of opto-pro-biotic wherein the sensitivity, or size of components facilitate treatment in the final packaging enclosure saving time, eliminating the need to keep transferring the volume to additional processes related steps and increasing the bio-compatibility and bio-safety, or purity, or freshness, or nutrient, or flavor, color or taste, smells or visibility or look, composite or density. A beneficial preferred embodiment for biological, physiological, and medical fields according to the methodology of the

present invention is wherein multi-components compounds and medical and immunology fields thus optical dissociation of noxious species could be performed wherein the biodosimetric values required for dissociation are achieved using the methodology of the present invention. The benefits could extend from using the present invention to dissociate M.R.na type or any other multi component composite substances or chemical signatures thus that the dissociated remaining bio and/or chemical mass is appropriate for immunization processes upon consumption. More specifically, the present invention could be utilized for the production processes of opto-pro-biotic produce, products aseptically beneficial for medical, agricultural and industrial applications, beneficial for the bottling industry and for production processes of agro-food production lines. Further more triggering positive immune response actions and effects (MHC II, III, I) for example such as for Major-Histo-Compatibility Complex or MHCC, the acquired Human Immune system may be triggered according to the methodology of the present invention from liquid or gases or solids in a predetermined packaging containing a pre-form, or compounding volumes of noxious species therein (in the packaging content/volume/inner space), such beneficial basic preparation could be triggered processed, dissociated or oxygenated, or sterilized, or modified, or photochemical adjusted, or treated, until reaching by the utilization of the light which sound creates, and the sound which light creates i.e., for example the attack transient acoustically thus created via utilization of light in the present invention, and Sono-luminescence or light produced by applying vibration excitation measures, such that the appropriate proportions upon consumption by end users, or producers, or human, plant or animal their immune system is enhanced, in simple words the final processing according to the present invention is occurring in the respective packaging, through said packaging material, and without causing damage, or molecular migration from said packaging to the liquid or gas or solid or combination therein such that freshness, natural components, integrity in terms of geometry of multi components is maintained, prolonged, and higher quality of production is facilitated by the methodology of the present invention of Disinfection, and sterilization, and phototreatment through packaging (DTP) and therefore as well as longer and safer shelf life, the methodology of the present invention surpass limitation of current methodologies in the field and require less steps, less time, and less transport of processed items such that the probability of cross contamination, and transfer of infected, or toxic compounds is substantially lower as the final processing is done (in) Through the packaging (DTP).

A preferred embodiment of the present invention wherein a line of mass production for mineral Water bottles, is equipped according to the method of the present invention with at least one high intensity source of light, or laser and said light source is pulsed, having peak power density from about 0.O1mJ/Cm2, to around 5OJs/Cm2, and wherein said light source is monochromatic (i.e. laser), having wavelength from about 222nm, to about 355nm, and said light pulses are having a repetition rate from between about Hz, to about 1 GHz and said light is directed at a transparent, or translucent portion, or lid, or cork of said bottles, thus ensuring that harmful or noxious bacteria is inactivated, or eliminated therein, and DNA, & RNA replication Sequences of noxious species are thus inactivated inside the bottles by using appropriate wavelength and characteristics of light, before, during, or after they have been filled, corked, and/or sealed for use at later date.

A further environmental embodiment of the method of the present invention wherein the content of the bottles, conduits, or chambers may be selected from: beverages, wine, medical preparation, juice, drinking water, mineral water, insulin products or medical preperation. Spring water, flavored water, flavored beverages, biological traceable compounds, water, and/or drinks containing vitamines or nutrients, alcohol, blood products, plasma products, air products, gases for propelling medications, sprays, or any liquid or gasses or hybrid combination thereof.

A Novel environmental embodiment of the present Invention is having a high repetition rate, high peak power laser of the Nd:Yag, or Nd:Glass, or Nd: YLF, type or any combination thereof operating in the Fourth Harmonic generation mode (i.e. FHG), a further preferred embodiment of the present invention is having said solid state (i.e. Nd: Yag type for example), working in the Third Harmonic Generation mode (i.e. THG), a preferred embodiment according to the method of the present invention is having an electrical discharge laser such as an excimer laser operating in wavelength from about 193nm, through to about the 308, and 351nm, and wherein each of said pulses of light is aligned into the content of the bottled liquids or gasses for purifying, disinfecting, and ensuring that DNA, and RNA replication sequences are thus inactivated providing a non invasive disinfecting methodology wherein light pulses from the laser are penetrating the material from which the bottles, (i.e. conduits or chambers, or bottles, or pipes) are made.

A preferred embodiment according to the method of the present Invention is having a hybrid laser system operating wherein (a) a solid state laser operating at THG (355nm), is attached, or aligned to the transparent lid, or cork, or encapsulation, or conduit, or chamber, and wherein together in hybrid format an electrical discharge laser is also operating for maximizing the efficiencies associated with the non destructive disinfection according to the method of the present invention Further preferred embodiment according to the present invention wherein the packaging is a liquid waveguide, or concentrator.

A preferred embodiment of the present invention wherein a Nd:Yag laser is used having a third Harmonic generator producing 355nm wavelength which penetrates the packaging materials of PET types and inactivating DNA & RNA replication sequences therein (in the bottle, or packaging). Such preferred embodiment of the present invention could be implemented with a single laser unit having its beam of pulsed UVA light split, and distributed to a plurality of location by means of waveguiding light through HGFS optical fibers, photonic band gap waveguides, or polymer waveguides, or hybrid combinations. A further preferred embodiment of the present invention is wherein several lasers are used having high repetition rates, or high peak powers, and pulse duration from about 1 ms, to about 1 fs, and wherein their respective beams are collected, or deflected, or diverted or stirred to form a three dimension element of UVA light at high energy density, and wherein said high energy density is below the damage threshold of PET packaging, or polymeric hybrid combination used as packaging materials.

A preferred embodiment of the present invention wherein the laser light source is sellected from (a) Gas discharge laser (b) diode pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e)

semi conductor lasers, (f) crystal type of lasers, (9), X-rays pumped lasers, (h) E-beam pumped gas lasers types, (I) FEL (Free Electron Laser amplifier), (J) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

A preferred embodiment of the present invention wherein the laser light source is tunable from about 1 nm to about 3000 nm, a further preferred embodiment of the present invention is wherein the laser light source is tunable from about 333nm to about 360nm, and wherein the peak power density of individual pulses reach from about 1nJ/Cm2, to about 5OJs/Cm2' and wherein said pulsed laser light source is pulsing at repetition rates from about 1 Hz to about 300MHz thus the proffered embodiment of the ptresent invention is suitable for wide ranging application involving different packaging materials, thus their specie specific optical calibration standards are calculated for a specific biodosimetric value or curve to appropriately correspond (being lower) with damage threshold of the packaging material used in a specific application.

A further environmental embodiment of the method of the present invention wherein the content of the bottles, conduits, or chambers may be selected from: beverages, wine, medical preparation, juice, drinking water, mineral water, insuline products or medical preperation. Spring water, flavored water, flavored beverages, biological traceable compounds, Drug delivery using water based, and/or expanded or flavored water drinks containing vitamines or nutrients, alcohol, blood products, plasma products, air products, gases for propelling medications, sprays, or any liquid or gasses or hybrid combination thereof.

A Novel environmental embodiment of the present Invention is having a high repetition rate, high peak power laser of the Nd:Yag, or Nd:Glass, or Nd: YLF, type or any combination thereof driving the uvjet, or spatially processing pulsed laser light therein, or throughout and operating in the Fourth Harmonic generation mode (i.e. FHG), a further preferred embodiment of the present invention is having said solid state (i.e. Nd: Yag type for example), working in the Third Harmonic Generation mode (i.e. THG), a preferred embodiment according to the method of the present invention is having an electrical discharge laser such as an excimer laser operating in wavelength from about 193nm, through to about the 308, and 351nm, and wherein each of said pulses of light is aligned

into the content of the bottled liquids or gasses for purifying, disinfecting, and ensuring that DNA, and RNA replication sequences are thus inactivated, providing a non invasive disinfecting methodology wherein light pulses from the laser are penetrating the material from which the bottles, (i.e. conduits or chambers, or bottles, or pipes) are made.

A preferred embodiment according to the method of the present Invention is having a hybrid laser system driving the uvjet, thus operating wherein (a) a solid state laser operating at THG (355nm), is attached, or aligned to the transparent lid, or cork, or encapsulation, or conduit, or chamber, and wherein together in hybrid format an electrical discharge laser is also operating for maximizing the efficiencies associated with the non destructive disinfection according to the method of the present

invention. Further prefered embodiment according to the present invention wherein the packeging is a liquid waveguide, or concventrator.

A preffered embodiment of the present invention wherein a Nd:Yag laser is used having a third Harmonic generator producing 355nm wavelength which pentrates the surface of the skin in human, and animals and thus swiftly inactivates DNA & RNA replication sequences in blood therein (in the blood, i.e. under the skin, non invasively). Such preffered embodiment of the present invention could be implemented with at least one laser unit having its beam of pulsed UVA light split, and distributed to a plurality of location by means of waveguiding light through HGFS optical fibers, photonic band gap waveguides, or polymer waveguides, or hybrid combinations, each distal tip is attached, supported, or threaded, in proximity or distributed to cover areas inthe body wherein blood vessels are relatively exposed, and are conviniently positioned around the surface (i.e. inporoving transmission, and coupling conditions). A further preffered embodiment of the present invention is wherein several lasers are used having high repetition rates, or high peak powers, and pulse duration from about 1 ms, to about 1 fs, or Atosecond and wherein their respective beams are collected, or diflected, or diverted or sttired to form a three dimension element of UVA light at high energy density, and wherein said high energy density is below the damage threshold of blood components, nutrients, conditioners, complimental systems, MHC type 1,2,3, and any vital cell present in blood or blood products, yet they are efficient for inactivation of noxious species therein, i.e. within the blood, or blood products.

A preffered embodiment of the present invention wherein the laser light source is sellcted from (a) Gas discherge laser, (b) diod pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e) semi conductor lasers, (f) crystal type of lasers, (g), X-rays pumped lasers, (h) E-beam pumped gas lasers types,

FEL (Free Electron Laser amplifier), (j) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

A preffered embodiment of the present invention wherein the laser light source is tunable from about 1nm to about 3000nm, a further preffered embodiment of the pesent invention is wherein the laser light source is tunable from about 333nm to about 360nm, and wherein the peak power density of individual pulses reach from about 1nJ/Cm2, to about 50Js/Cm2, and wherein said pulsed laser light source is pulsing at repetition rates from about 1 Hz to about 300MHz thus the preffered embodiment of the ptresent invention is suitable for wide ranging application involving different packeging materials, thus their specie specific optical caliberation standards are calculated for a specific biodosimetric value or curve to appropriately corasponde (being lower) with damage threshold of the substrate material used in a specific application, or tool, or device.

DETAILED DESCRIPTION OF THE FIGURES

A preferred embodiment of the present invention illustrating a preferred mode for devices using the method of the present invention wherein sterilizing and disinfecting of water based products in their packaging without causing damage or migration or photochemical damage products or by products from said packaging or its content according to the present invention is being disinfected or sterilized throughout wherein the packaging material having a volume capacity of between about 1ml to about 10,000 liters and wherein said packaging is selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, silicon, paper or silk cellulite or composite combination, or glass or any polymer resins combination thereof and containing sugar or flavoring or food additives or vitamins or minerals or supplements or nutritional additives and wherein each of said proportional components in the content of said packaging contains sugar in said water is from about 1Gram per liter to about 987Gram Liter per volume concentration to about 99% per volume concentration thus flavored water with up to 100 Gram of sugar per liter and Glucose packages having higher concentration are an example of the scope and diversity of the present invention. A further environmental protection embodiment of the present invention is wherein a warehouse, or storage or filling or packaging, or delivery lines are equipped with devices according to the method of the present invention and wherein bottled water products at volumes from about 100ml to about 100 liters are being disinfected or sterilized through the packaging and thus made safe for drinking or consumption increasing its quality standards.

A preferred embodiment of the present invention wherein a solid state pulsed UVA laser light source operating at about 355nm is projecting light through an optical channeling and amplification system having at least one liquid flowing waveguide such that high energy density is coupled to a predetermined packaging material containing bottled water, treated water, flavored water, or carbonated water and wherein sparkling or still combination is enclosed within said packaging and being sterilized or disinfected according to the methodology of the present invention and wherein the volumes of the packaging to be disinfected throughout is selected from 100ml, or half liter, or 1 liter, or 1.5 liters or from about half a gallon to about 20 Gallon, and wherein said light is bouncing or reflecting, deflecting or diffusing, scattering or being absorb in a predetermined statistical portion of predetermined concentration of noxious biological or chemical components therein (I.e. in the content within the packaging), and wherein the components of the packaging, or the components in the content inside the packaging remain stable and unharmed while disinfection, sterilization or oxidation occurs cumuli attentively in a pre-calibrated dose response curve of said laser energy characteristic and the packaging, multi components therein (in the liquid or gas in the packaging) and adequate inactivation of DNA/RNA replication sequences, or mineralization of toxic organic compounds therein (in the liquids or gases in the packaging). A further preferred embodiment of the present invention is wherein the laser

pulses repetitoon rate is between about 1 Hz to about 1 T Hz, and wherein its energy density reach from about 1 nJ to about 1000Js Cm2 .

A preferred mode for operation is when lasers or light sources operate at about 355nm, and if pulsed have a pulse width or pulse duration at sub-microsecond, however it may be that additional evolutionary steps in packaging material fabrication techniques may facilitate additional materials for packaging of liquids or gases not yet utilized by industry, agricultural or medical fields, such materials may have additional transmission windows (so that packaging will not be damaged) other then the 355nm, that why the methodology of the present invention facilitate an evolutionary step by utilizing a faster light transposing, or pumping, shifting or optronically or spatially manipulating, or delivering or targeting or diffusing or absorbing then the molecular thermal dynamic of the packaging material thus no damage to packaging occurs while disinfection or sterilization performance is engaged.

A preferred embodiment of the methodology of the present invention for a preferred mode of operation for devices using the method of the present invention for disinfection through packaging (DTP) is wherein the packaging for water based products is selected from ½, 1 liter, 1.5 liter, or 2 liter bottles or 1,2, 5,10 or 20 gallons, or wherein a conduit or camber shape pipe is interconnected or inter-operated for the delivery throughout of liquids or gases thereunto the packaging, or to/from said packaging aseptically or untreated, flavored or carbonated, oxygenated or enriched, supplemented or expanded with components or multi-components chemically and or biologically harmonious to the global optronic qualities and optival characteristics therein (in the packaging)

An especially beneficial environmental embodiment of the present invention is wherein the packaging is selected from a capsule, or pill, bottle or jug, container of tank, shaped as conduit or chamber or combinations or it may be made out of paper such as mail items or envelopes for letters, the addition of oxygenated water vapor at predetermined pressure throughout the process according to the present invention may be beneficial for making Advance Oxidation Technologies (AOT) therein and throughout the packaging using light and oxygen enriched water (H2O2). An improved embodiment of the present invention is having preferred mode for operating devices using the method of the present invention for disinfection or sterilization through packaging (DTP) without causing damage to said packaging material or causing molecular migration into said packaging from their liquid or gas content; a preferred mode for operating devices using the methodology of the present invention is wherein הסח

A preferred embodiment of the present invention is wherein the packaging item is a bottle or jug, or container, or a conduit or chamber type shape made from selection of monomers, carbomer, polymers, resins, or combination, and for example; any biocompatible packaging having ability of holding temporarily, or permanently water, air, liquids or gases for later consumption by end users, producers, industrialists, technologists, medical personnel, patients, and agro-food production market destination, and scientists and engineers. An additional preferred embodiment for disinfection through packaging is wherein the packaging is selected from a pill, or a capsule, or a bag, or combination, or perforated sausage like bags, or the packaging material could be selected from polymer or plastic or combination.

An environmental protection preferred embodiment is wherein the packaging material is used for containing or transferring, holding or channeling water for drinking, flavored water, carbonated water, beverages, Juices, agro-food products, sweets, or confectionery products. A preferred embodiment of the methodology of the present invention is wherein the packaging is holding glucose, biomedical preparation, vaccination agents, or preparation for vaccination or medical optoprobiotic compounds according to the method of the present invention.

A preferred embodiment of the present invention is wherein the packaging is exposed to at least one radiation unit or light source selected from solid state lasers, electrical discharge lasers, plasma driven lasers, semiconductor lasers, organic lasers, electron beam pumped lasers, free electron lasers, , fiber lasers doped, or SASE/EA/FEL lasers, fiber lasers, diode pumped lasers, crystal based lasers, doped glass based lasers, FELs lasers, polymer lasers, PW/CW type lasers, quantum dote lasers, laser arrays, flush lamp pumped lasers, water lasers, photonic bandgap lasers, seeded or amplified lasers, time compressed or expanded lasers, q-switch type lasers, interactive harmonic lasers, acoustic-optical lasers, ultrasonic lasers, X-ray pumped lasers, Y pumped lasers, E-beam pumped lasers, catalytic lasers, photoelectrocatalytic lasers, air lasers, ground stationary lasers, mobile and sub-miniaturized lasers, thin film type lasers, vapor lasers, water lasers, photonic bandgapped lasers, CW lamps, PW lamps, Quasi CW lamps, LPHO lamps, Medium pressure UV lamps, Low pressure UV lamps, hybrid combination of CW, PW, Quasi CW lamps and lasers or combinations, and wherein light from said radiation unit or light sources is coupled to waveguides extending from said light units to reaching the proximity of said packaging, and wherein the high intensity light is reaching to cover the entirety of the packaging and content therein for disinfection and sterilization of said content or volume or packaging surfaces within a predetermined space, over a predetermined period of time.

A preferred embodiment of the methodology of the present invention is wherein the light from the radiation units or light sources or hybrid combination of lasers and lamps is delivered through optical processing units able to control aspects of the delivered or distributed light such as to manipulate their optical or spatial properties so as to maximize the distribution, or uniformity, or to adjust the cumulative, or immediate biodosimetric curves adequate for the inactivation, sterilization or disinfection or dissociation or oxidation of noxious species present inside the packaging, in the content of said packaging or on the surfaces of said packaging.

A preferred embodiment especially beneficial for the provision and facilitation of vaccination production methodologies and techniques are being enhanced by using the methodology of the present invention wherein the remains, and the residual, or the bio-mass or chemical-mass within said content, or packaging surfaces, or liquids or gasses, or solids therein are being processed and exposed according to the methodology of the present invention such that opto biotic beneficial effects are facilitated to the agro-food, or bio-medical domains production.

A further preferred embodiment of the present invention is wherein opto-pro-biotic products are being produced according to the method of the present invention wherein noxious species within the

packaging and content to be disinfected are exposed and traceable recognition will occur upon consumption, or preceding treatment of the methodology of the present invention. A preferred mode for devices operating according to the method of the present ibvehntion is wherein the radiation unit or laser or light source is a pulsed, or continuos wave light source, or a further preferred mode is wherein the light radiation instrument includes a sub-microsecond pulsed source.

A preferred embodiment of the present invention is wherein the optical processing unit, which delivers the light to the packaging or content or space or volume or combination, is selected from diffractive optical elements, lenses or cubes, splitting or recombining optics and electro-optical elements, diffusers, reflectors, prisms, telescopic zooms, and zoom expanders, refractive optics, conversion or harmonic generators, pumping or amplified signals, amplifiers, converters, spatial processors, scanners, stirrers, beam positioning, location equation and transport interfaces, robotic arms with optical support means, optical bread boards, waveguids (HGFS, SFS,), photonic band gap, crystals, liquid waveguides, flowing liquid waveguides, or any combination thereof

A preferred embodiment of the present invention wherein the lasers or lamps operating is CW, PW, quasi CW, hybrid, liquid or gas based lasers, or the radiation unit or light sources combined or integrated include diamond based lasers, fiber lasers, TSA/SE/EA/FELs lasers, or electrical discharge lasers, or water lasers, or diod pumped or organic type lasers, or plasma lasers, or semi-conductor lasers, or amplified or harmonically generated lasers, or CW, PW lamps, or combination

A preferred embodiment of the present invention wherein the instrument or device is optically synchronized, or electronically linked or referenced, triggered or resolved to a particular machine control protocol for enhancing delivery and distribution of optical energy through packaging, and for the calibration and adjustment of the biodosimetric or chemical dosimetric curve adequate for sterilization or disinfection, dissociation or oxygenation of noxious species through the packaging without damaging said packaging or multi-components therein (in the packaging content or volume).

A preferred embodiment of the present invention wherein the packaging to be disinfected is an envelope or a mail item containing spores, bacteria or harmful compounds of biological or chemical origin. A Further beneficial biomedical preferred embodiment is wherein the effective range of the phototreatment effects according to the methodology of the present invention wherein opto-biotic, and/or opto probiotic water are produces according to the methodology of the present invention, such water may be beneficial for the immune system of consumers as the noxious species will be dissociated by the photochemical action or effects of processes according to the present invention, however, while the parent compound (example: before treatment, while liquids or gases or solids are in the packaging) before, or during, or after being treated, does not need to be transferred, or poured to, or transported via additional steps (i.e. additional chambers or conduits, bottles or jugs, containers or pipes for example), thus the methodology of the present invention is beneficial for the production of opto-pro-biotic wherein the sensitivity, or size of components facilitate treatment in the final packaging enclosure saving time, eliminating the need to keep transferring the volume to additional processes

related steps and increasing the bio-compatibility and bio-safety, or purity, or freshness, or nutrient, or flavor, color or taste, smells or visibility or look, composite or density. A beneficial preferred embodiment for biological, physiological, and medical fields according to the methodology of the present invention is wherein multi-components compounds and medical and immunology fields thus optical dissociation of noxious species could be performed wherein the biodosimetric values required for dissociation are achieved using the methodology of the present invention. The benefits could extend from using the present invention to dissociate M.R.na type or any other multi component composite substances or chemical signatures thus that the dissociated remaining bio and/or chemical mass is appropriate for immunization processes upon consumption. More specifically, the present invention could be utilized for the production processes of opto-pro-biotic produce, products aseptically beneficial for medical, agricultural and industrial applications, beneficial for the bottling industry and for production processes of agro-food production lines. Further more triggering positive immune response actions and effects (MHC II, III, I) for example such as for Major-Histo-Compatibility Complex or MHCC, the acquired Human Immune system may be triggered according to the methodology of the present invention from liquid or gases or solids in a predetermined packaging containing a pre-form, or compounding volumes of noxious species therein (in the packaging content/volume/inner space), such beneficial basic preparation could be triggered processed, dissociated or oxygenated, or sterilized, or modified, or photochemical adjusted, or treated, until reaching by the utilization of the light which sound creates, and the sound which light creates i.e., for example the attack transient acoustically thus created via utilization of light in the present invention, and Sono-luminescence or light produced by applying vibration excitation measures, such that the appropriate proportions upon consumption by end users, or producers, or human, plant or animal their immune system is enhanced, in simple words the final processing according to the present invention is occurring in the respective packaging, through said packaging material, and without causing damage, or molecular migration from said packaging to the liquid or gas or solid or combination therein such that freshness, natural components, integrity in terms of geometry of multi components is maintained, prolonged, and higher quality of production is facilitated by the methodology of the present invention of Disinfection, and sterilization, and phototreatment through packaging (DTP) and therefore as well as longer and safer shelf life, the methodology of the present invention surpass limitation of current methodologies in the field and require less steps, less time, and less transport of processed items such that the probability of cross contamination, and transfer of infected, or toxic compounds is substantially lower as the final processing is done (in) Through the packaging (DTP).

A preferred embodiment of the present invention wherein a line of mass production for mineral Water bottles, is equipped according to the method of the present invention with at least one high intensity source of light, or laser and said light source is pulsed, having peak power density from about 0.O1mJ/Cm2, to around 5OJs/Cm2, and wherein said light source is monochromatic (i.e. laser), having wavelength from about 222nm, to about 355nm, and said light pulses are having a repetition rate from between about Hz, to about 1 GHz and said light is directed at a transparent, or translucent portion, or lid, or cork of said bottles, thus ensuring that harmful or noxious bacteria is inactivated, or eliminated

therein, and DNA, & RNA replication Sequences of noxious species are thus inactivated inside the bottles by using appropriate wavelength and characteristics of light, before, during, or after they have been filled, corked, and/or sealed for use at later date.

A further environmental embodiment of the method of the present invention wherein the content of the bottles, conduits, or chambers may be selected from: beverages, wine, medical preparation, juice, drinking water, mineral water, insulin products or medical preperation. Spring water, flavored water, flavored beverages, biological traceable compounds, water, and/or drinks containing vitamines or nutrients, alcohol, blood products, plasma products, air products, gases for propelling medications, sprays, or any liquid or gasses or hybrid combination thereof.

A Novel environmental embodiment of the present Invention is having a high repetition rate, high peak power laser of the Nd:Yag, or Nd:Glass, or Nd: YLF, type or any combination thereof operating in the Fourth Harmonic generation mode (i.e. FHG), a further preferred embodiment of the present invention is having said solid state (i.e. Nd: Yag type for example), working in the Third Harmonic Generation mode (i.e. THG), a preferred embodiment according to the method of the present invention is having an electrical discharge laser such as an excimer laser operating in wavelength from about 193nm, through to about the 308, and 351nm, and wherein each of said pulses of light is aligned into the content of the bottled liquids or gasses for purifying, disinfecting, and ensuring that DNA, and RNA replication sequences are thus inactivated providing a non invasive disinfecting methodology wherein light pulses from the laser are penetrating the material from which the bottles, (i.e. conduits or chambers, or bottles, or pipes) are made.

A preferred embodiment according to the method of the present Invention is having a hybrid laser system operating wherein (a) a solid state laser operating at THG (355nm), is attached, or aligned to the transparent lid, or cork, or encapsulation, or conduit, or chamber, and wherein together in hybrid format an electrical discharge laser is also operating for maximizing the efficiencies associated with the non destructive disinfection according to the method of the present invention Further preferred embodiment according to the present invention wherein the packaging is a liquid waveguide, or concentrator.

A preferred embodiment of the present invention wherein a Nd:Yag laser is used having a third Harmonic generator producing 355nm wavelength which penetrates the packaging materials of PET types and inactivating DNA & RNA replication sequences therein (in the bottle, or packaging). Such preferred embodiment of the present invention could be implemented with a single laser unit having its beam of pulsed UVA light split, and distributed to a plurality of location by means of waveguiding light through HGFS optical fibers, photonic band gap waveguides, or polymer waveguides, or hybrid combinations. A further preferred embodiment of the present invention is wherein several lasers are used having high repetition rates, or high peak powers, and pulse duration from about 1 ms, to about 1 fs, and wherein their respective beams are collected, or deflected, or diverted or stirred to form a three

dimension element of UVA light at high energy density, and wherein said high energy density is below the damage threshold of PET packaging, or polymeric hybrid combination used as packaging materials.

A preferred embodiment of the present invention wherein the laser light source is sellected from (a) Gas discharge laser (b) diode pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e) semi conductor lasers, (f) crystal type of lasers, (9), X-rays pumped lasers, (h) E-beam pumped gas lasers types, (I) FEL (Free Electron Laser amplifier), (J) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

A preferred embodiment of the present invention wherein the laser light source is tunable from about 1 nm to about 3000 nm, a further preferred embodiment of the present invention is wherein the laser light source is tunable from about 333nm to about 360nm, and wherein the peak power density of individual pulses reach from about 1nJ/Cm2, to about 5OJs/Cm2' and wherein said pulsed laser light source is pulsing at repetition rates from about 1 Hz to about 300MHz thus the proffered embodiment of the ptresent invention is suitable for wide ranging application involving different packaging materials, thus their specie specific optical calibration standards are calculated for a specific biodosimetric value or curve to appropriately correspond (being lower) with damage threshold of the packaging material used in a specific application.

A further environmental embodiment of the method of the present invention wherein the content of the bottles, conduits, or chambers may be selected from: beverages, wine, medical preparation, juice, drinking water, mineral water, insuline products or medical preperation. Spring water, flavored water, flavored beverages, biological traceable compounds, Drug delivery using water based, and/or expanded or flavored water drinks containing vitamines or nutrients, alcohol, blood products, plasma products, air products, gases for propelling medications, sprays, or any liquid or gasses or hybrid combination thereof.

A Novel environmental embodiment of the present Invention is having a high repetition rate, high peak power laser of the Nd:Yag, or Nd:Glass, or Nd: YLF, type or any combination thereof driving the uvjet, or spatially processing pulsed laser light therein, or throughout and operating in the Fourth Harmonic generation mode (i.e. FHG), a further preferred embodiment of the present invention is having said solid state (i.e. Nd: Yag type for example), working in the Third Harmonic Generation mode (i.e. THG), a preferred embodiment according to the method of the present invention is having an electrical discharge laser such as an excimer laser operating in wavelength from about 193nm, through to about the 308, and 351nm, and wherein each of said pulses of light is aligned

into the content of the bottled liquids or gasses for purifying, disinfecting, and ensuring that DNA, and RNA replication sequences are thus inactivated, providing a non invasive disinfecting methodology wherein light pulses from the laser are penetrating the material from which the bottles, (i.e. conduits or chambers, or bottles, or pipes) are made.

A preferred embodiment according to the method of the present Invention is having a hybrid laser system driving the uvjet, thus operating wherein (a) a solid state laser operating at THG (355nm), is attached, or aligned to the transparent lid, or cork, or encapsulation, or conduit, or chamber, and wherein together in hybrid format an electrical discharge laser is also operating for maximizing the efficiencies associated with the non destructive disinfection according to the method of the present invention. Further prefered embodiment according to the present invention wherein the packeging is a liquid waveguide, or concventrator.

A preffered embodiment of the present invention wherein a Nd:Yag laser is used having a third Harmonic generator producing 355nm wavelength which pentrates the surface of the skin in human, and animals and thus swiftly inactivates DNA & RNA replication sequences in blood therein (in the blood, i.e. under the skin, non invasively). Such preffered embodiment of the present invention could be implemented with at least one laser unit having its beam of pulsed UVA light split, and distributed to a plurality of location by means of waveguiding light through HGFS optical fibers, photonic band gap waveguides, or polymer waveguides, or hybrid combinations, each distal tip is attached, supported, or threaded, in proximity or distributed to cover areas inthe body wherein blood vessels are relatively exposed, and are conviniently positioned around the surface (i.e. inporoving transmission, and coupling conditions). A further preffered embodiment of the present invention is wherein several lasers are used having high repetition rates, or high peak powers, and pulse duration from about 1 ms, to about 1 fs, or Atosecond and wherein their respective beams are collected, or diflected, or diverted or sttired to form a three dimension element of UVA light at high energy density, and wherein said high energy density is below the damage threshold of blood components, nutrients, conditioners, complimental systems, MHC type 1,2,3, and any vital cell present in blood or blood products, yet they are efficient for inactivation of noxious species therein, i.e. within the blood, or blood products.

A preffered embodiment of the present invention wherein the laser light source is sellcted from (a) Gas discherge laser, (b) diod pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e) semi conductor lasers, (f) crystal type of lasers, (g), X-rays pumped lasers, (h) E-beam pumped gas lasers types,

FEL (Free Electron Laser amplifier), (j) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

A preffered embodiment of the present invention wherein the laser light source is tunable from about 1nm to about 3000nm, a further preffered embodiment of the pesent invention is wherein the laser light source is tunable from about 333nm to about 360nm, and wherein the peak power density of individual pulses reach from about 1nJ/Cm2, to about 50Js/Cm2, and wherein said pulsed laser light source is pulsing at repetition rates from about 1 Hz to about 300MHz thus the preffered embodiment of the ptresent invention is suitable for wide ranging application involving different packeging materials, thus

their specie specific optical caliberation standards are calculated for a specific biodosimetric value or curve to appropriately corasponde (being lower) with damage threshold of the substrate material used in a specific application, or tool, or device.

The present invention disclosed a novel methodology for non-invasive disinfection, purification, and inactivation or equlization of (DNA, & RNA) replication sequences of noxious species in myriad of biomedical, and biotechnological applications involving end users, producers, and researchers in associated fields comprising the following steps:

Filling, distributing into, holding, or storing - in a predetermined chamber or conduit, a predetermined volume of liquids, or gasses to be non-invasively non residually treated.

Closing said conduit, or chamber with a transparent polymer or glass type lid, having a predetermined action spectrum, able to deliver, and transmit throughout any wavelength of light from about 260nm, to about the 360nm.

Implementation of the novel methodology of the present invention for surface treatment and for improving the hygiene of the mouth, may include (a) harnessing the illumination or irradiation of a waveguiding dielectric brush [WDB] having delivery capacity from about one quarter of a million of photons per Cm2/Second, to about 999 trillion potons per Cm2/1 picosecond, or Femtosecond, or Atosecond, thus swiftly sterilizing its complex curvature inner surfaces, and volumes, having variable depth of penetration catalytically using new generation tooth paste comprising; Catalytic centilayted compound [CCC] according to the methodology of the present invention, and wherein

Constructing or integrating a multi-component compound structurally modular, containing predetermined portion of yielding Oxygen Charge (SYOCH) in a U.P.W, PH stabilized, held temporarily or permanently in a 3D polymeric frame work of biodegradable biocompatible carbomer or BI-polymers expanded to contain photo-catalytic, and, or centilating conversion elementally each having predetermined electron charge transfer co.-efficiencies and absorption, refractive index profile, and acoustic properties, selected pre-production for quantum objective application specific efficiencies driven thus from supper conductive, to dielectric, or semi conducting, wherein the flexibility of water may provide generic structurally yielding Oxygen Charge accommodating into manageable forms the decomposed species inactivated radically (SYOCH1), within water, liquid or gas or air suspension, body fluids,or inside mouth.

DETAILED DESCRIPTION OF THE FIGURES:

Thew present invention will be further described in detail by Figures 1 - 15. These Figures are solely intend to illustrates some preferred embodiments of the present invention, and in no manner intend to limit the scope of the invention.

Figure 1 illustrates a method of the present invention as illustrated as figure 1 herein comprising: A method for disinfection and sterilization through packaging, non invasively, without causing damage to said packaging and content comprising: A radiation unit having a high intensity source of light (not Shawn) wherein its light delivery or pulse duration is shorter then the thermal dynamics of the packaging according to the methodology of the present invention for projecting or delivering a pulsed light beam (3), illustrated penetrating the packaging without causing damage or migration or change in composition of said packaging or content; light is Shawn delivered (3) via direct trajection or projection of light or through the use of optical waveguide (not Shawn). Bacteria, viruses, cysts, molds, germs, spores, and toxic or noxious species of chemical and biological origins which may be present in said packaging or chamber or conduit (not Shawn) are sterilized, inactivated, disinfected or dissociated therein (in the packaging and on packaging surfaces) are thus being made innocuous according to the present invention The bottle packaging (2) is illustrating as holding water, mineral water, flavored water, carbonated water, spring water, and bottled or treated water according to the methodology of the present invention. (4) Represent the air capsule, or space remaining between the top inner surface of the liquid in the bottle and the cap (1), air having the refractive index of 1.00, and water having a refractive index of about 1.3, thus when twisted to form a diffuser or to spatially equalize and distribute uniformly through out packaging and content volume, thus the packaging and its content are sterilized, or disinfected so liquids and gases or solids or surfaces are being sterilized or disinfected through packaging, non invasively, through packaging bounderies without causing damage to packaging and content or volume therein (in the packaging). By the plurality of refractive index profiles thus created according to the methodology of the present invention for non invasive through the packaging DTP photochemical interactions, light could be guided, and distributed throughout the bottle, jug, container, pipes, or any chamber or conduit having adequate spectral properties or transparency, and appropriately composed so as to be biocompatible for holding agro-food production items or packaged water products. Especially beneficial for agro-food industries and for biomedical domain hence methodology of the present invention is environmental friendly, and has a non chemical, non toxic, non residual processing capabilities through packaging (1-4).

Figure 2 illustrates a schematic view of the method of the present invention implemented in a mass production line of mineral water, flavored water, beverages, spring water, bottled water, or carbonated water, or enhanced water, or any combination thereof or in biotechnology production lines for medical preparation, or for blood processing; A schematic view of the method of the present invention for non invasive, non damaging disinfection through packaging DTP is herewith disclosed comprising: 5 gallons or a series of water containers, or chambers are Shawn (5,6,7,8,10) wherein a beam of light (11) is illustrated penetrating (5-11) the packaging (5,6,7,8,10) wherein 9 illustrate the air capsule or pocket left in any bottled water, or packaged beverage or water thus illustrating the potential diversity of refractive index profiles thus being generated by twisting the volume (and/or the packaging with the content) therein (in the packaging) or by delivering light throughout from adequate angular orientation, thus disinfecting and sterilizing, dissociating or oxidizing noxious species on the packaging surfaces, or

throughout the packaging content, or combination, according to the present invention the time domain of the delivered light (pulsed sub-microsecond time domain) is shorter then the thermal dynamics of he packaging material (for example , PET penetrated by a diod pumped Yag at 355nm, 75mHz repetition rate, and 3 ns pulse width), thus disinfection, or phototreatment (i.e. Oxidation, dissociation, reduction, elimination, inactivation, sterilization, photolysis, photo activation), optoprobiotic effects are achieved, and occurs according to the present invention non invasively without causing damage to said packaging or content. Especially beneficial for agro-food industries, for bottling industry (5,6,7,8,10) and for the production of bottled water (5,6,7,8,10) and biomedical preparation of optoprobiotic water based or bottled water products (5,6,7,8,10).

Figure 3 illustrates a method for disinfection and sterilization through packaging, non invasively, without causing damage to said packaging and content comprising: A radiation unit (12) having a high intensity source of light (13), or laser, or hybrid platform having pulsed light at wavelength of about 355nm, having pulsed duration or width of between 1 microsecond and about 1 Ato-second, As, wherein its light delivery or pulse duration is shorter then the thermal dynamics of the packaging (15) to be disinfected or sterilized or phototreated according to the methodology of the present invention for projecting or delivering a pulsed light beam (15), illustrated penetrating the packaging without causing damage or migration or change in composition of said packaging or content; light is Shawn delivered (15) via direct trajection or projection of appropriate spectral distribution over a predetermined space over a predetermined period of time thus appropriate biodosimetric curve, or chemical dosimetric values (not Shawn) for noxious species Bacteria, viruses, cysts, molds, germs, spores, and toxic or noxious species of chemical and biological origins which may be present in said packaging or chamber or conduit (not Shawn), or content or volume therein is being sterilized, inactivated, disinfected or dissociated therein (in the packaging and on packaging surfaces) are thus being made innocuous according to the present invention The bottle packaging (2) is illustrating as holding water, , (bottom of the bottles are not Shawn) mineral water, flavored water, carbonated water, spring water, and bottled or treated water according to the methodology of the present invention. (16) Represent the air capsule, or space remaining between the top inner surface of the liquid in the bottle, chamber or conduit, and the cap (14), air (16) having the refractive index of 1.00, and water having a refractive index of about 1.3, thus when twisted to form a diffuser or to spatially equalize and distribute uniformly through out packaging (15) and content volume, thus the packaging and its content are sterilized, or disinfected so liquids and gases or solids or surfaces are being sterilized or disinfected through packaging (15 a,b,c) , non invasively, through packaging bounderies without causing damage to packaging and content or volume therein (in the packaging). By the plurality of refractive index profiles (16,15), (13a, 13b, 13c) thus created according to the methodology of the present invention for non invasive through the packaging DTP photochemical interactions, light could be guided, and distributed (13a, 13b, 13c) throughout the bottle, jug, container, pipes, or any chamber or conduit having adequate spectral properties or transparency, and appropriately composed so as to be biocompatible for holding agro-food production items or packaged water products. Especially beneficial for agro-food industries

and for biomedical domain hence methodology of the present invention is environmental friendly, and has a non chemical, non toxic, non residual processing capabilities through packaging (15,a,b,c).

Figure 4 illustrates transmission through packaging and sterilization and disinfection through packaging DTP without damaging said packaging or content therein, non invasively comprising a packaging (20, 21) selected from polymers having appropriate transparency or optical properties (20, 21) or combination including polyethylene naphtalat (PEN), poilyalkyl naphtalat (PETG) having adequate refractive index profile throughout for the delivery, penetration or distribution of light throughout for disinfection, or sterilization, or dissociation, or oxygenation through packaging or DTP (18-21) (Disinfection Through Packaging) according to the present invention (1-80), a radiation unit (18) is illustrated as having a sub-microsecond pulse duration or width and a wavelength (not Shawn) at about 355nm, and repetition rates from about 1 Hz to about THz, exposure of the bottles can be accessed from any angular orientation as the diffuser therein created by twisting the content or volume of liquids or gasses therein (in the packaging), or twisting said packaging will deliver the light throughout uniformly, and spatially be distributed within the predetermined inner space or volume of the packaging (20, 21) over a predetermined period of time, each optronic event or pulse is shorter then the thermal dynamic curve of said polymers or combination or any other packaging material or conduit or chamber throughout so as to disinfect or sterilize the packaging (20, 21) or content therein non invasively using light. Especially beneficial for agro-food industries, biomedical, or for bottled water products containing sugar or flavoring, or for carbonated water or for beverages, or for milk based products or for medical preparation of opto-pro-biotic items, or for optoprobiotic water or drinks wherein the non invasive methodology of the present invention is utilized for processing by light (19) or disinfecting water and water based products through packaging (20, 21), DTP (Disinfection Through Packaging) according to the methodology of the present invention.

Figure 5 illustrates schematic view of the method of the present invention; A method for non invasive disinfection through packaging (DTP) is schematically illustrated featuring transmission through packaging (22-28) and sterilization and disinfection through packaging (24, 25, 26, 27,) DTP without damaging said packaging (24-27) or content therein, non invasively comprising a packaging (24, 25, 26, 27,) selected from polymers having appropriate transparency or optical properties (24-28) or combination including polyethylene naphtalat (PEN), poilyalkyl naphtalat (PETG), or Polycarbonate, or PET, or PET HD, or combination having adequate refractive index profile throughout for the delivery, penetration or distribution of light (22a) at about 355nm (22a) throughout (24, 25,) for disinfection, or sterilization, or dissociation, or oxygenation through packaging or DTP (1-80) (Disinfection Through Packaging) according to the present invention (1-80), a radiation unit (18) is illustrated as having a sub-microsecond pulse duration or width and a wavelength (not Shawn) at about 355nm, and repetition rates from about 1 Hz to about THz, exposure of the bottles can be accessed from any angular orientation as the diffuser therein created by twisting the content or volume of liquids or gasses therein (is not Shawn).Especially beneficial for disinfection through packaging (DTP) of bottled water products,

liquids or gases for medical preparation, and for agro-food production lines having packaged water product with volumes reaching from 1 micro-liter to about 20 liters, or from a single drop to about 1000 liters, wherein each liter may contain sugar or flavoring or additives or supplements or enhancements from about 1 mg per liter to about 999 Grams per liter. Especially beneficial for bottling industry or for biomedical domain for the preparation of opto probiotic and immune system enhancement in water and bottled water products. An instrument being a laser or lamp or hybrid combination is illustrated (22) has having light coupled to the packaging (24-27) from the right side, the light (22a) is illustrated penetrating the packaging without causing damage to said packaging, thus non invasively facilitates disinfection through packaging (DTP).

Figure 6 illustrates Disinfection through packaging (DTP) without damaging said packaging or content therein, non invasively comprising a packaging (31) selected from polymers having appropriate transparency or optical properties (38, 31) or combination including polyethylene naphtalat (PEN), poilyalkyl naphtalat (PETG) having adequate refractive index profile throughout for the delivery, penetration or distribution of light throughout for disinfection, or sterilization, or dissociation, or oxygenation through packaging or DTP (29-39) (Disinfection Through Packaging) according to the present invention (1-80), a radiation unit (not shown) is illustrated as having a sub-microsecond pulse duration or width and a wavelength (not Shown) at about 355nm, (29) represents the pulsed (sub-microsecond) light penetrating from the cap, and said cap is transparent from about 318nm to about 787nm, and wherein the air capsule or pocket (41) is illustrated right underneath the cap, the bottle bounderies is illustrated in (31-38), wherein the hollow star in the packaging illustrated by (34) is representing a harmful bacteria, cysts, virus or noxious biological species origin, and (35) illustrated in the black star - represent toxic chemicals or noxious organic compounds of chemical origin, especially beneficial for protecting packaging content and surfaces without damage (envelopes not shown) (35) represent flavoring in a 5 tips shape in black (37), and the moon shape on the lower right (36) represent flavoring molecule undamaged by the delivered light throughout, the top right black star type shape (33) illustrate preservative or additives, nutrient or enhancement also undamaged by the distributed light throughout (DTP), the time domain, or pulse width or modulated light delivered according to the methodology of the present invention (29, light source not shown) is substantially shorter then the thermal dynamic of the packaging material or the oxygenation threshold of the flavoring, sugars, additives, in said packaging or bottle thus non invasively, the method of the present invention facilitate disinfection through packaging without damage to packaging composition or content compositions therein. Especially beneficial for bottled water production lines, or for agro-food industries, beneficial for biomedical domain and for the production of optoprobiotic drinks for enhancing the immune system of human, animal or plants. Especially beneficial for the bottling industry for disinfection through packaging without damage to flavors or preservatives or additives, or packaging, or freshness, eliminating the need to use thermal expensive aseptic filling, and processing, and reduce the high

periodical maintenance and replacements associated with conventional non DTP technologies. The edge of the light (39) is illustrated after transgressing or penetrating the packaging (30-38) non-invasively. Especially beneficial for agro-food production, production and distribution lines for bottled water, flavored water, spring water, beverages, juices, and biomedical domain and preparation of optoprobiotic water based products.

Figure 7, illustrates Disinfection through packaging (DTP) without damaging said packaging or content therein, non invasively from (90 degrees to said packaging, illustrating the plurality of angular orientation possible with th methodology of the present invention) comprising; a packaging (50) having adequate refractive index profile throughout for the delivery, penetration or distribution of light (42) throughout for disinfection, or sterilization, or dissociation, or oxygenation through packaging (43) DTP (Disinfection Through Packaging), according to the present invention (1-80), a radiation unit (not shown) is illustrated having a sub-microsecond pulse duration or width and a wavelength (not Shown) at about 355nm, (46, 45, 44, 48, 47) illustrates flavorings, or additives, or sugars, or coloring, or carbonated, or CO2, or Nitrogen, or bacteria, or toxic chemicals, or organic toxic compounds undamaged by the methodology of the present invention, (41) represent the cap having transparent, translucent or semi-opaque composition this light may be delivered for distribution throughout, especially beneficial for bottled water production sites, distribution lines, and for agro-food industries, beneficial for the production of opto-probiotic using DTP methodology according tot he present invention, especially beneficial for disinfection through packaging (DTP) of ½, 1, 2, and up to 20 liters (5 gallons) of bottled water products including flavored water, carbonated water, and for liquids and gases in need of disinfection in their packaging without damaging said packaging (43), (51) illustrates the air capsule or gap twisted with the inner volume or content of said packaging (Not shown) so a to create a diffuser for the delivered or distributed light for disinfection through packaging (DTP) the air remaining (51) after the bottle or jug, camber or conduit or container have being filled, thus according to the methodology of the present invention facilitate refractive index profile manipulation of the light delivered throughout (42)

Figure 8, illustrates Disinfection through packaging (DTP) without damaging said packaging or content therein, thus disinfecting it non invasively illustrating preferred mode for coupling light to packaging using plurality of angular orientation possible [360 deg.] according to the methodology of the methodology of the present invention comprising; a packaging (53) having adequate refractive index throughout, a predetermined transparency and ability for the delivery, penetration or distribution of light (52) throughout for disinfection, or sterilization, or dissociation, or oxygenation through packaging (53) DTP (Disinfection Through Packaging), according to the present invention (1-80), a radiation unit (not shown) is illustrated having a sub-microsecond pulse duration or width and a wavelength (not Shown) at about 355nm, (57, 58, 59, 56, 55,) illustrates flavorings, or preservatives, or additives, or sugars, or coloring, or carbonated, or CO2, or Nitrogen, or bacteria, or toxic chemicals, or organic toxic compounds undamaged by the methodology of the present invention, especially beneficial for bottled

water production sites, distribution lines, and for agro-food industries, beneficial for the production of opto-probiotic using DTP methodology according tot he present invention, especially beneficial for disinfection through packaging (DTP) from about ½ liter to about 20 liters (5 gallons), or from about one micro-liter to about Two Thousand liters, or for bottled water products including flavored water, carbonated water, and for liquids and gases in need of disinfection in their packaging without damaging said packaging (60), (54) illustrates the air capsule or gap twisted with the inner volume or content of said packaging (Not shown) so a to create a diffuser for the delivered or distributed light for disinfection through packaging (DTP) the air remaining (54) after the bottle or jug, camber or conduit or container have being filled, thus according to the methodology of the present invention facilitate refractive index profile manipulation of the light delivered throughout (52). Preffered mode for devices utilizing the methodology of the present invention wherein DTP processes are being utilized for optoprobiotic production of bottled water aimed at strengthening the immune system of consumers while offering fresh, natural composition and flavored, or goodness or nutrient value, or shelf life or combinations.

Figure 9, illustrates Disinfection through packaging (DTP) without damaging said packaging or content wherein the packaging is immersed in water non invasively, comprising; a packaging (63,a,b,c) having adequate refractive index profile (62,a) throughout for the delivery, penetration or distribution of light (61) throughout for disinfection, or sterilization, or dissociation, or oxygenation through packaging (a,b,c) DTP (Disinfection Through Packaging), according to the present invention (1-80), a radiation unit (not shown) is illustrated having a sub-microsecond pulse duration or width and a wavelength (not Shown) at about 355nm, (57, 58, 59, 56, 55,) illustrates flavorings, or preservatives, or additives, or sugars, or coloring, or carbonated, or CO2, or Nitrogen, or bacteria, or toxic chemicals, or organic toxic compounds undamaged by the methodology of the present invention, especially beneficial for bottled water production sites, distribution lines, and for agro-food industries, beneficial for the production of opto-probiotic using DTP methodology according to he present invention, especially beneficial for disinfection through packaging (DTP) from about ½ liter to about 20 liters (5 gallons), or from about one micro-liter to about Two Thousand liters, or for bottled water products (a,b,c,) including flavored water, carbonated water, and for liquids and gases in need of disinfection in their packaging without damaging said packaging (65, a,b,c, 63), Figure Nine illustrate a preferred mode for coupling the light (61) to the packaging (a,b,c, 65, 63) after the bottle or jug, camber or conduit or container (63 –65, a,b,c,) have being filled, thus according to the methodology of the present invention facilitate refractive index profile manipulation of the light delivered throughout (61), the benefit of coupling light (61) to the packaging through a predetermined volume of water (62,a) is a narrow refractive index profile (air is 1.00, water is 1.3, PET at 1.45, quartz wall of camber (62) at 1.45 thus reducing the refractive index profile range facilitate better coupling of the light to the packaging thus performing disinfection through packaging DTP. The shapes in the bottle (c) illustrated as (65) illustrate bacteria, viruses, molds, cysts, germs, toxic organic molecules or compounds in the bottle such that only noxious species are inactivated without damaging sensitive components therein (in the content or on the surfaces of the packaging).

Figure 10, illustrates a method for disinfection non-invasively through packaging comprising; An envelope array or stack (67, 68, 69, 70, 71), the optronic (or optoelectronic) energy dose is represented by (66), illustrating the high peak power, sub-microsecond, pulsed light beams generated by a radiation unit having a high intensity source of light (not shown), spores (74), or noxious biological or chemical species is represented by (72) being inactivated (such as inactivating DNA/RNA replication sequences), or photochemical oxidized or reduced such that the content (74, 72, 73) is being made innocuous by the methodology of the present invention for Disinfection Through Packaging (DTP). The methodology of the present invention does not cause molecular migration or does not cause heat as the time domain of the delivered light (Example: i.e. submicrosecond, 266nm or 355nm pulsed UV laser, or lamps or hybrid platform or combinations respectively) is considerably shorter then the thermal dynamic of the packaging, envelope (67, 68, 69, 70, 71), (paper for example, or polymer varieties). Especially beneficial for disinfection or sterilization of mail items from noxious species of biological or chemical origins (74, 72, 73). Especially beneficial for post offices, and mail delivery and sorting facilities and post office authorities.

Figure 11, illustrates a schematic view of the method of the present invention for enhancing biosecurity, and chemical safety in a mass production line of mineral water, flavored water, beverages, spring water, bottled water, or carbonated water, or enhanced water, or any combination thereof or in biotechnology production lines for medical preparation, or for blood processing; A schematic view of the method of the present invention for non invasive, non damaging disinfection through packaging DTP is herewith disclosed comprising: 5 gallons jug, or a container, or chamber, or bottle, or conduit is Shown (80), wherein a beam of light (75) is illustrated penetrating (75, 76, 77), the packaging (80) wherein (77) illustrate the air capsule or pocket left in any bottled water, or packaged beverage, juice, milk or water thus illustrating the potential diversity of refractive index profiles thus being generated by twisting the volume (and/or the packaging with the content) according tot he methodology of the present invention therein (in the packaging) or by delivering light throughout from adequate angular orientation, thus disinfecting and sterilizing, dissociating or oxidizing noxious species on the packaging surfaces, or throughout the packaging content, or combination, according to the present invention the time domain of the delivered light (pulsed sub-microsecond time domain) is shorter then the thermal dynamics of he packaging material (80), (for example , PET penetrated by a diod pumped Yag at 355nm, 75mHz repetition rate, and 3 ns pulse width), thus disinfection, or phototreatment (75, 76, 77, 78, 79,) (i.e. Oxidation, dissociation, reduction, elimination, inactivation, sterilization, photolysis, photo activation), optoprobiotic effects are achieved, and occurs according to the present invention non invasively without causing damage to said packaging (80), or content (78, 79). Especially beneficial for agro-food industries, for bottling (80) industry (75, 76, 77, 78, 79,) , and for the production of bottled water (75, 76, 77, 78, 79,), and biomedical preparation (75, 76, 77, 78, 79,) of optoprobiotic water based or bottled water products (75, 76, 77, 78, 79, 80,), the present invention by coupling light (75) to the vortex r tornado shaped diffuser having a predetermined refractive index profile in relation to the content or the volume of the packaging (80), therein (in the packaging) for distributing appropriate spectral distribution

uniformly within a predetermined space (packaging receptive capabilities of inner volume) over predetermined period of time for disinfection sterilization oxidation and reduction or elimination through the packaging (DTP, Disinfection through Packaging) according tot he methodology of the present invention.

Figure 12 illustrate the methodology of the present invention for disinfection through packaging non invasively comprising:

A high intensity beam of light from about 1nm to About 999nm (81), penetrating through the packaging (82), wherein the packaging (82), (83), contains remaining air capsule or gas (88), illustrating the refractive index profile therein (88), (81), (84), (82), and when said air space or capsule is twisted or spun (85) it extend to reach (85) across any portion of the camber or conduit , or bottle (82, 83, 85) length, or depth, or width, or inner volume (84) , or content such that noxious species (not shown) of biological, or chemical origin which may be present in the content, and/or said packaging surfaces (inner surfaces, or outer surfaces)are being inactivated, or disinfected, or reduced, or equalized, or eliminated, or oxygenated, or dissociated (81, 85, 84) by light (81, 85, 84), or being sterilized through packaging (83, 82), (84) without causing damage to said packaging or content composition (82), (84), thus facilitating disinfection Through Packaging (DTP) according to the methodology of the present invention. Especially beneficial for agro-food production processes,, and for production of opto-pro-biotic (immunifying) bottled water based products. The time domain or pulse width of the delivered light from about below the one microsecond (1ms) to about above 1 Ato-second (As), and wherein pulse repetition rates, quasi-CW modulation or cross modulation frequency is from about 1 Hz, to about the 18 GHz, Substantially faster then the thermal dynamic of the polymer, or packaging materials, thus no temperature rise, or damage to packaging material (82) occurs, yet noxious species in said packaging (82), and threatening species of biological or chemical origin are disinfected through packaging, DTP such that they are innocuous forms, and may be beneficial for the immune system, or MHC type I, II, III, or according to the present invention made biocompatible for consumption or use throughout (i.e. both packaging and content or volume therein have being disinfected or sterilized through utilization of the methodology of the present invention for disinfection through packaging (DTP), (87), illustrates the electrical wiring for Three individual ultra-sound drivers, or tapered extensions wherein once active, spin the content, or packaging such that a diffuser (88, 85, 84, 81) is formed (extending to reach across the entire length of the bottle, camber or conduit (82, d,), (a,b,c,) represent the transient, or static cavitation (ultra sound), or ultrasound probes, or drivers responsible for vibrationally (not shown) twisting or spinning the air remaining in the bottle, or the air capsule therein (in the packaging), thus creating from the air or gas therein having a refractive index therein (in the packaging) from about 1.00 for air, 1.3 for liquids (water), and 1.45 for the packaging material, thus facilitating uniform distribution of the delivered light throughout the packaging or the content or the volume therein simultaneously, or sequentially, or cyclically, or non recurrently, or recurrently for disinfection of said packaging or content through packaging (DTP). (81) and (81a) represent a radiation

unit and its associated high intensity light, coupled to the vortex or tornado shaped diffuser illustrated by (84).

Figure 13 illustrate a methodology of the present invention for disinfection through packaging non invasively, comprising: A bottled water (z), illustrated with its bottom (y), an its top capped (q), wherein a radiation unit, or instruments (a-p) are illustrated operating singularly (a-p), or in unison (a, b, c, d, e, f, g, h, I, j, k, l, m, n, o, p, q, r, s, t, w, x, y, z) for the purposes of disinfection,or sterilization or dissociation or reduction or oxygenation, or elimination or equalization through packaging (disinfection through packaging i.e. DTP), and wherein each of said units having a high intensity source of light selected from lasers, or lamps CW, PW, quasi CW, hybrid, liquid or gas based lasers, (a-p)or the radiation unit or light sources combined or integrated include diamond based lasers, fiber lasers, TSA/SE/EA/FELs lasers, or electrical discharge lasers, or water lasers, or diode pumped or organic type lasers, or plasma lasers, or semi-conductor lasers, or amplified or harmonically generated lasers, or CW, PW lamps, or combination thereof (a-p) each capable of individually or collectively (a-p) to disinfect the packaging or the content or the volume (z/a) illustrated by the dotted line underneath the cap (q), without damaging said packaging or content or causing migration from packaging to content therein (in the packaging) thus according to the methodology of the invention facilitates disinfection through packaging DTP (a-p), (a-z). a/1 illustrates the light beam generated by each of the units (a-p) coupled to the bottle (z) from any angular orientation over 360 degrees to said packaging surface (z).

Figure 14 illustrate a methodology of the present invention for disinfection through packaging non invasively, comprising: A conduit or chamber or bottled water (100-115) illustrated on positioning coordinates (X = 102, 105), Y= 103, 104), wherein x represent the longitudinal length of the bottled water, and y represent its width, z represent its depth (106, 107), the lines (x,y,z) have been included for clarity in order to -portray to the reader that any angular orientation(360degrees) could be accommodated according the methodology of the present invention for disinfection and photo-treatment through packaging DTP. (110, 111, 112, 109) collectively illustrate the noxious, and health threatening compounds of biological, or chemical origin (110, 111, 112, 109), (115) illustrate the air capsule or remaining air, or gas at the top of the bottled water, underneath the cap (102), (100) represent the boundary of the packaging, and (114) represent the apex top water level line in the packaging (100), (108) represent an inactivated bacteria which can not replicate as a result of exposure to the methodology of the present invention for Disinfection through packaging (DTP), thus a bacteria which can not replicate can not infect, especially beneficial for the agro-food industries, and for production of bottled water products, having opto-pro-biotic competitive advantages for enhancing the immune system of human, animal or plants according to the methodology of the present ikbnvewnhtion for disinfection through packaging DTP.

Figure 15 illustrate the methodology of the present invention for disinfection through packaging non invasively using wave-guides and instrumental beam management, comprising: A radiation unit having a high intensity, or pulsed source of light (133) represent spectral distribution within a

predetermined space or volume over a predetermined period of time wherein the delivered light is having at least one wavelength at 355nm, and pulsed sub-microsecond pulse width extending from about 1 micro-second to about 1 Ato-second, and wherein cross sectional energy density, or interference (133), or energy density per cubic centimeter (Cm3) is reaching to extend from about 1nJ (1 Nano Joul) per Cm2, to about 18 Js Cm2, and wherein repetition rate or modulation frequencies reaching between about 1 Hz, to about 118 THz (131, 133, 129, 1170), and wherein said radiation unit, or instrument, or spectral distribution of the delivered light or applied bio-dosimetric, or chemical dosimetric energy curve or levels is adjusted, calibrated, or having a radiance, or fluence rate from About 250,000 photons per about 187 angstrom, or per adequate measure of contaminants (i.e. of biological or chemical origin to about 118 Trillion photons per measure (116), coupled to (117), a common end termination or optical distribution system (118) or detection circuits (141), wherein at least one optical wave guide (119a, 119b) is illustrated (119b) as being Bi- directionally able to deliver light throughout (i.e. to and from bottled water or target site or packaging or detection circuit) represent an additional wave guide (119b) extending to reach the target site, or packaging, or bottled water, or biomedical camber or conduit (122) for distribution of the light therein (134, 135, 128, 137,, 138, 129, 133,), into the packaging (122), for disinfection of said packaging surfaces and the content of the liquid or gas therein). An additional optical wave-guide is shown (125) extending to reach the proximity or appropriate angular orientation for delivering (131), (132), (141), (140), or distribution, (133), or diffusion, or projection, or inactivation (138), or disinfection (138, 133, 129, 137, 135, 128), or sterilization, or photo-reactivation, or proteolysis, or oxidation, or illumination, or exposure, or Combination, or for receiving light from said packaging or bottle for diagnostics, collecting calibration data or fluorescent events or spectroscopy observing packaging and/or content (OPB), or combination therein (through the packaging), for transmission from target site, or packaging, or bottled water (122) to said detection circuit for adjusting bio-dosimetric curves, energy levels, and spectral, and spatial properties of the delivered light for disinfection, or oxidation (129) 133) through packaging DTP. (126) illustrates a light projection point shown (129) to inactivate (129,, 137, 128) at least one DNA/RNA replication sequences thus a bacteria (135, 137) which cannot replicate, can not infect (129, 137, 135,), (134), represent a toxic organic or chemical component not yet oxidized, or reduced, or eliminated or dissociated (OPB), or processed (OPB), or photo-treated or combination (129,, 133, 128, 137) by the delivered light (131, 132, 133, 128, 129, 119a, 119b, 117). (130) represent the bottom of the bottled water , or packaging, (141) represent a transparent Cap (141, 131, 132, 133, i.e. light seeing as penetrating said cap)) wherein light from the radiation unit (116) is delivered through said cap, or lid, or top, or cover (141) for disinfection, or sterilization, or photo-treatment through packaging or DTP according to the methodology of the present invention. Especially beneficial for the agro-food industries, and bottled water industries, and for biomedical preparation of opto-pro-biotic compounds (OPB) through packaging such that once consumed or reach their respective destination, enhances the opulent, or positive, educated, or rehearsed human immune system, or acquired immune system of human, animal or plants. Especially beneficial for the production of opto-pro-biotic (optoprobiotic meaning that the dissociated or photo-treated components therein in the packaging are being dissociated without damaging their geometrical integrity, thus allowing traceable recognition by the

acquired immune system of human, animal or plants) bottled water products (122), chemical vaccination and programming and preparation (OPB of immune system [Computer is the MHC I, II, III, disk is the water , or the content of the packaging, and the data is the noxious species therein in the packaging), such that opto-pto-biotic compounding and photo-production is herewith illustrated according to the methodology of the present invention, especially beneficial for medical preparation requiring high level of bio-compatibility, and bio-security. Light (133, 129, 132, 131, 117) I seeing projected, or delivered, or combination distributed from optical wave guide distal tips (far ends) (126, 120) so as to penetrate the packaging (126, 129, 131, 132, 133, 129), via DTP (disinfection through packaging) sufficiently fast for disinfection or sterilization of noxious species in said packaging (122), but substantially faster then the thermal dynamics of the packaging material (122) such that no molecular migration occurs from packaging to its content or volume internally (i.e. in the packaging) especially beneficial for bottled water products, and for agro-food production process, and for biomedical procedures, providing bio-security by light through packaging DTP.

CLAIMS

1. Method for non invasive disinfection of packages using light radiation, said method is especially useful for disinfecting non-opaque package, and for disinfecting the content of packages having at least one non-opaque portion through which light radiation may enter inside the package, comprising the steps of;

   (a) positioning at least one package opposite at least one light radiation means capable of emitting submicrosecond light pulses;

   (b) directing at least one submicrosecond pulse of light emitted from said light radiation means, to at least one non-opaque portion of said at least one package;

   wherein said pulse of light contains at least one light component having a wavelength of between 1nm and 999nm, and wherein said component has a peak power of energy sufficient to destroy the toxic or noxious nature of compounds of biological or chemical origin anticipated to be present on said package or in its content, and wherein the time extent of said pulse is short enough such that its energy is insufficient for damaging or releasing unwanted particles from said package or its content.

2. Method for non invasive disinfection of packages according to claim 1, wherein the package is sealed with its content inside prior to the disinfection.

3. Method for non invasive disinfection of packages according to any of the preceding claims, wherein the content of the package is selected from the group of liquid, frozen liquid, jell, powder, solid or gas, or a combination thereof.

4. Method for non invasive disinfection of packages according to any of the preceding claims, wherein the light pulses emitted from the light radiation means are being directed or guided to a predetermined transparent portion of the package, and in a beam having a predetermined angle relatively to said transparent portion, such that the transparent portion of the package becomes a waveguide or diffuser distributing the light radiation throughout the package and its content.

5. Method for non invasive disinfection of packages according to any of the preceding claims, further comprising scanning the package with beamed light by vibrating or spinning either the light beam, the package, or the content, during a disinfection sequence.

6. Method for non invasive disinfection of packages according to any of the preceding claims, wherein the package is sealed with its content prior to the disinfecting, and wherein the content includes liquid or jell with a gap of a predetermind amount of air or gas trapped between the apex of the liquid or of the jell, and the upper covering of the package, further comprising the step of vibrating or spinning the package close to or during a disinfecting sequence, wherein said vibrating or spinning

are useful for affecting vortex such that the trapped amount of air or gas is being extended downwards along a mid portion inside the package, and such that a substantially homogenous diffusion of the light throughout the content and the package may be effectively achieved, wherein the at least one light pulse is being non invasively directed through the package into said air or gas.

8. Method for non invasive disinfection of packages according to any of the preceding claims, wherein the at least one light radiation means is being used during a disinfection sequence together with a plurality of other light sources usefull for disinfection.

9. Method for non invasive disinfection of packages according to any of the preceding claims, wherein the at least one light radiation means is being used during a disinfection sequens together with at least one ultrasonic transducer.

10. Method for non invasive disinfection of packages according to any of the preceding claims comprising; Activating at least one radiation unit having a high intensity source of light in proximity or vicinity to a predetermined volume of liquid or gases or solid being packaged held temporality and/or permanently in its packaging such as a bottle, jug or conduit or chamber; or capsule, or droplet, Stirring and beam managing at least one pulsed UVA laser light source from about 100nm to about 400nm, and wherein said light is pulsed between about 1Hz to about 100 GHz, and at least one pulse out of a plurality of pulses delivered is having a time duration or pulse width reaching between about 1 microsecond to about 1 Femto-second Fs, and wherein the intensity, or fluence rate, or total irradiant, or biodosimetric dose, or number of photons, or the relative distance between photons, or energy density, or average energy is calibrated to species specific calibration standards for inactivating at least one DNA/RNA replication sequences, or oxidizing at least one organic toxic compound or components of said liquid or gases or solids such that said liquids or gas content and packaging made safe for consumption or delivery to end user bio compatible and chemically innocuous throughout by said laser having adequate calibrated spectral distribution for disinfection or sterilization or oxidation through predetermined type of packaging over a predetermined space or volume over a predetermined period of time without damaging said packaging or causing molecular migration of packaging to liquid or gas or solids therein.

