Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/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/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	n/a
Filing Date	October 5, 2015
First Named Inventor	Wayne Ernest Conrad
Title	SURFACE CLEANING APPARATUS
Art Unit	n/a
Examiner Name	n/a
Attorney Docket Number	10452-P39194US04

SIGNATURE of Applicant or Patent Practitioner

Signature	/Philip C. Mendes da Costa/	Date (Optional)	2015-10-05
Name	Philip C. Mendes da Costa	Registration Number	33106
Title (if Applicant is a juristic entity)	Agent for Applicant		
Applicant Name (if Applicant is a juristic entity)	Omachron Intellectual Property Inc.		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 01059

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Omachron Intellectual Property Inc.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	July 28, 2015
Name	Philip C Mendes da Costa		
Title	Vice President		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/AIA/14 (07-14)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	
Title of Invention	SURFACE CLEANING APPARATUS	

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
	Wayne	Ernest	Conrad	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Hampton	Country of Residence [i]	CA

Mailing Address of Inventor:

Address 1	9 King Lane		
Address 2			
City	Hampton	**State/Province**	ON
Postal Code	L0B 1J0	**Country** [i]	CA

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	01059		
Email Address	pmdcosta@bereskinparr.com	Add Email	Remove Email

Application Information:

Title of the Invention	SURFACE CLEANING APPARATUS		
Attorney Docket Number	10452-P39194US04	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	18	**Suggested Figure for Publication (if any)**	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	
Title of Invention	SURFACE CLEANING APPARATUS	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	01059		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing 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.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13/782217	2013-03-01
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/782217	Continuation in part of	13/720754	2012-12-19

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	
Title of Invention	SURFACE CLEANING APPARATUS	

Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13/720754	Division of	11/954331	2007-12-12	8359705	2013-01-29

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11/954331	Claims benefit of provisional	60/870175	2006-12-15

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11/954331	Claims benefit of provisional	60/884767	2007-01-12

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. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. 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.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	
Title of Invention	SURFACE CLEANING APPARATUS	

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

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. ☒

Organization Name	Omachron Intellectual Property Inc.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	
Title of Invention	SURFACE CLEANING APPARATUS	

Mailing Address Information For Applicant:			
Address 1	9 King Lane		
Address 2			
City	Hampton	**State/Province**	ON
Country i	CA	Postal Code	L0B 1J0
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including 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 if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	
Title of Invention	SURFACE CLEANING APPARATUS	

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	/Philip C. Mendes da Costa			Date (YYYY-MM-DD)	2015-10-05
First Name	Philip	Last Name	C. Mendes da Costa	Registration Number	33106
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 C o 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.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SURFACE CLEANING APPARATUS
First Named Inventor/Applicant Name:	Wayne Ernest Conrad
Filer:	Philip C. Mendes da Costa/Snezana Lisowsky
Attorney Docket Number:	10452-P39194US04

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Claims:				
Claims in Excess of 20	1202	2	80	160
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1760**

Electronic Acknowledgement Receipt	
EFS ID:	23696066
Application Number:	14875381
International Application Number:	
Confirmation Number:	2483
Title of Invention:	SURFACE CLEANING APPARATUS
First Named Inventor/Applicant Name:	Wayne Ernest Conrad
Customer Number:	1059
Filer:	Philip C. Mendes da Costa/Snezana Lisowsky
Filer Authorized By:	Philip C. Mendes da Costa
Attorney Docket Number:	10452-P39194US04
Receipt Date:	05-OCT-2015
Filing Date:	
Time Stamp:	18:04:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1760
RAM confirmation Number	5250
Deposit Account	022095
Authorized User	MENDES DA COSTA, PHILIP C.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Specification	P39194US04_Disclosure.PDF	8122306 e529c2614d84c43ffc92c5f9f8a42c66012cadddc	no	36
Warnings:					
Information:					
2	Claims	P39194US04_Claims.PDF	650158 93b2b2fc016007d3a480ec1b6bdc9cfa614f93db	no	4
Warnings:					
Information:					
3	Abstract	P39194US04_Abstract.PDF	26112 0b07146a25d7728fd59397e62598ab0ff80313cf	no	1
Warnings:					
Information:					
4	Drawings-only black and white line drawings	P39194US04_Drawings.PDF	1819762 294bab1adc7b630640e494c654db537ab6b74430	no	18
Warnings:					
Information:					
5	Oath or Declaration filed	P39194US04_Declaration.PDF	337879 a851732de9f1d8bcdccec1b3de4cce73f6776df4	no	1
Warnings:					
Information:					
6	Power of Attorney	P39194US04_POA.PDF	783604 e39ea087a1c66b823d6c2bc3ae37ce6e627e973f	no	2
Warnings:					
Information:					
7	Application Data Sheet	P39194US04_ADS.pdf	1819290 4813a9f0a4afd5d4296aa37b87f855a6f682aeef	no	7
Warnings:					
Information:					

8	Fee Worksheet (SB06)	fee-info.pdf	36897 a43df45ff123e05dc5e56b5fd5c60547f0914447	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	13596008	

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
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New International Application Filed with the USPTO as a Receiving Office
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SURFACE CLEANING APPARATUS

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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of co-pending U.S. Patent Application 13/782,217, filed on March 1, 2013, which itself is a continuation in part of co-pending U.S. Patent Application 13/720,754, filed on December 19, 2012, which itself is a divisional application of U.S. Patent 8,359,705, which issued on January 29, 2013, which itself claims priority from United States Provisional Patent applications 60/870,175 (filed on December 15th, 2006), and 60/884,767 (filed on January 12th, 2007), each of which are incorporated herein by reference in their entirety.

FIELD

[0002] This specification relates to a surface cleaning apparatus comprising a base with a removable portable surface cleaning unit such as a pod or other hand carriable surface cleaning apparatus wherein the portable surface cleaning apparatus is usable when mounted on the base or when removed therefrom.

INTRODUCTION

[0003] The following is not an admission that anything discussed below is part of the prior art or part of the common general knowledge of a person skilled in the art.

[0004] Various types of surface cleaning apparatuses are known in the art. Such surface cleaning apparatuses include vacuum cleaners, including upright vacuum cleaners, hand carriable vacuum cleaners, canister type vacuum cleaners, and Shop-Vac™ type vacuum cleaners. Some such vacuum cleaners are provided with wheels. For example, typical upright vacuum cleaners are provided with a surface cleaning head that includes wheels mounted to a bottom surface thereof. Upright vacuum cleaners are

easy for a consumer to use since the consumer does not have to carry the vacuum cleaner but merely push it over a surface. However, depending on the size of the surface cleaning head, an upright vacuum cleaner may not be useable in smaller or crowded areas. Canister vacuum cleaners have a flexibly hose extending between a surface cleaning head and the canister body, thereby improving mobility of the cleaning head. However, consumers must separately move a canister body, which can add an extra step during the cleaning process.

SUMMARY

[0005] This summary is intended to introduce the reader to the more detailed description that follows and not to limit or define any claimed or as yet unclaimed invention. One or more inventions may reside in any combination or sub-combination of the elements or process steps disclosed in any part of this document including its claims and figures.

[0006] According to one broad aspect of this invention, a surface cleaning apparatus comprises a portable cleaning unit, which may be carried by hand or a shoulder strap such as a pod, which is removably mounted on a wheeled base. The portable cleaning unit may be provided with a suction motor and an energy storage member (such as batteries). Accordingly, the suction motor of the portable cleaning unit may be operable on DC current. However, in accordance with this embodiment, the wheeled base may include a second suction motor (e.g. an AC powered suction motor). Accordingly, when the portable cleaning unit is provided on the wheeled base and the wheeled base is connected to a source of current, the suction motor in the wheeled base may be operated, e.g. on AC current, and used to draw air through an airflow path to the air treatment member in the portable cleaning unit. An advantage of this design is that the suction motor provided in the wheeled base may produce a higher airflow and therefore increase cleanability when the portable cleaning unit is provided on the wheeled base. However, when the portable cleaning unit is removed from the wheeled base, a smaller and lighter suction motor is utilized. While the velocity of the airflow

through the portable cleaning unit when removed from the base may be decreased, the reduced weight of the suction motor may be beneficial. In addition, a smaller airflow path may be provided when the portable cleaning unit is removed from the base, and, accordingly, a smaller DC power suction motor may provide substantially similar airflow in the hand carriable mode.

[0007] The portable cleaning unit may comprise at least one cyclonic separation stage and a suction motor. Accordingly, the portable cleaning unit is useable, e.g., as a vacuum cleaner or the like, when removed from the wheeled base. The cyclonic separation stage comprises a cyclone chamber and a material collection chamber. The portable cleaning unit is configured such that the material collection chamber is removable for emptying when the portable cleaning unit is mounted on the wheeled base. For example, the material collection chamber may be removed by itself when the portable cleaning unit is mounted on the wheel base. Alternately, the material collection chamber and the cyclone chamber may be removable as a unit (e.g. a cyclone bin assembly). It will be appreciated that the material collection chamber, either by itself or in conjunction with the cyclone chamber and possibly other elements, may be removable from the portable cleaning unit when the portable cleaning unit has been removed from the wheeled base. An advantage of this design is that the usability of the surface cleaning apparatus is increased. In particular, when it is needed to empty the dirt collection chamber, all that is needed is to remove the dirt collection chamber either by itself, or, for example, together with the cyclone chamber for emptying. Accordingly, a user did not carry the weight of the motor when the user is emptying the dirt collection chamber.

[0008] Preferably, in accordance with this embodiment, the dirt collection chamber and, optionally, the cyclone chamber may be provided on an upper portion of the portable cleaning unit so as to be removable upwardly therefrom.

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[0009] It will be appreciated by a skilled person in the art that any of the features of the configuration of a portable cleaning unit to permit a dirt collection chamber to be removed from the portable cleaning unit when the portable cleaning unit is mounted on the wheeled base as discussed herein may not be utilized with dual motor design disclosed herein, but may be used by itself or in combination with any other feature disclosed herein.

[0010] In accordance with another embodiment, the portable cleaning unit may be provided with a pod hose which is removable with the portable cleaning unit from the wheeled base. The pod hose may have a smaller diameter and, accordingly, may be used only when the portable cleaning unit has been removed from the wheeled base. Accordingly, when the portable cleaning unit is on a wheeled base, the pod hose does not form part of the fluid flow path. Accordingly, the smaller diameter of the pod hose does not restrict the airflow path when the portable cleaning unit is placed on a wheeled base. An advantage of this design is that the portable cleaning unit may carry a longer hose without increasing the volume taken by the pod hose. In addition, the pod hose, being a smaller diameter, may be more flexible and enhance the usability of the portable cleaning unit in a hand carriable mode. For example, the pod hose may have a greater stretch ratio, for example, of 4:1 to 7:1 or more.

[0011] In accordance with this embodiment, a valve may be provided on the portable cleaning unit whereby the pod hose is not in airflow communication with the suction motor when the portable cleaning unit is mounted on the wheeled base. However, when the portable cleaning unit is removed from the wheeled base, the valve may be actuated (e.g. automatically upon removal of the portable cleaning unit from the wheeled base, manually by the user or automatically when the hose is deployed for use) such that pod hose form part of the air flow path.

[0012] It will be appreciated by a person skilled in the art that any of the features of the pod hose which are discussed herein may not be utilized with

the dual motor design disclosed herein, but may be used by itself or in combination with any other feature disclosed herein.

[0013] In accordance with another embodiment, the portable cleaning unit may be operable by AC power supplied to the base when the portable cleaning unit is mounted on the base and may be operable on DC power when the portable cleaning unit is removed from the base. Accordingly, the portable cleaning unit may include an energy storage member (e.g. one or more batteries) which may power the suction motor when the portable cleaning unit is removed from the base. Accordingly, the suction motor may be operable on DC current. When the pod is mounted on the wheeled base, and the wheeled base is connected to a source of current by an electrical cord, then the suction motor may be in electrical communication with the base so as to be powered by AC current supplied through the electrical cord. For example, the suction motor could have dual winding so as to be operable on both AC and DC current. Alternately, the base may include a power supply to convert the AC current to DC current which is then supplied to the suction motor when the portable cleaning unit is placed on the base. For example, the power supply may comprise an inverter.

[0014] In this particular embodiment, it will be appreciated that the batteries in the portable cleaning unit may be charged while the portable cleaning unit is mounted on the wheeled base and the wheeled base is plugged into an electrical outlet.

[0015] In a further alternate embodiment, instead of utilizing electricity from an electrical outlet, the wheeled base may include a fuel cell or an alcohol powered internal or external combustion engine. In such an embodiment, the wheeled base may produce AC current or DC current, which is then supplied to the suction motor when the portable cleaning unit is mounted on the wheeled base and actuated.

[0016] It will be appreciated by a person skilled in the art that any of the features of a portable cleaning unit which is operable on AC and DC current

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as disclosed herein may not be utilized with the dual motor design disclosed herein, but may be used by itself or in combination with any other feature disclosed herein.

[0017] In accordance with the further embodiment, the portable cleaning unit may comprise both an energy storage member and a power supply. Accordingly, when the portable cleaning unit is connected to a power source (e.g. a cord extends from the portable cleaning unit to an electrical outlet), AC power may be supplied to the power supply (e.g. an inverter) to convert the AC current to DC which is then utilized to power the suction motor. When a user is unable to or does not want to plug the portable cleaning unit into a wall outlet, the portable cleaning unit may be powered by the energy storage member (e.g. batteries), which provide DC current to a suction motor. Accordingly, the portable cleaning unit may be powered by both AC current from a wall outlet and DC current supplied by batteries as may be desired. In a further alternate embodiment, the suction motor may be provided with two windings. In such a case, the power supply is not required and the suction motor may be powered by both DC current from the batteries and AC current from a wall outlet.

[0018] It will be appreciated by a person skilled in the art that any of the features of a pod operable with both AC and DC current as discussed herein may not be utilized with dual motor design disclosed herein, but may be used by itself or in combination with any other feature disclosed herein.

[0019] In one embodiment, there is provided a surface cleaning apparatus comprising

[0020] (a) a wheeled base comprising an AC suction motor;

[0021] (b) a portable cleaning unit removably mounted on the wheeled base and comprising at least one cyclonic separation stage, a first energy storage member and a portable cleaning unit suction motor that is operable on DC power; and,

[0022] (c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

[0023] wherein the AC suction motor provides motive power to move fluid through the fluid flow path when the surface cleaning unit is switched on and when the portable cleaning unit is mounted on the wheeled base, and

[0024] wherein the portable cleaning unit suction motor provides motive power to move fluid through the fluid flow path when the portable cleaning unit is switched on and when the portable cleaning unit is removed from the wheeled base

[0025] In some embodiments, the wheeled base may further comprise or is connectable to a power cord and the portable cleaning unit is powered solely by the first energy storage member when the portable cleaning unit is removed from the wheeled base.

[0026] In some embodiments, the wheeled base may further comprise or is connectable to a power cord, the first energy storage member comprises batteries and the batteries are charged when the portable cleaning unit is mounted on the wheeled base.

[0027] In some embodiments, the suction motor in the portable cleaning unit may not be used to provide motive power to move fluid through the fluid flow path when the surface cleaning unit is switched on and when the portable cleaning unit is mounted on the wheeled base.

[0028] In some embodiments, the fluid flow path may comprise an upstream portion that extends from the first dirty fluid inlet to the portable cleaning unit and the AC suction motor is in the fluid flow path.

[0029] In some embodiments, the fluid flow path may comprise a downstream fluid flow path extending through the portable cleaning unit to the clean air outlet and the portable cleaning unit suction motor is in the downstream fluid flow path.

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[0030] In some embodiments, the portable cleaning unit may comprise a flexible hose having a second dirty fluid inlet and the flexible hose is part of the downstream fluid flow path when the portable cleaning unit is removed from the wheeled base.

[0031] In some embodiments, the flexible hose may be an electrified flexible hose.

[0032] In some embodiments, the wheeled base may further comprise a second energy storage member.

[0033] In some embodiments, the second energy storage member may charge the first energy storage member when the portable cleaning unit is mounted on the wheeled base.

[0034] In some embodiments, the portable cleaning unit suction motor may be a DC motor.

[0035] In one embodiment, there is provided a surface cleaning apparatus comprising

[0036] (a) a wheeled based connectable to a source of current;

[0037] (b) a portable cleaning unit removably mounted on the wheeled base and comprising at least one cyclonic separation stage, a first energy storage member and a portable cleaning unit suction motor that is operable on DC power; and,

[0038] (c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

[0039] wherein the portable cleaning unit suction motor is operable on DC power when removed from the wheeled base and is operable on power provided by the wheeled base when mounted on the wheeled base.

[0040] In some embodiments, the portable cleaning unit suction motor may be a DC motor.

[0041] In some embodiments, the wheeled base may further comprise or is connectable to a power cord and the portable cleaning unit is powered solely by the first energy storage member when the portable cleaning unit is removed from the wheeled base.

[0042] In some embodiments, the wheeled base may further comprise or is connectable to a power cord, the first energy storage member comprises batteries and the batteries are charged when the portable cleaning unit is mounted on the wheeled base.

[0043] In some embodiments, the wheeled base may further comprise or is connectable to a power cord, the wheeled base further comprises a circuit that receives AC current and outputs DC current and the portable cleaning unit is powered the DC current when the portable cleaning unit is mounted on the wheeled base.

[0044] In some embodiments the portable cleaning unit suction motor may operate at a first power level when removed from the wheeled base and at a second power level when is mounted on the wheeled base.

[0045] In some embodiments the first power level may be less than the second power.

[0046] In accordance with another aspect, a surface cleaning apparatus, preferably a canister or Shop-Vac™ style vacuum cleaner is provided which comprises a portable cleaning unit and a wheeled base. Preferably, the cleaning unit is removably mounted to the wheeled base. Alternately, or in addition, the wheeled base has wheels mounted outward of the wheeled base, and which are preferably of a larger diameter (e.g., 1 - 3 inches in diameter, preferably 1.5 - 2.5 inches in diameter).

[0047] According to this aspect, the surface cleaning apparatus may comprise a member having a dirty fluid inlet. A fluid flow path extends from the dirty fluid inlet to a clean air outlet of the surface cleaning apparatus. The surface cleaning apparatus further comprises a wheeled based. A portable

cleaning unit is removably mounted on the wheeled base and comprising at least one cyclonic separation stage and a suction motor positioned in the fluid flow path.

[0048] Embodiments in accordance with this broad aspect may be advantageous because the surface cleaning apparatus may have increased maneuverability. That is, the surface cleaning apparatus may be used as a wheel mounted surface cleaning apparatus when convenient for a user since the user need not carry the surface cleaning apparatus, or as a hand or strap carriable surface cleaning apparatus, such as when a stairs or a smaller or crowded area is to be cleaned, according to the user's preference.

[0049] In some embodiments, the at least one cyclonic separation stage may comprise a cyclone chamber having at least one material outlet, a divider plate associated with the material outlet and an associated material collection chamber in flow communication with the material outlet.

[0050] In some embodiments, the material collection chamber may be positioned below the material outlet. In a further embodiment, the divider plate may be positioned in the material outlet.

[0051] In some embodiments, the material collection chamber may be moveable relative to the cyclone chamber. In a further embodiment the material collection chamber may be removable from the at least one cyclone chamber.

[0052] In some embodiments, the material collection chamber may have a portion that is openable. In a further embodiment, the portion that is openable may be a bottom wall. Such embodiments may be advantageous because the wheeled base may prevent accidental opening of the material collection chamber.

[0053] In some embodiments, the suction motor may be positioned laterally spaced from the at least one cyclonic separation stage. Accordingly,

the surface cleaning apparatus may have a relatively wide stance and low center of mass, and therefore may have increased stability.

[0054] In some embodiments, the cleaning unit has a front end having the dirty fluid inlet and the front end of the cleaning unit is positioned at a front end of the wheeled base and the suction motor is positioned rearward of the at least one cyclonic separation stage.

[0055] In some embodiments, the wheeled base may have a length greater than its width. In further embodiments, the wheeled base may be generally polygonal, and preferably generally triangular in shape. Such embodiments may be advantageous because the surface cleaning apparatus may have both increased maneuverability and increased stability.

[0056] In some embodiments, the wheeled base may have at least one front wheel and at least two rear wheels, the rear wheels may have a larger diameter then the at least one front wheel and the at least one front wheel may be steerable. Such embodiments may be advantageous because the larger rear wheels may provide the wheeled base with increased stability, and the steerable front wheel may provide the wheeled base with increased maneuverability. Alternately, the front wheels may have a larger diameter or essentially the same diameter as the rear wheels.

[0057] In some embodiments, the wheeled base may have at least one front wheel and at least two rear wheels and the rear wheels may have a larger diameter then the at least one front wheel.

[0058] In some embodiments, the wheeled base may have at least one front wheel and at least two rear wheels and the rear wheels may have a smaller diameter then the at least one front wheel.

[0059] In some embodiments, the at least one front wheel may be steerable.

[0060] In some embodiments, the wheeled base may have rear wheels that are positioned outwardly of an area occupied by the cleaning unit when

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the cleaning unit is mounted on the wheeled base. Alternately, or in addition, the wheeled base may have front wheels that are positioned outwardly of an area occupied by the cleaning unit when the cleaning unit is mounted on the wheeled base. Such embodiments may be advantageous because the wheeled base may have a relatively wide stance, thereby providing greater stability to the surface cleaning apparatus. Additionally, the surface cleaning apparatus may be relatively close to the ground, and may therefore have a lower center of mass and increased stability.

[0061] In some embodiments, the cleaning unit may have a front end having a fluid inlet downstream from the dirty fluid inlet and the front end of the cleaning unit is positioned at a front end of the wheeled base.

[0062] In some embodiments, the cleaning unit may be lockably receivable on the wheeled base.

[0063] In some embodiments, the wheeled base may have at least one front wheel having a diameter of 1 to 3 inches and at least two rear wheels having a diameter of 1 to 3 inches.

[0064] In some embodiments, the cleaning unit may have a carry handle and/or a shoulder strap.

[0065] In some embodiments, the wheeled base may have at least one front wheel and at least two rear wheels, and the cleaning unit is receivable on an open platform.

[0066] In some embodiments, the wheeled base may have an absence of operating components.

[0067] It will be appreciated by a person skilled in the art that a surface cleaning apparatus may embody any one or more of the features contained herein and that the features may be used in any particular combination or sub-combination.

BRIEF DESCRIPTION OF THE DRAWINGS

[0068] The drawings included herewith are for illustrating various examples of articles, methods, and apparatuses of the teaching of the present specification and are not intended to limit the scope of what is taught in any way.

[0069] In the drawings:

[0070] Figure 1 is a perspective view of an embodiment of a surface cleaning apparatus of the present invention;

[0071] Figure 2 is a front view of the embodiment of Figure 1;

[0072] Figure 3 is a side view of the embodiment of Figure 1;

[0073] Figure 4 is a top view of the embodiment of Figure 1;

[0074] Figure 5 is a perspective view of the embodiment of Figure 1, showing a surface cleaning unit removed from a wheeled base;

[0075] Figure 6 is a side view of the embodiment of Figure 1, showing a surface cleaning unit removed from a wheeled base;

[0076] Figures 7-9 are cross-sections taken along line 7-7 in Figure 1, showing alternate configurations of a cleaning unit;

[0077] Figure 10 is a perspective illustration of an alternate embodiment of a surface cleaning apparatus of the present invention, showing a lid in an open position;

[0078] Figure 11 is a perspective view of another embodiment of a surface cleaning apparatus;

[0079] Figure 12 is another perspective view of the surface cleaning apparatus of Figure 11;

[0080] Figure 13 is a perspective view of the surface cleaning apparatus of Figure 11 with a surface cleaning unit detached;

[0081] Figure 14 is another perspective view of the surface cleaning apparatus of Figure 11 with a surface cleaning unit detached;

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[0082] Figure 15 is a schematic representation of another embodiment of a surface cleaning apparatus;

[0083] Figure 16 is a schematic representation of the surface cleaning apparatus of Figure 15 with a surface cleaning unit detached;

[0084] Figure 17 is a schematic representation of another embodiment of a surface cleaning apparatus;

[0085] Figure 18 is a perspective view of another embodiment of a surface cleaning apparatus;

[0086] Figure 19 is another perspective view of the surface cleaning apparatus of Figure 18 with a cyclone bin assembly removed;

[0087] Figure 20 is a perspective view of the surface cleaning apparatus of Figure 18 with a surface cleaning unit detached and a cyclone bin assembly removed from the surface cleaning unit; and,

[0088] Figure 21 is a bottom perspective view of the cyclone bin assembly of the surface cleaning apparatus of Figure 18 in the open position.

DESCRIPTION OF VARIOUS EMBODIMENTS

[0089] Various apparatuses or processes will be described below to provide an example of an embodiment of each claimed invention. No embodiment described below limits any claimed invention and any claimed invention may cover processes or apparatuses that differ from those described below. The claimed inventions are not limited to apparatuses or processes having all of the features of any one apparatus or process described below or to features common to multiple or all of the apparatuses described below. It is possible that an apparatus or process described below is not an embodiment of any claimed invention. Any invention disclosed in an apparatus or process described below that is not claimed in this document may be the subject matter of another protective instrument, for example, a continuing patent application, and the applicants, inventors or owners do not

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intend to abandon, disclaim or dedicate to the public any such invention by its disclosure in this document.

PORTABLE CLEANING UNIT CONSTRUCTION

[0090] The following is a description of portable cleaning unit constructions that may be used by itself in any surface cleaning apparatus or in any combination or sub-combination with any other feature or features disclosed herein.

[0091] Referring to Figures 1-4, an embodiment of a surface cleaning apparatus 10 of the present invention is shown. Surface cleaning apparatus 10 may be a canister type vacuum cleaner, a Shop-Vac™ type vacuum cleaner, or another type of vacuum cleaner that may be mounted to a wheeled base. Surface cleaning apparatus 10 comprises a dirty fluid inlet 12, a clean air outlet 14, and a fluid flow path extending therebetween. A portable cleaning unit 16 is provided in the fluid flow path. Cleaning unit 16 comprises at least one cyclonic separation stage 18 for removing dirt from air, or for removing liquid from air or to pick up liquid. Cleaning unit 16 further comprises a suction motor 20 for drawing fluid from the dirty fluid inlet 12 to the clean air outlet 14.

[0092] Dirty fluid inlet 12 is provided in a member 34. In the embodiment shown in Figures 1-6, member 34 is a hose. In the embodiment shown in Figures 7-10, member 34 is a nozzle. In other embodiment, member 34 may be, for example, a surface cleaning head. It will be appreciated that a flexible hose, a rigid wand or other attachment may be affixed or removably affixed to portable cleaning unit 16.

[0093] Referring to the exemplified embodiments of Figures 7-9, from dirty fluid inlet 12, fluid is directed to cleaning unit 16. Cleaning unit 16 may be of a variety of configurations. In the embodiment of Figures 7 and 8, cleaning unit 16 comprises a single cyclonic cleaning stage 18 preferably

comprising a single cyclone housed in a first housing 44, and a filter assembly 38 and motor 20 housed in a second housing 46 adjacent the first housing. Accordingly, in this embodiment, the suction motor 20 is positioned laterally adjacent and laterally spaced from the cyclonic cleaning stage 18. In the embodiment of Figure 9, cleaning unit 16 comprises first 18 and second 48 cleaning stages housed in first housing 44, and filter assembly 38 and motor 20 housed in second housing 46 laterally adjacent the first housing. In this embodiment, motor 20 is positioned laterally spaced from and laterally adjacent both of first 18 and second 48 cleaning stages. It will be appreciated that portable cleaning unit may utilize one or more cyclonic cleaning stages, each of which may comprise a single cyclone or a plurality of cyclones in parallel. In any embodiment, one or more additional cleaning stages may be used such as one or more filters.

[0094] For example, in the embodiments exemplified, cyclonic cleaning stage 18 includes a single cyclone chamber 22. Cyclone chamber 22 comprises a dirty air inlet 24, a separated or dirty material outlet 26, and a clean air outlet 28. A dirty or separated material collection chamber 30 is mounted below dirty material outlet 26, for collecting material removed from the air in cyclone chamber 22. In the embodiment shown, a divider plate 32 is associated with dirty material outlet 26. Divider plate 32 is positioned below the dirty material outlet 26, within the material collection chamber 30. It will be appreciated that a divider plate may be used any one or more of the cyclones and it may be of any configuration and located at any position known in the art. Alternately, a divider plate may not be used and the cyclone chambers may be of any design.

[0095] Material collection chamber 30 may be of any configuration and may be emptied by a user in any manner known in the art. In the embodiment shown in Figure 7 and 8, material collection chamber 30 has a bottom 31 that is openable by pivoting about a pivot pin 33. In this embodiment, material collection chamber further comprises a latch 35, for locking bottom 31 in place, and a button 37 for releasing the latch. In other embodiments, material

collection chamber 30 may be emptied in another manner. For example, material collection chamber 30 may be movable or removable from surface cleaning apparatus 10, such that it may be emptied, or may have another portion that opens. It may be removable from portable cleaning unit with the associated cyclone or cyclones as a sealed unit. See for example the embodiments of Figures 14 and 19.

[0096] In some embodiments, a filter or a screen may be associated with clean air outlet 28. For example, as shown in Figure 8, a cylindrical housing 53 may be mounted on clean air outlet 28 and may have a plurality of openings 55 which are provided with a screen (e.g. a wire mesh). Any such screen or filter known in the art may be used.

[0097] In the embodiment of Figures 7 and 8, air is directed from cyclone chamber 22 out of clean air outlet 28, and into an airflow passage 36, which extends between first housing 44 and second housing 46. From airflow passage 36, air is directed through a filter assembly 38, which, in the embodiments exemplified, comprises a pre-motor foam filter 40, and a screen filter 42. From filter assembly 38, air is drawn past motor 20, and out of clean air outlet 14.

[0098] In the exemplified embodiment of Figure 9, from cyclone chamber 22, air is directed out of clean air outlet 28 and into second cyclonic cleaning stage 48. Second cyclonic cleaning stage 48 comprises a plurality of second stage cyclones 50 in parallel. Each second stage cyclone comprises an inlet (not shown) in fluid communication with clean air outlet 28, and an outlet 52 in fluid communication with airflow passage 36. Each second stage cyclone comprises a cyclonic cleaning region 54, and a dirt collection region 56. From outlets 28, air is directed into airflow passage 36, and into filter assembly 38. From filter assembly 38, air is drawn past motor 20, and out of clean air outlet 14.

[0099] In other embodiments, cleaning unit 16 may be otherwise configured. For example, cleaning unit 16 may not comprise a filter assembly,

or may comprise a plurality of filter assemblies. Additionally, cleaning unit 16 may comprise additional cleaning stages, which may be positioned laterally adjacent each other or above each other.

[00100] In the embodiments shown, the first 44 and second 46 housings are integrally molded. In other embodiments, the first 44 and second 46 housings may be separately manufactured and then secured together, such as by a common base or by gluing, welding or mechanically securing the two housings together. In some embodiments, first 44 and/or second 46 housing may be provided with an openable lid 45, as shown in Figure 10. When a user opens lid 45, the user may have access to components housed in first 44 and/or second housing 46. For example, as shown in Figure 10, lid 45 may be provided with a plurality of flanges 47, which are mounted on flanges 49 provided on housings 44 and/or 46. Flanges 47 are pivotally connected together by pivot pins 51. Accordingly, lid 45 may be pivoted from the closed position, as shown in Figures 1-9, to the opened position, as shown in Figure 10.

[00101] Referring to Figure 11, another embodiment of a surface cleaning apparatus 110 is shown. Surface cleaning apparatus 110 is generally similar to surface cleaning apparatus 10, and analogous features are identified using like reference characters indexed by 100.

[00102] Surface cleaning apparatus 110 comprises a dirty fluid inlet 112, a clean air outlet 114, and a fluid flow path extending therebetween. A portable cleaning unit 116 is provided in the fluid flow path. Cleaning unit 116 comprises at least one cyclonic separation stage 118 for removing dirt from air, or for removing liquid from air or to pick up liquid. Cleaning unit 116 further comprises a suction motor 120 for drawing fluid from the dirty fluid inlet 112 to the clean air outlet 114. Dirty fluid inlet 112 is provided in a member 134, which in this embodiment is a surface cleaning head.

[00103] In this embodiment the cleaning unit 116 is mounted to a wheeled base 158. Wheeled base 158 comprises a plurality of wheels 160,

and a cradle 162, which receives cleaning unit 116. The portable cleaning unit 116 can be operated while seated in the cradle 162 (Figures 11 and 12) and can be lifted out of the cradle 162 and used as a hand carriable apparatus (Figure 13).

[00104] Referring to Figure 14, in this embodiment the cyclone cleaning stage 118 includes a cyclone chamber 122. Cyclone chamber 122 comprises a dirty air inlet 124, a separated or dirty material outlet 126, and a clean air outlet 128 (Figure 14). A dirty or separated material collection chamber 130 is beside the cyclone chamber 122 and in communication with the dirty material outlet 126, for collecting material removed from the air in cyclone chamber 122.

[00105] Material collection chamber 130 may be of any configuration and may be emptied by a user in any manner known in the art. In the embodiment shown in Figure 14, material collection chamber 130 has a bottom 131 that is openable by pivoting about a pivot pin 133. In this embodiment, material collection chamber further comprises a latch 135, for locking bottom 131 in place, and a button 137 for releasing the latch. In this embodiment the material collection chamber 130 may be movable or removable from surface cleaning apparatus 110 and from the portable cleaning unit 116, such that it may be emptied, and is removable from portable cleaning unit 116 with the associated cyclone 118 or cyclones as a sealed unit.

[00106] Referring to Figures 18-21, another embodiment of a surface cleaning apparatus 510 is shown. Apparatus 510 is generally similar to surface cleaning apparatus 10, and analogous features are identified using like reference characters indexed by 500.

[00107] Referring to Figure 18, surface cleaning apparatus 510 comprises a dirty fluid inlet 512, a clean air outlet 514, and a fluid flow path extending therebetween. A portable cleaning unit 516 is provided in the fluid flow path. Cleaning unit 516 comprises at least one cyclonic separation stage

518 (Figure 21) for removing dirt from air, or for removing liquid from air or to pick up liquid. Cleaning unit 516 further comprises a suction motor 520 (Figure 20) for drawing fluid from the dirty fluid inlet 512 to the clean air outlet 514. Dirty fluid inlet 512 is provided in a member 534, which in this embodiment is a surface cleaning head.

[00108] In this embodiment the cleaning unit 516 is mounted to a wheeled base 558. Wheeled base 558 comprises a plurality of wheels 560, and a cradle 562 (Figure 20), which receives cleaning unit 516. The portable cleaning unit 516 can be operated while seated in the cradle 562 (Figure 18) and can be lifted out of the cradle 562 and used as a hand carriable apparatus (Figure 20).

[00109] Referring to Figure 21, in this embodiment the cyclone cleaning stage 518 includes a cyclone chamber 522. Cyclone chamber 522 comprises a dirty air inlet 524 (Figure 19), a separated or dirty material outlet 526, and a clean air outlet 528. A dirty or separated material collection chamber 530 is beside the cyclone chamber 522 and in communication with the dirty material outlet 526, for collecting material removed from the air in cyclone chamber 522.

[00110] Material collection chamber 530 may be of any configuration and may be emptied by a user in any manner known in the art. In the embodiment shown in Figure 21, material collection chamber 530 has a bottom 531 that is openable by pivoting about a pivot pin 533. In this embodiment, material collection chamber further comprises a latch 535, for locking bottom 531 in place, and a button 537 for releasing the latch.

[00111] WHEELED BASE CONSTRUCTION

[00112] The following is a description of a wheeled base construction that may be used by itself in any surface cleaning apparatus or in any

combination or sub-combination with any other feature or features disclosed herein.

[00113] Referring again to Figures 1-4, portable cleaning unit 16 is mounted to a wheeled base 58. Wheeled base 58 comprises a plurality of wheels 60, and a cradle 62, which receives cleaning unit 16.

[00114] In some embodiments, cleaning unit 16 may be permanently mounted to wheeled base 58, for example via one or more bolts. In other embodiments, cleaning unit 16 may be removably mounted to wheeled base 58. For example, a user may remove cleaning unit 16 from wheeled base in order to maneuver cleaning unit 16, or to empty material collection chamber 30. In such embodiments, cleaning unit 16 is portable. For example, as shown in Figures 5 and 6, cleaning unit 16 may be removed from wheeled base 58 by lifting cleaning unit 16 off of wheeled base 58.

[00115] In any embodiment, surface cleaning apparatus 10 may comprise a handle 64, and/or a shoulder strap 65 (shown in Figure 8) for maneuvering cleaning unit 16 when it is removed from wheeled base 58. In some embodiments, handle 64 may be integrally formed with one or both of first 44 and second 46 housings.

[00116] Surface cleaning apparatus 10 may further comprise a locking member (not shown), such that cleaning unit 16 may be lockably received on wheeled base 58. The locking member may comprise any suitable locking member known in the art, such as, for example, a quick release latch, a friction or snap fit, a set screw, a tie down strap (e.g., a strap which may be wrapped around cleaning unit 16) or the like. The lock may be actuatable by a foot pedal. Alternately wheeled base 58 may have side wall extending up around cradle 62 within which portable cleaning unit 16 is received. It will be appreciated that cradle 64 may be any member on which portable cleaning unit 16 may be received or secured, such as a flat base with or without side walls.

[00117] In the embodiments exemplified, wheeled base 58 comprises a front wheel 66, and two rear wheels 68a, 68b. Accordingly, cradle 62 is a platform that is generally polygonal and, preferably, generally triangular in configuration. This configuration may provide increased maneuverability to surface cleaning apparatus 10. In other embodiments, wheeled base 58 may comprise another number of wheels. For example, in some embodiments, wheeled base 58 may comprise two front wheels and two rear wheels. It will be appreciated that, as exemplified, housings 44, 46 may be oriented on cradle 62 with the suction motor at the rearward end of portable cleaning unit 16 and the inlet to portable cleaning unit 16 at the forward end of the front housing. In alternate configurations, housings 44, 46 may be positioned side by side. Further, if more than two housings 44, 46 are provided, then the housings may be arranged linearly, in a triangular configuration or any other desired configuration.

[00118] In some embodiments, front wheel 66 is rotatably mounted about a vertical axis to cradle 62 (e.g., is a caster wheel), and rear wheels are non-rotatably mounted about a vertical axis. Accordingly, front wheel 66 may be steerable. In other embodiments, all of front wheel 66 and rear wheels 68 may be caster wheels, or may be non-rotatably mounted wheels.

[00119] In some embodiments, wheeled base 58 has a length greater than its width. That is, the distance L between front wheel 66 and axis 67 extending between rear wheels 68a, 68b, is greater than the distance W between rear wheels 68a, 68b, along axis 67. In other embodiments, wheeled base 58 may have a width W greater than its length L, or may have width W equal to its length L.

[00120] In the embodiments shown, front wheel 66 is of a smaller diameter than rear wheels 68a, 68b. Alternately, rear wheels 68a, 68b may be smaller than front wheel 66. Preferably, both the front and rear wheels are each relatively large. For example, in some embodiments, front wheel(s) may have a diameter of between about 0.5 – 4 inches, preferably 1 – 3 inches and

more preferably 1.5 – 2.5 inches. In some embodiments, rear wheels may have a diameter of between about 0.5 – 4 inches, preferably 1 – 3 inches and more preferably 1.5 – 2.5 inches. In one particular embodiment, both front wheel(s) 66 and rear wheels 68a, 68b have a diameter in the same range. Such embodiments may be advantageous to provide surface cleaning apparatus 10 with increased maneuverability and with increased stability.

[00121] In the embodiments shown, wheeled base 58 is configured such that, when cleaning unit 16 is mounted on cradle 62, rear wheels 58 are positioned outwardly of cleaning unit 16. That is, rear wheels 58 are separated by a distance W that is greater than the width W' of cleaning unit 16. Such embodiments may provide surface cleaning apparatus 10 with a wider stance, and accordingly with increased stability. Additionally, because rear wheels 68 are positioned outwardly of cleaning unit 16, rear wheels 68 may be provided with an increased diameter, as previously mentioned, without increasing the distance between cleaning unit 16 and a surface such as a floor. Accordingly, the center of mass of cleaning unit 16 may remain low, which further increases the stability of surface cleaning apparatus 10.

[00122] In some embodiments, wheeled base 58 may comprise operating components of surface cleaning apparatus 10, such as a suction motor (see Figure 17). For example, wheeled base may comprise a portion that is provided in the fluid flow path, and includes a filter assembly (not shown). In other embodiments, as exemplified, wheeled base 58 may not comprise any operating components (i.e. wheeled base has an absence of operating components).

[00123] In the embodiments shown, cleaning unit 16 is oriented such that dirty fluid inlet 12 is provided at a front end 70 of surface cleaning apparatus 10, adjacent front wheel 66, and suction motor 20 is provided at a rear end 72 of surface cleaning apparatus 10, adjacent rear wheels 68. In other embodiments, cleaning unit 16 may be otherwise oriented. For example, suction motor 20 may be provided at front end 70, and dirty fluid

inlet 12 may be provided at rear end 72. Alternatively, cleaning unit 16 may be oriented such that suction motor 20 and dirty fluid inlet 12 are equally spaced from front wheel 66 and rear wheels 68. That is, cleaning unit 16 may be positioned substantially sideways in wheeled base 58.

[00124] In some embodiments, portable cleaning unit 16 may be connected to a remote surface cleaning head by connected in air flow communication with the wheeled base, wherein the remote surface cleaning head may be connected or removably connected in air flow communication with the wheeled base. Accordingly, when portable cleaning unit 16 is placed on the wheeled base, it may be automatically connected in air flow communication with the wheeled base (see for example Figures 15, 17 and 19) or the user may have to connect portable cleaning unit 16 in air flow communication with the wheeled base, such as by connecting a hose of portable cleaning unit 16 in air flow communication with an air outlet of the wheeled base (see for example Figures 5 and 6).

[00125] As exemplified in Figures 5 and 6, wheeled base 62 may comprise a floor cleaning mount 82 coupled to cradle 62. A first end 84 of mount 82 is configured for receiving member 34, which, in the embodiments exemplified in Figures 1-6, is a hose. A second end 86 of mount 82 is configured for receiving another member, for example a remote surface cleaning head that is preferably at the distal end of a wand and a flexible hose extends between the wand and mount 82 (not shown). It will be appreciated that portable cleaning unit 16 may be designed such that the inlet of the portable cleaning unit automatically is connected in flow communication with mount 82 when portable cleaning unit 16 is positioned on wheeled base 58, such as by use of an inlet port aligned with first end 84 or a rigid pipe that is fittable thereon. Alternately, as exemplified, a flexible hose 34 that is manually insertable may be used. An advantage of this design is that the attachment member for a wand or the like is provided on the platform and not the portable cleaning unit. Therefore, the wand may be used to pull wheeled base 58 without risk of pulling portable cleaning unit 16 off of wheeled base 58.

Further, preferably the attachment point is close to the floor, preferably at the level of cradle 62, thereby lowering the point at which wheeled base 58 may be pulled and increasing the stability of wheeled base 58 when it is being pulled.

[00126] It will be appreciated that in the portable mode, a wand or flexible hose and wand, or other member known in the art may be attached to hose 34 or hose 34 may be removed and the wand or flexible hose and wand, or other member known in the art may be attached directly to the inlet to housing 44.

[00127] In some embodiments, one or more accessories, such as cleaning brush 74 and wand extension 76 may be secured to the upper surface of lid 45, such as by means of mounts 78. Accordingly, extension 76 may be configured to function as a handle (e.g. central section 76 may be arcuate in shape or be spaced from lid 45), to define an opening 80 between the upper surface of lid 34 such that extension 76 of brush 74 may be a carry handle 64 for the vacuum cleaner. Alternately, extension 76 may be configured to seat on handle 64 and permit handle 64 to be used when brush 74 is mounted on portable cleaning unit 16. In other embodiments, one or more accessories may be provided in a recess in the lower surface of portable cleaning unit 16 or in an upper surface of wheeled base 58.

REMOVABLE DIRT CHAMBER

[00128] The following is a description of a portable cleaning unit having a removable dirt chamber that may be used by itself in any surface cleaning apparatus or in any combination or sub-combination with any other feature or features disclosed herein.

[00129] As exemplified in Figure 14, the cyclone chamber 118 and material collection chamber 130 may be constructed as a one piece assembly and are referred to collectively as a cyclone bin assembly 188. In accordance

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with this aspect, cyclone bin assembly 188 may be removed from the portable surface cleaning unit 116 when the portable surface cleaning unit 116 is seated on the base 158 (Figures 14 and 19) and when the portable surface cleaning unit 116 is separated from the base 158 (Figure13). This may allow a user to remove only the cyclone bin assembly 188, for example for emptying, regardless of whether the surface cleaning unit 116 is docked on the base 158.

[00130] As exemplified in Figures 18-21, the material collection chamber 530 may be movable or removable from surface cleaning apparatus 510 and from the portable cleaning unit 516, such that it may be emptied, and is removable from portable cleaning unit 516 with the associated cyclone 518 or cyclones as a sealed unit.

[00131] In the illustrated embodiment, the cyclone chamber 518 and material collection chamber 530, referred to collectively as a cyclone bin assembly 588, can be removed from the portable surface cleaning unit 516 when the portable surface cleaning unit 516 is seated on the base 558 (Figure 19) and when the portable surface cleaning unit 516 is separated from the base 558 (Figure 20). This may allow a user to remove only the cyclone bin assembly 588, for example for emptying, regardless of whether the surface cleaning unit 516 is docked on the base 558.

[00132] Referring to Figure 18, in the illustrated embodiment, when the surface cleaning unit 516 is mounted on the base 558 the air flow path between the surface cleaning head 534 and the suction motor in the surface cleaning unit 516 includes a rigid conduit 589, a flexible hose 590a.

[00133] In this embodiment, the first hose 190a is connected to the surface cleaning unit 516 and extends between a downstream end 592a (with reference to the direction of airflow through the hose 590a) that is connected to the surface cleaning unit 516 and the rigid conduit 589. In this configuration, when the surface cleaning unit 516 is removed from the base 558 the hose 590a comes with the surface cleaning unit 516 (Figure 20).

[00134] It will be appreciated that, in alternate embodiments, material collection chamber 130 may be a separate unit and may be removable without the cyclone chamber. Alternately, or in addition, material collection chamber 130 may be removed with the handle of the portable cleaning unit. An advantage of this design is that the handle of the portable cleaning unit may be useable to manipulate the material collection chamber 130 or cyclone bin assembly when removed for emptying.

AUTOMATIC PORTABLE CLEANING UNIT HOSE CONNECTION

[00135] The following is a description of automatically connecting a hose of the portable cleaning unit in air flow communication with the base when the portable cleaning unit is placed on the base that may be used by itself in any surface cleaning apparatus or in any combination or sub-combination with any other feature or features disclosed herein.

[00136] Referring to Figure 12, in the illustrated embodiment, when the surface cleaning unit 116 is mounted on the base 158, the air flow path between the remote surface cleaning head 134 and the suction motor in the surface cleaning unit 116 includes a rigid conduit or wand 189, a first flexible hose 190a and a second flexible hose 190b (see also Figure 14) positioned downstream from the first hose 190a.

[00137] The first hose 190a extends from its upstream that is connected to rigid conduit 189 to its downstream end 192a (with reference to the direction of airflow through the hose 190a) that is connected to the base 158. The first hose 190a has a diameter 191a. While the first hose 190a may be removably connectable to the base 158, first hose 109a remains attached to the base 158 regardless of the position of the surface cleaning unit 116 (Figures 12 and 14).

[00138] Referring to Figure 13, the second hose 190b is attached to and is removable with the surface cleaning unit 116. A downstream end 192b of

the hose 190b is attached to the air inlet 124 of the cyclone chamber 118 and the upstream end 193b is removably connectable in air flow communication with the air outlet of the base 158 (e.g., opening 195 of coupling 194). When the surface cleaning unit 116 is removed from the base 158, the upstream or inlet end 193b of the hose 190b can be used as a second or auxiliary dirty air inlet for drawing fluid and debris into the air flow path. Optionally, auxiliary cleaning tools may be attached to the inlet end 193b of the hose 190b. In this configuration, the first hose 190a does not form part of the airflow path to the surface cleaning unit 116.

[00139] The second hose 190b is shown in a wrapped or storage position in Figure 13 in which it is wrapped around part of the surface cleaning unit 116. When the surface cleaning unit 116 is in use as a portable cleaning unit the second hose 190b can be unwound and extended. Preferably, the second hose 190b is extensible to increase its cleaning range. The second hose 190b has a diameter 191b, which optionally may be smaller than diameter 191a. This may help reduce the overall size of the surface cleaning unit 116 and may help it nest on the base 158. However, it is preferred that they have the same or similar diameters so as to provide an air flow path that has a generally constant diameter. The hoses 190a and 190b may be generally similar. Alternatively, they may have different properties. For example, the first hose 190a may be non-extensible and relatively stiff (to allow a user to pull the hose 190a to advance the base 158 across the surface) and the second hose 190b may be extensible and less stiff.

[00140] Referring to Figure 12, when the surface cleaning unit 116 is seated on the base 158, the inlet end 193b of the second hose 190b is connected in air flow communication with the downstream end 192a of the first hose 190a, using coupling 194, thereby re-establishing air flow communication between the cleaning head 134 and the surface cleaning unit 116.

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[00141] Referring to Figure 13, the coupling 194 may be any suitable connector, and in the example illustrated, is an elbow-type connector with a downstream opening 195 surrounded by a sealing face 196. The surface cleaning unit 116 may be configured such that the upstream end 193b of the second hose 190b is aligned with the opening 195 and seals against seal face 196 to establish the air flow path when the surface cleaning unit 116 is placed on base 158. Accordingly, sealing face 196 is sealed by the inlet end 193b automatically when the surface cleaning unit 116 is inserted vertically onto the base 158.

[00142] In order to provide a seal, one or both of base 158 and surface cleaning unit 116 may be configured to provide sufficient abutment therebetween so that an air tight seal is created. As exemplified in Figure 13, the rear face of coupling 194 is angled and a mating angled surface may be provided on portable cleaning unit 116. Accordingly, when portable cleaning unit is placed on base 158, portable cleaning unit is urged rearwardly and the rear end of portable cleaning unit 116 may abut the rear wall of base 158 thereby pressing the upstream end 193b of the second hose 190b against the opening 195 and optionally compressing a gasket or the like to create an air tight seal.

[00143] If the cyclone bin assembly is removable, then the remaining body of portable cleaning unit 116 may also or alternately be angled to press the cyclone inlet 524 against opening 195 (see for example Figure 19).

VALVE TO SWITCH BETWEEN HOSES

[00144] The following is a description of alternate air flow paths that may be used by itself in any surface cleaning apparatus or in any combination or sub-combination with any other feature or features disclosed herein.

[00145] In accordance with this aspect, the portable cleaning unit may incorporate a hose which is different to first hose 190a. For example, it may

have a smaller diameter. Accordingly, it may be preferred not to use such a hose in the air flow path when portable cleaning unit 116 is mounted on the base since the smaller diameter hose would reduce air flow and increase the back pressure. However, the smaller diameter hose may be lighter and easier to use in a portable mode (i.e., when surface cleaning unit 116 is removed from base 158). In such a case, a valve may be provided to selective connect the cyclone air inlet with the different hoses or air flow paths. The valve may be manually operable or automatically operable. For example, the valve may be actuated automatically when the surface cleaning unit 116 is removed from the base or when the smaller diameter hose is deployed from a storage position for use.

[00146] Accordingly, if second hose 190b has a smaller diameter into the air flow path when the surface cleaning unit 116 is docked, a user may optionally detach the downstream end 192b of the second hose 190a from the air inlet 124 (thereby removing the second hose 190b from the air flow circuit) and can reposition the downstream end 192a of the hose 190a to be connected directly to the inlet 124.Alternately, inlet 124 could be automatically connected in air flow communication with opening 195 when surface cleaning unit 116 is placed on base 158.

[00147] Optionally, instead requiring a user to reconfigure a hose, the surface cleaning apparatus may include a valve positioned in the air flow path that allows the air flow to be switched between the first and second hoses. In this configuration, both hoses can remain attached to their respective components, and the air flow path to the surface cleaning unit 116 can include either of the first and second hoses. Optionally, one of the hoses may be detachable and connectable to the other of the hoses, such that one large hose is created and forms the air flow path to the surface cleaning unit.

[00148] Referring to Figures 15 and 16, a schematic representation of another embodiment of a surface cleaning apparatus 210 is illustrated. Surface cleaning apparatus 210 is generally similar to apparatus 10, and

analogous features are identified using like reference characters indexed by 200.

[00149] In this embodiment, the surface cleaning unit 216 includes a valve 297 provided in the air flow path, upstream from the air inlet of the cyclone chamber 218. The valve is connected to the downstream end 292b of the second hose 290b, and the valve 297 and second hose 290b are removable with the surface cleaning unit 216 (Figure 16). When the surface cleaning unit 216 is seated on base 258, the valve can connect to coupling 294 automatically or manually. An actuating lever 298 allows a user to change to position of the valve 297 so that, when the surface cleaning unit 216 is docked, the first hose 290a is connected in air flow communication with the surface cleaning unit 216 and the second hose 290b is sealed (but remains attached and does not require re-configuration). Optionally, the valve 297 can be automatically actuated when the surface cleaning unit 216 is placed on or removed from the base 258 to adjust the air flow path accordingly.

USE OF DUAL SUCTION MOTORS

[00150] The following is a description of the use of dual suction motors that may be used by itself in any surface cleaning apparatus or in any combination or sub-combination with any other feature or features disclosed herein.

[00151] Optionally, the base of the surface cleaning apparatus may include some operating components of the surface cleaning apparatus, including, for example a suction motor, the power cord and a cord reel. Providing components in the base may help reduce the weight and/or overall size of the portable surface cleaning unit.

[00152] Referring to Figure 17, a schematic representation of another embodiment of a surface cleaning apparatus 310 is shown. The surface

cleaning apparatus 310 is generally similar to surface cleaning apparatus 10, and analogous features are identified using like reference characters indexed by 300.

[00153] In the illustrated embodiment, the surface cleaning apparatus 310 includes a base 358 and a surface cleaning unit 316 that can be mounted on the base 358 (as illustrated), and can be detached to be used separately from the base 358.

[00154] The surface cleaning unit 316 includes a cyclone bin assembly 388 that has a cyclone chamber 318 and a dirt collection chamber 330. The cyclone chamber 318 has an air inlet 324 and an air outlet 328. A dirt outlet in the form of a slot 326 provides communication between the cyclone chamber 318 and the dirt collection chamber 330.

[00155] A first suction motor 320a is provided in the surface cleaning unit 316. An air flow conduit 400 provides an air flow path between the air outlet of the pre-motor filter housing and the suction motor 320a. Accordingly, a pre-motor filter 338 is provided in the air flow path between the air outlet 328 of the cyclone chamber 318 and the motor 320a.

[00156] In the illustrated embodiment the electrical cord 401 is wound around a cord reel 402 that is provided in the base 358. In addition, a second suction motor 320b is provided in the base 358 and is in electrical communication with the power cord 401 such that the second suction motor 358 can be powered by an external power supply (e.g. a wall socket). A base conduit 403 provides air flow communication between the second suction motor 320b and a port 404 on the upper surface of the base 358.

[00157] When the surface cleaning unit 316 is mounted on the base 358, a mating port 406 on the surface cleaning unit 316 may connect to and seal the port 404. Preferably, a valve 407 (e.g. any suitable valve such as a two position valve and a ball valve) is provided, e.g., in the air flow path between the filter 338 and the motor 320a. The valve 407 is also in air flow communication with the port 406, and is operable to selectively connect either

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port 406 or conduit 400 in airflow communication with the cyclone bin assembly 388. When conduit 400 is connected, suction motor 320a may be used draw air through the surface cleaning unit 316 (and preferably motor 320b is not). When port 406 is connected, suction motor 320b may be used to draw air through the surface cleaning unit 316 (and preferably motor 320a is not). Preferably, the valve 407 is configured (for example via a biasing member or linkage member) so that when the surface cleaning unit 316 is lifted off the base 358 the valve 407 automatically seals port 406 and connects conduit 400.

[00158] It will be appreciated that valve may be actuatable by other means, such as a member that is drivingly connected to the valve and the member is operable as the surface cleaning unit is paced and or removed from base 358. It will be appreciated that motor 320b may be connected in air flow communication at an alternate location. For example, it could be downstream of motor 320a. Alternately, it could be a dirty air motor and located upstream of cyclone chamber 318.

[00159] Because the electrical cord 401 is provided in the base 358, when the surface cleaning unit 316 is detached from the base 358, it may no longer be connected to the external power source (e.g. wall socket). To provide power to the surface cleaning unit 316 when it is detached, the surface cleaning unit 316 includes an on-board energy storage member, e.g., one or more batteries 405. Alternatively, any other suitable energy storage member or power source can be used (fuel cell, combustion engine, solar cells, etc.). In the illustrated example, the batteries 405 provide DC power. In this configuration, when the surface cleaning unit 316 is detached from base 358, the suction motor 320a may operate using DC power, and may operate solely on the power supplied by batteries 405.

[00160] Optionally, when the surface cleaning unit 316 is re-attached to the base 358, power from the base 358 can be transferred to the surface cleaning unit 316, for example via detachable electrical connector 408.

Preferably, if an electrical connector 408 is provided the power received from the base 358 can be used to charge the batteries 405 to help ensure the batteries 405 are charged when the surface cleaning unit 316 is removed.

[00161] Alternatively, there need not be an electrical connection between the base 358 and the surface cleaning unit 316. In such a configuration the batteries 405 may be charged via an alternate power source, or may be replaced with fresh batteries as needed. For example, the surface cleaning unit 116 may be provided with its own power cord, or the power cord 401 may be removable from base 358 and may be plugged into surface cleaning unit 116.

[00162] Optionally, the suction motor 320a may be smaller and/or less powerful than the suction motor 320b. Making the suction motor 320a smaller and lighter than suction motor 320b may help reduce the overall size and weight of the surface cleaning unit 316. For example, the suction motor 320b may be a 1000 watt motor, and the suction motor 320a may be a 600 watt motor. Reducing the power consumption of the suction motor 320a may also help prolong the amount of cleaning time that can be achieved using the batteries 405, before they need to be replaced and/or recharged.

[00163] In the illustrated embodiment, because suction motor 320b is in the base 358 with the electrical cord, it may be an AC motor that can run on AC power received from a wall socket. Motor 320a may be operated on DC power supplied by the batteries 405.

[00164] In this configuration, a user may be able to select which suction motor 320a or 320b is to be used when the surface cleaning unit 316 is docked. For example, if performing a small job or if it is desirable to keep the noise level low a user may activate the smaller suction motor 320a. Alternatively, if performing a large job a user may select to use the suction motor 320b by activating the motor 320b and positioning the valve 407 as appropriate.

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DUAL OPERATIONAL MODE FOR A PORTABLE SURFACE CLEANING UNIT

[00165] The following is a description of the use of a dual operational mode for a portable surface cleaning unit that may be used by itself in any surface cleaning apparatus or in any combination or sub-combination with any other feature or features disclosed herein.

[00166] Alternately, or in addition to providing a motor 320b in the base 358, the suction motor 320a in the surface cleaning unit may be operable on current supplied by an on board energy storage member (e.g., batteries 405) when removed from base 358 and may be operable on current supplied from base 358 when mounted thereon.

[00167] Accordingly, when removed from the base 358, motor 320a may be operable on DC current supplied from batteries 405. However, when mounted on the base 358 and electrical code 401 is plugged into an electrical outlet, current may be supplied from base 358 to motor 320a. The current may be AC, in which case, motor 320a may be operable on both AC and DC current (e.g., it has dual windings) or the AC current may be converted to DC current (such as by providing a power supply in one or both of the base 358 and the surface cleaning unit 116).

[00168] Accordingly, for example, as shown in Figure 17, an electrical connector 408 may be used to power the suction motor 320a when the surface cleaning apparatus is docked on the base 358. In this configuration the suction motor 320a may be configured to also run on AC power or a power supply or converter module 409 may be provided to convert the incoming AC power to DC power. Optionally, the convertor module 409 may be in the base 358 so that the connector 408 is provided with DC power.

[00169] It will be appreciated that the suction motor of the portable cleaning unit may be operable on different power levels. It may be operable on a first or higher power level when mounted to the base and operable on

power supplied from the base (which may be AC or DC). It may be operable on a lower power level when removed from the base.

[00170] It will be appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments or separate aspects, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment or aspect, may also be provided separately or in any suitable sub-combination.

[00171] What has been described above has been intended to be illustrative of the invention and non-limiting and it will be understood by persons skilled in the art that other variants and modifications may be made without departing from the scope of the invention as defined in the claims appended hereto. The scope of the claims should not be limited by the preferred embodiments and examples, but should be given the broadest interpretation consistent with the description as a whole.

WHAT IS CLAIMED IS:

1. A surface cleaning apparatus comprising:

a) a wheeled base comprising or connectable to a power cord;

b) a portable cleaning unit removably mounted on the wheeled base and comprising at least one cyclonic separation stage, a first energy storage member and a portable cleaning unit suction motor; and,

c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

wherein the energy storage member may be charged when the portable cleaning unit is mounted on the wheeled base.

2. The surface cleaning apparatus of claim 1 wherein the portable cleaning unit further comprises a power cord.

3. The surface cleaning apparatus of claim 1 further comprising a power cord, wherein the power cord is removably electrically connected to the portable cleaning unit.

4. The surface cleaning apparatus of claim 3 wherein the power cord is also removably electrically connected to the wheeled base.

5. The surface cleaning apparatus of claim 4 wherein the power cord provides AC current to the wheeled base and the wheeled base provides current to the portable cleaning unit when the portable cleaning unit is mounted to the wheeled base.

6. The surface cleaning apparatus of claim 5 wherein the wheeled base provides DC current to the portable cleaning unit when the portable cleaning unit is mounted to the wheeled base.

7. The surface cleaning apparatus of claim 1 further comprising a power cord electrically connected to the wheeled base and wherein the power cord

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provides AC current to the wheeled base when connected to the wheeled base and the wheeled base provides current to the portable cleaning unit when the portable cleaning unit is mounted to the wheeled base.

8. The surface cleaning apparatus of claim 7 wherein the wheeled base provides DC current to the portable cleaning unit when the portable cleaning unit is mounted to the wheeled base.

9. The surface cleaning apparatus of claim 1 wherein the portable cleaning unit is powered solely by the first energy storage member when the portable cleaning unit is removed from the wheeled base.

10. The surface cleaning apparatus of claim 1 wherein the first energy storage member comprises batteries.

11. The surface cleaning apparatus of claim 1 wherein the wheeled base further comprises a suction motor which is used to provide motive power through the fluid flow path when the surface cleaning unit is switched on and when the portable cleaning unit is mounted on the wheeled base.

12. The surface cleaning apparatus of claim 11 wherein the suction motor in the portable cleaning unit is not used to provide motive power to move fluid through the fluid flow path when the surface cleaning unit is switched on and when the portable cleaning unit is mounted on the wheeled base.

13. The surface cleaning apparatus of claim 1 wherein the wheeled base further comprises a second energy storage member.

14. The surface cleaning apparatus of claim 13 wherein the second energy storage member charges the first energy storage member when the portable cleaning unit is mounted on the wheeled base.

15. The surface cleaning apparatus of claim 1 wherein the portable cleaning unit suction motor is a DC motor.

16. The surface cleaning apparatus of claim 15 wherein the wheeled base further comprises or is electrically connectable to a power cord, the wheeled base further comprises a circuit that receives AC current and outputs DC current and the portable cleaning unit is powered by DC current when the portable cleaning unit is mounted on the wheeled base.

17. A surface cleaning apparatus comprising:

a) a wheeled base;

b) a portable cleaning unit removably mounted on the wheeled base and comprising at least one cyclonic separation stage, an energy storage member and a portable cleaning unit suction motor; and,

c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

wherein the portable cleaning comprises or is electrically connectable to a power cord whereby the portable cleaning unit suction motor may be powered by the energy storage member or power supplied by the power cord.

18. The surface cleaning apparatus of claim 17 wherein the wheeled base further comprises a portion of the fluid flow path and has a suction motor provided in the portion of the fluid flow path.

19. The surface cleaning apparatus of claim 17 wherein the power cord or an alternate power cord provides AC current to the wheeled base and the wheeled base provides current to the portable cleaning unit when the portable cleaning unit is mounted to the wheeled base.

20. The surface cleaning apparatus of claim 19 wherein the wheeled base provides DC current to the portable cleaning unit when the portable cleaning unit is mounted to the wheeled base.

21. The surface cleaning apparatus of claim 17 wherein the power cord is electrically connectable to the portable cleaning unit and the wheeled base.

22. The surface cleaning apparatus of claim 21 wherein the wheeled base further comprises a portion of the fluid flow path and has a suction motor provided in the portion of the fluid flow path. The energy storage member may be charged when the portable cleaning unit is mounted on the wheeled base and/or the portable cleaning comprises or is electrically connectable to a power cord whereby the portable cleaning unit suction motor may be powered by the energy storage member or power supplied by the power cord.

ABSTRACT

A portable surface cleaning apparatus is removably mounted from a wheeled base. The portable surface cleaning apparatus is provided with an energy storage member and a suction motor.

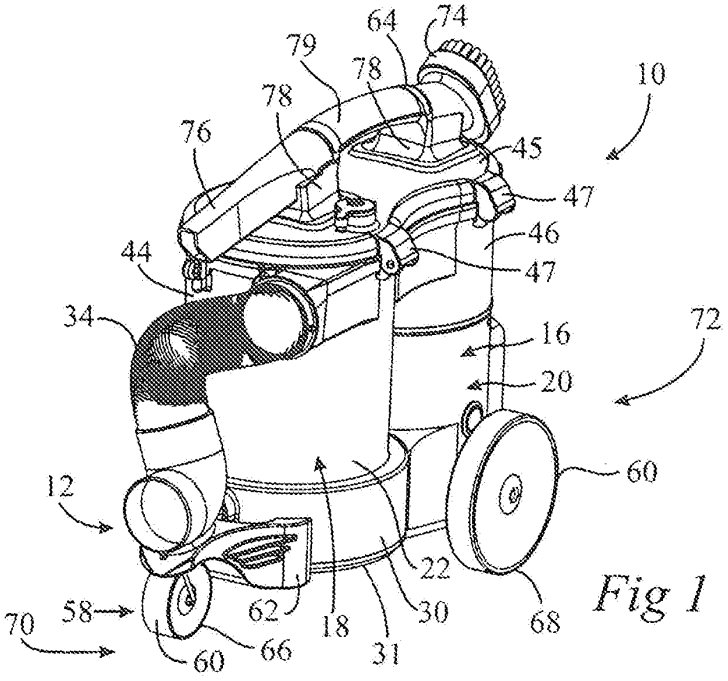
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Fig 1

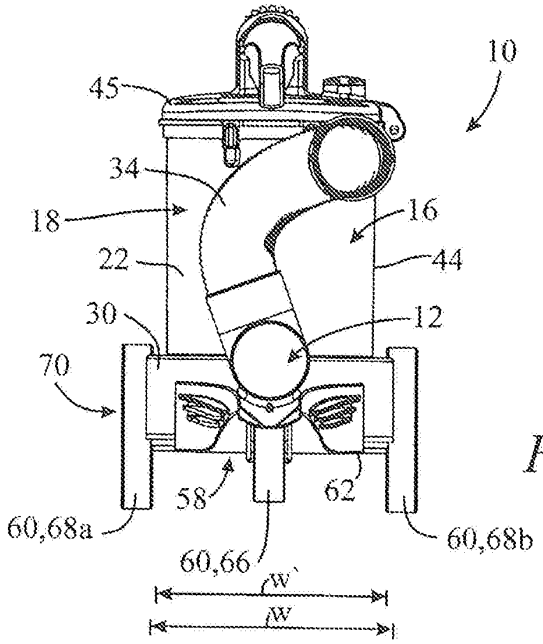
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Fig 2

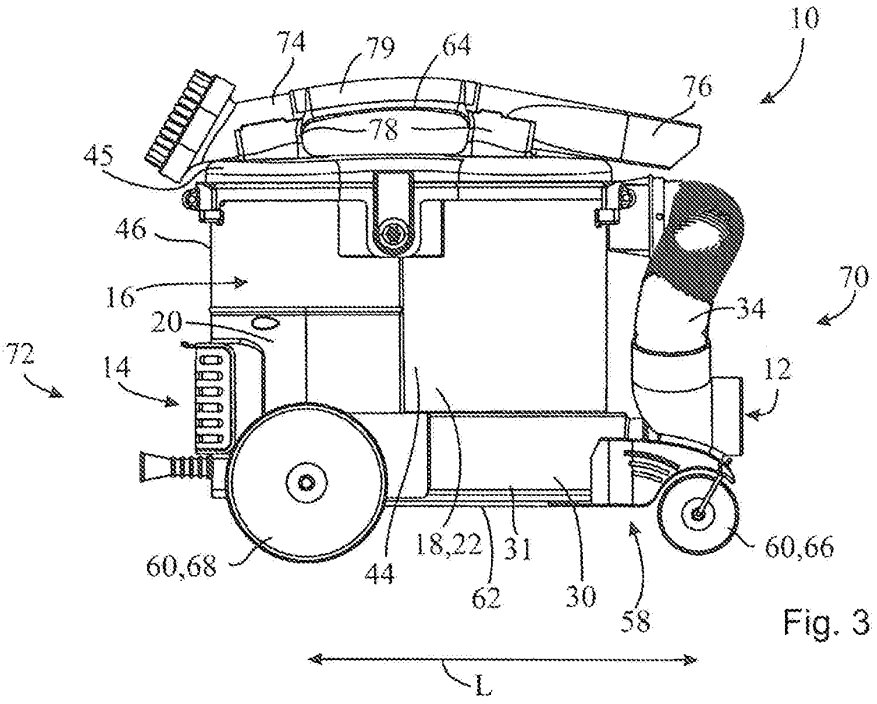
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Fig. 3

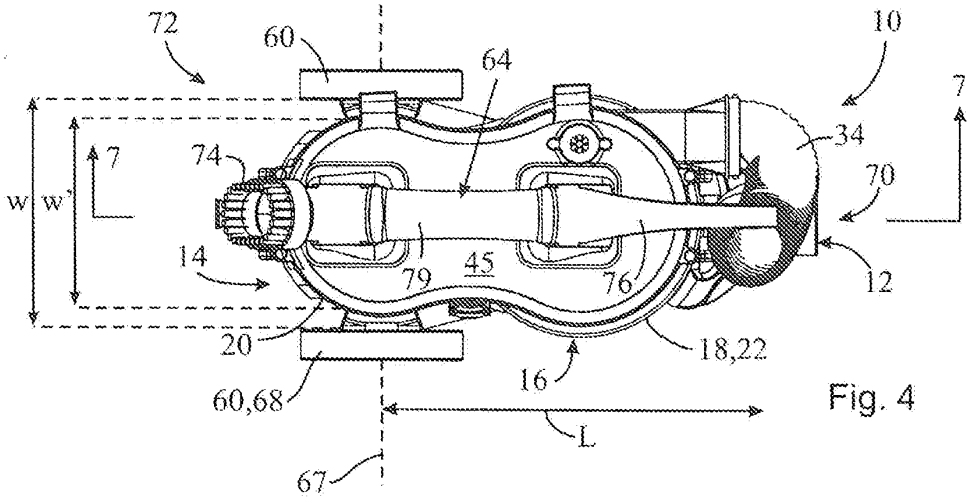
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Fig. 4

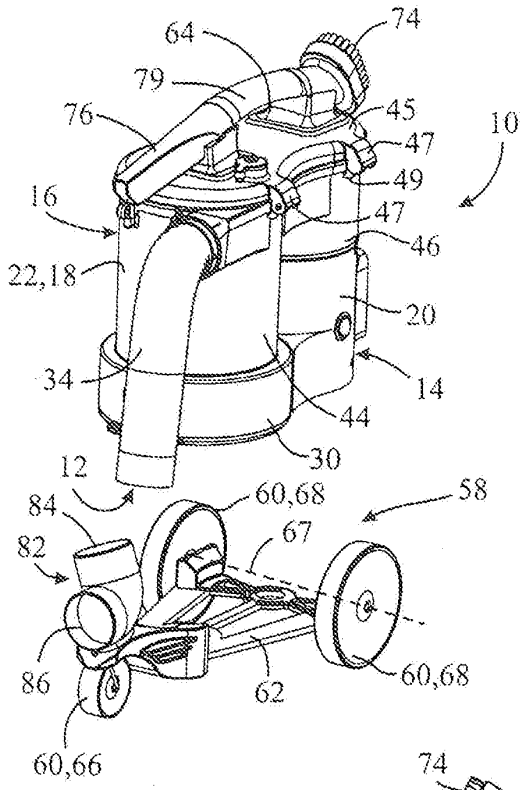
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Fig. 5