11. Method for non invasive disinfection of packages according to any of the preceding claims comprising; Exposing at least one predetermined packaging material selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, paper or silk cellulite or composite combination, or glass or any polymer resins combination thereof having a predetermined volume therein of liquid or gas or solids or food or drink supplements, a predetermined flavoring, or natural preservatives, and wherein said packaging is having a predetermined surface area, a thermal dynamic curve, a refractive index profile and a transmission characteristics calibrated to said external exposure, and when combined or measured individually with the liquid or gases or solids content therein facilitates disinfection or sterilization of content or packaging simultaneously or separately or in combination; Calibrating a

dose response curve for the predetermined transmission or absorbency, or opto-electronic or photochemical characteristics or reaction portfolio for light of said packaging, and wherein said dose is tuned to its scattering angle, or reflecting, or refracting, or deflecting or manipulating light throughout and therein without changing said packaging composition or causing toxic molecular migration from said packaging to said content or damaging to said packaging while as function of biodosimetric and chemodosimetric values of the delivered or distributed light throughout realize said disinfection or sterilization or oxidation objectives of producers, end users or quality standards wherein accumulative and continuum pounding of optical, acoustic, and thermal photochemical effects, in a predetermined cyclic, or recurrent or non recurrent, sequential or consecutive steps or photochemical disinfection, sterilization or oxidation or reduction or mineralization events throughout said packaging volume,, surface area, and content therein; Activating at least one radiation unit having a high intensity source of pulsed light from about 1nm to about 999nm, and energy density from 1nJ cm2 , to about 40 kJ cm2 , and repetition rate from 1Hz to about 918 GHz, in proximity to said packaging, synchronized or resolved and linked or remotely interfaced via optical fibers, waveguides, liquid waveguides or reflective or refractive stirring optics targeting or transgressing, or transversing or covering, or aiming at said packaging so light from the radiation unit is transmitted through said packaging without causing damage to it; Inactivating, or disinfecting or sterilizing, or oxidizing said noxious species within the packaging and on said packaging surfaces or volume thus enhancing its quality and biological and chemical compatibility, preserving content freshness, flavor, or appearance improving its overall quality level over a predetermined period of time.

12. Method for non invasive disinfection of packages according to any of the preceding claims, comprising; Exposing at least one predetermined packaging material selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, glass or any polymer resins combination thereof having a predetermined volume therein of liquid or gas or solids or supplements, surface area, a predetermined thermal dynamic curve, a refractive index profile when combined with the liquid or gases or solids therein; Calibrating the predetermined transmission or absorbency characteristics for light of said packaging, or scattering ration, or reflecting, or refracting, or deflecting or manipulating light throughout without changing said packaging composition or causing toxic molecular migration or damaging to said packaging; Activating at least one radiation unit having a high intensity source of pulsed light from about 1nm to about 999nm, and energy density from 1nJ cm2 , to about 40 kJ cm2 , and repetition rate from 1Hz to about 918 GHz, in proximity to said packaging, synchronized or resolved and linked or remotely interfaced via optical fibers, waveguides, liquid waveguides or reflective or refractive stirring optics targeting or transgressing, or transversing or covering, or aiming at said packaging so light from the radiation unit is transmitted through said packaging without causing damage to it; Inactivating, or disinfecting or sterilizing, or oxidizing said noxious species within the packaging and on said packaging surfaces thus enhancing its quality and biological and chemical

compatibility, preserving content freshness, flavor, or appearance improving its overall quality level over a predetermined period of time.

13. Method for non invasive disinfection of packages according to any of the preceding claims comprising; Activating at least one solid state laser radiation unit having a high intensity source of pulsed light in proximity or vicinity to a predetermined volume of liquid or gases or solid or combination is being packaged held temporality and/or permanently in its packaging such as a bottle, jug or conduit or chamber; Stirring or beam managing said pulsed laser light source from about 100nm to about 400nm, and wherein said light is pulsed between about 1Hz to about 100 GHz, and at least one pulse out of a plurality of pulses delivered is having a time duration or pulse width reaching between about 1 microsecond to about 1 Ato second As and wherein the intensity, or fluence rate, or total irradiant, or biodosimetric dose, or number of photons, or the relative distance between photons delivered, or the energy density therein, or average energy delivered throughout packaging and content is calibrated to noxious species specific calibration standards for inactivating at least one DNA/RNA replication sequences, or oxidizing at least one organic toxic compound or components of said liquid or gases or solids or combination such that said liquids or gas content and packaging made safe for consumption or delivery to end user stable or bio compatible and chemically innocuous throughout by said laser having adequate calibrated spectral distribution for disinfection or sterilization or oxidation through predetermined type of packaging over a predetermined space or volume over a predetermined period of time without damaging said packaging or causing molecular migration of packaging to liquid or gas or solids combination content therein.

14. Method for non invasive disinfection of packages according to any of the preceding claims comprising; Activating at least one radiation unit having a high intensity source of pulsed or continues light in the vicinity to at least one packaging; Stirring and beam managing at least one pulsed UVA laser light source in unison, single, or hybridizing pulsed and continuos radiation units such that said units are actively operating together simultaneously, or in alternating, cross modulating, or triggered for cyclic, recurrent, non recurrent, or combination and wherein their total electro-optical output at a given period of time operating from about 100nm to about 400nm synchronously, and wherein said light is pulsed between about 1Hz to about 100 GHz, and at least one pulse out of a plurality of pulses, quasi CW beams, or coherent and non coherent light delivery or pumping, or collimated light, or amplified combination is delivered towards or through said packaging when having a time duration or pulse width or modulation signal reaching between about 1 microsecond to about 1 Femto-second Fs, or picosecond Ps, and wherein the intensity, or fluence rate, or total irradiant, or biodosimetric dose, or number of photons, or the relative distance between photons in selected beams or burst of light from said units, or energy density, or average energy is calibrated to species specific calibration standards for inactivating at least one DNA/RNA replication sequences, or oxidizing at least one organic toxic compound or components of said liquid or gases or solids such that said liquids or gas content and packaging

made safe for consumption or delivery to end user bio compatible and chemically innocuous throughout by said laser having adequate calibrated spectral distribution for disinfection or sterilization or oxidation through predetermined type of packaging over a predetermined space or volume over a predetermined period of time without damaging said packaging or causing molecular migration of packaging to liquid or gas or solids therein.

15. Method for non invasive disinfection of packages according to any of the preceding claims comprising; Activating a plurality of radiation units having a high intensity source of light or sound, magnetic or ultrasonic vibrations in proximity or vicinity or remotely guided or reflected or deflected or refracted or diffracted or stirred or scanned or combination aimed and targeted or delivered or distributed to a predetermined packaging selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, paper or silk cellulite or composite combination, or glass or any polymer resins combination thereof having a predetermined volume therein of liquid or gas or solids or food or drink supplements, a predetermined flavoring, or natural preservatives, and wherein said packaging is having a predetermined volume or content, surface area, a thermal dynamic curve, a refractive index profile and a transmission characteristics calibrated to said external exposure; Stirring and beam managing at least one of said units optical or acoustic-optical outputs from about 1nm to about 4000nm, and wherein said light is pulsed or modulated controlled continuously, or triggered, synchronized or resolved electro-mechanically or optronically between about 1Hz to about 1997 THz, and at least one pulse out of a plurality of pulses delivered is having a time duration or pulse width reaching between about 1 second to about 1 Ato-second, and wherein the intensity, or fluence rate, or total irradiant energy, or biodosimetric dose value, or number of photons delivered from all directions over time, or the relative distance between photons thus delivered, or global energy density, or average energy delivered by units per volume or content is calibrated to species specific calibration standards for inactivating at least one DNA/RNA replication sequences, or oxidizing at least one organic toxic compound or components of said liquid or gases or solids such that said liquids or gas content and packaging made safe for consumption or delivery to end user bio compatible and chemically innocuous throughout by said units having each adequate calibrated spectral distribution for disinfection or sterilization or oxidation through predetermined type of packaging throughout a predetermined space, or volume, over a predetermined period of time such that said volume, content or surfaces throughout are sterilized or disinfected or oxidized or made safe biologically or chemically without damaging said packaging or causing molecular migration of packaging to liquid or gas or solids, volume or content therein and without adjusting, changing or deteriorating the flavor and details, taste or composition, wholesomeness and freshness, quality and shelf-life of said agro-food, or biomedical packaged products so said products quality is maintain throughout for long periods of time.

16. Method for non invasive disinfection of packages according to any of the preceding claims, wherein the packaging is selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, paper or silk cellulite or composite combination, or glass or any polymer resins combination thereof having a predetermined volume from about 1Microliter to about 1 1cubic meters of bottled water, mineral water, spring water, flavored water, carbonated water, drinking water, biomedical preparation of any liquid or gas or solid combination thereof; Transferring said packaging mechanically or pneumatically, or electronically or electro-mechanically, or hydraulically, or combination through a high energy density zone generated by a laser light source pulsed in the UVA region wherein pulse width or time domain of each pulse of light is sub-microsecond and wherein the wavelength of said energy density zone is from about 347nm through to about 399nm and wherein appropriate spectral distribution over a predetermined space volume or content of said packaging over a predetermined period of time is adequate for sterilization or disinfection or oxidation of all noxious species therein while leaving packaging intact undamaged and whole in composition and stable chemically or without damage to components.

17. Method for non invasive disinfection of packages according to any of the preceding claims; wherein the packaging material is selected PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, silicon, paper or silk cellulite or composite combination, or glass or any polymer resins combination thereof and containing sugar or flavoring or food additives or vitamins or minerals or supplements or nutritional additives and wherein the content of sugar in said water is from about 1% per volume concentration to about 99% per volume concentration.

18. Method for non invasive disinfection of packages according to any of the preceding claims comprising comprising; Targeting at least one predetermined packaging item comprising bottled water, or mineral water, or spring water, or treated water, or flavored water, or carbonated water, or vitamin and nutrient enriched or enhanced water, or colored water, or water containing food supplements, or preservatives, or drinking water or combination water packaged in a predetermined material selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, silicon, or any biocompatible and optically compatible polymer capable of transmitting wavelength from about 233nm to about 999nm, a paper or silk, cellulite, or composite combination, or glass or any polymer, or monomer, or carbomer or resins combination thereof having a predetermined volume from about half of a liter, to about 20 liters and wherein each packaging is almost full to the top where capped; Twisting said packaging item such that when said packaging item is ultrasonically, or mechanically, or hydraulically, or pneumatically or electronically or opto spatially, or opto – electronic, or combination twisted at the appropriate speed or rounds per minutes RPMs, during said packaging transport or standstill from about 1 RPMs to about 30,000 RPMs, then as the volume in said packaging globally is stirred and sonically or mechanically push to twist, said air capsule is

twisting in the direction, or motion of said volume cyclically thus it is stretched in a vortex, tornado, in a conical or cylindrical , or longitudinal combinations shape having efficient light diffusing properties; Diffusing At leas one 355nm radiation unit or laser having a high intensity source of light, and said vortex or tornado shaped air capsule containing on average at least about 21 percent free available oxygen is reaching to extend from about the input , or output of said packaging or bottle, or jug, or capsule where capped to proximity or touching the bottom of said packaging and relaxing in a linear smooth curve when exit active processing or exposure according to the methodology of the present invention; Exposing simultaneously, sequentially, recurrently or non recurrently or cyclically, or combination thereof at least one packaging item to at least one pulse from a radiation unit or laser having high peak power, at about sub-microsecond pulse width, a repetition rates extending variably from about 1 Hz to about 22 THz, Tera Hertz, and a wavelength of about 355nm said targeting, or twisting, or diffusing, or exposing said packaging in synchronization or linked or related to said twisting , or stirring, or sonication, or diffusion of said content within the packaging, and wherein said packaging material containing the water product therein turning is exposed to at least one pulse from said radiation unit or laser and said twisted air capsule, now stretched, facilitate diffusing and illuminating or irradiating or distributing of the light from said radiation unit throughout the volume to be disinfected or sterilized therein facilitating the provision of biodosimetric curves for single or a cumulative counting of a plurality of 1st and/or 2nd order photonic interactions, and photo-products or effects, to accommodates cumulative dosimetric values, or thresholds for species specific biological calibration standards for inactivation, disinfection, sterilization or oxidation, or equalization or reduction of their DNA/RNA replication sequences, or combination thereof, thus disinfecting, or sterilizing, or oxidizing noxious, or toxic chemicals or combination, making content and packaging more innocuous, and safe increasing its quality and bio security over a predetermined period of time, preserving its flavor, freshness and natural purity for consumption.

19. Method for non invasive disinfection of packages according to any of the preceding claims comprising comprising; Targeting at least one predetermined packaging item selected from PET, Polyolefin, and Polyamide, Polycarbonate, Polyeteramid, or Polyester or PE/HD, nylon or plastic, silicon, or glass, or any biocompatible and optically compatible polymer; Twisting said packaging item or content, or volume, or surface ultrasonically, or mechanically, or hydraulically, or pneumatically or electronically or opto spatially, or opto – electronic, or hydro-optically, or; Coupling and Diffusing at leas one pulsed or continuos wave, or quasi continuos light at about 355nm from at least one radiation unit or laser having a high intensity source of light; forming vortex or tornado shaped air capsule diffuser by said twisting action and wherein said twisted or stretched air capsule contain about 21 percent free available oxygen as air, or nitrogen, or other gas having refractive index lower then the refractive index of transparent water, or liquids or gases in said packaging, or wherein the refractive index of said capsule is higher then the refractive index of air, and wherein said vortex or tornado shaped diffuser is reaching to extend

from about the input , or output of said packaging to proximity touching the bottom of said packaging and relaxing in a linear smooth curve at about the center of said packaging or maneuvered or stirred or turned so as the stretched diffuser will be positioned at the appropriate angle or distance; Exposing simultaneously, sequentially, recurrently or non recurrently or cyclically, or combination thereof at least one packaging immersed in water within a conduit or chamber, or said packaging is surrounded by air or vacuum and wherein said packaging item or its content or combination is exposed to at least one pulse from said radiation unit or laser or hybrid integration or combinations, and wherein said radiation units or laser are selected from solid state lasers, electrical discharge lasers, plasma driven lasers, semiconductor lasers, organic lasers, electron beam pumped lasers, free electron lasers, , fiber lasers doped, or SASE/EA/FEL lasers, fiber lasers, diode pumped lasers, crystal based lasers, doped glass based lasers, FELs lasers, polymer lasers, PW/CW type lasers, quantum dote lasers, laser arrays, flush lamp pumped lasers, water lasers, photonic bandgap lasers, seeded or amplified lasers, time compressed or expanded lasers, q-switch type lasers, interactive harmonic lasers, acoustic-optical lasers, ultrasonic lasers, X-ray pumped lasers, Y pumped lasers, E-beam lasers, catalytic lasers, photoelectrocatalytic lasers, air lasers, ground stationary lasers, mobile and sub-miniaturized lasers, thin film type lasers, vapor lasers, water lasers, photonic bandgapped lasers and wherein light from said radiation unit or light sources is coupled to waveguides extending from said light units to reaching the proximity of said packaging, and wherein the high intensity light is reaching to cover the entirety of the packaging and content therein for disinfection and sterilization of said content or volume or packaging surfaces within a predetermined space, over a predetermined period of time.

20. System for non-invasive disinfection of packages, said system is especially useful for disinfecting non-opaque package, and for disinfecting the content of packages having at least one non-opaque portion through which light radiation may enter inside the package, comprising;

(a) at least one light radiation instrument capable of emitting pulses of light that contain at least one light component having a wavelength of between 200nm and 1000nm;

(b) mechanical means for positioning at least one package intended to be disinfected, opposite said at least one light radiation instrument, for receiving light radiation;

(c) control means for controlling said light radiation instrument to transmit pulses of light toward packages positioned by the mechanical means in order to be treated by the light radiation emitted from the instrument;

wherein said pulses of light contain at least one light component having a wavelength of between 1nm and 999nm, and wherein said component has a peak power of energy sufficient to destroy the toxic or noxious nature of compounds of biological or chemical origin anticipated to be present on said packages or in their content, and wherein the time extent of each pulse is short enough

such that the accumulative energy of the pulses being transmitted into one package during a disinfection sequence is insufficient for damaging or releasing unwanted particles from said package or its content.

21. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument is positined such that the light pulses emitted from it are being directed or guided to a predetermined non-opaque portion of a package intended to be treated by light, and wherein the light radiation is arranged in a beam having a predetermined angle relatively to said non-opaque portion, such that the non-opaque portion of the package becomes a waveguide or diffuser distributing the light radiation throughout the package and its content.

22. System for non-invasive disinfection of packages according to any of the preceding claims, further comprising mechanic, electro-mechanic, or electro-acoustic means, for vibrating or spinning either the light beam, the package, or the content, during a disinfection sequence, said vibrating or spinning are in order to make the light beam scan either the package or its content during a disinfection sequence.

23. System for non-invasive disinfection of packages according to any of the preceding claims further comprising a plurality of light sources in combination with the least one light radiation means.

24. System for non-invasive disinfection of packages according to any of the preceding claims further comprising an ultra-sonic trasducer in combination with the least one light radiation means.

25. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation unit includes a solid state laser.

26. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the radiation instrument or light source is a continuous wave lamp.

27. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a pulsed lamp.

28. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a quasi-cw type of lamp or laser.

29. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes an electrical discharge laser.

30. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes plasma pumped laser.

31. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes an e-beam type of laser.

32. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a gas type laser.

33. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes an TSA/SE/EA/FELs type of laser.

34. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a semi-conductor type of laser.

35. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a quantum dot matrix type of laser.

36. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes an organic type laser.

37. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a crystal type laser.

38. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a liquid type laser.

39. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes an amplified type of laser.

40. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a q- switched lamp pumped laser with 2nd, 3rd, 4th, 5th, 6th harmonic generator or frequency doubler or converter.

41. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes pulsed and wherein the time duration or pulse width is selected from about 1 Ato-second, As, to about 1 second.

42. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a hybrid laser and lamp integrated on a single platform.

43. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes amplified or spatially processed, or converted, or deflected, or reflected, or refracted, or holographically surround or penetrating, or splitted, or recombined, or channeled, or distributed directly or guided or through pockels cells, delivered

through packaging for sterilization or disinfection, dissociation, or oxidation, reduction or equalization of noxious species from packaging or content throughout.

44. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes diode pumped laser.

45. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a diod laser.

46. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a LED.

47. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes an acoustic, or optically, electronic, hydraulic, or pneumatically or combination modulated laser.

48. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a space charged electronic laser.

49. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a fiber type laser.

50. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a doped type fiber or photonic band-gapped laser.

51. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a water laser.

52. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a hybrid laser lamps wherein the spectral distribution over a predetermined space over a predetermined period of time is linked or synchronized such that the appropriate dose or energy density is delivered for disinfection and sterilization through packaging of liquids or gasses or solids therein or throughout.

53. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a laser.

54. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a diamond based laser.

55. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a pulsed UV solid state Nd; Yag laser operating at between 1Hz to about 200MHz having a wavelength selected from about 1nm to about 3000nm,

and wherein the pulse duration or width is selected from 1 second, 1s, to about 1 Ato second, 1As.

56. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the light radiation instrument includes a pulsed UV solid state laser operating at between 1Hz to about 75MHz having a wavelength selected at about 355nm, and wherein the pulse duration or width is sub-microsecond causing 2nd order interactions, or multiphoton absorption processes on the surface of packaging and through out the volume or content of said packaging.

57. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a half liter bottle of water, flavored water, bottled or treated water, or carbonated water for drinking

58. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is 5-gallon jug, or container containing water based products for drinking such as mineral, flavored, or supplemented water.

59. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a 1 liter bottle of mineral, flavored, carbonated, treated, or spring water for drinking.

60. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a liter and a half bottle of mineral water, flavored water, bottled or treated water, or carbonated water, or spring water for drinking

61. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a Two liter bottle of mineral water, flavored water, bottled or treated water, or carbonated water for drinking

62. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a half gallons jug of mineral water, flavored water, bottled or treated water, or carbonated water for drinking

63. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a bag or conduit, or pipe, or reactor for Photochemistry.

64. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is selected from capsule, pills, gels, plastic, polymers, monomers, carbomer, elastomer, or cellulite, paper or silk materials such that are adequately biocompatible for agro-food products for consumption or biomedical or optoprobiotic preparation or food or drink or combination supplements compounding volumes

65. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is a predetermined volume of vitamin water or nutrient enriched water

66. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is containing a twisted air capsule vortex or tornado shape such that its lower refractive index acts within the volume or content of packaging as a longitudinal diffuser or reflector for sterilization or disinfection, reduction or oxygenation distribution or uniformly penetrating the liquids or gasses or solids within the packaging.

67. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is penetrated by light from the radiation unit without damaging its composition, without causing molecular migration such that the delivered light has a shorter time duration then the time it takes for thermal effects or dynamic curve, or temperature rise to occur.

68. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging is containing components selected from water, air, flavoring, sugar, food or drink supplements, vitamins or nutrients, coloring or preservatives and wherein exposed according to the method of the present invention no damage is occurring to said components or packaging while sterilization or disinfection of packaging or content is efficiently applied through packaging.

69. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the packaging contains water based or bottled water products and wherein the sugar concentration in said content or volume is reaching between about 1 gram per liter to about 999 Grams per litter

70. System for non-invasive disinfection of packages according to any of the preceding claims, wherein the instrument or laser, or optics, or beam management system is position in proximity or remote to the location of the packaging to be sterilized and disinfected through said packaging and wherein the delivered light is delivered through air, water, liquid or gases, or waveguides to the destination.

71. Use of a system for non-invasive disinfection of packages according to any of the preceding claims, for production of opto-pro-biotic water based products wherein the dissociated components therein are traceable for recognition by MHC,I,II,III, or by human immune system such that the opulent and positive response portfolio of said immune system is expanded, and positively assimilated or triggered for human, animal or plants.

Figure 1

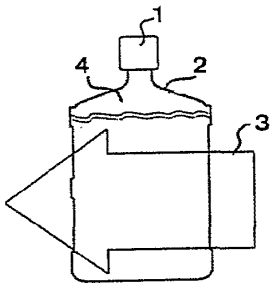


Figure 2

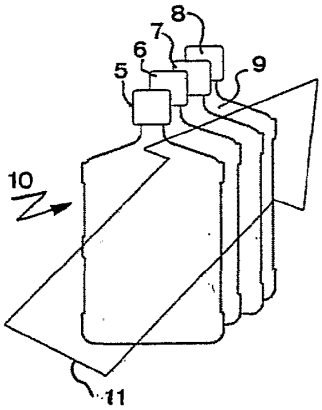


Figure 3

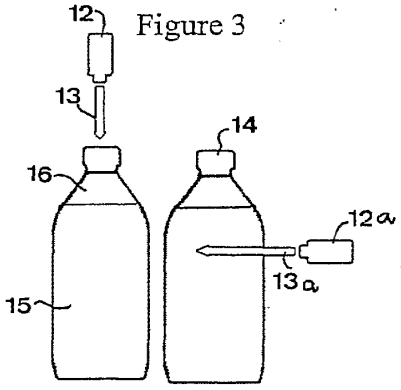


Figure 4

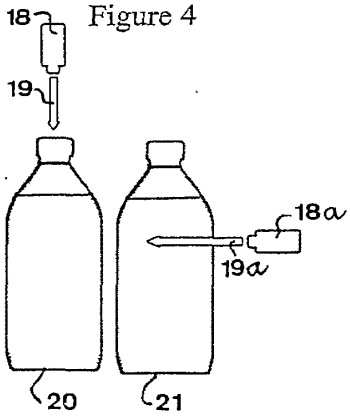


Figure 5

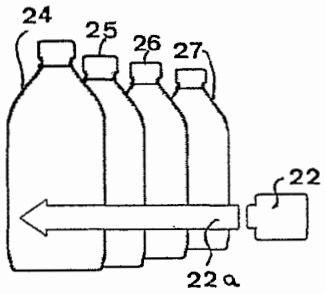


Figure 6

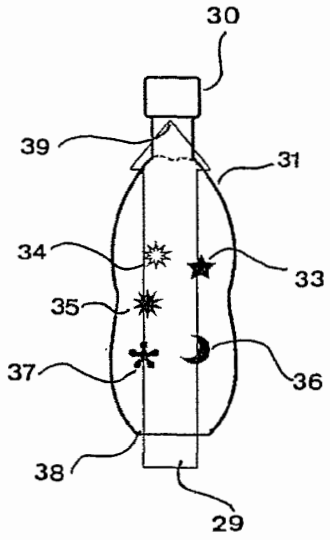


Figure 7

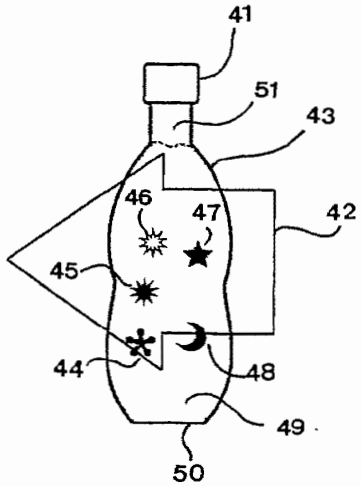


Figure8

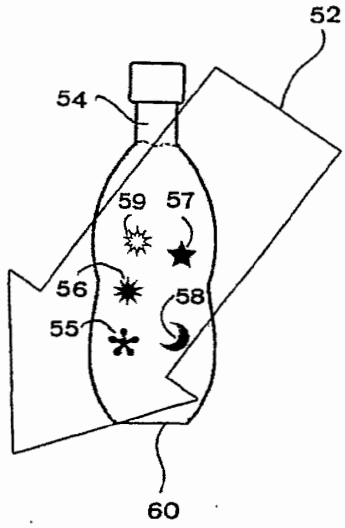


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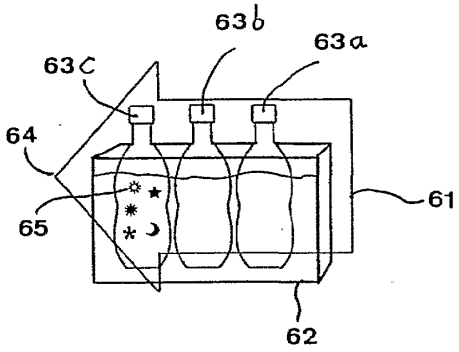


Figure 10

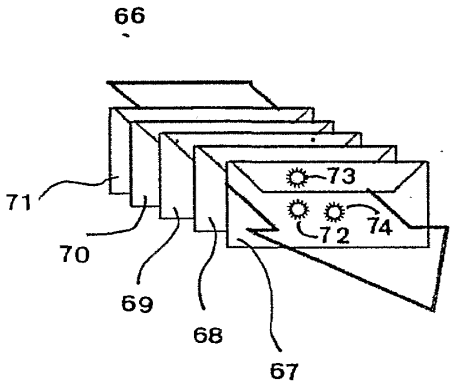


Figure 11

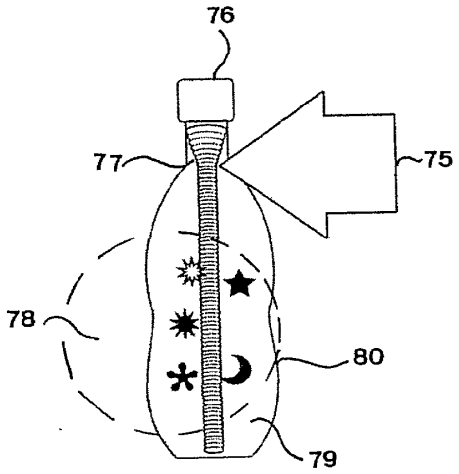


Figure 12

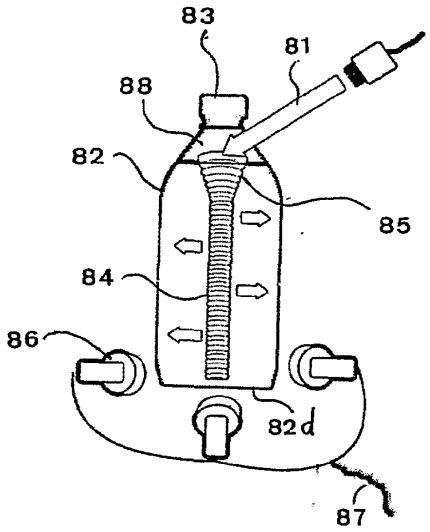


Figure 13

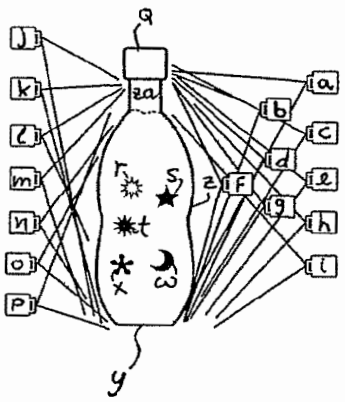


Figure 14

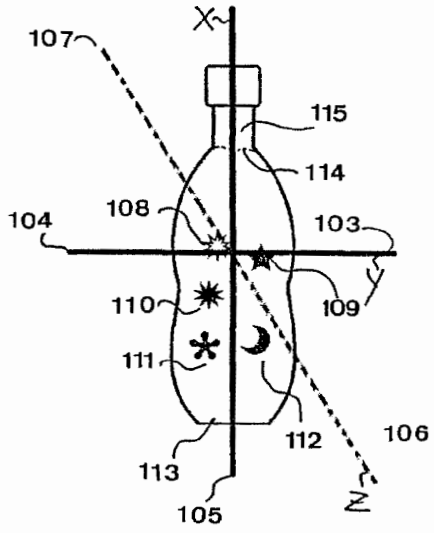
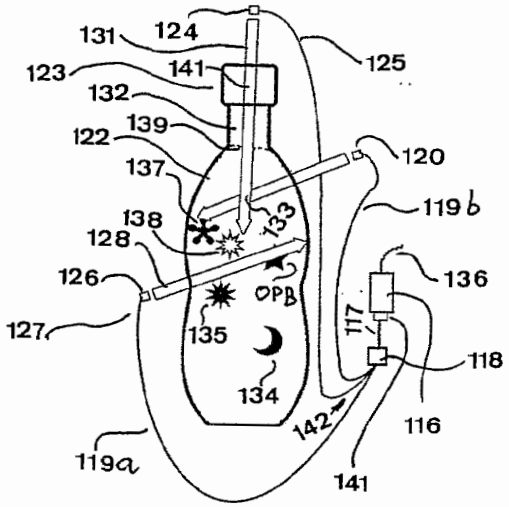


Figure 15



SUBSTITUTE SHEET (RULE 26)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 June 2002 (13.06.2002)

PCT

(10) International Publication Number
WO 02/45756 A2

(51) International Patent Classification[7]: A61L 2/00, 2/10, 2/16, 2/28

(21) International Application Number: PCT/IL01/01137

(22) International Filing Date: 7 December 2001 (07.12.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
140180 7 December 2000 (07.12.2000) IL

(71) Applicants and
(72) Inventors: **TRIBELSKY, Zamir** [IL/IL]; 37 Hadror st., 90805 Mevaseret Tzion (IL). **ENDE, Michael** [IL/IL]; 90855 Moshav Shoeva (IL).

(74) Agent: **NOAM, Meir**; P.O. Box 34335, 91342 Jerusalem (IL).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 02/45756 A2

(54) Title: ADVANCED OXIDATION OF DANGEROUS CHEMICAL AND BIOLOGICAL SOURCES

(57) Abstract: Advanced Oxidation Technologies (AOT) using laser triggered and driven AOT platform are disclosed, including a method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, a variety of uses of said method, and the environments where it can be implemented. The method has two basic steps that are; (c) spraying the regions to be treated with a cloud of gas, vapors, microdroplets, droplets, or bubbles formed from at least one liquid solution containing at least one type of photocatalitic oxidizing substance; (d) directing across said cloud at least one high intensity beam of light having wavelength of between 220 and 390 nanometer for triggering said cloud thereby causing a catalyzed activation that releases free radicals of said oxidizing substance in order to react with said chemical or biological sources. Various types and embodiments of systems and devices using the method of the present invention are also disclosed, including a bubble generator adapted for implementation of the method in various sites where treatment procedures according to the method are required.

Advanced oxidation of dangerous chemical and biological sources

Field of the invention:

The present invention relates to Advanced Oxidation Technologies (AOT) using laser triggered and driven AOT platform.

More specifically, the present invention relates to a method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions. The present invention further relates to the various uses of said method, and environments where it is useful.

The present invention further relates to various embodiments of systems and devices using the method of the present invention, and to a bubble generator useful and adapted for implementation of the method in various sites where treatment procedures according to the method are required.

Background of the invention:

Scientist, engineers, bio-technologists, and producers, and end users have been searching for years for a non invasive disinfection technology, such technology which does not require any physical contact with the medium to be treated, and thus may provide a solution in manufacturing sites, mass production of bottled mineral waters, and food, drink, and beverages industries around the world. Further more, the type of "non invasive treatment technologies available today include: Gamma rays, X rays, Y rays, photons, radio waves, micro-waves, and several types of ionizing radiation. These available non invasive instrumentation are often dangerous, expensive, and require substantial periodical maintenance and replacements. Furthermore, instrumentation using such ionizing radiation types, require sophisticated support means, and infrastructure safety measurements, further complicating design criteria, and implementation. Several of these radiation types have already confirmed as causing cancer, and public confidence in these technologies at manufacturing plants is declining. Stringent legislation, and standards further fuel the need for alternative, safer, more economical methodologies for non interfering treatment. Conventional chemical technologies are limited since there is always the need to clear the liquids, and gases (of the "harmful" chemicals), and remove them from the specific volume to be consumed (i.e. after disinfection, or purification have occurred) once they have finished their useful cycle, or their disinfection, and oxidation activities. Recent

activities in solid state electronics, lasers, and advanced polymer for optronics, laser pumping architectures, all have contributed to production of light sources small enough to be incorporated, or integrated (fig.1, 1-30) into system in close proximities to bottles, lids, corks, packaging production processes, and wide variety of packaging for foods, drinks, and many biotechnology products, and applications. Evolution of waveguide technology, and polymer production techniques making packages from material selected from at least one PET packaging layer/s, or polyolefin, or polyamide, or polycarbonate, or polyesteramide, or polyester or any resine combination thereof having refractive index profile for partial, or total internal reflection therein for equalizing the concentration of bacteria, viruses, cysts, phatogens, or biological, or organic, non organic, or toxic or noxious species therein. All have further contributed to much higher levels of biocompatibility, and interconnectivity, and interoperability to commercial mass production environments.

As introduced in the field of the invention, the subject of the present invention includes environmental protection, and the protection of public health, and tools associated with domestic industrial, medical, engineering and environmental fields, using pulsed power technology in the UVA/B/C. The driving principle behind the technology is synchronized control of the time domain in which appropriate dose of light is delivered into specified geometry, or predetermined surface area causing specific electro-optical effects. More specifically, the present invention discloses a novel methodology for surface disinfection, and purification, and for dimensional treatment platform, by facilitating the catalytic formation of radical species (such as OH*) barrier technology (CFRS), a layer which upon triggering turns to "fire wall" (thus preventing passage through of noxious species due to the short duration of time [Fs] in which the catalytic processes occurs) made out of multiple layers of highly radical species, lasting extremely short fraction of time, for the purpose of forming photoreactive layer wherein the preferred mode for advance Catalytic Oxidation, Electro catalytic Oxidation, photolysis, and photo dissociation (of upper surface layers of medical instrumentation, as well as actual damaged tissues of the Human body) occurs.

More specifically, the present invention facilitate the provision of a protective photoreactive barrier technology (PPRBT), by means and utilization of light, liquid, gasses, and optronic time domain triggering (such as can be produced by high peak power high rep. rate uv lasers) the present invention is beneficial in cases wherein external cuts may hinder physiological activity, and may lead for infection, or further complications. Further more, the present invention facilitate phototreatment of surfaces faster then any previous methodology in the field by using photocatalysis, electrocatalysis, and hybridazation techniques. The novel methodology of he present invention facilitate the protection of large areas from harmful effects of contact with bacteria, or from contact with noxious or poisonous species.

By calibrating the action spectrum (i.e. absorption, transmitance, transparency, refractive index, or refractive index profile of the air/body, air/instrument, liquid or gas encapsulating layer (i.e. the layer "barrier between the surface of the actual instrumentation or body surface, and enterinmg/triggering beams of pulsed light, and the required coupling of light to the surface to be treated, thus taking into account specie specific wavelength interactions of the laser light (source used in accordance

with the methodology of the present invention), the present invention offer economical solution using energy efficient methodology, and extremely safe operation procedures, requiring no skill operators, or special complex hardware procedure. The method of the present invention is simple to implement, and include fully automatic procedure management, so easy integration intro already made set up is simplified, and conserve time and energy during integration, installation, and operation procedures.

More specifically, the method of the present invention by using for example, a pulsed, high repetition rate, high peak power laser light sources, facilitate the formation of high energy density zone through which liquids, or gasses carrying contamination, or may be penetrated by invading antigens, are thus treated according to the methodology of the present invention.

One best mode among the many utilizing the method of the present invention is especially beneficial for disinfection of wide variety of medical instrumentation.

Further more, the methodology disclosed by the present invention offer solution for medical procedures requiring short working cycles, and thus offer important benefits in terms of shorter duty cycles, faster processing time, safer inactivation/Dissociation effectiveness, and important capital savings due to the novelty of the methodology of the present invention for photocatalytic protection of medical instrumentation or surfaces, or dimensions, or volumes by using UVA, UVB, UVC light produces by high repetition rates, high peak power lasers.

Modern society encapsulating a wide diversity of cultures, and professional occupations has often created population unrest, exposing challenges to leaders in search of peace, prosperity and positively charged commercial interactions.

Certain factors effecting the depletion, and contamination of natural water AND air resources, population expansion, global warming, modern, competitive world of man often riddle with socioeconomic positioning, conflicts in need of resolutions is presenting challenges associated with a diversity of eventualities requiring proficient, and capable technologies. Scientific, engineering, and industrial producers, and end users are engaged intensively in the search for new innovative technologies capable of offering solutions. Several evolutionary steps towards technologies that surpass limitations imposed by currently used chemical methodologies, and backed by trends and progress in such fields as solid state electronics, electro-optic fabrication techniques, photo-chemistry, photo-catalysis, and photo-electro-catalysis and laser technologies. When combined expertise in these fields are extrapolated against the geographical locations factor for different nations of the world, and population concentration driven by interests of accessibility to natural resources (such as water and air), and in the context of often-destructive and sinister nature of certain industries engage in the preparation of noxious species, from biological and/or chemical origins. Awareness is growing rapidly, that such noxious species may be used against fellow man illegally.

In view of the above scientists, engineers, technologists, producers, and end users have all been searching for the perfect technology able to offer adequate protection of bio-terrorism, and terrorist attacks using unconventional weapons.

The present invention disclosed a novel methodology wherein the destructive effects of such threatening eventualities are minimized, and or eliminated in situ, in real time and for wide variety of terrain and applications. More specifically, the methodology of the present invention discloses method and related devices for the protection of mankind, animal and live stock, key building installation, metropolitan areas, and large surface, volume or dimension areas in almost any geometrical utilization required for specific applications. The methodology of the present invention challenge strict limitation imposed by use of current chemical, radiation means, or temperature sterilization techniques. Current methodologies use mainly chemical disinfectant (applying, spraying, or distributing) formulated with toxic compounds capable of damaging the treated area as well as the noxious species within it. A single perfect chemical disinfectant for all eventualities of contamination (or cross contamination) does not exist, as it will have to poses so many features at once, however, even in the event that a multi components suspension, and complex chemical compounding volumes will in most cases facilitate the formation of toxic residual effects, DBPs (Disinfection By Products). Currently used chemical agents (or reagents) accumulate, and can penetrate the surface of the ground, reaching natural water resources, and under-ground aquifers, when above ground, these compounds may endanger living beings, animal and plants. More specifically, given the chemical toxic nature, or biological noxious threatening aspects of these compounds, associated relevant transport, storage and application delivery aspects are often cumbersome, expensive, and require highly skilled human resources and infrastructure for safe, prolonged, and repeatable industrial operation. Effective operability, interconnectivity, and interoperability is thus difficult to achieve with currently used technologies. Radiation chemistry has already proven that Gamma rays, electron beams, and conventional mercury based UV lamps fail to provide adequate protection against the diversity of geometrics involved, and for reason of feasibility and practicality. Currently used UV lamps (medium pressure, low pressure, LPHO (Low Pressure High Output) cannot provide efficient disinfection, sterilization or dissociation capabilities due to their polychromatic spectral nature. More specifically, mercury (the principle means for generating UV from lamps is already recognized as extremely toxic substance, and it is a self limited technology. More specifically, the more pressure a UV lamp contain, the higher the energies that could be generated from the lamp, however the actual energy the lamp will produce will almost not include any UV (more pressure = more power, but no UV at output), lower pressure will yield less power, but much more relevant UV at output.

In contradistinction to conventional, currently used technologies in the field, the non chemical, non toxic methodology of the present invention is not so limited, that why the method of the present invention and devices using same, could be used for wide variety of applications in numerous fields offering open architecture modular design platform for maximum adaptability and rapid response to threatening eventualities involving liquids, gases, solids and surfaces. More specifically, the methodology of the present invention facilitate the formation of highly reactive species created by light and the photochemical interaction of said light with a proprietary non toxic multi-component compound for photo-catalytic rapid reduction, oxygenation, and effective chemical chain reactions which swiftly mineralizes, and dissolve, eliminate, an inactivate said noxious species, and thus turn them into more innocuous

manageable forms. Further more, the methodology of the present invention is using lasers

Summary of the invention

The present invention relates to a method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, comprising the steps of;

(a) spraying over said regions a cloud of gas, vapors, microdroplets, droplets, or bubbles formed from at least one liquid solution containing at least one type of photocatalitic oxidizing substance;

(b) directing across said cloud at least one high intensity beam of light having wavelength of between 220 and 390 nanometer for triggering said cloud thereby causing a catalyzed activation that releases free radicals of said oxidizing substance in order to react with said chemical or biological sources.

The method of the present invention is useful for protection of public metropolitan areas, air volumes, surfaces, or combinations thereof using advanced oxidation processes triggered by pulsed UV laser, and photo-catalytic bubbles, droplets, jets, or combinations thereof, wherein said photo-catalytic components include at least one oxidizing agent, fluorescent, or phosphorous, or glowing, or reflecting, shifting, or vibrating or combination element such that once said photo reactive, or photo-catalytic compounds interact with light, it could be traceable for monitoring, and verification of bio-dosimetric dose, and chemical dissociation dosimetric values required for adequate inactivation and reduction, or minimization of threatening eventualities or contamination, cross contamination in any predetermined liquids, gases, surfaces, and combination.

The method of the present invention may further comprise scanning the cloud with the beam of light, which is especially essential for large scale treatments wherein the cloud extends along wide area (and volume).

The beam of light used in the method of the present invention is preferably emitted from at least one laser unit, wherein the laser unit may be selected according to design and engineering considerations, from; solid state lasers, electrical discharge lasers, plasma driven lasers, semiconductor lasers, organic lasers, electron beam pumped lasers, free electron lasers, , fiber lasers doped, or SASE/EA/FEL lasers, fiber lasers, diode pumped lasers, crystal based lasers, doped glass based lasers, FELs lasers, polymer lasers, PW/CW type lasers, quantum dote lasers, laser arrays, flush lamp pumped lasers, water lasers, photonic bandgap lasers, seeded or amplified lasers, time compressed or expanded lasers, q-switch type lasers, interactive harmonic lasers, acoustic-optical lasers, ultrasonic lasers, X-ray pumped lasers, Y pumped lasers, E-beam lasers, catalytic lasers, photoelectrocatalytic lasers, air lasers, ground stationary lasers, mobile and sub-miniaturized lasers, thin film type lasers, vapor lasers, water lasers, or photonic bandgapped lasers.

According to various preferred embodiments of the method of the present invention, the laser beam is being pulsed.

The pulses of the beam may be in duty cycle of between 0.1 and 50 percent, in pulse repetition rate of between 1 Hertz and 100 Gigahertz.

According to various preferred embodiments of the method, the beam is pulsed in short pulse duration having acoustic attack transient properties.

According to various preferred embodiments of the method the cloud contains bubbles of size useful for opto-acoustic interaction between a beam of light scanning the cloud and the acoustic vibrations of the bubble mantles caused by the hit of the beam, which in turn, resulting in a multidirectional scattering of the beam, reflecting it to a plurality of surrounding bubbles or droplets.

According to various preferred embodiments of the method the solution contains phosphoric or fluorescense substance reactant to the light beam, to the light beam reflections from surrounding bubbles or droplets, or to particles released during the catalyzed activation, and wherein said method further comprising the step of tracing the light glowing from said phosphoric or fluorescense substance in order to identify whether or what portions of said region have been covered with an activated oxidizing substance.

According to the various embodiments of the method of the present invention, wherein the photo-catalytic bubbles or droplets contain at least one component of fluorescent, or phosphorous type, spectroscopic data acquisition can be made, and the accumulated data provides for dosimetric value for inactivation of noxious species of biological or chemical origin, and thus the spectral distribution over a predetermined space, over a predetermined period of time can be calibrated against specie specific calibration standards so as to identify the relevant thresholds needed for protecting, and treating application in predetermined surface area, volume or combination thereof. Thus, according to additional preferred embodiments, the method is further comprising measuring and calibrating the acoustic energy that light creates, and the light that acoustic energy creates. in order for establishing bio-dosimetric values or adapting the energy dose required for mineralizing or oxidizing predetermined toxic chemical species or biological noxious species,

According to various preferred embodiments of the method is further comprising the step of automatically deflecting the beam of light across the cloud according to light reflection data acquired from the cloud during the catalyzed activation of the oxidizing substance.

According to various preferred embodiments of the method (especially in building regions, wherein a system using the method of the present invention can be integrated with the conventional water system of the building, and/or with other existing security systems of the building) the solution is produced in real time or in immediate proximity to a disinfection procedure that is being implemented in an infection suspected site, and said solution is being prepared directly into flowing water supplied to sprinklers or bubble generators that create the cloud, wherein

oxygen or any other essential dissolvent materials, are being dissolved into said flowing water during their flow to the sprinklers or bubble generators.

According to the method, the concentration of at least one of the solution ingredients may be controlled by a computer and is case sensitive to the seriousness of dangerous chemical and biological sources under treatment.

The present invention further relates to a system for advanced oxidation of dangerous chemical and biological sources suspected in particular regions, comprising;

(a) means for the formation and distribution of a cloud of gas, vapors, microdroplets, droplets, or bubbles formed from at least one liquid solution containing at least one type of photocatalitic oxidizing substance, said means having at least one outlet for releasing or spraying said cloud;

(b) at least one laser unit generating light beam having properties that are useful for triggering said cloud, thereby causing a catalyzed activation that releases free radicals of said oxidizing substance in order to react with said chemical or biological sources.

The system according to the present invention may further comprise, according to various preferred embodiments, means for deflecting said light beam for scanning the cloud.

Said means for deflecting said light beam for scanning the cloud, may further cooperate with camera or sensor means for acquiring and for processing data which relates to light glowing from different portions of the cloud during its triggering or during its catalyzed activation, and with means for steering the scanning automatically according to said data.

The present invention further relates to a bubble generator for forming a cloud of bubbles for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, comprising; at least one liquid container adapted to receiving a solution containing at least one type of photocatalitic oxidizing substance, means for gas compression, and at least one nozzle in liquid communication with the liquid reservoir, and in gas communication with the gas compression means.

The bubble generator may further comprise means for dissolving pure oxygen or any other essential dissolvent materials, into water flowing to the nozzle, for real time accomplishment of the solution.

The present invention further relates to a use of the system for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions such as outdoor regions; domestic regions; sea, air or ground vehicles; or space ships, and to the use of the system for disinfection of medical and surgical equipment and spaces, and to the use of the system for disinfection of toilet rooms, wherein the system is integrated to the toilet room and having means for automatic activation, cooperating with sensor means for determining the absence of humans when activating a disinfection treatment sequence.

The present invention disclosed a novel methodology for Non destructively sealing, disinfecting, purifying, sterilizing wide varieties of medical instrumentation by inactivating noxious species on the surface of said instruments in wide variety of medical, commercial, industrial, domestic, and agricultural applications. Further more, the novel methodology of the present invention does not require any direct contact with the actual surface, and/or volume of liquids, and gases (containing or holding permanently, or temporarily to be disinfected).

More, specifically, the present invention combine the utilization of light which have the appropriate wavelength to penetrate the surface of the packaging materials which are used for enclosure, using the packaging itself for geometrical utilization guiding, and concentrating light therein (example: in the bottle fig. 1, 1-30). Safely sealing, and sterilizing, disinfecting the liquids, and gases therein (example: in the bottle). and is calibrated for specie specific penetration spectrum or calibration standards against noxious species, such as found in water, and air, and/or liquids and gases, forming essential combination such as needed for sustaining life on earth. The present invention disclosed a novel methodology for disinfection through packaging selected from at least one PET packaging, or polyolefin, or polyamide, or polycarbonate, or polyesteramide, or polyester or any resine combination thereof having refractive index profile for partial, or total internal reflection therein for equalizing the concentration of bacteria, viruses, cysts, phatogens, or biological, or organic, non organic, or toxic or noxious species therein for example in packaging composed of selected materials such as at least one PET packaging, or polyolefin, or polyamide, or polycarbonate, or polyesteramide, or polyester or any resine combination thereof having refractive index profile appropriate for partial, or total internal reflection or homogenic scattering therein for the purpose of equalizing the concentration of bacteria, viruses, cysts, phatogens, or biological, or organic, non organic, or toxic or noxious species therein. The present invention discloses a novel methodology for disinfection through the packaging by using a UVA pulsed laser, or a continues laser, or hybrid interaction between CW, and PW types of light wherein said light is transferred, coupled to, or distributed through (packaging) materials selected from Polyolefine, polyamide, polycarbonate, polyesteramide, polyester resine combination thereof, or terephtalate (PET), Polybutylen terephtalate (PBT), polyalkyl terephtalate, polyethylene naphtalate (PEN), polyalkyl naphtalate (PETG) having adequate refractive index profile therein for guiding light throughout. Especially beneficial for external non invasive treatment methodology for reaching and geometrically utilizing small, and larger blood vessels (while still un effected in the body), and areas of the body wherein vital fluids needs to be treated in real time. Such beneficial embodiments and devices using the methodology of the present invention may be best described as optronic dialysis of liquids in real time without puncturing the external surface of the body, or volume to be disinfected, or treated. Thus optronic inactivation of specific species in blood may be facilitated using the methodology of the present invention. More specifically by using the methodology of the present invention end users could simply wear breaslates, and O/F wristlets, and specific devices using the method of the present invention delivering appropriate dose response curves for a predetermined specie specific calibration standards, thus allowing the determination of dose response curves for specific diseases, viruses, cysts, bacteria, pathogens, and noxious species.

Especially beneficial for disinfection through the skin of internal blood flow, and bodily fluids without causing any damage, such as in an optical dialysis according to the present invention (non invasively ref: claim 1-100, fig. 3) or for packaging materials by using UVA pulsed laser, operating in pulsed mode, beneficial for quality control applications (in mass production lines of mineral waters, flavored waters, beverages, juices, liquids, gasses, food based products, and medical preparation sites), and for optical, and electrooptical dialysis devices using the method of the present invention.

including the production, and polishing of insulin based products. The novel methodology of the present invention is also beneficial for disinfecting corks, lids, and bottle necks of packaging, further more, the method of the present invention could be used to treat non invasively blood flow while in the body, by using pulsed high intensity UVA laser delivering a plurality of micropulses, leading to cumulative dose response delivered by using optical waveguides, and uniform diffusers.

In treating medical instrumentation and engineering tools with pulsed UVA, UVB, UVC laser light - where the geometrical curvature is often difficult to reach using conventional disinfection, or purification technologies. The method of the present invention is also disclosing a novel methodology wherein the cork, or lid themselves are made of polymer varieties having higher refractive index then the liquids, and/or gases therein (i.e. in the packaging), in order to maximize geometrical utilization.

More specifically, as an example; the methodology of the present invention for surface treatment is also beneficial for improving the hygiene of the mouth by harnessing the illumination or irradiation of a waveguiding dielectric brush [WDB] sterilizing its complex curvature inner surfaces, and volumes, having variable depth of penetration catalytically using new generation of paste, comprising:

Constructing or integrating a multi-component compound structurally modular, containing predetermined portion of yielding Oxygen Charge (SYOCH) in a U.P.W, PH stabilized, held temporarily or permanently in a 3D polymeric frame work of biodegradable biocompatible carbomer or BI-polymers expanded to contain photo-catalytic, and, or centilating conversion elementally each having predetermined electron charge transfer co.-efficiencies and absorption, refractive index profile, and acoustic properties, selected pre-production for quantum objective application specific efficiencies driven thus from supper conductive, to dielectric, or semi conducting, wherein the flexibility of water may provide generic structurally yielding Oxygen Charge accommodating into manageable forms the decomposed species inactivated radically (SYOCH1), within water, liquid or gas or air suspension, body fluids, or inside mouth using new generation of paste according to the methodology of the present invention.

The present invention relates also to a method for treatment of surfaces having complex curvature wherein additional substances may be added for electronic trapping so as to facilitate prolonging the lifetime of free radical species , OH, produced according to the methodology of the present invention, such substances may be selected from liquids, gasses, or solids, in order to trap electron-pair holes,

thus increasing beneficial sustaining, and delaying of the hydroxyl radial species lifetimes, increasing the quantum yield of efficiency according to the methodology of the present invention, especially beneficial for catalytic, scintillated, pH stabilized, oxygen charged toothpaste, or spray for the reduction of humic acids, and other factors effecting bad smells, tastes, substantially improving catalytic efficiencies of the methodology of the present invention.

The present invention relates also to a method for sterilizing and disinfecting the surface of medical instrumentation, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or coupling gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

More specifically, the methodology of the present invention also relate to a catalytic tooth paste capable of scintillating or repeatable triggering by using visible, UVA, UVB, UVC, optical triggering signal eliminating the need for repeatable brushing. More specifically the present invention facilitate the dissolving of pluck formation catalitically, scintillating, and deep disinfection, and dissociation therapeutic effective treatment.

In the context of the present invention Acquired immunodeficiency Syndrome means A life threatening disease caused by virus and characterized by breakdown of the body's immune defenses, specie specific calibration standards mean in the context of the present invention the efficient reduction of viruses which causing immunodeficiency syndromes without interfering with the body external surfaces.

In the context of the present invention Active immunity means that the immunity produced by the body in response to stimulation by a disease causing organism or vaccine, or treatment according to the present invention wherein blood is circulated in the body, or in loop to/from the body through optronic dialysis according to the methodology of the present invention and therapeutic responses are following as a result of the treatment according to the methodology of the present invention.

In the context of the present invention Agamaglobulinemia means An almost total lack of immunoglobulines, and/or antibodies.

In the context of the present invention Allergen means any substance that causes an Allergy, and/or allergic reaction by the misfunctioning of the MHC type 1, 2, 3, and/or any combination thereof.

In the context of the present invention Allergy means An inappropriate and harmful response of the immune system to normally harmless substances (i.e. see Allergic reaction as an example)

In the context of the present invention Anaphylactic Shoch a life threatening Allergic reaction characterized by swelling of the body tissues including the throat, difficulties in breathing, and a sudden fall in blood pressure.

In the context of the present invention Anergy means A state of unresponsiveness, induced when the T cell antigen receptor is stimulated, that effectively freezes T cell responses, pending a 2ND Signal from the Antigen presenting cell.

In the context of the present invention Antibody means a soluble protein molecule produced and secreted by B cell in the response to an antigen, which is capable of binding to the specific antigen.

In the context of the present invention Antibody-dependent Cell - mediated Citotoxicity (ADCC) means in the context of the present invention An immune response in which antibody, by coating target cells makes them vandurable to attack by immune cell (see coating and marking cells)

In the context of the present invention Antigen means any substance that, when in traduced into the body is recognized by the immune system.

In the context of the present invention Antigen presenting cells means B cells of the monocyt lineage (including macrophages as s dantritic cells), and various other body cells that present antigen in a form that T cells can recognize.

In the context of the present invention Anti nuclear antibody (ANA) means an autoantibody directed against a substance in the cell nucleus.

In the context of the present invention Antiserum means a Serum that contains antibodies.

In the context of the present invention Antitoxins mean Antibodies that in terlockk with and inactivate toxins produced by certain bacteria.

In the context of the present invention Appendix means a lymphoid organ in the intestine.

In the context of the present invention Attenuated means a weakened; no longer infectious (innocuous form)

In the context of the present invention Autoantibody an antibody that reacts against persons own tissue.

In the context of the present invention Auoto immune desease a desease that result when the immune system mistakenly attacked the bodies own tissues. For example the Rheumatoid arthritis and systemic lupus erythematosus aree auto immune diseases.

In the context of the present invention Bacterium means a microscopic noxious microorganism composed of a single cell. Mant but not all bacteria cause desease.

In the context of the present invention Bassophile means A white blood cell that contributes to inflammatory reactions. A long with mast cells, Basophiles are responsible for the symptoms of Allergy. (and/or Allergic reactions).

In the context of the present invention B cells means small white blood cells crucial to the immune defenses. Also known as B lymphocites, they are derived from bon Marrow and develop into plasma cells that are the source of antibodies.

In the context of the present invention Biological response modifiers means a substances, either natural or synthesized, that boost, direct, or restore normal immune defenses. BRMs include interferons, interleukins, thymus hormones and monoclonal antibodies.

In the context of the present invention Biotechnology means the use of living organisms or their products to make or modify a substance. Biotechnology includes recombinant DNA technique (such as genetic engineering), and hybridoma technology.

In the context of the present invention Bon-marrow means soft tissue located in the cavities of the bones. The bone marrow is the source of all blood cells.

In the context of the present invention Cellular immunity means immune protection provided by the direct action of the immune cells (as distinct from soluble molecules such as antibodies).

In the context of the present invention Chromosomes mean physical structures in the cell's nucleus that have the genes. Each Human cell has 23 pares of chromosomes.

In the context of the present invention Clone A group of genetically identical cells or organisms descended from a single common ancestor., (v) to reproduce multiple identical copies.

In the context of the present invention Complement means a complex series of blood proteins whose action complements the work of antibodies. Complement destroys bacteria produces inflammation, and regulates the immune reactions.

In the context of the present invention Complement cascade means a precise sequence of events usually triggered by an antigen/antibody complex in which each component of the complement system is activated in turns.

In the context of the present invention Constant region means that part of an Antibody structure that is characteristic for each antibody class.

In the context of the present invention Co stimulation means the delivery of a 2nd signal from an antigen-presenting cell to a T cell. The 2nd signal rescues the

activated T cell from Anergy, allowing it to produce the lymphokinds necessary for the growth of additional T cells.

In the context of the present invention Cytikines means powerful chemical substances secreted by Cells. Cytokines include lymphokines produced by lymphocytes and monokines produced by monycites and macrophages.

In the context of the present invention Dandritic cells means] white blood cells found in the spleen and other lymphoid organs. Dandritic cells typically use thread like tentacles to enmesh antigen, which they present to T cells.

In the context of the present invention DNA (deoxyribonucleic acid) means a nucleic acid that is found in the cell nucleus and that is the carrier or co. represents genetic information. (I.e. see RNA, Ribonucleic Acid or any combination thereof)

In the context of the present invention Enzyme means a protein; produced by living cells that promotes the chemical processes of life without itself being altered.

In the context of the present invention Eosinophil means a white blood cell that contains granules filled with chemicals damaging to parasites, and enzymes that damp down inflammatory reactions.

In the context of the present invention Epitop means a unique shape or marker carried on antigen's surface, which triggers a corresponding antibody response.

In the context of the present invention Fungus means a member of a class of relatively primitive vegetable organism. Fungi include mushrooms, yeast, rusts, molds and smuts.

In the context of the present invention Gene means a unit of genetic material (DNA) that carries the directions a cell uses to perform a specific function, such as making a given protein.

In the context of the present invention Graft-versus-host disease (GVHD) means a life threatening reaction in which transplanted immunocompetent cells attack the tissues of the recipient (such as in transplant medical procedures).

In the context of the present invention Granulocytes means A white blood cell file with granules containing potent chemicals that allow the cell to digest micro organisms (noxious types and non noxious types) or to produce inflammatory reactions. Neutrophiles eosinophiles and basophiles are examples of granulocytes.

In the context of the present invention Helper T cells means A subset of T cells that tipically carry the T4 marker and are essential for turning on the antibody production, activating cytotoxic T cells, and initiating many other immune responses.

In the context of the present invention Hematopoiesis means the formation and development of blood cells, usually takes place in the bone marrow.

In the context of the present invention Histo Compatibility Testing means A method of matching the self-antigens (HLA) on the tissues of a transplant doner with those of the recipient. The closer the natch, the better the chance that the transplant procedure will be successful "and will take"

In the context of the present invention HIV means (Human Immunodificiancy virus) it is the virus that causes AIDS.

In the context of the present invention Human lococyte antigens (HLA) means a protein in markers of self use in histocompatibility testing. Soma HLA types also correlate with certain autoimmune diseases.

In the context of the present invention Humoral immunity means an immune protection provided by the soluble factors such as antobodies, which circulate in the body fluids or Humors, primarily Serum and lymph.

In the context of the present invention Hybridoma means A Hybrid cell created by fusing B lymphocytes with as long lived neoplastic plasma cell or T lymphocyte with a lymphoma cell. B cell Hybridoma secretes a signal specific antibody.

In the context of the present invention Hypogammmaglobuilinemia means is an abnormally low level of immunoglobuline.

In the context of the present invention Ideotypes means a unique and characteristic part of an antibody variable region, which can dam cells serve as antigens.

In the context of the present invention Immune Complex (IC) means a Cluster of interleukines, antigens and antibodies.

In the context of the present invention Immune response means the reactions of the immune system to foreign substances.

In the context of the present invention Immunoassay means A test using antibodies to identify and quantify substances. Often the antibody is link to a marker such as a fluorescent molecule, a radio active molecule or an enzyme type, or combination of the above

In the context of the present invention Immunocompetent means the capability of developing an immune response.

In the context of the present invention Immunoglobulines means a family of large protein molecules also known as antibodies.

In the context of the present invention Immunosupression means A reduction of the immunresponses for instance by giving drugs to prevent transplant rejection/s.

In the context of the present invention Immunotoxines A monoclonal antibody linked to a natural toxins, a toxic drugs or radioactive substance or combination.

In the context of the present invention Inflammatory response means A redness, warmth, swellin g, pain, and/or loss of function produced in response to infection as the result of increased flood flow and an influx of immune cells and secretions.

In the context of the present invention I8nterleukines means A major group of lymphokines and monokines.

In the context of the present invention Kupffer cells means specialized macrophages in the liver.

In the context of the present invention LAK cells means lymphocytes transformed in the laboratory into lymphokines activated Killer cells, which attack tumor cells.

In the context of the present invention Langerhans cells means A drandritic cells in the skin that pick up antigen and transport it to lymph nodes.

In the context of the present invention Leukocytes and all white blood cells.

In the context of the present invention Lymph means a transparent, slightly yellow fluid that carries lymphocytes, bathes the body tissues, and drains into the lymphatic vessels.

In the context of the present invention In the context of the present invention Lymphatic vessels mean a body-wide network of channels, similar to the blood vessels, which transport lymph to the immune organs and into the bloodstream.

In the context of the present invention Lymph nodes mean small bean-shaped organs of the immune system, distributed widely throughout the body and linked by lymphatic vessels. Lymph nodes are garrisons of B, T, and other immune cells.

In the context of the present invention Lymphocyte means small white blood cells produced in the lymphoid organs and paramount in the immune defenses.

In the context of the present invention Lymphoid organs mean the organs of the immune system, where lymphocytes develop and congregate. They include the bone marrow, thymus, lymph nodes, spleen, and various other clusters of lymphoid tissue. The blood vessel and lymphatic vessels can also be considered lymphoid organs.

In the context of the present invention Lymphokines means powerful chemical substances secreted by lymphocytes. These soluble molecules help direct and regulate the immune responses.

In the context of the present invention Macrophages mean a large and versatile immune cell that acts as a microbe-devouring phagocyte, an antigen-presenting cell, and an important source of immune secretions.

In the context of the present invention Major histocompatibility complex (MHS) means a group of genes that controls several aspects of the immune response. MHC genes code for self-markers on all body cells.

In the context of the present invention Mast cells means a granule-containing cell found in tissue. The contents of mast cells, along with those of basophils, are responsible for the symptoms of allergy.

In the context of the present invention Microbes means minute living organisms, including bacteria, viruses, fungi and protozoa.

In the c ontext of the present invention Microorganisms means microscopic plants or animals.

In the context of the present invention Molecule means the smallest amount of a specific chemical substance that can exist alone. (The break a molecule down into its constituent atoms is to change its character. A molecule of water, for instance, reverts to oxygen and hydrogen).

In the context of the present invention Monoclonal antibodies mean antibodies produced by a single cell or its identical progeny, specific for a given antigen. As a tool for binding to specific protein molecules, monoclonal antibodies are invaluable in research, medicine and industry.

Monocyte means a large phagocytic white blood cell which, when it enters tissue, develops into a macrophage.

In the context of the present invention Monokines means powerful chemical substances secreted by monocytes and macrophages. These soluble molecules help direct and regulate the immune responses.

In the context of the present invention Natural killer (NK) cells mean large granule-filled lymphocytes that take on tumor cells and infected body cells. They are known as natural killers because they attack without first having to recognize specific antigens.

In the context of the present invention Neutrophil means a white blood cell that is an abundant and important phagocyte.

In the context of the present invention Nucleic acids means large, naturally occurring molecules composed of chemical building blocks known as nucleotides. There are two kinds of nucleic acids, DNA and RNA.

In the context of the present invention OKT3 means a monoclonal antibody that targets mature T cells.

In the context of the present invention Opportunistic infection means an infection in an immunosuppressed person caused by an organism that does not usually trouble people with healthy immune systems.

In the context of the present invention Opsonize means to coat an organism with antibodies or complement protein so as to make it palatable to phagocytes.

In the context of the present invention Organism means an individual living thing.

In the c ontext of the present invention Parasite means a plant or animal that lives, grows, and feeds on or within another living organism.

In the context of the present invention Passive immunity means immunity resulting from the transfer of antibodies or antiserum produced by another individual.

In the context of the present invention Peyer's patches means a collection of lymphoides tissues in the intestinal tract.

In the context of the present invention Phagosites means a large white blood cells that contribute to the immune defenses by ingesting microbes or other cells and/or forign particles.

In the context of the present invention Plasma cells means a large antibody producing cell that develops from B cell.

In the context of the present invention Platelets mean A granule containing cellular fragments critical for blood clotting and sealing of wounds. Platelets also contribute to the immune response.

In the context of the present invention Plymorphes means short for Poly Morpho Neuclear locosytes or granulocytes.

In the context of the present invention Proteins means an organic compound made up of aminoacids. Proteins are one of the major constituents of plants and animals and human cells.

In the context of the present invention Protozoa means a group of one-celled animals few of, which can cause Human desease (including maleria and sleepoing sickness types)

In the context of the present invention Rheumatoid factor means an auto antibody found in the serum of most persons with rheumatoid arthritis.

In the context of the present invention RNA (Ribonucleic Acid) a nucleic acid that is found in the cytoplasm and also in the nucleus of some cells. One function of RNA is to direct the synthesis of proteins.

In the context of the present invention Scavenger cells means any of the diverse groups of cells that have the capability to engulf and destroy foreign materials, dead tissues, or other cells.

In the context of the present invention SCID mouse a laboratory animal that, lacking enzyme necessary to fashion an immune system of its own, can be turned into a model of the human immune system when injected with human cells or tissues.

In the context of the present invention Serum means a clear liquid that separates from the blood when it is allowed to clot these fluids retains any antibodies that were present in the whole blood.

In the context of the present invention Severe combined immunodefficency desease (SCID) means A life threatening condition in which infants are born lacking all major immune defenses.

In the context of the present invention Splin means a lymphoid organ in the abdominal cavity that is important center for immune system activities.