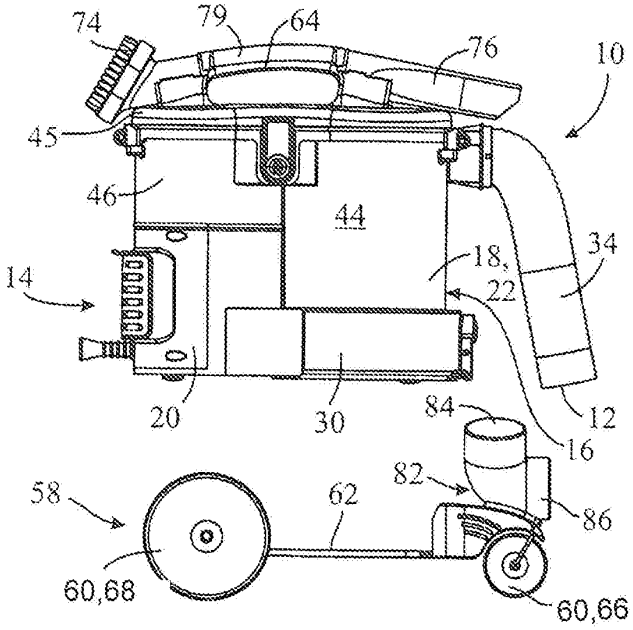
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Fig. 6

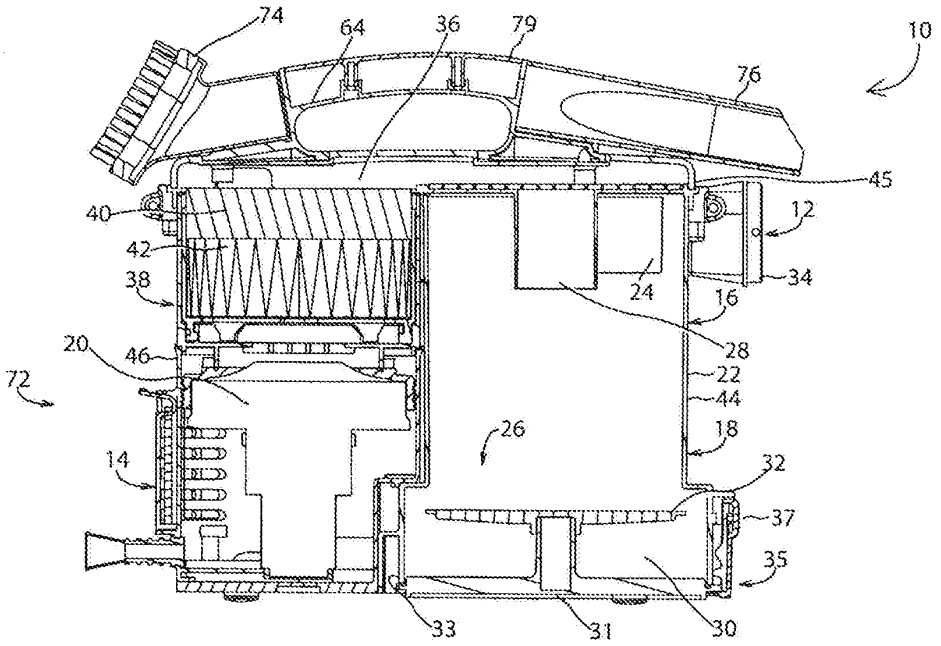
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Fig. 7

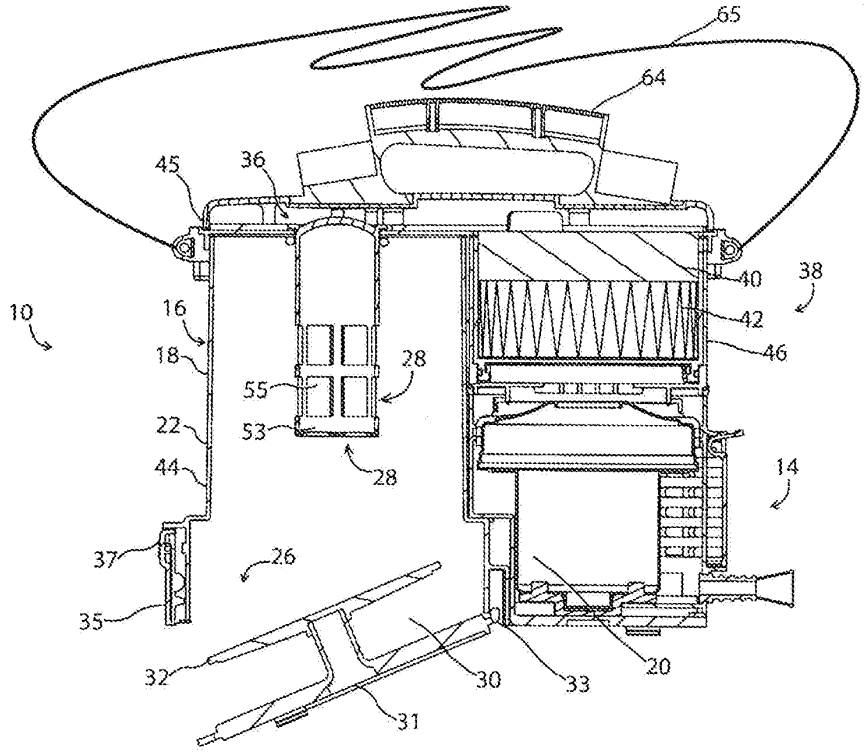
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Fig. 8

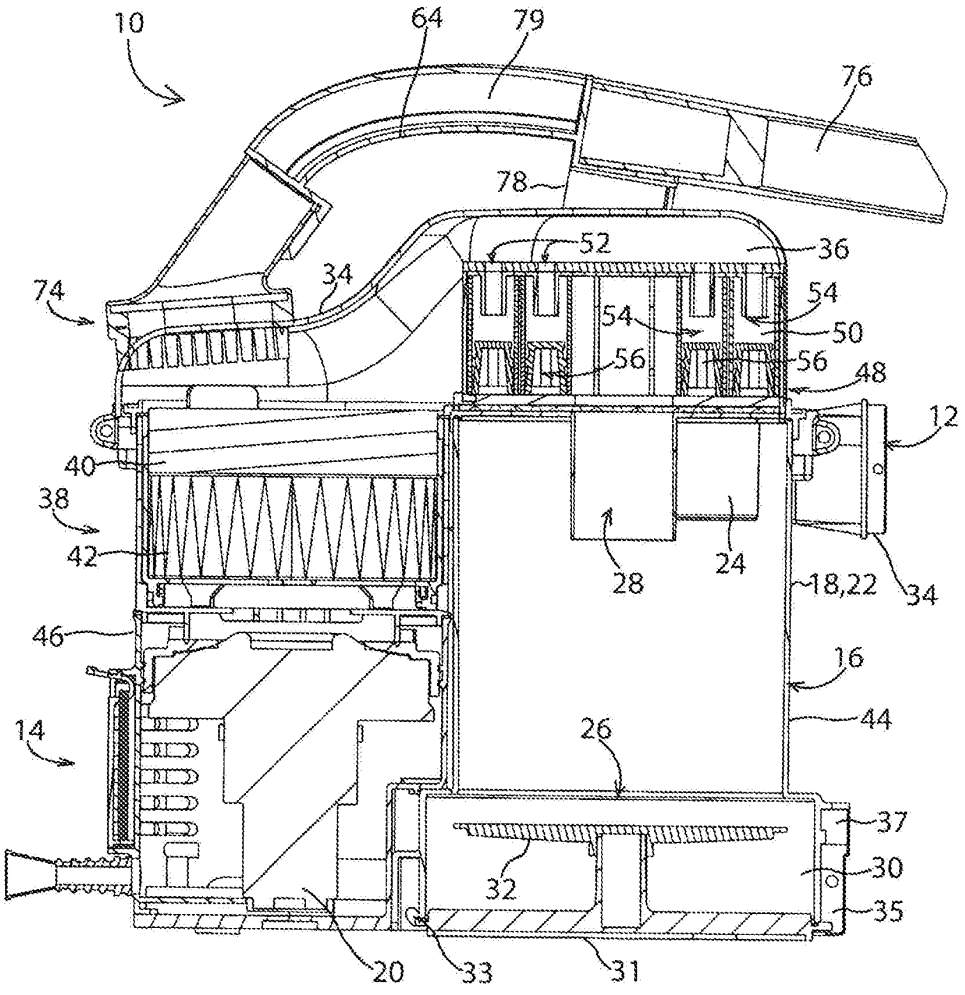
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Fig. 9

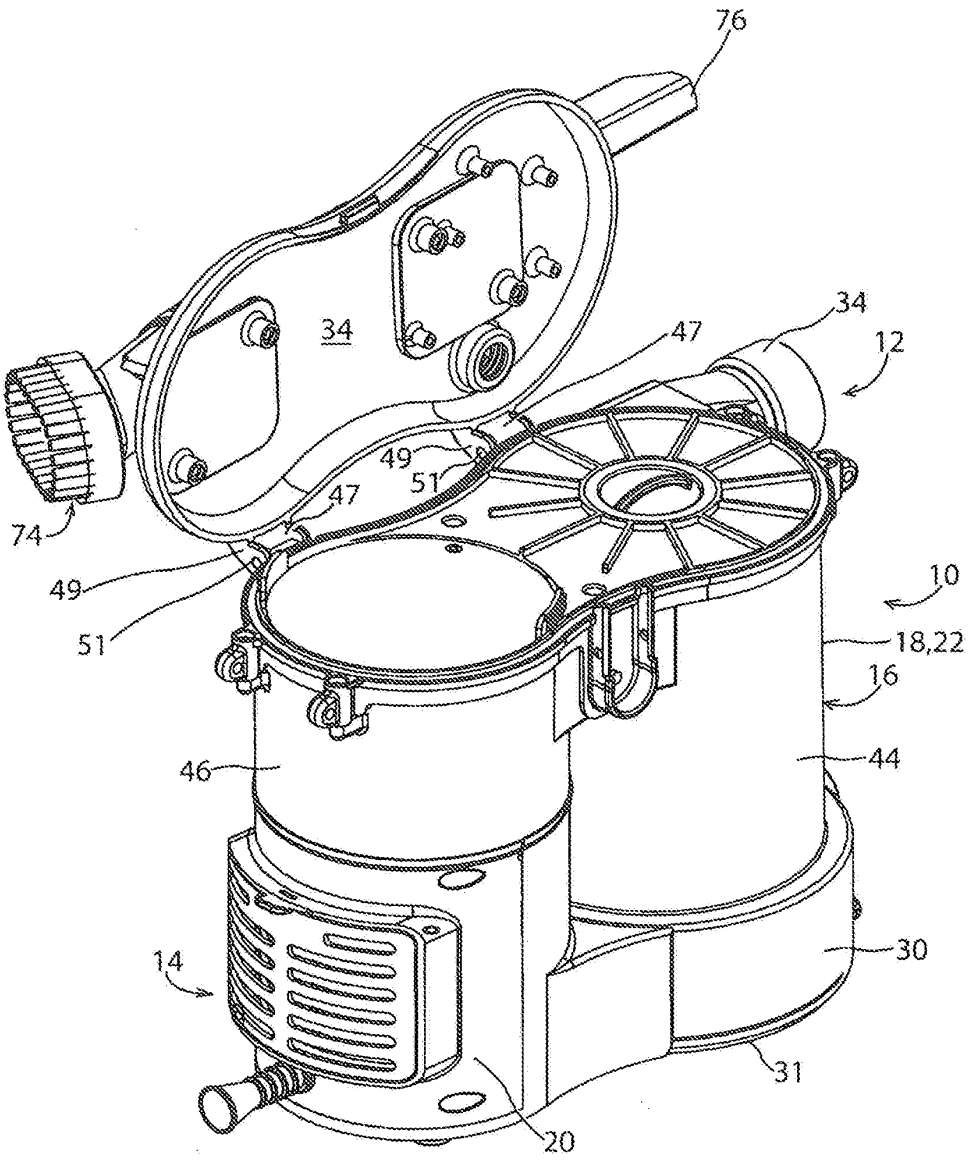
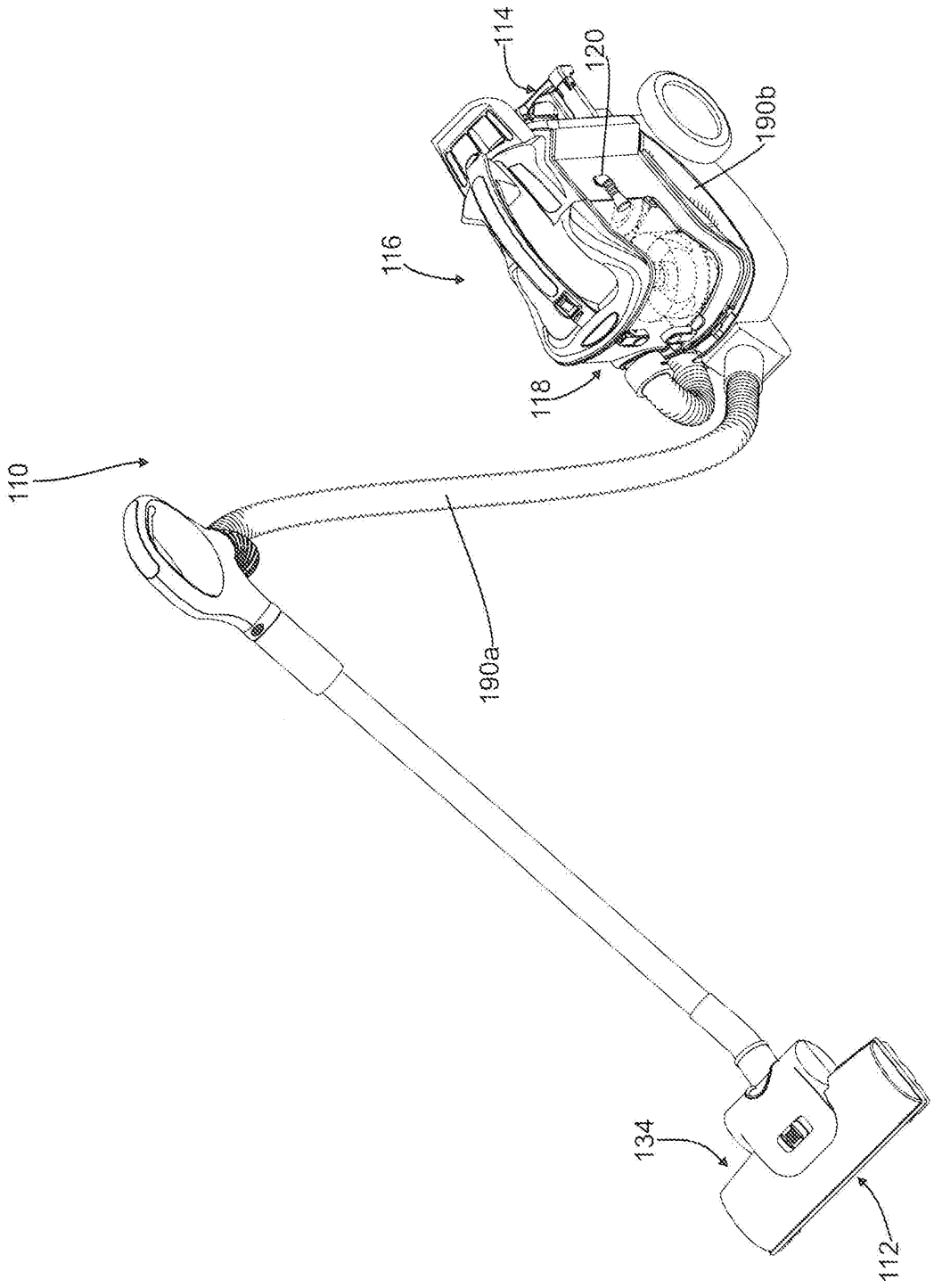


Fig. 10



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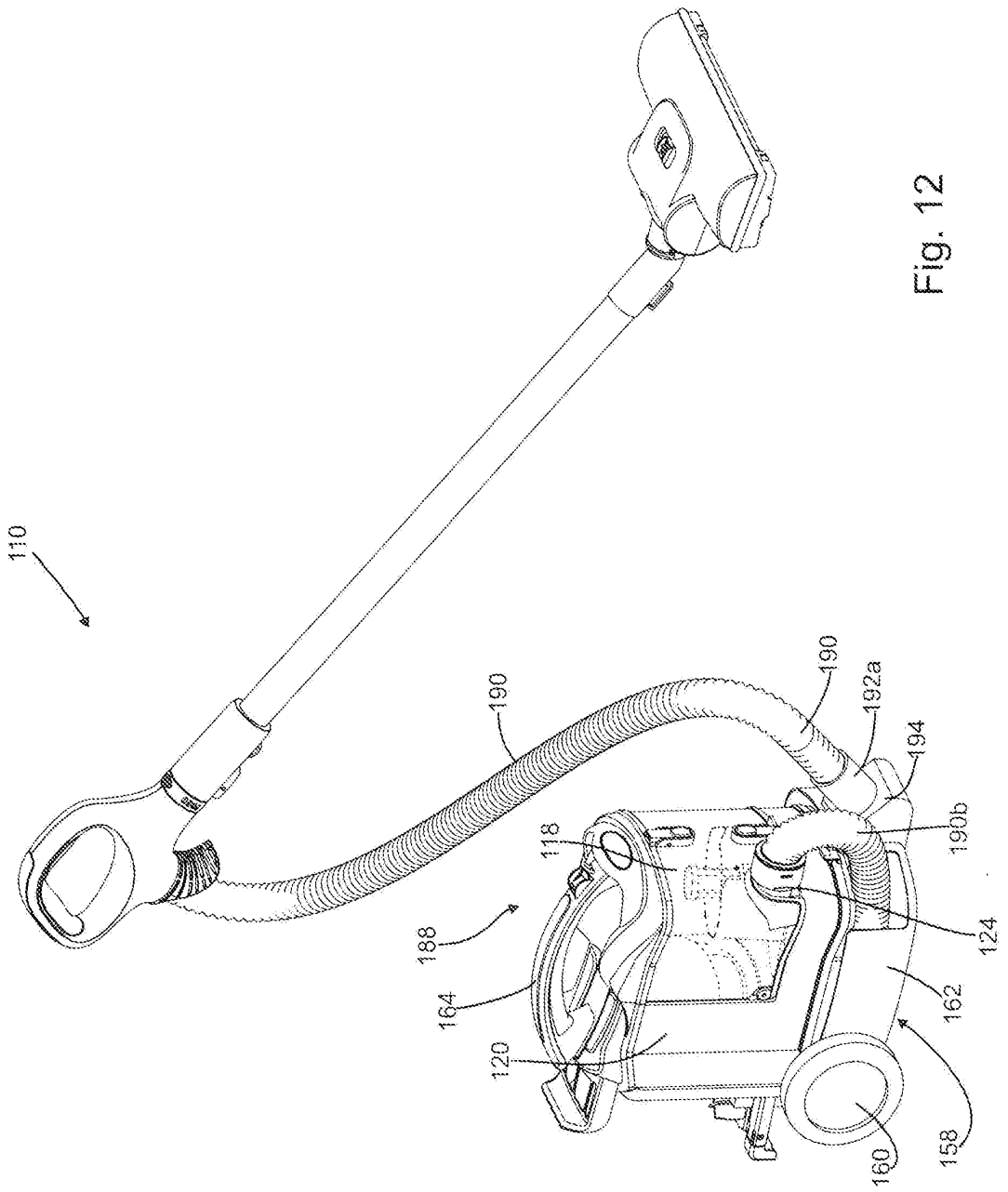

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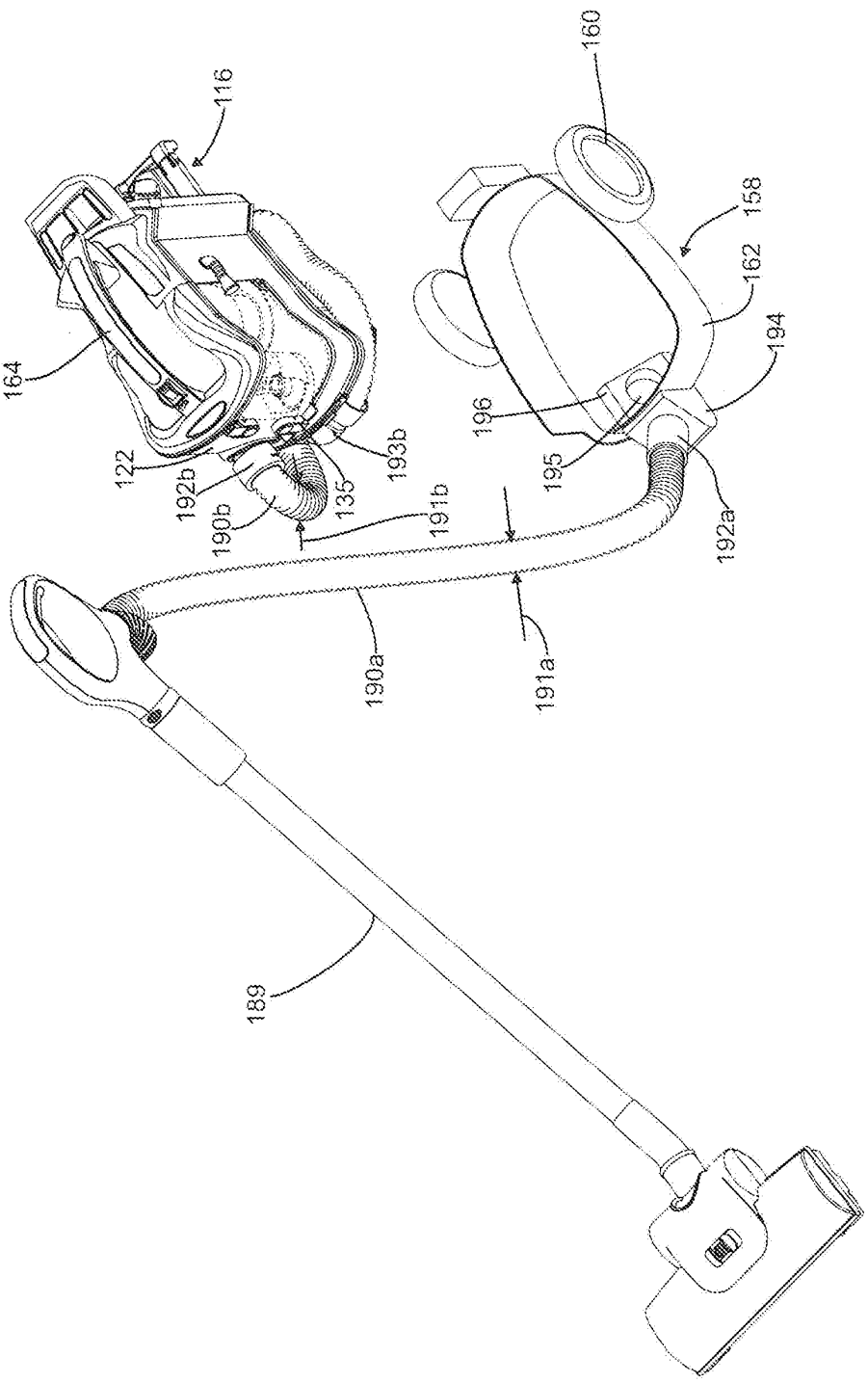
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Fig. 13

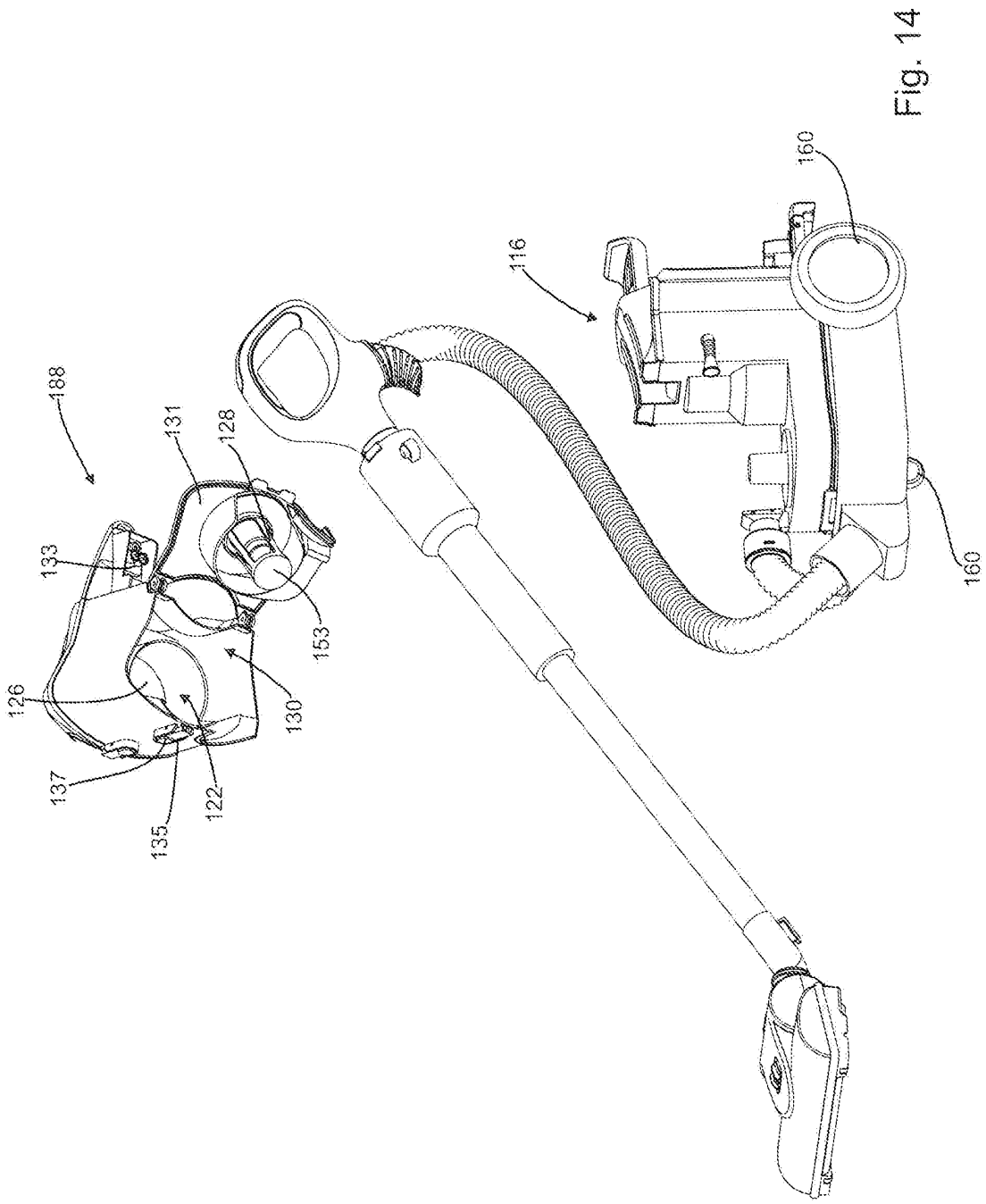
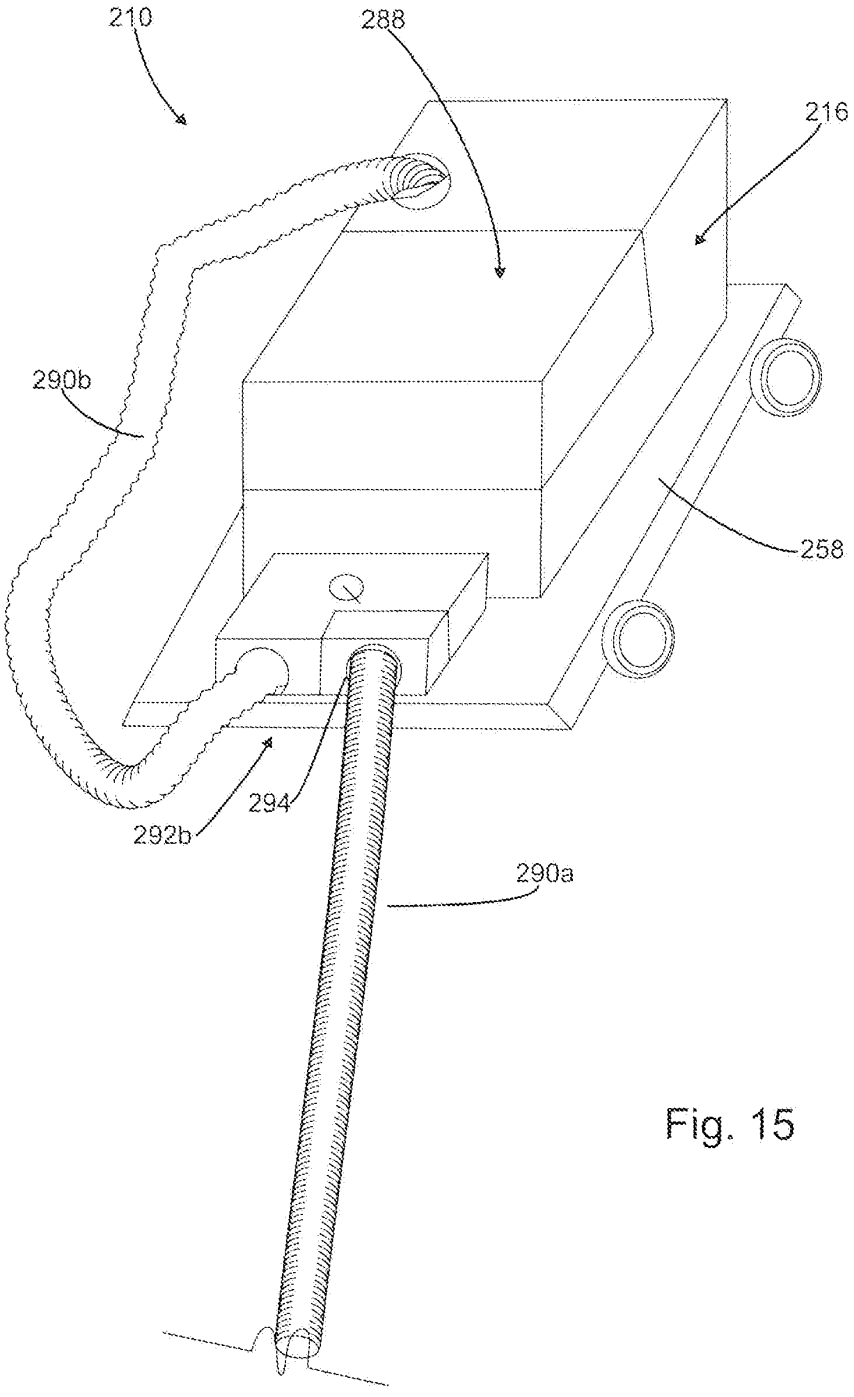


Fig. 14



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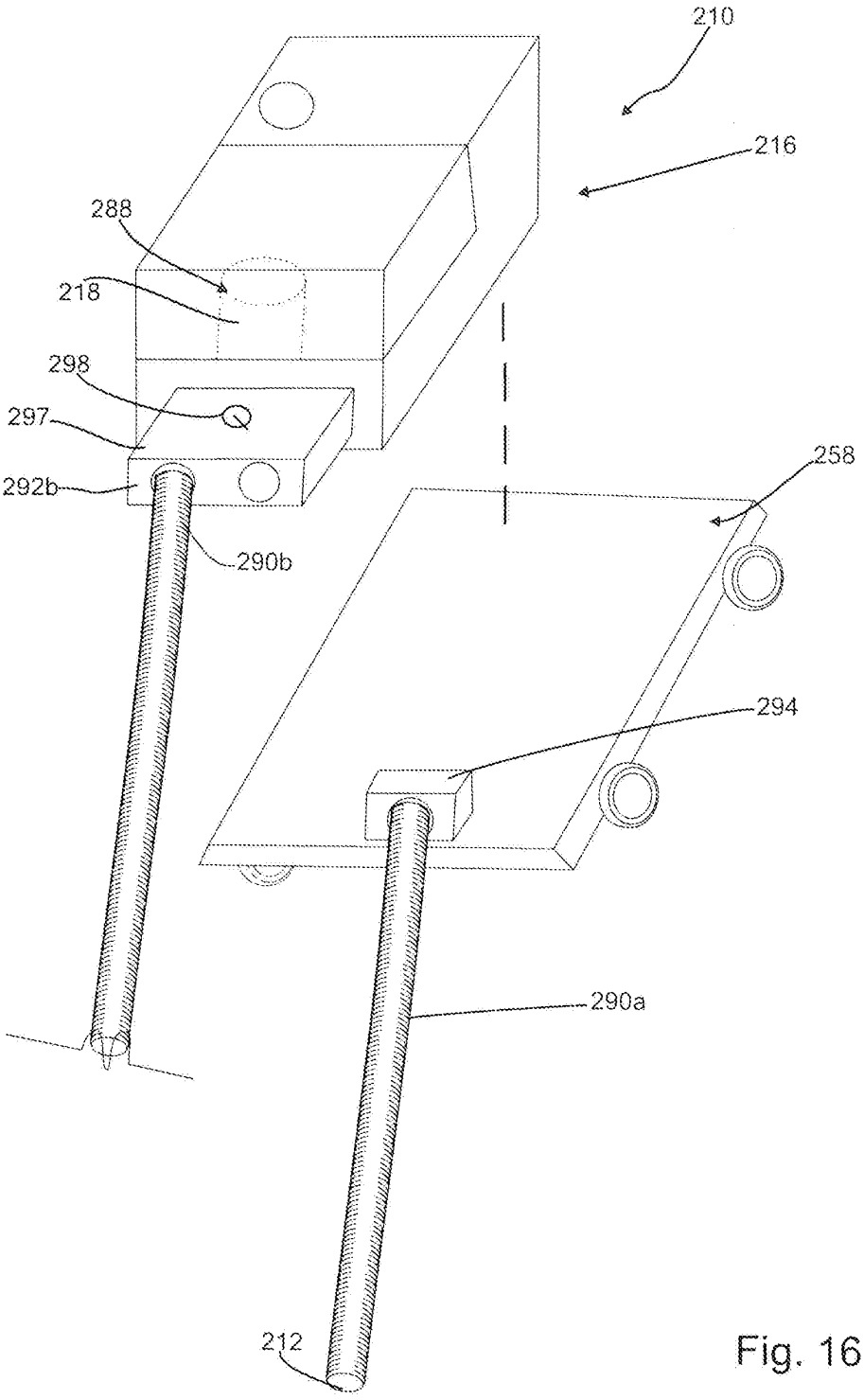