In the context of the present invention Stem cells mean Cells from which all blood cells are derived. The bone marrow is rich in stem cells.

In the context of the present invention Suunit vaccine means a vaccine that uses marely one component of an infectious agent rather then the whole to stimulate an immune response.

In the context of the present invention Supeantigens means a class of antigens, including certain bacterial toxins that unleash a massive and damaging immune response.

In the context of the present invention Suppresser T cells means a subset of T cells that turn off antibod y production and other immune response.

In the context of the present invention T cells means small white blood cells that orchestrate and/or directly participate in the immune defenses. Also known as T lymphocytes, they are processed in the thymus and secret lymphokines.

In the context of the present invention Thymus means a primary lymphoides organ, high in the chest where T lymphocyte proliferate and mature.

In the context of the present invention TIL means a tumor Infiltrating Lymphocytes. These immune cells are extracted from a tumor tissue, treated in laboratory and re-injected into the cancer patient.

In the context of the present invention Tissue typing means (see MHC, Major Histocompatibility Testing HCT).

In the context of the present invention Tolerance a state of nonresponsivnes to a particular antigen or group of antigens.

In the context of the present invention Tonsils and adenoids means are a prominent oval massive of lymphoid tissues on either side of the throat.

In the context of the present invention Toxins means agents produced by plants and bacteria, normally very damaging to mammalian cells, that can be delivered directly to target cells by lionkiun gthenm to monoclonal antibodies or lymphokines.

In the context of the present invention Vaccine means a substance that contains antigenic components from an infectious organism by stimulating an immune response (but not disease) it protect against subsequent infection by that organism.

In the context of the present invention Variable region means that part of an antibody structure that differs from one antibody to another.

In the context of the present invention Virus means a sub-microscopic microbe that causes infectious disease. A virus can reproduce only in living cells.

In the context of the present invention Libido- pranic a state of increased vitality (i.e. the word prana, pranic means vitality, or states of ample vitality), or such states in which the body is tuned, and the immune system is at rest, empowered by biological traces of specific origin, and nature. Libido is the sensual drive induced as a result of the body being tuned, and/or referenced, and systems in the body aren't over loaded, and thus a state of improved feelings is induced, i.e. a libido-pranic state.

In the context of the present invention Resonativistic means a state of resonance created when energy of high peak powers is being applied, projected into, coupled to, or are being generated into biomass, such resonance is subject to the expansion In the context of the present invention ration, or density of the holding media, or medium, the term represent a state in which light and sound, ultrasound and mechanical, and physiological process are occurring and causing resonance which when said resonance utilizes the individual resonance of elements, organs, or cells of the noxious species, and could identify, or recognize, separate, sort and inactivate, dissociate, or vibrate said biomass,

In the context of the present invention The following terms included to improve the understanding of photochemistry the specific context have been selected for benefits of clarity and familiarization.

Physical Constants of interest in Ultraviolet and Photochemistry means

Constant	Symbol	Value	Units
Speed of light	c	2.99792458×10^{8}	$M\ s^{(-1)}$
Charge on electron	e	$1.60217733 \times 10^{(-19)}$	C
Planck constant	h	$6.6260755 \times 10^{(-34)}$	J s
Boltzmann constant	k	k $1.380658 \times 10^{(-23)}$	$J\ K^{(-1)}$
Avogadro number	NA	6.0221367×10^{23}	$mol^{(-1)}$
Gas constant	R	8.31451	$J\ mol^{(-1)}\ K^{(-1)}$

Further Characteristics of light and context explanatory notes are herewith included:

In the context of the present invention Planck Law of Radiation means in the context of the present invention:

Light which has both particle and wave properties. It is transmitted in discrete packets of energy (photons) and yet has a frequency and wavelength. The connection between these two properties is embodied in the Planck flaw of Radiation

In the context of the present invention Photochemical wave changes means in the context of the present invention:

In the context of the present invention The usual wavelength range in Photochemistry is 100 - 1000 nm. Light photons with wavelengths longer than 1000 nm have a photon energy too Small to cause chemical change when absorbed, and photons with wavelengths shorter than 100 nm have so much energy that ionization and molecular disruptions characteristic of radiation chemistry prevail. The total In the context of the present invention photochemical wavelength range is divided up into bands with specific names as given below.

In the context of the present invention Spectral ranges or interest in Photochemistry means in the context of the present invention:

Range Name	Wavelength
Near Infrared	700-10000
Visible	400 - 700
Ultraviolet	
UVA	315 -400
UVB	280-315
UVC	100-280

Little photochemistry occurs in the Near Infrared. Except for some photosynthetic bacteria. Which are capable of storing solar energy at wavelengths out to 980 nm. The Visible range is completely active for photosynthesis in green plants and algae. Also many dyes can undergo photochemical transformations themselves or sensitize reactions in other molecules. Most studies in photochemistry involve the Ultraviolet range. The division into three sub-ranges [UVA, UVB, UVC] is connected with the human skin's sensitivity to ultraviolet light. The UVA range causes changes in the skin that lead to sun tanning. The UVB range can cause sun burning and is known to eventually induce skin cancer. The UVC range is extremely dangerous since it is absorbed by proteins, RNA and DNA and can lead to cell mutations and/or cell death. The UVC range is sometimes called the germicidal range, since it is very effective in inactivating bacteria and viruses. The Vacuum Ultraviolet range is absorbed by almost all substances (including water and air). Thus it can only be transmitted in a vacuum. The absorption of a VUV photon causes one or more bond

Breaks. However, even though photons with wavelengths less than 561.6 nm are capable of splitting the H202 molecule, no photolysis, or proteolysis occurs in this wavelength region because H202 does not begin to absorb ultraviolet light until below 300 nm. This illustrates the first Law of Photochemistry; namely that no photochemical reaction can occur unless a photon/s of light is absorbed.

In the context of the present invention Coherent and incoherent light means Light sources used in photochemistry can either be coherent (all emitted photons are in phase with each other as they propagate) or incoherent (all emitted photons have random phases). All lasers emit coherent radiation and usually at one wavelength. The dispersion is very small so that a laser beam remains at or near its original diameter as it propagates; the light emitted by all other light sources is almost always incoherent. Most of these sources are either "hot element" sources (e.g., the incandescent light bulb) or "plasma" sources (e.g., a fluorescent light tube).

In the context of the present invention Point sources, means Light sources have finite dimensions (e.g., often a cylindrical shape). Emission from such a source is difficult to treat mathematically. It is convenient to mode] these sources as a collection of point sources, in which all light is emitted from the point equally in all directions. The optics treatment for point sources is especially simple.

In the context of the present invention The Terms and concepts associated with the emission of tight, are herewith included for clarity of explanation and to simplify the understanding of the method of the present invention, especially wherein photochemistry is involved, or photochemical polishing is active in the processing according to the present invention:

The light emitted from a source can be viewed in many different ways. In this Section, the various terms that may be used to describe this emission are defined and explained.

In the context of the present invention Radiant energy means:

Radiant energy (Q) is a total amount of radiant emission (J) from a source over a given period of time,

In the context of the present invention Radiant power means:

The radiant power (P) of a source is the rate of radiant energy or total radiant power (W) emitted in all directions by a light source. For example, the radiant power of the Sun is 3-842 x 1026 w. in theory, P, should include all wavelengths emitted by the source; however, ~ is usually restricted to the wavelength range of interest to photochemistry. For example, if a light source were being used for ultraviolet photochemistry, P would be specified for emission in the 200 - 400 nm ultraviolet ranges.

In the context of the present invention Radiant power efficiency means:

The radiant power efficiency (q) is defined as

Q = P/e

Where e is the input electrical power (W) supply.

Radiant emittance or excitance means:

The r Radiant emittance or excitance of a source is the radiant power emitted from an infinitesimal area on the surface of the source.

In the context of the present invention Radiant Intensity means:

The radiant intensity (I) (W sr^(-1)) is the total radiant power P emitted by a source in a given direction about an infinitesimal solid angle.

Radiance means:

Radiance (L) is defined as the radiant power d^2P, emitted from an infinitesimal area dA of the source surface in a given direction about the solid angle di, divided both by the solid angle di) and the orthogonal projected area.

The emittance M from an infinitesimal surface element dA is obtained by integrating L in spherical polar coordinates over the hemisphere of all outward-bound directions above dA.

An isotropic light source is defined as one in which the radiance L is uniform over all

Outward directions. Terms and concepts associated with the receipt of light When light is emitted from a source, it radiates outward at the speed of light, when it impinges on an object, it may be reflected, transmitted or absorbed. There are several terms that relate to the receipt of light.

Fluence Rate means:

Fluence Rate (E) (W m^(-2) is the radiant power of all wavelengths passing from all

Directions through an infinitesimally small sphere of cross-sectional area d, divided by

CM

Irradiance means:

Irradiance (symbol E; units W m^(-2) is defined as the total radiant power of wavelengths incident on an infinitesimal element of surface of area as containing the point under consideration divided by as. The following are some important points regarding characteristics and differences between "irradiance" and "fluence rate":

Examples: For a parallel and perpendicularly incident beam, not scattered or reflected, irradiance and fluence rate becomes identical. For any UV source within a

three-dimensional volume, the integration of UV irradiance over the interior surface of the volume yields the UV power of the larnp., This is not true for UV fluence rate.

The appropriate term for UV disinfection is "UV fluence rate" because a

Microorganism can receive UV power from any direction, especially when there is more than one UV lamp in the vicinity. In general usage, the irradiance or fluence rate may be expressed as MW cm^(-2). The irradiance is often incorrectly termed "light intensity" see the proper definition of "radiant intensity" above.

Light dose or fluence means:

The light dose or fluence (symbol H. units J m~2) is the total radiant energy of all

Wavelengths passing from all directions through an infinitesimally small sphere of cross-sectional area dA, divided by dA It is given by the average fluence rate times the exposure tune in seconds. The term UV dose is often used in UV disinfection literature. It represents the UV exposure of a given organism in the germicidal range.

Spectral units means:

All of the terms for tight emission or incidence refer to all relevant wavelengths. One can define spectral derivatives for each of these terms. For example. the light power emission of a LIV lamp is often expressed as the spectral power (W nm^(-1), defined as the power output in a narrow wavelength band divided by the width of the band. The solar spectrum received at the Earth's surface is described in terms of the solar spectrum irradiance. Also the spectral distribution of a lamp emission is often given an a plot of spectral power versus wavelength.

Photon based units means:

Photochemistry involves the interaction of photons of light with molecules and means: the definitions units that are based on photons.

Photon irradiance, photon fluence rate and photon flow means:

Each of the spectral terms can be convened to a corresponding equivalent photon flow and fluence rate ' by dividing the term by the average photon energy in the narrow wavelength band.

Quantum yield means:

The quantum yield (unites) Q is a measure of the photon efficiency of a photochemical reaction. e Is defined as the number of moles of product formed or reactant removed (P) per Einstein of photons absorbed

Line sources means:

When atoms are raised to an excited state, they emit only in very narrow lines with

Virtually no emission between the lines. The low-pressure mercury lamp is a very

Common lamp of this type. Table 3 gives the wavelengths and relative emittance for the emission lines of a low-pressure mercury vapor lamp.

Certain radiation units and associated light sources, (lasers) and lamps emit at longer wavelengths, This is the basis of the very popular fluorescent lamp.

For example, The emission lines of a mercury lamp are only sharp when the pressure of the gas is low (<10 tore). If the pressure is increased, the lamp can carry much more power, but the emission lines broaden. For the same length of lamp (about 120cm), a medium pressure lamp (pressure about 1000 tore) can carry up to 30,000W. These lamps are very common in commercial Systems utilizing ultraviolet light. Figure 5 shows a comparison of the emission of low pressure and medium pressure lamps in the ultraviolet region.

Excimer lamps means:

Excimer lamps arc unique in that they emit in a narrow band of wavelengths. An excimer is an atomic dimmer that is stable only in the excited state and dissociates on decaying to the ground state. Table 4 gives the wavelengths of sonic of the common excimer lamps.

Examples: Emission wavelengths (or some common excimer lamps

Excimer	Wavelength (nm)	Excimer	Wavelength (nm)
Xe2	172	XeCl	308
KrCl	222	I2	342
Cl2	259		

Flash lamps

Flash lamps are similar to continuous wave (CW), but could also operate in (PW), pulsed mode operation, and are lamps that consist of a cylindrical quartz tube with electrodes at each end and filled with a ga.½ (e.g.. xenon). A power supply "fires' the lamps by discharging a large amount of electrical energy in a very short period of time (several us) by applying a very high voltage (10 - 30 kV}. The resulting plasma reaches temperatures of 10,000 - 13,000 K and the emission is essentially that of a blackbody (see Fig. 4). In commercial flash lamp Systems the lamp , a typical "flashed" about 30 times per s, but given a special electronic pulsing circuitry is added, repetition rates could reach Khz regime.

FEL means Free Electron Laser and its derivatives, wherein space charged technologies (such as the Electrostatically Accelerated Free Electron Laser) include

an electronic pulsing circuits, charging, or an accelerator (Such as R.F. Linac) is involved in the production of photons (around 100, 000,000 photons per electrons, in contradistinction of a conventional crystal based laser having around 1 photon per electron, it is a laser which have less maintenance associated with its operation and its wall plug efficiency is reaching around the 40-51% respectively, and respectfully of the exact pumping geometry used.

The term EAFEL means Electrostaticely Accelerated Free Electron Laser and is an extremely efficient laser pumping geometry wherein recycling of the Accelerated electrons is being performed by utilizing deceleration techniques and its wall plug efficiency is estimated to reach in access of the 55% (amount of light being produced or converted from the electricity being consumed for its operation.

Biologically enhanced or photo-chemically polished drinking water or breathing air means any liquid or gas which have been passed through or processed by the method of the present invention such as water and/or air), more specifically such processes involved in the polishing and enhancing may include; Optical inactivation, disinfection, inactivation of DNA and/or RNA replication sequences, Photocatalysis, electro catalysis, a hybrid of photo and electro-catalysis, optical dissociation, physiological dissociation, biomass expansion, filtration (pre/post), physical separation and sorting, reactivation, activation, sonication, acoustics, electroacoustics, electro-optical treatment (by photons of light), transgressing, or transversing said liquids and gasses through a photonic band gaped wave guides having an aerobic, non toxic passage for light and liquids or gasses or combination together, synchronously and or separately.

Peak power means, the energy generated when squeezing (i.e. such as when pulsing) electromagnetic energy in short duration of time, for example: a pulse of a given average energy and power – lasting, or having a pulse width of around 1 second (1s) will generate several watts in peak power, a pulse lasting or having width of microseconds (ms) will generate peak powers reaching the kilo-watts scale, while a pulse lasting nano (ns) seconds will generate peak powers reaching into the hundreds of million of watts which is especially beneficial for purposes such as optical dissociation, optical inactivation, optical polishing, and optical secretion and spectroscopy for control and diagnostics, so in short the shorter the pulse duration the higher its respective peak power.

Multi-photon – absorption - processes means a processes which when harnessed could be very beneficial for the photochemistry involved in the processing according to the present invention, for example when 10mj of energy (250,000 photons) are projected into a liquid or gas, the time it takes this projection is very important, if these photons will be furnished over 1 second time domain, then it leaves sufficient time for the electrons in said liquid or gasses, to relax back to the relaxed state, but if we apply these photons in a time domain of 5 nano seconds, then we do not leave time for the electrons to relaxed and the processes is called Multiphoton absorption processes, this processes are non linear in nature and yield much higher quantum yield , or efficiencies, or speed of the reactivation, or a more efficient methodology for optical treatment, processing and polishing

A hybrid of light sources means plurality of light sources and wherein their total spectral emitence, or total spectral distribution, or their total irradiance will cause multiphotonic absorption processes by means of super imposing their time domain (example: 1 light source is slow = 1s pulse duration, and additional light sources are very fast =5ns laser for example), their total irradiance is great and beneficial for the processes of the method of the present invention to occur efficiently, further more, such hybridization could includes, lamps and lasers, lasers and flash lamps, or any combination of CW, or PW type of light source working together, in synchronisity, and or sequentially or link or resolved by time domain manipulation for maximizing photonic interaction in matter, especially beneficial for triggering th catalytic scintillating elemental compound according to the present onvention.

Photo catalysis means: The use of energy of a photon of light to catalyze chemical reactions. More specifically, such reaction may include the decomposition of water into hydrogen, and oxygen, and the complete oxidation of organic contaminants in aqueous environments. More specifically, the first step in Photocatalysis is for the catalyst material to absorb photon of light in order to excite an electron from the velance band (VB), to the conduction band (CB), thus creating electron-hole-pairs. Each Species must then migrate to the surface before recombination occurs. If this condition is met, the electron can be transferred to a surface adsorbed molecule, reducing it. The overall process is illustrated , it is important to note that for the processes to occur efficiently (preventing pre-matured recombination of the said electron-hole pairs), the rates of reduction, and the oxidation must be comperable.The position of the band edges is critical for each step of the process, a photocatalyst material which is stable in water is tio2, (or known as Titanium Oxide).

Electrocatalysis, similar to that explained in photo-catalysis, but instead of photons, an electrical charge is used, through the use of semiconductor material which has been specially selected (its band gap) for the charge applied, for the context of the present invention an electrocatalysis, stable in water is I.T.O, or known in its chemical name and signature Indium Tinoxide). Further more, it is especially beneficial to combine, and operate both electrocatalysis, and photo-catalysis simultaneously, or serially, or sequentially or in unison, or each separate catalytic is triggered separately in order to maximize the collective efficiencies, thus harnessing and improving the performance of current and future catalytic technologcal evolution according to the methodology of the present invention.

Detailed description of the Invention:

The present invention disclosed a novel methodology for non-invasive disinfection, purification, and inactivation or equlization of (DNA, & RNA) replication sequences of noxious species in myriad of biomedical, and biotechnological applications involving end users, producers, and researchers in associated fields comprising the following steps:

1) Filling, distributing into, holding, or storing - in a predetermined chamber or conduit, a predetermined volume of liquids, or gasses to be non-invasively non residually treated.

2) Closing said conduit, or chamber with a transparent polymer or glass type lid, having a predetermined action spectrum, able to deliver, and transmit throughout any wavelength of light from about 260nm, to about the 360nm.

Implementation of the novel methodology of the present invention for surface treatment and for improving the hygiene of the mouth, may include (a) harnessing the illumination or irradiation of a waveguiding dielectric brush [WDB] having delivery capacity from about one quarter of a million of photons per Cm^2/Second, to about 999 trillion potons per Cm^2/1 picosecond, or Femtosecond, or Atosecond, thus swiftly sterilizing its complex curvature inner surfaces, and volumes, having variable depth of penetration catalytically using new generation tooth paste comprising; Catalytic centilayted compound [CCC] according to the methodology of the present invention, and wherein

Constructing or integrating a multi-component compound structurally modular, containing predetermined portion of yielding Oxygen Charge (SYOCH) in a U.P.W, PH stabilized, held temporarily or permanently in a 3D polymeric frame work of biodegradable biocompatible carbomer or BI-polymers expanded to contain photo-catalytic, and, or centilating conversion elementally each having predetermined electron charge transfer co.-efficiencies and absorption, refractive index profile, and acoustic properties, selected pre-production for quantum objective application specific efficiencies driven thus from supper conductive, to dielectric, or semi conducting, wherein the flexibility of water may provide generic structurally yielding Oxygen Charge accommodating into manageable forms the decomposed species inactivated radically (SYOCH1), within water, liquid or gas or air suspension, body fluids,or inside mouth.

The present invention discloses a novel methodology for treating surfaces with changing curvature parameters. More specifically, by photocatalytically innitiating protection for medical instrumentation by light, the methodology according to the present invention facilitate the formation of a catalytic light barrier technology creating a "fire wall" wherein no known noxious specie may penetrate. The present invention a also disclosed a novel methodology for treating surfaces with changing curvature parameters. More specifically, as an example; by photocatalytically initiating protection for inner space of the mouth by light, the methodology according to the present invention facilitate the formation of a catalytic light barrier technology creating a "fire wall" wherein no known noxious specie may penetrate, replicate, and thus have no ability to infect (inactivation of their DNA, and RNA replication sequences). Especially Beneficial for the removal of plaque formation in periodontal treatment, and in keeping maintaining, and reapeatingly triggering photocatalytically, centilating processes, thus oxidizing noxious species which may inhibit the surfaces curvature, and the deeper layers, and avolume surrounding the mouth area.

More specifically, wherein cuts and sores to body external surface, may cause damage to external body parts/tissues, and thus open the potential for infecious

events entering the body, such events introduce potential threat of contamination, and cross contamination through use, and thus the methodology according to the present invention offer the realization and harnessing of advance catalytic oxidation technology facilitating uncontestable technological advantages.

More specifically by prepering in advance all relevant parameters for efficient oxidation processes to occur (i.e. such as Oxygen, PH levels, stebilization, and the photocatalysts) in a tight cohesive, and homofenic multi-component system thus the present invention simplify, and gurenties photocatalysis processes in the presence of triggering energy density thresholds. The present invention discloses competitive advantages when geometrically utilizating thouroughlly space, and time, and light causing sterilization by pulsed ultraviolet (time domain driven) laser light for disinfection of wide variety of medical instrumentation and engineering tools.

Several technologies exist for the provision of surface treatment applications, These currently used technologies (x) introduce strict safety, reliability, and credibility and efficiency limitations due to their chemical, residual, often toxic, expensive, slow, labor and material driven procedures. Further more current methodologies for surface treatment of instrumentation is cumbersome, and could not easily be adapted to cover applications requiring actual treatment of physiological damage to tissues, and/or for cuts, sores, wounds, to living human beings. Further more, in the field, or as in during critical medical procedures under time constraints, wherein often thereisn't sufficient time available to wait for certain chemical action to proceed (such as when using biocydal, or chemical disinfectants), or for instrumentation to be returned from central, often far autoclaving, and disinfection equipment centre (i.e. such as in hospitals, and medical centres, or clinics), Faile to provide adequat safety measures for vital tools, and instrumentation, often results in making their associated working cycles longer, less efficient, requiring substantial replacement hardware components, and leads to unessary manual procedures, and subsequent expenses in human resources, and high energy consumption (high capital, and operation costs) as well as potential falure of vital medical procedures. The methodology according to the present invention is not so limited, that's why the present invention could be utilized for wide variety of application including but not limited to (a) Ultra sound procedures (b) medical surgical procedures, (c) Dental treatment procedures, (d) Cosmetic procedures, (e) Gynicological procedures, (f) 1st aid treatment applications, (g) Bulk sterilization of tools and medical instruments, (h) Medical preperation, (I) Transplant procedures, (j) Diagnostic procedures, (k) By-pass operations, (l) Skin, and darmatological treatment procedures, (m) Chemical production sites for drugs, and medicine (n) Rehabilitation centres, (o) Hospitals, (p) Clinics, (q) Operation procedures in cancer treatment, (r) Mediacal procedure for birth, and pregnency diagnostics, and treatment, (s) Treatment of burns, (t) Treatment of cuts, bruises, wounds, (w) Treatment of areas exposed to radiation, (x) Treatment of packaging of medical preperation, and drugs production or analysis, (y) Treatment of surgical instrumentation, (z) Treatment of diabitis wounds.

The present invention is also beneficial for cleaning applications such as (100) Cleaning vehicles, (101) Cleaning airplanes, (102) cleaning ships, and (103) busses, (104) lories, and (105) semi-trailers, (106) tankers on land, sea, and (107) air. Further

more, several applications illustrated herewith as having best mode for utilization of the methodology of the present invention.

More specifically, Such preffered applications clearly illustrate an important inovative solution wherein the size of the actual triggering light (or energy, and/or energy density under no circumstances dictate the size of the catalytic 'fire", or free radical species thus generated by the processes according to the presesnt invention. The present invention disclose a novel methodology for hybrid disinfection of surfaces, to disinfection of volumes, to static storage sites, to large installations treating high flow rates or complexed surface curvatures (i.e. 2D/3D) such as apearing to shape modern medical instrumentations, and wide varieties of engineering tools.

a/1 Air based catalytic compound oxygen charged and triggered, b/1 Catalytic globulin mixture wherein its best mode of being trigered is by at least one pulse of light being generated by a high peak power, high repetition rate laser, c/1 A catalytic compound lighter, or heavier then air being triggered while in transition or drifting, and wherein its catalytic actions produces sufficient free radicals to efficently dissolve toxic substances, traces, or any liquid or gas or combination containing noxious or poisonous nature, d/1 Steam type catalytic multi component compound having being produce on the ground or from a flying vhiecle or plain, or propeled to/from different locations according to needs.

indeed the goal of many scientist, biotechnologists, medical engineers, doctors, and surgeon requiring tools for dealing with infectious events is the ability to reduce working cycle, periodical maintenance, and replacements, and offer a more efficient treatment methodology thus able to remedy larger portions of the population in need, and to offer enhancment to currently available socio-economical performance. The method according to the present invation present competitive advantages, and important saving benefits especially for medical, biotechnological, hospitals, clinics, and agricultural, and industrial applications, thus enhancing the quality of life in the human sphare.

Further more, the methodology of the present invention disclose a real time treatment methodology by pulse power triggering of photochemical, and/or photocatalytical surface treatment processes, and further penetrative techniques (using surface treatment to trigger volume treatment). It is already known in theory that every material may oxidize or break down if energy is applied to it, having at least equivelant amount of energy as the one holding it's molecules and atoms together. The real world is very different - More specifically, due to already available vibrational excitation stages available to help break the "bond", the methodology of the present invention disclosed several techniques the present invention offer the ability to keep operating equipment use in medical procedures safe at all times, offering much quicker turn over, shorter working cycle, and the ability to ensure high level of biocompatibility, acustic excellence, while turning noxious species on the surface of said medical instrumentation into more inocious, more managable forms in real time, especially beneficial for ultrasound procedures using photocatalytic water based silicon coupling gell, and for the protection of wide variety of medical instrumentation, and equipment peripherals. Most medical instrumentation are in

need of sterilization, or disinfection leaving bacteria, and/or noxious species at a sufficiently low concentration according to standards, and health, and safety regulations. Further more, medical instrumentation used in wide variety of medical procedures are currently being treated with chemical disinfectants. As heat already being considered as one of the most expensive disinfectant, or sterilizing methodology often requiring long, and wastful work cycles schedule. More aspecifically, the long time cycle chemical disinfectant takes for effective inactivation of DNA & RNA replication sequences, or for oxidizing thus inactivating noxious species fule the drive for new more efficient, non chemical methodologies. Such is the method of the present invention, it is a non chemical, non residual treatment technology. The Present invention by using a photocatalytic compound made out of water, silicon, and photocatalytic material, such as TIO2, for example, the present invention disclose a novel methodology for treating wide variety of surfaces (of medical instrumentation) in short time facilitating the formation of workstations, and devices using the method of the present invention transffering pulsed laser light to a remote receptive interface, activating photocatalytic agent therein (in the coupling solution used). More specifically, the methodology of the present invention is using Ultraviolet light from about 200nm, to about 400nm to activate the photocatalytic agent present in the water based coupling gell (normally made out of silicon/water solution). By exposing the thin film coating left on probes, and ultrasound accessories, or body parts externally wounded, or for cuts, to a plureality of laser pulses in the region of the UVA, UVB, UVC, the present invention, triggers said thin film catalytically, and thus photocatalytically inucing beneficial photochemical processes (for example disinfection, and sterilazation), thus purifying, disinfecting, and inactivating noxious species on the plurality of surface described above (i.e. such as the surface of the medical instrumentations, wounds, cuts, sores, or externally damaged body surfaces). Further more, according to the method of the present invention said laser pulses having germicidal wavelength, and sufficient e/V energy for the specific treatment require for a particilar application wherein mild dissociation effects are beneficial for the methodology according to the present invention to offer photocatalytic solution in the field, or in disaster areas, or in places wherein the population is exposed to unexpected conditions dictating medical procedures to be performed without the infrastructure normaly associated with hardware equipment for disinfection (i. Such as aotoclave, ovens, Gamma rays, Radio waves, X-rays, microwaves, heat, cold, Sonication).

The present invention disclosed a novel methodology for photoreactive disinfection of surfaces, beneficial for the disinfection, and treatment of wide varieties of medical instrumentation, and for the thin-film coating, and activation on the surface of wounds, cuts, bruises, sores, damaged parts of external body surface), and in air, such as when infectious events may pause threat to humans, animals, and plants. Further more, by integrating into high purity water enriched with oxygen, and mixed with catalytic powder, or liquid, or gas, or light the methodology of the present invenvention facilitate the formation of active free radical layer swiftly making the surface curvature/proximities sterilized. Noxious species on the said surface are then inactivated, thus the surface is been made safe from infectioius events, (bacteria, viruses, and other health threatening noxious species). The present invention is extremely beneficial for many medical application hence there are no need for actual physical touching, terring, or swiveling of tisues, or there is no need for physically

interffering with an already sensative, and often critical medical treatment scenarios. The present invention facilitate the formation of a free sterilized zone extending to reach the entirety of the spread of siad catalytic compound, naturally in line with environmental conditions such as wind, air compound, PH levels, dissolved Oxygen and othe factors effecting photocatalysis quantum yield of efficiency (100-107), (a-z), (a/1-z/10). (Figures 1-30).

Disinfection, purification, and sterilization and photo-treatment by Ultra Violet light technology is well known, this technology is preferred due to its non residual, non chemical, and effective (wavelength range from about 220nm-357nm) in inactivating DNA & RNA replication sequences in wide variety of noxious species, bacteria, viruses, Cysts, and Pathogens. Currently used methodologies utilizing UV light for disinfection, and photo-treatment is making use of (CW) Continuos Wave, often polychromatic light sources, most of which having radial emission, and not sufficient peak power (i.e. such as generated by P.W. type light sources). More specifically, the principle means for the generation of Ultra Violet light for disinfection and for photo-treatment is by using Mercury type light sources, or lamps. These lamps generate continuos type of light (i.e. CW), and the majority of the light they generate (their peak emission) (mercury), is at the region of about 254nm. These light sources/lamps, thus does not have the required wavelength for offering efficient disinfection, and sterilization of wide varieties of medical instrumentation. More specifically, current methodologies for disinfection, and sterilization of medical instrumentation include heat, Gamma rays, X-rays, Y-rays, radion waves, Ultra Violet, microwaves, chemicals. These methodologies while offering currently implemented solutions, imposed strict limitations on

ablation in the context of the present invention means the removal of material or tissue by melting, evaporation, or vaporization.

absorb in the context of the present invention means to transform radiant energy into a different form, usually with a resultant rise in temperature.

absorbance in the context of the present invention means the ability of a medium to absorb radiation depending on temperature and wavelength. expressed as the negative common logarithm of the transmittance.

absorption coefficient in the context of the present invention means the amount of radiant energy absorbed per unit or path-length.

active medium in the context of the present invention means a medium in which lasing will take place, rather than absorption, at a given wavelength.

afocal in the context of the present invention means literally, "without a focal length"; an optical system with its object and image point at infinity.

air-cooled laser in the context of the present invention means a laser using fans to force air over the laser tube and through the power supply. air-cooled lasers have the benefit of needing no water supply, although the fan noise can sometimes be a disadvantage. usually only small and medium power lasers are air-cooled. very small

lasers, typically helium-neon, need no fans. although technically they are "air cooled" via convection, the term is usually applied only to fan-forced cooling.

amplification in the context of the present invention means the growth of the radiation field in the laser resonator cavity. as the light wave bounces back and forth between the cavity mirrors, it is amp stimulated emission on each pass through the active medium.

amplitude in the context of the present invention means the maximum value of the electromagnetic wave, measured from the mean to the extreme; put simply, the height of the wave.

angstrom unit in the context of the present invention means a unit of measurement for a wavelength of light (written å), equal to one ten billionth of a meter (10^{-10} meter). occasionally still used.

anode in the context of the present invention means an electrical element in laser excitation which attracts electrons from a cathode. an anode can be cooled directly by water or by radiation.

ar coatings in the context of the present invention means anti-reflection coatings, used on the backs of laser output mirrors to suppress unwanted multiple reflections which reduce power.

argon laser in the context of the present invention means a laser filled with argon gas. it gives off green and blue light. the strongest lines are at 514 nm (green) and 488 nm (blue). argons range from small 15 milliwatt 110 volt air-cooled models to large 50 watt 440 volt water-cooled systems. argon lasers are the most common type of light show lasers since they provide unable brightness at a reasonable cost.

average power in the context of the present invention means the sums of the energy of all single discrete pulses, in one second, of a pulsed laser.

autocollimator in the context of the present invention means a single instrument combining the functions of a telescope and a collimator to detect small angular displacements of a mirror by means of its own collimated light.

axial-flow laser in the context of the present invention means the simplest and most efficient of the gas lasers. an axial flow of gas is maintained through the tube to replace those gas molecules depleted by the electrical discharge used to excite the gas molecules to the lasing state.

axis, optical axis in the context of the present invention means the optical center-line for a lens system; the line passing through the centers of curvature of the optical surfaces of a lens.

beam diameter in the context of the present invention means the diameter of that portion of the beam which contains 86% of the output power.

beam expander in the context of the present invention means optical device increasing beam diameter and reducing divergence.

beam splitting in the context of the present invention means optically splitting a laser beam into two or more beams, of various or identical energys.

brewster windows in the context of the present invention means the transmissive end (or both ends) of the laser tube, made of transparent optical material and set at brewster's angle in gas lasers to achieve zero reflective loss of vertically polarized light. non-standard on industrial lasers, but a must if polarization is desired.

brightness in the context of the present invention means the visual sensation of the luminous power of a light beam, as opposed to scientifically measured power of the beam.

calorimeter in the context of the present invention means an instrument which measures the heat generated by absorption of the laser beam—another way to measure laser power.

cathode in the context of the present invention means the element providing the electrons for the electrical discharge used to excite the lasing medium.

co_2 laser in the context of the present invention means a laser largely used in industry in which the primary lasing medium is carbon dioxide.

coaxial gas in the context of the present invention means most laser welding is done with a shield of inert gas flowing over the work surface to prevent plasma oxidation and absorption, to blow away debris, and to control heat reaction. the gas jet has the same axis as the beam so the two can be aimed together.

coherent light, coherent radiation in the context of the present invention means radiation composed of wave trains vibrating in phase with each other. coherent light waves all travel the same direction (spatial coherence) at the same frequency and in phase (temporal coherence). a laser produces coherent light, conventional light sources produce incoherent light.

collimated light in the context of the present invention means beam light rays traveling parallel to each other.

collimation in the context of the present invention means the process by which divergent rays are converted into parallel rays.

convergence in the context of the present invention means the bending of light rays toward each other, as by a positive (convex) lens.

current saturation in the context of the present invention means maximum flow of electric force in a conductor; in a laser, the point at which further electrical charge will not increase lasing action.

cw in the context of the present invention means an abbreviation of continuous wave of a laser as opposed to pulsed operation.

depth of field in the context of the present invention means the working range of the beam, a function of wavelength, diameter of the unfocused beam, and focal length of the lens. to achieve a small diameter spot size, and thus a high power density, a short depth of field must be accepted.

dichroic filters and mirrors in the context of the present invention means a piece of glass with an optical thin-film coating that transmits certain colours (wavelengths), and reflects the remaining colours. dichroic filters are used to combine or eliminate specific colours as needed in a laser projector. dichroic mirrors are used to maximise the amount of light reflected from a laser of a particular wavelength. dichroics should be handled with care to prevent damage to the coating. [see also: colour box]

diode laser in the context of the present invention means a semiconductor similar to an led (light-emitting diode) but which produces coherent light. diode lasers are small and efficient, which has led to their use in compact disc players and pen-type laser pointers. currently, diode lasers are too dim or expensive for most light show uses. this is likely to change over the next few years. [see also: solid-state laser]

divergence in the context of the present invention means the angle at which the laser beam spreads in the far field; the bending of rays away from each other, as by a concave lens or convex mirror.

drift, angular in the context of the present invention means all undesirable variations in output (either amplitude or frequency); angular drift of the beam, measured in milliradians before, during, and after warm-up.

duty cycle in the context of the present invention means the length of time the laser beam is actually cutting, drilling, welding, or heat-treating, as compared to the entire work cycle time.

electromagnetic wave in the context of the present invention means a disturbance which propagates outward from an electric charge which oscillates or is accelerated. includes radio waves; x-rays; gamma rays; and infrared, ultraviolet, and visible light.

emissivity, emittance in the context of the present invention means rate at which emission takes place; the ratio of the radiant energy emitted by a source or surface to that emitted by a blackbody at the same temperature.

exposure in the context of the present invention means a measure of the total radiant energy incident on a surface per unit area; radiant exposure.

far-field imaging in the context of the present invention means an imaging technique with solid-state lasers that has several limitations: non-uniform energy distribution, very short working distances, and poor control of hole geometry.

fiber optic cable in the context of the present invention means flexible glass or plastic strands made into a cable, used to carry light from one place to another. there are

two main types; step index and graded index fiber. within these two main types there are two further subgroups:

- transmission fibers carry the beam with as little loss as possible. they are used to transmit the laser's light to remotely located projection devices.

- display fibers [also knows as side glow fibers] have no cable jacket, so some light scatters out the side of the strands. the strands themselves look like microscopic neon tubing and become a special effect, such as a laser-lit "whip" or a glowing "rope" wrapped around objects.

flashlamp in the context of the present invention means source of powerful light; often in the form of a helical coil and used to excite photon emission in a solid-state laser.

fluorescence in the context of the present invention means the glow induced in a material when bombarded by light. brewster windows of fused silica fluoresce in uv light, increasing absorption of laser radiation and degrading laser mode and output.

flux in the context of the present invention means the radiant, or luminous, power of a light beam; the time rate of the flow of radiant energy across a given surface.

focus in the context of the present invention means noun: the point where rays of light meet which have been converged by a lens. verb: to adjust focal length for the clearest image.

focal point in the context of the present invention means (same as first definition under "focus;" in laser work,) the focal point of the beam relative to the work surface has a critical effect, such as the depth and shape of drilled holes. when the focal point is at the surface, holes are of uniform diameter. when the focus is below the surface, conical holes are drilled.

folded resonator in the context of the present invention means construction in which the interior optical path is bent by mirrors mounted on corner blocks bolted into pre-aligned position, permitting compact packaging of a long laser cavity.

frequency in the context of the present invention means the number of light waves passing a fixed point unit of time, or the number of complete vibrations in that period of time.

gain in the context of the present invention means another term for amplification, usually referring to the efficiency of a lasing medium in attaining a population inversion. high gain is typically more than 50% per pass of the light wave between cavity mirrors.

gas discharge laser in the context of the present invention means a laser containing a gaseous lasing medium in a glass tube in which a constant flow of gas replenishes the molecules depleted by the electricity or chemicals used for excitation. the discharged gas can be filtered and 90% recycled for economy.

gas jet assist in the context of the present invention means an assisting coaxial gas, such as oxygen, argon, or nitrogen, which may be used to achieve very high power levels for cutting certain metals.

gas transport in the context of the present invention means a laser design, which generates very high beam power within a fairly small resonator structure. long electrodes parallel the axis and gas is circulated across the resonator cavity.

gaussian in the context of the present invention means the "normal curve," or normal distribution, an example of which is the symmetrical bell shape of the holes created by the uncorrected, unfocused laser beam in its optimum mode. a gaussian laser beam has most of its energy in the center.

haz in the context of the present invention means heat-affected zone, or the area where laser beam and metal (or other) surface are in contact.

helium-neon laser in the context of the present invention means ("hene"), laser in which the active medium is a mixture of helium and neon, which is in the visible range. used widely in industry for alignment, recording, printing, and measuring, it is also valuable as a pointer or aligner of invisible co_2 laser light.

heat sink in the context of the present invention means a substance or device used to dissipate or absorb unwanted heat, as from a manufacturing process (or, with lasers, from reflected rays).

hertz in the context of the present invention means the approved international term, abbreviated hz, which replaces cps for cycles per second.

image in the context of the present invention means the optical reproduction of an object, produced by a lens or mirror. a typical positive lens converges rays to form a "real" image which can be photographed. a negative lens spreads rays to form a "virtual" image which can't be projected.

incident light in the context of the present invention means a ray of light that falls on the surface of a lens — or any other object. the "angle of incidence" is the angle made by the ray with a perpendicular to the surface.

intensity in the context of the present invention means the magnitude of radiant energy (light) per unit, such as time or reflecting surface.

ion laser in the context of the present invention means a type of laser employing a very high discharge current, passing down a small bore to ionize a noble gas such as argon or krypton. the ionization process creates a population inversion for lasing to occur. a research laser useful for some industrial applications.

ionization in the context of the present invention means the process by which ions are formed.

irradiation in the context of the present invention means exposure to radiant energy, such as heat, x-rays, or light; the product of irradiance and time.

joule in the context of the present invention means one watt per second; a measurement frequently given for laser output in pulsed operation.

krypton laser in the context of the present invention means a laser filled primarily with krypton gas. when used with "all-line" or "white" optics, it produces red, yellow, green and blue light. a "red-only" krypton laser uses with specially tailored optics to output a very strong red line at 647 nm.kryptons are similar to argons (the same tube design can be used for both). however, krypton gas produce less light (output power) than an equivalent volume of argon gas.

krypton lasers are primarily used when a powerful red light is needed.

laser in the context of the present invention means "laser" is an acronym derived from "light amplification by stimulated emission of radiation".

a device which produces a coherent beam of light. the beam remains parallel for long distances and contains one or more extremely pure colours.light show lasers are usually gas-filled tubes using high voltage current to ionise the gas (cause the gas to glow). mirrors at each end of the tube help amplify a process called "stimulated emission". most of the stimulated emission light travels between the two mirrors; between 1% and 4% comes out of one of the mirrors to create the beam of light that we see.the gas used determines the colour (or colours) of the beam. gas lasers remain the overwhelming choice for display applications. the four main types used are a helium-neon mixture, argon, krypton, and an argon-krypton "mixed gas" mixture.

laser oscillation in the context of the present invention means the buildup of the coherent wave between laser cavity end mirrors. in cw mode, the wave bounding back and forth between mirrors transmits a fraction of its energy on each trip; in pulsed operation, emission happens instantaneously.

laser rod in the context of the present invention means a solid-state, rod-shaped lasing medium in which ion excitation is caused by a source of intense light, such as a flashlamp. various materials are used for the rod, the earliest of which was synthetic ruby crystal.

light in the context of the present invention means the range of visable electromagnetic radiation frequencies detected by the eye, or the wavelength range from about 400 to 750 nanometers. it is sometimes extended to include photovoltaic effects and radiation beyond visible limits.

light regulation in the context of the present invention means a form of power regulation in which output power is maintained at a constant level by controlling discharge current.

luminance in the context of the present invention means commonly called illumination; the luminous or visible flux per unit area on a receiving surface at any given point.

meniscus lens in the context of the present invention means the lens used primarily in co_2 lasers by coherent, inc. it has one side convex, the other concave.

metastable, metastable state in the context of the present invention means unstable condition in which the energy of a molecule is at some discrete level above the lowest, or ground state. it is this condition which is necessary for emission of photons in a laser. (from quantum theory.)

millijoule: one thousandth of a joule.

milliwatt in the context of the present invention means one thousand milliwatts equal one watt. small lasers' beam powers are measured in milliwatts. for example, a 50 mw laser is one-twentieth of a watt; a 500 mw laser is one-half watt.

mode in the context of the present invention means a particular functioning arrangement, setup, or condition for laser operation, such as continuous emission, pulses, or grouped pulses. "mode" also describes the cross-sectional shape of the beam. (see "tem.")

modulation in the context of the present invention means the ability to superimpose an external signal on the output beam of the laser as a control.

monochromatic light in the context of the present invention means theoretically, light consisting of just one wavelength. since no light is completely monochromatic, it usually consists of a very narrow band of wavelengths. lasers provide the narrowest bands.

nanometer in the context of the present invention means a unit of length in the international system of units (si) equal to one billionth of a meter (10^{-9} meter). once called a millimicron, it is used to represent wavelength. abbreviated "nm."

near field imaging in the context of the present invention means a solid-state laser imaging technique offering control of spot size and hole geometry, adjustable working distance, uniform energy distribution, and easily produced range of spot sizes.

nd:glass laser in the context of the present invention means a solid-state laser of neodymium:glass offering high power or short pulses, or both, for specific industrial applications.

nd:yag laser in the context of the present invention means a solid-state laser of neodymium:yttrium-aluminum garnet, similar to the nd:glass laser. both are pumped by flash lamps, or diode lasers.

nema in the context of the present invention means national electrical manufacturers' association, a group which defines and recommends safety standards for electrical equipment.

noise in the context of the present invention means unwanted, minor currents or voltages in an electrical system.

object in the context of the present invention means the subject matter or figure imaged by, or seen through, an optical system.

optical density in the context of the present invention means protection factor provided by a filter (such as used in eyewear, viewing windows, etc.) at a specific wavelength. each unit of od represents a 10x increase in protection.

optical pumping in the context of the present invention means exciting the lasing medium by the application of light rather than electrical discharge from anode and cathode.

output coupler in the context of the present invention means the resonator mirror which transmits light; the one at the opposite end is totally reflective.

output power in the context of the present invention means the energy per second emitted from the laser in the form of coherent light, usually measured in watts for continuous-wave operation and joules for pulsed operation.

peek power in the context of the present invention means the power of an individual pulse in a pulsed laser. it is obtained by dividing the pulse energy in joules to the pulse width in seconds. typical values can be reach mega and giga watts.

photoacoustic effects in the context of the present invention means arises with the use of very short-duration high-energy laser pulses, at pulse durations typically below 10 microseconds. significant amounts of energy are absorbed and a rapid expansion occurs in the tissue, generating an acoustic shock wave that causes mechanical disruption to cellular structures.

photochemical effects in the context of the present invention means effects that occur from long exposure durations at incident power levels insufficient to cause damaging photothermal effects. it is an energy dependent process (a function of the total quantity of radiation absorbed rather than its rate of absorption).

photometer in the context of the present invention means an instrument which measures luminous intensity.

photon in the context of the present invention means in quantum theory, the elemental unit of light, having both wave and particle behavior. it has motion, but no mass or charge.

photothermal effects in the context of the present invention means the damage mechanism for acute laser injury (i.e. for injury immediately following exposure). the radiation incident at the surface is absorbed in the underlying tissue, increasing the temperature of the tissue to the level at which damage can occur, and laser burns result. it is a power dependent process (a function of the rate at which energy is absorbed rather than the total quantity of energy involved).

plasma in the context of the present invention means in laser welding, a metal vapor that forms above the spot where the beam reacts with the metal surface. also used to

describe the laser tube (plasma tube, discharge tube) which contains the completely ionized gas in certain lasers.

polarization in the context of the present invention means restriction of the vibrations of the electromagnetic field to a single plane, rather than the innumerable planes rotating about the vector axis. this prevents optical losses at interfaces between the lasing medium and optical elements. various forms of polarization include random, linear (plane), vertical, horizontal, elliptical, and circular. of two polarization components (so-called), s and p, the p component has zero losses at brewster's angle.

population inversion in the context of the present invention means when more molecules (atoms, ions) in a laser are in a metastable state than in the ground state (a situation needed for sustaining a high rate of stimulated emissions), a "population inversion" is said to exist. without a population inversion, there can be no lasing action.

power density: the amount of radiant power concentrated on a surface. units watts per square meters or square centimeters

pulse energy in the context of the present invention means the energy of a single, brief emission from a laser programmed for pulsed behavior rather than continuous operation. pulse power can be several times greater than cw emission.

pulse tail in the context of the present invention means pulse decay time, which can be shortened (by using a special mixture of gases) to allow for fast repetition of laser pulses within a given length of time.

q-switch in the context of the present invention means a device that has the effect of a shutter moving rapidly in and out of the beam to "spoil" the resonator's normal q, keeping it low to prevent lasing action until a high level of energy is stored. result: a giant pulse of power when normal q is restored.

quasi cw in the context of the present invention means the pulsating of a continious light into pulsed light by acusto optic, electrooptic, electronic, or mechano optical means, so peak powers are reduced, by number of pulses (see rep. rate) are increased.

radiance in the context of the present invention means brightness; the radiant energy per unit solid angle and per unit projected area of a radiating surface.

radiant energy in the context of the present invention means energy traveling as wave motion; specifically, the energy of electromagnetic waves (light, x-rays, radio, gamma rays).

radiant flux: the rate of emission or transmission of radiant energy.

radiant intensity in the context of the present invention means radiant power, or flux, expressed as emission per unit solid angle about the direction of the light in a given length of time.

radiant power in the context of the present invention means the amount of radiant energy available per unit; the radiant flux.

reflectance in the context of the present invention means the ratio of the reflected flux to the incident flux, or the ratio of reflected light to light falling on the object.

reflection in the context of the present invention means the return of radiant energy (incident light) by a surface, with no change in wavelength.

refraction in the context of the present invention means the change of direction of propagation of any wave, such as an electromagnetic wave, when it passes from one medium to another in which the wave velocity is different. simply put, the bending of incident rays as they pass from one medium to another, such as air to water.

resolution in the context of the present invention means resolving power, or the quantitative measure of the ability of an optical instrument to produce separable images of different points on an object; the capability of making distinguishable the individual parts of an object, closely adjacent images, or sources of light.

resonator in the context of the present invention means the mirrors (or reflectors) making up the laser cavity containing the laser rod or tube. the mirrors reflect light back and forth to build up amplification under an external stimulus. emission is through one of them, called a coupler, which is partially transmissive.

rockwell c in the context of the present invention means a scale or test used to define hardness in metals, particularly steel and titanium.

solid-state laser in the context of the present invention means a laser where the lasing medium is a solid material such as a ruby rod. these can be optically pumped by a flashlamp or diodes. solid state lasers also include diode lasers as they use electrically pumped solids to produce light.currently, solid-state lasers are too expensive for most light show uses. this may change over the next few years. the most promising solid-state laser uses a material called nd:yag, which produces infrared light. this can be frequency doubled (second harmonic generation) to produce up to 60 watts of green light at 532 nm. the green light can again frequency doubled (fourth harmonic generation) to produce uv light at 266 nm, up to several watts.

spectral response in the context of the present invention means the response of a device or material to monochromatic light as a function of wavelength.

stimulated emission in the context of the present invention means when an atom, ion, or molecule capable of lasing is excited to a higher energy level by an electric charge or other means, it will spontaneously emit a photon as it decays to the normal ground state. if that photon passes near another atom of the same frequency which is also at some metastable energy level, the second atom will be stimulated to emit a photon. both photons will be of the same wavelength, phase, and spatial coherence. light amplified in this manner is intense, coherent (collimated or parallel), and monochromatic. in short, laser light.

tem in the context of the present invention means abbreviation for transverse electromagnetic mode, the cross-sectional shape of the working laser beam. an infinite number of shapes can be produced, but only a relatively small number are needed for industrial applications. in general, "the higher the tem, the coarser the focusing."

• tem00: a gaussian-curve mode that is the best collimated and produces the smallest spot of high power density for drilling, welding and cutting.

• tem01: divided into two equal beams for special applications.

threshold in the context of the present invention means during excitation of the laser medium, this is the point where lasing begins.

transmission in the context of the present invention means in optics, the passage of radiant energy (light) through a medium.

transmittance in the context of the present invention means the ratio of transmitted radiant energy to incident radiant energy, or the fraction of light that passes through a medium.

vignetting in the context of the present invention means the loss of light through an optical element when the entire bundle does not pass through; an image or picture that shades off gradually into the background.

visible light transmission/transmittance in the context of the present invention means the amount of visible light usable to the eye that passes through a filter. as a rule of thumb, as optical density increases, visible light transmission decreases — but not always.

watt in the context of the present invention means an objective measure of power; in lasers, usually refers to the optical output power, or strength, of a laser beam. watts are also used in a more conventional sense, to measure electrical power used by a laser. for example, a 10 w (optical) argon laser consumes around 10,000 w of electrical power.

wave in the context of the present invention means an undulation or vibration, a form of movement by which all radiant energy of the electromagnetic spectrum is thought to travel.

wavelength in the context of the present invention means the fundamental property of light—the length of the light wave, which determines its color. common units of measurement (which is usually from crest to crest) are the micron, the nanometer, and (earlier) the angstrom. visible light has wavelengths extending from about 700 nanometers (red) through orange (~600 nm), yellow (~580 nm), green (~550 nm), blue (~450 nm) and violet (~400 nm).

white-light beam in the context of the present invention means broadly, a laser beam which contains a number of different wavelengths (colours) so the beam appears white. if the beam is passed through a prism or diffraction grating, it is separated into

individual laser beams, each of a single specific wavelength.more specifically, a white-light beam ideally contains twice as much red as green and blue light for correct colour balance (see appendix). it can be from a single white-light laser or from two or three lasers whose beams have been combined into a single beam. white-light beams are primarily used in rgb laser projectors.see the definition of white-light laser for more information on what constitutes an "equal mixture" of light

white-light laser In the context of the present invention means Many lasers can produce a number of wavelengths (colours) simultaneously. A white-light laser is designed to give a good balance of red, green and blue wavelengths. Usually the laser is intended for an RGB laser projector. (Some models also deliberately add yellow light for specialised 4-colour projectors.) Most white-light lasers use an anrgon/krypton gas mixture. It is somewhat

difficult to produce an equal balance of desired colours, and to keep this balance consistent during the lifetime of the laser tube. At present, there are no standards defining the exact wavelengths and colour proportions for a laser to be called "white-light". In addition, the sought-after colour balance can be defined either as equal amounts on a photometer, or as visually equal amounts. Since the eye is much more sensitive to green, a visually equal or "photopically balanced" laser has roughly five times more power in red and blue than in green. Most white-light lasers today are not photopically balanced.

window In the context of the present invention means A piece of glass with plane parallel sides which admits light into or through an optical system and excludes dirt and moisture.

A further environmental embodiment of the method of the present invention wherein the content of the bottles, conduits, or chambers may be selected from: beverages, wine, medical preparation, juice, drinking water, mineral water, insulin products or medical preperation. Spring water, flavored water, flavored beverages, biological traceable compounds, Drug delivery using water based, and/or expanded or flavored water drinks containing vitamines or nutrients, alcohol, blood products, plasma products, air products, gases for propelling medications, sprays, or any liquid or gasses or hybrid combination thereof.

A Novel environmental embodiment of the present Invention is having a high repetition rate, high peak power laser of the Nd:Yag, or Nd:Glass, or Nd: YLF, type or any combination thereof operating in the Fourth Harmonic generation mode (i.e. FHG), a further preferred embodiment of the present invention is having said solid state (i.e. Nd: Yag type for example), working in the Third Harmonic Generation mode (i.e. THG), a preferred embodiment according to the method of the present invention is having an electrical discharge laser such as an excimer laser operating in wavelength from about 193nm, through to about the 308, and 351nm, and wherein each of said pulses of light is aligned

into the content of the bottled liquids or gasses for purifying, disinfecting, and ensuring that DNA, and RNA replication sequences are thus inactivated, providing a non invasive disinfecting methodology wherein light pulses from the laser are

penetrating the material from which the bottles, (i.e. conduits or chambers, or bottles, or pipes) are made.

A preferred embodiment according to the method of the present Invention is having a hybrid laser system operating wherein (a) a solid state laser operating at THG (355nm), is attached, or aligned to the transparent lid, or cork, or encapsulation, or conduit, or chamber, and wherein together in hybrid format an electrical discharge laser is also operating for maximizing the efficiencies associated with the non destructive disinfection according to the method of the present invention. Further prefered embodiment according to the present invention wherein the packaging is a liquid waveguide, or concventrator.

A preffered embodiment of the present invention wherein a Nd:Yag laser is used having a third Harmonic generator producing 355nm wavelength which pentrates the surface of the skin in human, and animals and thus swiftly inactivates DNA & RNA replication sequences in blood therein (in the blood, i.e. under the skin, non invasively). Such preffered embodiment of the present invention could be implemented with at least one laser unit having its beam of pulsed UVA light split, and distributed to a plurality of location by means of waveguiding light through HGFS optical fibers, photonic band gap waveguides, or polymer waveguides, or hybrid combinations, each distal tip is attached, supported, or threaded, in proximity or distributed to cover areas inthe body wherein blood vessels are relatively exposed, and are conviniently positioned around the surface (i.e. inporoving transmission, and coupling conditions). A further preffered embodiment of the present invention is wherein several lasers are used having high repetition rates, or high peak powers, and pulse duration from about 1 ms, to about 1 fs, or Atosecond and wherein their respective beams are collected, or diflected, or diverted or sttired to form a three dimension element of UVA light at high energy density, and wherein said high energy density is below the damage threshold of blood components, nutrients, conditioners, complimental systems, MHC type 1,2,3, and any vital cell present in blood or blood products, yet they are efficient for inactivation of noxious species therein, i.e. within the blood, or blood products.

A preffered embodiment of the present invention wherein the laser light source is sellcted from (a) Gas discherge laser, (b) diod pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e) semi conductor lasers, (f) crystal type of lasers, (g), X-rays pumped lasers, (h) E-beam pumped gas lasers types,

(I) FEL (Free Electron Laser amplifier), (j) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

A preffered embodiment of the present invention wherein the laser light source is tunable from about 1nm to about 3000nm, a further preffered embodiment of the pesent invention is wherein the laser light source is tunable from about 333nm to about 360nm, and wherein the peak power density of individual pulses reach from about $1nJ/Cm^2$, to about $50Js/Cm^2$, and wherein said pulsed laser light source is pulsing at repetition rates from about 1 Hz to about 300MHz thus the preffered embodiment of the present invention is suitable for wide ranging application involving different packaging materials, thus their specie specific optical caliberation standards

are calculated for a specific biodosimetric value or curve to appropriately corasponde (being lower) with damage threshold of the substrate material used in a specific application, or tool, or device.

Detailed description of the Figures:

The figures according to the method of the present invention illustrate preferred embodiments of the present invention, and block schematics of devices using the methodology of the present invention, and as such, do not intend to limit the scope of the present invention what so ever; figures 1-10, are herewith disclosed, and forthwith are herewith presented for clarity illustrating competitive advantages, benefits, and modularity in which scaling down or up design criteria for devices according to the method of the present invention mat be performd, and excecuted.

The figures according to the method of the present invention illustrate preferred embodiment of the present invention do not intend to limit the scope of the present invention what so ever; figures 1-10, together with scientific support data is herewith disclosed:

Figure 1 illustrates a block schematic of the present invention for sterilization surfaces of a vehicle or car according to the methodology of the present invention. A car (102) is shown being disinfected by a mobile photo-catalytic (hand held) device (106, 105, 107) held by a person (100) standing in proximity to said car. An optical fiber (107) is illustrated for clarity connected at one end to a pulsed UV laser (not shown), and at the other end to the catalytic hand held device (106), light from the laser is delivered through the optical fiber to the hand held device and being projected (105, 105a, 105b) to the surface of the contaminated (105c) car surface being sterilized. Advance oxidation processes are being initiated by the photochemical interaction of the laser with the oxidizer (105a) shown in droplet format (105a), especially beneficial for protection against contaminants of biological, and/or chemical origin, and for photo-treatment , and disinfection of wide variety of surface in metropolitan areas, and in domestic, commercial or medical applications.

Figure 2 illustrates a block schematic of the present invention for sterilization surfaces of a vehicle or car automatically according to the methodology of the present invention. (108) represent support means of the laser (not shown), and for the oxidizer jets (112a, 112b, 112c), a car is illustrated (113), and the light (114,, 111, 109, 110) is shown to interact with the oxidizer suspension or H2O2 water based compound sprayed (115), radical species (OH-, not shown) are thus produced according to the methodology of the present invention triggered by the pulsed laser light (114), the car is static or moving through the automatic car sterilization support means (108) for advanced oxidation processes to be initiated by the laser light interacting with the oxidizer (water based H2O2 suspension).

Figure 3 illustrates a schematic view of the present invention for sterilization of air volume and/or surfaces in metropolitan areas according to the methodology of the present invention. (117) illustrate a person holding a portable pulsed UV laser (118) device using the methodology of the present invention. The beam of the portable

laser is illustrated in (119), the pulsed UV laser beam (119, 127) is shown traversing photo-catalytic bubbles which have being released or delivered, or produced in situ (not shown) at the contaminated areas. (120) represent a bubble hit by the laser creating an acusto-optic effects, diffusing, and scattering the light from the pulsed UV laser in 360 degrees, such that it could trigger bubbles in the proximity of the 1st effected bubble, a spore or contaminated specie (124) is illustrated effected by the free radical species created by the interaction of the pulsed UV light (121, 1222, 123, 126, 120,) from the laser (118, 119). An additional person is standing near by in proximity (129, 128) to illustrate the high safety levels of the methodology of the present invention, the physical distance between (124), (126) illustrate the capabilities of the methodology of the present invention wherein the pulsed laser light is the trigger or match, and the scattered light causing advance oxidation processes to occur is the fire, thus the size of the match does nope correspond with the size of the fire. The photo-catalytic bubbles are thus facilitating disinfecting, or sterilization or dissociation or oxidation processes to occur in places, locations wherein the actual light have nor reached or covered, substantially increasing the geometrical utilization of the methodology of the present invention. (1120, 125, 126, 127) illustrate the light scattered, and diffused from the original hit bubble (120), thus covering and treating areas larger then the areas covered by the light from the laser alone.

Figure 4 illustrates a block schematic view of the present invention for sterilization of surfaces, and/or air volumes in a multi store/floor building according to the methodology of the present invention. (130) illustrate a central laser system coupled (not shown)(to a harness of optical fibers (131) 133,) to extending to reach individual trajection or projection points throughout the building floors (in each floor) (132, 135, 134,) light from the laser is interacting with the oxidizer photo-catalytic compound, or bubbles (147, 146, 144, 143, 140, 141, 138) for the purpose of producing free radical species (not shown). Much like the sprinklers gains fire which are installed in hotels, and other key building, the methodology of the present invention and devices for use thereof could be installed in a building's infrastructure support means (1336a,b,c,), (137, 154), (154) represent the ceiling or floor of the 1st floor, people are illustrated in each floor (150, 142, 139,) being protected by the method and related devices according to the present invention.

Advanced oxidation processes are occurring in each floor inactivating DNA replication sequences of noxious species, or dissociating and reducing toxic chemical species which may enter the building. (152a,b,c) represent nozzles for dispersing the catalytic compound in bubbles or vapor or droplet formats, H2O2 could be added to the general water utility (not shown) or additional oxygen could be dissolved into the water utility just before use, in situ, in real time, and at concentration according to the specific threat or eventuality. (155) illustrate the floor, or ground zero, (156) illustrate the roof top of the building.

Figure 5 illustrates a schematic view of the method of the present invention wherein people (157a,b,c,d, 158, 159,) contaminated with noxious or toxic chemical or biological components or multi components are being cleaned by a photo-catalytic mobile sterilization, and dissociation interface (160). Pulsed UV light from an attached laser (not shown) is arriving through optical fibers, or waveguides (165), connected at one end to the laser (not shown), and at the other end (164) connected

to the extendable integrated arm (160), (162a) illustrate the catalytic oxidizer being dispersed, and distributed, extending to reach the contaminated skin, or cloth of the contaminated people, (162b) illustrate a portion of the beam of light together with the oxidizer compound thus creating free radical species and sterilizing, disinfecting, cleaning, and oxidizing, thus making noxious species inactivated, and much more innocuous, and manageable, minimizing damage, saving lives in threatening eventualities. (161) Represent a jet, or diffuser, dispersed interface, or projecting element telescopically adjusted so as to fit the appropriate surface curvature of the area to be treated. And so Advanced Oxidation processes are initiated, triggered by the pulsed UV laser for making safe wide variety of surfaces.

Figure 6 illustrates a schematic view of devices using the methodology of the present invention.

Preferred mode of utilization using a photo-catalytic, reactive bubble (166) technology for treatment of surfaces, liquids, and gasses volumes. (167, 169c, 171, 170, 169b, 169a, 168, 169, d) illustrate reflected pulsed UV light from the laser or high intensity light source (not shown), the opto-acoustic vibration created at the bubble level affect light which transverse said bubble, and thus effect additional bubbles (not shown) which are in proximity, such that the energy threshold required for the triggering of AOT (Advanced Oxidation Processes) in the surrounding areas, and vicinity of the original bubble first interacted with the light, especially beneficial when scanning larger area, surfaces, air volumes. In this figure, the size of the match (i.e. the laser, not shown) does not correspond with the size of the fire (meaning the radical species OH* thus created). Especially beneficial for protection against chemical, or biological noxious or toxic species pausing health threatening eventualities.

Figure 7 illustrates the capabilities of the methodology of the present invention according to the methodology of the present invention for treatment of larger areas, surfaces, air volumes, and combination wherein (175) represent an air born pulsed UV laser, (182, 172) illustrate mobile ground based UV pulsed laser, light beams from the lasers are extending to reach the photo-catalytic, and photo-reactive oxidizer species (bubbles, or droplet format) represented by (177). (176) represent the light from the laser after passing through several bubbles or droplets and (185) illustrate the opto-acoustic effects and scattering, and reflecting, diffusing of the light (186), (178) represent toxic, or noxious species in need of immediate inactivation or reduction (biological or chemical species). (181, 180, 178, 183) illustrate building in a metropolitan area or city, or key building or installation (179) illustrate the height of the building relative to the surrounding areas, (174a) illustrate the remaining by products which are mainly CO2, and H2O which are harmless, and does not effect the environment leaving no toxic residuals. (182) represent the vehicle or track carrying the laser (mobile)(173) illustrate light passing from the ground upwards, (194) represent constructive interference created by the two or several laser beams interacting together.

Figure 8 illustrates schematic view of the devices using the method of te present invention for territorial protection of key building, farms, industrial or commercial sites, and predetermined areas. (189) Illustrate the light from the laser being applied over large area (scanning head), the laser is positioned on the ground (187), and its light is delivered through the central pole (188), (190a,b,cd) represent the portion of the laser beams covering different portion of the area to be protected/treated. (197) Illustrate the end point of the area to be protected, (191) illustrate a building in the area, (192) illustrate the other end of the defined protected area, ((190c) illustrate a toxic chemical specie or biological noxious specie which have entered the defined protected area and thus have being disinfected, sterilized, inactivated or dissociated or oxidized or mineralized or combination. (196) Illustrate the ground zero point of the ground, (193) represent additional toxic or noxious biological components or chemical substances which have not yet entered the field of action (i.e. the area protected by the device using the met9idilogy of the present invention. (195) Illustrate the acoustic-optic effects of the distributed, reflected, or scattered light from the bubbles as results of the interacting light from the laser.

Figure 9 illustrates a schematic view of the methodology of the present invention for treatment of the water surface of lakes, rives, and water resources according to the present invention wherein (209) illustrate air-born laser, (199, 200) illustrate a ground based laser, (204) illustrate a helicopter (air born laser), the surface of the water is represented by (208), (209) illustrate the boundary of the water resource, (210) illustrate the vehicle carrying the mobile laser, (203) represent pulsed UV laser in the sub-microsecond time duration (per pulse), (214) illustrate the acoustic-optic effects helping to diffuse, and distribute the light to the surrounding area wherein additional catalytic compounds in forms of bubbles, droplets, or streams is illustrated (207, 214, 206, 207) the light is swiping or scanning the surface of the water wherein the dangerous mosquito such as the one promoting fever of the Nile, and other dangerous diseases, and thus enhancing the biosecurity of the area in proximity to the said water resource. (205, 206, 203, 212, 202) illustrate for clarity the pulsed UV laser light being applied by the methodology of the present invention.

Figure 10 illustrates a panoramic scale up view of globally positioned devices on land, air, and/or sea using the method of the present invention a schematic view for non interfering , non residual catalytic/sceniliting disinfection, and detoxification, sterilization and dissociation treatment to exact coordinates is herewith disclosed comprising:

(1), (2), (3), illustrate coordinates, relating to altitude, distances, hight, directional orientation, and targeting information, hence of the triggering laser beams, and hence of the diagnostic measurements relating to the data equasition involved in the spreading of the photocatalytic compound according to the present invention (1-34), (4) represent an antenna recieving ground truth monitoring information relating to weather information, and ground truth information relating to winds, clauds, smoke, catalytic dispersing areas, trigering efficiencies, spectral distribution measurements, and other sensing relating to the quality of air, liquids, and gasses, present, and atmospheric sensing of components which may effect the dosimetric valuers set for a predetermine d specific triggering event (illustrated here in air). (5) illustrate a claud type dispersion from passing air plane (9) of the photocatalytic scintillating

comppound according to the methodology of the present invention, (6) illustrate noxious speicies introduced ion to the field of action (fig.1) by external source (not shawn), (7) represent inactivated species carrying the marking (-), in contradistinction to (6=+) shwn above the catalytic cloud dispersion; thus the processes of inactivation, dissociation, and advance oxydation is herewith disclosed and illustratedi a helicopter (8) shawn triggering, and sensing simultaniously, or sequnecially (Two primery beams29,&30), (9) illustrate a plane dispersing the catalytic compound according to the methodology of the present invention, the plave is also shawn projecting two beams one pulsed dotted line, one continious wave shawn for clarity in a continious line, (10) illustrate a rocket propelled vhiecle shawn having trhee squares in theside, these reprsent recieving data from sattalite (17), and from ground truth monitoring station (16, 19, 4, 23). (11) illustrate the catalytic compound of this invention discharged at a predetermined hight (x/y/z) altitude or speed (12) represent live noxious species, potent, wherein (13) illustrate inactivated, disinfected, catalytically oxydized species marked with negative sign (-). (14) represent the laser gun stationed on a ship (16), (15) illustrate radar antenna recieving the satlite communication (17), 16 illustrate the ship itself, (17) illustrate th4e sattalite giving cordination, (18) laser gun stationed on the mobile track, (19) represent antenna to recieve GPS positioning data, (20) illustrate dripping pipe designated for dischatge of catalytic scentilating compound according to the poresent invention, (21) represent compressor pumping air to discharge the bubles throug tht e pipe, (22) illustrate globulines, bubbles formed out of catalytic compound according to the presebt ivanntion, (22a) dripping iirigation type pipe used for sendiong bubbles into the air, or proximitt, (23) antenna for tracking th4 dimansion of the cata;ytic suspension thus disperes from the airplane (9).(24) illustrate the building on top which the antenna is stationed, (25) reprsent beam for environmental snsing, and data aquasition, (26) a – e illustrate beams for communication of ground thruth monitoring statrion for global positioning oriantation shawn here for clarity between the helicopter, and the sattalite, and ground sensing equipment, (27) illustrate pulsed laser beam in the UVA,UVB,UVC, wherein it is used in the contectr 0ooj the present ojvebtion to trigger the catalytic compounf accrdon top the preseb tnvwebtion, (29-30) illustrate both:diagnostic CW type beam for sensing, and PW type beam for triggering, (31) illustrate building for clarity and perspective ights, (32) illustrate ground level (earth) shawn her foe clarity extending right to the panoramic view of the schematic doiagram pf the o0ressadsv tknvebntion., (33) illusdtrate a globulin, or buble weherein shawn herewith as bursting due to the acoustioc transpebnt thus generated accoprding to thep ursdb tojvebtion, (33a) post supe hydrophelicity effect shawn her for clarirty illustrating competitivce afvantegs of thr reaen onvention, wherein the remains of the bubble, or globulin is shawn her to fall, and thus ensure further appropriate mixing with the Oxygen ion ther air (21% free available ogygen content from which to take vitaol electrond for the efficnecies, and ehnacment Accprding p the present onwvntion, (34a) illustrate same processes as depicted by 33 with the exception of illustrating different hight /altitude (Y,Z,X) illudstration te ability od thre – resebty onvebntion to cover larger fireld of actionb as may be needed in incominf enfectious events or toxuc compouynds.

The method according to the present inventin is useful for catalytically protecting the surface of medical instrumentations, and sensitive or externally exposed, wounded or teard or burned body surface, or effecting internal blood and bodily fluids without

effecting external surface of body (non invasive) comprising:Compounding a predeteermined volume of ultra-pure-water-based multi component system containing at least one liquid or gas or polymer, or bonding agent, or -catalytic-compound, PH stebilizers suspended, or expanded to contain at least one semi conductor, or catalyticaly potent or photoreactive components, or TIO2 photocatlyst having a predetermined acustic coupling density, or resonance potential;Calibrating semi opeque optomechanical properties of said catalytic compound for predetermined absorption band, or action spectrum, density, or predetermined refractive index, or refractive profile throughout for coupling or converting light or sound to and from predetermined destination;Innitiating acoustic optronic, or electronic diagnostic procedure, or objective using at least one tool or instrument which needs to be disinfected or made safe, or made biocompatiblelly free of noxious or infectious predetermined specie component, in a predetermined multi-component enviornment or threatening antigen, or wherein incoming infecsious events may cause health concern as a result of surface penetration or transmision through of noxious species;Encapsulating said instrument or tool with photoreactive, or catalytically potent compound whiping, or spraying, aplying or delivering or removing acces catalytic compound pre, or post said tool or instrument,is being utilized for said diagnostic objective or medical engineering procedure ;Inserting said medical instruments, or device, or catalytically coated or charged tool into a predetermined receptive interface or conduit or chamber type geometry having a predetermined volume, and managable baundaries optomechanically impermieble to radiation from therein outwardly in the wavelength range of concern;Activating at least one radiation unit or interface directly, or continiously, in recurrently, or cyclically, or non recurrentl mode involving at least one high intensity source of light, and wherein said light is aligned to the end of at least one optical fiber, or wave-guide, or photogenic band gap, or aerobic or liquid wave-guide, or integrated arm, and wherein from other side of optical fiber, or bundle of fibers, or wave guide, or photonic band gap, or liquid light guide, or any combination thetreof, or directly illuminating or irradiating within said interface, the surface of said coated instrument, or tool, or catalytic compound therein;Triggering predetermined portion of said catalytic compound thin lyer encapsulation left on the surface of said tool, or instrument, or device photo-catalytically, or radically, thus inactivating, purifying, dissociating, and sterilizing the surface of said devices, or instruments in preperation for their associated cyclic, recurent, and non recurrent medical or engineering procedure, or working cycle, decontaminating or sterilizing, or disinfecting the surface of said tools or instrumentation to be more managable, and innociously safe for use within a predetermined period of time or duty cycle.

The present invention further relates to a method for treatment of surfaces having complex curvature wherein additional substances may be added for electronic trapping so as to facilitate prolonging the lifetime of free radical species , OH, produced according to the methodology of the present invention, such substances may be selected from liquids, gasses, or solids, in order to trap electron-pair holes, thus increasing beneficial sustaining, and delaying of the hydroxyl radial species lifetimes, increasing the quantum yield of efficiency according to the methodology of the present invention, especially beneficial for catalytic, scintillated, pH stabilized, oxygen charged toothpaste, or spray for the reduction of humic acids, and other

factors effecting bad smells, tastes, substantially improving catalytic efficiencies of the methodology of the present invention.

Claims

1. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, comprising the steps of;

   (a) spraying over said regions a cloud of gas, vapors, microdroplets, droplets, or bubbles formed from at least one liquid solution containing at least one type of photocatalitic oxidizing substance;

   (b) directing across said cloud at least one high intensity beam of light having wavelength of between 220 and 390 nanometer for triggering said cloud thereby causing a catalyzed activation that releases free radicals of said oxidizing substance in order to react with said chemical or biological sources.

2. A method for protection of public metropolitan areas, air volumes, surfaces, or combinations thereof using advanced oxidation processes triggered by pulsed UV laser, and photo-catalytic bubbles, droplets, jets, or combinations thereof, wherein said photo-catalytic components include at least one oxidizing agent, fluorescent, or phosphorous, or glowing, or reflecting, shifting, or vibrating or combination element such that once said photo reactive, or photo-catalytic compounds interact with light, it could be traceable for monitoring, and verification of bio-dosimetric dose, and chemical dissociation dosimetric values required for adequate inactivation and reduction, or minimization of threatening eventualities or contamination, cross contamination in any predetermined liquids, gases, surfaces, and combination.

3. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, further comprising scanning the cloud with the beam of light.

4. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, wherein the beam of light is emitted from at least one laser unit.

5. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, wherein the beam of light is emitted from at least one Laser unit selected from; solid state lasers, electrical discharge lasers, plasma driven lasers, semiconductor lasers, organic lasers, electron beam pumped lasers, free electron lasers, , fiber lasers doped, or SASE/EA/FEL lasers, fiber lasers, diode pumped lasers, crystal based lasers, doped glass based lasers, FELs lasers, polymer lasers, PW/CW type lasers, quantum dote lasers, laser arrays, flush lamp pumped lasers, water lasers, photonic bandgap lasers, seeded or amplified lasers, time compressed or expanded lasers, q-switch type lasers, interactive harmonic lasers, acoustic-optical lasers, ultrasonic lasers, X-ray pumped lasers, Y pumped lasers, E-beam lasers, catalytic lasers, photoelectrocatalytic lasers, air lasers, ground stationary lasers, mobile and

sub-miniaturized lasers, thin film type lasers, vapor lasers, water lasers, or photonic bandgapped lasers.

6. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, wherein the beam of light is emitted from at least one laser unit, and is being pulsed.

7. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, wherein the beam of light is emitted from at least one laser unit, and being pulsed in duty cycle of between 0.1 and 50 percent, in pulse repetition rate of between 1 Hz and 1 THz Gigahertz.

8. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, wherein the beam of light is emitted from at least one laser unit, and is pulsed in short pulse duration having acoustic attack transient properties.

9. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, wherein the cloud contains bubbles of size useful for opto-acoustic interaction between a beam of light scanning the cloud and the acoustic vibrations of the bubble mantles caused by the hit of the beam, which in turn, resulting in a multidirectional scattering of the beam, reflecting it to a plurality of surrounding bubbles or droplets.

10. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, wherein the solution contains phosphoric or fluorescense substance reactant to the light beam, to the light beam reflections from surrounding bubbles or droplets, or to particles released during the catalyzed activation, and wherein said method further comprising the step of tracing the light glowing from said phosphoric or fluorescense substance in order to identify whether or what portions of said region have been covered with an activated oxidizing substance.

11. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, further comprising the step of automatically deflecting the beam of light across the cloud according to light reflection data acquired from the cloud during the catalyzed activation of the oxidizing substance.

12. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, wherein the photo-catalytic bubbles or droplets contain at least one component of fluorescent, or phosphorous type such that the spectroscopic data acquisition thus accumulated provide for dosimetric value for inactivation of noxious species of biological or chemical origin, and thus the spectral distribution over a predetermined space, over a predetermined period of time is calibrated against

specie specific calibration standards so as to identify the relevant thresholds needed for protecting, and treating application in predetermined surface area, volume or combination thereof.

13. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, further comprising measuring and calibrating the acoustic energy that light creates, and the light that acoustic energy creates. in order for establishing bio-dosimetric values or adapting the energy dose required for mineralizing or oxidizing predetermined toxic chemical species or biological noxious species,

14. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, wherein the solution is produced in real time or in immediate proximity to a disinfection procedure that is being implemented in an infection suspected site, and said solution is being prepared directly into flowing water supplied to sprinklers or bubble generators that create the cloud, wherein oxygen or any other essential dissolvent materials, are being dissolved into said flowing water during their flow to the sprinklers or bubble generators.

15. Method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, wherein the solution is produced in real time or in immediate proximity to a disinfection procedure that is being implemented in an infection suspected site, and said solution is being prepared directly into flowing water supplied to sprinklers or bubble generators that creates the cloud, wherein oxygen or any other essential dissolvent materials, are being dissolved into said flowing water during their flow to the sprinklers or bubble generators, and wherein the concentration of at least one of the solution ingredients is controlled by a computer and is case sensitive to the seriousness of dangerous chemical and biological sources under treatment.

16. Use of the method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, in outdoor regions; domestic regions; sea, air or ground vehicles; or space ships.

17. Use of the method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, for the disinfection of medical or surgical equipment and spaces.

18. Use of the method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, for the disinfection of toilet rooms.

19. Use of the method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, for catalytically protecting the surface of medical instrumentations, and sensitive or externally exposed, wounded or torn or

burned body surface, or effecting internal blood and bodily fluids non invasively and without effecting external surface of body comprising Compounding a predetermined volume of ultra-pure-water-based multi component system containing at least one liquid or gas or polymer, or bonding agent, or -catalytic-compound, pH stabilizers suspended, or expanded to contain at least one semi conductor, or catalytically potent or photoreactive components, or TIO2 photocatalyst having a predetermined acoustic coupling density, or resonance potential; Calibrating semi opaque optomechanical properties of said catalytic compound for predetermined absorption band, or action spectrum, density, or predetermined refractive index, or refractive profile throughout for coupling or converting light or sound to and from predetermined destination;Innitiating acoustic optronic, or electronic diagnostic procedure, or objective using at least one tool or instrument which needs to be disinfected or made safe, or made biocompatibility free of noxious or infectious predetermined specie component, in a predetermined multi-component environment or threatening antigen, or wherein incoming infectious events may cause health concern as a result of surface penetration or transmission through of noxious species;Encapsulating said instrument or tool with photoreactive, or catalytically potent compound whiping, or spraying, applying or delivering or removing access catalytic compound pre, or post said tool or instrument,is being utilized for said diagnostic objective or medical engineering procedure ;Inserting said medical instruments, or device, or catalytically coated or charged tool into a predetermined receptive interface or conduit or chamber type geometry having a predetermined volume, and manageable boundaries optomechanically impermeable to radiation from therein outwardly in the wavelength range of concern;Activating at least one radiation unit or interface directly, or continuously, in recurrently, or cyclically, or non recurrent mode involving at least one high intensity source of light, and wherein said light is aligned to the end of at least one optical fiber, or wave-guide, or photogenic band gap, or aerobic or liquid wave-guide, or integrated arm, and wherein from other side of optical fiber, or bundle of fibers, or wave guide, or photonic band gap, or liquid light guide, or any combination thereof, or directly illuminating or irradiating within said interface, the surface of said coated instrument, or tool, or catalytic compound therein;Triggering predetermined portion of said catalytic compound thin layer encapsulation left on the surface of said tool, or instrument, or device photo-catalytically, or radically, thus inactivating, purifying, dissociating, and sterilizing the surface of said devices, or instruments in preparation for their associated cyclic, recurrent, and non recurrent medical or engineering procedure, or working cycle, decontaminating or sterilizing, or disinfecting the surface of said tools or instrumentation to be more manageable, and innocuously safe for use within a predetermined period of time or duty cycle.

20. System for advanced oxidation of dangerous chemical and biological sources suspected in particular regions, comprising;

(a) means for the formation and distribution of a cloud of gas, vapors, microdroplets, droplets, or bubbles formed from at least one liquid solution containing at least one type of photocatalitic oxidizing substance, said means having at least one outlet for releasing or spraying said cloud;

(b) at least one laser unit generating light beam having properties that are useful for triggering said cloud, thereby causing a catalyzed activation that releases free radicals of said oxidizing substance in order to react with said chemical or biological sources.

21. System for advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, further comprising means for deflecting said light beam for scanning the cloud.

22. System for advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, further comprising means for deflecting said light beam for scanning the cloud, camera or sensor means for aquiring and for processing data which relates to light glowing from different portions of the cloud during its triggering or during its catalyzed activation, and means for steering the scanning automatically according to said data.

23. Bubble generator for forming a cloud of bubbles for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, comprising; at least one liquid container adapted to receiving a solution containing at least one type of photocatalitic oxidizing substance, means for gas compression, and at least one nozzle in liquid communication with the liquid reservoir, and in gas communication with the gas compression means.

24. Bubble generator for forming a cloud of bubbles for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, further comprising means for dissolving pure oxygen or any other essential dissolvent materials, into water flowing to the nozzle, for real time accomplishment of the solution.

25. Use of the system for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions according to any of the previous claims, in outdoor regions; domestic regions; sea, air or ground vehicles; or space ships.

26. Use of the method for the advanced oxidation of dangerous chemical and biological sources suspected in particular regions, according to any of the previous claims, for catalytically protecting the surface of medical instrumentations, and sensitive or externally exposed, wounded or teard or burned body surface, comprising:Compounding a multi component system containing at least one liquid or gas or carbomer, or bonding agent forming a micro, and macro mollecular hybridization network having large external surface area within an ultra-pure water base pre-earated, or pre-charged with oxygen, or diatomic oxygen, of peroxide, or H2O2, or semi conductor photocatalytic particles mixed to form variable densities, multi resonance catalytic coupling compound featuring polytextural fromation from about heavy gel to about light spray, from about 1m3 to about sevarl microdroplets;Calibrating semi opeque optomechanical properties of said catalytic compound for predetermined absorption band, or action spectrum, for coupling or amplifying, diagnosing or monitoring, observing life forms converting light or ultra-sound to and from

predetermined origin of vibrations in line with available vibrational excitation stage required to break the bond by light between at least one components within said multicomponent photocatalytic photoreactive system;Innitiating acoustic optronic, or electronic diagnostic procedure, or objective using at least one tool or instrument which needs to be disinfected or made safe, or made biocompatiblelly free of noxious or infectious predetermined specie components;Encapsulating said instrument or tool with photoreactive, or catalytically potent compound whiping, or spraying, aplying or delivering or removing acces catalytic compound pre, or post medical procedure, living thin film of catalytic compound on said tool, or instruments, or device;Inserting at least one medical instrument, or device, catalytically and temporerily coated or charged encapsulated tool into at least one receptive interface being a conduit or chamber type geometry;Activating at least one radiation unit or interface directly, or continiously, in recurrently, or cyclically, or in non recurrentl mode involving at least one high intensity source of light, and wherein said light is aligned to the end of at least one optical fiber, or wave-guide, or photogenic band gap, or aerobic or liquid wave-guide, or integrated arm, and wherein from other side is position or suported or held at proximity to the surface of said coated instrument, or tool, or catalytic compound therein;Triggering predetermined portion of said catalytic compound thin lyer encapsulation left, cover, or sprayed or applied on to the the surface of said tool, or instrument, or device, or body cut sore, or wound, or burn, thus ensuring safety photo-catalytically, or radically, thus inactivating, purifying, dissociating, and sterilizing the surface of said devices, or instruments in preperation for their associated cyclic, recurent, and non recurrent medical or engineering procedure over apredetermined period of time.

27. Method for catalytic surface treatment according to any of the previous claims, comprising; non invasive, non contact, non interfering treatment methodology, wherein, by remote, inociously biocompatible automatically triggering through coupling predetermined aportioned predetermined light of expanded ultra pure water based electro-photocatalytic coupling compound, and all acousto-optronic accurate triggerring devices for disinfection and sterilization ensuring safe surface treatment of medical instrumentation, and external sensative tissue damage events, throughout associated areas of body thereof in real and step time process initiation format Compounding with water Calibrating with sound or light Innitiating with light intensities Encapsulating in catalytic thin layer Inserting coated Activating therein Triggering by light for inactivation over predetermined period of time.

28. A device comprising: at least one laser, or high intensity pulsed, or continuous, or hybrid combination of light sources is operating at pulse repetition frequencies from about 1 Hz, to about 1 THz.

29. A device comprising: at least one laser, or high intensity light source operatively utilized at pulse repetition frequencies from about 1 Hz, to about 1 THz.

30. A device comprising: at least one laser, or high intensity light source is projecting its beam of light directly, or through waveguides to the surface of the instrument, tools, or wounds, or burns.

31. A device for catalytic surface treatment using the method of the present invention in line with any of the preceeding claims, comprising: At least one receptive interface or support means or coated particle from PET, or polyolefin, or polyamide, or polycarbonate, or polyesteramide, or polyester or any resine combination thereof having refractive index profile for partial, or total internal reflection therein, or throughout, or coated oe combined with TIO2 semi conductor photocatalysts for equalizing the concentration of bacteria, viruses, cysts, phatogens, or biological, or organic, non organic, or toxic or noxious species therein, around, externally or combination when exposed to high peak power high intensity pulsed sub microsecond UVA UVB UVC laser light.

32. A device for disinfection of packaging of medical instrumentation and tools using the method of the present invention according to any of the preceding claims comprising; at least one beam homogenizer, or micro positioning stage, or optical lense, or array of lenses, or colimator optics, expansion optics, focusing or defocusing optics, difractive, or non fifractive optics, mirrors, prizma optical fibers, photonic waveguides, bandgap waveguides, liquid wave guides, aerobic non toxic waveguides, diagnostic semi conductor coated surfaces, or any combination thereof is used to shape the beams of light utilized for the purpose of reducing the population, or concentration of noxious species present in the predetermined volume of liquids, or gases in the packaging without damaging the packaging, and without causing migration of molecules from the packaging to the liquid or gas therein while in suspended, suspension or multi or single component system frame work.

33. A device using the method of the present invention and all of its preceeding claims, comprising: the prteffered mode for the packaging being penetrated is made out of PET, or polyolefin, or polyamide, or polycarbonate, or polyesteramide, or polyester or any resine combination thereof having refractive index profile for partial, or total internal reflection therein for disinfection, or equlization of the concentration of contaminents, or noxious species therein, i.e. in the packaging containing the predetermined volume of liquids, or gas therein.

34. A device as claimed in any of the previous claims wherein at least one Nd:Yag laser is operating at THG, third harmonic generation as preffered mode for the production of at least one pulse of light having wavelength of 355nm, and wherein each time duration of said pulses of light is from about 1s, to about 1 fs, and wherein repetition rates of said laser light source is from about 1 Hz to about 1 THz for the preffered mode of triggering catalytic reaction, and or disinfection or sterilization of surface or dimension.

35. A device for quality control applications comprising a preffered mode especially beneficial for packaging materials having high refractive index selected from from Polyolefine, polyamide, polycarbonate, polyesteramide, polyester resine combination thereof, or terephtalate (PET), Polybutylen terephtalate (PBT),

polyalkyl terephtalate, polyethylene naphtalate (PEN), polyalkyl naphtalate (PETG) having adequate refractive index profile therein for guiding light throughout. Especially beneficial for disinfection through the packaging by UVA laser, operating in pulsed mode, beneficial for quality control applications in mass production lines of mineral waters, flavored waters, beverages, juices, liquids, gasses, food based products, and medical preperation including the production, and polishing of insulin based products.

36. A device wherein the polymers selected from from Polyolefine, polyamide, polycarbonate, polyesteramide, polyester resine combination thereof, or terephtalate (PET), Polybutylen terephtalate (PBT), polyalkyl terephtalate, polyethylene naphtalate (PEN), polyalkyl naphtalate (PETG) having adequate refractive index profile therein for guiding light throughout, and wherein the light from a high intensity source of light is guided to reach the surface of the medical instrument, or tool, then activates photoreactive layer sorrounding said tool, or instruments forming fire wall barrier technology preventing external health threatening bacteria, viruses, and phathogenes from penetrating inside sensitive areas, or systems.

37. A device using the method of the present invention wherein according to any of the preceeding claims the cork or lid or bottom of the packaging, or any layer in the packaging is made out of from Polyolefine, polyamide, polycarbonate, polyesteramide, polyester resine combination thereof, or terephtalate (PET), Polybutylen terephtalate (PBT), polyalkyl terephtalate, polyethylene naphtalate (PEN), polyalkyl naphtalate (PETG), PET/PEN, PET/nylon, PET/Evoh, PET/Evoh copolymer or blend with ethylen-meth) acrylic acid, or combination with ultrapure water based catalytic compound having adequate refractive index profile therein for guiding light throughout. Especially beneficial for disinfection through the multi textural, multiple curvatures surface of medical instruments, tools, and engineering, and biotechnological devices having loaded working cycle.

38. A device using the method of the present invention and all of its preceeding claims, comprising: A method for surface treatment and for sterilization using modular, structurally yielding Oxygen Charged (SYOC) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light and all optronic delivery and triggering devices for dimensional use thereof

39. A device using the method of the present invention according to any of its preceeding claims wherein the the preffered mode for sterilizing dental accesories, tools and medical instrumentation, comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a

predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional use thereof.

40. A device using the method of the present invention according to any of its preceeding claims wherein the the preffered mode for sterilizing tools accesories, and instrumentation used in vetrinaric medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional use thereof.

41. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in emergency & field medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional use thereof.

42. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in medical engineering involved inmedical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional use thereof.

43. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in emergency & field medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed

UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional use thereof.

44. A device according to the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in small local autoclaving, or large central disinfection chambers for Surgical instrumentation of medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional use thereof.

45. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used from Surgical instrumentation kits, autoclaving, emergency & field, medical engineering, vetrinaric, dental, wherein the preffered mode according to the specific applications preffered mode of operation will necesitate integraton or assimilation of the laser light source to be sellcted from (a) Gas discherge laser, (b) diod pumped lasers, (c) plasma discharged lasers, (d) solid state lasers, (e) semi conductor lasers, (f) crystal type of lasers, (g), X-rays pumped lasers, (h) E-beam pumped gas lasers types, FEL (Free Electron Laser amplifier), (j) EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof for providing the necessary potons at the appropriate wavelength, tuning energy or energy density required for triggering and acoustooptical utilization.

46. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cosmetics, plastic surgery from medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

47. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories,

and instrumentation used in alternative medicine or alternative medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

48. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in aquapuncture or aquapressure medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

49. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in gynicologycal medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

50. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in angioplastic medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

51. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cardiac vascular medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

52. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in darmatological medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

53. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in PDT medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

54. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in peridental medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein

Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

55. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cancer medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

56. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in allergenic medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

57. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in geriatric medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

58. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in pediatric medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser

Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

63. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in eye surgery or medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

64. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in administrating anathstetics during plurality of medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

65. A device using the method of the present invention according to all of its preceding claims wherein the preferred mode for sterilizing tools accessories, and instrumentation used in physiotherapy treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stabilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to manageable levels within a predetermined space over a predetermined period of time, and wherein Activating on all peak power optronic delivery and triggering apparatuses synched for dimensional acoustooptical utilization thereof.

66. A device using the method of the present invention according to all of its preceding claims wherein the preferred mode for sterilizing tools accessories, and instrumentation used in toxicology or decontamination of medical treatment procedures areas comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

67. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in nose ear, and throat doctors administrating medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

68. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in brain surgery medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

69. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in ultrasound medical treatment and diagnostics procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein

Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

70. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in endoscopic medical diagnostic treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

71. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in stenting or angioplastic medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

72. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in first aid medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

73. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in respiratory medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed

UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

74. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in medical treatment procedures for food poisening comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

75. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in blood transfusion and processing during medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

76. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in manicure, and pedicure cosmetic treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

77. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cleaning ships, plains, or vehicles treatment procedures comprising: Triggering surface treatment and or sterilization using

modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

78. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cleaning traceable air polution comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles, or bubles comprising liquids, and gases expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

79. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in domestic cleaning, in locations, such as sanitary support means, sinks, ovens, fridges, microwave ovens, heaters, coolers, support means, copboards, tiles, floor, ceilings, medical treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

80. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cleaning rubbish dumps comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

81. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in cleaning chips in electronic industries treatment procedures comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

82. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in optical washing machines applying catalytic treatment procedures to fabrics comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

83. A device using the method of the present invention according to any of its preceeding claims wherein the preffered mode for sterilizing tools accesories, and instrumentation used in food and beverage treatment production, and packaging procedures on sites comprising: Triggering surface treatment and or sterilization using modular, structurally yielding Oxygen Charged (SYOCH) U.P.W, PH stebilized, carbomer variable photo-catalytic-water or air suspension, suspended polymeric plurality particles expanded coated and calibrated to be mobilized by pulsed UVA/UVB/UVC laser light reducing the level of toxic noxious species below concentration, CFU, or danger threshold to managable levels within a predetermined space over a predetrmined period of time, and wherein Activating on all peak power optronic delivery and triggering aperatuses synched for dimensional acoustooptical utilization thereof.

84. A device using the methodology of the present invention for effecting internal blood and bodily fluids without effecting external surface of body non invasive, according to any of the preceding claims comprising:Calibrating semi opeque optomechanical properties of skin, and/or said catalytic compound of the present invention for predetermined absorption band, or action spectrum, density, or predetermined refractive index, or refractive profile throughout for coupling or converting light or sound to and from predetermined destination, and for enhancing the coupling efficiency, and absorption spectrum of the blood flow therein;Innitiating acoustic optronic, or electronic diagnostic procedure, or objective using at least one tool or instrument;Activating at least one radiation

unit or interface directly, or continiously, in recurrently, or cyclically, or non recurrentl mode involving at least one high intensity source of light, or pulsed Vis, UVA, UVB laser and wherein light from the laser is aligned to the end of at least one optical fiber, or wave-guide, or photogenic band gap, or aerobic or liquid wave-guide, or tapered guide or integrated arm, and wherein from other side of optical fiber, or bundle of fibers, or wave guide, or photonic band gap, or liquid light guide, or any combination thetreof delivering light to/from external surface of body, or directly illuminating or irradiating within said interface, the surface of the outer body in a predetermined energy density, cumulative dose response curve, over a predetermined surface area, over a predetermined period of time or duty cycle.

85. A device using the methodology of the present invention for effecting internal blood and bodily fluids without effecting external surface of body (non invasive), according to any of the preceding claims comprising:Compounding a predeteermined volume of ultra-pure-water-based multi component system containing at least one liquid or gas or carbomer, or bonding agent, or -catalytic-compound, PH stebilizers suspended, or expanded to contain at least one semi conductor, or catalyticaly potent or photoreactive components, or TIO2 photocatlyst, or chemical precursor, or chamical biocompatible marker or colorimetric component having a predetermined acustic coupling density, or resonance potential;Calibrating semi opeque optomechanical properties of said catalytic compound for predetermined absorption band, or action spectrum, density, or predetermined refractive index, or refractive profile throughout for coupling or converting light or sound to and from predetermined destination, and for enhancing the coupling efficiency, and absorption spectrum of the blood flow therein;Innitiating acoustic optronic, or electronic diagnostic procedure, or objective using at least one tool or instrument which needs to be disinfected or made safe, or made biocompatiblelly free of noxious or infectious predetermined specie component, in a predetermined multi-component enviornment or threatening antigen, or wherein incoming infecsious events may cause health concern as a result of surface penetration or transmision through of noxious species, or wherein blood flow therein body contain noxious species concentration above threshold for safety risking health;delivering seperately photoreactive, or catalytically potent compound whiping, or spraying, aplying or delivering, infusing inserting, injecting, or activating intake of catalytic compound pre, or post exposure to pulsed light of UVA, laser or medical engineering procedure ;Inserting or attaching said medical instruments, or device, or optically charged delivery tool into a predetermined receptive interface or conduit or chamber type geometry on the outer surface of the body having a predetermined volume, and managable baundaries optomechanically permieble to wavelength from about 350nm to about 999nm in the effective wavelength range approproate;Activating at least one radiation unit or interface directly, or continiously, in recurrently, or cyclically, or non recurrentl mode involving at least one high intensity source of light, or pulsed Vis, UVA, UVB laser and wherein light from the laser is aligned to the end of at least one optical fiber, or wave-guide, or photogenic band gap, or aerobic or liquid wave-guide, OR tapered guide or integrated arm, and wherein from other side of optical fiber, or bundle of fibers, or wave guide, or photonic band gap, or liquid light guide, or

any combination thetreof delivering light to/from external surface of body, or directly illuminating or irradiating within said interface, the surface of the outer body in a predetermined energy density, cumulative dose response curve, over a predetermined surface area, over a predetermined period of time or duty cycle.

86. A device using the methodology of the present invention for effecting internal blood and bodily fluids without effecting external surface of body (non invasive), according to any of the preceding claims comprising: attaching optical waveguides, and diffusing elements to predetermined location externally to the human or animal body; Activating at least one radiation unit having high intensity source of monochromatic light at about 355nm to about 999nm, at energy densities from 0.001mW/Cm2, to about 200mW/Cm2; exposing synchroniousylly different part of the external relatively exposed blood vessels, such as found in areas sellected from head, legs, hands, wrists, feets, neck, forhead, stomech, belly, rectum, or any combination thereof to energy from said light source over a predetermined surface area, over a predetermined period of time thus reducing the population of noxious species in the blood therein without damaging external, or internal blood or physiological components.

87. A device using the methodology of the present invention for effecting internal blood and bodily fluids without effecting external surface of body (non invasive), according to any of the preceding claims comprising: attaching optical waveguides, and diffusing elements to predetermined location externally to the human or animal body; Activating at least one radiation unit having high intensity source of monochromatic light at about 355nm to about 999nm, at energy densities from 0.001mW/Cm2, to about 200mW/Cm2; exposing synchroniousylly different part of the external relatively exposed blood vessels, such as found in areas sellected from head, legs, hands, wrists, feets, neck, forhead, stomech, belly, rectum, or any combination thereof to energy from said light source over a predetermined surface area, over a predetermined period of time thus reducing the population of noxious species in the blood therein without damaging external, or internal blood or physiological components thus facilitating non invasive disinfection of intenally flowing blood components.

88. A method and device using the methodology of the present invention for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the duty cycle of procedures thus performed in these respective field are shortened, and time and resources saved, effectively reducing the population of noxious species, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

89. A method and device using the methodology of the present invention for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric

dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or coupling gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

90. A method and device using the methodology of the present invention for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising te light which provide the triggering signal is produced by flush lamps, UVA, UVB, UVC laser pumped by diodes bar arrays, flush lamp pumped Nd;Yag lasers, sub microsecond lasers, gas discharge lasers, hybrid of CW/PW integration, X-ray pumped lasers, E-beam pumped lasers, FEL, AEFEL lasers, and semi conductor lasers, or space charged excitation charged lasers or any combination thereof for the delivery of static, stable, or cumulative dose made out of a plurality of micro, or macro pulses from 1 photon per second to about 100 Billion Photons per second, at repetition rates from about 1 Hz, to about 10 THz, at wavelength from about 355nm to about 999nm, and wherein acousto-optical-interaction are thus been facilitated as result of translational relationships between acoustics, electronic, and optics causing resonance useful to determined optical masking od certain mollecules while making other mollecules in proximity more suseptible for predetermined specie specific action spectrum, thus inactivating specie specific calibration standards using the acuosto-optronic interaction using the methodology of the present invention.

91. A method and device using the methodology of the present invention for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising the beam is delivered directly on to the surface of the instrument or tool, or the beam is cooupled to the end of a waveguide interface or integrated arm for remote delivery of the appropriate energy levels to the destination, and wherein such bundle formation, harness, or multisplit level optical waveguide is adjusted as to illuminateor irradiate the surface area at the appropriate energy density levels require for implementing at least one biodosimetric curve against at least one noxious specie which causes health concern ahen found in high population concentration.

92. A method and device using the methodology of the present invention for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for emergency medicine requiring fast responses to incoming or inflicted infectious events wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or coupling gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the

methodology of the present invention facilitating safe sterilized surface area on tools, or body external surface.

93. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for anesthesiology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

94. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dermatology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

95. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for gastroenterology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

96. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for Ob-Gyn wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

97. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred

mode of utilization for oncology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

98. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for opthalmology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

99. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for ostheopathy wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

100. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for pain management wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

101. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for pathology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of

the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

102. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for pediatrics wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

103. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for podiatry wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

104. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for radiology wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

105. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for cardiothoracic surgery wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

106. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for cardiology and invasive diagnbostic and treatment procedures wherein the duty cycle of said procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

107. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for cosmetics, and plastic surgery wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

108. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for orthopedics wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

109. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for ENT wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

110. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for general surgery in wide diversified medical fields wherein

the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

111. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for endoscopic surgery/procedures wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

112. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for skin treatment, ear diorders, eay disorders, mouth disorders, throat disorders, dental disorders wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

113. A method for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for external non invasive treatment by light at high energy density wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with/to gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention.

114. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for domestic cleaning and disinfection, and sterilization of

aparatuses sellected from kitchens, sinks, bathrooms, infrastructural support means, floors, ceilings, air wherein the duty cycle of procedures thus performed in these respective field or domestic enviornment using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and hygine applications of devices according to the methodology of the present invention.

115. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for domestic cleaning and disinfection, and sterilization of aparatuses sellected from kitchens, sinks, bathrooms, infrastructural support means, floors, ceilings, air enhancing super hydrophelicity wherein the duty cycle of procedures thus performed in these respective field or domestic enviornment using multicomponent catalytic U.PW based compound or directly coupling pulsecd UVA, UVB, UVC laser light directly, or in combination with gel, spray, or liquid or gas facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species on surface or volume, within predetermined area or dimension, thus increasing the level of health, and hygine applications of devices according to the methodology of the present invention.

116. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the duty cycle of procedures thus performed in these respective field when using multicomponent catalytic U.PW based compound or coupling gel, spray, or liquid or gas, or tooth paste for catalytic, scintilating, repeatable triggering, thus facilitating the shortening, and time and resources saving, as results of effectively reduction of the population of noxious species such as pluck formation on surface or volume, within predetermined area or dimension, on teeth, or between teeth, ot gums, thus increasing the level of health, and therapeutic applications of devices according to the methodology of the present invention for preventative treatment as well as for damage limitation exercises, and for cleaning deep, and thoughroughlly the entire mouth.

117. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein acatalytic tooth paste is been used containing scintillating elementals causing efficient conversion from Visible, NIR, IR to UVA, UVB, UVC thus facilitating triggering, and re-triggering using light alone, in addition to using an optronic brush to apply said paste when 1st brushing teeth in the

mornings, or cyclically, or non recurrently, cleaning the mouth continiouslly throughout the day using light.

118. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the brush contain at least one optical fiber, difuser, aerobic, and non aerobic guide, support means, and power supply on board for triggering the catalytic action of catalytic paste repeatedly.

119. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the photocatalystic tooth paste is containing mint flavore or aromatic elements so as to esthetically fit behavoral pattern, and prefferances of producers, end users, and doctors, effectively increasing the cleanliness of he moutgh area.

120. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the brush used to triggered the photocatalytic tooth paste contain a sub-miniaturized radiation ubit having a relatively high intensity source of light from about 1mW Cm2, to about 180mW Cm2, and wherein light from the brush is reaching to exposed said tooth paste throughout the mouth, teeth, and gums, and wherein after 1st application of the paste, repeatable triggering may occur just by exposing the thin film layer left on the tooth over several hours, so by introducing light to the mouth after brushing has occurs the catalytic processes according to the present invantioon continue to occur bringinh with them protection, and treatment benefits for the health of the mouth, and sorrounding area.

121. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the brush used to trigger the catalytic tooth paste is containing at least one LED, laser, flash lamp, quasy CW laser, hybrid, or integrated light source or guiding light from external light source in proxinitym or hrough the use of a photonic fiber, guide, or bundle of fibers.

122. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and

orthodontists wherein only light is efectively treating the coated area after firsts application of the paste have occured.

123. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein catalytic tooth paste accrdong to ther present invention is reducing the humic acids, bad smells, and improving decay condition by reducing the concentration of noxious species, bacteria, viruses, cysts which may threat a mouth healthy condition.

124. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein global solar radiation is used to triggere the potocatalysts at about the 1mW/Cm2, energy density, and wherein a scintillating elemental has been added, doped, spattered, vaporized, mixed to convert visible radiation to UVA, UVB, UVC from about 1eV, to about 9.1eV, and wherein condensing optics, and delivery interfaces guidethe light into the mouth area, surface, or exact location to be remedied.

125. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the catalytic scintillating toothe paste is stored, temporerily, or permanently in a tube, or capsule, conduit or chaimber prior to application, delivery, or triggering, or re-triggering, cyclically, recurrently, or non recurrently for the elimination of pluck, and noxious bacteria, and bad smell effect and humic acids.

126. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the catalytic scintillated compound according to TIO2 photocatalyst into homoginic distribution within the multi-component which characterizes the catalytic compound according to the present invention is stored, temporerily, or permanently in form of a light spray containing ph stebilized, water and oxygen charged carbomer based textural suspension and wherein scintillating elemental is used to inse.

127. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and

orthodontists wherein the catalytic scentilated compound according to the present invention is stored, temporerily, or permanently in a compressed form.

128. A method and device for sterilizing and disinfecting the surface of medical instrumentation, according to any of the preceding claims, comprising: Preferred mode of utilization for dentistry, general dentists, periodontists, prothodontists, pedodontists, pediatric dentists, endodontists, oral/maxillofacial surgeons, and orthodontists wherein the catalytic scentilated compound according to the present invention is stored, temporerily, or permanently in form of a light spray.

129. A method and device for sterilizing and disinfecting the surface of medical instrumentation, the mouth, and blood, non invasively according to any of the preceding claims, comprising: A preffered mode of geometrical utilization of devices using method of the present invention wherein the laser light source is sellcted from Gas discherge laser, diod pumped lasers, plasma discharged lasers, solid state lasers, semi conductor lasers, crystal type of lasers, X-rays pumped lasers, E-beam pumped gas lasers types, FEL (Free Electron Laser amplifier), EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

130. A method and device for sterilizing and disinfecting the surface of medical instrumentation, the mouth, and blood, non invasively according to any of the preceding claims, comprising: A preffered mode of geometrical utilization of devices using method of the present invention wherein the laser light source is sellcted from Gas discherge laser, diod pumped lasers, plasma discharged lasers, solid state lasers, semi conductor lasers, crystal type of lasers, X-rays pumped lasers, E-beam pumped gas lasers types, FEL (Free Electron Laser amplifier), EA/FEL (Electrostatically Accelerated Free Electron Laser), or organic laser types or any combination thereof.

131. A method for disinfecting a target, comprising electrooptically exciting a water-based photoreactive compound with a high peak-power, high repitition rate, submicrosecond time domain, pulsed UV laser, wherein the water-based photoreactive compounds comprises a multi-component system having at least one pH stabilizer ot bonding agent, at least biocompatible polymer, a photocatalytic agent, and a predetermined oxygen charge.

132. A method for producing a photoreactive multi-component system comprising combining a photosensitive compound with at least one polymer, a pH stabilizer or bonding agent, ultrapure water, a photocatalytic agent, and dissolved oxygen.

133. A method according to claim 132, further comprising adding a scintilating agent having the ability to convert incoming light to an appropriate triggering wavelength.

134. A method according to claim 132, further comprising adding a component selected from the group consisting of: nutrients, food supplements, colors, flavors, medications, or carbomers, said carbomers for modifying the texture of said multi-component system.

135. A multi-component system made according to the method of any one of claims 132-134.

136. A device for disinfecting a target, comprising; at least one radiation unit having a high intensity source of light having a peak power energy density of between about 1*10-7 to 1*10-29mJ/cm2 having a wavelength between 1 and 3000nm and a repitition rate between 1Hz to 180THz; a nonaerobic, nontoxic optical waveguide in connection with said radiation unit for delivering radiation from said radiation unit to said target over a predetermined area and predetermined period of time.

137. A method for phototreatment of a target using the device of claim 112 comprising exposing said target area to radiation from said radiation unit for a predetermined period of time.

138. A method for treatment of surfaces having complex curvature wherein additional substances may be added for electronic trapping so as to facilitate prolonging the lifetime of free radical species , OH, produced according to the methodology of the present invention, such substances may be selected from liquids, gasses, or solids, in order to trap electron-pair holes, thus increasing beneficial sustaining, and delaying of the hydroxyl radial species lifetimes, increasing the quantum yield of efficiency according to the methodology of the present invention, especially beneficial for catalytic, scintillated, pH stabilized, oxygen charged toothpaste, or spray for the reduction of humic acids, and other factors effecting bad smells, tastes, substantially improving catalytic efficiencies of the methodology of the present invention.

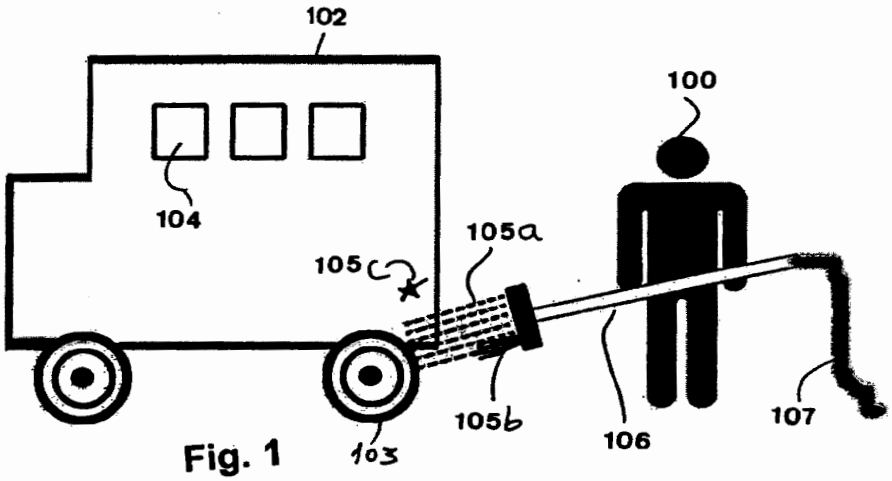

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100
104
105a
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105b
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107
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Fig. 1

Fig. 2

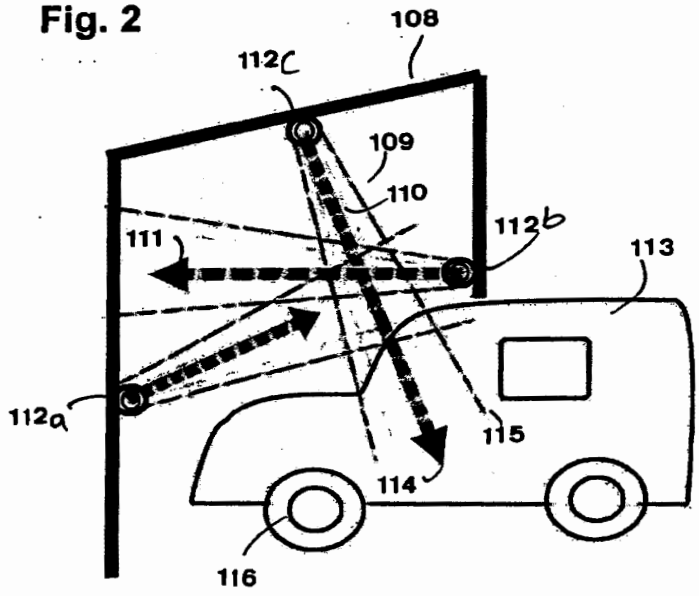

108
112c
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112b
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112a
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Fig. 3

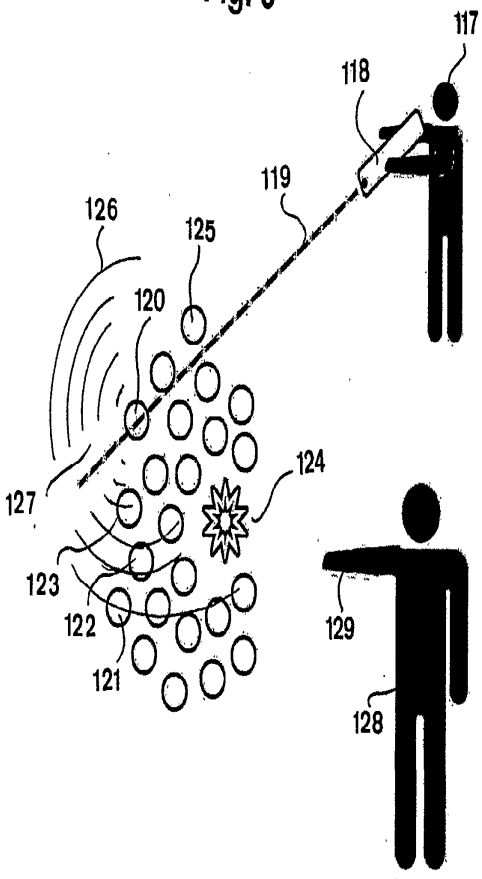

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Fig. 4

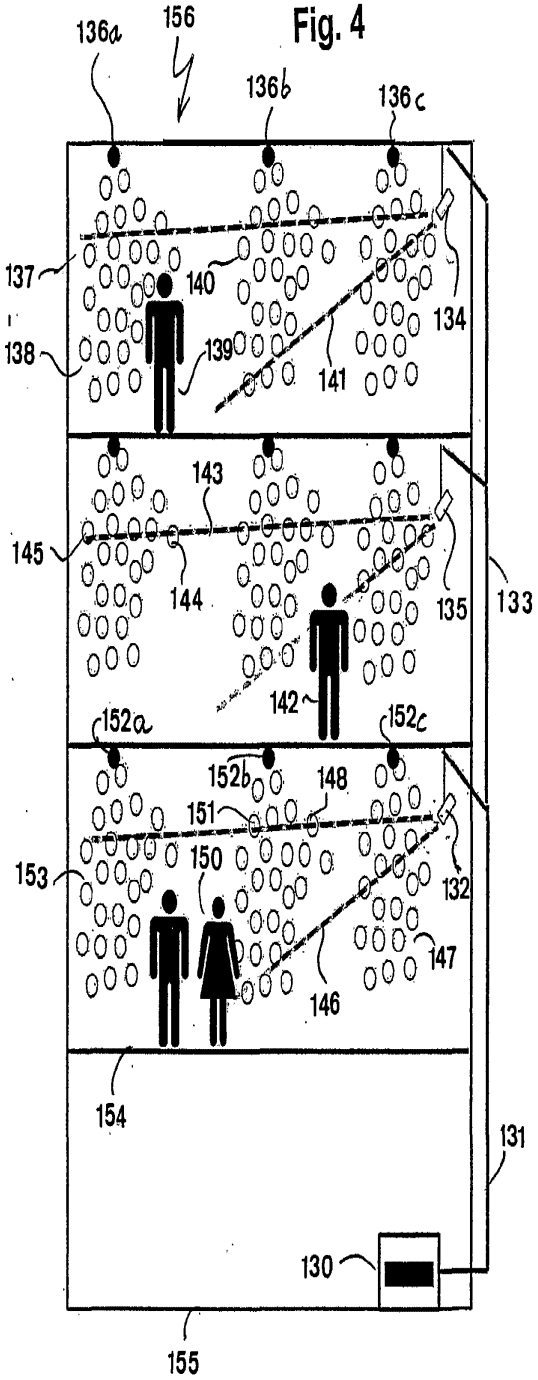

136a
156
136b
136c
137
140
134
138
139
141
143
145
144
135
133
142
152a
152c
152b
148
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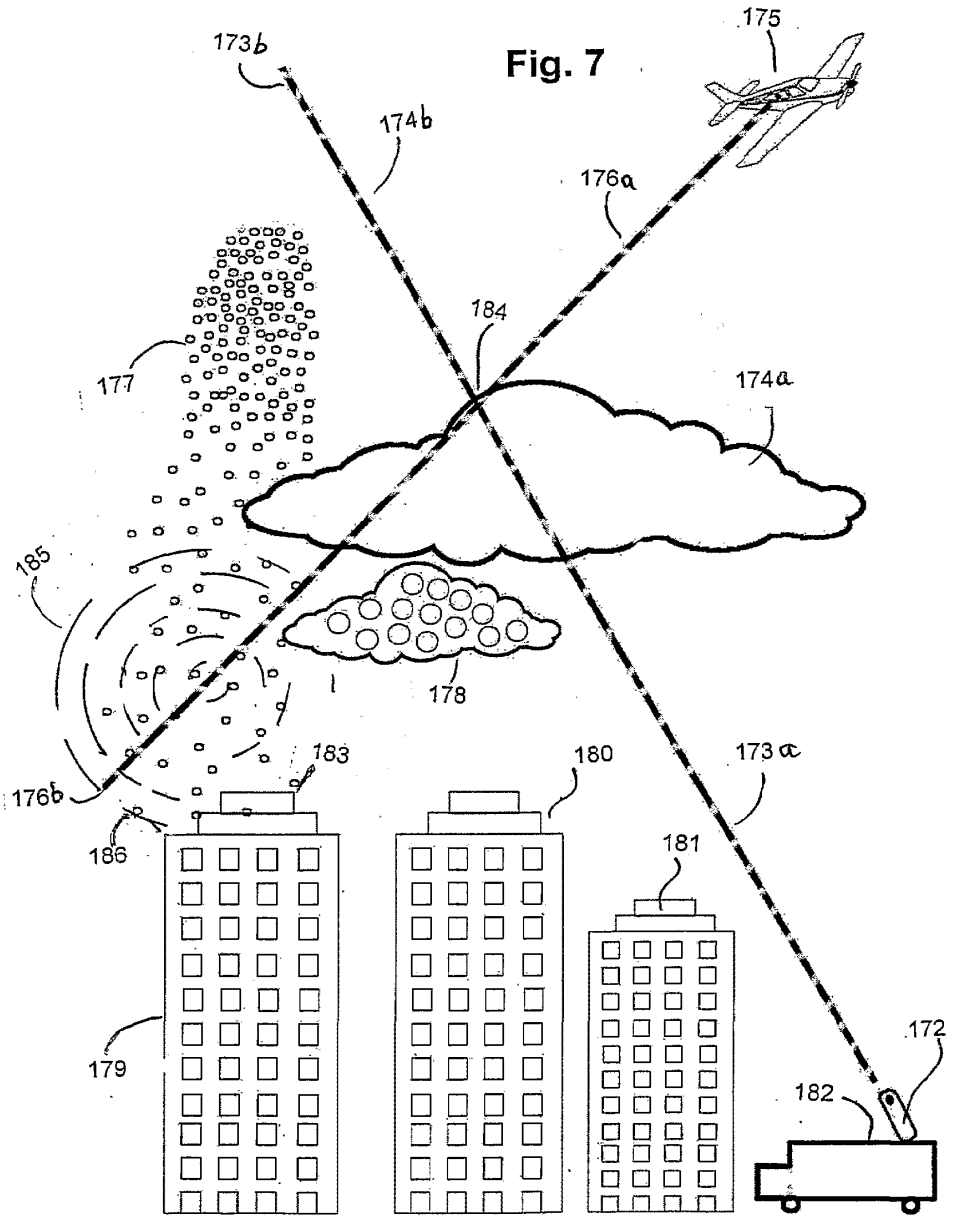
Fig. 5

157a
157b
157c
157d
158
159
164
162b
163
160
165
161
162a

Fig. 6

169b
170
169a
171
168
169c
167
169d
166

Fig. 7


173b
175
174b
176a
184
177
174a
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183
180
173a
176b
186
181
172
179
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SUBSTITUTE SHEET (RULE 26)

Fig. 8

Fig. 9

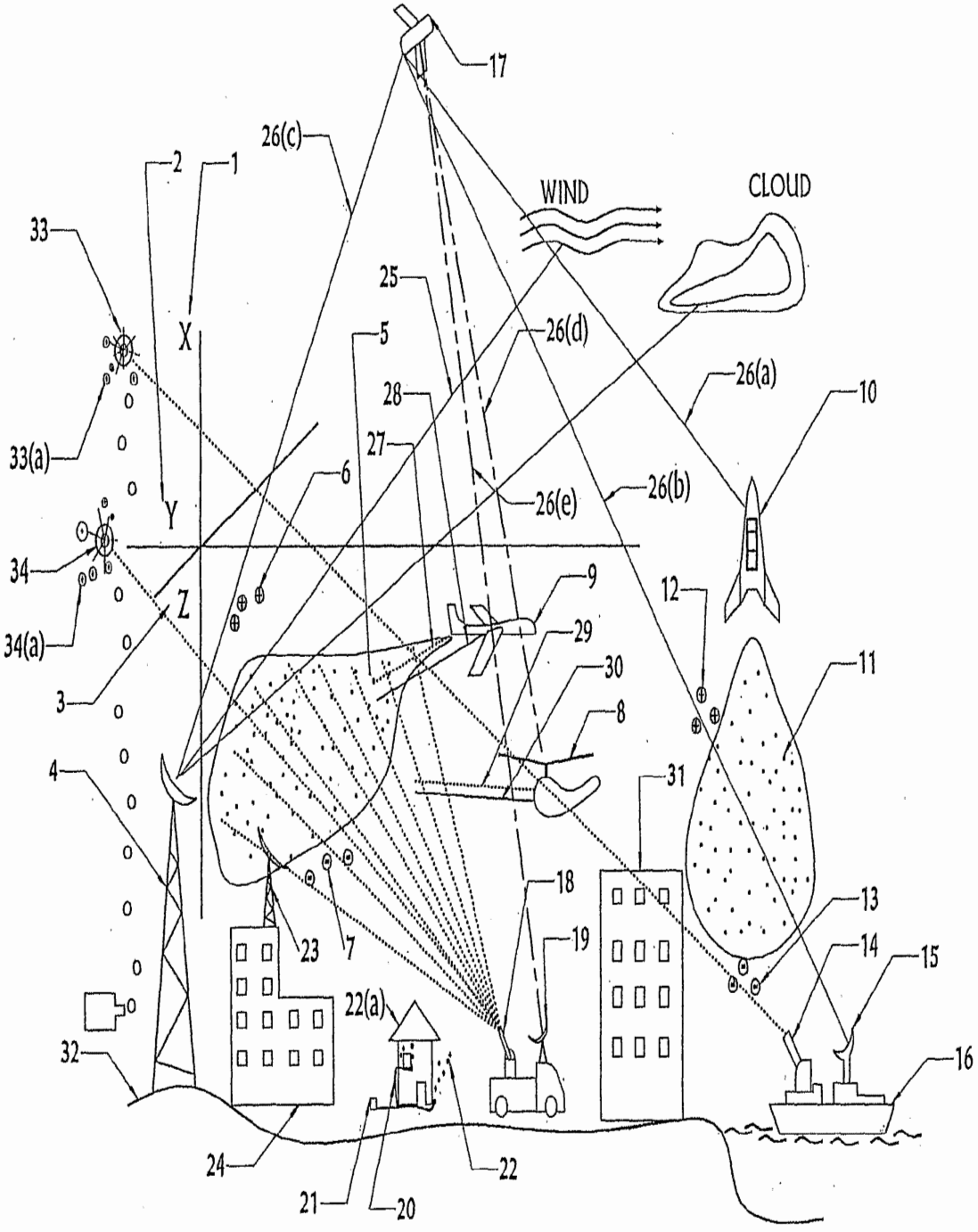

17
26(c)
2
1
WIND
CLOUD
33
25
X
5
26(d)
26(a)
10
28
33(a)
27
6
26(e)
26(b)
Y
34
9
12
Z
29
34(a)
30
11
3
8
4
31
18
13
23
7
19
14
15
22(a)
32
16
24
22
21
20

Fig.10

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 October 2002 (10.10.2002)

PCT

(10) International Publication Number
WO 02/078754 A1

(51) International Patent Classification[7]: A61L 9/20, 9/00, 9/015, F24F 3/16, B01J 19/12

(21) International Application Number: PCT/CA02/00420

(22) International Filing Date: 27 March 2002 (27.03.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/822,886 30 March 2001 (30.03.2001) US

(71) Applicant: L2B ENVIRONMENTAL SYSTEMS INC. [CA/CA]; 143 Ferndale Drive North, Barrie, Ontario L4M 4S4 (CA).

(72) Inventors: MORROW, William, H.; L2B Environmental Systems Inc., 143 Ferndale Drive North, Barrie, Ontario L4M 4S4 (CA). MCLEAN, Larry, James; L2B Environmental Systems Inc., 143 Ferndale Drive North, Barrie, Ontario L4M 4S4 (CA).

(74) Agent: SMART & BIGGAR; Ronald D. Faggetter, 438 University Avenue, Suite 1500, Box 111, Toronto, Ontario M5G 2K8 (CA).

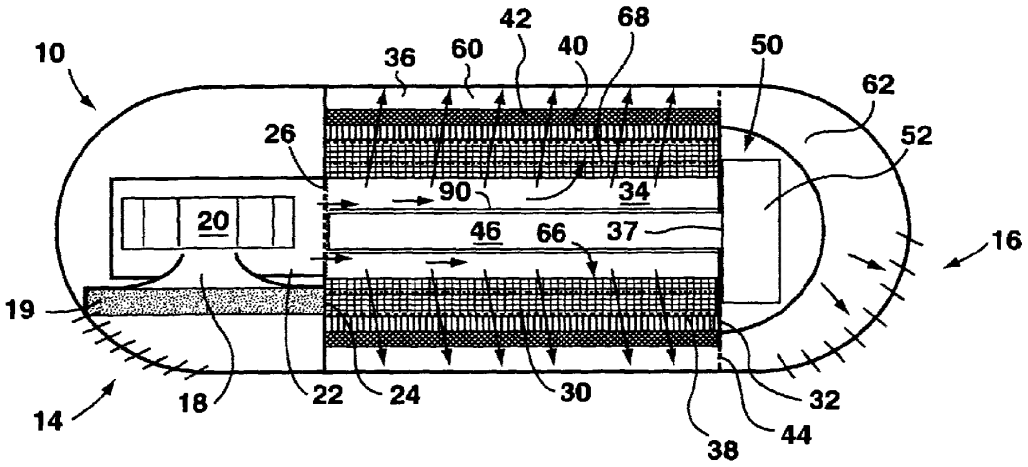
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: AIR PURIFIER



(57) Abstract: An air purifier has an air flow path with a dielectric body (30) interposed across the path. The dielectric body may be made of, for example, quartz or alumina fibres or silica granules or sponge so that it is porous to air and transmissive to ultraviolet ("UV") light. A source (46, 50) of ultraviolet light emits UV1 and UV2 llight into the airflow path upstream of the dielectric body and at least UV2 light into the dielectric body itself. The UV light forms ozone. The ozone, as well as water vapour in the air, naturally attaches to the dielectric body which concentrates these materials in the dielectric body. The UV light irradiating the ozone and water in the dielectric body causes the formation of highly reactive hydroxyl radicals which assist in sterilising the incoming air.

WO 02/078754 A1

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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AIR PURIFIER

BACKGROUND OF THE INVENTION

This invention relates to an air purifier and to a method of air purification.

It is known that ultraviolet ("UV") light sterilizes DNA so that biological material (such as viruses, bacteria, molds, yeasts, and pollens) exposed to UV light either dies or cannot reproduce. This property of UV light has been utilized to sterilize air in a building by simply placing UV lamps in the building's air ducts. One drawback with this approach is that biological material may not be exposed to UV light for a sufficient time to be sterilized. To address this drawback, it is known to utilize a porous air filter and mount a UV light for reciprocating movement across a face of the filter. In operation, a fan draws air through the filter resulting in biological material becoming trapped in the filter. The irradiation of the filter with the reciprocating UV light acts to kill this trapped biological material. However some biological material, namely viruses, readily pass through porous filters and would not, therefore, be sterilized with the combination of a porous filter in conjunction with a UV lamp. Furthermore, UV light degrades a porous filter requiring frequent replacement of same.

In our U.S. patent no. 5,656,242 issued August 12, 1997, we describe several air purifiers which sterilise air with UV radiation. In one embodiment air is drawn through a filter and a perforated metal plate into a primary radiation cavity containing a UV light. The filter traps biological material which is exposed to a low UV dose via the perforations in the metal plate. In another embodiment, air is drawn along a U-shaped path defined by a filter transmissive to UV2 and blocking UV1. UV1 and UV2 radiation generated by a lamp in the first leg of the U-shaped path forms sterilising ozone (O_3) in this leg; the UV2 which passes through the filter into the second leg of the U-shaped path breaks down this ozone. Water misters in this second leg result in the disassociated ozone forming hydroxyl radicals (OH) which further sterilise the air. Thus, the air is sterilised directly by the UV radiation and also indirectly by the UV radiation creating ozone and hydroxyl radicals. While this embodiment results in an effective purifier, water misters may not be readily available and increase maintenance needs of a system.

Therefore, there remains a need for an effective air purifier.

SUMMARY OF INVENTION

An air purifier has an air flow path with a dielectric body interposed across the path. The dielectric body is fabricated so as to be porous to air and transmissive to ultraviolet ("UV") light. A source of UV light emits UV light into the dielectric body and, optionally, also into the air flow path upstream of the dielectric body. The UV light may form ozone. Ozone, as well as water vapour in the air, naturally attaches to the dielectric body which concentrates these materials in the dielectric body. The UV light irradiating the ozone and water in the dielectric body causes the formation of highly reactive hydroxyl radicals which assist in sterilising the incoming air.

Accordingly, in one aspect, there is provided an air purifier comprising: an air flow path; a dielectric body which is porous to air and transmissive to ultraviolet light interposed across said air flow path; and a source of ultraviolet light for emitting ultraviolet light such that ultraviolet light is present in said dielectric body.

According to another aspect of the invention, there is provided an air purifier comprising: an air flow path; a dielectric body interposed across said air flow path, said dielectric body being porous to air and fabricated of at least one of silica, silicon dioxide, aluminum oxide, magnesium fluoride, calcium fluoride, barium fluoride, strontium fluoride, lithium fluoride, quartz and sapphire; and a source of ultraviolet light for emitting ultraviolet ("UV") light such that ultraviolet light is present in said dielectric body

According to a further aspect of the present invention, there is provided a method of air purification comprising: passing contaminated air through a dielectric body which is porous to air and transmissive of ultraviolet ("UV") radiation; and UV irradiating said dielectric body.

BRIEF DESCRIPTION OF THE DRAWINGS

In the figures which illustrate example embodiments of the invention,

Figure 1 is a schematic side view of an air purifier made in accordance with an embodiment of this invention,

Figure 2 is a schematic top view of the purifier of **Figure 1**,

Figure 3 is a schematic cross-sectional view along the lines 3-3 of **Figure 2**,

Figure 3a is a graph of UV intensity versus radial distance, and

Figure 4 is a schematic side view of an air purifier made in accordance with another embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referencing **Figures 1** to **3**, an air purifier **10** has a housing **12** with an air intake **14** and an air exhaust **16**. Within housing **12**, an intake plenum **18** extends from the air intake **14**, through a dust filter **19**, to the suction inlet of a blower **20**. An outlet plenum **22** extends between the outlet of the blower and an annular wall **24** inwardly depending from housing **12**. Annular wall **24** has a concentric aperture covered with an ultra-violet ("UV") reflecting screen mesh **26** which allows the flow of air but which reflects UV. An annular dielectric body **30** extends between annular wall **24** and a second annular wall **32** inwardly depending from the housing to define a central cavity **34** and a peripheral annular cavity **36**. Dielectric body **30** is enveloped by a screen mesh sleeve **38**, a particulate filter **40**, and a chemically absorbent filter **42**. Sleeve **38** may, optionally, be provided with a UV coating on its inside surface such that it allows the transmission of air but reflects UV. The second annular wall **32** has a central opening **37** and a peripheral annular, UV reflecting, screen mesh section **44**. The gas containing tube **46** of an ultraviolet lamp **50** extends through the opening **37** of wall **32** into cavity **34**. The ballast **52** of lamp **50** is secured to wall **32**.

Walls **24** and **32** along with the wall of the housing **12**, define a UV chamber **60**. The walls of this UV chamber many have a UV reflective coating. The outer cavity **36** opens into an exhaust plenum **62**.

An inner member, shown as annular inner wire mesh **66**, lines the inside wall of the dielectric body **30** and an outer member, shown as annular outer wire mesh **68** is embedded within the dielectric body **30**. A voltage source **70** (**Figure 3**) is connected (through a switch-not shown) between the inner mesh **66** and mesh sleeve **38**, on the one hand, and outer wire mesh **68**, on the other. Each mesh might be in the form of thin metal (Al with gold, rhodium or nickel coatings) radial blades which would reflect UV by grazing incidence but intercept significant amounts of light.

The intake and exhaust plenums **18** and **62** may be coated with a UV absorbing paint which, optionally, may be impregnated with a UV activated biocide such as TiO_2.

The UV lamp **50** may emit UV1, UV2 and UV3 radiation. UV1 radiation is defined as UV radiation below approximately 185 NM in wavelength, UV2 is defined as radiation between 185 and 300 NM in wavelength and UV3 is defined as UV radiation above 300 NM in wavelength.

UV1 radiation photo dissociates O_2 into ground state atomic oxygen (O) and water vapor into hydroxyl free radicals (OH) and hydrogen (H). UV2 radiation photo dissociates O_3 into O_2 and excited atomic oxygen (O*). These dissociation processes create powerful oxidants which can oxidize both bio-aerosols and volatile organic compounds rendering them either harmless, or converting them into species which are readily absorbed by filters. UV3 radiation does not photo dissociate any gaseous species but can excite photo catalysts, such as surfaces of TiO_2 and similar semiconductor catalysts.