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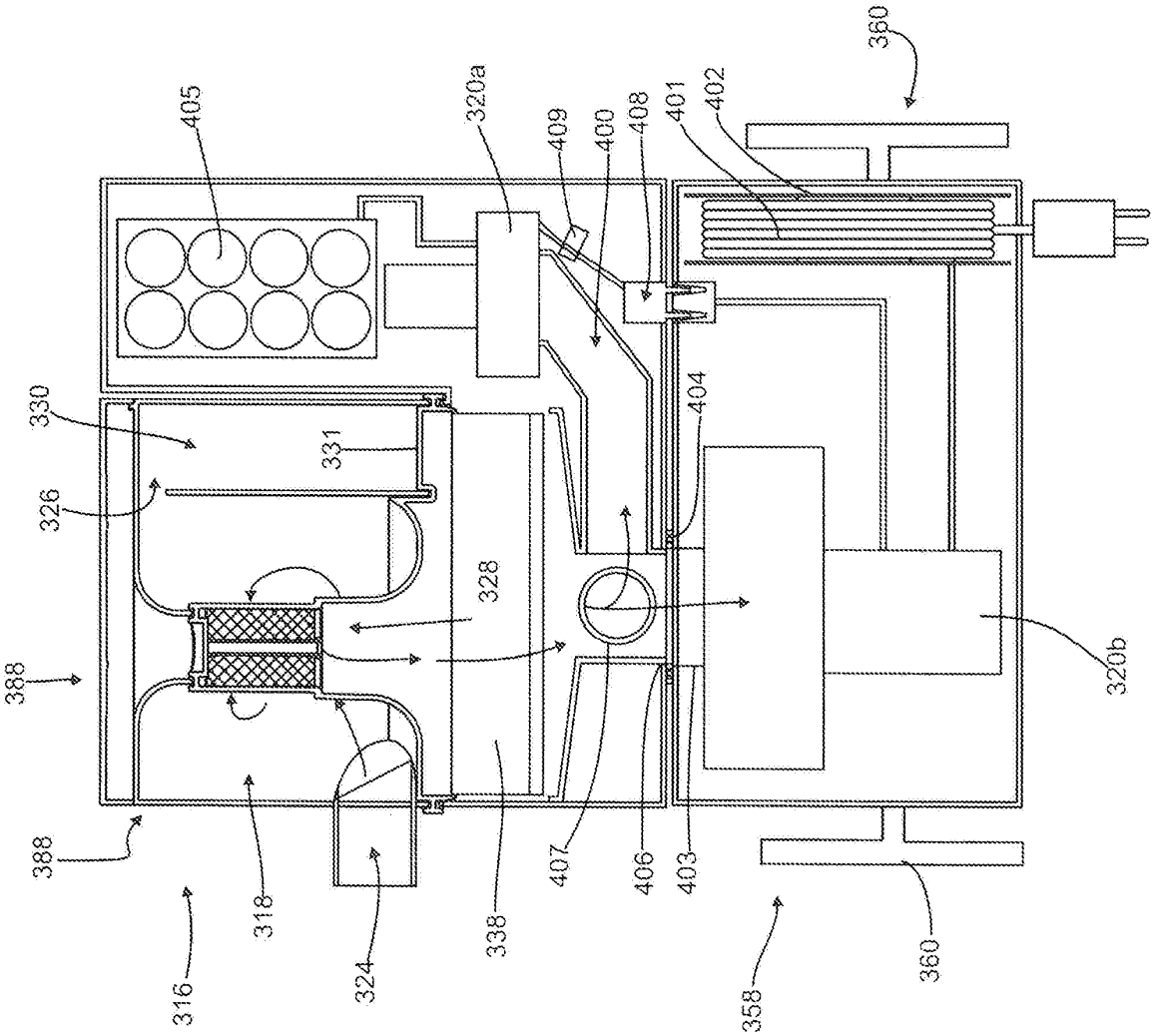
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Fig. 17

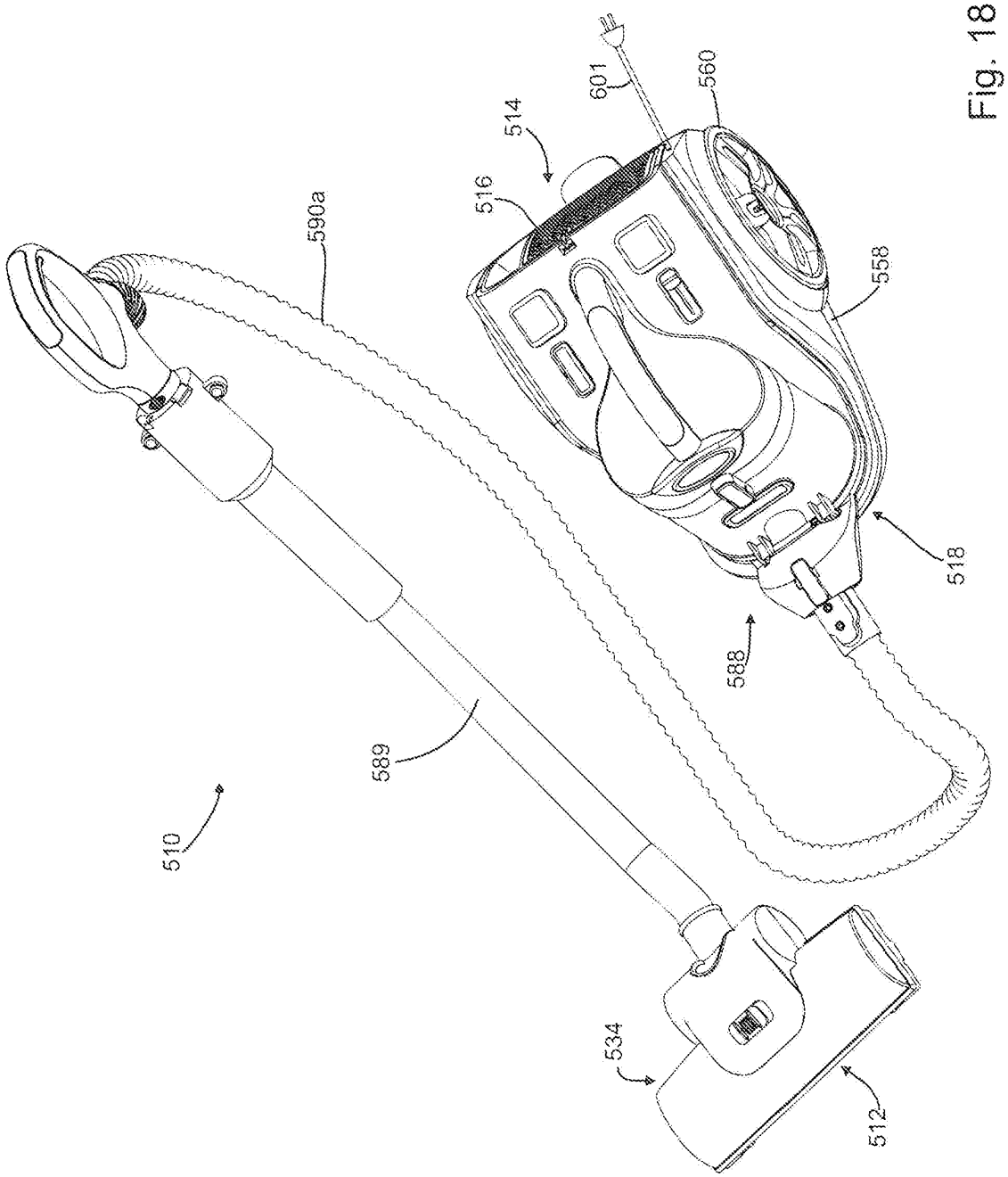
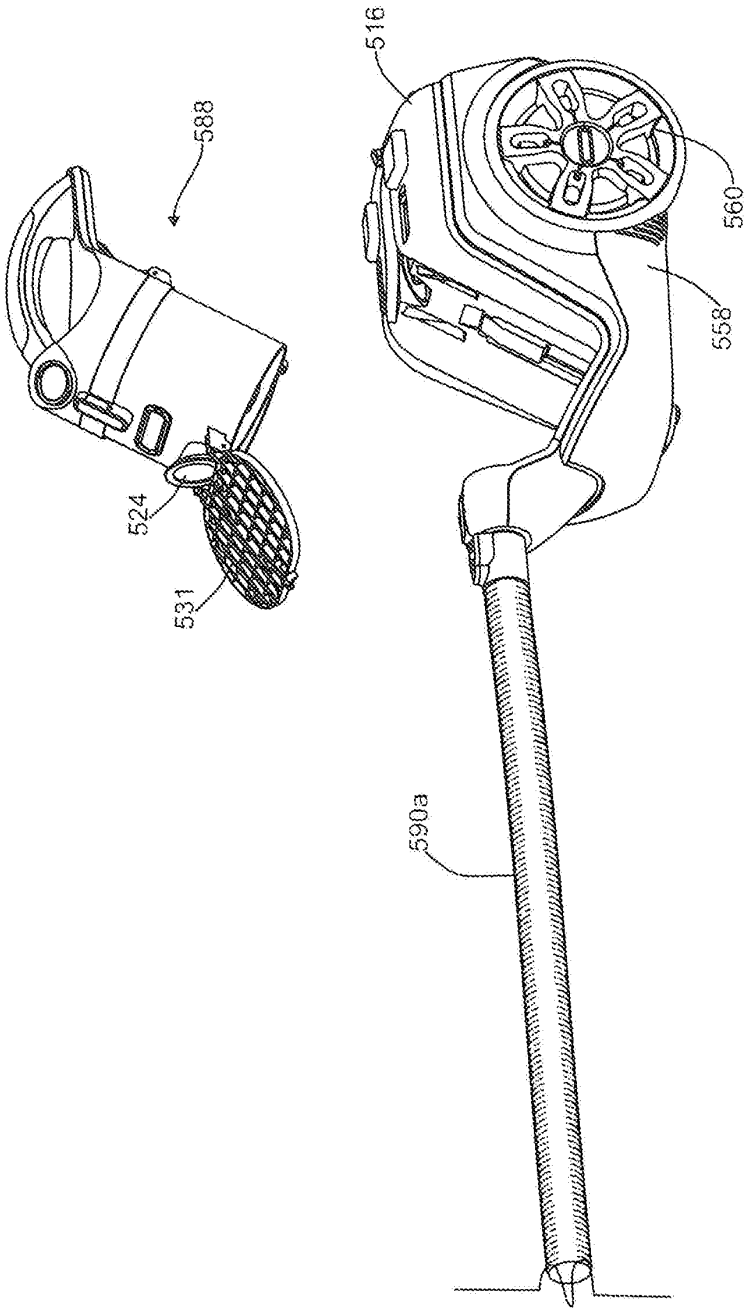


Fig. 18



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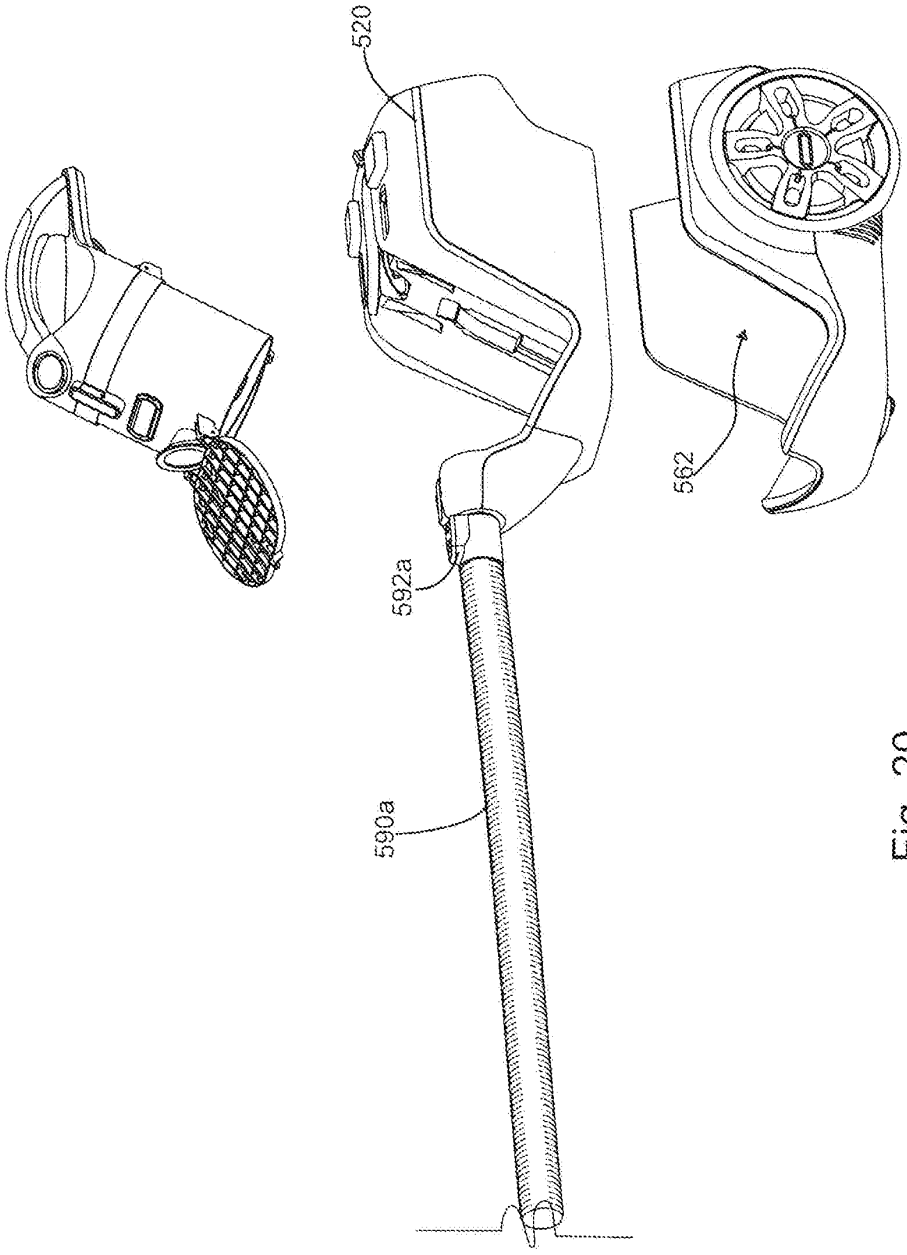

Fig. 20

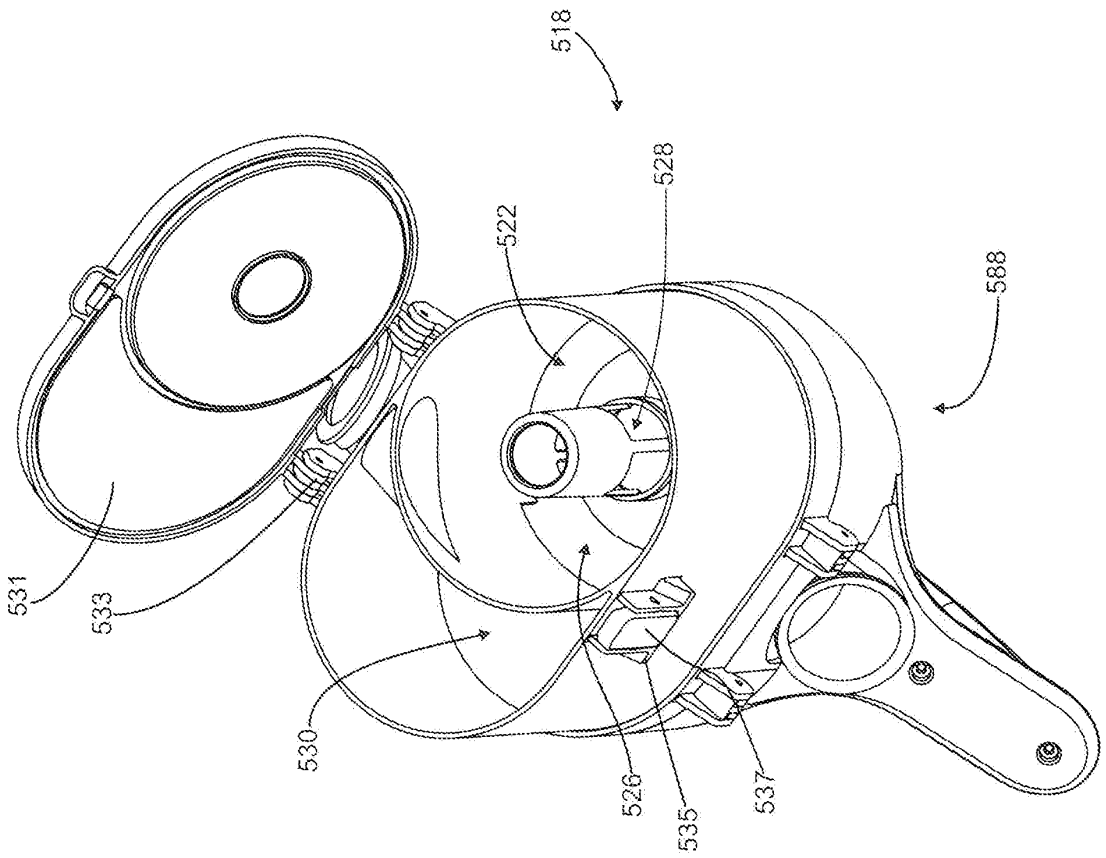

Fig. 21

PTO/AIA/01 (06-12)
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U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SURFACE CLEANING APPARATUS

As the below named inventor, I hereby declare that.

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I 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.

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.

LEGAL NAME OF INVENTOR

Inventor: Wayne Ernest Conrad Date (Optional): _____

Signature: Wayne Conrad

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/875,381	10/05/2015	Wayne Ernest Conrad	10452-P39194US04

CONFIRMATION NO. 2483

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

IMPROPER AUTHORIZATION LETTER

OC000000078139506

Date Mailed: 10/20/2015

Title: SURFACE CLEANING APPARATUS

Improper Submission of Authorization to Permit Access to Application by Participating Offices under 37 CFR 1.14(h)

The Authorization to Permit Access to Application by Participating Offices under 37 CFR 1.14(h) (authorization to permit access) submitted on 10/05/2015 in the above identified application is not accepted because of the reason(s) listed below:

- The authorization to permit access was not properly signed in accordance with 37 CFR 1.14(h)(2). If applicant still wishes to provide authorization to permit access under 37 CFR 1.14(h), applicant must submit a properly signed authorization (e.g., PTO/SB/39).

Any authorization should be submitted prior to filing a subsequent foreign application with a participating intellectual property office in which priority is claimed to the above-identified U.S. application to ensure that it is likely that the participating foreign intellectual property office will be successful in its attempt to retrieve a copy of the U.S. priority application from the Office.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zmoguss/

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UNITED STATES DEPARTMENT OF COMMERCE
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/875,381	10/05/2015	3723	1760	10452-P39194US04	22	2

CONFIRMATION NO. 2483

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

FILING RECEIPT

OC000000078139500

Date Mailed: 10/20/2015

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)

Wayne Ernest Conrad, Residence Not Provided;

Applicant(s)

Wayne Ernest Conrad, Residence Not Provided;

Power of Attorney: None

Domestic Applications for which benefit is claimed - None.
A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

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.

If Required, Foreign Filing License Granted: 10/19/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/875,381**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No

Title

SURFACE CLEANING APPARATUS

Preliminary Class

015

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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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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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/875,381	10/05/2015	Wayne Ernest Conrad	10452-P39194US04

CONFIRMATION NO. 2483

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

FORMALITIES LETTER

OC000000078139501

Date Mailed: 10/20/2015

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- A mailing address for each inventor has not been submitted. A new application data sheet (ADS) in compliance with 37 CFR 1.76 or inventor's oath or declaration in compliance with 37 CFR 1.63 identifying the mailing address and residence (if the inventor lives at a location which is different from where the inventor customarily receives mail) is required.
  Wayne Ernest Conrad

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

- The ADS received on 10/05/2015 was not properly signed. Therefore, the Office will treat it only as a transmittal letter. See 37 CFR 1.76(e). Inventorship has not been set by this document and any foreign priority or domestic benefit claims contained therein are ineffective. See 37 CFR 1.55 or 37 CFR 1.78.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zmoguss/

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
14/875,381	10/05/2015	Wayne Ernest Conrad	10452-P39194US04

CONFIRMATION NO. 2483

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

IMPROPER CPOA LETTER

OC000000078139566

Date Mailed: 10/20/2015

NOTICE REGARDING POWER OF ATTORNEY

This is in response to the power of attorney filed 10/05/2015. The power of attorney in this application is not accepted for the reason(s) listed below:

- The power of attorney has not been accepted because the party who is giving power has not been identified. Power of attorney may only be signed by the applicant for patent (37 CFR 1.42) or the patent owner. A party who is not the applicant must become the applicant in accordance with 37 CFR 1.46(c) and appoint any power of attorney in compliance with 37 CFR 3.71 and 3.73. For a reissue application, reexamination proceeding, or supplemental examination proceeding, a patent owner who was not the applicant under 37 CFR 1.46 must appoint any power of attorney in compliance with 37 CFR 3.71 and 3.73. See 37 CFR 1.32(b)(4).

/tnguyen/

Office of Data Management, 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: 14/875,381

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			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	22 minus 20 =	* 2			OR	x 80 =	160
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 420 =	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			TOTAL	1760

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

Bereskin & Parr
INTELLECTUAL PROPERTY LAW

Appl. No	:	14/875,381	Confirmation No.:	2483
Applicant	:	Wayne Ernest Conrad		
Filed	:	October 5, 2015		
Title	:	SURFACE CLEANING APPARATUS		
TC./A.U.	:	3723		
Examiner	:	N/A		
Docket No.	:	10452-P39194US04		
Customer No.	:	001059		

Mail Stop Amendment
Honorable Commissioner for Patents
P. O. Box 1450
Alexandria, Virginia 22313–1450

November 23, 2015

PRELIMINARY AMENDMENT

Sir:

Prior to examination of the above-captioned application, please amend the application as follows.

Amendments to the Claims are reflected in the listing of claims, which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

Bereskin & Parr LLP
Scotia Plaza, 40 King Street West, 40th Floor, Toronto, Ontario, Canada M5H 3Y2
Tel: 416.364.7311 Fax: 416.361.1398 www.bereskinparr.com
TORONTO MISSISSAUGA WATERLOO MONTRÉAL

Amendments to the Claims:

Please amend the claims as follows. Insertion are shown **underlined** while deletions are ~~**struck through**~~ or **[[double-bracketed]].** This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A surface cleaning apparatus comprising:
   a) a ~~wheeled~~ base comprising or connectable to a power cord;
   b) a portable cleaning unit removable from a position in which the portable cleaning unit is supported by ~~removably mounted on~~ the ~~wheeled~~ base and comprising at least one cyclonic separation stage, a first energy storage member and a portable cleaning unit suction motor; and,
   c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

   wherein the energy storage member may be charged when the portable cleaning unit is supported by ~~mounted on~~ the ~~wheeled~~ base.

2. (Original) The surface cleaning apparatus of claim 1 wherein the portable cleaning unit further comprises a power cord.

3. (Original) The surface cleaning apparatus of claim 1 ~~further comprising a power cord~~, wherein the power cord is removably electrically connected to the portable cleaning unit.

4. (Currently Amended) The surface cleaning apparatus of claim 3 wherein the power cord is also removably electrically connected to the ~~wheeled~~ base.

5. (Currently Amended) The surface cleaning apparatus of claim 4 wherein the power cord provides AC current to the ~~wheeled~~ base and the ~~wheeled~~ base provides current to the portable cleaning unit when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

6. (Currently Amended) The surface cleaning apparatus of claim 5 wherein the ~~wheeled~~ base provides DC current to the portable cleaning unit when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

7. (Currently Amended) The surface cleaning apparatus of claim 1 further comprising a power cord electrically connected to the ~~wheeled~~ base and wherein the power cord provides AC current to the ~~wheeled~~ base when connected to the ~~wheeled~~ base and the ~~wheeled~~ base provides current to the portable cleaning unit when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

8. (Currently Amended) The surface cleaning apparatus of claim 7 wherein the ~~wheeled~~ base provides DC current to the portable cleaning unit when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

9. (Currently Amended) The surface cleaning apparatus of claim 1 wherein the portable cleaning unit is powered solely by the first energy storage member when the portable cleaning unit is removed from the position in which the portable cleaning unit is supported by the ~~wheeled~~ base.

10. (Original) The surface cleaning apparatus of claim 1 wherein the first energy storage member comprises batteries.

11. (Currently Amended) The surface cleaning apparatus of claim 1 wherein the ~~wheeled~~ base further comprises a suction motor which is used to provide motive power through the fluid flow path when the surface cleaning unit is switched on and when the portable cleaning unit is mounted on the ~~wheeled~~ base.

12. (Currently Amended) The surface cleaning apparatus of claim 11 wherein the suction motor in the portable cleaning unit is not used to provide motive power to move fluid through the fluid flow path when the surface cleaning unit is switched on and when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

13. (Currently Amended) The surface cleaning apparatus of claim 1 wherein the ~~wheeled~~ base further comprises a second energy storage member.

14. (Currently Amended) The surface cleaning apparatus of claim 13 wherein the second energy storage member charges the first energy storage member when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

15. (Original) The surface cleaning apparatus of claim 1 wherein the portable cleaning unit suction motor is a DC motor.

16. (Currently Amended) The surface cleaning apparatus of claim 15 wherein the ~~wheeled~~ base further comprises or is electrically connectable to a power cord, the ~~wheeled~~ base further comprises a circuit that receives AC current and outputs DC current and the portable cleaning unit is powered by DC current when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

17. (Currently Amended) A surface cleaning apparatus comprising:

a) a ~~wheeled~~ base;

b) a portable cleaning unit removable from a position in which the portable cleaning unit is supported by ~~removably mounted on~~ the ~~wheeled~~ base and comprising at least one cyclonic separation stage, an energy storage member and a portable cleaning unit suction motor; and,

c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

wherein the portable cleaning comprises or is electrically connectable to a power cord whereby the portable cleaning unit suction motor may be powered by the energy storage member or power supplied by the power cord.

18. (Currently Amended) The surface cleaning apparatus of claim 17 wherein the ~~wheeled~~ base further comprises a portion of the fluid flow path and has a suction motor provided in the portion of the fluid flow path.

19. (Currently Amended) The surface cleaning apparatus of claim 17 wherein the power cord or an alternate power cord provides AC current to the ~~wheeled~~ base and the ~~wheeled~~ base provides current to the portable cleaning unit when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

20. (Currently Amended) The surface cleaning apparatus of claim 19 wherein the ~~wheeled~~ base provides DC current to the portable cleaning unit when the portable cleaning unit is supported by ~~mounted to~~ the ~~wheeled~~ base.

21. (Currently Amended) The surface cleaning apparatus of claim 17 wherein the power cord is electrically connectable to the portable cleaning unit and the ~~wheeled~~ base.

22. (Cancelled).

23. (New) The surface cleaning apparatus of claim 1 wherein the base comprises a surface cleaning head.

24. (New) The surface cleaning apparatus of claim 17 wherein the base comprises a surface cleaning head.

25. (New) A surface cleaning apparatus comprising:

a) a portable cleaning unit removable from a remainder of the surface cleaning unit and comprising at least one cyclonic separation stage, a first energy storage member and a portable cleaning unit suction motor;

b) the remainder of the surface cleaning apparatus comprising or connectable to a power cord; and,

c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

wherein the energy storage member may be charged when the portable cleaning unit is supported by the remainder of the surface cleaning apparatus.

26. (New) The surface cleaning apparatus of claim 25 wherein the power cord is removably electrically connected to the portable cleaning unit.

27. (New) The surface cleaning apparatus of claim 25 wherein the power cord provides AC current to the remainder of the surface cleaning apparatus and the remainder of the surface cleaning apparatus provides current to the portable cleaning unit when the portable cleaning unit is supported by the remainder of the surface cleaning apparatus.

28. (New) The surface cleaning apparatus of claim 27 wherein the remainder of the surface cleaning apparatus provides DC current to the portable cleaning unit when the portable cleaning unit is supported by the remainder of the surface cleaning apparatus.

29. (New) A surface cleaning apparatus comprising:

a) a portable cleaning unit removable from a remainder of the surface cleaning apparatus and comprising at least one cyclonic separation stage, an energy storage member and a portable cleaning unit suction motor; and,

c) a fluid flow path extending from a first dirty fluid inlet to a clean air outlet of the surface cleaning apparatus,

wherein the portable cleaning comprises or is electrically connectable to a power cord whereby the portable cleaning unit suction motor may be powered by the energy storage member or power supplied by the power cord.

30. (New) The surface cleaning apparatus of claim 29 wherein the remainder of the surface cleaning apparatus further comprises a portion of the fluid flow path and has a suction motor provided in the portion of the fluid flow path.

31. (New) The surface cleaning apparatus of claim 29 wherein the power cord or an alternate power cord provides AC current to the remainder of the surface cleaning apparatus and the remainder of the surface cleaning apparatus provides current to the portable cleaning unit when the portable cleaning unit is supported by remainder of the surface cleaning apparatus.

32. (New) The surface cleaning apparatus of claim 31 wherein the remainder of the surface cleaning apparatus provides DC current to the portable cleaning unit when the portable cleaning unit is supported by the remainder of the surface cleaning apparatus.

REMARKS/ARGUMENTS

By this amendment, the Applicant has amended the claims so as to put them into a form that the Applicant desires to present for examination. In particular, claims 1, 4-9, 11-14, 16-21 have been amended, claim 22 has been cancelled without prejudice and new claims 24-32 have been inserted.

The application now contains 31 claims including 4 independent claims. The Applicant has already paid for 2 claims in excess of 20. The Applicant encloses herewith the requisite fees under 37 CFR 1.16(i) and 37 CFR 1.16(h) which are due in conjunction with the filing of 1 additional independent claim in excess of 3 and 9 additional claims in excess of 20.

The Applicant believes that no other additional fees are due; However, should any additional fees be required, the Commissioner is authorized to charge any such deficiencies necessary for entry of this amendment, including any claim fees and/or extension fees from our Deposit Account no. 022095.

No Disclaimers or Disavowals

Although the present communication may include the alteration to the claims, Applicant is not conceding in this application that previously pending claims are not patentable. Rather, any alterations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at the later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, the reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

In view of the foregoing, favourable consideration of the above-noted amendments is respectfully requested.

Respectfully submitted,

BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.

P. Mendes da Costa

By _____
Philip Mendes da Costa
Registration No. 33,106
(416) 957-1695

Electronic Patent Application Fee Transmittal

Application Number:	14875381
Filing Date:	05-Oct-2015
Title of Invention:	SURFACE CLEANING APPARATUS
First Named Inventor/Applicant Name:	Wayne Ernest Conrad
Filer:	Philip C. Mendes da Costa/Snezana Lisowsky
Attorney Docket Number:	10452-P39194US04

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:				
Claims in Excess of 20	1202	9	80	720
Independent claims in excess of 3	1201	1	420	420
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1140**

Electronic Acknowledgement Receipt	
EFS ID:	24167442
Application Number:	14875381
International Application Number:	
Confirmation Number:	2483
Title of Invention:	SURFACE CLEANING APPARATUS
First Named Inventor/Applicant Name:	Wayne Ernest Conrad
Customer Number:	1059
Filer:	Philip C. Mendes da Costa/Snezana Lisowsky
Filer Authorized By:	Philip C. Mendes da Costa
Attorney Docket Number:	10452-P39194US04
Receipt Date:	23-NOV-2015
Filing Date:	05-OCT-2015
Time Stamp:	17:19:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1140
RAM confirmation Number	4839
Deposit Account	022095
Authorized User	MENDES DA COSTA, PHILIP C.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	Commissioner_ResponseToMissingParts.pdf	165470 845257e000cda717406e951b90550a087c6ea955	no	1
Warnings:					
Information:					
2	Application Data Sheet	P39194US04_ads.PDF	2264150 26327128f4436b619defc73f38276434d2578ec	no	7
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3	Power of Attorney	P39194US04_POA.pdf	557918 2dbb6b4e95b5c50177059bebb43128c8bff6e547	no	2
Warnings:					
Information:					
4	Assignee showing of ownership per 37 CFR 3.73	P39194us04_Statement.pdf	120887 9e8b1587e5ba4031f475f1594c2ca6bf7f826d80	no	3
Warnings:					
Information:					
5	Authorization to access Appl. by Trilateral Office	sb0039.pdf	176621 35f1cfa0ec75ac435bca8dd257d73bc6a77ed1ac	no	2
Warnings:					
Information:					
6	Preliminary Amendment	P39194US04_Preliminary_Amendment.pdf	198809 e3711b5fce3bb713c235a5d384be09a622a159ef	no	9
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	32026 48f8e44b896f7a3197c220b033ab2f8847c25a23	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3515881		

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: PD.TO.AUTH
Document Description: Authorization to access Appl. by Trilateral Office

PTO/SB/39 (10-14)
Approved for use through 05/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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AUTHORIZATION TO PERMIT ACCESS TO APPLICATION BY PARTICIPATING OFFICES

Send completed form to: Commissioner for Patents
P.O. Box 1450, Alexandria, VA 22313-1450

COMPLETE IF KNOWN	
Application Number	14/875381
Filing Date	October 5, 2015
First Named Inventor	Wayne Ernest Conrad
Attorney Docket Number	10452-P39194US04
Title (Required)	SURFACE CLEANING APPARATUS

The undersigned hereby grants the USPTO authority to provide access to the above-identified patent application by the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), and the World Intellectual Property Office (WIPO), and any other foreign intellectual property offices participating with the USPTO in a bilateral or multilateral priority document exchange agreement, in which a foreign application claiming priority to the above-identified patent application is filed. See 37 CFR 1.14(c) and (h).

In accordance with 37 CFR 1.14(h)(3) and the respective priority document exchange agreement, access to the above-identified application will be provided 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 written authorization should be submitted prior to the filing of a subsequent foreign application, in which priority is claimed to the above-identified patent application, with any participating intellectual property office (e.g., the EPO, JPO, KIPO, SIPO, or DAS Accessing Office). However, if applicant does not wish the EPO, JPO, KIPO, SIPO, WIPO, or other participating 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, this written authorization should not be filed.

No fee will be charged under 37 CFR 1.19(b)(1) for providing a participating intellectual property office with an electronic copy of the above-identified patent application.

This form must be signed by an authorized party in accordance with 37 CFR 1.14(c).

/Philip C. Mendes da Costa/	November 23, 2015
Signature	Date
Philip C. Mendes da Costa	416.957.1695
Printed or Typed Name	Telephone Number
Agent of Record	33106
Title	Registration Number, if applicable

This collection of information is required by 37 CFR 1.14(h). 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 6 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.

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.

Bereskin & Parr
INTELLECTUAL PROPERTY LAW

Appl. No	:	14/875,381	Confirmation No.: 2483
Inventor:	:	Wayne Ernest Conrad	
Filed	:	October 5, 2015	
Title	:	SURFACE CLEANING APPARATUS	
TC./A.U.	:	3723	
Examiner	:	N/A	
Docket No.	:	10452-P39194US04	
Customer No.	:	01059	

Mail Stop Missing Parts
Honorable Commissioner for Patents
P. O. Box 1450
Alexandria, Virginia 22313–1450

November 23, 2015

RESPONSE TO NOTICE OF FILE MISSING PARTS OF APPLICATION

Sir:

The applicant acknowledges receipt of the Notice to File Missing Parts of Application which was mailed on October 20, 2015.

In response to the Notice to File Missing Parts, the Applicant encloses herewith the following:

- a copy of the Updated and Amended Application Data Sheet
- a Power of Attorney
- a Statement under 37 CFR 3.73(c)
- Form PTO/SB/39

In view of the foregoing, it is respectfully submitted that filing of this application is now complete.

Respectfully submitted,
BERESKIN & PARR0 LLP
/S.E.N.C.R.L., s.r.l.

P. Mendes da Costa

By _____
Philip C. Mendes da Costa
Reg. No. 33,106
Tel: 416-957-1695

Bereskin & Parr LLP
Scotia Plaza, 40 King Street West, 40th Floor, Toronto, Ontario, Canada M5H 3Y2
Tel: 416.364.7311 Fax: 416.361.1398 www.bereskinparr.com
TORONTO MISSISSAUGA WATERLOO MONTRÉAL

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	14/875381
Title of Invention	SURFACE CLEANING APPARATUS	

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
	Wayne	Ernest	Conrad	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Hampton	Country of Residence	CA

Mailing Address of Inventor:

Address 1	9 King Lane
Address 2	

City	Hampton	State/Province	ON
Postal Code	L0B 1J0	Country	CA

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	01059		
Email Address	pmdcosta@bereskinparr.com	Add Email	Remove Email

Application Information:

Title of the Invention	SURFACE CLEANING APPARATUS		
Attorney Docket Number	10452-P39194US04	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	18	Suggested Figure for Publication (if any)	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	14/875381
Title of Invention	SURFACE CLEANING APPARATUS	

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	01059		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing 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.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13/782217	2013-03-01
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13/782217	Continuation in part of	13/720754	2012-12-19

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	14/875381
Title of Invention	SURFACE CLEANING APPARATUS	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13/720754	Division of	11/954331	2007-12-12	8359705	2013-01-29

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11/954331	Claims benefit of provisional	60/870175	2006-12-15

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
11/954331	Claims benefit of provisional	60/884767	2007-01-12

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☒ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	14/875381
Title of Invention	SURFACE CLEANING APPARATUS	

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

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

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. ☒

Organization Name	Omachron Intellectual Property Inc.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	14/875381
Title of Invention	SURFACE CLEANING APPARATUS	

Mailing Address Information For Applicant:			
Address 1	9 King Lane		
Address 2			
City	Hampton	**State/Province**	ON
Country	CA	Postal Code	L0B 1J0
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not 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 if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10452-P39194US04
	Application Number	14/875381
Title of Invention	SURFACE CLEANING APPARATUS	

Signature:

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

Signature	/Philip C. Mendes da Costa/			Date (YYYY-MM-DD)	2015-11-23 ~~2015-10-05~~
First Name	Philip	Last Name	C. Mendes da Costa	Registration Number	33106

Additional Signature may be generated within this form by selecting the Add button.