All of these species will attach to surfaces in the annular dielectric **30** resulting in a concentration of the processes of oxidation. In this regard, when voltage source **70** is switched in, photo-electrically generated electrons from the inner wire mesh **66** and mesh sleeve **38** flow towards the oppositely charged outer mesh **68**. These electrons attach to particulate and to the outer wire mesh **68**. Such charge attachments retard the flow of the particulate enhancing the UV exposure by increasing the exposure time. In addition, electrostatic attachment of the particulate to the outer filters is enhanced increasing the efficiency of the filtration of the particulate.

The photoelectric effect is enhanced at shorter wavelengths for many materials. Thus using the inner wire mesh **66** as the cathode, which is near the lamp, would allow UV1 to be used to eject photo-electrons. An alternate method to using a mesh would be to coat a thin metal transparent conductive film directly on the lamp. Such cathodes (usually called semitransparent) are commonly used in optical sensing devices. This cathode should absorb only a tiny amount of UV1 exiting the lamp but could be highly photo-emissive by virtue of the enhanced quantum efficiency at shorter wavelengths. A very thin layer of gold, nickel, rhodium or other metal might be used. Cesium iodide or cesium telluride (in small quantity or low concentration) might also be used.

The inner mesh cathode **66** of the dielectric body may be coated with a UV reflective coating or may be constructed with a UV reflective material such as aluminum or aluminum coated with rhodium. This would concentrate the UV1 and UV2 in the central cavity **34** increasing the kill of bio-aerosols and photo-dissociative effects in the air. In addition, UV enhancement in the central chamber will not be at the expense of UV reaching the dielectric body if the reflective coating has a low absorbance. This occurs since the intensity of light inside the central cavity **34** will increase proportionately to the reflectance of the inner mesh cathode **66**. Even though the cathode will transmit a smaller percentage of the light striking it, a larger amount of light will be available at its surface. Thus, a higher intensity of UV can be gained inside the central cavity **34** while preserving the flux into the annular dielectric body **30**.

The UV reflective coating of the UV chamber **60**, the inner mesh cathode **66**, and the screen mesh sleeve **38** may be comprised of rhodium coated aluminum which can exhibit both high reflectance and a photoelectric effect. It may also be pure aluminum with a very thin protective film to protect it from oxidation but which will allow photoelectrons to escape. Such a film might be comprised of pure aluminum oxide, magnesium fluoride, or other fluoride material. The coating might also be comprised of an alkali metal with high UV reflectance in pure form and high photoelectric effect with a thin oxidation protective film such as a fluoride. The mesh size of the screen mesh sleeve **38** is chosen so that the preponderance of UV light reaching the sleeve is reflected. One way of achieving this is to keep the mesh size less than one tenth the size of the smallest wavelength to be reflected in

a conductive mesh. In this fashion the mesh could serve as a particulate filter as well as a light reflector.

Unlike UV2 and UV3, UV1 radiation forms ozone which is a toxic gas. Consequently, it is desirable that most, or all, of the UV1 radiation be absorbed within central cavity **34** so as to reduce the prospect of ozone leaking from purifier **10**.

The radial extent of the central cavity **34** of UV chamber **60** may therefore be dependent on the largest wavelength of UV1 produced by lamp **50**. More particularly, in some embodiments of the invention, it may be desirable to have the most of the UV1 at no greater than 170 NM. In such instance, even with the radial extent of the inner cavity being on the order of a few mm, most of the UV1 radiation will be absorbed by the air of the inner cavity **34**. On the other hand, if the lamp produces UV1 at up to 185 NM, the radial extent of the inner cavity would need to be on the order of at least 10 cm for most of this radiation to be absorbed while traversing the inner cavity.

The dielectric body **30** is formed so as to be porous to air. Consequently, an air flow path is defined from purifier air intake **14**, through the blower **20**, into the central cavity **34** of the UV chamber **60**, then through the annular dielectric body **30**, the screen mesh sleeve **38**, outer particulate filter **40**, outer chemically absorbent filter **42**, into the outer cavity **36** and out the air exhaust **16**.

The dielectric body **30** is fabricated of a porous dielectric material which transmits UV radiation. Suitable materials could include:

1. Silicon dioxide or pure silica in the form of fiber, sponge or frit
2. Silicon dioxide or pure silica in the form of an aerogel or xerogel
3. Silica gel granules
4. Silica gel granules coated onto silicon dioxide fibers or frit
5. Aluminum oxide (high purity) fibers, frit or granules
6. Aluminum oxide (high purity) coated aluminum fiber

7. Magnesium fluoride, calcium fluoride, barium fluoride, strontium fluoride or lithium fluoride powers, fibers, frits or coatings on transmitting or reflecting substrates.
8. Quartz fiber, quartz fiber with silica gel coating.
9. Sapphire fiber.

Other dielectric matrices with air passageways may also be used. Two properties are, however, needed: that the dielectric body transmit UV (UV1, UV2 and UV3) and that ozone and water vapour attach to the dielectric body. The latter property increases the availability of these species for photo-catalytic reactions which convert UV light into hydroxyl free radicals.

Water vapour and ozone will attach (i.e., bond) to all dielectrics to at least some extent. However, in some dielectric materials this property is particularly pronounced. For example it is well known that silica gel can absorb up to 30% of its mass of water vapor and ozone. For any dielectric material, the ability to attach to ozone and water vapour will increase if the material is provided with a large surface area. This suggests that the porous dielectric body should have relatively small pores to increase surface area (limited only in that the pores should not be so small as to inhibit the admission of the molecules of water and ozone).

Optionally, the dielectric body is fabricated of a material which more strongly absorbs UV1 radiation than it does UV2 radiation. This may be desirable where the radial extent of the inner cavity is such that an appreciable portion of the UV1 radiation is not absorbed in the air of the central cavity **34**. One suitable dielectric material with this property is quartz which, depending on the grade, will absorb more strongly at wavelengths below 185 nm than for wavelengths above 185 nm. Another material which may be suitable is aluminum oxide, provided it has sufficiently high purity to transmit UV.

The outer particulate filter **40** may be a pleated fabric filter or a fiber filter, which will trap biological contaminants such as virus, bacteria and moulds. UV light that transmits through the screen mesh sleeve **38** will sterilize the biological material on the filter. The outer chemically absorbent filter **42** may be a charcoal or zeolite filter, both of

which will trap gaseous chemical contaminants as well as biological material. The life of outer filter **42** will be enhanced if it is placed after (in the air flow sense) the particulate filter. This will insure that its absorbent material pores do not clog with micro particles. Filter **42** will serve to remove any residual organic breakdown fragments from the photochemical reactions that oxidize volatile organic compounds in the dielectric body **30** insuring the safety of the device.

Since UV2 and UV3 are expected to penetrate into the two outer filters **40**, **42**, photocatalytic materials such as TiO_2 may be added to either or both of these filters. This will produce a continuous cleaning effect, which may serve to cleanse the filters of organic particulate material, enhancing their lifetimes. The dielectric body **30** will also produce hydroxyl free radicals in the gas phase which will be entrained in the gas flow and which will also serve to continuously clean the filters of particulate. The dielectric body may also be coated with a photocatalytic material such as TiO_2 to enhance the destruction of volatile organic compounds.

Since UV3 will be readily transmitted through many materials, it is expected to make its way through the outer filter **42** and into the outer cavity **36**. The outer wall of housing **12**, which can also be coated with photo catalytic material, can then absorb UV3. Since the appropriate concentration of this material will act as a strong UV absorber, the outer wall will both absorb residual UV and add to the overall volatile organic compound removal by the device.

In operation, both the blower **20** and UV lamp **50** are activated and the switch to voltage source **70** is closed. The voltage then polarizes inner mesh **66**, mesh sleeve **38**, and outer mesh **68** establishing an electric field between the inner mesh and the mesh outer mesh and between the mesh sleeve and the outer mesh. Further, the UV radiation from lamp **50** results in photo-emission of electrons from the inner mesh **66** such that this mesh acts as a cathode. These electrons are attracted toward the outer mesh (which therefore acts as an anode) but attach themselves to the dielectric body **30** along the way. The body retains the static charge owing to its high electric impedance. (Note that a dielectric body **30** fabricated of quartz fibres is particularly advantageous in this regard due the high electrical resistance of quartz). This effect enhances the electric field established in the

body **30**. Blower **20** draws contaminated air from intake **14**, though intake dust filter **19**, and expels it into the central cavity **34** of UV chamber **60**. The pressurized air in the inner cavity **34** moves downstream from the inner cavity **34** through dielectric body **30** to the outer filters **40** and **42**. In doing so, much of the biological material (such as bacteria and viruses) in the air becomes trapped in the electric fields set up between meshes **38**, **66**, and **68**. Further, water vapor and ozone in the air is absorbed by the dielectric body **30**. These materials are converted to OH both in the gas phase and on the dielectric fill. As the air passes through outer filters **40** and **42**, residual biological material and chemicals are removed from the air. Both are destroyed by the wash of residual UV2 and by OH that is entrained in the air.

With lamp **50** activated, **Figure 3a** graphically illustrates the intensity of UV1, UV2 and UV3 radiation as a function of radial distance in the lamp cross-section illustrated in **Figure 3**. Turning to these figures, it will be seen inner cavity **34** of UV chamber **60** is flooded with UV1, UV2 and UV3 light (section **100**) and the dielectric body **30** is flooded with (predominately) UV2 and UV3 light (section **102**). A small amount of UV2 light passes through screen mesh sleeve **38** and into filters **40** and **42** (section **104**). The UV reflective coatings of walls **24** and **32** as well as of housing **12** and inner mesh **66** enhance the intensity of UV radiation in the central cavity **34**. The UV reflective coating on walls **24** and **32** and on the screen mesh sleeve **11** enhance the intensity of UV radiation in the dielectric body **30**. The UV absorbing coatings of intake plenum **18** and exhaust plenum **62** help ensure that any UV light reaching these extremities of purifier are absorbed and do not leave the purifier (section **106**).

The UV radiation produced by lamp **50** produces the following chemical reactions.

$$O_2 + UV1 \rightarrow O + O \qquad (1)$$

$$O_2 + O \rightarrow O_3 \qquad (2)$$

$$O_3 + UV1 \text{ or } UV2 \rightarrow O^* + O2 \qquad (3)$$

$$O^* + H_2O \rightarrow 2OH \qquad (4)$$

$$O^* + O_2 \rightarrow O_3 \qquad (5)$$

$$H_2O + UV1 \rightarrow OH + H \qquad (6)$$

$$O + O_2 \rightarrow O_3 \qquad (7)$$

As will be appreciated by those skilled in the art, these reactions have been simplified. In fact, other free radicals (such as H and HO_2) and compounds (such as H_2O_2) will play roles.

UV1 radiation produced by lamp **50** photo-dissociates oxygen (O_2) in the air resulting in the formation of ground state atomic oxygen (reaction (1)). This atomic oxygen is highly chemically reactive. A large portion of this atomic oxygen reacts with O_2 to form ozone (O_3: reaction (2)). Ozone may be further photo-dissociated by UV1 or UV2 to form excited atomic oxygen (O^*: reaction (3)). As will be appreciated by those skilled in the art, the optimum UV wavelength for dissociating ozone is about 250 nm. This excited atomic oxygen is even more chemically reactive than the oxygen formed in reaction (1) and rapidly attacks any water vapor present to form OH by reaction (4). The excited atomic oxygen can also be deactivated by oxygen (O_2) and nitrogen (N_2) in the air to form ground state atomic oxygen which then reacts with O_2 to reform ozone (reactions (5), (6) and (7)).

Atomic oxygen, ozone (O_3) and hydroxyl radicals (OH) will react with organic compounds and break them into oxidized fragments. However, OH removes most organic compounds at rates up to ten orders of magnitude faster than ozone. Further, ozone is a toxic gas. OH, on the other hand, is not a hazard because it is so chemically reactive that is cannot survive more than a few second in normal air. Thus, unlike ozone, it cannot accumulate.

In view of the forgoing it is desirable to create as much OH and a little ozone as possible. This means enhancing reactions (3) and (4) relative to reactions (5) to (7). This is

achieved by dielectric body **30** which traps ozone, thereby increasing the rate of its photo-dissociation by reaction (3), and which traps water vapor and ozone for use in reaction (4).

A highly porous dielectric body can absorb water or ozone to up to about 30% of its weight. The high absorbency and higher density of the dielectric body **30** relative to air results in an enhancement of the volume density of water and ozone of about three orders of magnitude. The dielectric body will absorb water vapor even when relative humidity is low making it unnecessary to add water vapor to the system.

Because UV1 is primarily or entirely contained within inner cavity **34** of UV chamber **60**, it will be apparent that atomic oxygen is primarily formed in the inner cavity (reaction 1). Ozone will therefore be formed (by reaction 2) in the inner cavity and in the dielectric body. Because the body **30** is primarily radiated with UV2, little ground level atomic oxygen (O) – which generates ozone – will be formed in the body. Instead, the UV2 irradiating the body will primarily photo-dissociate the ozone trapped by the body resulting in excited atomic oxygen (reaction (3)). Given the high concentration of water vapor in the body **30** and the presence of excited atomic oxygen there, OH (by reaction (4)) is formed primarily in the dielectric body.

If a suitable dielectric material is added to the inner cavity **34**, or if a porous UV1, UV2 and UV3 transmitting dielectric is coated onto the lamp walls, the production of OH by reaction (6) will increase relative to reactions (1) and (2). This enhancement results from the high absorption of H_2O relative to O_2 onto the surfaces of many dielectrics (e.g. silica gel or aluminum oxide). This effect can be useful in embodiments in which it is desirable to further minimize ozone production.

For example, by applying a pure silica gel coating **90** (**Figure 1**) which is a few millimetres thick to the light emitting tube **46** of the lamp **50** of **Figures 1** or **4**, the H_2O present in the coating will absorb all the UV1, converting the H_2O directly to OH. This will reduce the ozone production but will not block UV2 and UV3 radiation from the lamp.

As noted, the OH and atomic oxygen will fragment (oxidize) organic compounds thus destroying bacteria and viruses in the air. This will also result in fragmentation of other volatile organic compounds and organic pollutants which may be in the air, thereby reducing their concentration.

Organic compounds may stick to the dielectric body **30**. However, OH will rapidly attack these surface contaminants thereby fragmenting these materials. If the fragmented materials continue to stick, they continue to be fragmented until, in many cases, water vapor and carbon dioxide results. Carbon dioxide (CO_2) is not absorbed by zeolite or charcoal. Thus, where the outer chemically absorbent filter **42** is fabricated of such materials, CO_2 will float away and out of the purifier. Since the concentrations of volatile organic compounds are small (less than a part per million) compared to the ambient concentration of CO_2 (about 300 parts per million), any increase in CO_2 caused by the oxidation of volatile organic compounds by the purifier is negligible compared to other sources and will pose no health risk.

The UV light itself will also act to sterilize biological materials in the intake air. This is particularly so in respect of material trapped by the electric field in the body **30** or trapped in outer filter **42** in view of the increased time during which such biological materials is exposed to the UV light.

Ozone reaching the outer filter **42** is readily absorbed. While it is absorbed on the filter it will be broken down by the (small) amount of UV (UV2) radiation reaching outer filter **42** and will form OH. This reaction can be facilitated by adding a catalytic mesh (with a material such as TiO_2) to these filters.

Screen mesh **38** could be replaced with a porous wall formed of fused UV reflecting grains having a diameter approximating that of the UV2 radiation. These UV reflecting grains could, for example, be spheres of aluminum, high purity silica, or grains of barium sulfate. It might also be fabricated out of aerogel matrices with the desired average pore sizes.

While lamp **50** is described as emitting UV1, UV2 and UV3 radiation, air will still be purified by the purifier **10** (albeit not as efficiently or completely) if the lamp emitted solely UV1 or UV2 radiation. Further, two or three lamps could be provided, one which emits UV1 radiation into the airflow path upstream of the dielectric body, a second one which emits UV2 light into the dielectric body itself and a third one which emits UV3 radiation for use in the outer filters and outer wall.

Figure 4 illustrates an air purifier **100** in accordance with another embodiment of this invention. Turning to **Figure 4**, wherein like parts have like reference numerals, housing **112** of purifier **100** is tubular. Air inlets **114** in one end of the housing feed to blower **120**. An outlet plenum **22** extends between the exhaust of the blower and the central cavity formed by the annular dielectric body **30**. An annular plate wall **132** abuts the end of the dielectric body **30** remote from plenum **22**. Baffles **180** extend between housing **112** and an end of annular particulate filter **142**. A chemically absorbent outer filter **144** extends between particulate filter **142** and air exhaust **162**. Lamp **50** through the annulus formed by the particulate filter **140** and the annulus formed by dielectric body **30**. As well as the inner and outer annular wire mesh **66, 68** associated with the dielectric body, there is an inner and outer wire mesh **166, 168** associated with the filters **140, 142**. Like meshes **66, 68**, meshes **166, 168** are polarised with a voltage source (not shown). With purifier **100**, when blower **120** is activated, air flows out from the blower into dielectric body **30**, then out from the body to between body **30** and the wall of housing **112**. Air then passes into particulate filter **40**, then through outer filter **42** and out exhaust **162**. Unlike purifier **10** (**Figure 1**), there are no filters surrounding dielectric body **30**. Instead, filters **140, 142**, while concentric with lamp **50**, are separate from the body **30**. With this arrangement, UV light falls directly on the particulate and chemical filters. Appropriate screen meshes could be added to enhance UV2 in the cavity **134** inside the two filters **140, 142**. In addition, photoelectric effect mesh electrodes **166, 168**, if added to filters **40** and **42**, enhance their effectiveness. Instead of a mesh electrode, one method of producing a cathode might entail a coating of cesium iodide or similar material on an inner face of one of the filters. This coating would absorb wavelengths shorter than 185 NM and produce photo-electrons at such wavelengths. It would also be transparent at wavelengths longer than 200 NM. Thus, the cathode would inhibit the emission of UV1 past filters **140, 142** by blocking the ozone

producing UV but still allow UV2 and UV3 to be emitted which would sterilize the filters **140**, **142** and aid photochemical processes.

A basic purifier in accordance with this invention would comprise a source of UV which irradiates a suitable dielectric body interposed in the airflow path of the purifier. The effectiveness of the purifier is enhanced by the addition of a cathode and anode to attract and trap charged particles for UV irradiation. Further improvement in efficiency is obtained with the addition of the each of the other features described, such as the described filters and coatings.

Other modifications will be apparent to those skilled in the art and, therefore, the ambit of the invention is set out in the claims herefollowing.

WHAT IS CLAIMED IS:

1. An air purifier comprising:

an air flow path;

a dielectric body which is porous to air and transmissive to ultraviolet light interposed across said air flow path; and

a source of ultraviolet light for emitting ultraviolet light such that ultraviolet light is present in said dielectric body.

2. The air purifier of claim 1 further comprising an anode and cathode in said dielectric body.

3. The air purifier of claim 1 wherein said source of ultraviolet light is also for emitting ultraviolet light such that ultraviolet light is present in said airflow path upstream of said dielectric body.

4. The air purifier of claim 3 wherein said source of ultraviolet light emits ultraviolet light at a first wavelength in a range of 160 to 185 nm and at a second wavelength in a range of 185 to 300 nm.

5. The air purifier of claim 4 wherein said source of ultraviolet light is arranged to emit ultraviolet light such that ultraviolet light at least at said first wavelength is present upstream of said dielectric body and ultraviolet light at said second wavelength is present in said dielectric body.

6. The air purifier of claim 5 wherein said dielectric body more strongly absorbs ultraviolet light at said first wavelength than light at said second wavelength.

7. The air purifier of claim 1 wherein said dielectric body comprises silica.

8. The air purifier of claim 1 wherein said dielectric body comprises silica gel.

9. The air purifier of claim 1 wherein said dielectric body comprises silica granules.

10. The air purifier of claim 1 wherein said dielectric body comprises quartz fibres.

11. The air purifier of claim 10 wherein said quartz fibres are coated with a silica coating.

12. The air purifier of claim 1 wherein said dielectric material comprises alumina fibres.

13. The air purifier of claim 1 wherein said cathode has a coating which is highly reflective of ultraviolet light.

14. The air purifier of claim 12 wherein said coating comprises rhodium coated aluminum.

15. The air purifier of claim 1 wherein said dielectric body comprises a material which strongly attaches to water and ozone.

16. The air purifier of claim 1 wherein said dielectric body has a pore size sufficiently large to admit ozone and water molecules and sufficiently small to enhance attachment of water and ozone to said dielectric body.

17. The air purifier of claim 5 further comprising a mesh surrounding said dielectric body having a mesh size at least an order of magnitude less than said second wavelength.

18. The air purifier of claim 5 wherein said source of ultraviolet light also emits ultraviolet light at a third wavelength about 300 nm.

19. The air purifier of claim 18 further comprising a filter in said airflow path downstream of said dielectric body, said filter being porous to air, said filter arranged for trapping biological fragments.

20. The air purifier of claim 19 wherein at least one of said dielectric body and said filter has a photocatalytic material.

21. The air purifier of claim 20 wherein said photocatalytic material is TiO_2.

22. The air purifier of claim 5 wherein said dielectric body is annular and said source of ultraviolet light emits within a central cavity of said dielectric body.

23. The air purifier of claim 22 wherein said source of ultraviolet light a lamp extending within said cavity.

24. The air purifier of claim 23 wherein said lamp has a silica gel coating.

25. The air purifier of claim 22 wherein said central cavity is sized so that a preponderance of ultraviolet light at said first wavelength is absorbed in said central cavity.

26. An air purifier comprising:

an air flow path;

a dielectric body interposed across said air flow path, said dielectric body being porous to air and fabricated of at least one of silica, silicon dioxide, aluminum oxide, magnesium fluoride, calcium fluoride, barium fluoride, strontium fluoride, lithium fluoride, quartz and sapphire; and

a source of ultraviolet light for emitting ultraviolet ("UV") light such that ultraviolet light is present in said dielectric body.

27. The air purifier of claim 26 wherein said source of UV light is arranged for emitting UV1 light in said airflow path upstream of said dielectric body and UV2 light such that UV2 light is present in said dielectric body.

28. A method of air purification comprising:

passing contaminated air through a dielectric body which is porous to air and transmissive of ultraviolet ("UV") radiation; and

UV irradiating said dielectric body.

29. The method of claim 28 wherein said UV irradiating said dielectric body comprises UV irradiating with UV2 radiation.

30. The method of claim 29 further comprising irradiating said airflow path upstream of said dielectric body with at least UV1 radiation.

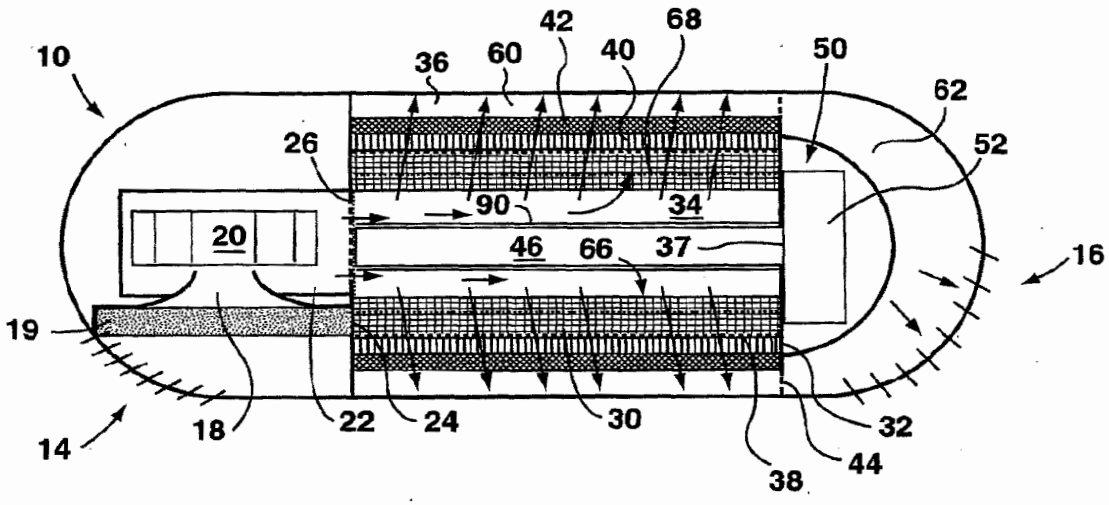

10
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38

FIG. 1

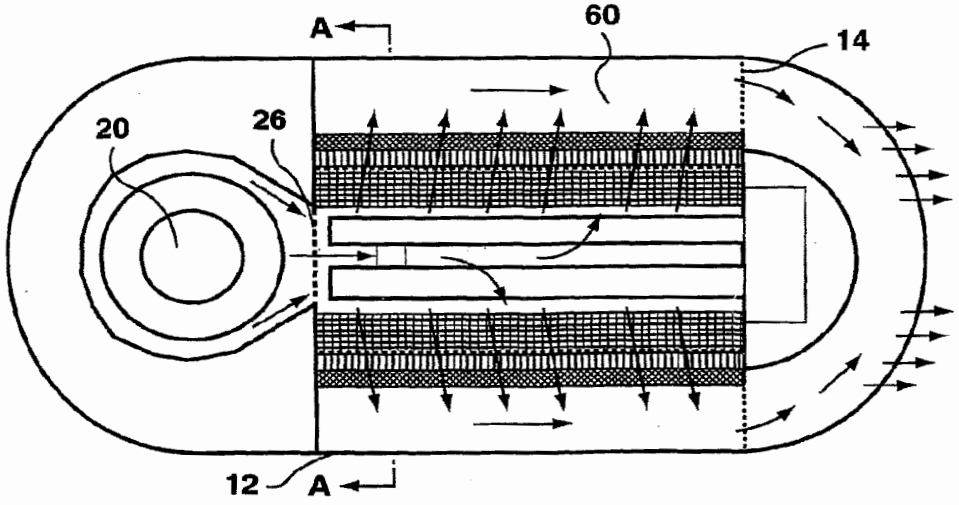

A
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26
12
A

FIG. 2

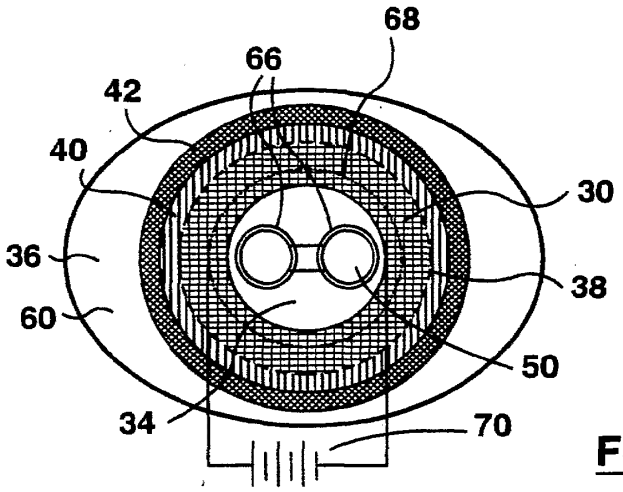

68
66
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34
70

FIG. 3

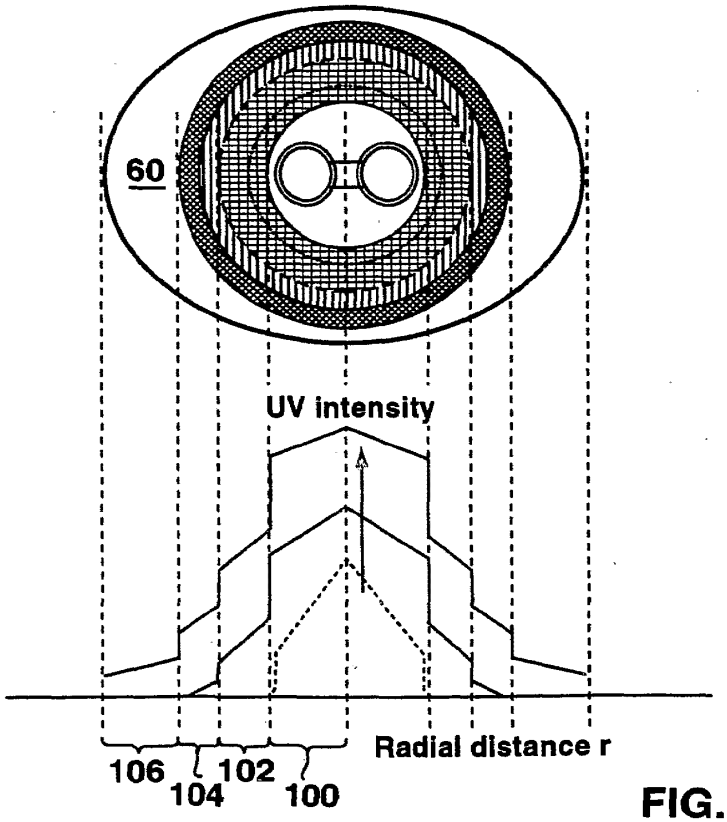

60
UV intensity
Radial distance r
106
104
102
100

FIG. 3A

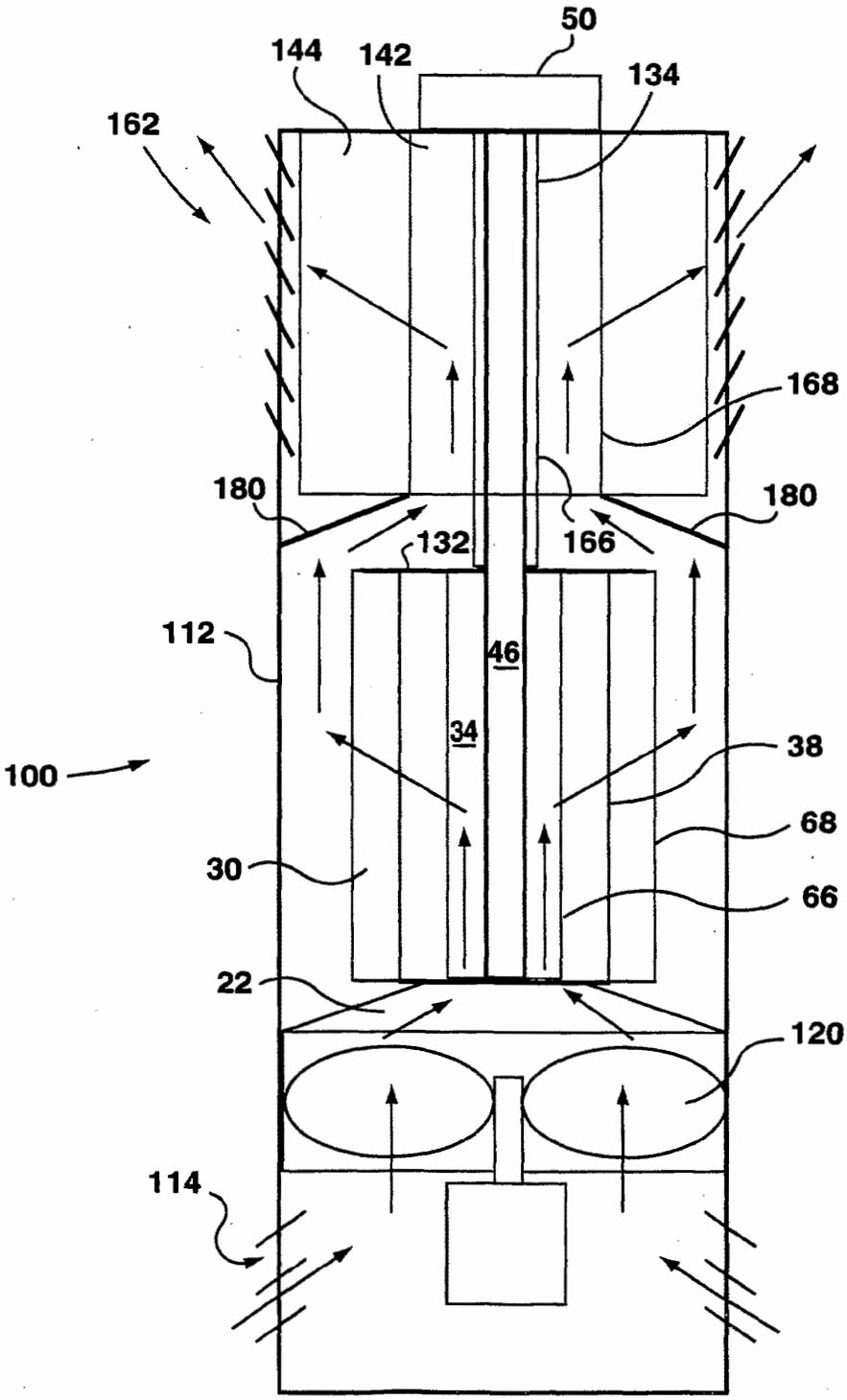

50
144
142
134
162
168
180
180
132
166
112
46
34
38
100
68
30
66
22
120
114

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 02/00420

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61L9/20 A61L9/00 A61L9/015 F24F3/16 B01J19/12

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 7 A61L F24F B01J

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 practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 198 36 619 A (QUARK SYSTEMS CO) 12 August 1999 (1999-08-12)	1,3, 7-10,15, 16,26-30
Y	column 1, line 3-37 column 8, line 9-24 column 8, line 49 -column 9, line 30; figures 12-15	4-6, 17-19, 22,23
X	US 5 330 722 A (PICK WILLIAM E ET AL) 19 July 1994 (1994-07-19)	1-3,10, 13,15, 16,26-30
Y	column 9, line 4 -column 10, line 42; figures	4-6, 17-19, 22,23

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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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
7 August 2002	14/08/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Persichini, C

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 02/00420

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	WO 96 37281 A (MINNESOTA MINING & MFG) 28 November 1996 (1996-11-28)	1,3, 7-10,15, 16,26-30
Y	page 4, line 8 -page 9, line 13; figures	4-6, 17-23
Y	US 5 656 242 A (MORROW WILLIAM ET AL) 12 August 1997 (1997-08-12) cited in the application column 2, line 37 -column 4, line 52; figures	4-6, 17-23

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 02/00420

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Form PCT/ISA/210 (patent family annex) (July 1992)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 July 2005 (07.07.2005)

PCT

(10) International Publication Number
WO 2005/061396 A1

(51) International Patent Classification[7]: C02F 1/463, 1/467, 1/50

(21) International Application Number: PCT/US2003/037510

(22) International Filing Date: 20 November 2003 (20.11.2003)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **MARINE ENVIRONMENTAL PARTNERS, INC.** [US/US]; 3874 Fiscal Court, Suite 200, West Palm Beach, FL 33404 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LEFFLER, Charles, E.** [US/US]; 2311 N.E. 48th Street, Lighthouse Point, FL 33064 (US). **PAUL, William** [US/US]; 17368 West 158th Terrace, Olathe, KS 66062 (US).

(74) Agent: **DIXON, Michael, K.**; Akerman Senterfitt, P.O. Box 3188, West Palm Beach, FL 33402-3188 (US).

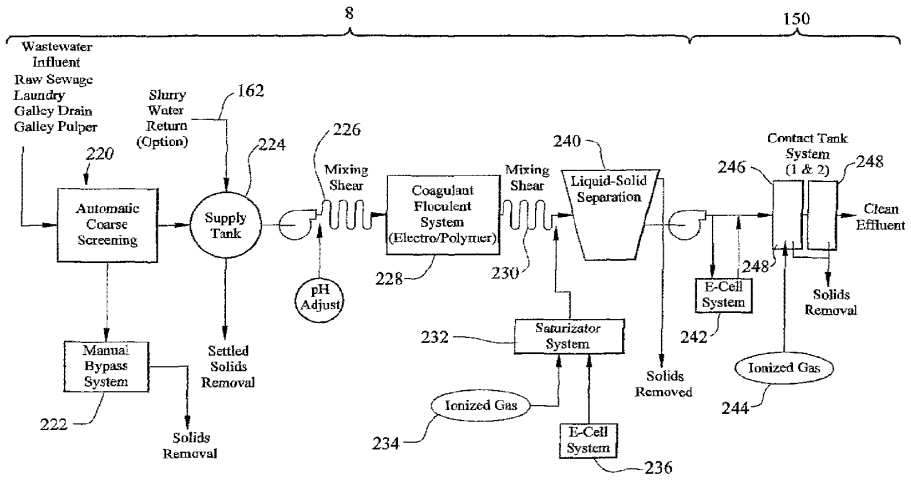
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) **Title:** WASTEWATER TREATMENT SYSTEM



(57) **Abstract:** A wastewater treatment system for removing contaminants from wastewater on a vessel using electricity. The wastewater treatment system may inject wastewater with one or more disinfectants or ionized gases, or both, to remove at least a portion of contaminants from the wastewater. The water treatment system may produce disinfectants from saltwater using one or more disinfectant generators (26) and return the byproducts to a water body. The wastewater treatment system may also pass wastewater through an electrical coagulation unit (50) in which an electrical current may be emitted into the wastewater, whereby flocculants are formed and cause suspended solids and other materials to settle out of the wastewater. The wastewater treatment system may include a secondary treatment system for further reducing concentrations of contaminants. In addition, the wastewater treatment system may include a solid waste treatment system (208) for incinerating solids produced by the wastewater treatment system.

WO 2005/061396 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WASTEWATER TREATMENT SYSTEM

FIELD OF THE INVENTION

[0001] The invention is directed generally to wastewater treatment systems, and more particularly, to wastewater treatment systems usable on vessels.

BACKGROUND

[0002] Vessels, such as ships, produce large amounts of wastewater, such as sewage, galley wastewater, and laundry wastewater. Typically, the wastewater is stored on the vessel or discharged from the vessel with little or no treatment. Storage of the wastewater on vessels requires large holding tanks, which consume valuable floor space in a vessel. In addition, the storage tanks often add undesirable weight to a vessel. Typically, storage tanks are emptied at port facilities and treated in land-based water treatment systems or emptied while the vessel is on the high seas.

[0003] The option of discharging wastewater overboard reduces the capacity of storage tanks needed and may, in at least some situations, eliminate the need for wastewater storage tanks altogether. However, discharging raw wastewater into a water body can be extremely damaging. Raw wastewater or wastewater having little treatment often is lethal to numerous organisms in offshore and nearshore ecosystems. In addition, regulations in various jurisdictions throughout the world prohibit discharges of contaminated water or limit such discharges.

[0004] Thus, a need exists for a water treatment system usable on a vessel for treating wastewater and removing contaminants to an acceptable level allowing

wastewater to be discharged overboard without causing adverse effects to the ecosystem in which the wastewater is discharged.

SUMMARY OF THE INVENTION

[0005] This invention is directed to a wastewater treatment system for removing one or more contaminants from a wastewater. In at least one embodiment, the wastewater treatment system is configured to remove contaminants from wastewater found on a vessel, such as, but not limited to, a ship, megayacht, or other vessel. Nonetheless, the wastewater treatment system may be used to treat other wastewaters as well. In at least one embodiment, components forming the wastewater system may be formed in modules so as to be easily installed on vessels in often space limited compartments. The wastewater treatment system may remove at least a portion of suspended solids, fecal coliforms, BODs, or CODs, or any combination thereof, from the wastewater using a combination of treatment systems. The wastewater treatment system may inject disinfectants, such as, but not limited to, chlorine, bromine, and other halides, hydrogen peroxide, or other disinfectants, into the wastewater, and may inject one or more ionized gases into the wastewater. One or more of the disinfectants may be generated from saltwater using a disinfectant generator. In at least some embodiments, the ionized gases may be produced on board a vessel to which the wastewater treatment system is attached using an ionized gas generator.

[0006] The wastewater treatment system may be formed from a primary treatment system and a secondary treatment system. The primary treatment system may be formed from one or more collection devices for collecting wastewater from one or more sources, which may include, but are not limited to, a laundry, a sewage system, a galley

drain, a galley pulper, bilge areas, or other sources, or any combination of these sources. The wastewater treatment system may also include one or more disinfectant injectors for injecting at least one disinfectant into the wastewater treatment system downstream of the collection device. One or more mixers may be included in the wastewater treatment system for mixing one or more ionized gases with the wastewater. The mixers may include a plurality of injectors for injecting ionized gases into the wastewater. In at least one embodiment, the plurality of injectors may be positioned in a helical configuration around the mixer. The wastewater treatment system may also include a dissolved air flotation system for removing suspended solids from the wastewater.

[0007] One or more disinfectant generators may be included in the wastewater treatment system for supplying disinfectants to the disinfectant injectors. The disinfectant generator may be formed from one or more conduits in a housing. Each conduit may have an electrical cell for applying an electrical charge to the fluid flowing through the conduit, which, in at least one embodiment, is saltwater. Each conduit may also include one or more sensors for determining the pressure, temperature, and other system parameters. The disinfectant generator may be coupled to an inlet in the hull of a vessel for receiving water from the water body in which the vessel is floating. The water may be drawn from the water body and passed through the disinfectant generator, where one or more disinfectants may be removed from the water. The water may then be returned to the water body.

[0008] The wastewater treatment system may also include one or more ionized gas generators for generating ionized gas to inject into the wastewater passing through the system. The ionized gas generator may be formed from one or more chambers, whereby the chambers may include one or more ultraviolet lamps and one or more magnets. In at

least one embodiment, the ionized gas generator may include a plurality of ultraviolet lamps that surround a plurality of magnets positioned generally along a longitudinal axis of a chamber. The magnets may be positioned so that ends of adjacent magnets have like polarity, which may widen the magnetic field cast by the magnets. A gas, such as, but not limited to air, may be passed through the ionized gas generator to produce ionized gases.

[0009] The wastewater treatment system may also include an electrical coagulation unit for applying an electrical current to the wastewater. In at least one embodiment, the electrical coagulation unit may be formed from a plurality of plates positioned generally parallel to each other and forming a serpentine pathway through which the wastewater flows. The plates may be formed from a material, such as, but not limited to, aluminum, which may break off of the plates during use and form flocculants in the wastewater. The flocculants may adhere to suspended solids in the wastewater, coagulate, and settle out of the wastewater flow.

[0010] The wastewater treatment system may also include a filtration system positioned upstream of the collection device for removing suspended solids and other materials from the wastewater treatment system having relatively large sizes. For instance, in at least one embodiment, the wastewater treatment system may include one or more filters sized to filter materials two millimeters (mm) and larger from the wastewater.

[0011] The wastewater treatment system may include one or more saturization systems for introducing ionized gases or disinfectants, or both, into the wastewater stream. The saturization system may be formed from a labyrinth of pipes sized for mixing the ionized gases and the disinfectants with the wastewater.

[0012] The wastewater treatment system may also include a secondary treatment system positioned downstream of the dissolved air flotation unit for further cleaning the wastewater. The secondary treatment system may or may not be used, depending on the desired levels of contaminants in the wastewater exhausted from the wastewater treatment system. The secondary treatment system may include one or more contact tanks, ozone generators, ionized gas injectors, ionized gas generators, or filters. The wastewater treatment system may also include a recirculation system coupled to a downstream location of the water treatment system for recirculating wastewater through the wastewater treatment system if the wastewater is determined to have levels of contaminants that exceed a selected threshold.

[0013] The wastewater treatment system may also include a solid waste treatment system for disposing of the solids generated by the various components of the wastewater treatment system. For instance, the solid waste treatment system may include a buffer tank for collecting solids from the wastewater treatment system, and a separator may be included for dewatering the solids. The dewatered solids may be burned in an incinerator to greatly reduce the size and weight of solids requiring containment until the vessel in which the water treatment system is attached is docked.

[0014] An advantage of this system if that the system uses relatively small amounts of chemicals to disinfect wastewater and leaves little residual chemicals in the wastewater emitted from the system.

[0015] These and other features and advantages of the present invention will become apparent after review of the following drawings and detailed description of the disclosed embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The accompanying drawings illustrate embodiments of this invention and, together with the description, disclose various aspects of the invention. These figures include the following:

[0017] Figure 1 is a schematic of an embodiment of a primary treatment system of the water treatment system;

[0018] Figure 2 is a schematic of an embodiment of a secondary treatment system of the water treatment system;

[0019] Figure 3 is a schematic of an embodiment of a solids treatment system of the solid waste treatment system;

[0020] Figure 4 is a front view of a filter usable in the water treatment system;

[0021] Figure 5 is a side view of the filter shown in Figure 4;

[0022] Figure 6 is a cross-sectional view of the filter shown in Figure 4 taken at line 6-6;

[0023] Figure 7 is a side view of a disinfectant generator usable in the water treatment system;

[0024] Figure 8 is an end view of the disinfectant generator shown in Figure 7;

[0025] Figure 9 is a side view of internal components of the disinfectant generator shown in Figure 7;

[0026] Figure 10 is a side view of a mixer usable in the water treatment system;

[0027] Figure 11 is a cross-sectional side view of a portion of the mixer of Figure 10;

[0028] Figure 12 is a cross-sectional top view of a portion of the mixer of Figure 11 taken along line 12-12.

[0029] Figure 13 is a schematic view of an electrical coagulation unit usable in the water treatment system;

[0030] Figure 14 is a cross-sectional side view of an ionized gas generator usable in the water treatment system;

[0031] Figure 15 is a cross-sectional end view of the ionized gas generator shown in Figure 14;

[0032] Figure 16 is a cross-sectional side view of the ionized gas generator taken at 16-16 in Figure 14;

[0033] Figure 17 is a side view of a collection of chambers forming an ionized gas generator;

[0034] Figure 18 is a front view of the collection of chambers forming an ionized gas generator shown in Figure 17.

[0035] Figure 19 is a schematic diagram of another embodiment of the primary and secondary treatment systems of the water treatment system; and

[0036] Figure 20 is a schematic diagram of yet another embodiment of the primary treatment system of the water treatment system.

DETAILED DESCRIPTION

[0037] Figures 1-20 illustrate a water treatment system 10 configured to remove one or more contaminants from a fluid, such as, but not limited to, wastewater. In at least one embodiment, the wastewater treatment system is configured to be used on a vessel, such as a ship, a megayacht, or other vessel producing wastewater. The water may be received from sources, such as, but not limited to, laundries, raw sewage systems, galley drains, galley pulpers, bilge areas, accommodations, such as water from cabin sinks,

showers, and other sources. The wastewater treatment system 10 may be capable of removing fecal matter, such as fecal coliform, organisms creating biological oxygen demands (BOD), organisms creating chemical oxygen demands (COD) to produce water close to drinking water standards.

[0038] As shown in Figures 1-20, the water treatment system 10 may be configured as a modular design such that components of the system 10 may be adapted for each application and may be sized to fit into small compartments commonly found in vessels. The water treatment system may include a primary treatment system 8 and a secondary treatment system 150. The primary treatment system may be configured to remove large suspended solids, and the secondary treatment system may be configured to provide additional disinfection and treatment.

[0039] In at least one embodiment, the water treatment system 10 may be configured to discharge decontaminated water out of a vessel, such as, but not limited to, a ship, and into the water in which the vessel floats. Contaminated water may be cleaned by injecting one or more decontaminants, such as, but not limited to, chlorine and bromine into the contaminated water. These decontaminants may be separated from saltwater using electrolysis. The water treatment system 10 may also emit an electrical current into the contaminated water to facilitate precipitation of contaminants from the water. One or more ionized gases may be injected into the contaminated water to facilitate additional disinfection of the wastewater. The components of the wastewater treatment system may be formed from materials that are resistant to corrosion, such as, but not limited to, stainless steel, aluminum, fiberglass, bond strand, and other appropriate materials.

I. Primary Treatment System

[0040] The water treatment system 10 may include a collection device 12, which may be an equalization tank, for collecting contaminated water from various sources and to regulate the flow of wastewater into the water treatment system 10. While the size of the collection device 12 depends on the peak loads for a particular vessel in which the water treatment system 10 is mounted, in at least one embodiment, the collection device 12 may have a capacity that is about 25 percent of the daily load for a vessel, which may be about 300 cubic meters (m^3). Discharge of contaminated wastewater from the collection device 12 may be controlled using a plurality of valves 14 and 16, which may or may not be remotely controlled using one or more solenoids or other appropriate devices.

[0041] The collection device 12 may also include a first stage filtration system 18, as shown in Figures 1 and 4-6. The first stage filtration system 18 may be positioned downstream of the collection device 12. The first stage filtration system 18 may include one or more coarse screen filters sized to remove solids larger than about two millimeters (mm). However, the filter may have other sizes as well. As shown in Figure 6, the first stage filter may be formed from one or more coarse filters 21 and one or more fine filters 23. The first stage filtration system 18 may be automatically controlled and include an automatic washing system to facilitate proper operation of the filter. In other embodiments, a manual coarse screen filter 20 may be used as a back up system or as substitution for the automatic coarse screen filter. The first stage filtration system 220, as shown in Figure 19, may include a manual bypass system 222.

[0042] The collection device 12 may also include one or more supply tanks 22 positioned downstream of the first stage filtration system 18 for receiving filtered fluids from the first stage filtration system 18. The supply tank 22 may be sized to receive

fluids from the first stage filtration system 18 to regulate the flow of fluids downstream into the other portions of water treatment system 10.

[0043] The water treatment system 10 may include one or more disinfectant injectors 24. The disinfectant injector 24 may inject one or more disinfectants into the contaminated fluid flowing through the water treatment system 10. In at least one embodiment, the disinfectant injector 24 may inject one or more disinfectants into the contaminated fluid downstream of the supply tank 22. The disinfectants may include, but are not limited to, disinfectants derived from saltwater, such as sea water, and may include chlorine and bromine. The disinfectants may be stored in a tank or other appropriate device.

[0044] In at least one embodiment, as shown in Figure 1, the water treatment system 10 may include a disinfectant generator 26 usable to generate disinfectants. In this embodiment, a storage tank for the disinfectant is not required, but may be used if desired. Thus, the disadvantages associated with a storage tank filled with disinfectants may be eliminated when using a disinfectant generator. The disinfectant generator 26 may be capable of generating one or more disinfectants from saltwater. The saltwater may be drawn from the water in which a vessel is floating. In at least one embodiment, as shown in Figure 7, the disinfectant generator 26 may be formed from a housing 28 containing one or more conduits 30 having electrical cells 32 for emitting electricity into the water flowing through the conduits 30. The housing 28 may be generally cylindrical or have another appropriate shape for containing the conduits 30. Likewise, the conduits 30 may be cylindrical or have another appropriate shape. The number of conduits 30 contained in the housing 28 may vary, but in at least one embodiment, housing 28 may

contain between four conduits and thirty conduits, and in at least one embodiment, may contain about twenty conduits.

[0045] The housing 28 may also include a header 33 for distributing saltwater to the plurality of conduits 30. In addition, the disinfectant generator 26 may also include a bypass conduit 27 for controlling the flow of fluid through the conduits 30. In at least one embodiment, one or more valves 29 may be attached to the conduit 27 for regulating flow of fluids through the disinfectant generator 26. Each conduit 30 of the disinfectant generator 26 may operate efficiently at a flow rate between about 5 gallons per minute (gpm) and about 40 gpm. To keep the disinfectant generator 26 operating at this level, the disinfectant generator may pass excess fluids through the bypass conduit 27. The fluids passing through the bypass conduit 27 and the fluids passing through the conduits 30 mix in the header 31 before flowing to downstream components of the water treatment system 10.

[0046] One or more of the conduits 30 may have a valve 35 on an upstream side and a valve 37 on a downstream side of the electrical cell 32 for controlling flow through the electrical cell 32 and enabling replacement of the electrical cell 32 without having to shutdown the entire system during the replacement. One or more of the conduits 30 may have one or more electrical cells 32. The electrical cells 32 may emit an electrical current into the saltwater, which promotes electrolysis. Electrolysis may break the bonds in various compounds and produce free halides, such as but not limited to, chlorine and bromine, in liquid form. The reduction potential for saltwater electrolysis may be as follows:

(1) Electrolysis of Water

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ 1.229 V;

(2) Potential Halide Reactions

$Cl_2 + 2e^- \rightarrow 2Cl^-$ 1.358 V;

$Br_2 + 2e^- \rightarrow 2Br^-$ 1.065 V;

[0047] The disinfectant generator 26 may be capable of producing halides, such as chlorine, in a concentration of between about 0.5 parts per million (ppm) and about 20 ppm. The desired amount of disinfectant produced is a concentration large enough to remove biota and other contaminants from the water and have residual concentrations of the chlorine or bromine left over.

[0048] The disinfectants may be collected and sent to a conduit 34 carrying contaminated fluids. Byproducts produced by this process may be returned to the sea or other body of water, or other source. The components of the disinfectant generator 26 may be formed from materials, such as, but not limited to, stainless steel, such as stainless steel 316L schedule 40 fiberglass or bond strand. One or more of the conduits 30 may include one or more sensors 36 for measuring salinity, pressure, temperature, and other system parameter. Sensor 36 is depicted as a tube in Figure 7; however, sensor 36 is not limited to this configuration. The disinfectant generator 26 may also include a water leak detector, which may send an alert signal in the event of internal piping failure to prevent catastrophic results. A petcock (not shown) may also be included in the housing 28 for manual viewing of the internal aspects of the disinfectant generator 26. Gas may be injected under pressure or drawn in under low pressure created behind the deflector 44 via the Venturri effect.

[0049] One or more mixers 38, as shown in Figures 1 and 10-12, may be positioned downstream of the location at which the disinfectant injector 24 is coupled to the conduit 34. In at least one embodiment, the mixer 38 may be formed from an elongated housing 40 containing a plurality of injectors 42. The injectors 42 may be positioned around the perimeter of the housing 40 and offset relative to each other so as to form a helical formation. In at least one embodiment, the injectors 42 may be positioned in other configurations about the housing 40. The injectors 42 may be offset about 76 millimeters and rotated about 45 degrees relative to each adjacent injector 42.

[0050] In at least one embodiment, as shown in Figures 11 and 12, the injectors may include a deflector 44 extending from the housing 40 into inner aspects of the mixer 38. In at least one embodiment, the deflector 44 may be formed from a V-shaped member. The injector 42 may also include a diffuser 46, which may be, but is not limited to, a stone, for diffusing a gas into a fluid contained in the mixer 38. The diffuser 46 may be adapted to emit a gas, such as an ionized gas. The ionized gas may be received from an ionized gas generator 60 or another source. The mixer 38 may include gaskets and bolt sleeves in appropriate locations to establish galvanic isolation between dissimilar metals to enhance the life of the mixer 38. In at least one embodiment, as shown in Figure 10, the mixer 38 may be generally cylindrical; however, in other embodiments, the mixer 38 may have other appropriate shapes.

[0051] The water treatment system 10 may include one or more ionized gas injectors 60 for injecting ionized gas into fluids flowing through the water treatment system 10, and more particularly, for injecting ionized gas into the mixer 38 through the injectors 42. The ionized gas injector 60 may be adapted to inject ionized gases, such as, but not limited to, nitrogen and oxygen, into the mixer 38.

[0052] As shown in Figures 14-18, the ionized gas generator 62 may be formed from a plurality of chambers 64 containing one or more ultraviolet (UV) lamps 66. The ionized gas generator 62 may include between one lamp and about 20 lamps, with at least one embodiment having about eight lamps as shown in Figure 15. In at least one embodiment, the ultraviolet lamps may have a wavelength between about 185 nm and about 255 nm. The chambers 64 may be, but are not limited to, generally cylindrical tubes sized and adapted to contain a plurality of UV lamps. The UV lamps may extend from a first end 68 of the chamber 64 to a second end 70 of the chamber 64, which is generally opposite to the first end 68.

[0053] The ionized gas generator 62 may also have a plurality of magnets 72 positioned in the chambers 64. In at least one embodiment, the magnets 72 may be, but are not limited to, permanent magnets, such as rare earth magnets. The magnets 72 may be positioned, as shown in Figure 16, generally along a longitudinal axis 74 of a chamber 64. Each chamber 64 may include a plurality of magnets 72 stacked on top of each other using spacers 76 and oriented so that ends of adjacent magnets 72 have like polarity. Orientation of the magnets in this manner increases the width of the magnetic field produced by the magnets 72. In at least one embodiment, the width of the magnetic field may be at least as large as the distance between the magnets 72 and an inside surface 78 of the chamber 64. Passing air through the magnetic fields produced by the magnets and exposing the air to ultraviolet light reduces nitrogen and oxygen in the air and produces free oxygen and nitrogen.

[0054] The number of chambers 64 used in a particular application depends on the circumference and length of the chambers 64 and the anticipated fluid flow through the water treatment system 10. In at least one embodiment, as shown in Figure 16, the

chambers 64 may have diameters that are about 15 centimeters and may be about 60 inches in length. In this embodiment, as shown in Figure 18, the ionized gas generator 62 may include between about one chamber and about 90 chambers 64; however, the ionized gas generator 62 is not limited to being formed from this number of chambers. Rather, the ionized gas generator 62 may be formed from other amounts of chambers 64. In at least one embodiment, the chambers 64 may be coupled together in parallel. Air flowing through the chamber 64 cools the ultraviolet lamps 66 while being ionized. In at least one embodiment, the air flow rate may be between about two cubic feet per minute (cfm) and about six cfm, depending on the circumference and length of the chambers 64. In one embodiment, the ionized gas generator 62 may have a flow rate of air through the generator 62 of about 2.5 cfm.

[0055] The reduction potential for ionized gas according to the present invention is as follows:

Oxidizing Gas Species

$O_3 + 2H^+ + 2e^- \rightarrow O_2 + H_2O$ 2.07 V;

$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ 1.32 V;

The ionized gas provides both a biological influence and an electromagnetic influence on the water containing the electrolytically produced disinfectants and enhances the coagulation of the contaminants, the separation of solid particles, and the removal of contaminants.

[0056] The water treatment system 10 may include one or more electrical coagulation units 50 downstream of the mixer 38 and the ionized gas generator 62. The electrical coagulation unit 50 may be capable of applying an electrical current to wastewater passing through the unit 50. In at least one embodiment, as shown in Figure 13, the electrical

coagulation unit 50 may be a generally metallic cell capable of imparting a direct current (DC) into the wastewater passing through the electrical coagulation unit 50. The electrical coagulation unit 50 may be formed from a plurality of plates 52 positioned generally parallel within a housing 54. The electrical coagulation unit 50 may be configured in at least one embodiment so that the wastewater flowing through the unit 50 flows along a serpentine pathway between each plate 52, as shown in Figure 13. The plates may be arranged in an alternating fashion such that negatively charged plates 52 are positioned on either side of a positively charged plate 52. The plates 52 may be formed of materials, such as, but not limited to, aluminum, iron, stainless steel, titanium and other composite materials.

[0057] The DC may saturate a wastewater stream flowing through the electrical coagulation unit 50 with electricity to provide an electromotive force necessary to facilitate chemical reactions. In at least one embodiment, the DC may have a relatively low voltage, such as, but not limited to, between about 1 volt and about 50 volts. The electricity introduces the electrons necessary to complete the valence shells of the elements, which, in turn, form more stable compounds. The stable compounds are generally difficult to dissolve in water and generally precipitate out of solution. In addition, application of the electricity causes electrolysis to occur. Electrolysis produces disinfectants, such as hypochlorite and halides, such as, but not limited to, bromine and chlorine, from saltwater in the wastewater. These disinfectants kill bacteria, viruses, and other living biological materials in the wastewater. If the wastewater does not have a sufficient concentration of salt, salt may be added in amounts such as between about 2,000 ppm and about 5,000 ppm to facilitate electrolysis. At times, seawater may be used having between about 30 and 35,000 ppm of salt.

[0058] The electrical coagulation unit 50 facilitates coagulation through electrical reactions with dissolved impurities. In operation, the electrical current introduced to the plates 52 cause sacrificial electrode ions to remove contaminants by chemical reaction, precipitation, or through coalescence of colloidal materials, or any combination thereof. In addition, the introduction of electricity to the wastewater may break oil emulsions in the fluid. Portions of the aluminum plates 52 may break off of the plates 52 and form flocculants in the fluid passing through the electrical coagulation unit 50. The electrical coagulation unit 50 may operate at a steady state by controlling the current and voltage of the electrical current applied to the plates 52. In an alternative embodiment, the water treatment system 10 may use a polymer injection unit in place of the electrical coagulation unit 50 for removing suspended solids.

[0059] The water treatment system 10 may also include one or more second mixers 80 downstream of the electrical coagulation unit 50. The second mixer 80 may be positioned to mix the one or more ionized gases generated by the ionized gas generator 63 or injected by the ionized gas injector 60 with wastewater passing through the water treatment system 10. The second mixer 80 may be similar to the mixer 38. However, in at least some embodiments the configuration or size, or both, of the second mixer 80 may differ from the mixer 38.

[0060] The water treatment system 10 may also include one or more dissolved air flotation units 90 for removing contaminants from the water using microbubbles. In at least one embodiment, the dissolved air flotation unit 90 may be positioned downstream of the second mixer 80. The dissolved air flotation unit 90 may be formed from a tank 92 having an inlet 94 near a bottom surface 96 of the tank 92. Injectors 98 may be positioned in the bottom surface 96 or proximate to the bottom surface 96 for injecting bubbles into

the tank 92 at the bottom portion of the tank 92. During operation, bubbles may carry solids to the top 100 of the tank 92 where the solids flow over the top of one or more weirs 102. In alternative embodiments, suspended solids may be taken off of the surface using one or more vacuums. In at least one embodiment, ionized gases may be injected as microbubbles into the tank 92. The relatively clean water may be expelled from the dissolved air flotation unit 90 through one or more exit orifices 104 positioned generally midway between the bottom 96 and the top 100 of the tank 92. Cleaned water may also be withdrawn from the dissolved air flotation unit 90 and injected into the injectors 98 of the dissolved air flotation unit 90 via a recirculation loop 91. In at least one embodiment, one or more electrical coagulation units 93 may be attached to the recirculation loop 91. In at least one embodiment, the dissolved air flotation unit 90 may have a capacity between about 300 gallons and about 500 gallons and capable of processing about 100 tons of wastewater per day.

[0061] An alternative embodiment of the primary treatment system 8, as shown in Figure 19, may include substantially all of the components previously described but in an alternative configuration. More specifically, the primary treatment system 8 may include a first stage filtration system 220 positioned upstream from the supply tank 224. The first stage filtration system may also include a manual bypass system 222. A mixer 226 may be positioned downstream of the supply tank 224. The pH of the wastewater flowing through the primary treatment system 8 may be controlled at the mixer 226. A flocculant system 228 may be positioned downstream of the mixer 226. In at least one embodiment, the flocculant system 228 may be an electrical coagulation unit 50, as previously described and shown in Figure 13. The primary treatment system may include a second mixer 230 positioned downstream of the flocculant system 228.

[0062] The primary treatment system 8 may also include a saturator system 232 for mixing ionized gases or disinfectants, or both, with a wastewater. In at least one embodiment, the saturator 232 may be formed from a chamber and may receive ionized gas or may receive disinfectants, or both. The saturator 232 is a pressure vessel operating between about 3 bars and about 6 bars in which one or more gases may be dissolved into a fluid forming a supersaturated fluid. In at least one embodiment, the saturator 232 may receive ionized gases from an ionized gas generator 234, as shown in Figures 14-18 and identified therein as ionized gas generator 62. The saturator 232 may receive disinfectants, such as, but not limited to chlorine, bromine, and other disinfectants, from a disinfectant generator 236, as shown in Figures 7-9 and identified therein as disinfectant generator 26. The gases dissolved into water, or other fluid, in the saturator 232 are released when the dissolved gas/fluid mixture is released into atmospheric conditions.

[0063] The primary treatment system 8 may also include one or more dissolved air flotation units 240 downstream of a connection point of the saturator 232. The dissolved air flotation unit 240 may inject microbubbles into the stream of wastewater to remove suspended solids. In at least one embodiment, ionized gases may be injected into the wastewater stream.

[0064] Another alternative embodiment of the primary treatment system 8, as shown in Figure 20, includes a saturator system 260. The saturator system 260 may be feed with one or more ionized gases or disinfectants, or both. In at least one embodiment, one or more ionized gas generators 262 may be coupled to at least one mixer 264. The mixer 264 may or may not resemble the mixer shown in Figures 10-12. The mixer 264 may be in communication with the saturator 260 and upstream of the saturator 260. A disinfectant source 265, which may be a tank, a disinfectant generator, as shown in

Figures 7-9, or other device, may also be coupled to the saturator 260. In at least one embodiment, a flocculant source 266 may be included in the primary treatment system 8. The flocculant source 266 may be, but is not limited to being, an electrical coagulation unit, as shown in Figure 13.

[0065] A dissolved air flotation unit 268, may be positioned downstream of the saturator 260. The dissolved air flotation unit 268 may be formed from various configurations. In at least one embodiment, as shown in Figure 20, the wastewater may enter the dissolved air flotation unit 268 at a bottom portion of the unit 268. Microbubbles consisting of air, ionized gases, or other gases, may be injected into the wastewater in the dissolved air flotation unit 268. Suspended solids may attach to the microbubbles and be carried to a surface of the wastewater. The solids may be separated from the wastewater using a vacuum system or by allowing the solids to flow over a weir 272 and out outlet 270. Cleaned wastewater may be removed from a bottom portion of the dissolved air floatation unit 268 through outlet 274. The cleaned wastewater may or may not be sent through a secondary treatment system.

[0066] The primary treatment system 8 may be configured to treat wastewaters containing large concentrations of oils, such as oil concentrations commonly found in bilge water. In particular, the primary treatment system 8 may include one or more gross oil/water separators 25, as shown in Figure 1, for removing a substantial portion of one or more oils from the wastewater before the wastewater has an opportunity to contact other components of the wastewater treatment system 10.

II. Secondary Treatment System

[0067] The secondary treatment system 150, as shown in Figure 19, may include one or more disinfectant injectors 150 for applying disinfectants to wastewater flowing through the secondary treatment system 150. The disinfectant injector 150 may be positioned downstream of the primary treatment system 8, and, in at least one embodiment, may be positioned immediately downstream of the dissolved air flotation units 90. The disinfectant injector 152 may include a disinfectant generator 154 for generating disinfectants to inject into the wastewater flowing through the secondary treatment system 150.

[0068] The secondary treatment system 150 may include a contact tank 156 for mixing one or more disinfectants and the wastewater. The contact tank 156 may have a capacity of between about 5 gallons and about 100 gallons.

[0069] The secondary treatment system 150 may also include one or more filters 160 for removing suspended solids and other contaminants that may not have been previously removed in the water treatment system 10. The filter 160 may be a filter, such as, but not limited to, a 35 micron filter. The filter 160 is not limited to this size but may be other sizes as well. The filters may include media such as, but not limited to, sand, glass beads, carbon, ion resins, or other appropriate materials. In at least one embodiment, the filter 160 may be formed from two filters 160 in parallel, which may be referred to a duplex filter mechanism. The duplex filter mechanism enables either or both of the filters 160 to be used. In the event one of the filters 160 needs to be cleaned, valves may be actuated to isolate one of the filters 160 to be cleaned or replaced.

[0070] The secondary treatment system 150 may also include a disinfectant light source 170. In at least one embodiment, the disinfectant light source 150 may be one or more ultraviolet lamps. The secondary treatment system 150 may also include a

recirculation loop 162, as shown in Figure 2 and 19, for directing wastewater having one or more contaminants above a selected standard to the beginning of the water treatment system 10 to be sent through the system 10 once again. The standards selected may be those standards of the jurisdiction in which a vessel containing the water treatment system 10 is present. In at least one embodiment, those standards may be the standards in force in Miami, Dade County, Florida, U.S.A.

[0071] In an alternative embodiment, the secondary treatment system 150 may be configured to inject one or more disinfectants or one or more ionized gases, or both, into a stream of wastewater flowing from the dissolved air flotation unit 240, as shown in Figure 19. The disinfectants may be supplied from one or more disinfectant generators 242, and the ionized gases may be supplied from one or more ionized gas generators 244. The ionized gas may be injected into the wastewater in one or more contact tanks 246. At least one of the contact tanks 246 may be used to remove solids from the wastewater. In at least one embodiment, the secondary treatment system 150 may include two contacts tanks 246. Some embodiments of the secondary treatment system 150 may also include an electrical coagulation unit 151, as shown in Figure 2, for coagulating contaminants in the wastewater.

III. Solid Waste Treatment System

[0072] The water treatment system 10 may also include a solid waste treatment system 200 for collecting sludge separated by the primary or secondary treatment systems 8, 150. The sludge may be transported to the solid waste treatment system 200 using one or more pumps 202, which may be, but is not limited to, a macerating pump. The solid

waste treatment system 200 may include a buffer tank 204 for collecting the sludge from the pump 202. Polymers may be added to the sludge while contained in the buffer tank 204. The solid waste treatment system 200 may also include a separator 206, which may be, but is not limited to, a centrifugal separator 206. Sludge received from the separator 206 may have a solids concentration of about 25 percent. The sludge may be sent to a garbage silo to be mixed with other combustible wastes. This mixture of garbage may be dried by sending the mixture through a dryer prior to being sent through an incinerator 208. The sludge may be sprayed directly into an incinerator 208 using one or more nozzles. Water received from the separator may be recirculated to the beginning of the water treatment system 10 for further treatment.

IV. Operation of Wastewater Treatment System

[0073] Operation of the wastewater treatment system 10 may be controlled using various controllers to automatically control and operate the various components of the wastewater treatment system described above. The controllers for the wastewater treatment system 10 may be completely contained on the vessel in which the wastewater treatment system 10 is mounted. In other embodiments, some or all of the controllers may be located on another vessel or on land. Thus, the wastewater treatment system 10 may be controlled by personnel not on the vessel in which the wastewater treatment system 10 is mounted. A configuration such as this prevents crew members from overriding the system 10 and discharging wastewater having concentrations of contaminants that are greater than applicable regulations. Thus, remote control of the system 10 may prevent an owner of a vessel from liability from illegal discharges.

[0074] The wastewater treatment system 10 may be configured from a plurality of modules sized to accommodate an anticipated maximum load from a supply source, such as sources commonly found on a vessel, such as a ship, a megayacht, or other vessel. The wastewater treatment system 10 may receive fluids from a variety of sources on a vessel, some of which are previously listed, such as, but not limited to, laundry facilities, raw sewage, galley drain, galley pulper, bilge areas, and other sources. The water treatment system may utilize one or more of the following: nitrogen, oxygen, bromine, chlorine, and hydrogen peroxide, to disinfect the wastewater. Thus, the wastewater treatment system 10 may treat wastewater without injecting the wastewater with significant amounts of chemicals that are harmful to the environment.

[0075] The wastewater is collected in the collection device 12, which is used to regulate the flow of fluids through the system 10. The wastewater flows from the collection device 12 through a filtration system 18 where large suspended solids are removed. In embodiments configured to cleanse wastewater with high concentrations of oils, such as bilge water, the wastewater may be passed through one or more gross oil/water separators 25 to remove at least a portion of the oils from the wastewater. The wastewater may then be passed to a supply tank 22, which also regulates the flow of fluids through the water treatment system 10. Waste waster flows from the supply tank 22 towards the mixer 38; however, before the wastewater is passed into the mixer 38, a disinfectant may be added into the wastewater through the disinfectant injector 24. The disinfectant may be taken from a storage tank or other holding source or may be produced using a disinfectant generator 26. In at least one embodiment, the disinfectant may be a halide taken from sea water and may include, but is not limited to, chlorine or bromine, or both.

[0076] The disinfectant may mix with the wastewater in the conduit 34 and may remove at least a portion of the fecal coliforms, BOD, or COD, or any combination thereof, from the wastewater. The mixture of the disinfectant and the wastewater may be passed to a mixer 38 to be mixed with one or more ionized gases. The ionized gas may be emitted into the wastewater stream by passing through an ionized gas injector 60. In at least one embodiment, the ionized gas may be generated by the ionized gas generator 62. The ionized gas may remove numerous contaminants from the wastewater.

[0077] The wastewater is then passed to an electrical coagulation unit 50, which emits electricity into the stream of wastewater. In at least one embodiment, the electrical coagulation unit 50 may be formed from a plurality of electrically conductive plates 52 that electrolyze and form flocculants in the wastewater. The flocculants facilitate removal of suspended solids, fecal coliforms, BODs, CODs, or other materials, or any combination of these materials. The waste materials settle out of solution and collect in the electrical coagulation unit 50, where the waste materials may be removed.

[0078] The wastewater may then be passed to a mixer 80 where the wastewater may be mixed with an ionized gas. The ionized gas may be generated in the ionized gas generator 63. The ionized gas removes at least a portion of the contaminants from the wastewater that has not been previously removed. The wastewater may then be passed to a dissolved air flotation unit 90 in which the suspended solids and other materials may precipitate out of the wastewater and the partially clean water may be removed from the unit 90. Microbubbles formed from air, ionized gases, or other gases, or any combination thereof, are passed through the dissolved air flotation unit 90 to separate suspended solids from the wastewater.

[0079] The partially clean water may then be passed to a secondary treatment system 150. In the secondary treatment system 150, a disinfectant may be added to the wastewater to further kill at least a portion of any remaining fecal coliforms, BODs, CODs, or any other organic materials. The disinfectant may be produced using a disinfectant generator 154 to generate disinfectants from sea water or taken from a storage tank in some embodiments. The wastewater may then be passed through a contact tank or pipe 156, which regulates the amount of time the disinfectant is in contact with the wastewater. The wastewater may then be passed to a filter 160 for removing any remaining suspended solids and other contaminants from the wastewater. In at least one embodiment, the filter 160 may be formed from two or more filters configured to enable removal and replacement of at least one of the filters 160 while the other filter remains operable, thereby reducing, or eliminating, downtime of the system 10. The cleaned wastewater may be tested to determine if the wastewater meets applicable standards. If the wastewater does not meet the standards, the wastewater may be sent back through the system by passing the wastewater through the recirculation loop 162 to be cleaned by the system once again. This process may be completed as many times as necessary, although it is possible that a single pass is sufficient.

[0080] Solids, such as sludge, recovered from the wastewater at various stages in the system 10 may be handled in the solid waste treatment system 200. The solids may be transported using the pump 202. The solids may be stored in the buffer tank 204 and sent to the separator 206 to remove additional water from the solids. Any water recovered from the system 10 may be sent to the beginning of the system 10 to be processed. Solid material in a dewatered form may be removed from the separator 206 and burned in the incinerator 208, thereby substantially reducing the amount of waste requiring storage.

[0081] The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described or portions thereof. Furthermore, the descriptions of this invention are directed to embodiments configured for use on ocean going ships and vessels; however, the invention may also be utilized in land based applications as well. Having thus described the invention in detail, it should be apparent that various modifications can be made in the present invention without departing from the spirit and scope of the following claims.

CLAIMS

We claim:

1. A water treatment system, comprising:

at least one collection device for collecting wastewater containing contaminants;

at least one disinfectant injector for injecting at least one disinfectant into the wastewater treatment system downstream of the at least one collection device;

at least one mixer for mixing an ionized gas with the wastewater;

at least one ionized gas injector coupled to the at least one mixer for injecting ionized gas into the wastewater in the at least one mixer; and

at least one dissolved air flotation unit for removing suspended solids from the wastewater using microbubbles.

2. The water treatment system of claim 1, wherein the at least one disinfectant injector further comprises a disinfectant generator for generating disinfectant materials from saltwater.

3. The water treatment system of claim 2, wherein the disinfectant generator comprises a housing containing a plurality of conduits having electrical cells for exposing electricity to saltwater flowing through the conduits.

4. The water treatment system of claim 3, wherein the disinfectant generator further comprises a single inlet coupled to a header that distributes saltwater to the

plurality of conduits and at least one of the conduits has a valve upstream of an electrical cell and a valve downstream of the electrical cell.

5. The water treatment system of claim 3, wherein the disinfectant generator further comprises at least one sensor positioned downstream of an electrical cell in at least one of the plurality of conduits.

6. The water treatment system of claim 3, wherein the disinfectant generator further comprises at least one bypass conduit for controlling flow of saltwater through the conduits of the disinfectant generator.

7. The water treatment system of claim 3, wherein the disinfectant generator comprises between about four conduits and about twenty conduits, each having an electrical cell.

8. The water treatment system of claim 1, wherein the ionized gas injector comprises an ionized gas generator formed from a plurality of chambers, each chamber containing a plurality of ultraviolet lamps and each chamber adapted to allow a gas to pass through the ionized gas generator.

9. The water treatment system of claim 8, wherein the plurality of ultraviolet lamps comprise between about one ultraviolet lamp and about twenty ultraviolet lamps extending from a first end of the ionized gas generator to a second end of the generator generally opposite to the first end.

10. The water treatment system of claim 9, wherein the plurality of chambers are coupled in parallel.

11. The water treatment system of claim 9, wherein the plurality of chambers forming the ionized gas generator comprises thirty chambers.

12. The water treatment system of claim 1, wherein the dissolved air flotation unit comprises a tank comprising: an inlet positioned proximate to a bottom surface of the tank; a plurality of injectors proximate to the bottom surface of the tank for emitting ionized gas microbubbles; and at least one contaminant removal device for separating suspended solids carried to the top of the unit by the ionized gas microbubbles from the wastewater.

13. The water treatment system of claim 1, further comprising at least one filtration system upstream of the collection device for removing at least a portion of the suspended solids from the wastewater.

14. The water treatment system of claim 13, wherein the at least one filtration system comprises at least one drum screen with an automatic cleansing system.

15. The water treatment system of claim 1, further comprising at least one electrical coagulation unit for applying an electrical current to the wastewater for removing at least a portion of the suspended solids.

16. The water treatment system of claim 15, wherein the electrical coagulation unit comprises a plurality of plates positioned generally parallel to each other and including a generally serpentine flow path between the plurality of plates.

17. The water treatment system of claim 1, wherein the at least one disinfectant injector comprises at least one first disinfectant injector positioned upstream of the electrical coagulation unit and at least one second disinfectant injector positioned downstream of the at least one dissolved air flotation unit.

18. The water treatment system of claim 17, wherein the first and second disinfectant injectors positioned upstream and downstream of the electrical coagulation unit each further comprise at least one disinfectant generator for generating disinfectant materials from saltwater, each comprising a housing containing a plurality of conduits having electrical cells for exposing electricity to the water flowing through the conduits.

19. The water treatment system of claim 17, further comprising at least one contact tank downstream of the second disinfectant injector.

20. The water treatment system of claim 1, further comprising at least one ionized gas injector downstream of the at least one dissolved air flotation unit for injecting ionized gas into the water treatment system.

21. The water treatment system of claim 20, further comprising at least one contact tank downstream of the ionized gas injector that is downstream of the at least one dissolved air flotation unit.

22. The water treatment system of claim 21, further comprising at least one filter downstream of the at least one dissolved air flotation unit.

23. The water treatment system of claim 22, wherein the at least one filter is comprised of at least a duplex filter system.

24. The water treatment system of claim 1, further comprising a recirculation loop coupled to a downstream location of the water treatment system for recirculating water through the water treatment system if the water, after passing through the water treatment system, does not meet selected standards.

25. The water treatment system of claim 1, further comprising a disinfectant light source downstream of the dissolved air flotation unit.

26. The water treatment system of claim 1, further comprising an ozone generator downstream of the dissolved air flotation unit and configured to emit ozone into the water treatment system to contact the wastewater.

27. The water treatment system of claim 1, further comprising a solid waste treatment system comprising at least one separator for dewatering solids produced by

the water treatment system and at least one incinerator for incinerating solids extracted from wastewater by the water treatment system.

28. The water treatment system of claim 1, further comprising at least one saturization system formed from a labyrinth of pipes upstream of the at least one dissolved air flotation unit for receiving at least one disinfectant and at least one ionized gas.

29. The water treatment system of claim 1, further comprising at least one oil/water separator for removing at least a portion of any oils present in the wastewater.

30. A water treatment system, comprising:

at least one collection device for collecting wastewater containing contaminants;

at least one filtration system upstream of the collection device for removing at least a portion of suspended solids from the wastewater;

at least one disinfectant injector for injecting at least one disinfectant into the wastewater treatment system downstream of the at least one collection device;

at least one disinfectant generator in communication with the at least one disinfectant injector for generating disinfectant materials from saltwater, the disinfectant generator comprising a housing containing a plurality of conduits having electrical cells for exposing electricity to saltwater flowing through the conduits;

at least one mixer for mixing an ionized gas with the wastewater;

at least one ionized gas injector coupled to the at least one mixer for injecting ionized gas into the wastewater in the at least one mixer;

at least one ionized gas generator formed from a plurality of chambers, each chamber containing a plurality of ultraviolet lamps and each chamber adapted to allow a gas to pass the through the ionized gas generator;

at least one electrical coagulation unit for applying an electrical current to the wastewater for removing at least a portion of the suspended solids; and

at least one dissolved air flotation unit for removing suspended solids from the wastewater using microbubbles.

31. The water treatment system of claim 30, wherein the disinfectant generator further comprises a single inlet coupled to a header that distributes saltwater to the plurality of conduits and at least one of the conduits has a valve upstream of an electrical cell and a valve downstream of the electrical cell.

32. The water treatment system of claim 30, wherein the disinfectant generator further comprises at least one sensor positioned downstream of an electrical cell in at least one of the plurality of conduits.

33. The water treatment system of claim 30, wherein the disinfectant generator further comprises at least one bypass conduit for controlling flow of saltwater through the conduits of the disinfectant generator.

34. The water treatment system of claim 30, wherein the disinfectant generator comprises between about four conduits and about twenty conduits, each having an electrical cell.

35. The water treatment system of claim 30, wherein the plurality of ultraviolet lamps comprise between about one ultraviolet lamp and about twenty ultraviolet lamps extending from a first end of the ionized gas generator to a second end of the generator generally opposite to the first end.

36. The water treatment system of claim 35, wherein the plurality of chambers are coupled in parallel.

37. The water treatment system of claim 35, wherein the plurality of chambers forming the ionized gas generator comprises between about one chamber and about 90 chambers.

38. The water treatment system of claim 30, wherein the dissolved air flotation unit comprises a tank having an inlet positioned proximate to a bottom surface of the tank, a plurality of injectors proximate to the bottom surface of the tank for emitting microbubbles, and at least one contaminant removal device for removing suspended solids carried to the top of the unit by the microbubbles from the wastewater.

39. The water treatment system of claim 30, wherein the at least one filtration system comprises at least one drum screen with an automatic cleansing system.

40. The water treatment system of claim 30, wherein the electrical coagulation unit comprises a plurality of plates positioned generally parallel to each other and including a generally serpentine flow path between the plurality of plates.

41. The water treatment system of claim 30, wherein the at least one disinfectant injector comprises at least one first disinfectant injector positioned upstream of the electrical coagulation unit and at least one second disinfectant injector positioned downstream of the at least one dissolved air flotation unit.

42. The water treatment system of claim 41, wherein the first and second disinfectant injectors positioned upstream and downstream of the electrical coagulation unit each further comprise at least one disinfectant generator for generating disinfectant materials from saltwater, each comprising a housing containing a plurality of conduits having electrical cells for exposing electricity to the water flowing through the conduits.

43. The water treatment system of claim 41, further comprising at least one contact tank downstream of the second disinfectant injector.

44. The water treatment system of claim 30, further comprising at least one ionized gas injector downstream of the at least one dissolved air flotation unit for injecting ionized gas into the water treatment system.

45. The water treatment system of claim 44, further comprising at least one contact tank downstream of the ionized gas injector that is downstream of the at least one dissolved air flotation unit.

46. The water treatment system of claim 45, further comprising at least one filter downstream of the at least one dissolved air flotation unit.

47. The water treatment system of claim 46, wherein the at least one filter is comprised of at least a duplex filter system.

48. The water treatment system of claim 30, further comprising a recirculation loop coupled to a downstream location of the water treatment system for recirculating water through the water treatment system if the water, after passing through the water treatment system, does not meet selected standards.

49. The water treatment system of claim 30, further comprising a disinfectant light source downstream of the dissolved air flotation unit.

50. The water treatment system of claim 30, further comprising an ozone generator downstream of the dissolved air flotation unit and configured to emit ozone into the water treatment system to contact the wastewater.

51. The water treatment system of claim 30, further comprising a solid waste treatment system comprising at least one separator for dewatering solids produced by

the water treatment system and at least one incinerator for incinerating solids extracted from wastewater by the water treatment system.

52. The water treatment system of claim 30, further comprising at least one saturization system formed from a labyrinth of pipes upstream of the at least one dissolved air flotation unit for receiving at least one disinfectant and at least one ionized gas.

53. The water treatment system of claim 30, further comprising at least one oil/water separator for removing at least a portion of any oils present in the wastewater.

54. A method of removing contaminants from wastewater, comprising:

collecting the wastewater in a collection device;

injecting at least one disinfectant into the wastewater;

injecting at least one ionized gas into the wastewater contained in at least one mixer adapted for mixing an ionized gas with the wastewater; and

passing the wastewater through at least one dissolved air flotation unit for removing suspended solids from the wastewater using microbubbles.

55. The method of claim 54, further comprising generating at least one disinfectant using saltwater and at least one disinfectant generator comprising a housing containing at least one conduit having an electrical cell for exposing electricity to saltwater flowing through the at least one conduit.

56. The method of claim 55, wherein generating the at least one disinfectant comprises receiving saltwater from a body of water, passing the saltwater through at least one conduit including at least one electrical cell, and imparting electricity to at least a portion of the saltwater passing through the disinfectant generator.

57. The method of claim 54, further comprising passing the wastewater through at least one electrical coagulation unit for applying an electrical current to the wastewater for coagulating at least a portion of suspended solids.

58. The method of claim 57, wherein passing the wastewater through at least one electrical coagulation unit comprises passing the wastewater along a generally serpentine flow path between a plurality of plates positioned generally parallel to each other.

59. The method of claim 57, further comprising passing solids generated by the at least one electrical coagulation unit, the at least one filtration system, and the at least one dissolved air flotation unit through a solid waste treatment system comprising at least one separator for dewatering solids and at least one incinerator for incinerating the solids.

60. The method of claim 54, further comprising generating at least one ionized gas.

61. The method of claim 60, wherein generating the at least one ionized gas comprises passing a gas through at least one ionized gas generator comprising a plurality of chambers, wherein at least one chamber contains a plurality of ultraviolet lamps and each chamber is adapted to allow a gas to pass through the ionized gas generator.

62. The method of claim 54, further comprising passing wastewater through at least one filtration system upstream of the collection device for removing at least a portion of suspended solids from the wastewater.

63. The method of claim 62, wherein passing wastewater through the at least one filtration system comprises passing wastewater through at least one drum screen having an automatic cleansing system.

64. The method of claim 54, wherein injecting the at least one disinfectant into the wastewater comprises injecting the at least one disinfectant into the wastewater upstream and downstream of the at least one dissolved air flotation unit.

65. The method of claim 54, further comprising passing the wastewater through at least one contact tank downstream of the at least one dissolved air flotation unit.

66. The method of claim 54, further comprising injecting at least one ionized gas into the wastewater upstream and downstream of the at least one dissolved air flotation unit.

67. The method of claim 54, further comprising injecting at least one ionized gas into the at least one dissolved air flotation unit.

68. The method of claim 54, further comprising passing the wastewater through at least one filter downstream of the at least one dissolved air flotation unit.

69. The method of claim 54, further comprising passing the wastewater through a recirculation loop coupled to the water treatment system downstream of the dissolved air flotation unit for recirculating water through the water treatment system if the water, after passing through the water treatment system, does not meet selected standards.

70. The method of claim 54, further comprising passing the wastewater past a disinfectant light source downstream of the dissolved air flotation unit.

71. The method of claim 54, further comprising generating ozone using an ozone generator and injecting the ozone into the wastewater downstream of the dissolved air flotation unit.

72. The method of claim 54, further comprising passing the wastewater through at least one oil/water separator to remove at least a portion of any oils in the wastewater.

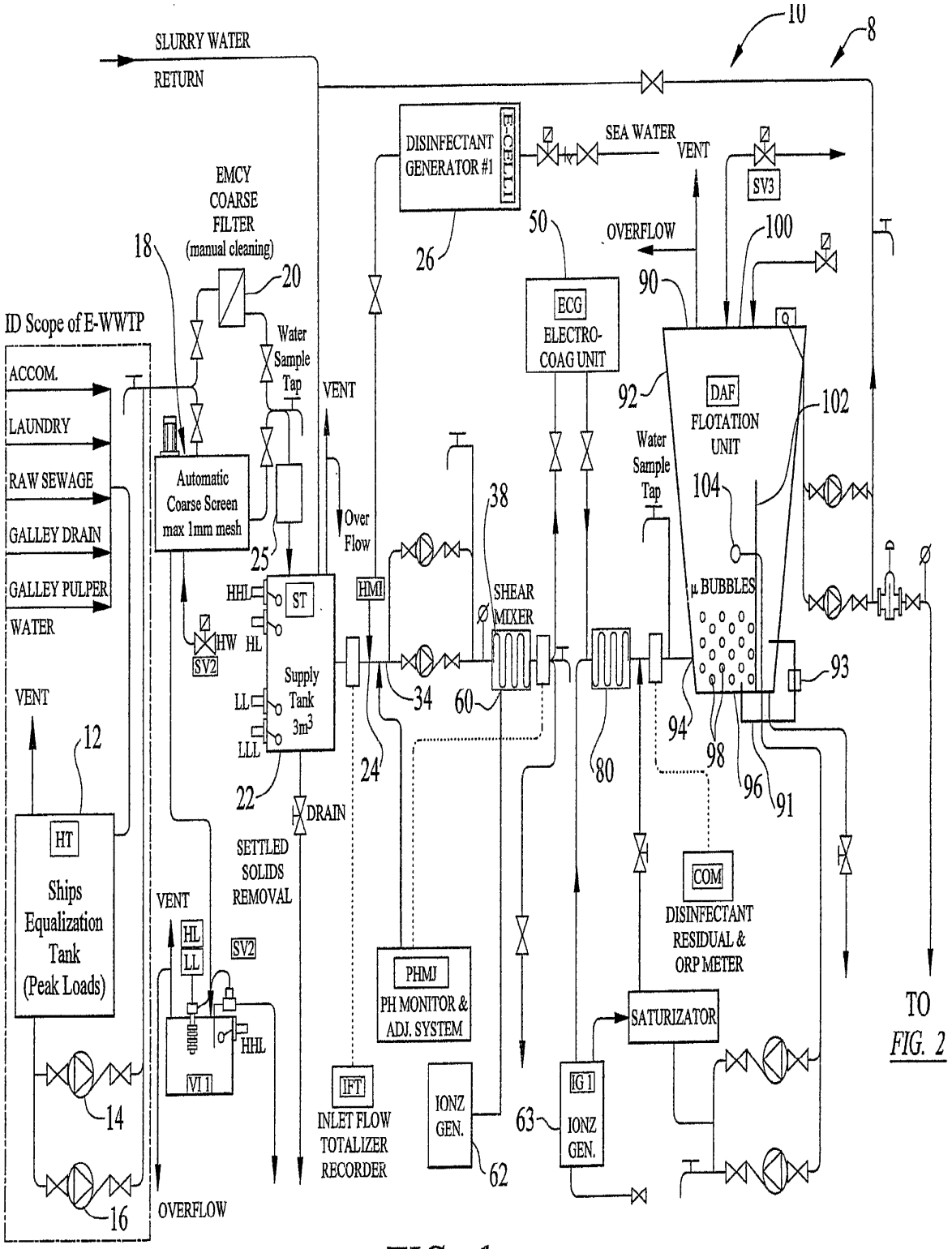

SLURRY WATER RETURN
10
8
DISINFECTANT GENERATOR #1
E-CELL 1
SEA WATER
VENT
SV3
EMCY COARSE FILTER (manual cleaning)
18
20
26
50
OVERFLOW
100
90
ECG ELECTRO-COAG UNIT
Q
ID Scope of E-WWTP
ACCOM.
LAUNDRY
RAW SEWAGE
GALLEY DRAIN
GALLEY PULPER WATER
Water Sample Tap
VENT
92
DAF FLOTATION UNIT
102
Water Sample Tap
104
Automatic Coarse Screen max 1mm mesh
Over Flow
38
25
HHL
ST
HMI
SHEAR MIXER
μ BUBBLES
HW
HL
SV2
Supply Tank 3m3
LL
LLL
34
60
93
94
98
96
91
VENT
12
22
24
80
DRAIN
HT
Ships Equalization Tank (Peak Loads)
SETTLED SOLIDS REMOVAL
COM
DISINFECTANT RESIDUAL & ORP METER
VENT
HL
LL
SV2
PHMJ
PH MONITOR & ADJ. SYSTEM
SATURIZATOR
HHL
VI 1
IFT
INLET FLOW TOTALIZER RECORDER
IONZ GEN.
62
63
IG 1
IONZ GEN.
14
16
OVERFLOW
TO FIG. 2

FIG. 1

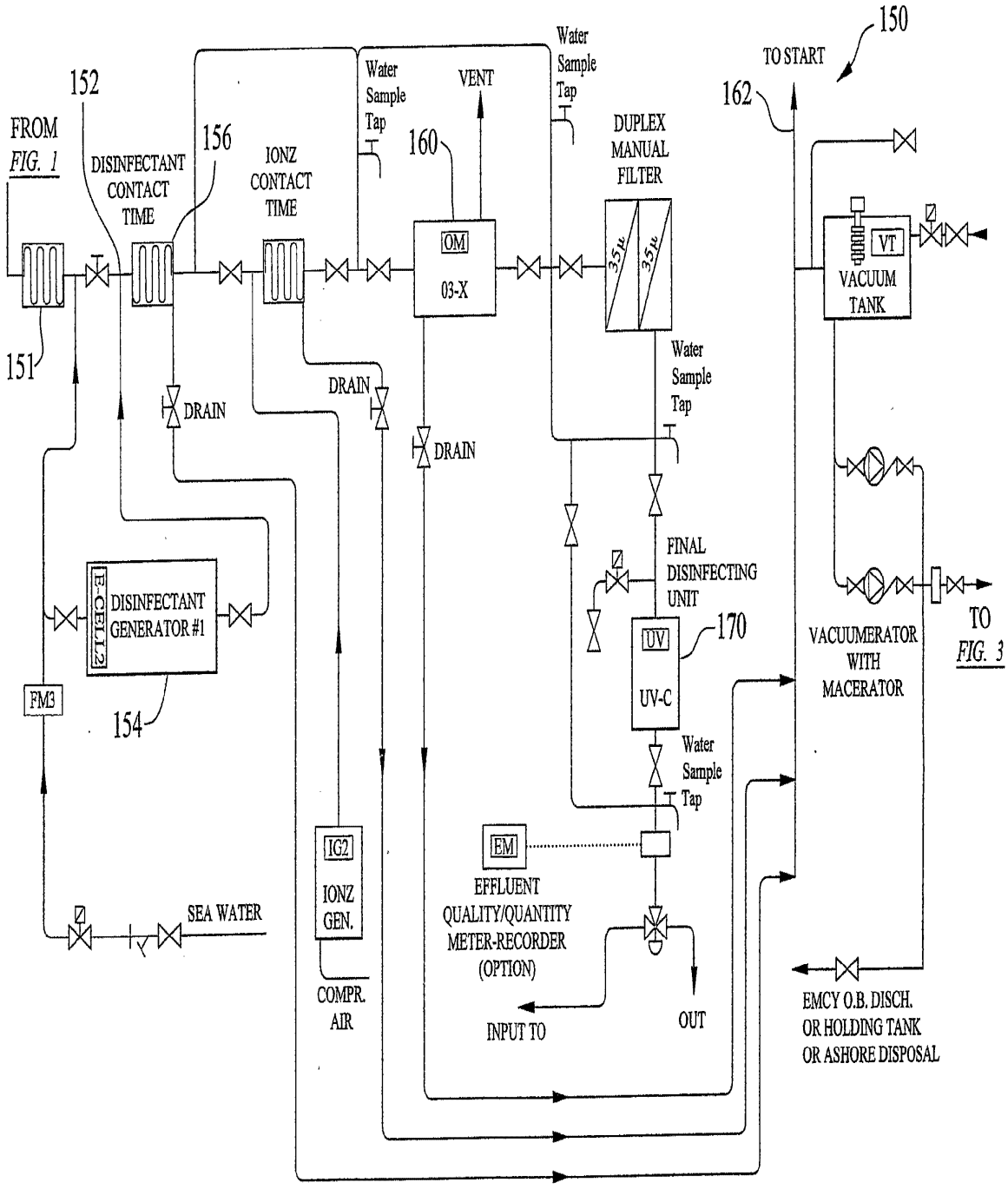

FROM FIG. 1
152
DISINFECTANT CONTACT TIME
156
IONZ CONTACT TIME
Water Sample Tap
VENT
160
Water Sample Tap
DUPLEX MANUAL FILTER
150
TO START
162
OM
03-X
35µ
35µ
VT
VACUUM TANK
151
DRAIN
DRAIN
DRAIN
Water Sample Tap
FINAL DISINFECTING UNIT
UV
UV-C
170
VACUUMERATOR WITH MACERATOR
TO FIG. 3
E-CELL2
DISINFECTANT GENERATOR #1
154
FM3
Water Sample Tap
IG2
IONZ GEN.
EM
EFFLUENT QUALITY/QUANTITY METER-RECORDER (OPTION)
SEA WATER
COMPR. AIR
INPUT TO
OUT
EMCY O.B. DISCH. OR HOLDING TANK OR ASHORE DISPOSAL

FIG. 2

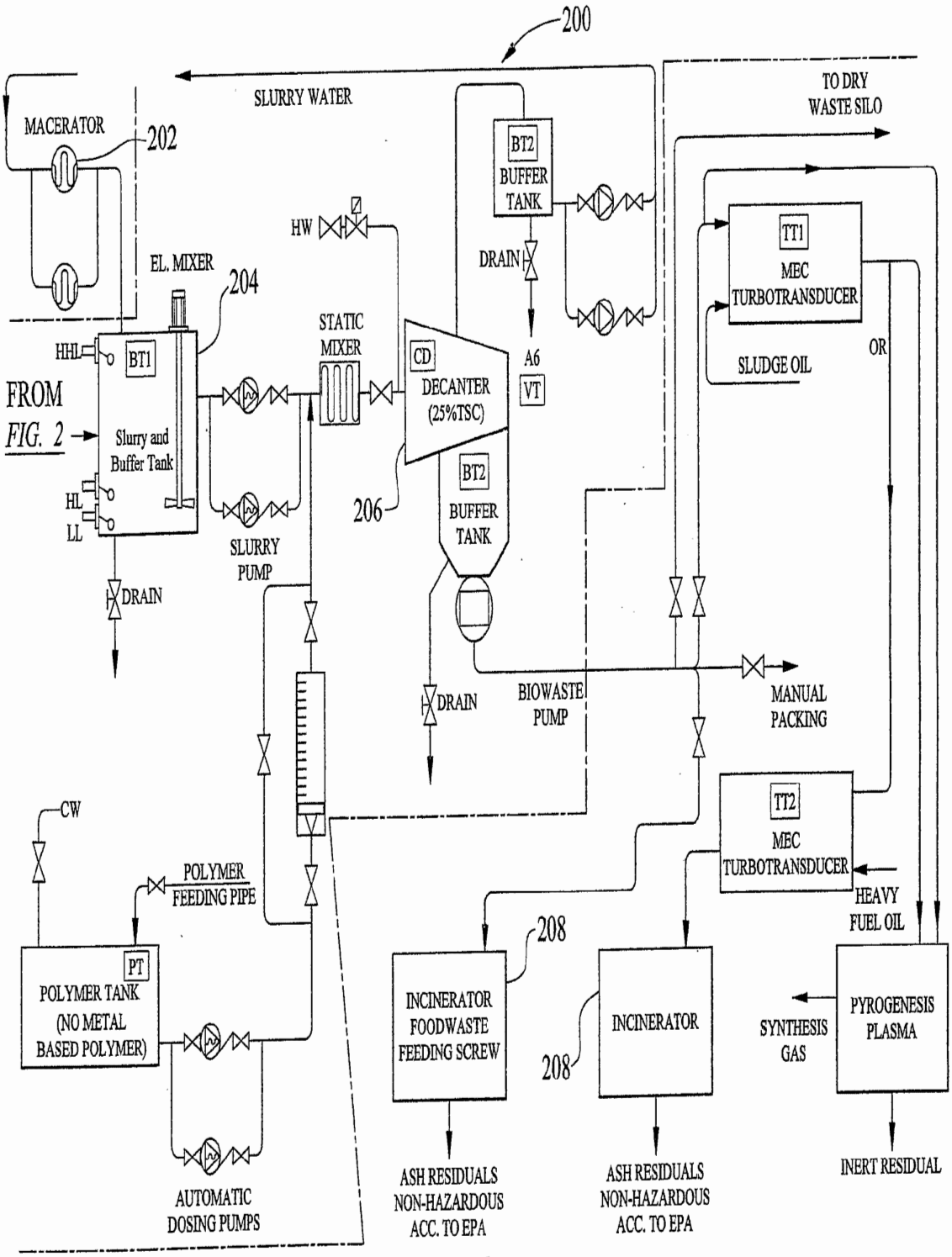

200
SLURRY WATER
TO DRY WASTE SILO
MACERATOR
202
BT2 BUFFER TANK
HW
DRAIN
EL. MIXER
204
TT1 MEC TURBOTRANSDUCER
STATIC MIXER
CD DECANTER (25%TSC)
A6 VT
HHL
BT1
FROM FIG. 2
Slurry and Buffer Tank
SLUDGE OIL
OR
HL
LL
206
BT2 BUFFER TANK
SLURRY PUMP
DRAIN
DRAIN
BIOWASTE PUMP
MANUAL PACKING
TT2 MEC TURBOTRANSDUCER
CW
POLYMER FEEDING PIPE
HEAVY FUEL OIL
208
PT POLYMER TANK (NO METAL BASED POLYMER)
INCINERATOR FOODWASTE FEEDING SCREW
INCINERATOR
208
SYNTHESIS GAS
PYROGENESIS PLASMA
AUTOMATIC DOSING PUMPS
ASH RESIDUALS NON-HAZARDOUS ACC. TO EPA
ASH RESIDUALS NON-HAZARDOUS ACC. TO EPA
INERT RESIDUAL

FIG. 3

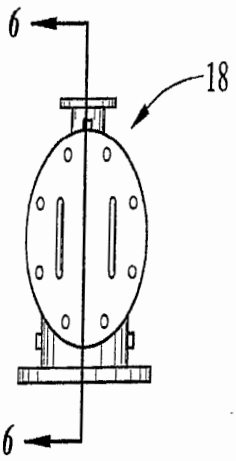


FIG. 4

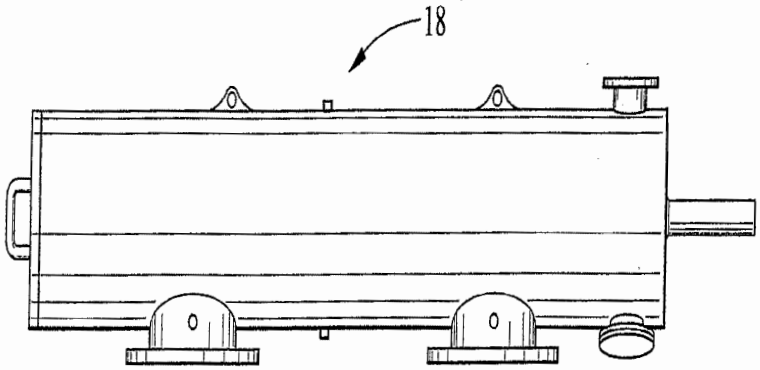


FIG. 5

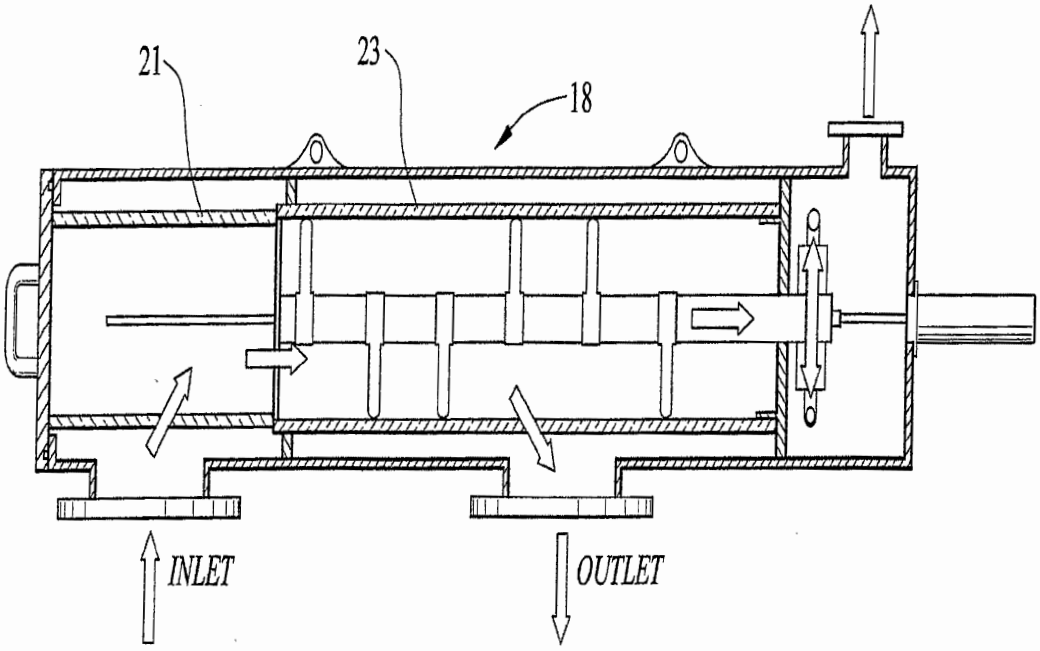


FIG. 6

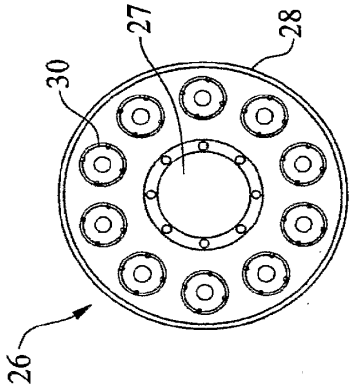


FIG. 8

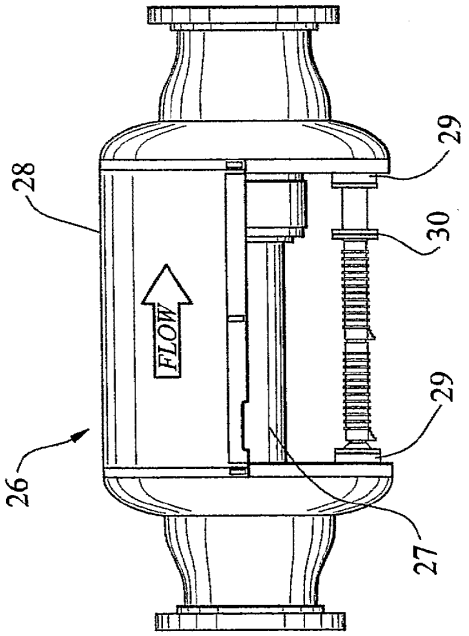


FIG. 7

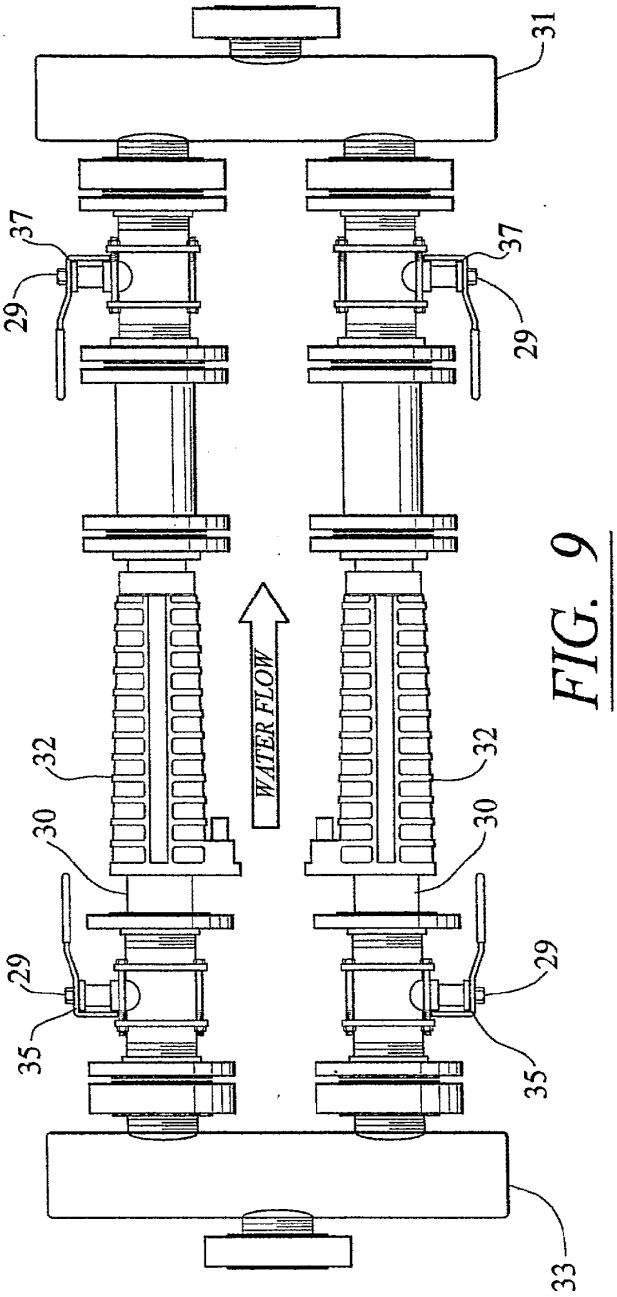


FIG. 9

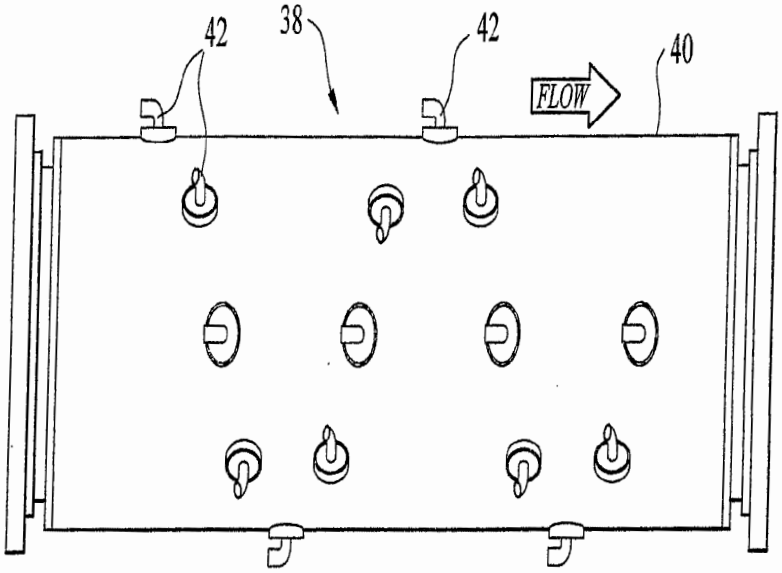


FIG. 10

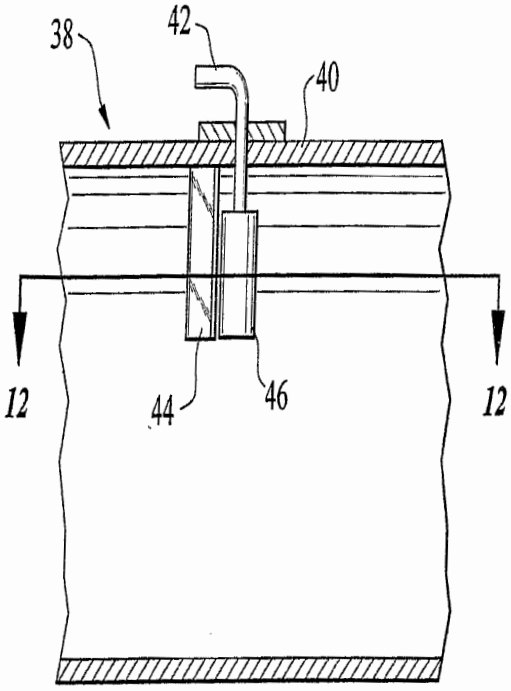


FIG. 11

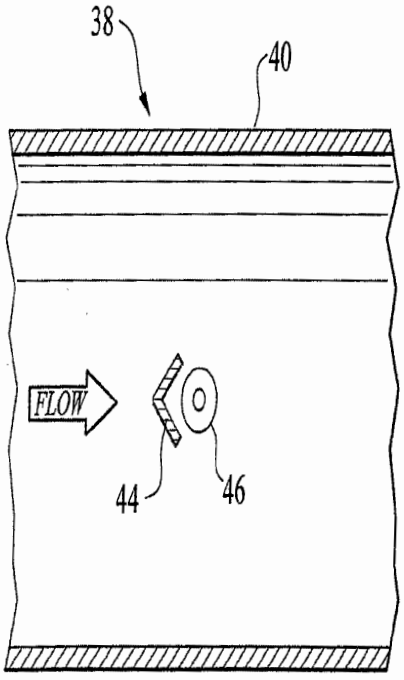


FIG. 12

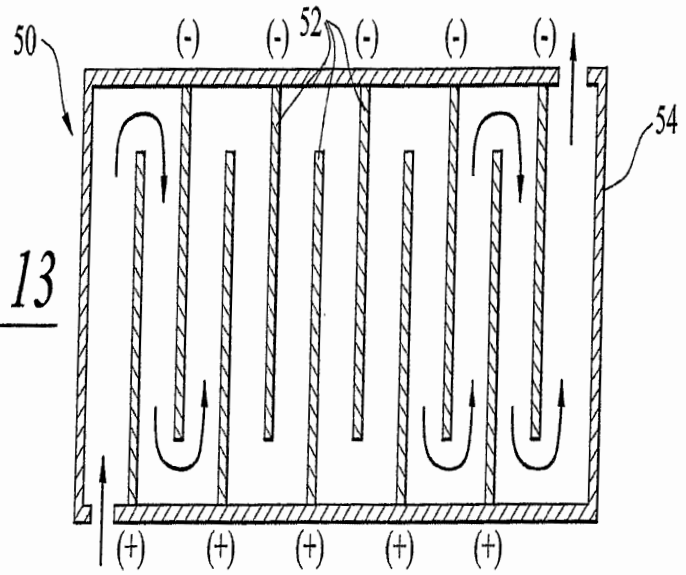


FIG. 13

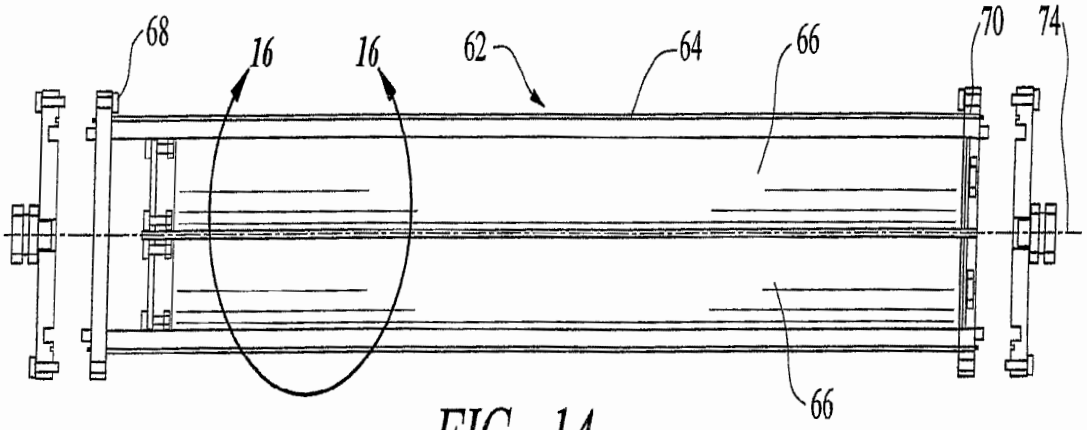


FIG. 14

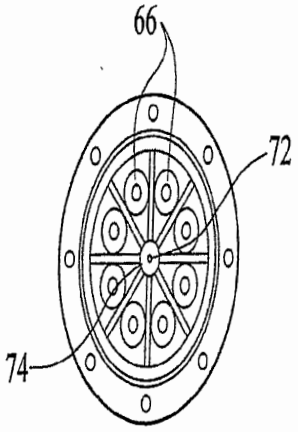


FIG. 15

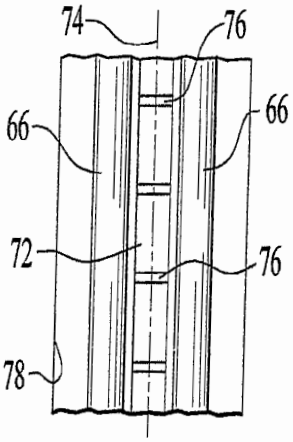


FIG. 16

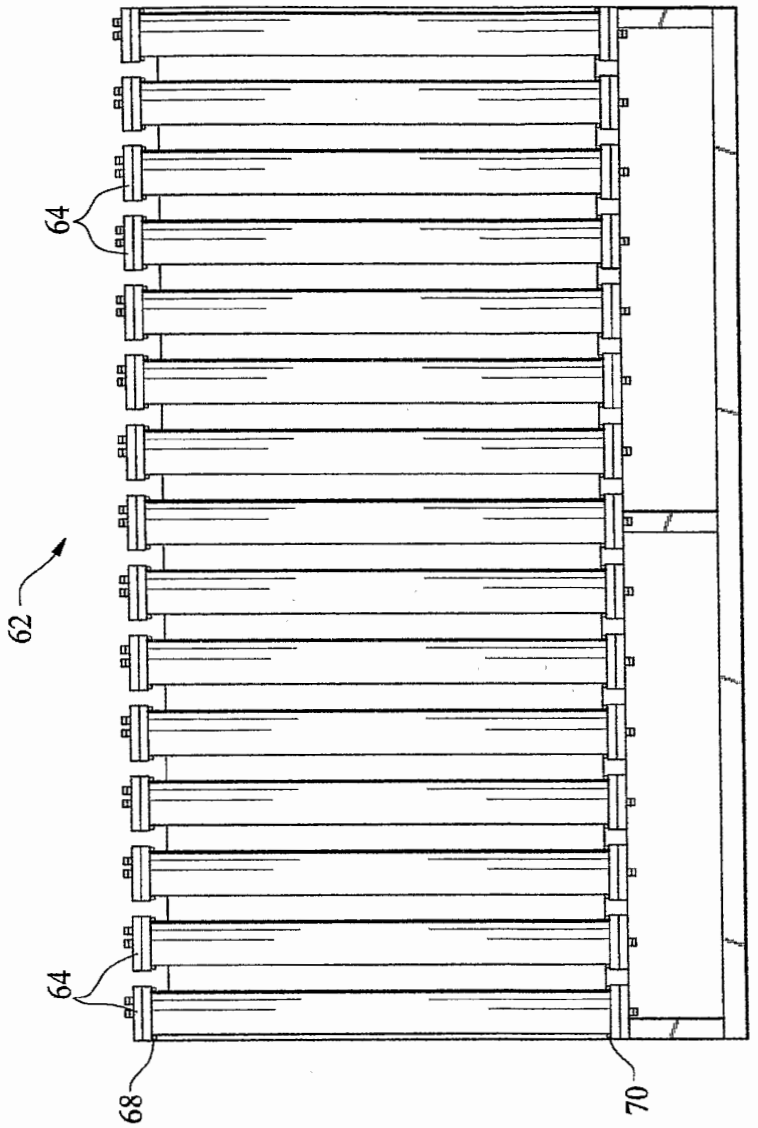


FIG. 18

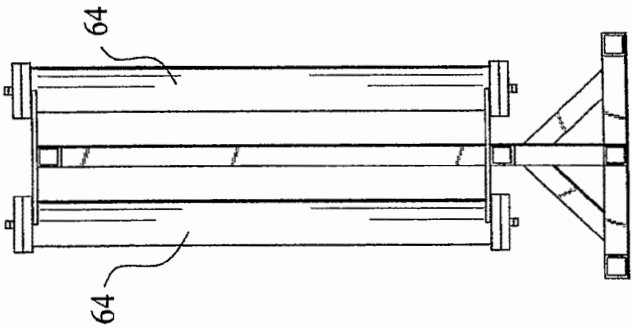


FIG. 17

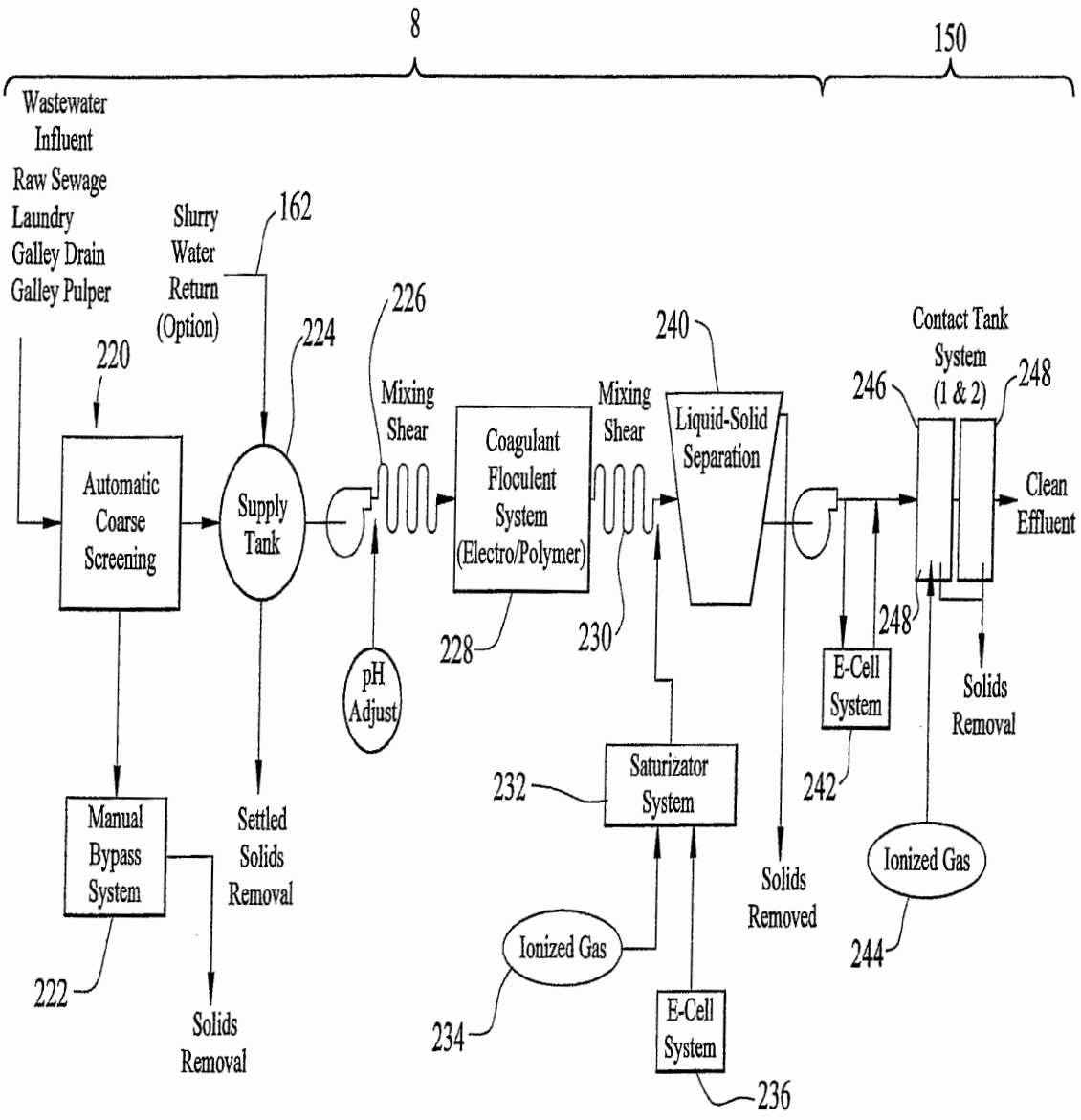

8
150
Wastewater Influent
Raw Sewage
Laundry
Galley Drain
Galley Pulper
Slurry Water Return (Option)
162
220
224
226
240
Contact Tank System (1 & 2)
246
248
Mixing Shear
Mixing Shear
Automatic Coarse Screening
Supply Tank
Coagulant Floculent System (Electro/Polymer)
Liquid-Solid Separation
Clean Effluent
pH Adjust
228
230
248
E-Cell System
Solids Removal
Saturizator System
232
242
Manual Bypass System
Settled Solids Removal
Ionized Gas
Solids Removed
Ionized Gas
244
222
Solids Removal
234
E-Cell System
236

FIG. 19

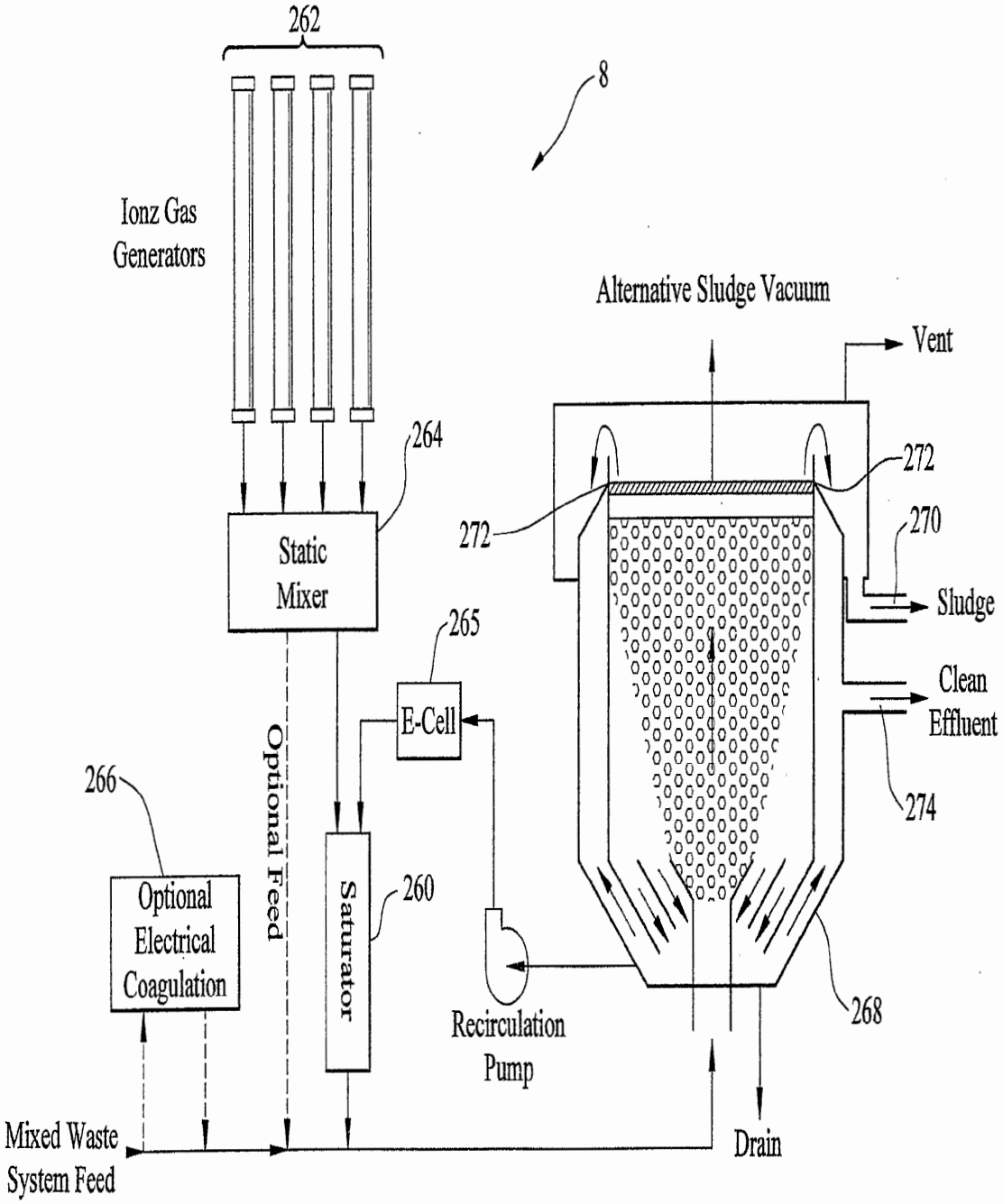

262
8
Ionz Gas Generators
Alternative Sludge Vacuum
Vent
264
272
272
270
Static Mixer
Sludge
265
E-Cell
Clean Effluent
266
Optional Feed
274
Optional Electrical Coagulation
Saturator
260
Recirculation Pump
268
Mixed Waste System Feed
Drain

FIG. 20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/37510

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : C02F 1/463, 1/467, 1/50
US CL : 210/703, 748, 760, 764, 765, 192, 202, 205, 221.1
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)
U.S. : Please See Continuation Sheet

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Please See Continuation Sheet

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.
A	US 5,958,229 A (FILIOPOULOS et al) 28 September 1999 (28.09.1999)	1-72
A	US 5,728,303 A (JOHNSON) 17 March 1998 (17.03.1998)	1-72
A,P	US 2002/0170816 A1 (LEFFLER et al) 21 November 2002 (21.11.2002)	1-72
A	US 5,635,059 A (JOHNSON) 03 June 1997 (03.06.1997)	1-72
A	US 3,945,918 A (KIRK) 23 March 1976 (23.03.1976)	1-72
A	US 5,538,631 A (YEH) 23 July 1996 (23.06.1996)	1-72

☐ 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 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
12 April 2004 (12.04.2004)	30 APR 2004
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. (703) 305-3230	Authorized officer Frank M. Lawrence Telephone No. 571-272-0987

Form PCT/ISA/210 (second sheet) (July 1998)

Continuation of B. FIELDS SEARCHED Item 1:
210/703, 748, 753, 754, 760, 764, 765, 769, 784, 800, 805, 192, 198.1, 202, 205, 221.1, 391, 513; 422/24, 29, 186.3; 204/554, 660

Continuation of B. FIELDS SEARCHED Item 2:
DERWENT
search terms: ionized gas, flotation, disinfect

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 July 2007 (26.07.2007)

PCT

(10) International Publication Number
WO 2007/084145 A2

(51) International Patent Classification:
A61N 5/06 (2006.01)

(21) International Application Number:
PCT/US2006/003393

(22) International Filing Date: 31 January 2006 (31.01.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/593,626 31 January 2005 (31.01.2005) US

(71) Applicant and
(72) Inventor: **NEISTER, S. Edward** [US/US]; 152 Brackett Road, New Durham, New Hampshire 03855 (US).

(74) Agent: **DECKER, Phillip**; Mesmer & Deleault, PLLC, One New Hampshire Avenue Suite 125, Portsmouth, New Hampshire 03801 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

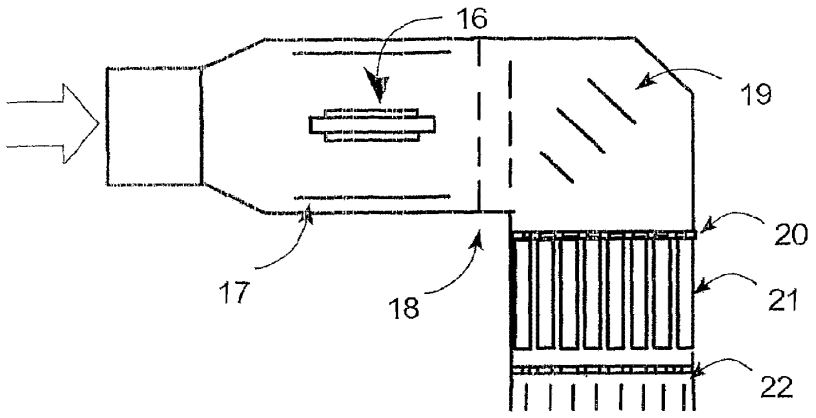
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION



Zone Air Purifier & Sterilizer

(57) Abstract: This invention relates to a method, process and apparatus for disinfecting and sterilizing all types of surfaces contaminated with microorganisms and toxic substances to render both inactive. Furthermore, this invention relates to both a method and apparatus for disinfecting and/or sterilizing breathable air and then using this air to protect a confined space from external contamination. The apparatus consists of a new ultra-violet (NUV) source that is more effective than mercury based 254 nm light for destroying DNA of virus, bacteria, spores and cists. It is most effective in breaking chemical bonds in toxic gases that are useful to terrorists. It is combined with other apparatus that remove particulates and byproducts sometimes produced by the NUV source and maintains positive pressure of the confined space so as to prevent the influx of air from outside the protected zone.

WO 2007/084145 A2

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

BACKGROUND

1. Field of the Invention.

This invention teaches a new method for disinfecting and sterilizing air, surfaces of all types and food from microorganisms and toxic chemical substances. More particularly, it relates to a process and apparatus for protecting surfaces in closed or captured environments (zones) from external sources of microbial contamination in an efficient and cost effective process. These zones can be large volumes such as high rise building, cruise ships and jet airliners, or small volumes such as small rooms or surgical operation areas whether in a hospital operating room or on the battle field.

2. Description of the Related Art.

All prior art for sterilizing and disinfecting air has been based on using commercially available ultra-violet (UV) lamps or by using magnetic fields. These lamps are either pulsed or continuous. Continuous lamps are mercury based and emit principally at 254 nm. A number of companies are presently producing UV light based apparatus for the destruction of virus, bacteria, spores and pathogens (microorganisms or VSP) that are in room air. This is an effective treatment because it continually exposes room air currents to the treatment light and over time has sufficient exposure time to VSP's. The required exposure times range from 10's to 100's of seconds, depending on the light absorption capability of the different virus and bacteria at the 254 nm. While this is effective for treating the room air of individual rooms, it is not practical for treating large flowing volumes of air that pass quickly down large ducts. Its long treatment time is impractical for treating most surfaces.

Magnetic based apparatus also require time to deactivate or destroy these VSP's. Two such inventions are directed to specific applications. Wesley, U.S. Pat. No. 4,458,153 is directed specifically towards liquid like substances enclosed in pipes, but does not discuss any test results. Sangster, U.S. Pat. No. 5,750,072 requires an injection of a sterilizing fluid as a mist or vapor for the magnetic field to

produce radicals that in turn are used to kill the VSP's. He does not discuss any test results. Hofmann, U.S. Pat. No. 4,524,079 is directed specifically to treating food stuffs. He speaks of requiring up to 100 pulses at frequencies ranging from 5 to 500 kHz. None of these patents are admitted to being prior art by their mention in this background section. Although the action time would be short, the power required to treat large areas and the apparatus design limit its practical application.

The broad ultraviolet spectrum has been divided into three regions depending on its different effects on biological systems. Reference to these regions are predominantly made in medical terminology with UV-A defined as a range or band between 320 nm and 400 nm, UV-B defined as a band between 280 nm and 320 nm, and UV-C defined as encompassing wavelengths shorter than 280 nm. Photochemists and photobiologists do not generally use these terms because absorption spectra of chemical bonds are much narrower than these generally defined bands. Instead, they use the wavelength of the applied radiation to define the observed effects.

Claims have been made that UV-C radiation is used to kill DNA. This is because the mercury lamp emission at 254 nm is close to a good DNA absorption band. None of these claims make reference to any shorter wavelengths and to the primary DNA protein absorption band that peaks at 200 nm (see figure 9). In fact, all literature directs researchers away from using any shorter wavelengths due to the high absorption of molecular water. Mercury lamps are used for wastewater treatment and work well for this application. However, this specification teaches that since we do not live underwater, the protein absorption band offers much more significant action spectra that can be used to kill the DNA of microorganisms more effectively. This concept is a significant advancement and a step change in the technology used for sterilization and disinfection.

During the past few years, new UV emitting lamps based on the excitation of excimers are becoming commercially available. These emitters produce single line or narrow spectral emission at a wavelength determined by the gas composition of the lamp. If the treatment lamp's wavelength is chosen to match closely to the peak of protein absorption of the microorganism's DNA, then a lethal dosage can be delivered to the VSP's in a shorter time. No patent has been found that teaches the use of new ultra-violet (NUV) sources coupled with supporting equipment that can

effectively and efficiently disinfect and sterilize large volumes of air, large and small surfaces, and food stuffs in various stages of preparation.