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 C o 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.

Doc Code: PA..
Document Description: Power of Attorney

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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/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	14/875,381
Filing Date	October 5, 2015
First Named Inventor	Wayne Ernest Conrad
Title	SURFACE CLEANING APPARATUS
Art Unit	3723
Examiner Name	N/A
Attorney Docket Number	10452-P39194US04

SIGNATURE of Applicant or Patent Practitioner

Signature	/Philip C. Mendes da Costa/	Date (Optional)	November 23,2 015
Name	Philip C. Mendes da Costa	Registration Number	33106
Title (if Applicant is a juristic entity)	Agent for the Applicant		
Applicant Name (if Applicant is a juristic entity)	Omachron Intellectual Property Inc.		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Doc Code: PA..
Document Description: Power of Attorney

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 01059

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Omachron Intellectual Property Inc.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	July 28, 2015
Name	Philip C Mendes da Costa		
Title	Vice President		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Omachron Intellectual Property Inc.

Application No./Patent No.: 14/875,381 Filed/Issue Date: October 5, 2015

Titled: SURFACE CLEANING APPARATUS

Omachron Intellectual Property Inc., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Wayne Ernest Conrad To: G.B.D. Corp.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 036730, Frame 0620, or for which a copy thereof is attached.

2. From: G.B.D. Corp. To: CONRAD, Wayne in trust

   The document was recorded in the United States Patent and Trademark Office at
   Reel 036730, Frame 0687, or for which a copy thereof is attached.

This collection of information is required by37 CFR3.73(b). The information is required toobtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentialityis governed by35 U.S.C. 122and 37 CFR1.11 and1.14. Thiscollection is estimated to take 12 minutes to complete, including gathering, preparing, and submittingthe 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 tothe 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/96 (08-12)
Approved for use through 01/31/2013. 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.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: CONRAD, Wayne in trust To: Omachron Intellectual Property Inc.

The document was recorded in the United States Patent and Trademark Office at
Reel 036730, Frame 0770, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), 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.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Philip C. Mendes da Costa/	November 23, 2015
Signature	Date
Philip C. Mendes da Costa	33106
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

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

The informationprovided 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 informationin 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 InternationalApplication 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, arecord 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 thissystem 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/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 14/875,381	Filing Date 10/05/2015	☐ 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 $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ 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

AMENDMENT	11/23/2015	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 31	Minus	** 31	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	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**

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ 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.
** 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 number found in the appropriate box in column 1.

LIE
/BRENDA TURNER/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/875,381	10/05/2015	Wayne Ernest Conrad	10452-P39194US04

CONFIRMATION NO. 2483

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

IMPROPER LETTER

OC000000078914155

Date Mailed: 11/27/2015

NOTICE OF ACCEPTANCE OF AUTHORIZATION TO PERMIT ACCESS TO APPLICATION VIA PRIORITY DOCUMENT EXCHANGE

This is in response to the applicant's authorization to permit access to the application-as-filed by participating offices under 37 CFR 1.14(h)(1) submitted on 11/23/2015.

The authorization to permit access to the application under 37 CFR 1.14(h)(1) 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**.

/mmasfaw/

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
14/875,381	10/05/2015	3723	2900	10452-P39194US04	31	4

CONFIRMATION NO. 2483

UPDATED FILING RECEIPT

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

Date Mailed: 11/27/2015

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)

Wayne Ernest Conrad, Hampton, CANADA;

Applicant(s)

Omachron Intellectual Property Inc., Hampton, CANADA;

Power of Attorney: The patent practitioners associated with Customer Number 01059

Domestic Priority data as claimed by applicant

This application is a CON of 13/782,217 03/01/2013 PAT 9192269
which is a CIP of 13/720,754 12/19/2012 PAT 8752239
which is a DIV of 11/954,331 12/12/2007 PAT 8359705
which claims benefit of 60/870,175 12/15/2006
and claims benefit of 60/884,767 01/12/2007

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.

Permission to Access Application via Priority Document Exchange: Yes

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: 10/19/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/875,381**

Projected Publication Date: 03/10/2016

Non-Publication Request: No

Early Publication Request: No
Title

SURFACE CLEANING APPARATUS

Preliminary Class

015

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

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/875,381

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			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	31 minus 20 =	* 11			OR	x 80 =	880
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1				x 420 =	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).						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			TOTAL	2900

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/875,381	10/05/2015	Wayne Ernest Conrad	10452-P39194US04

CONFIRMATION NO. 2483

1059
BERESKIN & PARR LLP/S.E.N.C.R.L., s.r.l.
40 KING STREET WEST
40th Floor
TORONTO, ON M5H 3Y2
CANADA

POA ACCEPTANCE LETTER

OC000000078913960

Date Mailed: 11/27/2015

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/23/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

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**.

/mmasfaw/

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	14875381
Filing Date	2015-10-05
First Named Inventor	CONRAD, Wayne E.
Art Unit	3723
Examiner Name	N/A
Attorney Docket Number	10452-P39194US04

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	8484799	B2	2013-07-16	Conrad	
	2	8225456	B2	2012-07-24	Håkan et al.	
	3	8161599	B2	2012-04-24	Griffith et al.	
	4	8156609	B2	2012-04-17	Milne et al.	
	5	8152877	B2	2012-04-10	Greene	
	6	8117712	B2	2012-02-21	Dyson et al.	
	7	8062398	B2	2011-11-22	Luo et al.	
	8	8021453	B2	2011-09-20	Howes	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14875381
	Filing Date	2015-10-05
	First Named Inventor	CONRAD, Wayne E.
	Art Unit	3723
	Examiner Name	N/A
	Attorney Docket Number	10452-P39194US04

	9	7979959	B2	2011-07-19	Courtney	
	10	7938871	B2	2011-05-10	Lloyd	
	11	7931716	B2	2011-04-26	Oakham	
	12	7922794	B2	2011-04-12	Morphey	
	13	7867308	B2	2011-01-11	Conrad	
	14	7811349	B2	2010-10-12	Nguyen	
	15	7805804	B2	2010-10-05	Loebig	
	16	7803207	B2	2010-09-28	Conrad	
	17	7779506	B2	2010-08-24	Kang et al.	
	18	7776120	B2	2010-08-17	Conrad	
	19	7770256	B1	2010-08-10	Fester	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14875381
	Filing Date	2015-10-05
	First Named Inventor	CONRAD, Wayne E.
	Art Unit	3723
	Examiner Name	N/A
	Attorney Docket Number	10452-P39194US04

	20	7740676	B2	2010-06-22	Burnham et al.	
	21	7628831	B2	2009-12-08	Gomiciaga-Pereda et al.	
	22	7597730	B2	2009-10-06	Yoo et al.	
	23	7547338	B2	2009-06-16	Kim et al.	
	24	7547337	B2	2009-06-16	Oh	
	25	7488363	B2	2009-02-10	Jeong et al.	
	26	7449040	B2	2008-11-11	Conrad et al.	
	27	7448363	B1	2008-11-11	Rasmussen et al.	
	28	7395579	B2	2008-07-08	Oh	
	29	7386915	B2	2008-06-17	Blocker et al.	
	30	7377953	B2	2008-05-27	Oh	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14875381
	Filing Date	2015-10-05
	First Named Inventor	CONRAD, Wayne E.
	Art Unit	3723
	Examiner Name	N/A
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	1	2012117231	WO	A1	2012-09-07	MILLINGTON		
	2	2012042240	WO	A1	2012-04-05	STICKNEY		
	3	2011189133	JP	A	2011-09-29	DYSON JAMES		
	4	2011054106	WO	A1	2011-05-12	CONRAD		
	5	2010220632	JP	A	2010-10-07	OKUDA SHINSUKE		
	6	2010178773	JP	A	2010-08-19	OTSUKA HIROTSUGU		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14875381
	Filing Date	2015-10-05
	First Named Inventor	CONRAD, Wayne E.
	Art Unit	3723
	Examiner Name	N/A
	Attorney Docket Number	10452-P39194US04

	7	2010142971	WO	A1	2010-12-16	FOLLOWS		
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	19	2000140533	JP	A	2000-05-23	UEHARA KOZO		
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	29	2441962	GB	B	2011-03-02	DYSON JAMES		
	30	2365324	GB	B	2002-07-31	OH JANG-KEUN		
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	1	International Preliminary Report on Patentability, dated September 16, 2008 for International application No.PCT/CA2007/000380	
	2	Supplementary European Search Report, dated June 16, 2009, as received on the corresponding EP application No. 07719394.4	
	3	A copy of the Office Action received in connection to the corresponding Chinese Patent Application No. 200880126486.6 dated MAR 23 2012	
	4	A copy of the Office Action received in connection to the corresponding US Patent Application No. 12720901 dated JUNE 10 2011	
	5	A copy of the Office Action received in connection to the related Chinese Patent Application No. 00813438.3 issued July 11, 2003	
	6	HANDBOOK OF AIR POLLUTION PREVENTION AND CONTRIOL, PP397-404, 2002	
	7	MAKITA 4071 HANDY VAC	
	8	MAKITA BCL180 USER MANUAL	
	9	European COMMUNICATION pursuant to Article 94(3) on European Patent Application No. 04078261.7, dated April 24, 2012	

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	10	European COMMUNICATION pursuant to Article 94(3) on European Patent Application No. 04078261.7, dated February 26, 2010	
	11	International Preliminary Examination Report on International application No. PCT/CA00/00873, dated October 26, 2001	
	12	Office Action dated Jul. 7, 2010, for Canadian Patent Application No. 2,675,714.	
	13	International Search Report and Written Opinion received in connection to International patent application no. PCT/CA2007/002211, mailed on April 21, 2008	
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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	/Philip C. Mendes da Costa/	Date (YYYY-MM-DD)	2015-12-16
Name/Print	Philip C. Mendes da Costa	Registration Number	33106

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

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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	7429284	B2	2008-09-30	OH, Jang-Keun	
	2	7563298	B2	2009-07-21	OH, Jang Keun	
	3	5970572	A	1999-10-26	HOMAS, Paul-Gerhard	
	4	8673487	B2	2014-03-18	CHURCHILL, John	
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	9	5815881	A1	1998-10-26	SJOGREEN, JORGEN	
	10	7128770	B2	2006-10-31	OH et al.	
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	12	5515573	A	1996-05-14	FREY, R.	
	13	5709007	A	1998-01-20	CHIANG, W.	
	14	7485164	B2	2009-02-03	JEONG et al.	

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	1	20060254226	A1	2006-11-16	JEON, Kyong-hui	
	2	20100132319	A1	2010-06-03	ASHBEE et al.	
	3	20110023261	A1	2011-02-03	PROFFITT, II et al.	

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	5	20140137363	A1	2014-05-22	WILSON	
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	7	20140208538	A1	2014-07-31	VISEL et al.	
	8	20060288516	A1	2006-12-28	SAWALSKI, Michael M.	
	9	20090282639	A1	2009-11-19	DYSON et al.	
	10	20100083459	A1	2010-04-08	BESKOW et al.	
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	12	20120222260	A1	2012-09-06	CONRAD	
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	1	2484587	CA	A1	2005-04-15	BLACK & DECKER INC.		
	2	2008088278	WO	A2	2008-07-24	ACTIEBOLGET ELECTROLUX		
	3	02/017766	WO	A3	2002-03-07	ROYAL APPLIANCE MFG. CO.		
	4	2508035	GB		2014-05-21	DYSON TECHNOLOGY LIMITED		
	5	2308360	EP	A2	2011-04-13	WAI L. Y.		
	6	1594386	EP	B1	2009-04-15	AKTIEBOLAGET ELECTROLUX		
	7	202932850	CN	U	2013-05-15	SOZHOU PFEIFFER ELECTRIC CO LTD		
	8	2035787	GB	B	1982-10-13	L & H Designs Limited		
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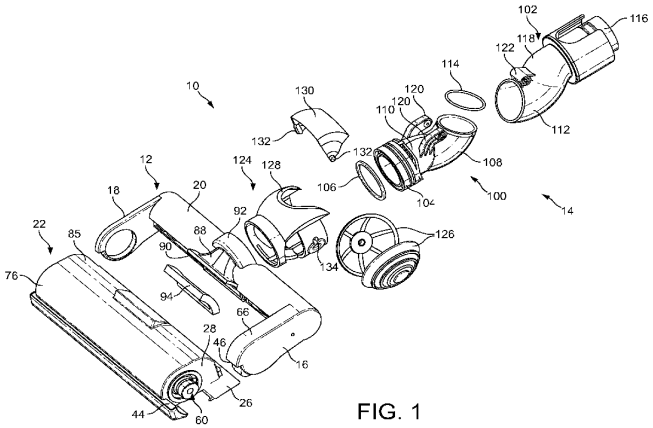

FIG. 1

(57) **Abstract**: A cleaner head (10) for a surface treating appliance includes a main body having a fluid outlet port located at the rear of the main body (12); a front conduit (100) for receiving a fluid flow from the outlet port of the main body, and a rear conduit for receiving the fluid flow from the front conduit. The front conduit includes a front section (104) connected to the main body for rotation relative thereto about a first axis extending rearwardly from the main body and centrally through the front section, a rear elbow section (108) and at least one first connector. The rear conduit includes a front elbow section into (112) which the rear elbow section of the front conduit is inserted, a rear section (20/116) and at least one second connector connected to said at least one first connector to enable the rear conduit (102) to pivot relative to the front conduit about a second axis which is orthogonal to the first axis and which lies outside a fluid flow path passing through the front conduit and the rear conduit.

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A CLEANER HEAD FOR A SURFACE TREATING APPLIANCE

FIELD OF THE INVENTION

The present invention relates to a cleaner head for a surface treating appliance. In its preferred embodiment, the present invention relates to a cleaner head for a vacuum cleaning appliance.

BACKGROUND OF THE INVENTION

Vacuum cleaners are generally supplied with a range of tools for dealing with specific types of cleaning. The tools include a cleaner head for general on-the-floor cleaning. The cleaner head comprises a main body which engages with a floor surface. The main body has a lower surface comprising a suction opening through which, in use, dirt and dust is drawn into the cleaner head from the floor surface.

It is useful for the main body to be pivotably connected to the remainder of the cleaner head so that the suction opening can remain in close proximity to the floor surface as the cleaner head is manoeuvred over the floor surface.

For example, JP 11-155786 describes a cleaner head having a main body and a conduit assembly connected to the main body for conveying an air flow away from the main body. The main body comprises a suction opening located in a lower surface of the main body, and which lies in a suction plane. The conduit assembly is connectable to a wand of a vacuum cleaner, which has a handle which is manipulated by the user to manoeuvre the floor tool over the floor surface. The conduit assembly comprises a generally tubular front conduit having a circular air inlet which is connected to the rear of the main body for rotation about a first axis which extends rearwardly from the main body parallel to the suction plane and through the bore of the front conduit. An air outlet extends from midway along the upper surface of the front conduit to the rear of the front conduit. The conduit assembly further comprises a rear conduit which is connected to the front conduit for pivotal movement relative to the front conduit about a second axis which is orthogonal to the first axis and parallel to the suction plane.

Opposing recesses are provided on the internal surface of the front conduit lying adjacent the front of the air outlet for receiving the ends of a shaft located on the upper surface of the front of the rear conduit. With the ends of the shaft received within the recesses, the rear conduit can move within the front conduit and about the second axis between raised and lowered positions.

Through combinations of a rotation of the front conduit about the first axis and a rotation of the rear conduit about the second axis, the conduit assembly is able to adopt different configurations relative to the main body to facilitate the manoeuvring of the main body over a floor surface, and between and beneath items of furniture. However, as the pivoting connection between the front and rear conduits is located within an airflow path passing through the conduits, there is a risk of air leaking around the connection, reducing the pick-up performance of the cleaner head. The presence of such a connection within the airflow path can disrupt the air flow through the conduit assembly, which can generate turbulence and noise.

SUMMARY OF THE INVENTION

In a first aspect the present invention provides a cleaner head for a surface treating appliance, comprising:

a main body having a fluid port located at the rear of the main body;

a front conduit comprising a front section connected to the main body for rotation relative thereto about a first axis extending rearwardly from the main body and through the fluid port and the front section, a rear elbow section and at least one first connector; and

a rear conduit comprising a front elbow section moveable within or about the rear elbow section of the front conduit, a rear section and at least one second connector connected to said at least one first connector to enable the rear conduit to pivot relative to the front conduit about a second axis which is orthogonal to the first axis and which lies outside a fluid flow path passing through the front conduit and the rear conduit.

As the connectors for connecting together the front conduit and the rear conduit lie outside a fluid flow path passing through the conduits, the connectors may have any desired configuration without requiring any seals for preventing fluid from leaking between the connectors. In a preferred embodiment, the front conduit comprises a pair of arms which extend towards the rear conduit, and the rear conduit comprises a shaft which is received between the arms. A bolt, pin or other connecting member may be provided for connecting the shaft to the arms so that the shaft can rotate relative to the arms. Alternative, the connectors may be connected together by means of a snap-fit connection. A relatively simple seal may then be provided between the elbow sections to prevent fluid from leaking between the elbow sections.

The front section of the rear conduit is preferably inserted into the rear section of the front conduit. As the rear conduit is inserted into the front conduit, at least the front section of the rear conduit has a greater cross-sectional area that the rear section of the front conduit. In a preferred embodiment, the cleaner head is used as part of a cleaning appliance in which fluid flows from the front conduit to the rear conduit. As the fluid flow enters the rear conduit, the fluid flow does not impinge on the front end of the rear conduit, which would disrupt the fluid flow through the conduits and generate noise, but instead passes into a region having a greater cross-sectional area.

The elbow sections preferably have substantially the same curvature so that a seal may be readily maintained between the elbow sections as the rear conduit is moved relative to the front conduit. For example, an annular sealing member may be located on the outer surface of the rear elbow section of the front conduit for engaging the inner surface of the front elbow section of the rear conduit as the rear conduit is pivoted relative to the front conduit. Alternatively, a sealing member may be disposed on the inner surface of the front elbow section for engaging the outer surface of the rear elbow section. The inner surface of the front section of rear conduit preferably has a diameter which is only slightly greater than that of the outer surface of the rear section of the front conduit so that the rear section of the front conduit can guide the movement of the front section of the rear conduit relative thereto as the rear conduit is pivoted and with

minimal wobbling of the rear conduit relative to the front conduit to minimise the risk of fluid leaking between the conduits. Preferably, the inner surface of the front elbow section of the rear conduit slides over the outer surface of the rear elbow section of the front conduit as the rear conduit pivots relative to the front conduit.

The front end of the front elbow section of the rear conduit preferably moves between the front end and the rear end of the rear elbow section of the front conduit as the rear conduit pivots between raised and lowered positions relative to the front conduit. In this case, the curvature of the elbow sections can determine the extent to which the rear section can pivot relative to the front section. The curvature of each elbow section is preferably at least 60°, and in a preferred embodiment each elbow section has a generally 90° curvature. When the cleaner head is located on a substantially horizontal surface, the rear section of the rear conduit may then move between a relatively horizontal position and a relatively vertical position as the rear conduit pivots relative to the front conduit.

The front section of the front conduit is preferably also horizontal when the rear conduit is in a lowered position relative to the front conduit. This can enable a conduit assembly comprising the front and rear conduits to have a relatively low profile when the rear conduit is in a lowered position. Each conduit preferably comprises a curved intermediate section located between the front section and the rear section thereof, with each intermediate section preferably having a curvature in the range from 40 to 50° to allow the conduit assembly to have a low profile.

Each conduit may comprise a number of tubes or pipes which are connected together and each provide a respective section of the conduit. Alternatively, each conduit may be a single tube or pipe providing the different sections of the conduit.

The cleaner head preferably comprises a chassis for supporting the front conduit on a surface. The chassis is preferably connected to the front conduit for rotation therewith about the first axis. The chassis may extend about the front conduit, and about the

connectors for connecting together the front and rear conduits to inhibit the ingress of dirt between the connectors.

The chassis preferably comprises a body, and a pair of wheels supported by the body. Contact between the rear conduit and the chassis may limit the movement of the rear conduit away from the lowered position. The body may comprise a recessed portion for receiving the rear conduit with pivoting movement thereof about the second axis so that the chassis does not inhibit movement of the rear conduit until the rear conduit has reached, or moved beyond, the desired raised position. This can allow the chassis to be located adjacent the rear conduit, and so allow the conduit assembly to be relatively compact to minimise the length of the cleaner head.

The cleaner head may comprise a shield member for inhibiting the ingress of dirt into the body of the chassis through the recess when the rear conduit is not in the raised position. The shield member preferably moves with the rear conduit as it pivots between the raised and lowered positions. For example, the shield member may be connected to the rear conduit. Alternatively, the shield member may be pivotably connected to the body of the chassis, and may be biased towards the rear conduit. The shield member may be pivotable about a third axis which intersects orthogonally the first axis. The shield member is preferably disposed between the recessed portion of the body and the rear conduit.

The shield member and the recessed portion of the body may each have a curved outer surface, with the curvature of the outer surface of the shield member preferably being substantially the same as the curvature of the recessed portion of the body. The wheels of the chassis are preferably dome-shaped, and preferably have a substantially spherical curvature. The curvature of the outer surface of the wheels is preferably substantially the same as the curvature of the outer surface of the recessed portion of the body so that the outer surfaces of the body and the wheels of the chassis are located on the surface of a common sphere. The third axis, about which the shield member pivots relative to the body of the chassis, preferably passes through the centre of this sphere. As the shield

member becomes exposed as the rear conduit moves away from the raised position, the similar curvatures of the shield member and the body of the chassis means that the emergence of the shield member does not disrupt unduly the spherical appearance of the chassis.

The cleaner head may be used with any cleaning or surface treating appliance that carries fluid to and/or from a surface, e.g. wet/dry vacuum cleaners, polishing/waxing machines and carpet shampoo machines.

In a second aspect, the present invention provides a conduit assembly for a cleaner head of a surface treating appliance, the conduit assembly comprises a front conduit, a rear conduit pivotably connected to the front conduit for movement between a raised position and a lowered position, and a chassis for supporting the front conduit, the chassis comprising a body and a pair of wheels rotatably connected to the body, the body having a recessed portion for receiving the rear conduit as the rear conduit moves towards the raised position, the chassis further comprising a shield member for covering a gap formed between the rear conduit and the recessed portion of the body as the rear conduit moves away from the raised position.

Features described above in connection with the first aspect of the invention are equally applicable to the second aspect of the invention, and vice versa.

BRIEF DESCRIPTION OF THE DRAWINGS

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded view of a cleaner head;

Figure 2 is a top view of the cleaner head, with a rear conduit of the cleaner head in a lowered positioned;

Figure 3 is a side view of the cleaner head with the rear conduit in the lowered position, and with a chassis of the cleaner head removed to reveal a front conduit of the cleaner head;

Figure 4 is a side sectional view along line A-A in Figure 2;

Figure 5 is a top view of the cleaner head, with the rear conduit in a raised positioned;

Figure 6 is a side view of the cleaner head with the rear conduit in the raised position, and with a chassis of the cleaner head removed to reveal a front conduit of the cleaner head; and

Figure 7 is a side sectional view along line B-B in Figure 5.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1 to 4 illustrate an embodiment of a cleaner head for a surface treating appliance. In this embodiment, the cleaner head 10 is arranged to be connectable to a wand or hose of a cylinder vacuum cleaning appliance. The cleaner head 10 comprises a main body 12 and a conduit assembly 14 connected to the main body 12. The main body 12 comprises substantially parallel side walls 16, 18 extending forwardly from opposite ends of a rear section 20 of the main body 12, and a moveable section 22 located between the side walls 16, 18 of the main body 12. In this embodiment the moveable section 22 is rotatably connected to the main body 12 for rotation about an axis which extends generally orthogonally between the side walls 16, 18 of the main body 12.

The moveable section 22 comprises an upper wall 24, a lower plate, or sole plate 26, and two side walls 28 which connect the sole plate 26 to the upper wall 24. The side walls 28 are located between the side walls 16, 18 of the main body 12, with each side wall 28 being located adjacent and substantially parallel to a respective one of the side

walls 16, 18 of the main body 12. In use, the sole plate 26 faces the floor surface to be cleaned and engages the surface of a carpeted floor surface.

With particular reference to Figures 3 and 4, the sole plate 26 comprises a leading section 30 and a trailing section 32 located on opposite sides of a suction opening 34 through which a dirt-bearing air flow enters the cleaner head 10. The suction opening 34 is generally rectangular in shape. The sole plate 26 comprises two working edges 36, 38 on opposing long sides of the suction opening 34 for agitating the fibres of a carpeted floor surface as the cleaner head 10 is manoeuvred over such a surface. To prevent the working edges 36, 38 from scratching or otherwise marking a hard floor surface as the cleaner head 10 is manoeuvred over such a surface, the cleaner head 10 comprises surface engaging support members which serve to space the working edges 36, 38 from a hard floor surface. In this embodiment, the cleaner head 10 comprises a plurality of surface engaging support members which are each in the form of a rolling element, preferably a wheel. A first pair of wheels 40 is rotatably mounted within a pair of recesses formed in the leading section 30 of the sole plate 26, and a second pair of wheels 42 is rotatably mounted within a pair of recesses formed in the trailing section 32 of the sole plate 26.

During use, a pressure difference is generated between the air passing through the cleaner head 10 and the external environment. This pressure difference generates a force which acts downwardly on the cleaner head 10 towards the floor surface. When the cleaner head 10 is located on a carpeted floor surface, the wheels 40, 42 are pushed into the fibres of the carpeted floor surface under the weight of the cleaner head 10 and the force acting downwardly on the cleaner head 10. The thickness of the wheels 40, 42 is selected so that the wheels 40, 42 will readily sink into the carpeted floor surface to bring at least the working edges 36, 38 of the sole plate 26 into contact with the fibres of the floor surface.

As the cleaner head 10 is pulled backwards over a carpeted floor surface by a user, there is a tendency for the user to raise the rear section 20 of the main body 12 of the cleaner

head 10. However, the rotatable connection of the moveable section 22 to the main body 12 allows the sole plate 26 to pivot relative to the main body 12 to maintain the working edges 36, 38 in contact with the floor surface. Clockwise rotation of the moveable section 22 relative to the main body 12 is restricted through the abutment of upwardly facing surfaces 44 located on the moveable section 22 with downwardly facing surfaces 46 located towards the front of the side walls 16, 18 of the main body 12. Anticlockwise rotation of the moveable section 22 relative to the main body 12 is restricted through the abutment of the upper surface 48 of the trailing section 32 of the sole plate 26 with the bottom surfaces 50 of the side walls 16, 18 of the main body 12.

The cleaner head 10 further comprises an agitator assembly for agitating dirt and dust located on the floor surface. In this example the agitator assembly comprises a rotatable brush bar 60 which is mounted within an agitator chamber 62 of the moveable section 22 of the main body 12. The agitator chamber 62 is partially defined by the upper wall 24 of the moveable section 22. The upper wall 24 is preferably formed from transparent material to allow the user to see whether the agitator chamber 62 has become blocked. The brush bar 60 is driven by a motor (not shown) located in the rear section 20 of the main body 12. The motor may be electrically connected to a terminal located in the conduit assembly 14 for connection with a conformingly profiled terminal located in a duct of the cleaning appliance to enable electrical power to be supplied to the motor. Alternatively, the motor may be driven by power supplied from a battery located in the rear section 20 of the main body 12.

The brush bar 60 is connected to the motor by a drive mechanism located, at least in part, within a drive mechanism housing 66 so that the drive mechanism is isolated from the air passing through the suction passage. One end of the brush bar 60 is connected to the drive mechanism to enable the brush bar 60 to be driven by the motor, whereas the other end of the brush bar 60 is rotatably supported by an end cap (not shown) removably connected to the side wall 18 of the main body 12. The drive mechanism comprises a drive pulley which is connected to a drive shaft rotated by the drive motor,

and a driven pulley which is connected to the drive pulley by a belt. A drive dog is mounted on one side of the driven pulley for connection to the brush bar 60.

The brush bar 60 comprises an elongate body 70. The brush bar 60 is rotated about the longitudinal axis of the elongate body 70 by the drive mechanism. The elongate body 70 bears two different types of bristles for agitating dirt and dust from the floor surface as the brush bar 60 is rotated by the motor. Each of the different types of bristles protrudes from the suction opening 34 in the sole plate 26 by respective different amounts as the brush bar 60 is rotated by the motor. In this embodiment, the brush bar 60 comprises relatively short, preferably relatively stiff, bristles 72, and relatively long, preferably relatively soft, bristles 74. The relatively short bristles 72 are arranged in two angularly spaced, helical rows extending along the body 70. Within each row, the relatively short bristles 72 are arranged in a series of clusters or tufts regularly spaced along the row. The relatively long bristles are arranged in two continuous helical rows, with each row being angularly spaced from a row of tufts formed from the relatively short bristles 72.

The length of the relatively short bristles 72 is chosen so that, as the brush bar 60 is rotated, the tips of these bristles 72 protrude outwardly beyond a first plane containing the suction opening 34, but not beyond a second plane containing the lowermost extremities of the wheels 40, 42. The relatively long bristles 74 protrude radially outwardly from the body 70 beyond the relatively short bristles 72 so that the relatively long bristles 74 protrude beyond both the first plane and the second plane during rotation of the brush bar 60.

When the cleaner head 10 is located on a carpeted floor surface the wheels 40, 42 sink between the fibres of the carpet so that the bottom surface of the sole plate 26 engages the fibres of the carpet. As both the relatively short bristles 72 and the relatively long bristles 74 protrude from the suction opening 26 as the brush bar 60 rotates, both of the different types of bristles are able to agitate dirt and dust from the floor surface. When an air flow is generated through the cleaner head 10, by operation of a fan unit of a

vacuum cleaning appliance to which the cleaner head 10 is connected, this dirt and dust becomes entrained within the air flow and is conveyed into the cleaner head 10 through the suction opening 34.

When the cleaner head 10 is moved from the carpeted floor surface on to a hard floor surface, the sole plate 26 becomes spaced from the hard floor surface by the wheels 40, 42. As the tips of the relatively short bristles 72 do not protrude beneath the plane containing the lowermost extremities of the wheels 40, 42, these bristles do not come into contact with the hard floor surface, thereby preventing scratching or other marking of the hard floor surface by these bristles. However, as the relatively long bristles 74 protrude beyond this plane, these bristles engage, and are swept across, the hard floor surface with rotation of the brush bar 60 to dislodge dirt and dust from the floor surface to become entrained within the air flow.

The suction opening 34 provides an opening through which dirt, dust particles and other debris is swept into the agitator chamber 62 by the rotating bristles 72, 74 of the brush bar 60. In this example, the motor and drive mechanism are arranged to rotate the brush bar 60 in such a direction that the bristles 72, 74 sweep dirt and dust rearwardly, that is, over the rear working edge 38, into the agitator chamber 62. The agitator chamber 62 is bounded by a curved front section 76 of the upper wall 24, the sole plate 26, the side walls 28, and a curved inner wall 78 connected to the upper wall 24. The front section 76 of the upper wall 24 and the inner wall 78 are in the form of a section of a cylinder, which is substantially co-axial with the rotational axis of the brush bar 60. The lower end of the inner wall 78 is spaced from the upper surface 80 of the sole plate 26 to define a dust outlet 82 from the agitator chamber 62. In this example the lower end of the inner wall 78 is generally straight, and extends substantially the entire length of the agitator chamber 62 so that the height of the dust outlet 82 is substantially constant along the length of the agitator chamber 62.

An exhaust port 84 is formed in the rear section 85 of the upper wall 24. In this example the exhaust port 84 is located midway between the side walls 28. A dust

channel 86 extends between the dust outlet 82 of the agitator chamber 62 and the exhaust port 84 to convey dust and debris to the exhaust port 84. The dust channel 86 is generally in the shape of a curved funnel having a relatively wide mouth and a relatively narrow outlet. The dust channel 86 defines part of an air flow path which extends through the cleaner head 10, and along which air is drawn by the motor and fan unit of a vacuum cleaning appliance to which the cleaner head is attached. The air flow path extends from the suction opening 34, through the dust outlet 82 of the agitator chamber 62 and through the dust channel 86 to the exhaust port 84.

The rear section 20 of the main body 12 includes an air channel 88 passing centrally therethrough for conveying an air flow from the moveable section 22 of the main body 12 to the conduit assembly 14. The air channel 88 comprises an inlet port 90 for receiving the air flow from the exhaust port 84, and an outlet port 92. A sealing member 94 is located between the rear section 20 and the moveable section 22 of the main body 12 to maintain an air tight seal between the exhaust port 84 and the inlet port 90 as the moveable section 22 pivots relative to the rear section 20. The outlet port 92 is generally circular, and is oriented so that when the cleaner head 10 is located on a hard floor surface with the upper surface 48 of the trailing section 32 of the sole plate 26 abutting the bottom surfaces 50 of the side walls 16, 18 of the main body 12, the outlet port 92 is substantially orthogonal to the second plane containing the lowermost extremities of the wheels 40, 42.

The conduit assembly 14 is connected to the rear section 20 of the main body 12. The conduit assembly 14 comprises a front conduit 100 for receiving the air flow from the outlet port 92 of the main body 12, and a rear conduit 102 for receiving the air flow from the front conduit 100. The rear conduit 102 is connectable to the wand or hose of a vacuum cleaning appliance for receiving the air flow from the conduit assembly 14.

The front conduit 100 comprises a front section 104 which is connected to the main body 12. The front section 104 is generally cylindrical in shape. The front section 104 is inserted into the outlet port 92, and is connected to the outlet port 92, for example by

a C-clip or a snap-fit connection, so that the front conduit 100 is able to rotate relative to the main body 12. An annular sealing member 106 is located between the front section 104 and the outlet port 92 to maintain an air tight seal between the main body 12 and the conduit assembly 14. The front conduit 100 is rotatable relative to the main body 12 about a first axis *A*, indicated in Figures 2 and 4, which extends rearwardly from the main body 12 and centrally through the outlet port 92 and the front section 104 of the front conduit 100. The first axis *A* is substantially orthogonal to the rotational axis of the brush bar 60.

The front conduit 100 further comprises a rear elbow section 108 from which the air flow enters the rear conduit 102. The rear elbow section 108 has a generally 90° curvature, and extends about a second axis *B* indicated in Figures 3 and 4. The second axis *B* is orthogonal to the first axis *A*. The rear elbow section 108 is connected to the front section 104 by a curved intermediate section 110. The intermediate section 110 has a smaller curvature than the rear elbow section 108, and in this embodiment the angle of curvature is around 40°.

The rear conduit 102 comprises a front elbow section 112 into which the rear elbow section 108 of the front conduit 100 is inserted. The elbow sections 108, 112 preferably have substantially the same curvature, and so the front elbow section 112 has a generally 90° curvature. The front elbow section 112 also extends about a second axis *B* indicated in Figures 3 and 4. An annular sealing member 114 is located about the outer periphery of the rear elbow section 108 of the front conduit 100 for forming an air tight seal with the inner surface of the front elbow section 112 of the rear conduit 102.

The rear conduit further comprises a rear section 116 which is connectable to a wand or hose of a vacuum cleaning appliance. The rear section 116 is generally cylindrical in shape. The front elbow section 112 is connected to the rear section 116 by a curved intermediate section 118. As above, the intermediate section 118 has a smaller curvature than the front elbow section 112, and in this embodiment the angle of curvature is around 50°.

The rear conduit 102 is connected to the front conduit 100 so that the rear conduit 102 can pivot relative to the front conduit 100. The rear conduit 102 is moveable relative to the front conduit 100 between a lowered position, as illustrated in Figures 2 to 4, in which the rear section 116 of the rear conduit 102 is generally parallel to the front section 104 of the front conduit 100, and a raised position, as illustrated in Figures 5 to 7, in which the rear section 116 of the rear conduit 102 is generally orthogonal to the front section 104 of the front conduit 100. When the rear conduit 102 is in the lowered position, the rear elbow section 108 of the front conduit 100 is substantially fully surrounded by the front elbow section 112 of the rear conduit 102. In this lowered position of the rear conduit 102, the front end of the front elbow section 112 of the rear conduit 102 abuts against the outer wall of the intermediate section 110 of the front conduit 100.