In this specification, sterilization or sterilize refers to sterilization or high level disinfectant as defined by US FDA. The terms disinfectant and disinfection refers to all other levels of disinfection.

NUV Background

The genetic makeup of all living organisms is contained in their DNA molecule. Replication occurs by the splitting of the DNA molecule, which duplicates itself through a transformation of its structure. Parts of the DNA molecule have been given names such as pyrimidine bases, cytosine, thymine or uracil that form a group of biochemicals that sustain life. The long DNA molecule holds itself together by using simple bonds like those found in sugars.

Researchers believe that the energy of the UV photon causes the formation of a strong (covalent) bond to develop between specific biochemicals. However, the bond strength of the covalent bond is very dependent on the relative position of the participating atoms. When the bond is symmetrical on both sides of a hydrogen atom in the bond, it is referred to as a dimer. A dimer is a very strong bond and is not generally broken during the vaporization of the liquid. UV light is known to produce Thymine, cytosine-thymine, and cytosine dimers. After the formation of the dimer, further replication of the DNA stops. Figure 8 shows the concept of the dimer formation in a DNA molecule.

The DNA molecule absorbs light from about 180 nm to about 300 nm. The most effective wavelength in water is about 254 nm because water absorption increases steadily as the wavelength decreases below 240nm. DNA absorption also increases with lower wavelength. Figure 9 graphically shows this relationship (Von Sonntag; Disinfection by free radicals and UV-radiation. Water Supply 4, 11-18 (1986)).

The commercial light source for UV irradiation near the 260 nm absorption peak of DNA has been produced by using mercury as the source for generating photons. The mercury gas and its pressure in the lamp determine the wavelength of the emitting light. For low-pressure (LP) and low-pressure high output (LPHO) lamps, the emitting wavelength is 254 nm. For medium pressure lamps, the

emission ranges from 200 nm to above 300 nm. However, the strength of the emitted light is not effective below 245 nm for the continuous emitting lamps and below 235 nm for medium pressure lamps. Xenon gas in pulsed lamps produces a similar emission as the medium pressure mercury lamps.

DNA action spectra show that absorption increases as the wavelength decreases, with a relative maxima at 260 nm and largest at 200 nm. Many articles indicate the principal action spectra of the DNA absorption is from 245 to 280 nm range and do not address the 200 nm peak. Since water absorption significantly increases below 235 nm, it becomes apparent that DNA effectiveness curves that omit the 200 nm peak apply only to organisms in water.

MS-2 Phage is a marker virus that is used to measure reproduction viability after UV irradiation. Figure 10 is DNA absorption without the influence of water (Gates, F.L. A study of the bactericidal action of ultra violet light III. Jour. General Physiology 14, 31-42 (1930)). Absorption is more than doubled at 222 nm.

A recent technical paper (Peak et al, UV action spectra for DNA dimer induction. Photochemistry and Photobiology, 40, 5 (613-620), 1984) suggests that dimer formation is not the only requirement to inactivate DNA. Absorption of other molecular groups in the long DNA chain increase as the wavelength is reduced from 254 nm. Damaging or destroying these bonds may be more effective in deactivating the DNA than compared to the 254 nm band. No one has done a detailed study of the effectiveness of inactivation for the different single line UV emitters that are produced by the new UV source (NUV) excimer lamps. Reports show that damage caused by 254 nm light can be reversed by longer wavelength UV and blue light (Figure 12). 222 nm photons with their higher energy are not expected to cause this 'photo-reactivation' phenomenon. However, this theory needs to be confirmed.

An excimer lamp emitting at 222 nm is considered the most effective source because DNA chains and biochemicals have greater absorption at this wavelength. The steep rise in absorption below 250 nm is exhibited by all proteins. It has been fairly well established that the peptide bonds are responsible for the steep rise in absorption exhibited by all proteins. This occurs as well for nucleo-proteins, aromatic amino-acids, diglycine, triglycine, and bovine albumin (McLaren, et al, Photochemistry of Proteins and Nucleic Acids, Pergamon Press, Macmillan Company, 1964). An organic chemist suggests that this lower wavelength is more

effective in breaking bonds and producing dimers in the purine bases and sugar phosphates instead of the pyrimidines. The 222 nm is not strongly absorbed by water vapor and oxygen in the air. A shorter wavelength would be most certainly rendered ineffective by water vapor and oxygen absorption for long irradiation distances in air. Shorter wavelength radiation would significantly increase the production of ozone that is harmful to humans and animals.

Tests

Using a lamp that emits 222 nm, a comparison test with and without water was made to determine the effect of this radiation on organisms. The organism used in all tests was the MS-2 virus, which has become a standard indicator of mutation effectiveness. The EPA report (811-R-96-002) reports a 4.3 average log reduction of the MS-2 virus using mercury light 254nm at an irradiance greater than 128 mj /cm^2.

Three wavelengths were tested: 222, 253, 259 nm. The 222 nm lamp was tested at three levels of irradiance with the virus in a thin layer of water in order to reduce the absorption effect of water. A separate test was also done with the virus in more water. The 253 and 259 nm lamps were tested at the identical irradiance levels with the virus in water. Controls were made on all tests and a single test dish on each lamp was made to check experimental error.

The 222 nm lamp (Figure 11) produced log 5 reductions at 40 mj/ cm^2 and log 6.5 reductions at 60 mj/ cm^2. The water test produced a 3.2 log reduction, which matched the equivalent calculated irradiance in air. The 253 and 259 nm lamps produced about log 4 reductions at 60 mj/cm^2. A 3 million reduction in population is about 10 to 100 times more effective than reported mercury 254nm results at the same irradiance.

Analysis

The results of the test indicate that 222 nm light is very effective in causing mutations in organisms. These tests indicate an improvement of between 10 to 1000 times, depending on the intensity of the lamp. It is important to note the improvement of the 259 nm source compared to the 254 nm source. This produced a 10 times improvement in the test sample. It illustrates the importance in using a

UV photon emitter that is near the absorption peak of the DNA or targeted chemical such as proteins, nucleic acids, or amino-acids.

It is important to note that DNA biochemicals will have different absorption spectra and the peak absorption will be shifted by water, pH, temperature, previously absorbed light and surrounding contaminates in the air. The presence of ozone can significantly reduce the resistance to damage and shorten the action kill time. For some applications, ozone is produced to improve the killing efficiency.

For example, tyrosine has a relative maximum at 275 nm, a red shift of 20 nm from the normal DNA curve. The tobacco mosaic virus peaks at 265 nm, but its X-protein at pH 7.3 peaks at 280 nm while the RNA peak occurs at 260 nm. Critical to the destruction of the organism is targeting the proper biochemical so the critical dosage can be delivered in the shortest time. The critical dosage is that dosage that destroys or deactivates the organism and also prevents its replication.

The excimer lamp is a coaxial design that can be made as small as a pencil to as large as 1 meter long. Lamp efficiency is about the same as mercury at 10-25% wall power to UV emission. The design has several advantages over mercury lamps. Most important is that its gas can be chosen to maximize its emission to the absorption peak of the targeted biochemical. Unlike the mercury lamp, the excimer intensity can be varied from near zero to maximum. It will produce 10 to 1000 times more intensity than mercury, depending on the lamp dimensions, and it does not use mercury that will soon become regulated by the EPA.

The energy of the emitted photon is determined by its wavelength. Photon energy is about 5ev at 250nm, and increases for shorter wavelengths. Different bonds in the DNA will be affected with photons of different energy.

Figure 12 illustrates the 254 nm dose required to deactivation different VSP's. The bars represent with (solid) and without (open) photo-reactivation. Note that a dose of 75 mj/cm^2 is required to deactivate the MS2 Phage virus and prevent photo-reactivation. In the tests shown in Figure 11, half the dose at 222 nm was just as effective as the higher dose at 254 nm. Even though the sample was under water, the 222 nm radiation was still more effective than 254 nm radiation.

The 222 nm photon has more energy and is absorbed by S-N, S-O, O-O, O-H, and many carbon bonds that do not absorb 254 nm. This suggest that 222 nm

light may also prevent DNA repair that has been reported for low level 254 nm UV sources. PCT/US06/03393

Toxic Gas Weapons

Biotoxins and nerve agents can be used by terrorists as weapons against groups of people. Nothing economical has been developed that could mitigate an attack and prevent the loss of life and incapacitation at the point of attack. While government agencies of the US have developed detectors that could be used in the future to warn people in the confined areas that are under attack, nothing would prevent the attack from being effective.

Biotoxins and nerve agents are organic molecules that contain either DNA or have long chain carbon molecules. Both of these are susceptible to destruction using NUV light sources. 222 nm will destroy the C=C and C=O bonds causing the destruction of the chemical.

The most effective means for delivery of these agents is to spread them in a gas phase through the air ventilation system. A detector would be used to turn on sufficient NUV sources so that the agents are destroyed before exiting the ventilation system into the confined area where the captured population is present. Tests still need to be done in regulated and controlled laboratories to develop the criteria for these sources to be effective and become the first line of defense. However, the concept of using the NUV source as well as the associated support equipment used for treating VSP's is valid and is also contained in the scope of this specification.

Support Equipment Contained in the Apparatus

Important to the sterilization and disinfecting apparatus is the use of a high E field electrostatic precipitator (ESP). Figure 13 compares the range of effectiveness with mechanical filters for different pollutant sizes. As illustrated in the fourth column, it is capable of removing VSP's. However, since it can also capture fog and mist, it has the ability to breakdown ozone O_3 into oxygen. Its use prevents levels of ozone from exceeding the EPA exposure safe levels.

The apparatus includes a humidification system to provide and maintain minimum moisture content at predetermined and controllable levels. In addition, the apparatus contains baffles and zone restriction devices that enhance the zone

protection and minimize the positive pressure required to maintain the protected zonePCT/US06/03393

SUMMARY OF THE INVENTION

Critical to this method is the development of a new ultra-violet (NUV) source that emits single line photons that correspond to the maximum absorption band for DNA. The preferred embodiment is a NUV source at 222 nm. This spectral emission is 10^4 times more effective than standard 254 nm photons for destroying DNA. Kill action times are reduced from 10's to 100's of seconds to times less than 0.1 seconds. Photon energy of the NUV source is sufficiently high to break carbon bonds of chemical toxic substances with similar action times. Unique to obtaining short action (kill) times is a determination of the specific wavelength required to destroy the targeted organism or chemical. The NUV source is chosen to supply the single line emission that matches the peak absorption of the targeted organism or chemical.

This makes for a cost effective method for sterilizing and disinfecting air, surfaces and food during normal daily activity, preventing the previous need to restrict occupation and use of areas being treated. Furthermore, the apparatus is capable of effectively and efficiently disinfecting floors, hand rails, objects that are in constant contact with transient populations for the purpose of preventing transmission of disease and toxic substances that can cause injury or illness to these populations. The NUV radiation can be applied to any object or surface that needs to be disinfected and/or sterilized. Testing will determine the correct exposure limits to prevent any harmful effects that could occur when used to disinfect human skin, hands, animal surfaces such as skin, fur, and hair, and critical plastics and materials used in medical devices,

Because the NUV source is a light source, it can be directed to expose different levels of thick materials by using light conducting fibers to distribute the light intensity. An example would have the NUV source disinfecting a floor by directing it at the floor while some of the light is directed to the bottom of a rug or floor scrubbing brush by light fibers imbedded in the brush. In a similar manner, products that have cavities or areas not exposed directly by the external source could be disinfected.

The NUV source can be used to directly disinfect room surfaces or particles and microbes in the room air by directly exposing all objects for the required exposure time. Several sources can be combined to assure exposure to all surfaces and to reduce total exposure time. Rooms contaminated by bioterrorist agents could be treated by moving the NUV source(s) in many directions and moving it (them) around the room during treatment.

Normal breathable air contains many contaminates including moisture droplets, dust, lint, bacteria, virus, cists, spores and possible toxic gases. The NUV source can be used by itself to disinfect air. Sterilization sometimes requires the removal of all particles to the smallest possible size. The NUV source can produce byproducts that must be removed for some treatment applications. These byproducts include oxidized air (ozone), condensable chemical byproducts, and damaged microorganisms. Critical to the apparatus is the removal of these contaminates and byproducts. In some special applications, ozone is added to make treatment more effective. Consequently, the apparatus includes high E field precipitators, ozone generators and ozone destroying light and apparatus to make effective use of the combination of these technologies.

Sterilized air is then used to prevent microbial contamination of a protected zone by preventing the influx of untreated air from outside this zone. The apparatus includes pressurizing equipment and zone baffles that provide sufficient outflow from the protected zone so as no contamination can occur. Protected zones can be as small as a wound area on a battlefield operating table to a cruise ship, airplane, or high rise building with thousands of inhabitants.

A major source of infection and terrorist's activity is directed at food and material handling. Photon emitters have been used to effectively clean food stuffs and surfaces for many years. However, this invention uses the NUV source that makes it cost effective in treating surfaces of food and materials since the action time is almost immediate. The apparatus of this invention is capable of irradiating foodstuffs in conveyor assemblies, stationary carts and in handling routes during the movement from storage to food preparation processes. It can also be used to sterilize/disinfect medical or critical parts on an assembly line prior to packaging.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components of the NUV source therein.

Figure 2 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting or sterilizing large volumes of air therein

Figure 3 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting floor surfaces and other surfaces such as chairs, hand rails, counter tops, trays, table tops and the like therein.

Figure 4 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting food prior to handling by kitchen or cooks before serving therein.

Figure 5 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for sterilizing air that is used to cover and protect the zone around a surgical operation or procedure independent of the location of the operation therein.

Figure 6 is a perspective schematic view of a preferred embodiment of the present invention illustrating the zone air sterilization apparatus in conjunction with the remote protected operation zone therein.

Figure 7 is a CFD view of a preferred embodiment of the present invention defining the emitted airflow pattern from the sterilization apparatus that is used to cover and protect the zone around a surgical operation or procedure independent of the location of the operation therein.

Figure 8 is a graphic showing dimer formation in a DNA molecule.

Figure 9 is a graph plotting UV absorption of DNA according to wavelength.

Figure 10 is a graph plotting DNA absorption without the influence of water.

Figure 11 plots the effectiveness for reduction of the MS-2 phage virus by different wavelengths of UV radiation.

Figure 12 plots the UV dose required to achieve a four log deactivation of selected microbes.

Figure 13 is a graphic comparing the range of effectiveness of various filters for removing airborne particles.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawings illustrate the invention in its different forms and the apparatus required for sterilization of air and surfaces that contain VSP's. Figure 1 illustrates the NUV light source. Figure 1a shows the NUV source that would be installed inside an air duct. The high voltage electrode 1 is located inside the inner tube of the annular lamp. The ground electrode screen 2 is located on the outside of the annular lamp. The gas that produces the UV photons is located in the annular region 3 between the inner and outer tubes 4. The gas type is chosen so that the emitted UV photons are absorbed by the targeted microorganism or chemical. The preferred embodiment is 222 nm. UV radiation is emitted radially outward 5. Changing the voltage or current between the two electrodes changes the amount of UV radiation that is produced.

Figure 1b illustrates the NUV light source used to direct the UV photons towards a specific location. The NUV source is shown in the center of the drawing as an end view. The specialized reflector 6 end view incorporates a specialized 'gull wing' design so that >90% of the emitted light is directed to the planar surface below. The specialized reflector 6 also incorporates barium sulfate (Ba_2SO_4) as the reflective material in order to maximize the number of photons that are reflected onto the planar surface. In some cases, a cover 6a is necessary to protect the NUV source and reflector from dirt. This cover is transparent to 222nm light. The specialized reflector can also have different shapes that change the directed radiation for different applications.

In use, the NUV source can be made to any size and length. In air ducts, the embodiment shown in Figure 2 item 6b would have the NUV source supported from the side, top or bottom of the duct so that its irradiation travels parallel to the airflow. For unique applications, a second embodiment Figure 5 item 16 would have the NUV source and cylinder reflector supported inside the duct so that irradiation is perpendicular to the airflow. An example of this embodiment would be a NUV source positioned in the center of a tumbling dryer. All garments would be irradiated during the drying process for a length of time that would guarantee disinfection.

Figure 2 illustrates the apparatus required for the disinfection and sterilization of airflow inside a large duct. NUV sources 7 precede an electrostatic precipitator (ESP) 9 by some distance 8 that permits a short action time to complete the destruction of the toxic gases or VSP's. A humidifier 10 may follow the precipitator with control sensors 11 so that the humidity of the exiting air can be selected and maintained. A fan(s) 12 may also be used to pressurize the exiting air so that a slight pressurization can be applied to a protected zone to prevent contaminated air from entering. Depending on the nature of the zone, restricting baffles (not shown) are used to assist in maintaining a positive pressure inside the protective zone.

Figure 3a illustrates the NUV source 13 located inside the forward compartment of a vacuum cleaner or floor cleaning machine. The vacuum cleaner can be either a standup floor model or a canister model. It could also be any device that would support and carry the NUV source close to the floor. The significant part is that the NUV source with reflector 6 consists of the components as described in Figure 1b. Figure 3b illustrates a preferred embodiment with the NUV source contained in a hand held wand. Sensing switches 14 can be included in this embodiment that shut off the NUV source when the wand is not directed correctly to the desired treatment surface.

Figure 4a illustrates the NUV source(s) located above a conveyor that carries raw and unprepared food prior to kitchen preparation as well as industrial packaging assembly lines that carry products that require disinfection. The conveyor assembly 24 is designed to maximize the surface area exposed to the NUV source(s). In some cases, several sources 13 are required because the exposed surface of the food or product can not be changed to expose the entire surface during the illumination time of one NUV source. Tumblers or vibrators are typically used to change the orientation of the foodstuffs and they move along the conveyor. Figure 4b illustrates the NUV source(s) 13 located beside heat lamps 15 or other heating surfaces used to keep the food hot on a serving counter prior to being delivered from the kitchen to the customer. In another embodiment, the NUV source is used to irradiate cool or cold foods, so heat lamps 15 are not used.

Figure 5 illustrates the NUV source located inside an air sterilization apparatus that provides air for remote and separate operation tables. The NUV source 16 is located inside a UV reflector chamber 17 in order to reduce the loss of

UV photons. A light trap 18 stops the UV light prior to the turning vanes 19 that direct the air flow vertically downward onto the operation site. A diffuser 20 ensures that the airflow is uniform across the duct. A high E field electrostatic precipitator (ESP) 21 follows the diffuser to remove particulates and reduce any ozone to oxygen. The airflow then passes through a second diffuser and humidifier 22 to ensure that the airflow is uniform across the duct and that the humidity level is controlled to some preset value. Figure 6 illustrates how the air sterilization apparatus would be used in conjunction with a remote operation site, where the doctor is using remote controlled surgical instruments that are inside the sterilized air zone. Figure 7 illustrates the airflow pattern using CFD computational fluidic design to ensure that the air above the operation zone is uniform and prohibits contaminated air from entering the protected zone.

Although the preferred embodiments of the present invention have been described herein, the above description is merely illustrative. Further modification of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the invention as defined by the appended claims.

CLAIMS

What is claimed is:

1. A disinfecting apparatus comprising:

a source of 222 nm wavelength photons; and

a photon relfector secured in a spaced relationship to the photon source, whereby the apparatus produces photons that are directed to a selected zone or surface and efficiently destroys DNA of microorganisms.

2. The apparatus of claim 1 further comprising a source of a discrete wavelength of photons other than 222 nm.

3. The apparatus of claim 1, wherein the source of 222 nm photons is an excimer lamp.

4. The apparatus of claim 1, wherein the photon reflector is a gull wing-shaped director selected to direct at least 90% of emitted light to a planar surface.

5. The apparatus of claim 1, the photon reflector comprising barium sulfate for enhancing its reflective properties.

6. The apparatus of claim 1 further comprising a floor cleaning apparatus, the photon source being secured to the floor cleaning apparatus in a position suitable for exposing a floor to photons.

7. The apparatus of claim 1 further comprising:

a handle attached to the photon source; and

a surface detection mechanism adapted to shut off the photon source when it is not near a surface to be disinfected.

8. The apparatus of claim 1 further comprising:

an air duct surrounding the photon source; and

a particle removal means in the duct to secured in a spaced relationship to the photon source selected to provide a particular action time in the airflow to disinfect the air.

9. The apparatus of claim 8, wherein the particle removal means is an electrostatic precipitator.

10. The apparatus of claim 8, further comprising a humidifier in the air duct downstream of the electrostatic precipitator.

11. The apparatus of claim 10, further comprising a humidity sensor downstream of the humidifier.

12. The apparatus of claim 8 further comprising a light trap disposed between the photon source and the particle removal means.

13. The apparatus of claim 8 further comprising turning vanes within the duct to change the direction of airflow.

14. The apparatus of claim 8 further comprising a diffuser.

15. A process for disinfecting a substance comprising the steps of
generating photons of 222 nm wavelength; and
directing the photons to a substance to be disinfected, whereby the photons destroy the DNA of microorganisms.

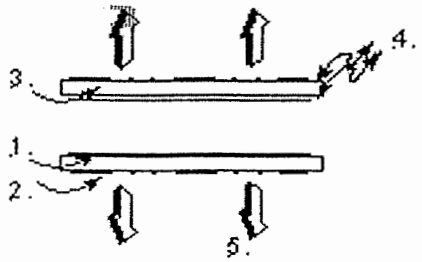
16. The process of claim 15, wherein the photons are directed by reflecting the photons to a desired surface.

17. A process for disinfecting a substance in an air stream comprising the steps of
directing the air stream to a source of 222 nm photons; and
exposing the air stream to 222 nm photons, whereby the photons destroy the DNA of microorganisms.

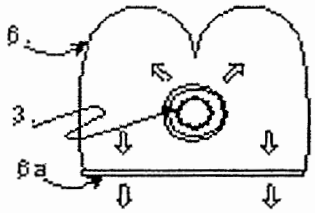
18. The process of claim 17, further comprising the steps of
determining required activity time to disinfect the air stream; and
removing particles from the air stream after the activity time.

19. The process of claim 18, further comprising the step of humidifying the air stream downstream of the removing step.

20. A process for providing a germ-free surgical space comprising the steps of:
directing an air stream to a source of 222 nm photons; and
exposing the air stream to 222 nm photons;
removing particles from the air stream; and
directing the air stream vertically downward to a surgical area, whereby a disinfected airflow surrounds the surgical space and prevents infected air from entering.



a. NUV Lamp



b. Directed Radiation

Figure 1: NUV Source

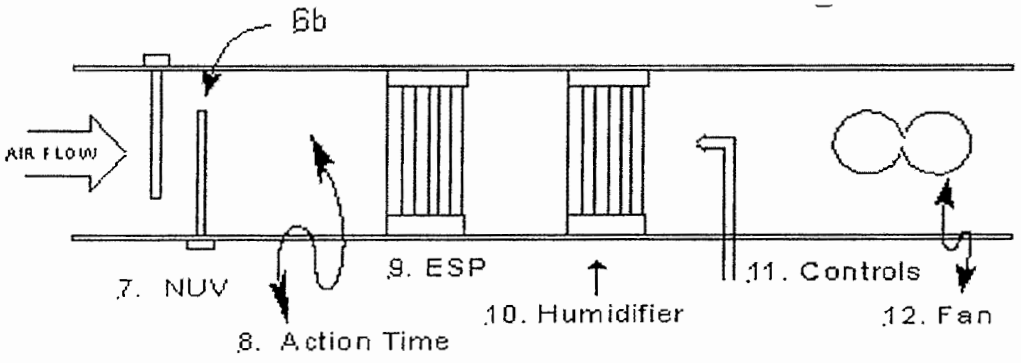
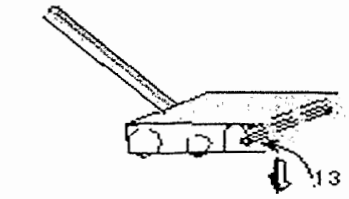
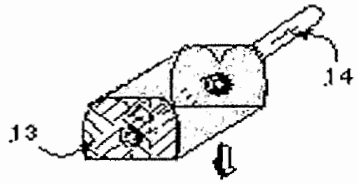


Figure 2: Volumetric Air Treatment

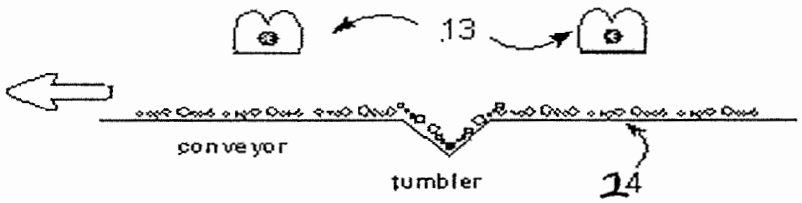


a. Floor Treatment & Cleaner

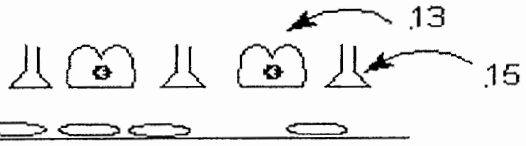


b. Handheld Surface Treatment

Figure 3: Surface Treatment



a. Unprepared food



b. Serving Counter

Figure 4: Food Treatment

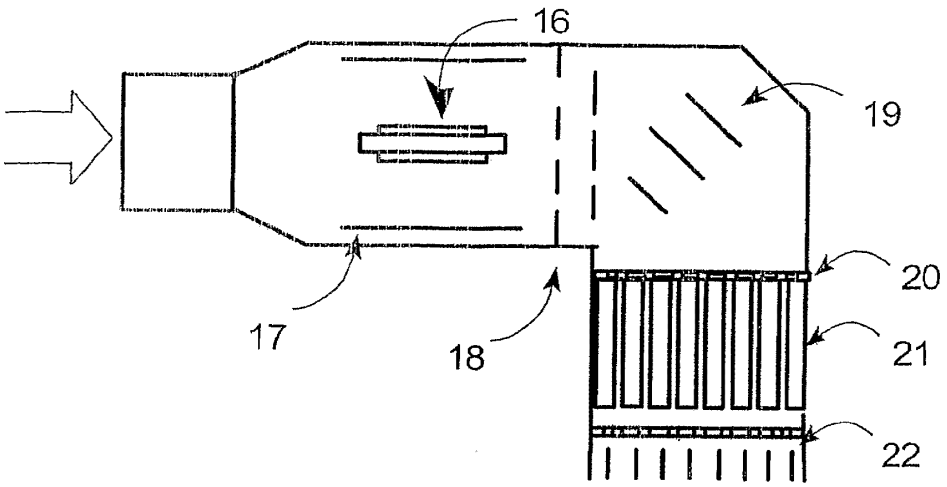


Figure 5: Zone Air Purifier & Sterilizer

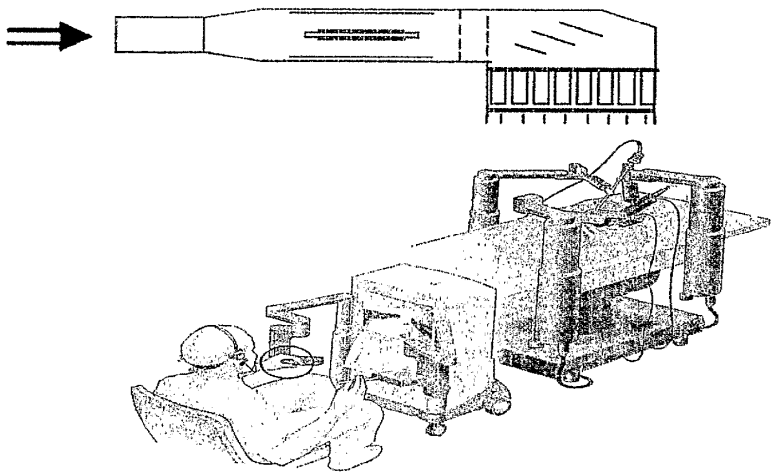


Figure 6: Operating Zone with Sterilizer

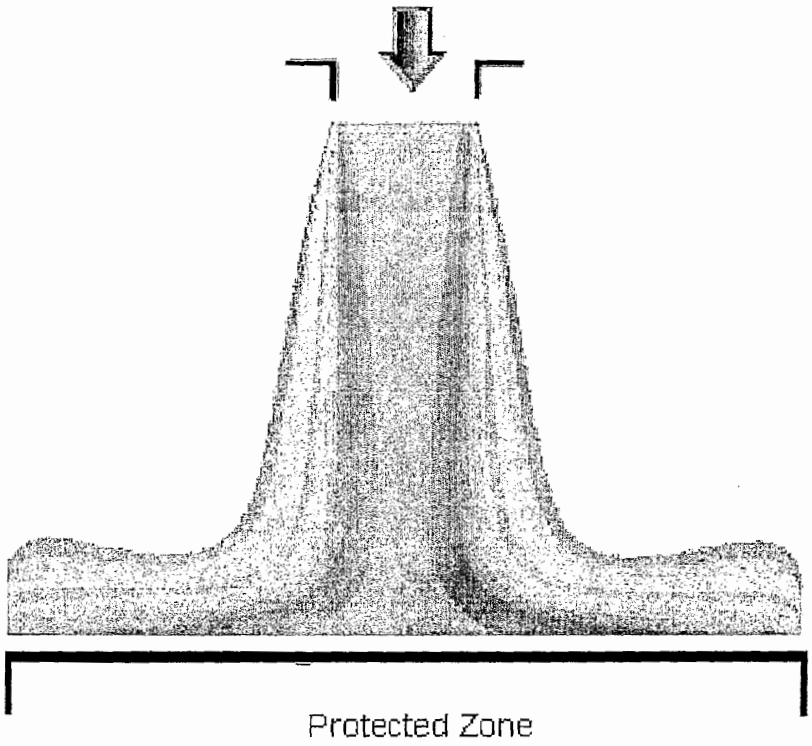


Figure 7: CFD Air Flow

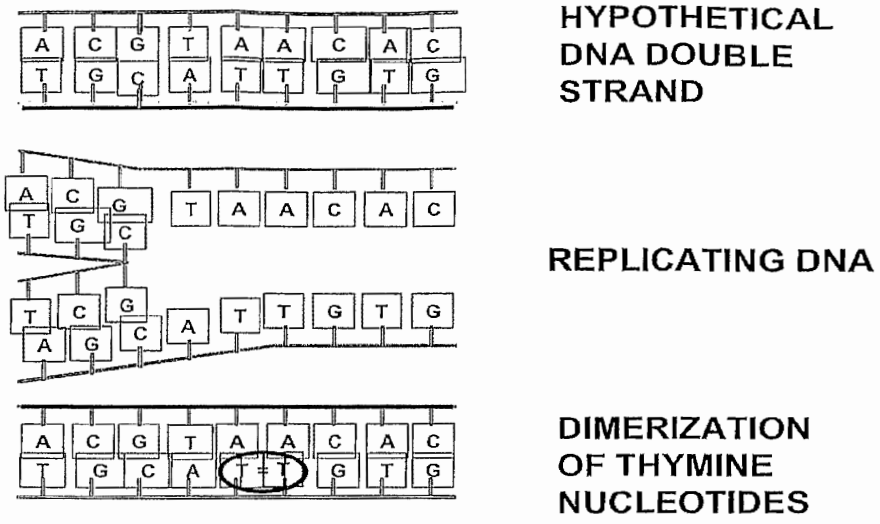


Figure 8: Dimer Formation by UV Photon
(by permission of ERG @ UNH)

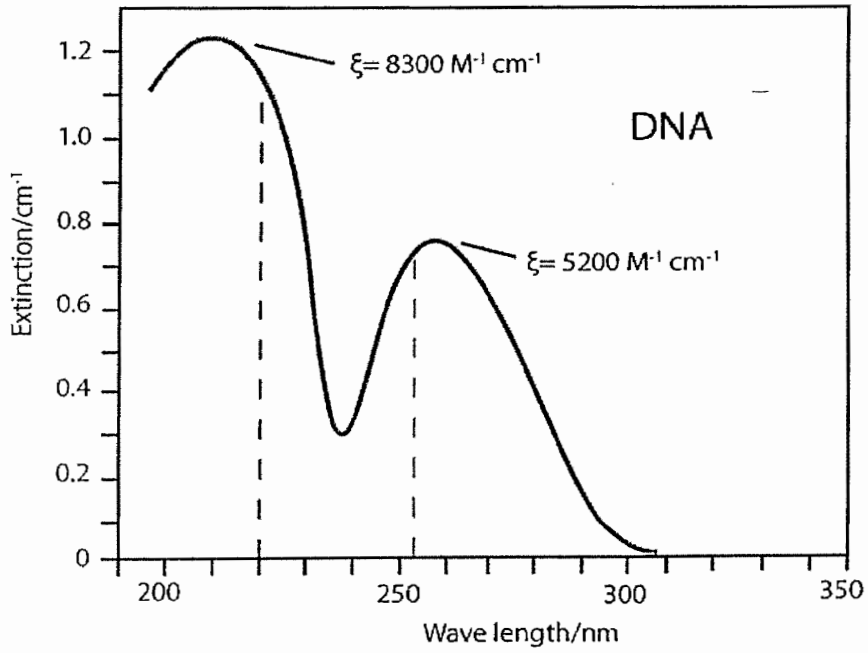


Figure 9: UV Absorption of DNA

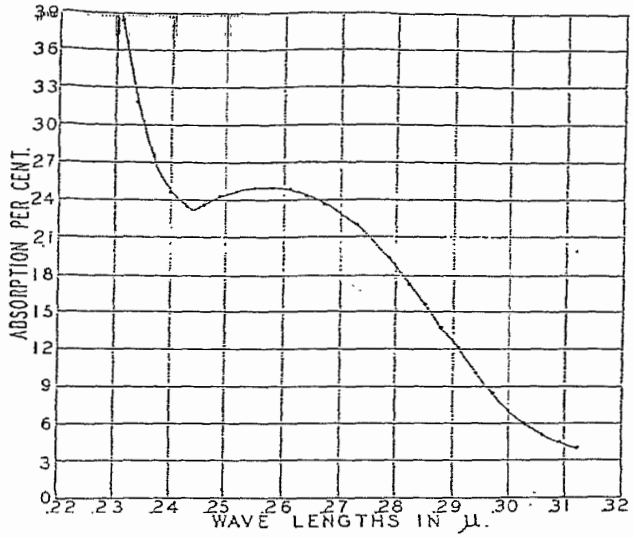


Figure 10: B. coli @ 0.8u absorption

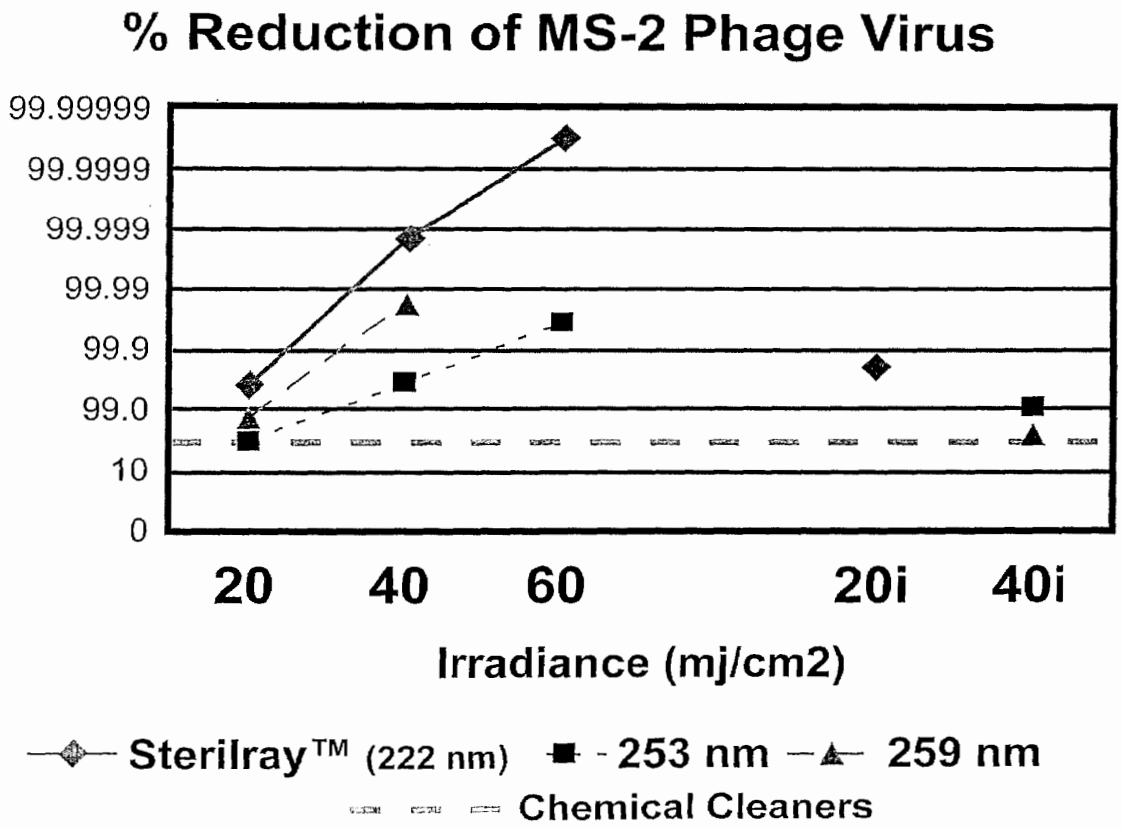


Figure 11: UV Irradiation Test on MS2

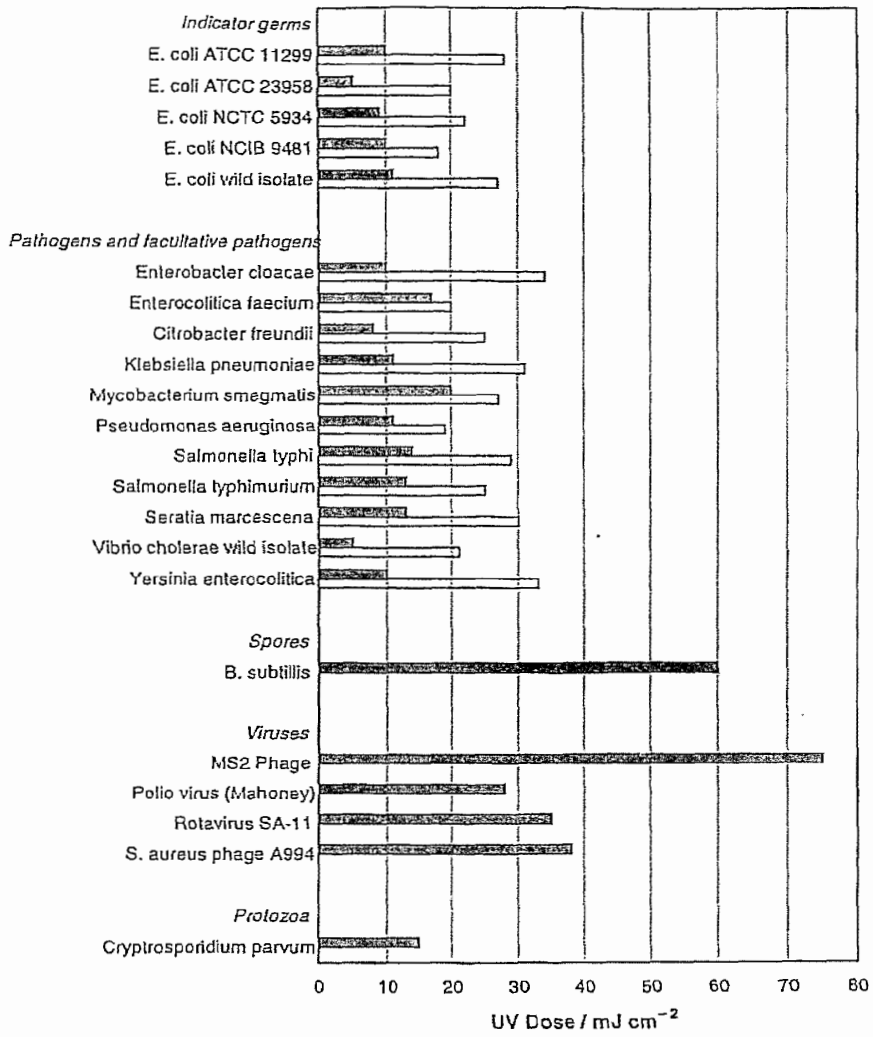


Figure 12: UV dose required for 4 log (99.99%) deactivation

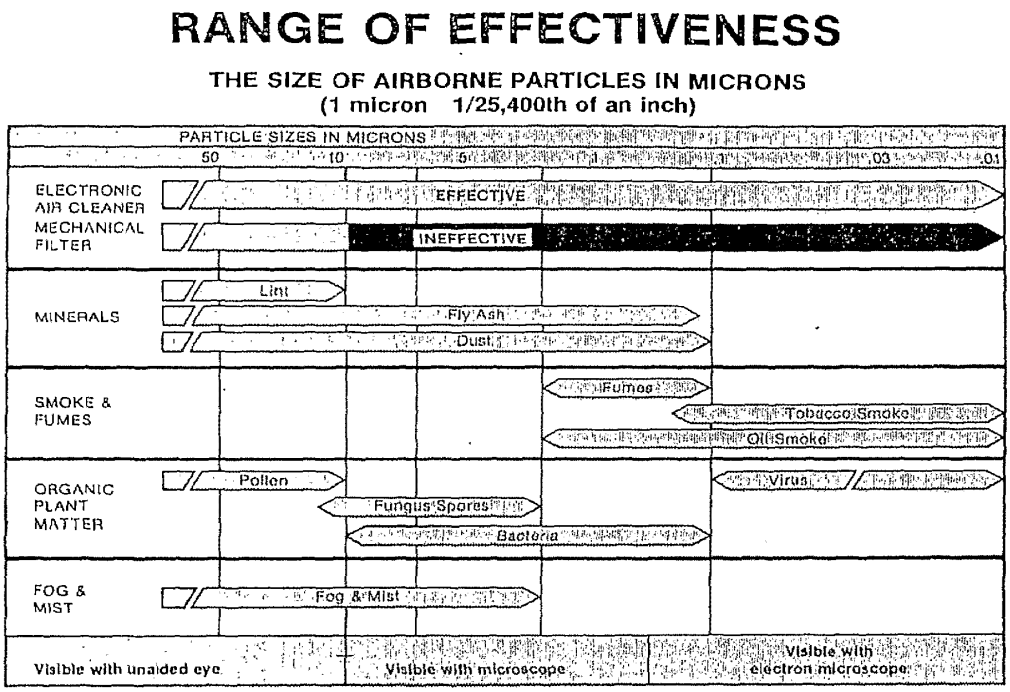


Figure 13: ESP range of effectiveness

Electronic Acknowledgement Receipt

EFS ID:	29830534
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert
Filer Authorized By:	
Attorney Docket Number:	17-093-EN
Receipt Date:	19-JUL-2017
Filing Date:	10-JUL-2017
Time Stamp:	15:34:07
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.)
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Warnings:

Information:					
2	Non Patent Literature	canceranduvB-17June.pdf	2842673 305d923c5a6f72ec9320053d6e81de8ae0862909	no	11
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22	Foreign Reference	WO0245756.pdf	6503749 b93d585e25b3bb653afa17deb6fc0c7d10a0dad2	no	90
Warnings:					
Information:					

23	Foreign Reference	WO02078754.pdf	1136398 8167feb9b542661168cd08afa06bc50b8e6b991c	no	26
Warnings:					
Information:					
24	Foreign Reference	WO2005061396A1.pdf	2115698 7b23a726930a933a1491face66a7ad5359de8ee2	no	56
Warnings:					
Information:					
25	Foreign Reference	WO2007084145A2.pdf	1227474 a35c0eb1c6b0b611594e607406c0d7d3cc7b157	no	25
Warnings:					
Information:					
		Total Files Size (in bytes):	33350617		

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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.

Doc Code: PA...
Document Description: Power of Attorney

PTO/AIA/82C (12)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

■ I hereby appoint 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 equivalent).

32118

OR

☐ I hereby appoint Practitioner(s) named below 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 equivalent).

Name	Registration Number	Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter 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:

■ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ 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)

SIGNATURE of Applicant for Patent

Signature		Date	
Name	Jean James Rowley	Telephone	
Title and Company			

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. Submit multiple forms for more than one signature, see below *.

■ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 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.

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Doc Code: PA .
Document Description: Power of Attorney

PTO/SB/82A (07-13)
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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/SB/82B or equivalent) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5. If the Power of Attorney by Applicant form is not accompanied by this transmittal form or an equivalent, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	
First Named Inventor	S. Edward Neister
Title	[illegible]
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

SIGNATURE of Applicant or Patent Practitioner

Signature	/David J. Connaughton, Jr./	Date	2017-08-22
Name	David J. Connaughton, Jr.	Telephone	
Registration Number	67275		

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

■ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 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:	15645480
Filing Date:	
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
LATE FILING FEE FOR OATH OR DECLARATION	2051	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**70**

Electronic Acknowledgement Receipt	
EFS ID:	29765633
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert
Filer Authorized By:	
Attorney Docket Number:	17-093-EN
Receipt Date:	12-JUL-2017
Filing Date:	
Time Stamp:	17:32:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$70
RAM confirmation Number	071317INTEFSW17330200
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	Oath or Declaration filed	Declaration_Supplement_scan.pdf	345070 65850a43091417b5470b48bceb3e426db871d410	no	1
Warnings:					
Information:					
2	Power of Attorney	POA_scan.pdf	787690 1793db0386249e7555cbb1bb51b757b256baff61	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30304 72a39726274b25b52e7e0590c58873c1fb7ca110	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1163064		

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<u>New Applications Under 35 U.S.C. 111</u>
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.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
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/SB/43 (09-12)
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SUPPLEMENTAL SHEET FOR DECLARATION | **ADDITIONAL INVENTOR(S)** Supplemental Sheet (for PTO/AIA/05.05) Page 1 of 1

Legal Name of Additional Joint Inventor, if any:
(E.g., Given Name (first and middle (if any)) and Family Name or Surname)
John James Rowsey

Inventor's Signature | Date (Optional)

Residence: City: Belleair | State: FL | Country: US

Mailing Address: 150 Belleview Blvd, #102

City: Belleair | State: FL | Zip: 33756 | Country: US

Legal Name of Additional Joint Inventor, if any:
(E.g., Given Name (first and middle (if any)) and Family Name or Surname)

Inventor's Signature | Date (Optional)

Residence: City | State | Country

Mailing Address

City | State | Zip | Country

Legal Name of Additional Joint Inventor, if any:
(E.g., Given Name (first and middle (if any)) and Family Name or Surname)

Inventor's Signature | Date (Optional)

Residence: City | State | Country

Mailing Address

City | State | Zip | Country

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 24 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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Doc Code: PA..

Document Description: Power of Attorney

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Application Number	
Filing Date	
First Named Inventor	S. Edward Neister
Title	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
Art Unit	
Examiner Name	
Attorney Docket Number	17-093-EN

SIGNATURE of Applicant or Patent Practitioner

Signature	/David J. Connaughton, Jr./	Date	2017-06-22
Name	David J. Connaughton, Jr.	Telephone	
Registration Number	67275		

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

■ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 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.**

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Doc Code: PA..

Document Description: Power of Attorney

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

☒ I hereby appoint 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 equivalent):

32118

OR

☐ I hereby appoint Practitioner(s) named below 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 equivalent):

Name	Registration Number	Name	Registration Number

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OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☒ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ 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)

SIGNATURE of Applicant for Patent

Signature	/S. Edward Neister/	Date	7/10/17
Name	S. Edward Neister	Telephone	
Title and Company			

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. Submit multiple forms for more than one signature, see below *.

☒ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.31, 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.**

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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 disclosure of these records is required by the Freedom of Information Act.
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 inspection 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.

Doc Code: Oath
Document Description: Oath or declaration filed

PTO/AIA/08 (06-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted With Initial Filing OR ☐ Declaration Submitted After Initial Filing (surcharge (37 CFR 1.16(f)) required)

Attorney Docket Number	17-093-EN
First Named Inventor	S. Edward Neister
COMPLETE IF KNOWN	
Application Number	
Filing Date	
Art Unit	
Examiner Name	

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

(Title of the Invention)

As a below named inventor, I hereby declare that:

This declaration is directed to:

☒ The attached application,

OR

☐ United States Application Number or PCT International application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge 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.

Authorization To Permit Access To Application by Participating Office

☐ If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the above-identified patent application is filed access to the above-identified patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the above-identified patent application is filed to have access to the above-identified patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the above-identified patent application with respect to: 1) the above-identified patent application-as-filed; 2) any foreign application to which the above-identified patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the above-identified patent application; and 3) any U.S. application-as-filed from which benefit is sought in the above-identified patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing the Authorization to Permit Access to Application by Participating Offices.

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 21 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/08 (06-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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DECLARATION — Utility or Design Patent Application

Direct all correspondence to:	■	The address associated with Customer Number:	32118	OR	☐ Correspondence address below

Name		
Address		
City	State	Zip
Country	Telephone	Email

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. Petitioner/applicant is advised that documents which form the record of a patent application (such as the PTO/SB/01) are placed into the Privacy Act system of records DEPARTMENT OF COMMERCE, COMMERCE-PAT-7, System name: *Patent Application Files* . Documents not retained in an application file (such as the PTO-2038) are placed into the Privacy Act system of COMMERCE/PAT-TM-10, System name: *Deposit Accounts and Electronic Funds Transfer Profiles* .

LEGAL NAME OF SOLE OR FIRST INVENTOR:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

S. Edward Neister

Inventor's Signature	Date (Optional)
/S. Edward Neister/	7/10/2017

Residence: City	State	Country	
Mailing Address			
City	State	Zip	Country

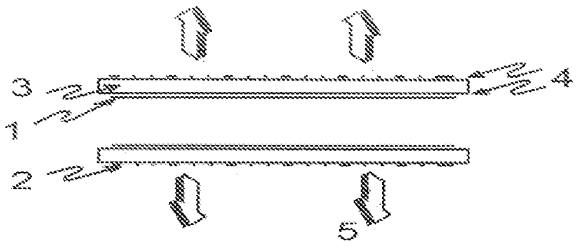
■ Additional inventors are being named on the 1 supplemental sheet(s) PTO/AIA/10 attached hereto

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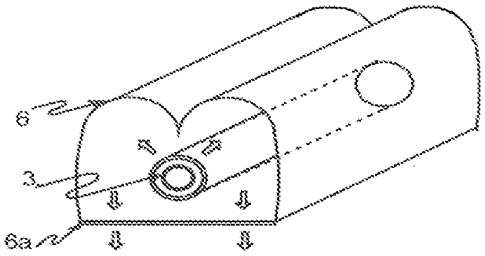
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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



a. NUV Lamp



b. Directed Radiation

Figure 1: NUV Source

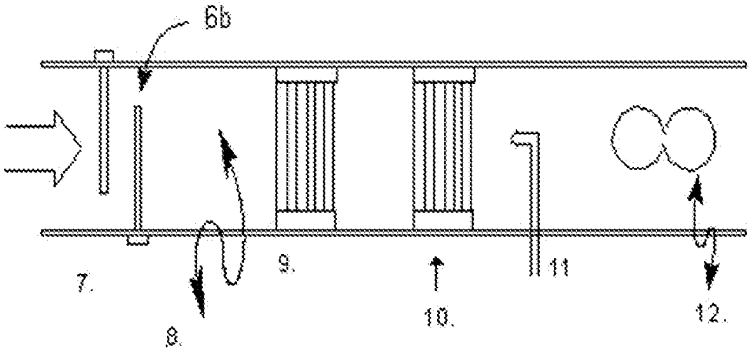
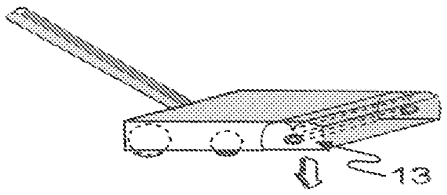
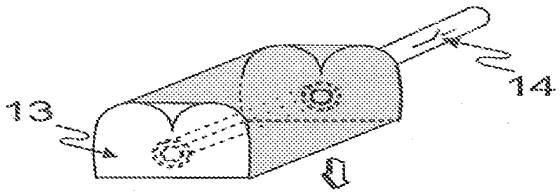


Figure 2: Volumetric Air Treatment

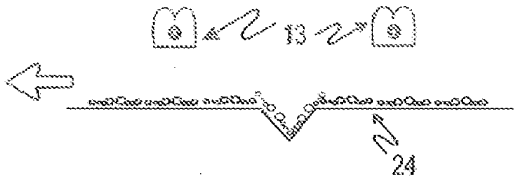


a. floor Treatment & Cleaner

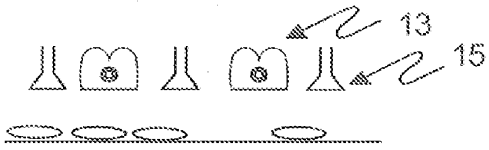


b. Handheld Surface Treatment

Figure 3: Surface Treatment



a. Unprepared Food



b. Serving Counter

Figure 4: Food Treatment

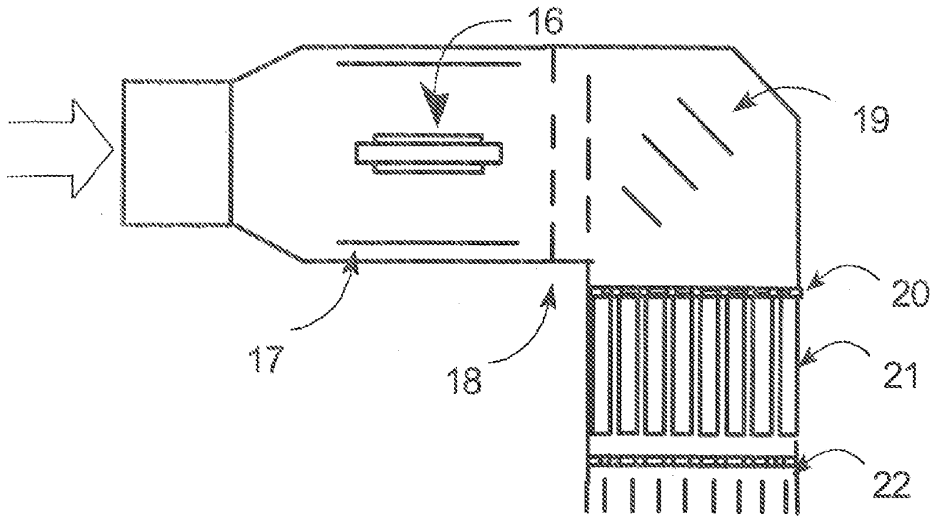


Figure 5: Zone Air Purifier & Sterilizer

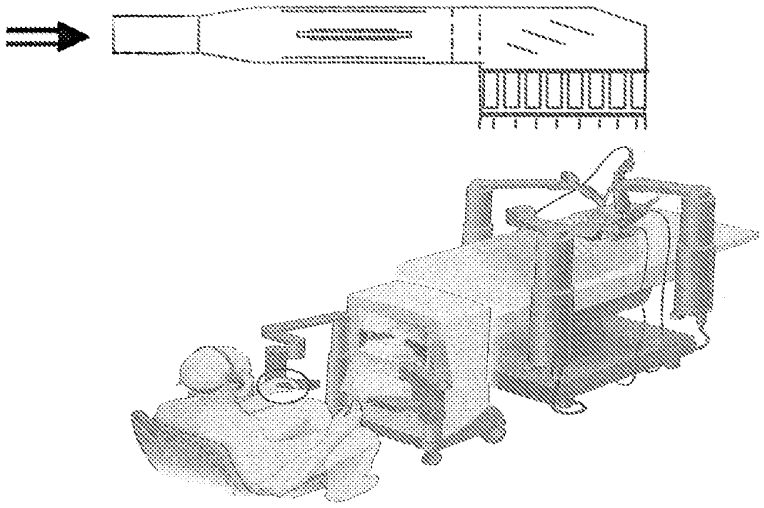


Figure 6: Operating Zone with Sterilizer

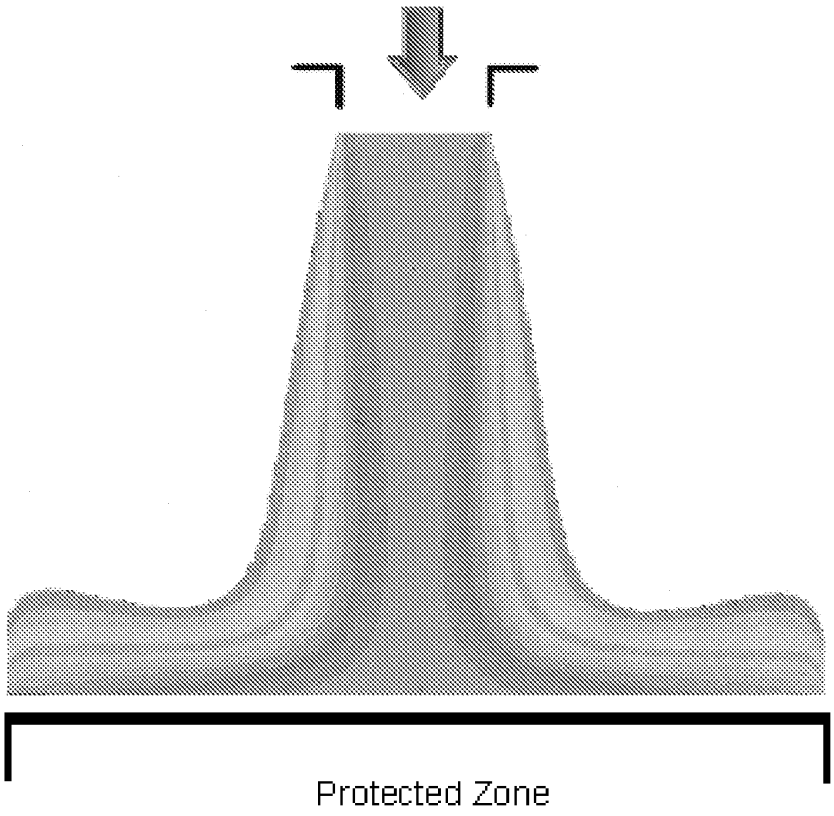


Figure 7: CFD Air Flow

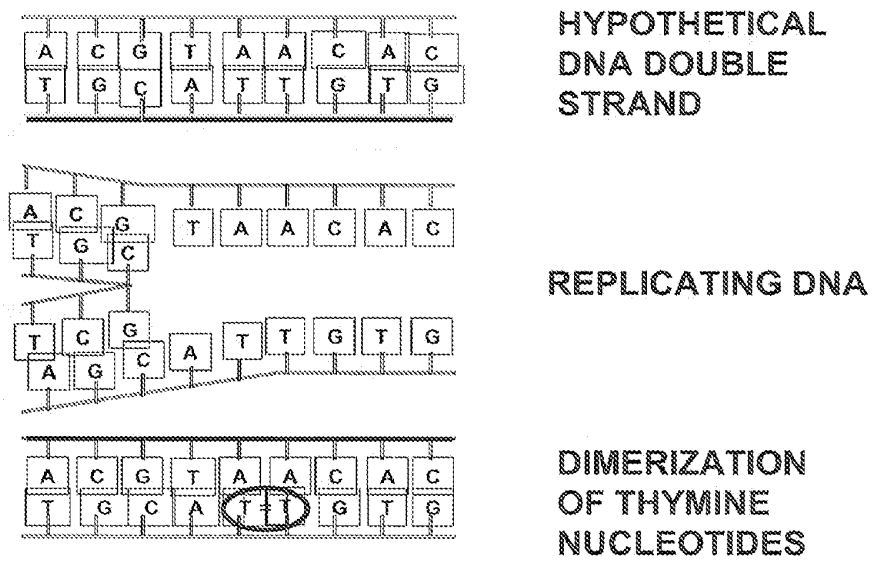


Figure 8: Dimer Formation by UV Photon
(by permission of ERG @ UNH)