The rear conduit 102 is connected to the front conduit 100 so that the rear conduit 102 can pivot relative to the front conduit 100 about the second axis *B*. In this example, the front conduit 100 comprises a pair of arms 120 which extend rearwardly towards the rear conduit 102 from the intermediate section 110 of the front conduit 100. The rear conduit 102 comprises a shaft 122 which is received between the arms 120, and which is secured to the arms 120 by a pin or rod (not shown) which is inserted through apertures formed in the arms 120 and the shaft 122 so that the shaft 122 is rotatable about the second axis *B*. Of course, the connections between the front conduit 100 and the rear conduit 102 may be reversed, so that the arms 120 are located on the rear conduit 102 and the shaft 122 is located on the front conduit 100.

The pivoting connection between the front conduit 100 and the rear conduit 102 is thus located external of an air flow path passing through the conduit assembly 14. This means that the connection between the front conduit 100 and the rear conduit 102 can be made in any desired manner without concern of any leakage of air from around or between components of this connection. As the rear conduit 102 moves from the lowered position to the raised position, the inner surface of the front elbow section 112

of the rear conduit 102 slides over the outer surface of the rear elbow section 108 of the front conduit 100, with the seal between the front and rear conduits 100, 102 being maintained by the annular sealing member 114 located about the periphery of the front conduit 100.

The conduit assembly 14 further comprises a chassis for supporting the conduit assembly 14 on a floor surface. The chassis is connected to the front conduit 100 so that the chassis rotates with the front conduit 100 as it is rotated about the first axis *A*. The chassis extends about the front conduit 100, and may be connected to the front conduit 100 by, for example, a snap fit connection which retains the chassis in a fixed angular position relative to the front conduit 100.

The chassis comprises a body 124, and a pair of wheels 126 supported by the body 124 for rotation relative to the body 124. In this embodiment each wheel 126 is domed-shaped, and rotates about a respective axis of rotation. The axes of rotation are non-parallel and lie in a common plane which is parallel to the outlet port 92 of the main body 12. The axes of rotation are tilted relative to the second axis *B* so that the wheels 126 converge beneath the body 124 to engage a floor surface. The wheels 126 have a substantially spherical curvature, and are arranged so that the surfaces of the wheels 126 are coincident with a common sphere. The first axis *A* passes through the centre of this sphere, so that a surface of the sphere remains in contact with the floor surface as the conduit assembly 14 is rotated about the first axis *A*. The upper surface of the body 124 of the chassis has a similar curvature to the wheels 126 so that this surface of the body 124 is also coincident with this sphere.

As illustrated in Figure 7, abutment of the intermediate member 118 of the rear conduit 102 against the body 124 of the chassis limits in one direction the pivoting movement of the rear conduit 102 relative to the front conduit 100. To allow the rear conduit 102 to be raised to the position shown in Figures 5 to 7 while allowing the chassis to be located adjacent the rear conduit 102, the body 124 of the chassis includes a recessed portion 128 located adjacent the rear conduit 102. As the rear conduit 102 is pivoted towards

the raised position, the rear conduit 102 moves into the recess defined by the body 124 of the chassis. The recess thus allows the rear conduit 102 to move freely towards the raised position shown in Figures 5 and 7, and is shaped so that the rear conduit 102 does not abut the chassis until the rear section 116 of the rear conduit 102 is substantially vertical.

To inhibit the ingress of dirt into the body 124 of the chassis through the recess when the rear conduit 102 is not in the raised position, the chassis comprises a shield member 130 which is disposed beneath the recessed portion 128 of the body 124. The shield member 130 is arranged to cover the gap formed beneath the body 124 of the chassis and the rear conduit. The shield member 130 is pivotably connected to the body 124. As illustrated in Figure 1, the shield member 130 comprises a pair of lugs 132 which are each located within an aperture 134 formed in a respective side surface of the body 124 to allow the shield member 130 to pivot about a third axis *C* indicated in Figures 2 and 4, which passes through the centre of the sphere defined by the body 124 and the wheels 126, and intersects orthogonally the first axis *A*.

The shield member 130 is biased towards the rear conduit 102. In this embodiment, a torsion spring (not shown) or other resilient element is provided between the body 124 and the shield member 130 for urging the shield member 130 towards the rear conduit 102. The biasing force of the resilient element is selected so that the resilient element does not impede unduly the pivoting movement of the rear conduit 102 relative to the front conduit 100, and thus relative to the chassis. Due to the biasing force acting on the shield member 130, the shield member 130 moves with the rear conduit 102 as it pivots between its raised and lowered positions to keep covered the gap between the rear conduit 102 and the body 124 of the chassis.

The shield member 130 preferably has a curved outer surface, with the curvature of the outer surface of the shield member 130 being substantially the same as the curvature of the upper surface of the body 124 of the chassis. This can both enable the shield member 130 to be positioned immediately beneath the upper surface of the body 124

when the rear conduit 102 is in its raised position, and cause minimal disruption to the external, spherical appearance of the chassis when the shield member 130 is exposed as the rear conduit 102 is pivoted away from its raised position.

In use, the rear section 116 of the rear conduit 102 may be connected to the wand of a vacuum cleaning appliance. The vacuum cleaning appliance is switched on to operate a fan unit which draws an air flow through the main body 12 and the conduit assembly 14 of the cleaner head 10. The cleaner head 10 is located on a floor surface or other surface to be treated, and is manoeuvred forwards and backwards over that surface using the wand of the appliance. As the cleaner head 10 is manoeuvred forwards and backwards, the rear conduit 102 pivots relative to the front conduit 100 about the second axis *B* so that the cleaner head 10 maintains a flat profile with the cleaning surface, and the moveable section 22 of the main body 12 pivots relative to the rear section 20 to maintain the sole plate 26, or the wheels 40, 42 of the sole plate, in contact with the floor surface. Steering of the cleaner head 10 is achieved by rotating the wand, which in turn causes the conduit assembly 14 to rotate about the first axis *A* so that the cleaner head 10 moves to the right or left in response to clockwise or anticlockwise rotation of the wand of the cleaning appliance.

As the cleaner 10 is manoeuvred forwards and backwards, the wheels 126 of the chassis rotate to provide a rolling support for the conduit assembly 14. In response to steering of the cleaner head 10, the front conduit 100, and therefore the chassis, rotates about the first axis *A*. As the chassis rotates, one of the two wheels 126 maintains contact with the floor surface and thus continues to provide rolling support for the conduit assembly 14. As the surfaces of the wheels 126 are coincident with a common sphere, the centre of which is coincident with the first axis *A*, the wheels 126 continue to support the front conduit 100 at the same height above the floor surface so that no lifting of the cleaner head 10 occurs and a flat profile with the floor surface is maintained.

CLAIMS

1. A cleaner head for a surface treating appliance, comprising:

a main body having a fluid port located at the rear of the main body;

a front conduit comprising a front section connected to the main body for rotation relative thereto about a first axis extending rearwardly from the main body and through the fluid port and the front section, a rear elbow section and at least one first connector; and

a rear conduit comprising a front elbow section moveable within or about the rear elbow section of the front conduit, a rear section and at least one second connector connected to said at least one first connector to enable the rear conduit to pivot relative to the front conduit about a second axis which is orthogonal to the first axis and which lies outside a fluid flow path passing through the front conduit and the rear conduit.

2. A cleaner head as claimed in claim 1, wherein the elbow sections have substantially the same curvature.

3. A cleaner head as claimed in claim 1 or claim 2, wherein the front elbow section of the rear conduit is inserted into the rear elbow section of the front conduit.

4. A cleaner head as claimed in claim 3, wherein the inner surface of the front elbow section of the rear conduit slides over the outer surface of the rear elbow section of the front conduit as the rear conduit pivots relative to the front conduit.

5. A cleaner head as claimed in any of the preceding claims, wherein each elbow section has a generally 90° curvature.

6. A cleaner head as claimed in claim 5, wherein each conduit comprises a curved intermediate section located between the front section and the rear section thereof.

7. A cleaner head as claimed in claim 6, wherein each intermediate section has a curvature in the range from 40 to 50°.

8. A cleaner head as claimed in any of the preceding claims, wherein said at least one first connector comprises a pair of arms which extend towards the rear conduit, and said at least one second connector comprises a shaft which is received between the arms.

9. A cleaner head as claimed in any of the preceding claims, comprising a chassis for supporting the front conduit on a surface, the chassis being connected to the front conduit for rotation therewith about the first axis.

10. A cleaner head as claimed in claim 9, wherein the chassis extends about the front conduit.

11. A cleaner head as claimed in claim 9 or claim 10, wherein the chassis comprises a body, and a pair of wheels supported by the body.

12. A cleaner head as claimed in claim 11, wherein the body of the chassis comprises a recessed portion for receiving the rear conduit with pivoting movement thereof about the second axis.

13. A cleaner head as claimed in claim 12, comprising a shield member disposed between the recessed portion of the body and the rear conduit.

14. A cleaner head as claimed in claim 13, wherein the shield member is pivotably connected to the body.

15. A cleaner head as claimed in claim 14, wherein the shield member is pivotable about a third axis which intersects orthogonally the first axis.

16. A cleaner head as claimed in claim 14 or claim 15, wherein the shield member is biased towards the rear conduit.

17. A cleaner head as claimed in any of claims 13 to 16, wherein the shield member and the recessed portion of the body each have a curved outer surface.

18. A cleaner head as claimed in claim 17, wherein the curvature of the outer surface of the shield member is substantially the same as the curvature of the recessed portion of the body.

19. A cleaner head as claimed in claim 17 or claim 18, wherein the wheels are dome-shaped.

20. A cleaner head as claimed in claim 19, wherein the wheels have a substantially spherical curvature.

21. A cleaner head as claimed in claim 20, wherein the curvature of the outer surface of the wheels is substantially the same as the curvature of the outer surface of the recessed portion of the body.

22. A cleaner head for a surface treating appliance substantially as herein described with reference to the accompanying drawings.

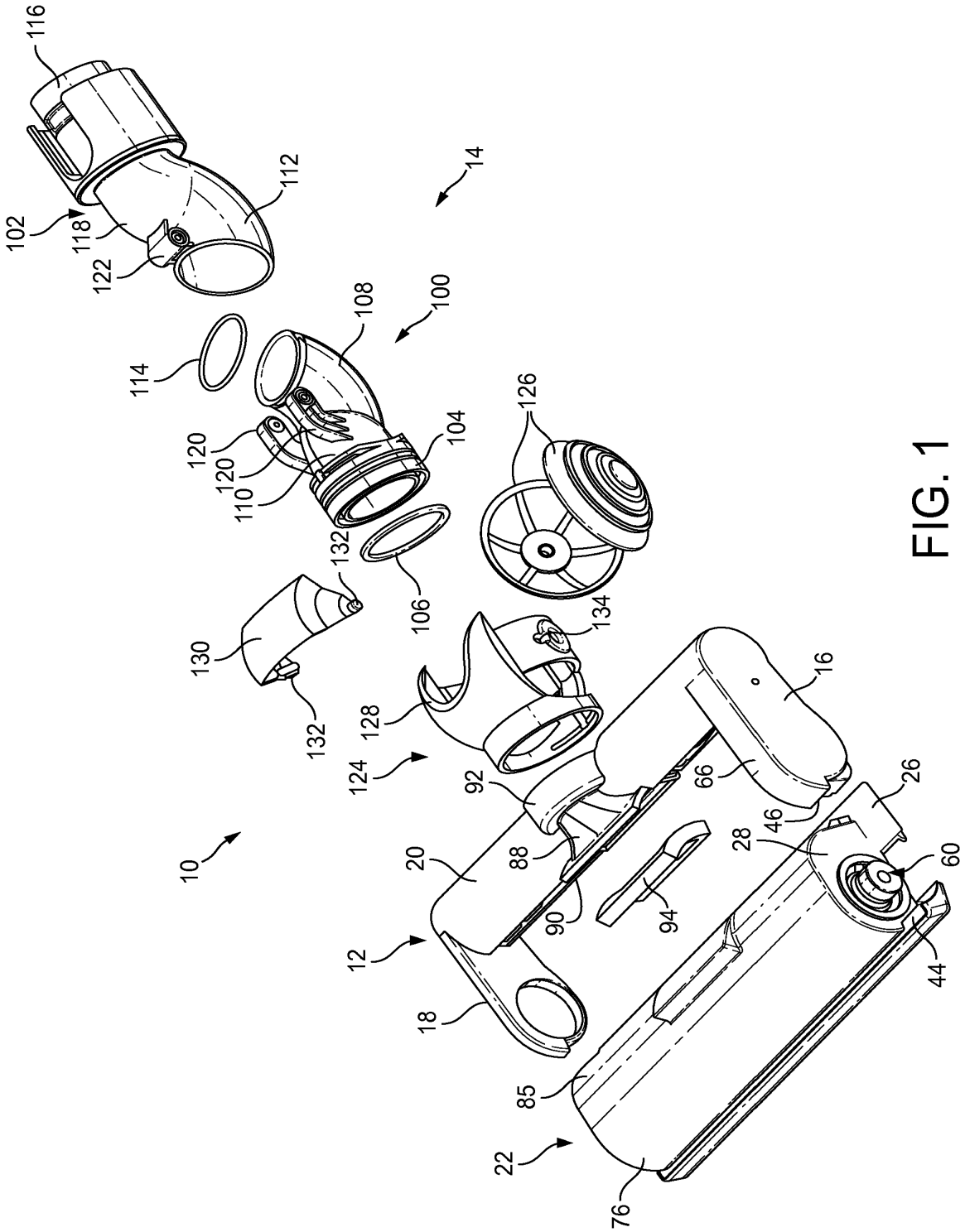
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FIG. 1

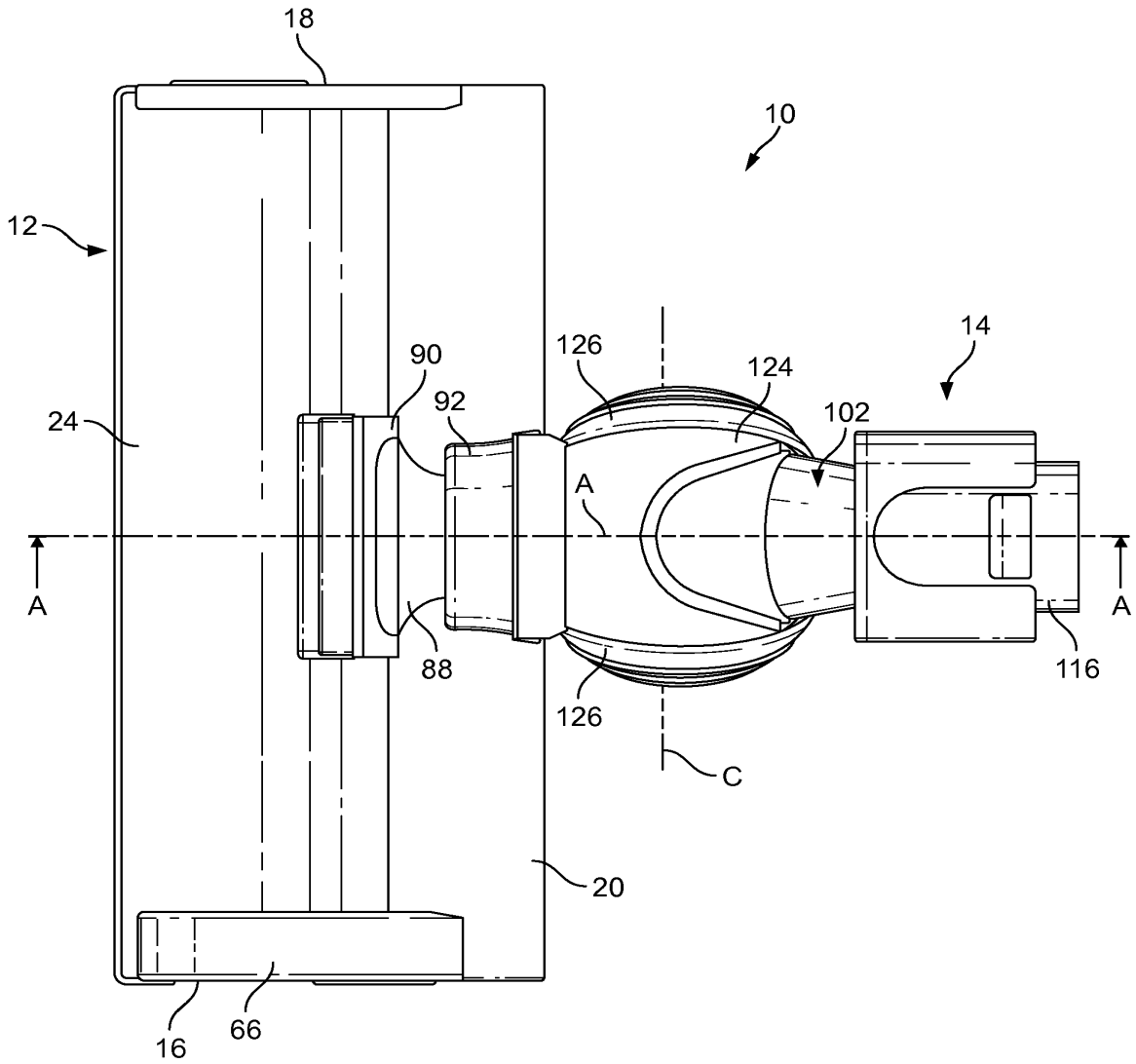

FIG. 2

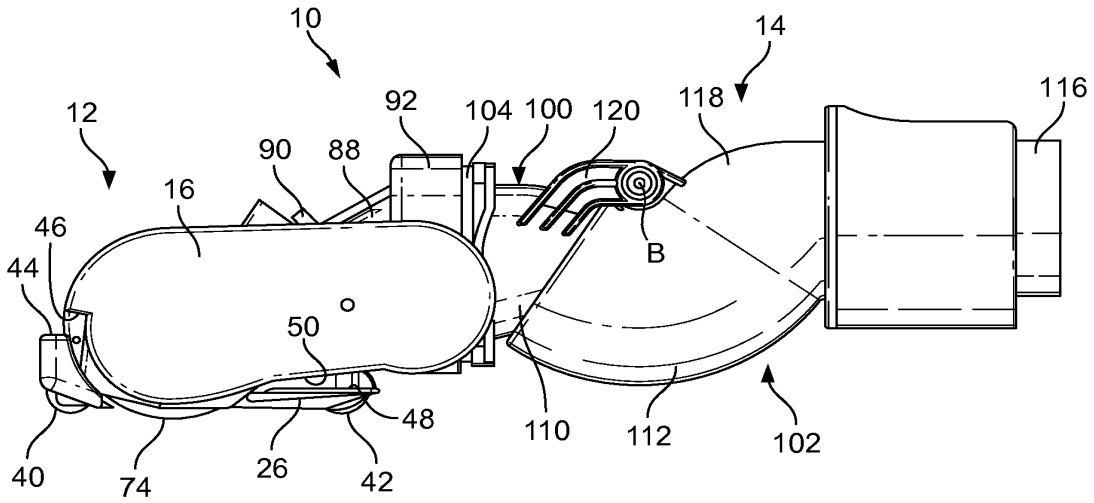
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FIG. 3

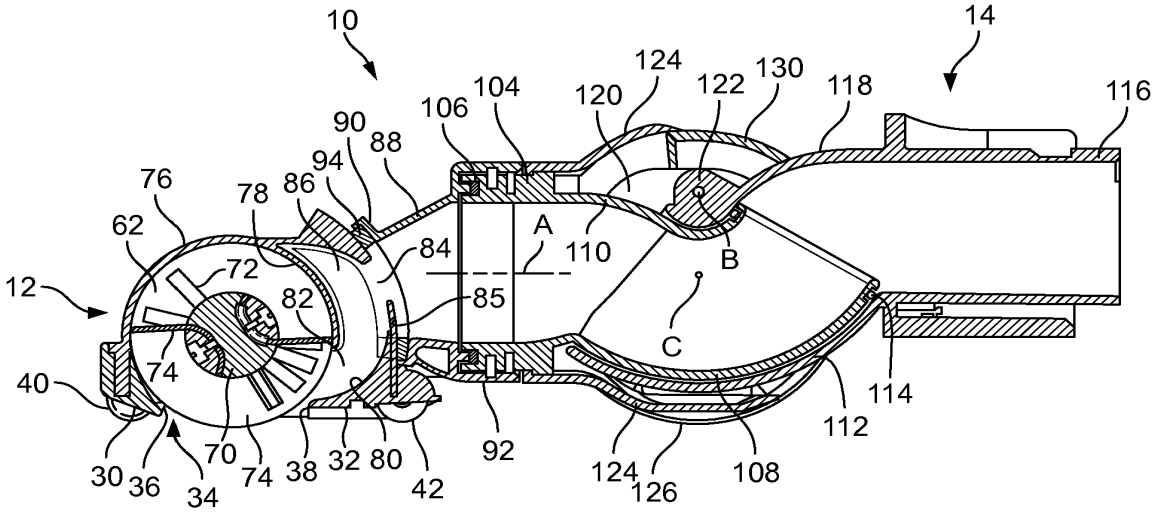
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FIG. 4

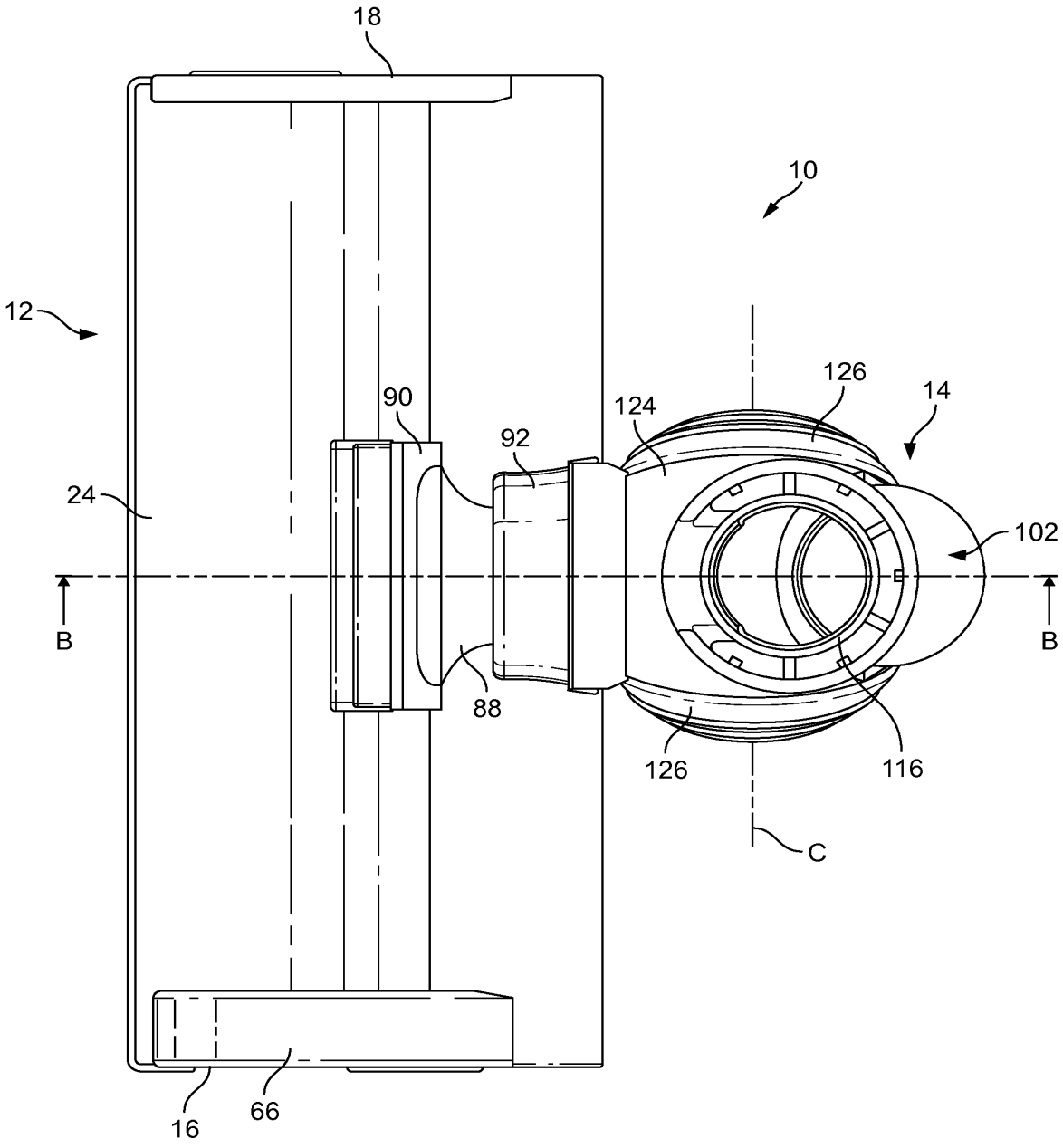

FIG. 5

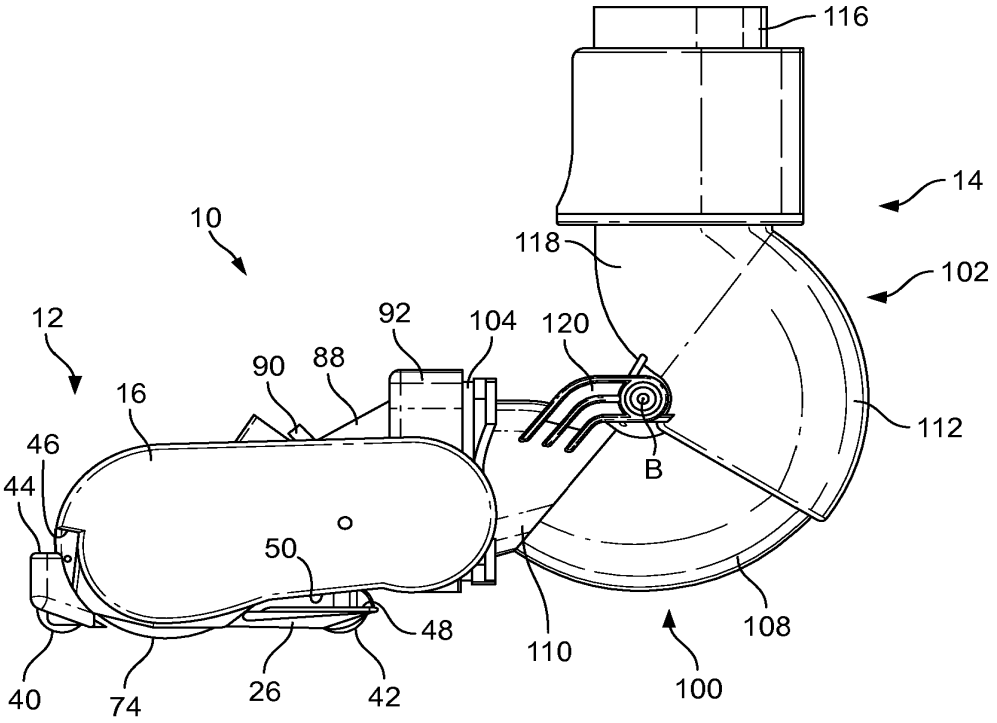
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FIG. 6

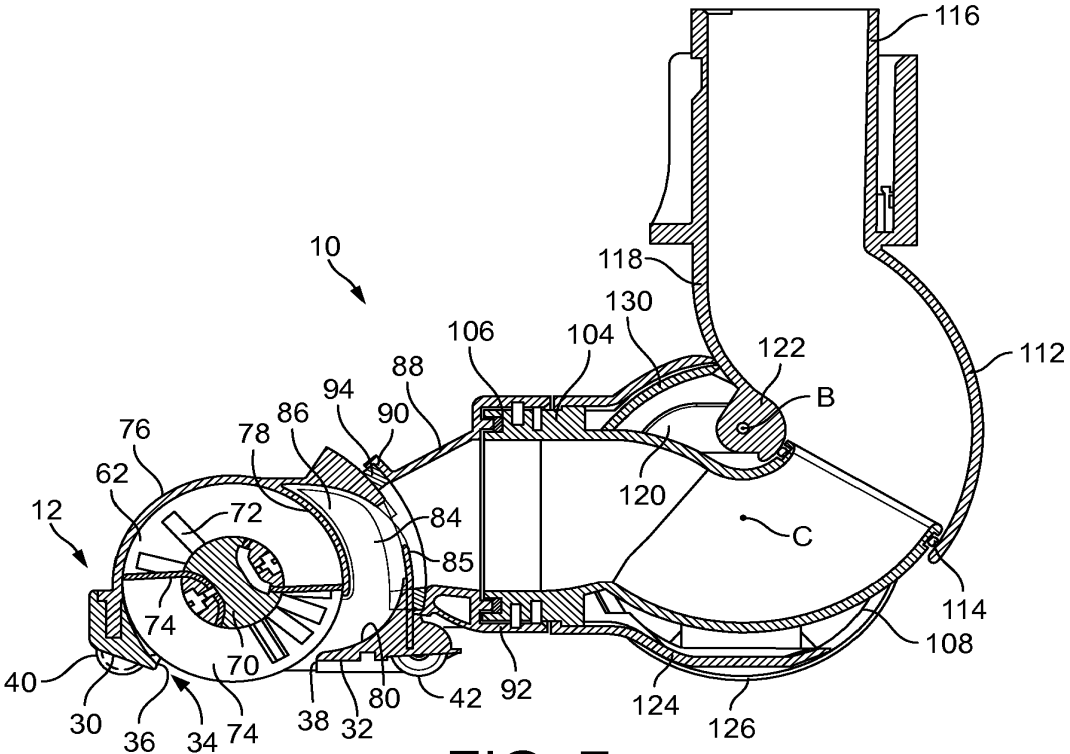
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FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2012/050084

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/02
ADD.

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)
A47L

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001 169977 A (TOSHIBA TEC KK) 26 June 2001 (2001-06-26) abstract; figures 1,2,6	1-22
A	WO 2008/009583 A1 (VORWERK CO INTERHOLDING [DE]) 24 January 2008 (2008-01-24) abstract; figures 2,3,4	1-22
A	EP 1 674 012 A2 (WESSEL WERK GMBH [DE]) 28 June 2006 (2006-06-28) abstract; figures 1,2,3	1-22

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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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
16 March 2012	29/03/2012

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, Fax: (+31-70) 340-3016	Blumenberg, Claus

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2012/050084

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2001169977 A	26-06-2001	NONE	
WO 2008009583 A1	24-01-2008	DE 102006033021 A1	24-01-2008
		EP 2040602 A1	01-04-2009
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		TW 200819108 A	01-05-2008
		WO 2008009583 A1	24-01-2008
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		CN 1792310 A	28-06-2006
		DE 102004061971 A1	06-07-2006
		EP 1674012 A2	28-06-2006
		ES 2319546 T3	08-05-2009
		US 2006137134 A1	29-06-2006

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A47L 9/02 (2006.01)

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(74) Agents: **FORRESTER, Simon** et al.; Dyson Technology Limited, Intellectual Property Department, Tetbury Hill, Malmesbury Wiltshire SN16 0RP (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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[Continued on next page]

(54) Title: A VACUUM CLEANER

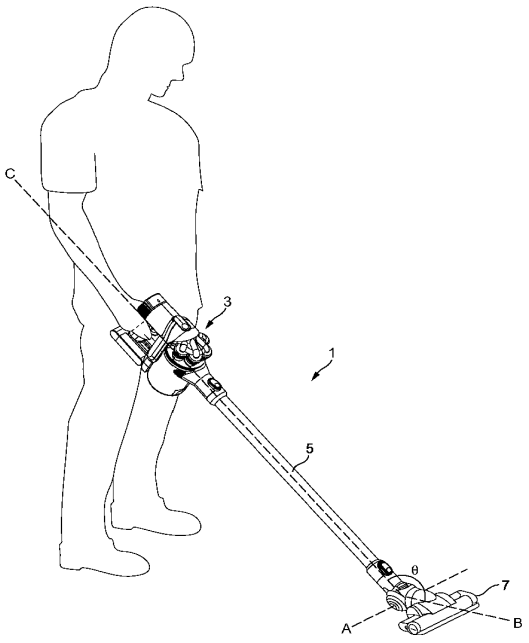

FIG. 4

(57) Abstract: A vacuum cleaner (1) of the stick-vac type, comprising a handheld vacuum cleaner (3) which is attached to an elongate, rigid wand (5) and which is fluidly connected to a cleaner head (7) provided at the end of the wand (5). The cleaner head (7) is connected to the wand (5) via a mechanical steering couple (25) for directionally steering the cleaner head (7) in plane parallel contact with the floor as the wand (5) is rotated about its axis.

WO 2012/042240 A1

ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

A Vacuum Cleaner

The present invention relates to the field of vacuum cleaners, and more specifically to "stick-vac" type vacuum cleaners of the general type comprising a handheld vacuum cleaner which is attached to an elongate, rigid wand and which is fluidly connected to a cleaner head provided at the end of the wand.

Broadly speaking, there are four types of vacuum cleaner: "upright" vacuum cleaners, "cylinder" cleaners (also referred to as "canister" cleaners), "handheld" vacuum cleaners and "stick" vacuum cleaners, the latter being popularly referred to as "stick-vac" cleaners, or simply "stick-vacs".

Upright cleaners and cylinder cleaners are well known. They tend to be mains-operated and are used for relatively heavy-duty cleaning applications.

Handheld vacuum cleaners are relatively small, highly portable vacuum cleaners, best suited to relatively low duty applications such as spot cleaning floors and upholstery in the home, interior cleaning of cars and boats etc. Unlike upright cleaners and cylinder cleaners, they are designed to be carried in the hand during use, and tend to be battery-operated.

Stick-vac cleaners essentially offer a lightweight, functional alternative to upright cleaners for relatively low duty floor-cleaning applications, such as cleaning up floor spills.

Broadly speaking, there are two distinct types of stick-vac. The first type is, in a sense, an ultra slim-line upright cleaner, though usually "cordless" rather than mains-operated. An example of this type of stick-vac cleaner is shown in UK Patent Application No.

GB2377880A1, in this case additionally incorporating a removable, handheld vacuum-cleaner.

The second type of stick-vac cleaner is a spin-off from the handheld vacuum cleaner, and comprises a handheld vacuum cleaner in combination with a rigid, elongate suction wand which effectively reaches down to the floor so that the user may remain standing while cleaning a floor surface. A floor tool is typically fixedly attached to the end of the rigid, elongate suction wand, or alternatively may be integrated with the bottom end of the wand. Designs of this type of stick-vac cleaner are shown in USD298875, USD303173 and USD280033. In each case, the handheld suction unit incorporates the motor, the fan and some sort of separating apparatus, which may be a bag or a cyclonic separation system.

The present invention relates to stick vac cleaners of the second type. In the case of these stick vac cleaners, the wand and floor tool are typically conceived and marketed as low-cost accessories for a handheld vacuum cleaner, and as such the functionality of the cleaner in stick vac mode tends to be relatively poor compared to dedicated stick vac cleaners of the first type.

It is an object of the present invention to seek to provide an improved stick vac cleaner of the second general type described above.

According to the present invention there is provided a stick-vac cleaner comprising a handheld vacuum cleaner which is attached to an elongate, rigid wand and which is fluidly connected to a cleaner head provided at the end of the wand, wherein the cleaner head is connected to the wand via a mechanical steering couple for directionally steering the cleaner head in plane parallel contact with the floor as the wand is rotated about its axis.

By providing a mechanical steering couple between the wand and cleaner head according to the present invention, the manoeuvrability of the stick-vac cleaner is

greatly improved compared to conventional stick-vac cleaners of the second general type..

Any suitable mechanical steering couple may be used. In particular, the mechanical steering couple may be configured to constrain the wand and the cleaner head for co-rotation about the wand axis whilst permitting relative rotation of the wand and cleaner head about an axis which is non-parallel to the wand axis. This type of steering couple can be implemented relatively cheaply, whilst still providing a high degree of manoeuvrability for the cleaner.

The wand and the cleaner head may be coupled for relative rotation along a rotatable scarf joint or via an elbow joint. The use of a scarf joint is considered to be particularly advantageous, in that it provides a mechanical turning advantage for the cleaner head during steering.

The wand may be hingedly connected to the cleaner head passively for varying the lie angle between the wand and the cleaner head. A variable lie angle helps maintain the cleaner head in contact with the floor across a relatively wide range of turning angles during steering of the cleaner head. Here, the term "lie angle" is somewhat analogous to the lie angle between the sole of a golf club head and the shaft of the club.

In the case where the wand and cleaner head are coupled by an elbow joint, this elbow joint may be a hinged elbow joint for varying the lie angle between the cleaner head and the wand.

The dust-laden air may be ducted to the handheld vacuum cleaning unit through the wand. The wand thus advantageously serves the dual purpose of fluidly connecting the cleaner head to the hand held vacuum cleaner whilst also transmitting steering torque to the cleaner head.

The handheld vacuum cleaner may comprise a pistol grip handle. The provision of a pistol grip handle on the handheld vacuum cleaner is considered to be particularly advantageous in a stick-vac cleaner according to the present invention, because it tends to align a user's forearm with the wand (the wand being analogous to the barrel of a pistol). Consequently, steering of the cleaner can be controlled primarily through supination and pronation of the forearm, which is comfortable and natural for the user.

A pistol grip handle also provides good leverage for effective transmission of steering torque between the handle and the cleaner head (via the wand), and in particular reduces the tendency for a user's hand to roll "over the top" of the handle as the handle is rotated to steer the cleaner head. The provision of a straight pistol grip which extends perpendicular to the wand is considered to be particularly beneficial in this regard.

The provision of a pistol grip handle does not make it essential to use a trigger, though use of a trigger may of course be convenient, for example to switch the handheld cleaner on and off.

The handheld vacuum cleaner will comprise some form of motor, which will be a relatively heavy component in the handheld vacuum cleaner. Advantageously, this motor may be positioned at or near the upper end of the pistol grip, so that the weight of the motor may be supported more comfortably on top of the user's hand.

The handheld vacuum cleaner may incorporate a cyclonic separation system, in which case the wand may be axially aligned with a tangential inlet to the cyclonic separation system. The dirty air thus feeds directly into the cyclonic separation system along the preferred inlet axis. This reduces "discontinuity" pressure losses between the wand and the separation system, which is particularly advantageous in the present case because of the relatively high pressure drop across the ends of the (relatively long) wand.

Embodiments of the invention will now be described, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view showing a stick vac cleaner in use;

Figure 2 is a close-up perspective view of part of the stick-vac cleaner in Figure 1;

Figure 3 is a perspective view of a floor tool forming part of the stick-vac cleaner shown in Figure 1;

Figure 4 is a view corresponding to Figure 1, but illustrating various operational axes of rotation associated with steering the stick-vac cleaner across the floor;

Figure 5 is a perspective view showing an alternative floor tool which may form part of a stick vac cleaner in accordance with the invention; and

Figure 6 is a cross-sectional side view of the tool shown in Figure 5.

Figure 1 shows a stick-vac cleaner 1 in use, comprising a handheld vacuum cleaner 3 which is carried in the hand, an elongate wand 5 attached to the handheld cleaner 3 and which reaches down to the floor and a cleaner head 7 provided at the end of the wand 5, which makes contact with the floor (the floor itself, though implicit, is not explicitly shown in Figure 1).

Referring to Figure 2, the handheld vacuum cleaner 3 comprises a motor-driven fan which is arranged inside a motor casing 9 for drawing air in through a suction nozzle 11 positioned at the front of the hand held vacuum cleaner 3. The elongate wand 5 is connected to the suction nozzle 11, and the cleaner head 7 is in turn connected to the lower end of the wand 5. In use, dirty air is drawn in through a suction opening 12 (Figure 3) on the underside of the cleaner head 7 and is ducted to the suction nozzle 11 on the handheld vacuum cleaner 3, through the wand 5.

Dirty air entering the suction nozzle 11 passes through a cyclonic separation system 13, where dirt is separated from the air, before the relatively clean air is then exhausted back to atmosphere via one or more fine-particulate filters (not visible). The dirt which is separated from the airflow inside the cyclonic separating system 13 is collected in a bin 15 for disposal. The hand held vacuum cleaner 3 is powered by a multi-cell rechargeable battery which is housed in a battery pack 17.

The cleaner head 7 forms part of a floor tool 19 which is detachable from the wand 5 by means of a catch 21. The wand 5 is in turn detachable from the handheld cleaner 3 by means of a catch 23. The handheld cleaner 3 can thus be used in isolation as a stand-alone handheld vacuum cleaner by detaching the wand 5 or, alternatively, the handheld vacuum cleaner 3 and wand 5 can be used in combination as a "long reach" handheld vacuum cleaner by detaching the floor tool 19. The use of a detachable floor tool is not essential: for example, the cleaner head 7 may be permanently secured to the wand 5.

The floor tool 19 is shown in more detail in Figure 3, detached from the wand 5.

The floor tool 19 comprises an articulated neck portion 25 which acts as a mechanical steering couple between the wand 5 and the cleaner head 7.

The neck portion 25 comprises a front part 27, the front end of which is connected to the cleaner head 7, and a rear part 29, the rear end of which incorporates the catch 21 for detachable connection to the wand 5. The front part 27 is pivotally connected to the rear part 29, so that the front an rear parts 27, 29 are constrained for relative movement about an axis A. The front and rear parts 27, 29 thus effectively form a hinged elbow joint which allows for variation in the lie angle θ between the cleaner head 7 and wand 5 when the floor tool is connected to the wand 5 (see Figure 4). Thus, the lie angle is adaptable to suit the height of the particular user and, in use, the cleaner can be moved into a lower profile orientation, as desired, for example to clean underneath a bed.

A flexible duct in the form of a hose 31 extends through the articulated neck portion 25. The hose 31 flexibly connects the cleaner head 7 to the end of the wand 5 in use so as not to hinder articulation of the neck portion 25 about the axis A.

The front end of the front part 27 is shaped as a cylindrical collar 27a. This cylindrical collar 27a is connected to the cylindrical end of a rear outlet duct 7a on the cleaner head 7 by a conventional circlip or snap ring arrangement (not visible in Figure 3) which constrains the cleaner head 7 and front part 27 for relative rotation about the axis B of the cylindrical collar 27a. A conventional gasket arrangement (not shown) can be used to form a compression seal between the cleaner head 7 and the neck portion 25; this seal should preferably be a low-friction seal (for example using a PTFE-coated gasket), so as not to hinder free rotation of the cleaner head 7 relative to the neck portion 25.

The neck portion 25 functions as a steering couple by constraining the cleaner head 7 and wand 5 for co-rotation about the wand axis C, whilst nevertheless permitting relative rotation of the cleaner head 7 and the front part 27 about the axis B, which in use is non-parallel to the axis C (see Figure 4). Accordingly, steering of the cleaner head 7 can be controlled by rotating the wand 5 about the wand axis C to direct the cleaner head 7 in the desired direction. As the wand rotates about the axis C, co-rotation of the cleaner head 7 with the wand 5 and relative rotation of the collar 8 and rear outlet duct 7a combine to turn the cleaner head 7 in plane parallel contact with the floor, so that the cleaner head 7 does not bank about the axis B as it turns. Hinging movement of the wand 5 and cleaner head 7 about axis A may also help to maintain the cleaner head 7 in plane parallel contact with the floor, particularly for large turning angles, though this hinging movement is not considered essential to obtain the benefit of directional steering.

A pair of domed wheels 33 is provided on the front part 27. The domed wheels 33 are mounted on stub axles (not visible) either side of the neck portion 25. These stub axles are each angled downwardly to set the respective wheel at a corresponding fixed, positive camber angle. This camber angle is the same for each of the wheels 33, so that

the wheels form a "V" when viewed from the front. As the wand 5 is rotated about the wand axis C, the dome-shaped wheels 33 bank accordingly to maintain rolling contact with the floor. The dome-shaped wheels 33 are thus better able to track through the turn than conventional "flat-sided" wheels.

The handheld vacuum cleaner 3 is provided with a pistol grip handle 35 (see Figure 2), which tends to position a user's forearm parallel to the wand 5. Consequently, steering of the cleaner 1 can be controlled primarily through supination and pronation of the forearm, and is therefore natural and comfortable for the user. A pistol grip also provides good leverage for effective transmission of steering torque from the handle 35 to the cleaner head 7 (via the wand 5 and neck portion 25), and in particular reduces the tendency for a user's hand to roll "over the top" of the handle as the handle is rotated to steer the cleaner head 7.

The motor casing 9 is provided at the upper end of the pistol grip handle 35. Consequently, the weight of the motor inside the motor casing 9 is comfortably supported on top of a user's hand during use of the cleaner 1.

Figure 5 shows an alternative floor tool 190 which may be connected to the wand 5 in accordance with the invention to provide a mechanical steering couple between the wand 5 and a cleaner head.

The floor tool comprises an articulated neck portion 250 which incorporates a front duct part 270 and a rear duct part 290. The front duct part 270 is fluidly connected to a cleaner head 70. The rear duct part 290 is configured to push fit onto the wand 5 (the end of the wand may need to be modified accordingly to accommodate the push fit).

The front duct part 270 is pivotally connected to the cleaner head 70 so that the front part 270 and cleaner head 70 are constrained for rotation about an axis D. This allows for variation of the lie angle between the wand 5 and the cleaner head 70 in use.

The front duct part 270 is connected to the rear duct part 290 by a rotatable scarf joint 300, which constrains the front duct part 270 and rear duct part 290 for rotation about an axis E, non-parallel with the longitudinal axis of the rear duct part 290.

The front duct part 270 and rear duct part 290 together form an air duct for fluidly connecting the cleaner head 70 to the wand 5 in use.

The neck portion 250 acts as a mechanical steering couple between the wand 5 and the cleaner head 70 in similar manner to the neck portion 25. Thus, the neck portion 250 is arranged to constrain the wand 5 and cleaner head 70 for co-rotation about the wand axis C whilst, nevertheless, permitting relative rotation of the wand 5 and cleaner head 70 about the axis E. Accordingly, as the wand 5 is rotated about the wand axis C, co-rotation of the cleaner head 7 with the wand 5 combines with relative rotation of the front part 270 and rear part 290 to turn the cleaner head 7 in plane parallel contact with the floor.

The axis E is non-parallel with the floor, so that relative rotation of the front and rear parts 17, 19 about the axis E involves both a horizontal and vertical component (cf. relative rotation about the axis B in Figure 4, which is solely in a vertical plane). Consequently, relative rotation of the front part 270 and rear part 290 not only counteracts undesirable banking of the cleaner head during steering, but also provides an associated mechanical advantage in turning the cleaner head 70 left or right, further improving manoeuvrability.

Air drawn in through the suction opening on the cleaner head need not be ducted through the wand. For example, the air may be ducted through a flexible hose running alongside the wand; in this arrangement, the wand would nevertheless couple to the cleaner head in similar manner for providing the necessary directional steering capability, so the wand would still physically connect the cleaner head to the handheld vacuum cleaner, but the wand itself need not be hollow.

A stick-vac cleaner according to the present invention, examples of which have been described, is considered to offer significantly better manoeuvrability than existing "stick- vacs" of the same general type, bringing the functionality of this type of stick-vac more into line with the stick-vac cleaners of the first general type described above.

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CLAIMS

1. A stick-vac cleaner comprising a handheld vacuum cleaner which is attached to an elongate, rigid wand and which is fluidly connected to a cleaner head provided at the end of the wand, wherein the cleaner head is connected to the wand via a mechanical steering couple for directionally steering the cleaner head in plane parallel contact with the floor as the wand is rotated about its axis.

2. A stick-vac cleaner according to claim 1, wherein, in use, the mechanical steering couple constrains the wand and the cleaner head for co-rotation about the wand axis whilst permitting relative rotation of the wand and cleaner head about an axis which is non-parallel to the wand axis.

3. A stick-vac cleaner according to any preceding claim, in which the cleaner head and wand are coupled for relative rotation along a scarf joint or via an elbow joint.

4. A stick-vac cleaner according to any preceding claim, in which the wand is hingedly connected to the cleaner head for varying the lie angle between the wand and the cleaner head.

5. A stick vac cleaner according to claims 3 and 4, wherein the cleaner head and wand are coupled by a hinged elbow joint for varying the lie angle between the cleaner head and the wand.

6. A stick-vac cleaner according to any preceding claim, wherein the handheld vacuum cleaner comprises a pistol grip handle.

7. A stick-vac cleaner according to claim 6, wherein the pistol grip handle is substantially straight.

8. A stick-vac cleaner according to claim 6 or 7, wherein the pistol grip handle extends substantially perpendicular to the wand.

9. A stick-vac cleaner according to any of claims 6 to 8, wherein the handheld vacuum cleaner comprises a motor which is positioned at or near the upper end of the pistol grip handle.

10. A vacuum cleaner according to claim any preceding claim, wherein the handheld vacuum cleaning unit incorporates a cyclonic separation system.

11. A vacuum cleaner according to claim 10, wherein the wand is axially aligned with a tangential inlet to the cyclonic separation system.

12. A stick-vac cleaner according to any preceding claim, wherein the wand fluidly connects the handheld vacuum cleaner to the cleaner head.

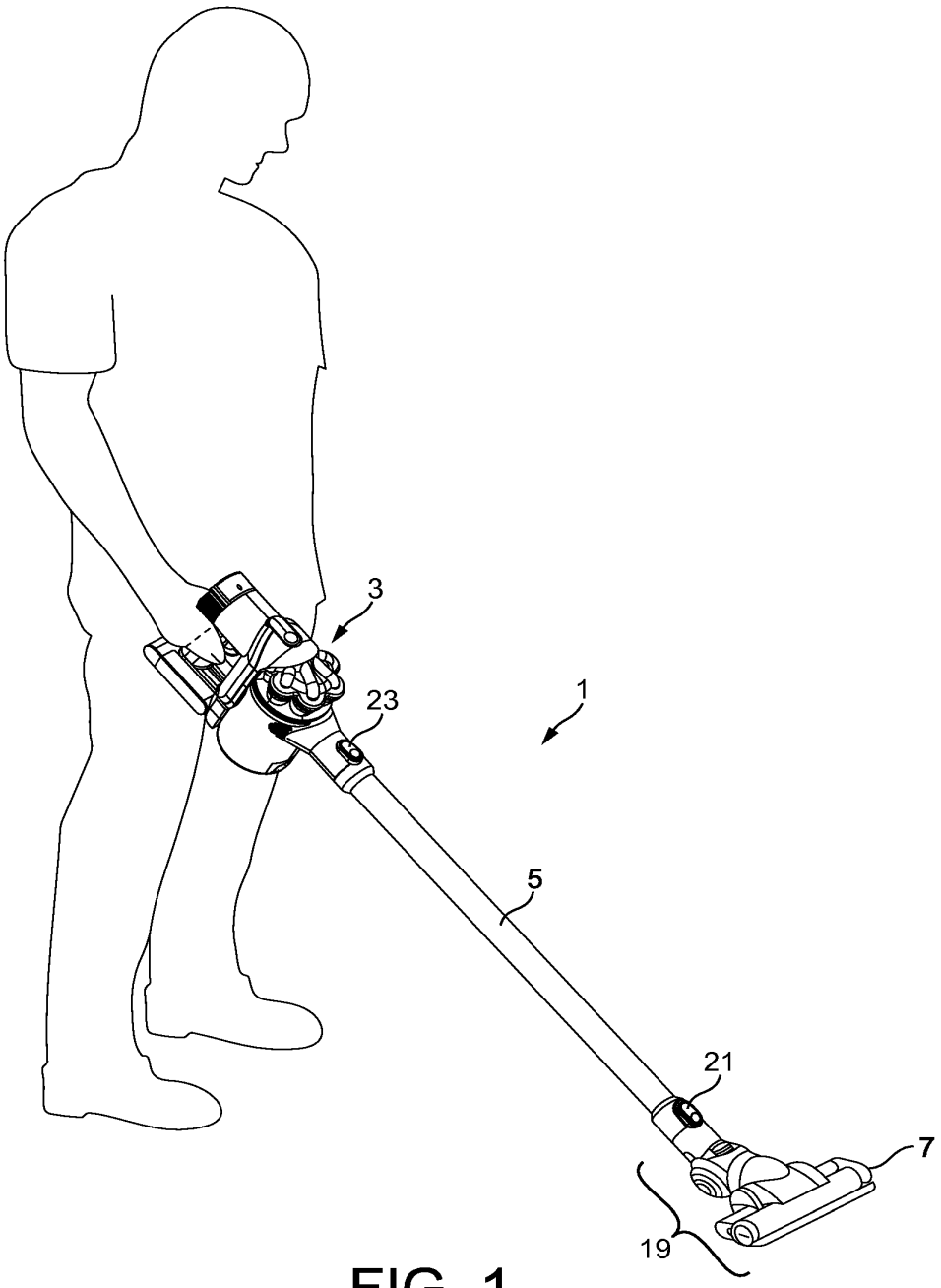

FIG. 1

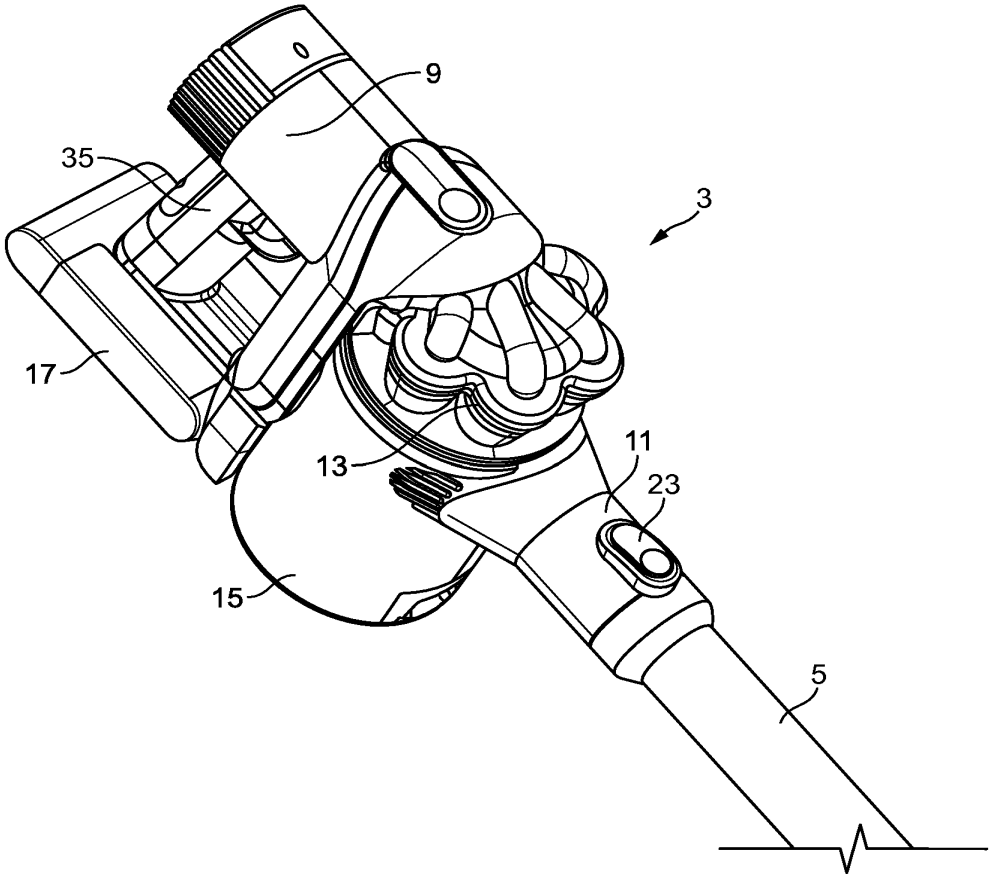

FIG. 2

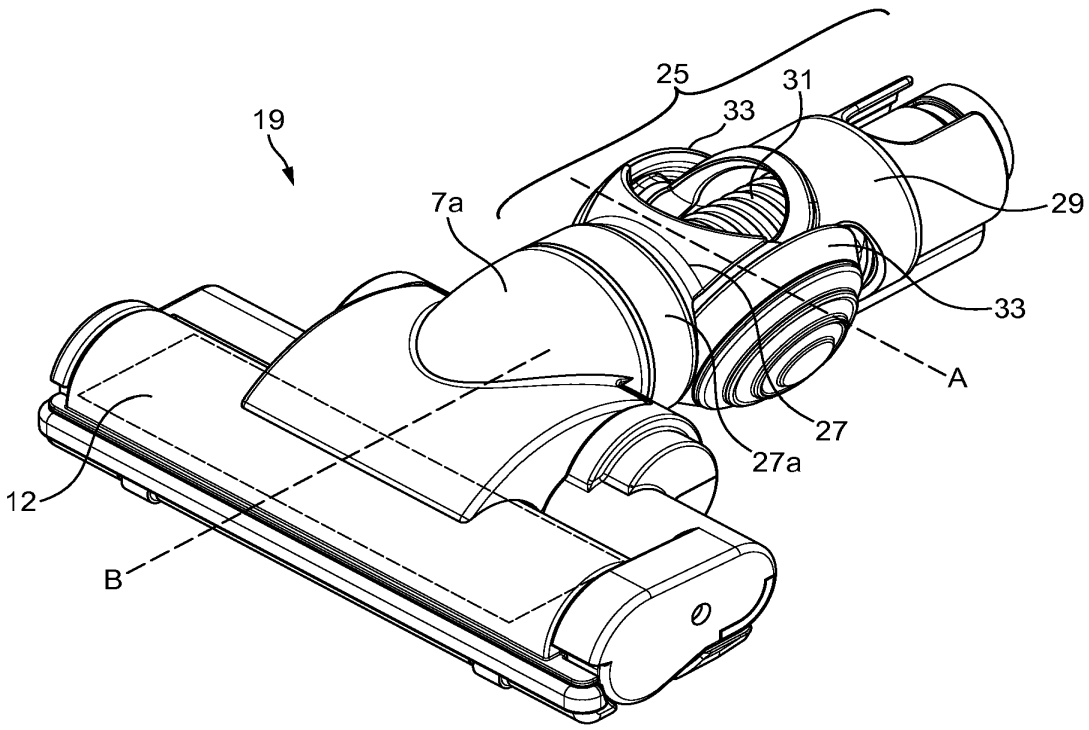

FIG. 3

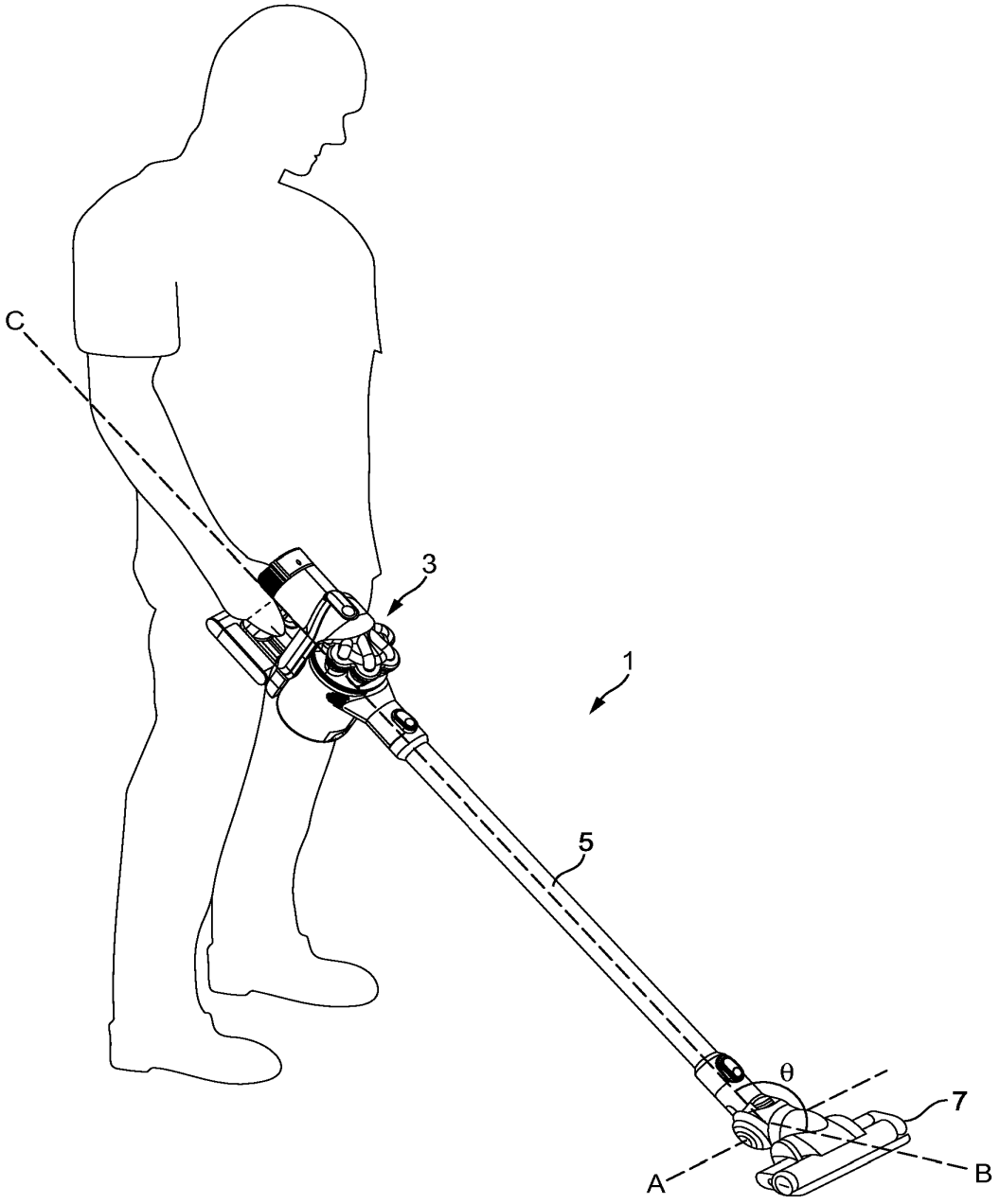

FIG. 4

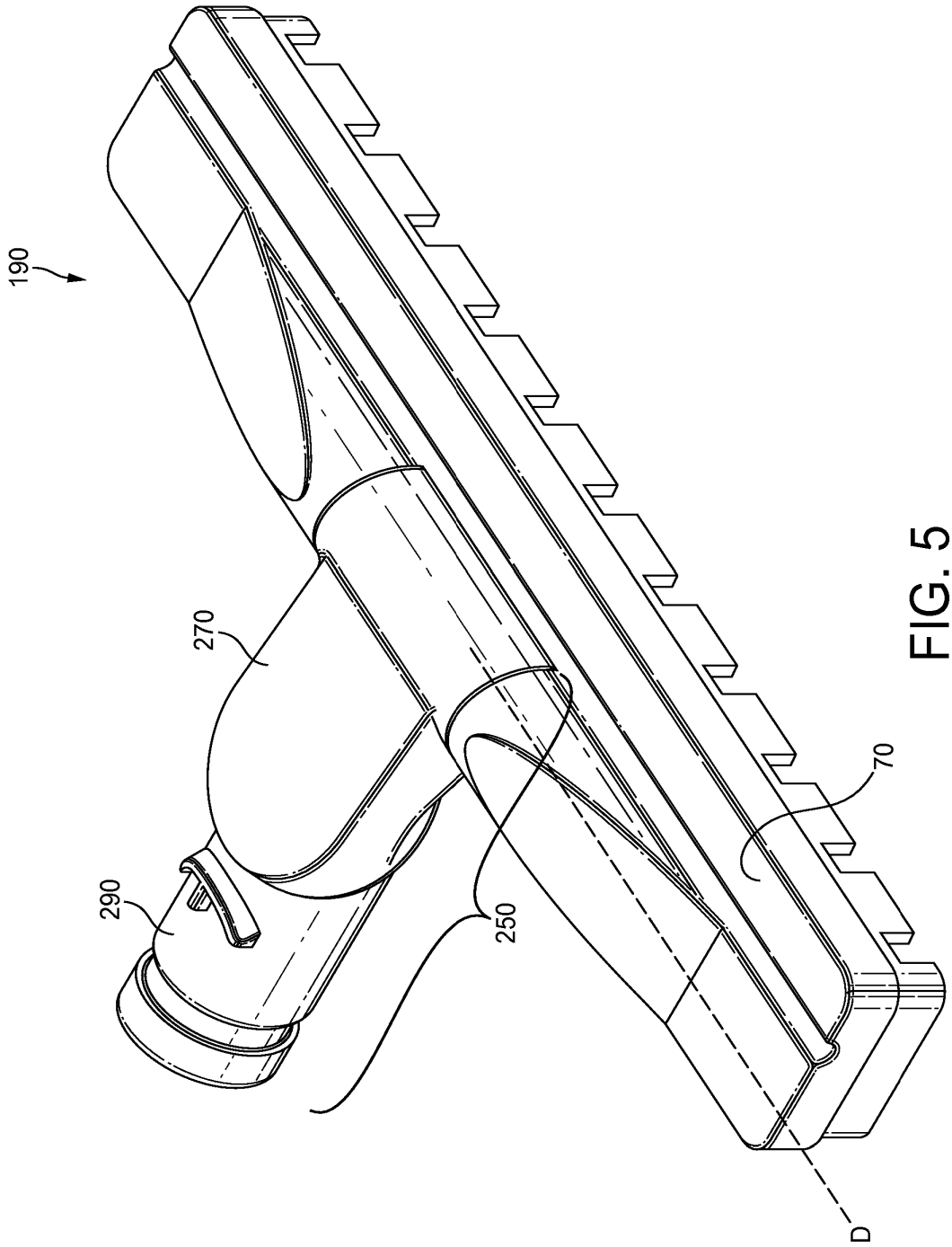

FIG. 5

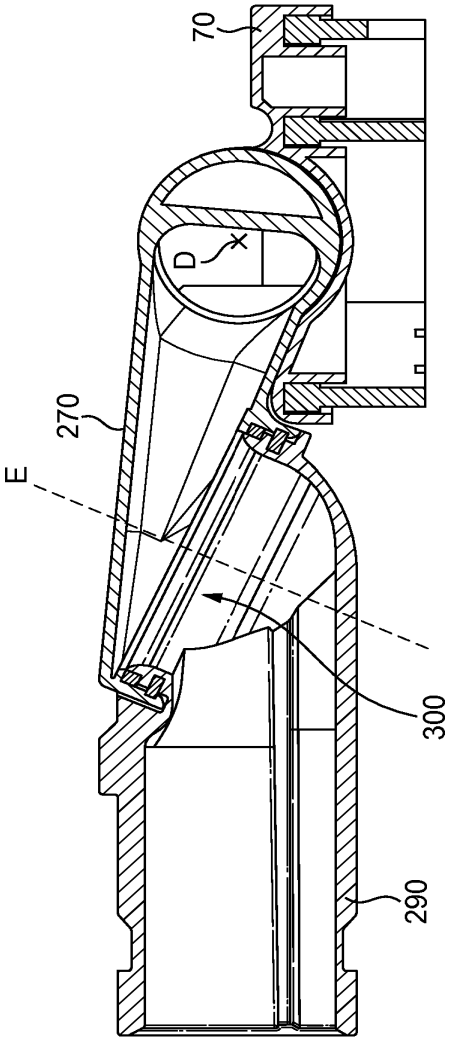

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24 A47L5/28 A47L9/02 A47L9/24 A47L5/22
ADD.