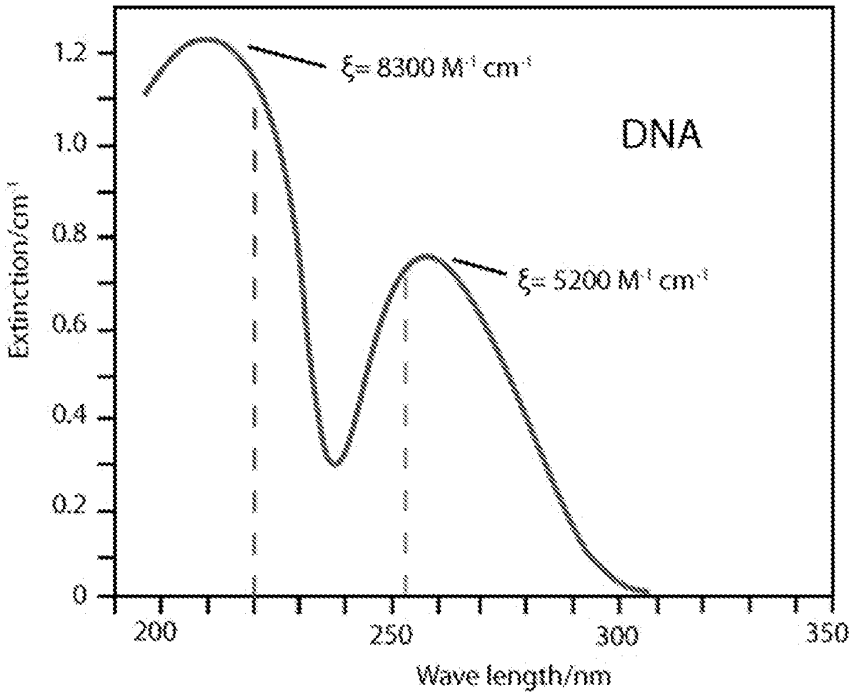


Figure 9: UV Absorption of DNA

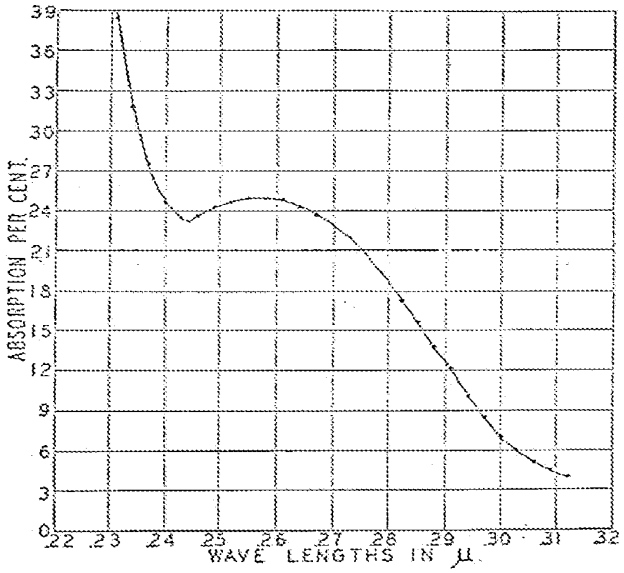


Figure 10: B. coli @ 0.8u absorption

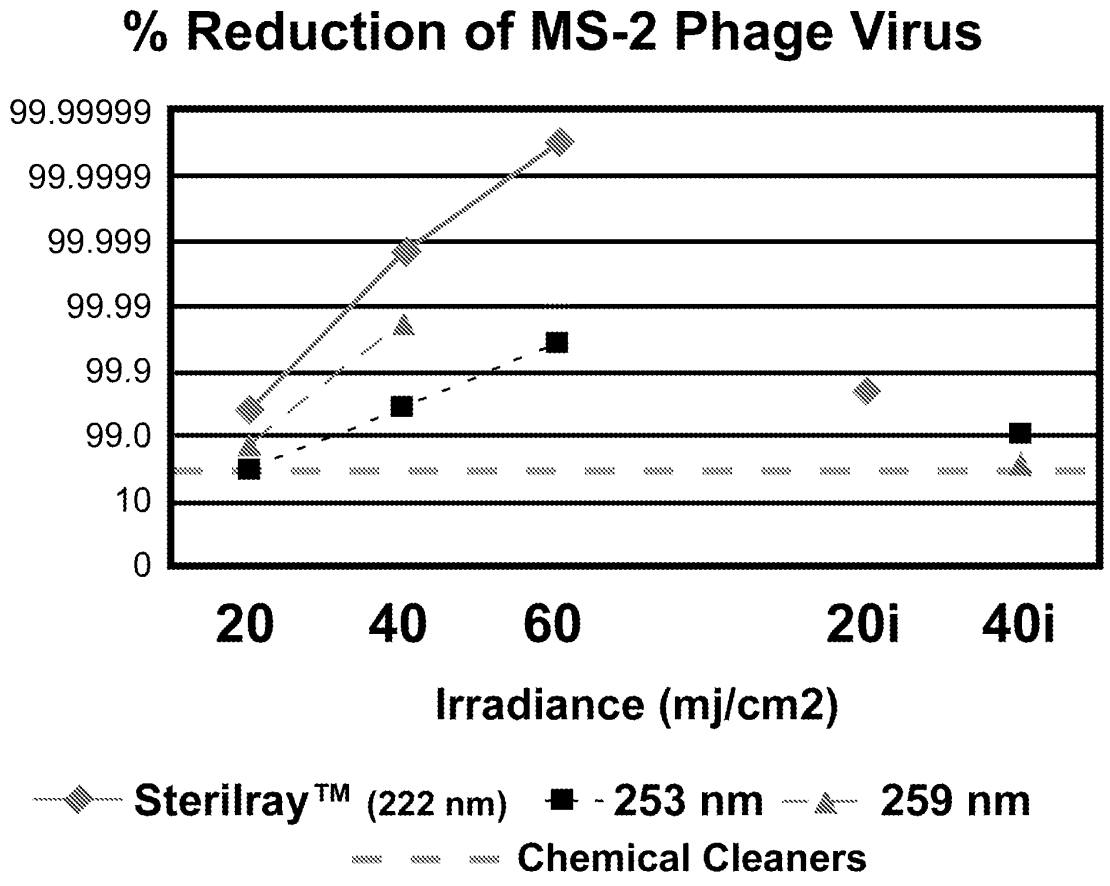


Figure 11: UV Irradiation Test on MS2

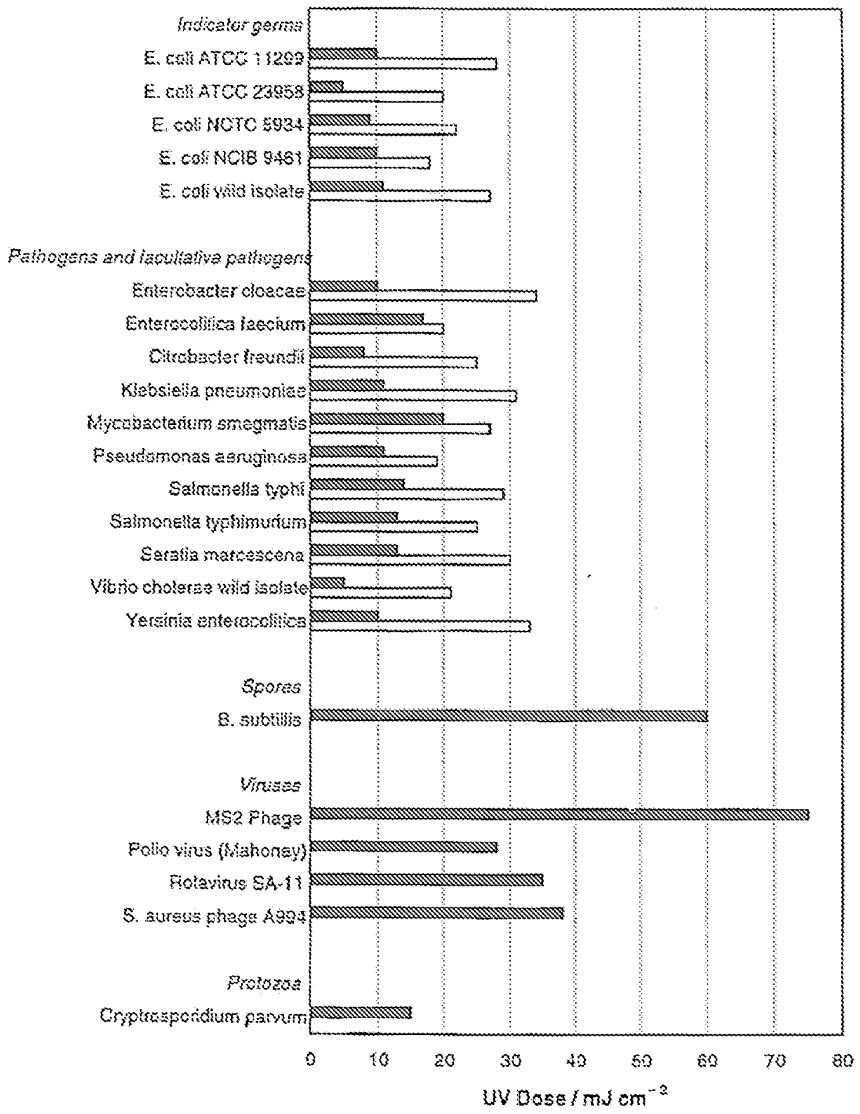


Figure 12: UV dose required for 4 log (99.99%) deactivation

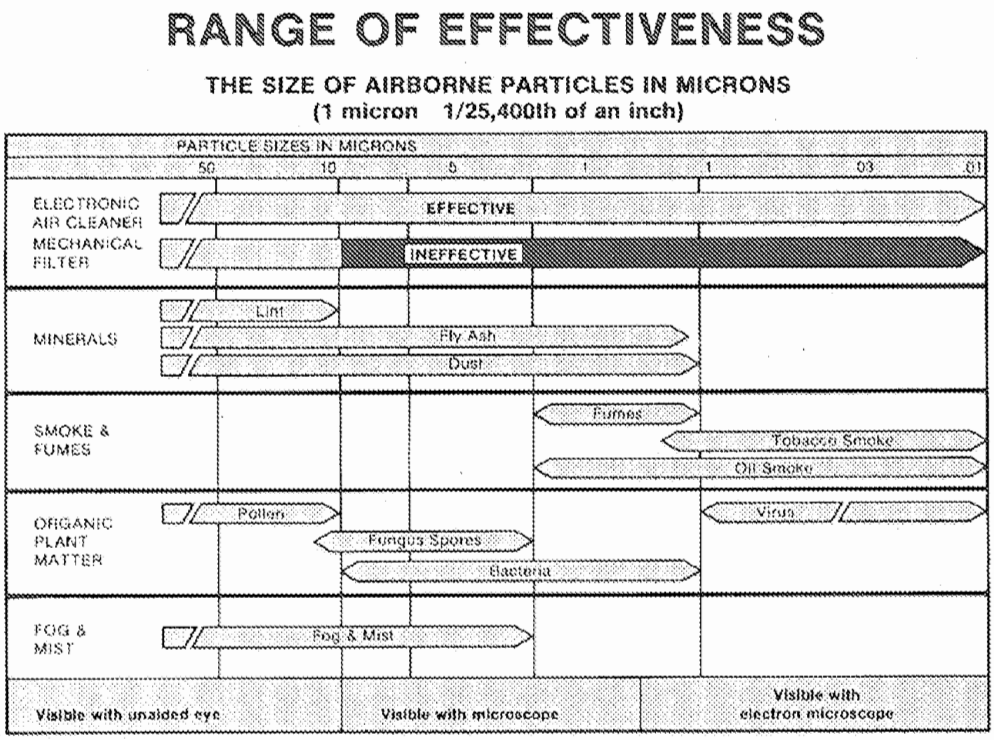


Figure 13: ESP range of effectiveness

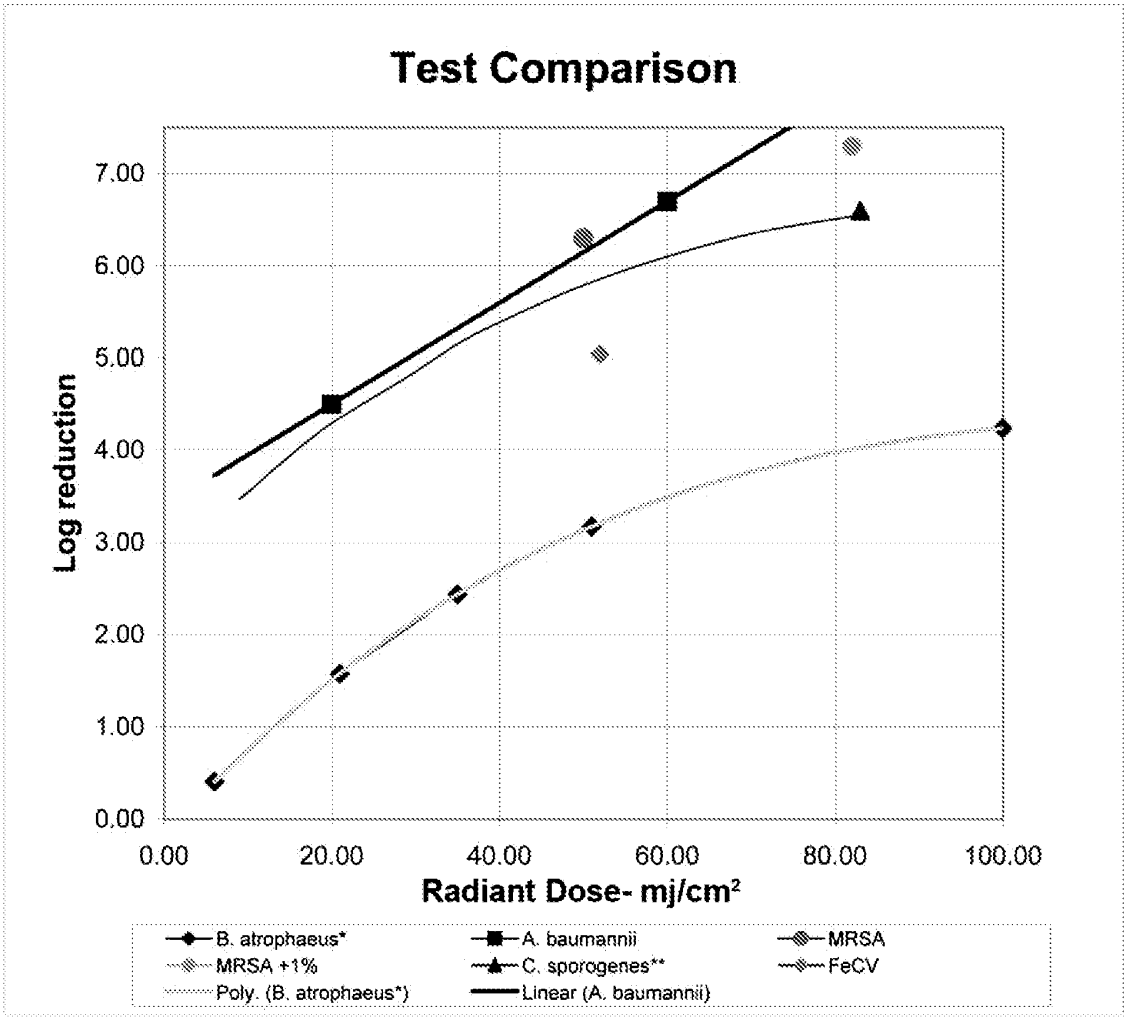


Figure 14: Sterilray Technology Test Data

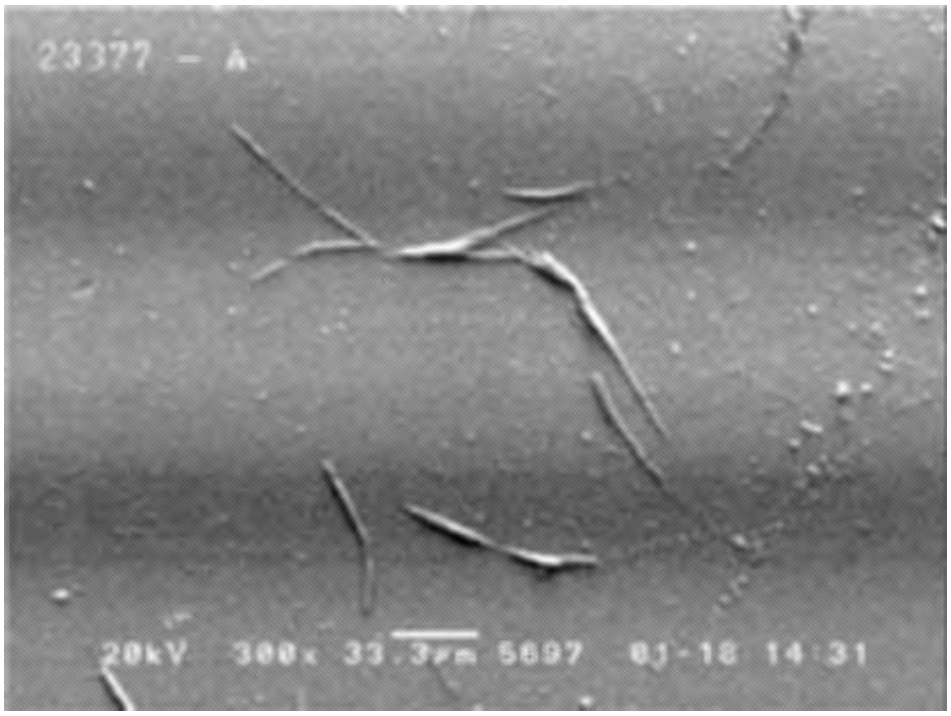




Figure 15: 300x and 100x micrographs of Bacillus atrophaeus

Claims

What is claimed is:

1. A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 207nm, 222nm, 280nm, 282nm, and 308nm;

directing the photons to the substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

2. The process of claim 1 wherein the human or animal tissue is an eye tissue.
3. The process of claim 1 wherein the human or animal tissue is blood.
4. The process of claim 1 wherein the human or animal tissue is an organ.
5. The process of claim 1 wherein the human or animal tissue is a wound.
6. The process of claim 1 wherein the microorganism is at least one of a bacteria, a virus, a fungus, an amoeba, and a protozoa.
7. The process of claim 1 wherein the step of directing is performed for approximately two seconds.
8. The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
9. The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a blood flow path in a dialysis machine.
10. The process of claim 1 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
11. The process of claim 1 wherein the step of directing comprises positioning a lamp approximately two centimeters away from the substance or surface to be disinfected.
12. The process of claim 1 wherein the step of generating photons comprises activating a lamp positioned within a case.

13. The process of claim 1 wherein the step of directing the photons further comprises the step of providing 540 kJ/mole of photon energy to the substance or surface to be disinfected.
14. A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least two single line wavelengths corresponding to a peak absorption wavelength of DNA or RNA, the at least two single line wavelengths being at least two of 207nm, 222nm, 254nm, 280nm, 282nm, and 308nm; and

directing the photons to the substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms.
15. The process of claim 14 wherein the substance or surface is a human or animal tissue.
16. The process of claim 14 wherein the substance or surface is an inanimate surface.
17. The process of claim 15 wherein the human or animal tissue is an eye tissue.
18. The process of claim 14 wherein the step of directing comprises passing the generated photons through a fiber optic cable.
19. The process of claim 14 wherein the step of generating photons comprises activating a lamp positioned within a wand, and wherein the step of directing comprises positioning of the wand.
20. A process for destroying a DNA or RNA of a microorganism on a substance or surface comprising the steps of:

generating photons of at least one wavelength corresponding to a peak absorption wavelength of DNA or RNA, the at least one wavelength being at least one of 222nm and 282nm;

directing the photons to the substance or surface to be disinfected, whereby the photons are selected to destroy a plurality of chemical bonds within the DNA or RNA of the microorganisms; and

wherein the substance or surface to be disinfected is human or animal tissue.

METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION

BACKGROUND

1. Field of the Invention.

This specification teaches a new method for disinfecting and sterilizing air, surfaces of all types and food from microorganisms and toxic chemical substances. In addition, it relates to a process and apparatus for protecting surfaces in closed or captured environments (zones) from external sources of microbial contamination in an efficient and cost effective process. These zones can be large volumes such as high rise building, cruise ships and jet airliners, or small volumes such as small rooms or surgical operation areas whether in a hospital operating room or on the battle field.

2. Description of the Related Art.

All prior art for sterilizing and disinfecting air has been based on using commercially available ultra-violet (UV) lamps or by using magnetic fields. These lamps are either pulsed or continuous. Continuous lamps are mercury based and emit principally at 254 nm. A number of companies are presently producing UV light based apparatus for the destruction of "virus, bacteria, spores and pathogens" (microorganisms or VSP) that are in room air. This is an effective treatment because it continually exposes room air currents to the treatment light and over time has sufficient exposure time to treat VSP's. The required exposure times range from 10's to 100's of seconds, depending on the light absorption capability of the different virus and bacteria at the 254 nm. While this is effective for treating the room air of individual rooms, it requires a long time to be effective in treating large flowing volumes of air that pass quickly down large ducts. Its long treatment time is impractical for treating most surfaces.

Magnetic based apparatus also require time to deactivate or destroy these VSP's. Two such inventions are directed to specific applications. Wesley, U.S. Pat. No. 4,458,153 is directed specifically towards liquid like substances enclosed in pipes, but does not discuss any test results. Sangster, U.S. Pat. No. 5,750,072 requires an injection of a sterilizing fluid as a mist or vapor for the magnetic field to produce radicals that in turn are used to alter the VSP's. He does not discuss any test results. Hofmann, U.S. Pat. No. 4,524,079 is directed specifically to treating food stuffs. He speaks of requiring up to 100 pulses at frequencies ranging from 5 to 500 kHz. Although the action time would be short, the power required to treat large areas and the apparatus design limit its

practical application. None of these patents are admitted to being prior art by their mention in this background section.

The broad ultraviolet spectrum had been divided into three regions depending on its different effects on human skin. Reference to these regions are predominantly made in medical terminology with UV-A defined as a range or band between 320 nm and 400 nm, UV-B defined as a band between 280 nm and 320 nm, and UV-C defined as encompassing wavelengths shorter than 280 nm. Recently the UV-C band has been shortened because strong water absorption causes different effects on the skin below 235 nm. UV-C is now considered the band encompassing wavelengths from 280 nm to 235 nm. The Far UV begins at 235 nm and encompasses wavelengths to the beginning of vacuum UV at 185 nm. Photochemists and photobiologists do not generally use these terms because absorption spectra of chemical bonds are much narrower than these generally defined bands. Instead, they use the wavelength of the applied radiation to define the observed effects.

Claims have been made that UV-C radiation is used to alter the DNA. This is because the mercury lamp emission at 254 nm is close to a good DNA absorption band and is the most widely available UV-C radiation source. None of these claims make reference to any shorter wavelengths and to the absorption band that peaks at 200 nm (see figure 9). Most literature credits this peak to protein absorption whereas the peak centered near 260 nm is attributed to many amino acids. In fact, all literature directs researchers away from using any shorter wavelengths due to the high absorption of molecular water. Mercury lamps are used for wastewater treatment and work well for this application. However, this specification teaches that since we do not live underwater, the protein absorption band offers much more significant action spectra that can be used to alter the DNA of microorganisms more effectively. A source of Far UV photons targets this protein absorption band. This concept is a significant advancement and a step change in the technology used for sterilization and disinfection.

During the past few years, new UV emitting lamps based on the excitation of excimers are becoming commercially available. These emitters produce single line or narrow spectral emission at a wavelength determined by the gas composition of the lamp. If the treatment lamp's wavelength is chosen to match closely to the peak of protein absorption of the microorganism's DNA, then a lethal dosage can be delivered to the VSP's in a shorter time. No patent has been found that teaches the use of "new ultra-violet" (NUV) sources coupled with supporting equipment that can effectively and efficiently disinfect and sterilize large volumes of air, large and small surfaces, and food stuffs in various stages of preparation in a practical manner.

The NUV lamp is a coaxial design that can be made as small as a pencil to as large as 1 meter long. Lamp efficiency is about 10-25% wall power to UV emission. The design has several advantages over mercury lamps. Most important is that its gas can be chosen to maximize its emission to the absorption peak of the targeted biochemical. Unlike the mercury lamp, the UV intensity can be varied from near zero to maximum. It will produce 10 to 1000 times more intensity than mercury, depending on the lamp dimensions, and it does not use mercury that will soon become regulated by the EPA.

In this specification, sterilization or sterilize refers to sterilization or high level disinfectant as defined by US FDA. The terms disinfectant and disinfection refers to all other levels of disinfection.

SUMMARY OF THE INVENTION

Destruction of pathogens is significantly improved by targeting a biochemical in its DNA/RNA with the proper wavelength so the critical dosage can be delivered in the shortest time. The concept is to direct the correct spectral emission to target specific bonds with sufficient intensity to destroy pathogens quickly and effectively on all types of surfaces and in the air.

Critical to this apparatus is the development of a new ultra-violet (NUV) source that emits a highly intense narrow wavelength band of photons that correspond to the maximum absorption band for DNA proteins and other component bonds. The preferred embodiment is the NUV source at 222 nm targets these proteins and their peptide bonds.

The NUV source can also be made to emit photons at 282 nm to target a mixture of amino acids and some proteins that absorb at this longer wavelength. For some specific cases, the NUV source may also produce 254 nm photons so as to target specific amino acids. The process is to use the irradiance from the NUV apparatus to produce high levels of disinfection on all types of contaminated surfaces and air and to destroy Biotoxins and nerve agents. The process includes support apparatus, ozone with the NUV source and preconditioning liquids and sprays that affect the tightness of the polypeptide helix which may improve absorption by the pathogen proteins or amino acids that result in improved destruction at lower dose or less time or both.

BACKGROUND FOR NUV APPARATUS

The genetic makeup of all living organisms is contained in their DNA molecule. This is a nucleic acid molecule that contains the genetic instructions to construct other components of living cells, proteins and RNA molecules. Replication occurs by the splitting of the DNA molecule, which duplicates itself through a transformation of its structure. Parts of the DNA molecule have been given names such as pyrimidine bases, cytosine, thymine or uracil that form a group of biochemicals that

sustain life. The long DNA molecule holds itself together by using simple bonds like those found in sugars.

Researchers believe that the energy of the UV photon causes the formation of a strong (covalent) bond to develop between specific biochemicals. However, the bond strength of the covalent bond is very dependent on the relative position of the participating atoms. When the bond is symmetrical on both sides of a hydrogen atom in the bond, it is referred to as a dimer. A dimer is a very strong bond and is not generally broken during the vaporization of the liquid. UV light is known to produce Thymine, cytosine-thymine, and cytosine dimers. After the formation of the dimer, further replication of the DNA stops. Figure 8 shows the concept of the dimer formation in a DNA molecule.

The DNA molecule absorbs light from about 180 nm to about 300 nm. One of the most effective wavelengths to treat VSP's in water is about 254 nm because of low water absorption. However, water absorption of UV light increases steadily as the wavelength decreases below 240 nm. This limits the ability for UV light of shorter wavelengths to be as effective for water treatment.

A standard commercial light source for UV irradiation near the 260 nm absorption peak of DNA is being produced by using mercury as the source for generating photons. The mercury gas and its pressure in the lamp determine the wavelength of the emitting light. For low-pressure (LP) and low-pressure high output (LPHO) lamps, the emitting wavelength is near 254 nm. For medium pressure lamps, the emission ranges from 200 nm to above 300 nm. However, the strength of the emitted light is not effective below 245 nm for the continuous emitting lamps and below 235 nm for medium pressure lamps. Xenon gas in pulsed lamps produces a similar emission as the medium pressure mercury lamps.

DNA action spectra show that absorption increases as the wavelength decreases, with a relative maxima at 260 nm and largest at 200 nm. Many articles indicate the principal action spectra of the DNA absorption is from 245 to 280 nm range and do not address the 200 nm peak. An exception is Figure 9 which graphically shows this relationship (Von Sonntag; Disinfection by free radicals and UV-radiation. Water Supply 4, 11-18 (1986)). Since water absorption significantly increases below 240 nm, it becomes apparent that DNA effectiveness curves that omit the 200 nm peak apply only to organisms in water.

MS-2 Phage is a marker virus that is used to measure reproduction viability after UV irradiation. Figure 10 is DNA absorption without the influence of water (Gates, F.L. A study of the bactericidal action of ultra violet light III. Jour. General Physiology 14, 31-42 (1930)). Absorption is more than doubled at 220 nm.

A recent technical paper (Peak et al, UV action spectra for DNA dimer induction; Photochemistry and Photobiology, 40, 5 (613-620)-1984) suggests that dimer formation is not the only requirement to inactivate DNA. Absorption of other molecular groups in the long DNA chain increase as the wavelength is reduced from 254 nm. Damaging or destroying these bonds may be more effective in deactivating the DNA than compared to the 254 nm band. Reports show that damage caused by 254 nm light can be reversed by longer wavelength UV and blue light (Figure 12). The DNA of pathogens not expected to have this 'photo-reactivation' phenomenon after being exposed to higher energy 222 nm photons.

The energy of the emitted photon is determined by its wavelength. Photon energy is about 5ev at 250nm, and increases for shorter wavelengths. Different bonds in the DNA will be affected with photons of different energy.

The 540 kJ/mole photon energy from the NUV lamp exceeds the bond energies of many of the peptide bonds. This should cause physical damage to the microorganism. Figure 15 shows a micrograph of the Bacillus atrophaeus after receiving a radiant dose from a NUV lamp. It shows a magnification of 300x and 1000x taken at low power to prevent any physical damage to the organisms during the picture process. The results of photon impact can be clearly seen in the 1000x frame by the ruptured sidewalls and segmentation of the organism. This is the first indication the author has seen that photons are actually causing physical damage and destruction to pathogens. A corresponding slide that received the same radiant exposure confirmed that all organisms were dead.

A NUV lamp emitting at 222 nm is considered the most effective source because DNA molecules and biochemical's have greater absorption at this wavelength. The steep rise in absorption below 240 nm is exhibited by most proteins. It has been fairly well established that the peptide bonds in protein molecules are responsible for the steep rise in absorption. This occurs as well for nucleo-proteins, aromatic amino-acids, diglycine, triglycine, and bovine albumin (McLaren, et al, Photochemistry of Proteins and Nucleic Acids, Pergamon Press, Macmillan Company, 1964). An organic chemist suggests that this lower wavelength is more effective in breaking bonds and producing dimers in the purine bases and sugar phosphates instead of the pyrimidines.

This wavelength is not strongly absorbed by water vapor and oxygen in the air. However, at 200 nm, oxygen absorption increases by 10 times and water absorption becomes slightly greater than oxygen. At 200 nm, ozone production vs. irradiance can not be controlled as it can at 222 nm. This would create a large amount of ozone that is harmful to humans and animals and reduce its effectiveness for applications in air, particularly for long irradiation distances.

TESTS

Using a lamp that emits 222 nm, a comparison test with and without water was made to determine the effect of this radiation on organisms. The organism used in all tests was the MS-2 virus, which has become a standard indicator of mutation effectiveness. The EPA report (811-R-96-002) reports a 4.3 average log reduction of the MS-2 virus using mercury light 254nm at an irradiance greater than 128 mj /cm^2.

Three wavelengths were tested: 222, 253, 259 nm. The 222 nm lamp was tested at three levels of irradiance with the virus in a thin layer of water in order to reduce the absorption effect of water. A separate test was also done with the virus in more water. The 253 and 259 nm lamps were tested at the identical irradiance levels with the virus in water. Controls were made on all tests and a single test dish on each lamp was made to check experimental error.

The 222 nm lamp (Figure 11) produced log 5 reductions at 40 mj/ cm^2 and log 6.5 reductions at 60 mj/ cm^2. The water test produced a 3.2 log reduction, which matched the equivalent calculated irradiance in air. The 253 and 259 nm lamps produced about log 4 reductions at 60 mj/cm^2. A 3 million reduction in population is about 10 to 100 times more effective than reported mercury 254nm results at the same irradiance.

The results of the test indicate that 222 nm light is very effective in causing mutations and destruction in microorganisms. These tests indicate an improvement of between 10 to 1000 times, depending on the intensity of the lamp. It is important to note the improvement of the 259 nm source compared to the 254 nm source. This produced a 10 times improvement in the test sample for just a 5% increase in absorption. It illustrates the importance in using a UV photon emitter that is near the absorption peak of the DNA or targeted chemical such as proteins, nucleic acids, or amino-acids.

Figure 12 illustrates the 254 nm dose required to deactivation different VSP's. The bars represent with (solid) and without (open) photo-reactivation. Note that a dose of 75 mj/cm^2 is required to deactivate the MS2 Phage virus and prevent photo-reactivation. In the tests shown in Figure 11, half the dose at 222 nm was just as effective as the higher dose at 254 nm. Even though the sample was under water, the 222 nm radiation was still more effective than 254 nm radiation.

The 222 nm photon has more energy and is absorbed by S-N, S-O, O-O, O-H, and many carbon bonds that do not absorb 254 nm. This suggest that 222 nm light may also prevent DNA repair that has been reported when low level 254 nm UV sources were used.

Figure 14 presents further testing done in independent research laboratories on many different pathogens. They include spores Bacillus atrophaeus and Clostridium sporogenes, feline calici virus, bacteria Acinetobacter baumannii, MRSA, MRSA + 1% serum. The chart plots radiant

dose against a log reduction of the target microorganism. It shows that high log reductions were achieved for viruses, bacteria and spores. This chart presents data that does not determine the minimum dose but only the log reduction at the dose tested. Since many tests represented a 100% kill, a lower dose could obtain the same log reduction at or near 100% kill.

A survival plot was made of the Bacillus atrophaeus spore. Since it is known to be one of the most difficult spores to kill or deactivate, this curve represents the base line for the dose required to kill most pathogens for the NUV source. Future tests will generate survival plots of the other pathogens to determine the minimum dose for various log reductions.

Since the NUV source can produce an irradiance of 100 mw/cm^2, then a log 4 reduction of all but the B. atrophaeus can occur in a 0.1 second treatment resulting in a radiant dose of 10 mj/cm^2. The chart demonstrates that the NUV source is a potent sporicide as well as capable of producing high disinfection on VSP's.

TECHNICAL DISCUSSION

One or multiple single line wavelengths are contemplated herein for disinfection, including, but not limited to human, animal, and plant tissue disinfection, as well as other non-living/inanimate surfaces and substances. As discussed with regard to various embodiments herein, one or a combination of single line wavelengths may be used. These include 207nm, 222nm, 254nm, 282nm, and 308nm whether produced by NUV lamps using the excimer process or by Light Emitting Diodes (LED's). Important to this specification is the single line nature of the light source. LED emission within about 5 nm of these lines may produce the same or similar effect as the specified line. For example, and LED emits at 280 nm and not at 282 nm will produce the same effect on tissue and cells as the 282 nm specification. It will be understood that the wavelengths noted and claimed herein may vary by +/- 5nm, and so long as they continue to be a single line wavelength, are within the scope of the claimed invention. It is noteworthy that the term tissue is used herein to refer to various living materials, as well as biological components including blood cells, cells in tissue, and other fluids, and the like. These listed wavelengths are advantageous because, at least under dose levels contemplated herein, they cause no damage to cellular structures of the human, animal and/or plant material treated, while achieving very high levels of microbial disinfection and fungi/yeast and spore destruction.

Critical to the destruction of the organism is targeting the proper biochemical with the proper wavelength so the critical dosage can be delivered in the shortest time. The critical dosage is that dosage that destroys or deactivates the organism and prevents its replication.

Pyrimidine and purine bases of nucleic acids have a strong absorption near 260 nm. But proteins also have an absorption maximum at about 280 nm due to the absorption by the aromatic amino acids phenylalanine, tyrosine and tryptophane. Numerous lipids also absorb near this peak. They include indole acetic acid and Lipase. And there are some major differences that occur in the synthesis of DNA to RNA. The protein thymine is replaced by the pyrimidine base uracil that has absorption near the 280 nm and not at lower wavelengths.

It is important to note that biochemicals of DNA and RNA will have different absorption spectra and the peak absorption will be shifted by water, pH, temperature, previously absorbed light and surrounding contaminates in the air. Uracil and cytosine are particularly susceptible to photohydrate formation. A protein crosslink can be formed between a pyrimidines base and an amino acid. Cysteine and thymine are easily affected and uracil preferentially binds to cysteine, phenylalanine and tyrosine. Protein crosslinks induce irreversible cell damage. The disulfide group of cystine can be split into reactive sulfhydryl groups. Tryptophane (280 nm absorption) can provide the singlet energy transfer to split the disulfide groups that strongly influence the structure and function of proteins in the DNA/RNA complexes.

The presence of ozone can significantly induce damage to the long polypeptide amino acid chains and shorten the UV action kill time. For some applications, the NUV intensity is increased to produce some ozone to improve the pathogen destruction of the contaminated surface.

Test data confirmed that proteins in the RNA of the norovirus do not absorb the NUV wavelength at 222 nm effectively. However, a number of RNA proteins do exhibit strong absorption near the amino acid peak absorption of 280 nm. More likely is the fact that RNA absorption is due to the combination of the proteins and the locations and types of amino acid bonds surrounding them. Testing is underway to confirm that a NUV source at 282 nm will cause similar destruction to the RNA of the norovirus compared to the DNA destruction seen in Figure 14.

There are many UV absorption plots that indicate how the degree of absorption in the DNA/RNA molecule changes with wavelength as the pH of the carrier solution is changed. The *secondary structure* is a term used to describe the coiling of the polypeptide chain. The tightness of the coil is also significantly affected by pH of the solution. This suggests that the closeness of the different amino acids to peptide bonds affect the DNA/RNA absorption at a specific wavelength. Consequently, pre-treating the surface with a solution or spray that improves the absorption of the targeted proteins and amino acids prior to delivering a UV radiant dose is also being tested. In many cases, it may significantly improve the process by reducing the UV dose or treatment time. The

concept of using the NUV source in conjunction with wipes and liquids for treating VSP's on surfaces is also contained in the scope of this specification.

Biotoxins and nerve agents can be used by terrorists as weapons against groups of people. Nothing economical has been developed that could mitigate an attack and prevent the loss of life and incapacitation at the point of attack. While government agencies of the US have developed detectors that could be used in the future to warn people in the confined areas that are under attack, nothing would prevent the attack from being effective.

Biotoxins and nerve agents are organic molecules that contain either DNA or have long chain carbon molecules. Both of these are susceptible to destruction using NUV light sources. 222 nm will destroy the C=C and C=O bonds causing the destruction of the chemical. Future testing will determine if the molecular extinction coefficient is sufficient to make this effective means for their destruction.

The most effective means for delivery of these agents is to spread them in a gas phase through the air ventilation system. A detector would be used to turn on sufficient NUV sources so that the agents are destroyed before exiting the ventilation system into the confined area where the captured population is present. Tests still need to be done in regulated and controlled laboratories to develop the criteria for these sources to be effective and become the first line of defense.

The use of a high E field electrostatic precipitator (ESP) is important to the sterilization and disinfecting apparatus for air in some situations. Figure 13 compares the range of effectiveness with mechanical filters for different pollutant sizes. As illustrated in the fourth column, it is capable of removing some percentage of VSP's. However, since it can also capture fog and mist, it has the ability to breakdown ozone O_3 into oxygen. Its use prevents levels of ozone from exceeding the EPA exposure safe levels.

In some cases the air disinfecting apparatus includes a humidification system to provide and maintain minimum moisture content at predetermined and controllable levels. In addition, the apparatus contains baffles and zone restriction devices that enhance the zone protection and minimize the positive pressure required to maintain the protected zone.

The concept of using the NUV source with associated support equipment for air disinfection of VSP's is valid and is also contained in the scope of this specification.

APPARATUS AND PROCESS DISCUSSION

The NUV source apparatus is made to supply a narrow emission band of UV light that is close to the peak absorption of the targeted organism or chemical with sufficient photon energy that break

bonds. Unique to obtaining short action (kill) times is a determination of the specific wavelength required to destroy the targeted organism or chemical.

The process is to direct the correct spectral emission to target specific bonds in proteins and amino acids in the DNA/RNA molecule with sufficient intensity to destroy pathogens quickly and effectively. It is effective for the breakdown of biofilm and protein based allergens.

The preferred embodiment is a NUV source at 222 nm. This spectral emission is 10^4 times more effective than standard mercury based lamp UV light for altering the DNA. Action times are reduced from 10's to 100's of seconds to times less than 0.1 seconds.

The NUV source can also be made to emit photons at 282 nm to target a mixture of amino acids and some proteins that absorb at this longer wavelength. This may be particularly important for single or double strand RNA of influenza or noroviruses. For some cases, the NUV source may also produce 254 nm photons so as to target specific amino acids. And the photon energy of the NUV source is sufficiently high to break carbon bonds of chemical toxic substances or biotoxins with similar action times.

This invention uses the NUV source that makes it cost effective in treating surfaces of materials since the action time is very quick. The apparatus of this invention is designed to make direct photons to the intended target as effectively and efficiently as possible. This makes for a cost effective process for sterilizing and disinfecting air, all types of surfaces and food during normal daily activity and prevents the previous need to restrict occupation and use of areas being treated.

Surfaces

The apparatus is designed to quickly disinfect floors, hand rails, objects that are in constant contact with transient populations for the purpose of preventing transmission of disease and toxic substances that can cause injury or illness to these populations. As a hand wand, it only needs to be waved or passed over the surface to obtain a high level of disinfection.

The NUV radiation can be applied to any object or surface that needs to be disinfected and/or sterilized. An example would be the use of a caddie cart whereby all instruments, papers and pens would be exposed after a patient examination to prevent the transmission of pathogens to the next patient. The cart could also provide a means to disinfect protective gloves or face masks if a shortage occurs during a pandemic. Testing will determine the correct exposure limits to prevent any harmful effects that could occur when used to disinfect human skin, hands, animal surfaces such as skin, fur, and hair, and critical plastics and materials used in medical devices. It also has the potential

to sterilize/disinfect medical equipment and surfaces and critical parts on an industrial assembly line prior to packaging.

In one specific embodiment of use, the present invention may be applied to skin disinfection. The wavelengths contemplated herein are not damaging to the epidermis, and therefore can quickly and effectively disinfect human or animal skin without skin cell damage. In one example, a doctor or nurse may expose their hands to the NUV source before, during, and/or after surgery. Because the NUV source may disinfect in a fraction of a second, hand disinfection is very quick and convenient, and can be done repeatedly to prevent any spread or growth of micro-organisms. Other examples of skin disinfection may be applied to livestock industries, food processing and treatment industries, pet cleaning, and the like. Livestock may be exposed to the NUV source to keep them clean and disinfected and prevent infection or spread of infection. Similarly, food treatment and processing industries may use the NUV source to treat and disinfect skin of animals and/or animal carcasses, as well as exterior surfaces of food products such as eggs, fruits and vegetables, leafy greens, eggs, nuts and any food products that need some level of disinfection such as spices, grains, and horticulture such as flowers and plants.

In one embodiment that may be particularly applicable to skin and/or wound (non-skin flesh) disinfection, as well as general human or animal tissue, at least one of 207 nm, 222 nm, or both may be used as wavelengths emitted from the NUV source (or two different NUV sources). These two wavelengths may be emitted by an excimer lamp or lamps. In an embodiment emitting both 207 nm and 222 nm, two separate lamps may be used, the two lamps in close proximity to each other. In another embodiment, a dual annulus lamp may be utilized. This lamp may have three coaxial tubes defining two annuli filled with two different gasses to generate the two wavelengths. Electrodes may serve to excite the gasses, emitting the two wavelengths simultaneously and from a single source.

Because the lamp in this embodiment's wavelength is chosen to match closely to the peak of protein absorption of the microorganism's DNA, both 207 nm and 222 nm may be particularly useful for skin and wound disinfection, as well as general human or animal tissue disinfection, because they do not penetrate the epidermis, and 207 in particular does not damage human or animal cells. Similarly, 222 nm does not penetrate into the dermal cell layer and therefore there is no concern of DNA mutation which leads to diseases such as cancer. As such, these two particular wavelengths are particularly well suited to skin and wound disinfection: Both are useful on skin because they do not penetrate the epidermis; and both are useful on wounds because 207 nm will not damage the exposed flesh, while 222 nm may damage internal cell structures which are repairable by normal exposed cells resulting in no ultimate harm. From an effectiveness standpoint however, 222nm is

approximately 3-4 times as effective at disinfection compared to 207 nm. Thus, while 207 nm alone is an option for disinfection, generally 222 nm alone or in combination emission with 207 nm will be utilized for most embodiments. However, the above-noted single line wavelengths may also be used for disinfection of skin, wound, and other tissue disinfection without straying from the scope of this invention.

In another embodiment, the NUV source of the present invention may be used to treat eye infections including corneal infections, corneal ulcers, streptococcus, pseudomonas, candida, mycobacterium cheloni, conjunctivitis, and Acanthamoeba, among many other infectious microorganisms of the eye. In a particular embodiment, the NUV source may produce 222 nm, either alone or in combination with one or more of the above noted single line wavelengths (namely, 207, 254, 280-282, and 308 nm) may be particularly advantageous for eye treatment and disinfection.

In a further embodiment, the present invention may be used to sterilize/disinfect contact lenses and contact lens cases. In a particular embodiment, a NUV source may be positioned within or adjacent to a contact lens case interior. In this embodiment, when the case is closed, the NUV source may be activated for a period of time, disinfecting the case and contact lenses within the case. In a particular embodiment, the NUV source may produce 222nm, either alone or in combination with one or more of the above noted single line wavelengths (namely, 207, 254, 280-282, and 308 nm) may be particularly advantageous for treatment and disinfection.

In another area of disinfection and eye-based treatment, the increased lipase activity seen in Meibomian gland disease of the eyelids could easily be reduced with a wand embodiment of the NUV source of the present invention. Treatment using the wand-based NUV source may decrease the inflammation of the eye lids seen in blepharitis, decrease styes and chalazions and reduce Rosacea of this lids and facial skin. This later infection is associated with demodex of the eyelid skin and lashes which should be eliminated with treatment using the NUV source.

Demodex folliculorum is common in facial redness and blepharitis especially , and rosacea of the eyelids andfacial skin. The mite eats the sebum from the base of the eyelashes and the dead skin and oil debris. The current treatment includes careful washing of the eyelashes with 50% baby shampoo, warm compresses, Teatree oil, and antibiotic or erythromycin ointment at night time. Far-UV light will give relief of symptoms of redness and discomfort as the mites are killed at the base of the eyelashes and the surrounding facial hair.

In some cases, intraepithelial neoplasia of the conjunctiva and carcinoma in situ of the conjunctiva and cornea that can turn to squamous cell carcinoma, requiring extensive surgery or exenteration of the orbit with loss of the eye. In addition, melanoma of the conjunctiva can kill the

patient or cause loss of the eye. The cell killing power of direct application of the NUV source to these cancer cells may allow eradication of these tumors without the need for the current freezing, 5FU, resection and Mitomycin treatment that is employed.

Apoptosis is an ordered and orchestrated cellular process that occurs in physiological and pathological conditions. Cancer is where too little apoptosis occurs, resulting in malignant cells that will not die. Apoptosis plays an important role in the treatment of cancer as it is a popular target of many treatment strategies. New drugs or treatment strategies that are designed to enhance apoptosis require extensive testing before they can be used safely in human subjects.

PDT is a treatment involving UV light-induced activation of photo-sensitizers. Most of the sensitizers used have had extensive testing and are safe for human use. The general thought is that the presence of oxygen produced by UV to photo-sensitizer absorption will produce free radicals capable of inducing cell death. In recent years, PDT has become an established treatment for selected neoplastic lesions, especially skin cancers, squamous cell carcinoma, actinic keratosis, Bowen's disease, and precancerous lesions.

There are three principal pathways that lead to cellular death. The study of apoptosis induced by PDT is mainly focused on mitochondrial pathway and the death receptors. The caspase receptor family is one of the most important death receptors. In mitochondrial pathway, photodynamic reaction creates oxidative stress by generating reactive oxygen molecules that damage the molecular structure of DNA. This reaction will activate mitochondria to induce cell apoptosis. In caspase pathway, when mitochondrial function is destroyed, cytochrome C is released and then mediates a series of caspase family apoptotic cascades which in turn lead to cell apoptosis.

Tests show that UV-B inhibits cellular proliferation in a dose-dependent manner. Inhibition increases with an increasing dose of irradiation in the range of 10–70 mJ/cm2. At 50 mJ/cm2, inhibition of proliferation of A431 protein marker cells is 49.94%, while for HaCaT protein marker cells inhibition is 41.92%. The inhibitory peak is reached at 70 mJ/cm2.

Single line emission in the Far-UV at 222 nm targets protein structures in cells including the nitrogenous bases in the DNA as well as the proteinaceous layer (lamina) that surrounds the cell nucleus. Consequently, Far-UV does not need a photo-sensitizer to activate mitochondria to induce cell apoptosis. Normal cells can repair their DNA with internal enzymes, but cancer cell proteins that decide whether a cell should repair itself are faulty. Since Far-UV actually ruptures molecular bonds due to it high photon energy, dimmer repair and DMA/RNA replication cannot take place quickly leading to cell apoptosis. The cell membrane also plays a critical role in tumor malignization. Spot

destruction and rupturing of the lamina with Far-UV photons can cause significant changes in surface receptors and internal structural changes that lead directly to apoptosis as well.

Single line emission in the Near-UV at 280-282 nm also targets protein structures in cells, but it penetrates further through tissue than 222 nm. New tests are being done to determine if similar degrees of apoptosis can be produced by both wavelengths.

In another embodiment, the NUV source may be mounted on an automated robot, the robot being programmed and configured to disinfect a room automatically. This robot may be specifically configured to disinfect hospital rooms automatically but moving into the hospital room, and activating the NUV source. This will disinfect all air and surfaces exposed to the UV radiation from the NUV source. Further, the robot may be configured to move around the room to expose other surface and air zones to the UV radiation from the NUV source. It should be understood that this embodiment is not limited to hospital room disinfection, and could be used for any room disinfection with the NUV source attached to a robot or robot controlled device. For example, the robot may be an automated vacuum cleaner or floor cleaner, or a robot specifically configured to enter a room in a building to disinfect the room.

In yet another embodiment, the NUV source can be used to disinfect all types of liquids by passing them through the center of the lamp where coupling efficiency with the light is maximized. Any liquid such as milk that will flow and requires some level of disinfection would be applicable. This would include wine, water for all types of uses, food products from salad dressings with low viscosity to chocolate which is most viscous. Other liquids used for medicines and health care would be disinfected at the point of container filling thereby killing any bacteria that could be resident in the piping and tubing from the supply vessel.

In another embodiment, the NUV source can be used to kill insects and psyllids that are transporting disease or harmful bacteria. As part of the killing process, it can also be used to prevent the spread of these insects by providing a containment area where they are killed if they try to fly through the irradiated zone. For example, the NUV source may be deployed in a field of crops itself, or may be used to set up a containment area around the field of crops. In a further example, containment areas may be set up around areas frequented by humans or animals to prevent infection and/or transfer of disease caused by the insects and/or psyllids.

In another embodiment, the NUV source can be used to kill fungus and molds in the fields of wheat, corn, cotton, and coffee as well as protect any other plants that need to be kept mold or fungus free. It can be further used to break down mycotoxins on food products that are produced by molds and fungus.

In another embodiment, the NUV source can be used to disinfect parts of containers that come in contact with storing food. Examples of these surfaces include bottle caps, the inside of bottles and plastic containers, and the inside of tubing and containers that handle these food products in the manufacturing and transporting in preparation to filling in consumer containers.

Other non-limiting examples of uses for the NUV source may include disinfection on foods of all types, including meat, poultry, eggs, vegetables, fruits, and the like. In particular blueberries and tomatoes may be particularly well suited for such disinfection because of their susceptibility to infection. Moreover, the NUV source may be useful for disinfection of conveyor lines, chiller liquids, water used for production requiring high levels of disinfection, hatcheries, farming, and the like. However, as noted previously, the NUV source contemplated herein may be applied to disinfection of any zone (such as a volume of air), or surface, and is in no way limited to the applications noted herein.

Because the NUV source is a light source, it can be directed to expose different levels of thick and loose materials by using light conducting fibers to distribute the light intensity. An example would have the NUV source disinfecting a floor by directing it at the floor while some of the light is directed to the bottom of a rug or floor scrubbing brush by light fibers imbedded in the brush. In a similar manner, products that have cavities or areas not exposed directly by the external source could be disinfected. An example of this would be a single fiber used to direct NUV light into a tooth cavity to disinfect the walls and tissue inside prior to sealing with a filling.

The NUV source can be used to directly disinfect room surfaces, apparatus, fixtures and clothing or particles and microbes in the room air by directly exposing all objects for the required exposure time. Several sources can be combined to assure exposure to all surfaces and to reduce total exposure time. It can provide effective treatment to isolation room air by preventing pathogens from remaining alive after exiting or entering the room. Rooms contaminated by bioterrorist agents could be treated by moving using robots to move the NUV source(s) in many directions and moving it (them) around the room during treatment.

Food

The NUV source may provide a significant improvement to the disinfection of food stuffs. The apparatus can be designed for each application that includes foodstuffs in conveyor assemblies, stationary carts and in handling routes during the movement from storage to food preparation processes. It can be use to disinfect specific types of foods such as seeds and sprouts prior to

planting, raw food stock like fruits and berries and leafy greens as they are prepared for transportation from the fields to processing centers, to warehousing and storage, to supermarket handling and kitchen preparation and delivery to the consumer. Furthermore, the process can be used to disinfect cutting and working surfaces of meat and poultry packaging rooms and even the cutters and equipment used to transport meat, poultry and other food products.

E-beam sources are currently the only other mechanism being tested to protect food supplies. It does irradiate food with high energetic electrons that is now causing concerns by many about the safety of the product after irradiation.

Air

Normal breathable air contains many contaminates including moisture droplets, dust, lint, bacteria, virus, cists, and spores. The NUV apparatus can be used by itself to disinfect air. The short action time means the NUV lamp can destroy pathogens in the air as they pass by. Another important consideration for its use in disinfecting of air is that it does not contain mercury.

Sterilization sometimes requires the removal of all particles to the smallest possible size. The NUV source can produce byproducts that must be removed for some treatment applications. These byproducts include oxidized air (ozone), condensable chemical byproducts, and damaged microorganisms. Critical to the apparatus is the removal of these contaminates and byproducts. In some special applications, ozone is produced by the NUV source to make treatment more effective. Consequently, the apparatus includes the making of ozone, the use of high E field precipitators and other UV light to remove ozone downstream after the disinfection area and apparatus to make effective use of the combination of these technologies.

Sterilized air is then used to prevent microbial contamination of a protected zone by preventing the influx of untreated air from outside this zone. The apparatus includes pressurizing equipment and zone baffles that provide sufficient outflow from the protected zone so as no contamination can occur. Protected zones can be as small as a wound area on a battlefield operating table to a cruise ship, airplane, or high rise building with thousands of inhabitants.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components of the NUV source therein.

Figure 2 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting or sterilizing large volumes of air therein

Figure 3 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting floor surfaces and other surfaces such as chairs, hand rails, counter tops, trays, table tops and the like therein.

Figure 4 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for disinfecting food prior to handling by kitchen or cooks before serving therein.

Figure 5 is a perspective schematic view of a preferred embodiment of the present invention defining the location of important components for sterilizing air that is used to cover and protect the zone around a surgical operation or procedure independent of the location of the operation therein.

Figure 6 is a perspective schematic view of a preferred embodiment of the present invention illustrating the zone air sterilization apparatus in conjunction with the remote protected operation zone therein.

Figure 7 is a CFD view of a preferred embodiment of the present invention defining the emitted airflow pattern from the sterilization apparatus that is used to cover and protect the zone around a surgical operation or procedure independent of the location of the operation therein.

Figure 8 is a graphic showing dimer formation in a DNA molecule.

Figure 9 is a graph plotting UV absorption of DNA according to wavelength.

Figure 10 is a graph plotting DNA absorption without the influence of water.

Figure 11 plots the effectiveness for reduction of the MS-2 phage virus by different wavelengths of UV radiation.

Figure 12 plots the UV dose required to achieve a four log deactivation of selected microbes using 254 nm UV light.

Figure 13 is a graphic comparing the range of effectiveness of various filters for removing airborne particles.

Figure 14 is a graph comparing tests of different pathogens for log reduction for different radiant dosages of NUV light.

Figure 15 is a low power exposure at 300x and 1000x micrographs of the Bacillus atrophaeus organism after receiving a radiant dose from the NUV light source.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The drawings illustrate the invention in its different forms and the apparatus required for sterilization or disinfection of air and surfaces that contain VSP's. Figure 1 illustrates the NUV light source. Figure 1a shows the NUV source. The high voltage electrode 1 is located inside the inner

tube of the annular lamp. The ground electrode screen 2 is located on the outside of the annular lamp. The gas that produces the UV photons is located in the annular region 3 between the inner and outer tubes 4. The gas type is chosen so that the emitted UV photons are absorbed by the targeted microorganism or chemical. The preferred embodiment is 222 nm but could also be 282 nm. UV radiation is emitted radially outward 5. Changing the voltage or current between the two electrodes changes the amount of UV radiation that is produced.

Figure 1b illustrates the NUV light source used to direct the UV photons towards a specific location, direction, surface, material or substance. . The NUV source is shown in the center of the drawing as an end view. The specialized reflector 6 end view incorporates a specialized 'gull wing' design so that >90% of the emitted light is directed to the planar surface below. The specialized reflector 6 also incorporates barium sulfate (Ba_2SO_4) as the reflective material in order to maximize the number of photons that are reflected onto the planar surface. In some cases, a cover 6a is necessary to protect the NUV source and reflector from dirt. This cover is transparent to 222 nm and 282 nm light. The specialized reflector can also have different shapes that change the directed radiation for different applications.

This design provides a convenient method and apparatus to disinfect commonly touched objects that act as fomites to transmit pathogens from one person to the next. It would also provide a means for wound treatment prior and post surgery and for the treatment of chronic wounds. It is also provides a means to disinfect hospital and health care rooms, operating tables, hand rails and equipment surfaces that support patient care.

Furthermore, in cases of critical shortages of gloves, robes and masks, the NUV source can be used in this manner to disinfect periodically when appropriate instead of retrieving new ones from supply.

The NUV source(s) can also be used to disinfect patient examining tools, records, pens and equipment between patients. Everything that is brought into the room for examining the patient should be put through the medical caddie after exiting the room and retrieved only after changing gloves and/or garments.

In use, the NUV source can be made to any size and length. In air ducts, the embodiment shown in Figure 2 item 6b would have the NUV source supported from the side, top or bottom of the duct so that its irradiation travels parallel to the airflow. For unique applications, a second embodiment Figure 5 item 16 would have the NUV source and cylinder reflector supported inside the duct so that irradiation is perpendicular to the airflow. An example of this embodiment would be a NUV source positioned in the center of a tumbling dryer. All garments or objects or food stuffs would

be irradiated during the drying or tumbling process for a length of time that would guarantee a high level of disinfection.

Figure 2 illustrates the apparatus required for the disinfection and sterilization of airflow inside a large duct. NUV sources 7 precede an electrostatic precipitator (ESP) 9 by some distance 8 that permits a short action time to complete the destruction of the toxic gases or VSP's. A humidifier 10 may follow the precipitator with control sensors 11 so that the humidity of the exiting air can be selected and maintained. A fan(s) 12 may also be used to pressurize the exiting air so that a slight pressurization can be applied to a protected zone to prevent contaminated air from entering. Depending on the nature of the zone, restricting baffles (not shown) are used to assist in maintaining a positive pressure inside the protective zone.

Figure 3a illustrates the NUV source 13 located inside the forward compartment of a vacuum cleaner or floor cleaning machine. The vacuum cleaner can be either a standup floor model or a canister model. It could also be any device that would support and carry the NUV source close to the floor. The significant part is that the NUV source with reflector 6 consists of the components as described in Figure 1b. Figure 3b illustrates a preferred embodiment with the NUV source contained in a hand held wand. Sensing switches 14 can be included in this embodiment that shut off the NUV source when the wand is not directed correctly to the desired treatment surface.

Figure 4a illustrates the NUV source(s) located above a conveyor that carries raw and unprepared food prior to kitchen preparation as well as industrial packaging assembly lines that carry products that require disinfection. The conveyor assembly 24 is designed to maximize the surface area exposed to the NUV source(s). In some cases, several sources 13 are required because the exposed surface of the food or product can not be changed to expose the entire surface during the illumination time of one NUV source. Tumblers or vibrators are typically used to change the orientation of the foodstuffs or parts as they move along the conveyor. However, a rotary tumbler similar to a cloth dryer with the NUV source located in the center would be the preferred embodiment for disinfecting leafy greens. Figure 4b illustrates the NUV source(s) 13 located beside heat lamps 15 or other heating surfaces used to keep the food hot on a serving counter prior to being delivered from the kitchen to the customer. In another embodiment, the NUV source is used to irradiate cool or cold foods, so heat lamps 15 are not used.

Figure 5 illustrates the NUV source located inside an air sterilization apparatus that provides air for remote and separate operation tables. The NUV source 16 is located inside a UV reflector chamber 17 in order to reduce the loss of UV photons. A light trap 18 stops the UV light prior to the turning vanes 19 that direct the air flow vertically downward onto the operation site. A diffuser 20

ensures that the airflow is uniform across the duct. A high E field electrostatic precipitator (ESP) 21 follows the diffuser to remove particulates and reduce any ozone to oxygen. The airflow then passes through a second diffuser and humidifier 22 to ensure that the airflow is uniform across the duct and that the humidity level is controlled to some preset value.

Figure 6 illustrates how the air sterilization apparatus would be used in conjunction with a remote operation site, where the doctor is using remote controlled surgical instruments that are inside the sterilized air zone.

Figure 7 illustrates the airflow pattern using CFD computational fluidic design to ensure that the air above the operation zone is uniform and prohibits contaminated air from entering the protected zone.

Figures 8 through 15 are discussed in the technical and background sections of this specification.

Human tissue cannot be sterilized of microbial contamination before transplantation. This microbial contamination leads to recipient patient infections. Surfaces of the human body, skin, mucous membranes and corneas cannot be adequately sterilized of microbial organisms in vivo. Antimicrobial agents all have toxicity to tissues and potential allergic responses precluding them from use in many patients.

The microbes are unusually sensitive to Far UV light, whereas the human tissues are more resilient. Eliminating the microbes in 2 to 20 seconds with Far UV light preserves the tissues, eliminates antibiotic toxicity and avoids allergic responses and the immune attack of the body.

Far UV light can be prescribed of a specific wavelength to deconstruct and cross link the cell wall of bacteria, fungi and viruses without injuring the adjacent human tissues, leaving the tissue sterile to be transplanted or heal unopposed by microbial disease,

The claimed invention differs from and improves on what currently exists. Topical antiseptics, systemic and topical antibiotics are currently utilized to fight microbial infections. Each of these agents have actual and potential damage to the tissues while decreasing but not eliminating the overwhelming microbial disease. Each known agent takes from minutes to hours, and in the case of fungi several days to eliminate the microbes. Far UV light sterilizes the field in 2 to 20 seconds, eliminating the need for costly and damaging antibiotics or antiseptic solutions.

The current medical state of the art in antimicrobial agents cannot eliminate all the extant organisms for several days. In this time period the body's responses with immune mechanisms, white blood cells and immunoglobulins have independent toxicities to the body.

Eliminating the microbes in 2 to 20 seconds preserves the tissues, eliminates antibiotic toxicity and avoids allergic responses and the immune attack of the body. The microbes are unusually sensitive to Far UV light, whereas the human tissues are more resilient.

During sepsis, the blood stream is contaminated with bacteria, fungi or viruses that are rapidly proliferating. The unit can be modified to sterilize the blood during one passage of a dialysis unit, eliminating the infection. In a particular embodiment, the Far UV wavelengths discussed herein may be directed through a fiber optic cable delivery system. A fiber optic delivery system within the body could sterilize isolated infectious pockets, such as infected heart valves or joints, not easily accessible to antibiotics.

In one embodiment, the present invention may include a sterile wand for counter surface cleaning. In a particular embodiment of use, the wand may be placed 2 cm from the infected tissue, human body surface or cavity, or corneal tissue in eye banking. The Far UV light has a prescribed wavelength based on the most prominent invasive organisms. The Lamp is turned on for the prescribed 2 to 20 seconds, or more depending on the organisms addressed, and microbial ablation is accomplished. The surface is debrided of all necrotic tissue prior to and following the irradiation.

In another embodiment, human or animal blood from a transfusion, as in a dialysis unit is passed adjacent to or through the center of the lamp and the blood is sterilized with the NUV Lamp of the present invention.

Using various embodiments of the present invention five modalities of treatment may be achieved:

1. Sterilization of corneal transplant tissue. At the bedside, as corneas are harvested from the deceased donor, for transplantation, the adjacent conjunctival tissue is excised. The Lamp is placed over the open patient eye and the lamp is turned "On", at 2 cm from the eyelids. The lamp sterilizes the entire field eyelid and eye field. The corneal tissue is removed and placed in a sterile viewing chamber for the eye bank. Once the lid of the viewing chamber is closed, the Lamp is placed directly on the top of the viewing chamber and turned "On", irradiating directly through the plastic, media and onto the endothelium of the donor cornea. This process sterilizes the cornea without further touching the tissue. The tissue can be processed and sent to the ophthalmic surgeon.

2. Corneal ulcers can be treated in an analogous fashion. When a patient presents with a corneal ulcer, the eye is washed with sterile saline to reduce the bacterial/fungal or viral load. The Lamp is placed between the eyelids, at the prescribed 2cm distance, and turned "On". The eye is then irrigated of all detritus to eliminate dead and dying organisms. Similar sterilization of decubitus

ulcers, gangrenous toes or limbs can be accomplished with the lamp as this devitalized tissue is inaccessible to systemic antibiotics. Similarly skin infections can be addressed for fungal infections, boils, erysipelas, herpes simplex or herpes zoster.

3. Sterilization of body fluids, whole blood or serum is accomplished by placing the lamp within a dialysis filter and irradiating the blood as it passes through the filter.

4. Corneal cross linking to prevent corneal ectasia in Keratoconus can be initiated by extending the exposure time to over 60 seconds, providing at least 48 mJoules of radiant Far UV light energy to the cornea. In infectious disease this modality can kill microbes and stabilize the cornea to prevent perforation, saving the eye.

5. Cellular apoptosis as discussed above using Far UV.

Regarding corneal cross linking, Corneal CXL with riboflavin and ultraviolet A (UV-A) is a technique to strengthen corneal tissue using riboflavin as a photosensitizer and UV-A to increase the formation of intra/inter fibril covalent bonds by photosensitized oxidation. The process releases reactive oxygen species that promote the formation of interconnects between and within collagen fibers.

This process requires a considerable corneal absorption of riboflavin which requires the removal of the epithelium to get sufficient absorption of riboflavin into the cornea. Riboflavin does not absorb uniformly into the cornea and decreases as the thickness increases. Another complication is that the exposure time over 30 minutes in order to achieve sufficient energy absorption for it to work.

This treatment process causes changes in stromal keratocytes and cell and collagen fiber shrinkage, chromatin condensation, and apoptotic bodies occur within 60 minutes after treatment. After treatment riboflavin can produce radicals or singlet oxygen molecules that induce covalent bonds that can connect one polymer chain to another, caus¬ing in vivo cornea links in collagen fibers. Photo-chemically induced cross-links in cornea can be detected through struc¬tural changes not related to CXL. The riboflavin/UVA procedure has had complications due to not only the debridement of the epithelia but also for long term UV exposure, postoperative discomfort and significant corneal haze/scarring.

In theory, direct exposure using selected single line wavelengths that target the protein chromophores may produce better results, more even cross-linking distribution, and fewer complications. Since directly targeting protein molecules, direct photon energy is transferred to collagen molecules which produce covalent bonds that directly link polymer chains in collagen fibers.

The two sources available are the Far-UV line at 222 nm and the 280-282 nm line as well. Both wavelengths have different absorption rates so a mixture of dose amounts of each can produce uniform cross linking, kill bacteria that have propagated through the cornea without causing damage to the epithelia or endothelia cells.

The application of the lamp to tissues, body surfaces, and fluids is the key to the correct process. A radiometer verification of the UV fluency may be performed on a weekly basis to confirm that microbial killing power persists for the prescribed Far UV wavelength.

In many embodiments, a double UV Lamp producing two single line wavelengths, as discussed above, is advantageous. This lamp may be provided with an automatic timer to ensure that toxicity is avoided. One to four of the prescribed narrow band Far UV and Near UV wavelengths (207 nm, 222 nm, 283 nm, 308 nm) are prescribed for maximum sterilization. Portability would be important in the field to allow access to patients who cannot make long journeys. A battery pack to allow portability would be auspicious.

The application of Far UV light at the bedside or in the eye bank is a specific protocol. In addition to the traditional use of antibiotics in the Eye Storage media, the use of UV light at the bedside and during the processing of the tissue would eliminate infectious organisms. The tissue could then be distributed to surgeons without fear of donor contamination.

The use of the lamp of the present invention in the clinic would eliminate the need for gram stains, and cultures, because all of the known organisms would be killed on contact. In addition, the use of topical and systemic antibiotics would be largely eliminated or minimized, as the infectious process would be abated in the doctor's office before the patient arrives at the pharmacy to pick up a prescription.

In one embodiment, the laboratory technician or physician may use the NUV lamp of the present invention available in a portable case, for the bedside in the hospital or in the sterile hood in the eye bank. The eye bank technician or physician would use the lamp by placing it 2 cm from the eye when harvesting corneas, with a lid speculum in place. Turning the Lamp to "On" will allow 10 seconds of exposure, a preset radiance. Similarly the physician would treat conjunctivitis or corneal ulcers or decubitus ulcers (bed sores) by placing the lamp 2 cm from the eye or skin and turn the Lamp "On". The lamp switches itself off automatically after 10 to 50 seconds as needed. All organisms have been killed in 2 seconds, so a sterile field is obtained.

Additionally: The Far UV Lamp could be used advantageously in acute wound care, or after trauma to sterilize the field. For example, in compound fractures of bones, with the bones protruding into the air, frequent contamination is observed. In additional to routine surgical asepsis the use of the Far UV light would sterilize the operative field of the wound during surgery, reducing the possibility of secondary infection.

Tests show that washing a wound area after tumor removal with saline or other fluids do not remove any tumor cells that have sloughed off and fallen into the wound cavity. Using Far-UV to photo-disinfect the wound area prior to closing should produce a significant reduction in the potential reoccurrence of cancer.

As noted above, during sepsis, the blood stream is contaminated with bacteria, fungi or viruses that are rapidly proliferating. In one embodiment, the NUV lamp or light source could be modified to sterilize the blood during one passage of a dialysis unit, eliminating the infection. For example, one or a plurality of NUV light sources may be positioned along a flow path of the dialysis unit. In yet another embodiment, a fiber optic delivery system within the body could sterilize isolated infectious pockets, such as infected heart valves or joint, not easily accessible to antibiotics.

In summary, embodiments of the present invention used in methods of killing microbial organisms, including bacteria, viruses, fungi and protozoa and pathogenic cells in or on patients or tissue is disclosed. Microbes are unusually sensitive to Far UV light, whereas the human tissues are more resilient. Eliminating the microbes in 2 to 20 seconds preserves the tissues, eliminates antibiotic toxicity or allergic responses and the immune attack of the body to replicating microbes. Sterile donor tissue can be provided for transplantation and poorly perfused tissue such as decubitus ulcers, or burns can be sterilized at the bedside. Corneal ectasia or progressive protrusion of the cornea can be prevented by cross linking the corneal collagen during treatment.

Although the preferred embodiments of the present invention have been described herein, the above description is merely illustrative. Further modification of the invention herein disclosed will occur to those skilled in the respective arts. All such modifications are deemed to be within the scope of the invention as defined by the appended claims and not limited thereto.

ABSTRACT

This invention relates to a method, process and apparatus for disinfecting and sterilizing all types of surfaces contaminated with microorganisms and toxic substances to render both inactive. Furthermore, this invention relates to both a method and apparatus for disinfecting and/or sterilizing breathable air and then using this air to protect a confined space from external contamination. The apparatus consists of a new ultra-violet (NUV) source that is more effective than mercury based 254 nm light for destroying DNA of virus, bacteria, spores and cists. It is most effective in breaking chemical bonds in toxic gases and Biotoxins that are useful to terrorists. It is combined with other apparatus that remove particulates and byproducts sometimes produced by the NUV source and maintains positive pressure of the confined space so as to prevent the influx of air from outside the protected zone.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Filer:	Gary Ervery Lambert
Attorney Docket Number:	17-093-EN

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	70	70
UTILITY SEARCH FEE	2111	1	300	300
UTILITY EXAMINATION FEE	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**730**

Electronic Acknowledgement Receipt	
EFS ID:	29735531
Application Number:	15645480
International Application Number:	
Confirmation Number:	4718
Title of Invention:	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION
First Named Inventor/Applicant Name:	S. Edward Neister
Customer Number:	32118
Filer:	Gary Ervery Lambert
Filer Authorized By:	
Attorney Docket Number:	17-093-EN
Receipt Date:	10-JUL-2017
Filing Date:	
Time Stamp:	16:18:16
Application Type:	Utility under 35 USC 111(a)

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1	Application Data Sheet	ADS.pdf	1503768 8497d4fd389a0a5c7cd49b735b9e2c98b01f2005	no	7
Warnings:					
Information:					
2	Power of Attorney	POA.pdf	197978 77eea1c3cd0c24a46a203b5ef87704aebe0f925c	no	3
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3	Oath or Declaration filed	Declaration_AIA08.pdf	187830 65cc0ca726dc807c773e2e1f5e3f4ab662fda1fb	no	3
Warnings:					
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4	Drawings-only black and white line drawings	Drawings.pdf	732648 7532ee899571612f153bbc4ee371da3da3019522	no	10
Warnings:					
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5	Claims	17-093-EN-CIP-Claims.pdf	17330 5af03bcbffc366418d7c34a92eae36ec7dce7f22	no	2
Warnings:					
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6		Clean-CIP-Spec-17-093-EN.pdf	145989 4f245609ae879355f12f3ade3d1023541f1a22d5	yes	25
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	Specification		1		24
	Abstract		25		25
Warnings:					
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7	Fee Worksheet (SB06)	fee-info.pdf	34900 e92bd53e1fbf51badf19d4a6547310b480def64e	no	2
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

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☐ 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
	S.	Edward	Neister	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	Dover	State/Province	NH	Country of Residence	US

Mailing Address of Inventor:

Address 1	273-B Locust Street
Address 2	

City	Dover	State/Province	NH
Postal Code	03820	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	John	James	Rowsey	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	Belleair	State/Province	FL	Country of Residence	US

Mailing Address of Inventor:

Address 1	150 Belleview Blvd
Address 2	#102

City	Belleair	State/Province	FL
Postal Code	33756	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

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Application Information:

Title of the Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION		
Attorney Docket Number	17-093-EN	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

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.

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Customer Number	32118		

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Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation in part of	14254957	2014-04-17
Prior Application Status	Patented		Remove

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14254957	Continuation in part of	PCT/US2006/003393	2007-07-31	8753575	2014-06-17

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11831667	Continuation in part of	PCT/US2006/003393	2006-01-31

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
PCT/US/2006/03393	non provisional of	60593626	2005-01-31

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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(d). 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(h)(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).

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Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

X 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.

Authorization to Permit Access:

Authorization to Permit Access to the Instant Application by the Participating Offices

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	17-093-EN
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In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

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 Remove

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 :

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	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

Mailing Address Information For Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Country[i]		Postal Code	
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	Application Number	
Title of Invention	METHOD AND APPARATUS FOR STERILIZING AND DISINFECTING AIR AND SURFACES AND PROTECTING A ZONE FROM EXTERNAL MICROBIAL CONTAMINATION	

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Signature	/David J. Connaughton, Jr./			Date (YYYY-MM-DD)	2017-06-22
First Name	David	Last Name	Connaughton	Registration Number	67275

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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.