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)
A47L

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.
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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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

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"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
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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, Fax: (+31-70) 340-3016	Martin Gonzalez, G

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2011/051697

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2011/051697

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(51)Int.Cl.			F I			テーマコード（参考）
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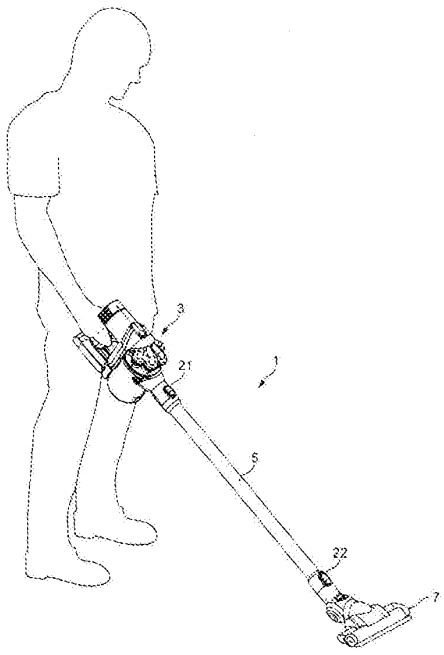
最終頁に続く

(54)【発明の名称】真空掃除装置

(57)【要約】
【課題】真空掃除機、特に、細長吸引ワンドによって床ツールに接続された可搬型吸引ユニットを一般的に含むタイプの「スティックバキューム」掃除機を提供する。
【解決手段】装置は、スティックバキューム掃除機を形成するために細長吸引ワンドと組み合わされた可搬型吸引ユニットを含み、装置は、更に、使用しない時に壁上のスティックバキューム掃除機を直立のドック位置に支持するための壁掛け可能なドッキングステーションを含む。装置は、使用に便利なように直立位置のスティックバキューム掃除機の比較的安定な保管を提供する。
【選択図】図1



【特許請求の範囲】
【請求項１】
細長吸引ワンドによって床ツールに接続された可搬型吸引ユニットを含むスティックバキューム掃除機と、
使用しない時に直立のドック位置で壁上に前記スティックバキューム掃除機を支持するための壁掛け可能なドッキングステーションと、を含み、前記可搬型吸引ユニットは、バッテリ作動式であり、かつ搭載再充電可能バッテリに接続された１組の外部充電接点を組み込み、該ドッキングステーションは、主電源に接続するためのそれぞれの組の充電接点を含み、該ドッキングステーション上の該充電接点は、該可搬型吸引ユニット上の該外部充電接点と係合するように配置されて前記スティックバキューム掃除機が前記直立のドック位置にある時にバッテリ充電回路を形成することを特徴とするバキューム掃除装置。
【請求項２】
前記ドッキングステーションは、スティックバキューム掃除機を直立位置に、解除可能に係止するように構成されている、ことを特徴とする請求項１に記載の装置。
【請求項３】
前記ドッキングステーションは、前記可搬型吸引ユニットを直立のドック位置に直接に支持するために該可搬型吸引ユニットと係合するように配置されることを特徴とする請求項１又は請求項２に記載の装置。
【請求項４】
前記ドッキングステーションは、前記直立のドック位置に前記スティックバキューム掃除機を係止するように前記可搬型吸引ユニットと係合するためのキャッチを含み、該キャッチは、該可搬型吸引ユニット上の前記充電接点を該ドッキングステーション上の前記充電接点との係合状態に保持するように配置されることを特徴とする請求項１から請求項４のいずれか1項に記載の装置。
【請求項５】
前記キャッチは、前記可搬型真空掃除機上の前記充電接点を前記ドッキングステーション上の前記充電接点との係合状態に押し付けるためにバネ荷重されることを特徴とする請求項４に記載の装置。
【請求項６】
前記可搬型吸引ユニット上の前記外部充電接点は、それらが、前記スティックバキューム掃除機が前記直立のドック位置にある時に上方を向くように位置決めされ、前記ドッキングステーション上の前記充電接点は、該充電接点を下方に押し付けて該可搬型吸引ユニット上の該上向き充電接点と係合させるためにバネ付勢されることを特徴とする請求項１から請求項５のいずれか１項に記載の装置。
【請求項７】
前記ドッキングステーションは、１組の対向する締め付け部材を含み、該締め付け部材の少なくとも一方は、他方の締め付け部材に対して前記スティックバキュームを弾力的に締め付けて該スティックバキュームを前記直立のドック位置に係止するために該他方の締め付け部材の方向に弾力的に付勢されることを特徴とする請求項１から請求項６のいずれか１項に記載の装置。
【請求項８】
前記締め付け部材の対は、前記可搬型吸引ユニットのそれぞれの下部部分に対して上方に締め付けるように配置された下部締め付け部材、及び該可搬型吸引ユニットのそれぞれの上部部分に対して下方に締め付けるように配置された対向する上部締め付け部材から構成されることを特徴とする請求項７に記載の装置。
【請求項９】
前記下部締め付け部材は、使用時に前記壁に対して固定され、前記上部締め付け部材は、該下部締め付け部材の方向に下方に弾力的に付勢されることを特徴とする請求項８に記載の装置。
【請求項１０】

前記締め付け部材は、締め付け軸に沿って相対摺動移動して前記スティックバキュームと係合するように配置され、少なくとも一方の締め付け部材は、更に、他方の締め付け部材との締め付けアラインメントに入りかつ出る移動に対して配置されることを特徴とする請求項７から請求項９のいずれか１項に記載の装置。

【請求項１１】

前記締め付け部材は、前記他方の締め付け部材との締め付けアラインメントに入りかつ出るピボット回転移動に対して配置されることを特徴とする請求項１０に記載の装置。

【請求項１２】

壁上に装着された前記ドッキングステーションとの使用において、前記ピボット回転可能締め付け部材は、該壁から離れるピボット回転移動に対して配置されることを特徴とする請求項１１に記載の装置。

【請求項１３】

前記上部締め付け部材は、滑り嵌めで前記可搬型ユニットの第１の部分を受け取るように配置されたドッキング受け台の形態であり、該ドッキング受け台は、前記下部締め付け部材に対して摺動可能であり、かつ該下部締め付け部材の方向に弾力的に付勢され、該ドッキング受け台は、更に、該可搬型ユニットの該第１の部分を受け取るために該下部締め付け部材との締め付けアラインメントから出る移動のために、使用時に前記壁から離れるようにピボット回転可能であることを特徴とする請求項１０に記載の装置。

【請求項１４】

前記下部締め付け部材は、該下部締め付け部材に対する横方向移動に対して前記スティックバキュームを固定するために前記可搬型ユニットの第２の部分と係合するための係止要素を含む固定式締め付け部材であることを特徴とする請求項１３に記載の装置。

【請求項１５】

請求項１から請求項１４のいずれか１項に記載の装置のドッキングステーションとして使用するためのドッキングステーション。

【発明の詳細な説明】

【技術分野】

【０００１】

本発明は、真空掃除機の分野に関し、より具体的には、細長吸引ワンドによって床ツールに接続された可搬型吸引ユニットを一般的に含むタイプの「スティックバキューム」掃除機に関する。

【背景技術】

【０００２】

広い意味では、「直立型」真空掃除機、「円筒形型」掃除機（「キャニスタ」掃除機とも呼ばれる）、「可搬型」真空掃除機、及び「スティック型」真空掃除機の４つのタイプの真空掃除機があり、最後のものは、「スティックバキューム」掃除機又は単に「スティックバキューム」と呼ばれる。

【０００３】

直立型掃除機及び円筒形型掃除機は、公知である。これらは、電源コンセント作動式である傾向があり、比較的苛酷な清掃用途に対して用いられる。

【０００４】

可搬型真空掃除機は、家庭における床及び内装のスポット清掃、車及びボートなどの内部の清掃のような比較的低荷重用途に最も適する比較的小さな携帯性に優れた真空掃除機である。直立型掃除機及び円筒形型掃除機と異なり、これらは、使用中に手で運ぶように設計され、バッテリ作動式である傾向がある。

【０００５】

スティックバキューム掃除機は、基本的に、床にこぼれたものの掃除のような比較的低荷重床清掃用途のための直立型掃除機の軽量の機能的代替手段を提供する。

【０００６】

広い意味では、２つのタイプのスティックバキュームがある。第１のタイプは、ある意

味では、超薄型直立型掃除機であるが、通常電源コンセント作動式ではなくて「コードレス」である。このタイプのスティックバキューム掃除機の例は、英国特許出願番号ＧＢ第２３７７８８０号Ａ１に示され、この場合には、取外し可能な可搬型真空清掃のためのユニットを更に組み込んでいる。このタイプのスティックバキュームは、支柱なしで立つことができ、そうでなければ、これらは、使用していない時には簡単にスティックバキュームを壁に立て掛けることによって格納される傾向がある（長いハンドルブラシ又はほうきのように）。

【０００７】

第２のタイプのスティックバキューム掃除機は、可搬型真空掃除機からの副産物であり、ユーザが床面を清掃する間は立ったままでいることができるように、可搬型真空掃除機と同じ方法であるが、実質的に床に届く剛性の細長吸引ワンドと組み合わせて手で運ぶ可搬型吸引ユニットを含む。床ツールは、典型的には、剛性の細長吸引ワンドの端部に取り付けられ、又は代替的にワンドの底端部と一体化することができる。このタイプのスティックバキューム掃除機の設計は、ＵＳＤ第２９８８７５号、ＵＳＤ第３０３１７３号、及びＵＳＤ第２８００３３号に示されている。いずれの場合にも、可搬型吸引ユニットは、モータと、ファンと、バッグ又はサイクロン分離システムとすることができる何らかの種類の分離装置とを組み込んでいる。

【０００８】

第２のタイプのスティックバキューム掃除機は、主にマルチモードのハイブリッド機械であり、そのような場合には、ワンドは取外し可能であり、可搬型吸引ユニットは、次に、必要に応じて可搬型真空掃除機として独立して使用することができる。しかし、これは、これらのタイプのスティックバキューム掃除機の基本的な特徴ではなく、ワンドは、可搬型吸引ユニットに恒久的に取り付けることができると考えられる。

【０００９】

第２のタイプのスティックバキュームを第１のタイプのスティックバキュームと区別する特徴は、第１のタイプが「底重」（下部が重い）であり、モータが普通サイズの直立型掃除機と類似の方式で下方に低く位置するが、第２のタイプは、「頭重」（上部が重い）であり、細長吸引ワンドと組み合わせた可搬型吸引ユニットの使用は、モータ（可搬型吸引ユニットの内側にある）が機械の上端により近く位置することを意味するという点である。

【００１０】

第２のタイプのスティックバキュームにおける重量の「頭重」配分は、これらが、スティックバキュームモードで格納するのに特に便利なものではないことを意味する。スティックバキューム掃除機が、床に支持された床ツール及び壁にもたれかかった可搬型吸引ユニットと共に直立位置の壁に立て掛けられる場合、可搬型吸引ユニットの相対重量は、スティックバキューム掃除機を全体として不安定にする傾向がある。他方、スティックバキューム掃除機は、床に支持されたかなり重い可搬型真空掃除機と共に上下を逆にして壁に立て掛ける場合、掃除機の比較的汚れた下端は、結果的に壁にもたれかかることになり、これは、望ましくない。同様に、スティックバキューム掃除機が、直立位置ではなくて逆さまの位置に格納される時に、使用するために掃除機を元に戻して直立位置に変えるためにスティックバキューム掃除機の比較的汚れた下端の領域でスティックバキューム掃除機が把持されるのが自然な傾向である。

【先行技術文献】

【特許文献】

【００１１】

【特許文献１】ＧＢ２３７７８８０Ａ１
【特許文献２】ＵＳＤ２９８８７５
【特許文献３】ＵＳＤ３０３１７３
【特許文献４】ＵＳＤ２８００３３

【発明の概要】

【発明が解決しようとする課題】
【００１２】
その結果、第２のタイプの従来のスティックバキューム掃除機は、多くの場合、床の上に格納される傾向があり、又はそうするための空間が不十分な場所では、使用後格納するために部分的に分解され、次に、スティックバキュームモードの機械を使用することが望ましい時に再び組み立てられる傾向がある。分解及び再組立の必要性は、スティックバキュームモードでの機械の使用を特に妨げる。
【課題を解決するための手段】
【００１３】
本発明によると、スティックバキューム掃除機を形成するために細長吸引ワンドと組み合わせた可搬型吸引ユニットを含む装置が提供され、装置は、使用していない時には直立のドック位置の壁上のスティックバキューム掃除機を支持するための壁掛け可能なドッキングステーションを更に含む。
【００１４】
「直立位置」により、細長吸引ワンドが、可搬型吸引ユニットから床の方向に下方に延びる位置を意味する。直立位置のスティックバキューム掃除機を格納することは、スティックバキュームが直立位置で準備が整っている時点で、ドッキングステーションからスティックバキュームを外すためにユーザが都合よく可搬型真空掃除機を把持することができるという点で有利であり、使用するための直立位置までスティックバキューム掃除機を操作するために、ユーザがスティックバキュームの比較的汚れた下端を把持する傾向はない。同時に、「頭重」スティックバキューム掃除機は、ドッキングステーション（これは、直立位置のスティックバキューム掃除機を横方向に支持する）によって比較的安定な直立位置に有利に支持される。
【００１５】
特に安定な配置では、ドッキングステーションは、直立のドック位置のスティックバキュームを固定するために、すなわち、スティックバキューム掃除機が基本的に直立のドック位置のドッキングステーションに対して固定されるように解除可能に配置される。
【００１６】
ドッキングステーションは、スティックバキューム掃除機が直立のドック位置にある時に可搬型吸引ユニットを直接支持するために、可搬型吸引ユニットと係合するように配置することができる。その結果、質量中心が大部分は可搬型吸引ユニットの内側にあるモータの位置によって決定付けられるので、スティックバキューム掃除機の質量中心は、壁の上の支点に比較的近くなり、これは、特に安定な直立のドック位置を提供し、ドッキングステーション構成要素に対して比較的低い応力をもたらす。
【００１７】
可搬型掃除機は、バッテリ式可搬型掃除機とすることができ、この場合には、可搬型掃除機は、搭載再充電可能バッテリに接続された１組の外部充電接点を組み込むことができ、ドッキングステーションは、主電源に接続するためのそれぞれの組の充電接点を含むことができ、ドッキングステーション上の充電接点は、可搬型掃除機上の上述の外部充電接点と係合するように配置され、スティックバキューム掃除機が直立のドック位置にある時にバッテリ充電回路を形成する。従って、ドッキングステーションは、スティックバキューム掃除機が直立のドック位置にある時に可搬型ユニットに搭載されたバッテリを有利に充電する。
【００１８】
可搬型吸引ユニット上の充電接点は、あらゆる好ましい方式で配置することができる。一部の場合では、スティックバキューム掃除機が直立位置にある時に接点が上方を向くことを意味する方法で、可搬型吸引ユニット上に接点を配置することが望ましいであろう。
【００１９】
可搬型吸引ユニット上の充電接点は、これらが、スティックバキューム掃除機が直立のドック位置にある時に上方を向くように配置される場合、充電接点が、スティックバキュ

ーム掃除機の重量の下でドッキングステーション上のそれぞれの接点から引き離される傾向がある可能性があることが見出されている。この問題に対処するために、ドッキングステーション上の充電接点は、可搬型吸引ユニット上の上述の上方向き充電接点と係合するように充電接点を下方に押し付けるためにバネ付勢することができる。

【００２０】

ドッキングステーションは、直立のドック位置にスティックバキューム掃除機を固定するために可搬型吸引ユニットと係合するためのキャッチを含むことができ、キャッチは、ドッキングステーション上の充電接点と係合状態の可搬型吸引ユニット上に充電接点を保持するように配置される。従って、スティックバキューム掃除機が直立のドック位置にある時にバッテリを充電するための確実な接点が保証される。

【００２１】

キャッチは、可搬型吸引ユニット上の充電接点を押し付けてドッキングステーション上の充電接点と係合するようにバネ付勢することができる。これは、ドッキングステーション上の充電接点を上述のようにバネ荷重することに加えて又はその代替とすることができる。

【００２２】

ドッキングステーションは、締め付け部材の対向する対を含むことができ、締め付け部材の少なくとも一方は、直立のドック位置のスティックバキュームを固定するために他方の締め付け部材に対してスティックバキュームを弾力的に締め付けるために他の締め付け部材の方向に弾力的に付勢される。これは、特に安定な装置を提供し、スティックバキュームは、直立のドック位置に確実に締め付けられる。更に、掃除機のドッキング及び解除は、下でより詳細に説明するように基本的に片手によるものである。

【００２３】

締め付け部材の対は、可搬型吸引ユニットのそれぞれの下部部分に対して上方に締め付けるように配置された下部締め付け部材と、可搬型吸引ユニットのそれぞれの上部部分に対して下方に締め付けるように配置された対向する上部締め付け部材とから構成することができる。これは、掃除機にかかる締め付け荷重が、重力の力と正反対であるという点で有利である。

【００２４】

特定の装置では、下部締め付け部材は、壁に対して使用時には固定され、上部締め付け部材は、下部締め付け部材の方向に下方に弾力的に付勢される。

【００２５】

締め付け部材は、締め付け軸に沿って相対摺動移動してスティックバキュームと係合するように配置することができ、少なくとも一方の締め付け部材は、他方の締め付け部材との締め付けアラインメントに入りかつそこから出る移動に対して更に配置される。他方の締め付け部材との締め付けアラインメントから締め付け部材を取り出す機能は、締め付け部材との掃除機の連続係合を考慮するものであり、これは、ドッキングを更に便利にする。締め付けアラインメントに出入りする締め付け部材の移動は、ピボット回転移動とすることができる。特に、壁上に装着されたドッキングステーションで使用する時には、上述のピボット回転可能締め付け部材は、ドッキングステーションが壁上に装着されて使用されている時に、締め付け部材が壁から離れてピボット回転移動するように配置されるように配置することができる。この後者の配置は、ピボット回転可能締め付け部材が、ドッキングステーションの占有面積内で移動するので、壁上のドッキングステーションの占有面積を低減するのに特に有利と考えられる。

【００２６】

直立位置に掃除機を係止するための特に安定な配置では、上部締め付け部材は、滑り嵌めで可搬型ユニットの第１の部分を受け取るように配置されたドッキング受け台の形態であり、ドッキング受け台は、下部締め付け部材に対して摺動可能であり、かつ下部締め付け部材の方向に弾力的に付勢され、ドッキング受け台は、更に、使用時に、可搬型ユニットの上述の第１の部分を受け取るために下部締め付け部材との締め付けアラインメントか

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ら出る移動に対して壁から離れてピボット回転可能である。この場合には、下部締め付け部材は、下部締め付け部材に対する横方向移動に対してスティックバキュームを固定するために、可搬型ユニットの第２の部分と係合するための係止要素を含む固定した締め付け部材とすることができる。

【００２７】

本発明の実施形態をここで添付の図面を参照して以下に説明する。

【図面の簡単な説明】

【００２８】

【図１】使用時のスティックバキューム掃除機を示す概略図である。

【図２】図１のスティックバキューム掃除機の一部の拡大斜視図である。

【図３】ドッキングステーションにより壁に支持されたスティックバキューム掃除機を示す斜視図である。

【図４】スティックバキューム掃除機のドッキング前のドッキングステーション及びスティックバキューム掃除機の一部の拡大斜視図である。

【図５】スティックバキューム掃除機のドッキング中のドッキングステーション及びスティックバキューム掃除機の一部の拡大斜視図である。

【図６】直立のドック位置のドッキングステーション及びスティックバキューム掃除機の一部を示す拡大斜視図である。

【図７】ドッキングステーションにより代替の向きに支持されているが依然として直立位置にあるスティックバキューム掃除機を示す斜視図である。

【図８】代替ドッキングステーションとドッキングしたスティックバキューム掃除機の斜視図である。

【図９】分離した状態の代替ドッキングステーションの斜視図である。

【図１０】ドッキングステーション上のドッキング受け台のピボット回転移動を示す代替ドッキングステーションの一部（及びスティックバキューム掃除機の一部）を示す斜視図である。

【図１１】ドッキングステーションからのスティックバキューム掃除機の解除を示すスティックバキューム掃除機及び代替ドッキングステーションの斜視図である。

【図１２】ドッキングステーションを有する掃除機のドッキングを示すスティックバキューム掃除機及び代替ドッキングステーションの斜視図である。

【図１３】ドッキングステーションを有する掃除機のドッキングを更に示すスティックバキューム掃除機及び代替ドッキングステーションの斜視図である。

【図１４】掃除機上のバッテリパックとのアラインメントまでドッキング受け台を最初にピボット回転させるために比較的浅い角度での掃除機の挿入を示すスティックバキューム掃除機及び代替ドッキングステーションの斜視図である。

【発明を実施するための形態】

【００２９】

図１は、可搬型真空掃除機３、細長ワンド５、及び床ツール７の形態の可搬型吸引ユニットを含むスティックバキューム掃除機１を示している。

【００３０】

図２を参照すると、可搬型真空掃除機３は、可搬型真空掃除機３の前部に位置決めされた吸引ノズル１１を通って空気を吸い込むためにモータケーシング９の内側に配置された電動ファンを含む。吸引ノズル１１を通して吸い込んだ汚れた空気は、サイクロン分離システム１３を通ってファン発生吸引圧力の下でダクトを通され、そこで、ごみは、比較的清浄な空気が次に１つ又はそれよりも多くの微粒子フィルタ（見えない）を通じて周囲に排出されて戻される前に、空気から分離される。サイクロン分離システム１３の内側の空気流から分離されたごみは、廃棄するためのごみ容器１５に収集される。可搬型真空掃除機３は、バッテリパック１７に収容されたマルチセル再充電可能バッテリで作動する。

【００３１】

使用時には、可搬型真空掃除機３は、ハンドル１９を用いて手で運ばれる。

【００３２】
可搬型掃除機３は、比較的小型である。それにも関わらず、手における均衡した感覚を容易にするために、モータ及びバッテリパック１７のようなより重い構成要素は、意図的にハンドル１９の比較的の近くに位置し、ごみ容器１５のような比較的軽い構成要素は、ハンドル１９から更に離れて位置する。従って、可搬型掃除機３の質量の大部分は、可搬型掃除機３の後部の方向に分配される。
【００３３】
細長ワンド５は、吸引ノズル１１に接続され、床ツール７は、次に、ワンド５の下端に接続される。汚れた空気は、床ツール５の下部の吸引開口部を通して吸い込まれ、ワンド５を通じて吸引ノズル１１に移動する。
【００３４】
キャッチ２１は、可搬型掃除機３をスティックバキューム掃除機１の一部としてではなく可搬型掃除機として使用することができるように、可搬型掃除機３からワンド５を切り離すために設けられる。キャッチ２２はまた、可搬型掃除機３及びワンド５が、スティックバキューム掃除機１の一部として用いられるのではなく、代替的に何らかの他の吸引ツールと組み合わせて用いられて部屋などの上部コーナ内を清掃するために「遠くまで届く」可搬型真空掃除機を形成することができるように、ワンド５から床ツール７を切り離すために設けられる。
【００３５】
スティックバキューム掃除機１は、「頭重」であり、従来の方式のこのタイプのスティックバキューム掃除機は、それを使用していない時には格納し難かった。スティックバキューム掃除機１が、床ツール７が床に支持されて可搬型掃除機３が壁にもたれかかった状態で、直列位置の壁に立て掛けられる場合、スティックバキューム掃除機１は、全体として比較的不安定になる傾向があり、他方、スティックバキューム掃除機１が、可搬型掃除機３が床に支持されて床ツール７が壁にもたれかかった状態で、逆さまに壁に立て掛けられる場合、使用するための直立位置にスティックバキューム掃除機１を操作して戻すために、ユーザは、比較的汚れた床ツール７を把持する傾向がある。比較的汚れた床ツール７はまた、壁にマークを付ける場合がある。
【００３６】
図３は、使用していない時にスティックバキューム掃除機１を都合よく格納するための配置を示し、スティックバキューム掃除機１は、壁掛け式ドッキングステーション２３によって壁２１上の直立位置に支持されている。
【００３７】
ドッキングステーション２３は、ドッキング直前、ドッキング中、及びドックした位置にそれぞれスティックバキューム掃除機を示す図４から６により詳細に示されている。
【００３８】
スティックバキューム掃除機１は、緊密な滑り嵌めでバッテリパック１７を受け取るように成形されたドッキング受け台２５に上方に（図４の方向Ａに）入り込むバッテリパック１７を通じてドッキングステーション２３とドッキングする。ドッキング受け台２５の前壁２５ａは、受け台２５の入口から後方へ延びるブラインドスロット２７を組み込み、このブラインドスロット２７は、バッテリパックがドッキング受け台２５に上方に挿入される時にハンドル１９を収容する。
【００３９】
１組の充電接点が、スロット２７の端部に隣接して位置決めされたジャックホルダ３１にクリップ式に入る充電ジャック２９の形態でドッキングステーション２３上に設けられる。充電ジャック２９は、差込式電源コード３４を通じて主電源に接続され、ハンドル１９の後方の充電ソケット３３を通じてドック位置の可搬型掃除機３上の対応する組の充電接点と係合するように配置される。充電ソケット３３と充電ジャック２９の係合は、ドック位置のスティックバキューム掃除機１を充電するためのバッテリ充電回路を完成する。
【００４０】

キャッチ３５は、スティックバキューム掃除機１を図６に示すドック位置に確実に係止するために設けられる。

【００４１】

キャッチ３５は、ドッキング受け台２５の側面に適合するキャッチハウジング３６上にピボット回転可能に装着され、図４に示す係止位置の方向にバネ付勢される。スティックバキューム掃除機１のドッキング中に、キャッチ３５は、キャッチ３５の下部の第１のカム表面３５ａと係合し、キャッチ３５を図４に示す係止位置から離れるように図５に示す位置にピボット回転させる可搬型掃除機３上の対応するキャッチ部分３７と協働する。可搬型掃除機３が、図５に示す位置から図６に示すドック位置に移動すると、キャッチ部分３７は、キャッチ３５を最終的にクリアし、これは、次に、係止位置の方向にかつキャッチ部分３７の下側に対する係止係合に戻るようにバネ付勢され、ドック位置にスティックバキューム掃除機１を保持する。

【００４２】

スティックバキューム掃除機１は、それがドッキングステーション２３とドッキングする時に、ドッキング受け台２５の側壁によって直立位置に横方向に支持される。更に、ドッキング受け台２５の側壁は、比較的重い可搬型掃除機３に対して直接横方向支持を有利に提供する。

【００４３】

スティックバキューム掃除機１の重量は、キャッチ３５上に実質的に支持される。更に、キャッチ３５は、比較的重い可搬型掃除機３を有利に直接に支持する。

【００４４】

製造公差は、キャッチ３５が充電ソケット３３をドック位置でジャック２９との係合状態に保持するように制御される。従って、可搬型掃除機に搭載されたバッテリは、スティックバキューム掃除機１が直立のドック位置にある時に確実に充電される。

【００４５】

製造公差の制御は、充電ソケット３３が、スティックバキューム掃除機が直立のドック位置にある時に上方を向き、従って、スティックバキューム掃除機の重量がソケット３３をジャック２９から離れるように引っ張る傾向があるので、図１から６に示すような配置において特に重要であると考えられる。

【００４６】

充電信頼性に対する製造公差の潜在的な悪影響は、ドッキングステーション上で充電接点にバネ荷重をかけることによって軽減することができる。例えば、代替的な実施形態（図示せず）では、ジャックホルダ３１は、充電ソケット３３との充電ジャック２９の正の係合を保証するために下方にバネ付勢することができる。

【００４７】

スティックバキューム掃除機１をドック位置から取り外すために、ユーザは、単に手動解除レバー３８を用いてキャッチ３５を解除し、バッテリパック１７がドッキング受け台２５から外れるまでスティックバキューム掃除機を下方に摺動させる。スティックバキューム掃除機は、次に、直立位置にあって有利に使用準備が整っている。

【００４８】

スティックバキューム掃除機１の重量の下でキャッチ３５が係止位置で動かなくなり、キャッチ３５の手動解除を妨げる場合があるその傾向を低減するために、キャッチ３５の上部側面３５ｂは、適切に傾斜している（図４参照）。代替的に、キャッチ３５の上部側面は、平坦にすることができ（図６の点線Ｂによってごく概略的に示す）、これは、上部側面が、次に、例えばドック位置にユーザによって強打された可搬型掃除機３の結果としてのいずれの偶然の横方向解除力もキャッチ３５に伝達することができないという利点を有する。スティックバキューム掃除機１の重量がキャッチ３５を動かなくする傾向がある場合、それにも関わらず平坦なプロフィールのキャッチを用い、キャッチの手動解除前にユーザがスティックバキューム掃除機１をキャッチ３５から持ち上げることを可能にするために少量の遊びを設けることが可能である場合があるが、しかし、スティックバキュー

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ム掃除機が、図６に示す直立のドック位置にある時に、ソケット３３をジャック２９から引き離せるほどの十分な遊びがないことを保証するように注意を要するであろう。

【００４９】

このドッキングステーション２３は、受け台２５の後壁２５ａの皿穴クリアランス孔（見えない）を通して壁２１にねじ込まれる壁固定式ネジ（図示せず）を用いて壁２１に固定することができる。接着パッドなどのような表面ファスナを含むあらゆる他の適切に強力な従来の壁固定法を用いて、壁２１上にドッキングステーション２３を装着することができる。

【００５０】

この場合には、スティックバキューム掃除機１は、完全に直立のドック位置に格納され、ワンド５は、実質的に垂直に下方に「ぶら下がる」。しかし、スティックバキューム掃除機が直立位置に格納される限り、これは、本発明の利点を得るのに必要であるとは考えられない。

【００５１】

図７は、壁２１に固定され（例えば、ネジを用いて）、壁上のドッキングステーション２３を支持するためにドッキング受け台２５上の装着ラグ４１（図４）と係合するように配置された装着ブラケット３９を用いて、代替の向きで壁２１上に装着されたドッキングステーション２３を示している。

【００５２】

キャッチハウジング３６は、摩擦嵌めでキャッチハウジング上に保持される間隙用ツール及び内装用ブラシのための装着点を組み込んでいる。

【００５３】

図８は、壁上の直立のドック位置にスティックバキューム掃除機１を固定するための代替の壁掛け可能なドッキングステーション２３０を示している。

【００５４】

この配置では、可搬型ユニット３は、ドッキング受け台２５０の形態の上部締め付け部材と、ごみ容器支持体３５０の形態の下部締め付け部材の間で直立のドック位置に確実に締め付けられる。締め付け荷重は、F_1及びF_2によって図８に表され、掃除機の重量と正反対にある。

【００５５】

ごみ容器支持体３５０は、使用時に好ましい壁固定を用いて示した向きで壁に対して平坦に固定される壁掛けプレート３７０（図９）に固定される。この特別の場合には、下部ごみ容器支持体３５０は、実際に壁掛けプレート３７０と一体的に形成されるが、これは必須ではない。係止要素３６０（図９）が、ごみ容器支持体３５０上に設けられ、これは、ごみ容器１５の前部上でキャッチ凹部１５ａ（図１１で少し見える）と係合し、ドック位置の横方向移動に対してごみ容器１５を固定する。「万能嵌め」ツールホルダ３４０は、ツール又は場合によってはワンド５を保持するために下部ごみ容器支持体３５０の下部に設けられる。

【００５６】

ドッキング受け台２５０は、ドッキング受け台２５と類似しているが、長さが短く、ドッキング受け台２５０も同様に緊密滑り嵌めでバッテリパック１７を受け取るように配置される。ブラインドスロット２７０は、ドッキング受け台２５０の前壁に設けられてハンドル１９を収容し、電源コンセント作動式充電ジャック２９０は、ハンドル１９（図８）の後方で充電ソケット３３と係合するように、スロット２７０のブラインド端に隣接してジャックホルダ３１０内に保持される。

【００５７】

ドッキング受け台２５０は、壁掛けプレート３７０に対して上下に移動してドッキング受け台２５０とごみ容器支持体３５０の間の（垂直）分離を変更することができる個別のキャリッジプレート３９０（図９）によって支持される。付勢バネ４１０（キャリッジプレート３９０の窓を通して図９で少し見える）は、キャリッジプレートと装着プレート３

７０との間でドッキング受け台２５０をごみ容器支持体３５０の方向に下方に付勢するように作用する。バネ４１０は、従って、ドッキング受け台２５０とごみ容器支持体３５０の間に正の締め付け作用をもたらし、これは、ドック位置で充電ジャック２９０と充電ソケット３３の間の確実な電気接点を維持するのに役立つ。

【００５８】

ドッキング受け台２５０は、支持ヨーク４３０を通じてキャリッジプレート３９０上にピボット回転可能に装着される。これは、ごみ容器支持体３５０（図１０参照）との締め付けアラインメントからドッキング受け台２５０を移動させるように、ドッキング受け台２５０が軸Ｏの周りでキャリッジプレート３９０から離れてピボット回転することを可能にする。

【００５９】

スティックバキューム掃除機１を図８に示すドック位置から解除するために、ユーザは、スティックバキューム掃除機を把持し、スティックバキューム掃除機１を上方に押し、係止要素３６０がごみ容器１５中のキャッチ凹部１５ａをクリアするまでバネ４１０の付勢に対してドッキング受け台２５０を移動させる。係止要素３６０がごみ容器１５上のキャッチ凹部１５ａをクリアした状態で、スティックバキューム掃除機１は、次に、装着プレートから離れてかつごみ容器支持体３５０との締め付けアラインメントから出て横方向にドッキング受け台２５０をピボット回転させるように操作することができ、これは、次に、バッテリパック１７が、掃除機１（図１１）を解除するためにごみ容器支持体３５０の前縁を過ぎてドッキング受け台２５０から摺動して出ることを可能にする。

【００６０】

図８に示すドック位置からのスティックバキューム掃除機１の解除は、ユーザが掃除機１を保持するのに片方の手、及びドッキングステーション２３０を作動させるのに他方の手を使用する必要がないという意味で片手作動である（ユーザは、勿論、掃除機１をドッキング又は解除する時に任意的に両手で掃除機１を把持することができ、実際にドッキングステーション２３０は、有利に人がそうすることを可能にする）。

【００６１】

ドッキングステーション２３０との掃除機１のドッキングも片手作動である。掃除機１の解除の後にドッキングステーション２３０と掃除機１をドッキングさせるために、バッテリパック１７は、単にドッキング受け台２５０に摺動して戻り、ドッキング受け台２５０は、次に、掃除機１を用いて移動され、下部ごみ容器支持体３５０（図１２及び１３）との締め付けアラインメントに戻る。この位置では、ユーザが掃除機１を手放すと、掃除機１は、圧縮バネ４１０の作用の下でドッキング受け台２５０とごみ容器支持体３５０との間で自動的に締め付けられ、係止要素３６０は、ごみ容器１５中のキャッチ凹部１５ａと係合する。

【００６２】

差込式電源コード３４０は、装着プレート３７０に成形されたチャンネル３７０ａを通って装着プレート３７０の背後で下方に延びている。チャンネル３７０ａの上端は、トランペット形状であり、これは、ドッキング受け台２５０のピボット回転移動中にコード３４０への応力を低減するのに役立つ。止め具３４０ａが、電源コード３４０上に設けられ、ドッキング受け台２５０が軸Ｏの周りでピボット回転される時にチャンネル３７０ａの内側の電源コード３４０の取り込みを防止し、止め具３４０ａの使用は、更に、電源コード３４０の長さがチャンネル３７０ａの上端とジャックホルダ２９０の間で固定されたままであることを保証することにより、電源コード３４０にかかる応力を低減する。

【００６３】

係止要素３６０には、傾斜前面３６０ａ（図１０）が設けられ、ドッキング受け台２５０が移動してごみ容器支持体３５０との締め付けアラインメントに戻る時にごみ容器１５が最初に係止要素３６０を超えることを可能にする。これは、ドッキング作動を簡略化するが、それは必須ではない。係止要素は、代替的に平坦な前面を有することができ、又は実際に固定係止要素とすることができ、これは、次に、ユーザが、掃除機１及びドッキン

グ受け台２５０を上方に押して、ドッキング受け台２５０が移動してごみ容器支持体３５０との締め付けアラインメントに戻る前にごみ容器１５が係止要素を完全にクリアすることを確実にする必要があるであろう。

【００６４】

ドッキングステーション２３０は、掃除機１が直立のドック位置で横方向の機械的衝撃を受ける場合、掃除機１及び／又はドッキングステーション２３０に対する偶然の損傷を低減するのに役立ついくつかの特徴を組み込んでいる。これらは、ごみ容器１５が横方向の衝撃力の下で係止要素３６０を横方向に超えることを可能にする係止要素３６０上の傾斜側面（側面３６０ｂのみが、図１０で見える）の具備と、同じくドッキング受け台２５０とキャリッジ３９０の間の横方向ある程度の「遊び」の具備とを含む。横方向荷重が、バネ４１０の付勢に対して垂直のドッキング受け台２５０の移動によって取り込まれるように、横方向力の下で掃除機１を上方に案内するガイド面（例えば、ごみ容器支持体３５０の湾曲面３５０ａ）も設けることができる。任意的に、ドッキング受け台２５０が結果的に軸Ｏの周りで外方に回転するように横方向力の下で掃除機１を案内するガイド面も設けることができ、その場合には、掃除機１は、十分な横方向荷重の下で「抜け出て」自動的に解除することができる。

【００６５】

図１２は、バッテリパック１７のドッキング受け台２５０への挿入を示しており、ドッキング受け台２５０は、ごみ容器支持体３５０との締め付けアラインメントから既に移動している。実際に、ドック位置からの掃除機１の解除の後に、ドッキング受け台２５０は、それ自体の重量の下で移動してごみ容器支持体３５０との締め付けアラインメントに戻る傾向があることになる。この場合には、図１４に示すように、ドッキング受け台２５０へのバッテリパック１７の部分的挿入は、それにも関わらず、掃除機１の片手ドッキングが依然として可能であるように、壁から離れてバッテリパック１７とのアラインメントに入るようにドッキング受け台２５０をピボット回転させる傾向があることになる。ドッキング受け台２５０のこの「自己アラインメント」は、バッテリパック１７が比較的浅い角度でドッキング受け台２５に挿入することを可能にするドッキング受け台２５０の比較的短い長さに一部は助けられる（図４から６のドッキング受け台２５０を参照）。付勢バネ（図示せず）は、必要に応じてドッキング受け台２５０を意図的に付勢して掃除機１の解除に続いてごみ容器支持体３５０との締め付けアラインメントに戻すのに使用することができると考えられる。

【００６６】

本発明によると、ドッキングステーション上の締め付け部材のいずれか又は両方は、弾力的付勢の作用に対して壁に対して移動するように装着することができる。例えば、ドッキングステーション２３０において、ドッキング受け台２５０は、壁に固定することができ、ごみ容器支持体３５０は、付勢バネの作用に対してドッキング受け台２５０に対して摺動移動するように装着することができるであろう。上部締め付け部材が固定される場合、下部締め付け部材は、図１１から１４のドッキング受け台２５０の作動と同様に、上部締め付け部材との締め付けアラインメントに入るか又は出るように移動可能にすることができる。ドッキングステーション２３の場合には、キャッチ３５及び／又はドッキング受け台２５はまた、締め付け部材として配置することができる。例えば、キャッチ３５は、係止位置でキャッチが実際にドッキング受け台２５に対して上方に掃除機１を積極的に締め付けるようにバネ付勢することができ、解除レバー３８は、必要に応じてドッキング受け台２５との締め付けアラインメントから出てキャッチ３５をピボット回転させるのに使用することができる。ドッキング受け台２５も、同様にバネ付勢し、掃除機をキャッチ３５に対して確実に締め付けることができる。

【００６７】

締め付け部材の一方（例えば、ドッキング受け台２５０）の他方の締め付け部材（例えば、ごみ容器支持体３５０）との締め付けアラインメントへの出入りの移動は、ピボット回転移動である必要はない。例えば、ドッキング受け台２５０は、ごみ容器支持体３５０

との締め付けアラインメントから出て横方向に摺動するように配置することができると考えられる。しかし、ピボット回転締め付け部材の使用は、ドッキングステーションの占有面積を最小にするのに役立つ。

【００６８】

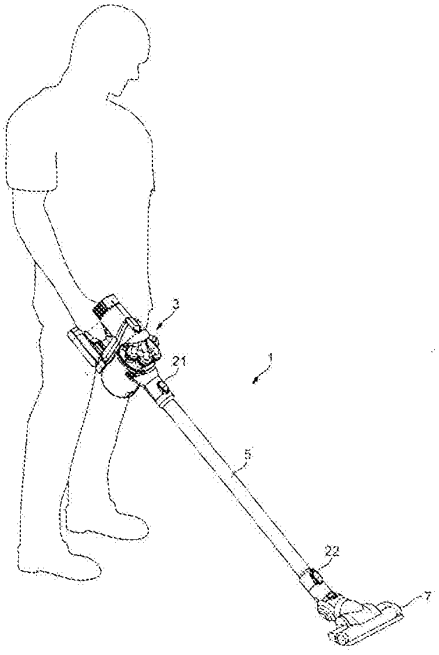
対向する締め付け部材との締め付けアラインメントに出入りして移動することができる第１の締め付け部材の使用は、有利であるが、片手ドッキング及び解除に対して必須ではない。例えば、ドッキング受け台２５０は、代替的に、摺動キャリッジプレート３９０に対してそれが固定ごみ容器支持体３５０との締め付けアラインメントに常に維持されるように固定することができると考えられる。固定ドッキング受け台は、ある程度までバッテリパックの挿入を抑制すると考えられ、これは、バッテリパック１７を非常に浅い角度で固定ドッキング受け台に挿入することができるようにドッキングの長さを最小にすることにより、必要に応じてある一定の範囲で軽減することができると考えられる。

【符号の説明】

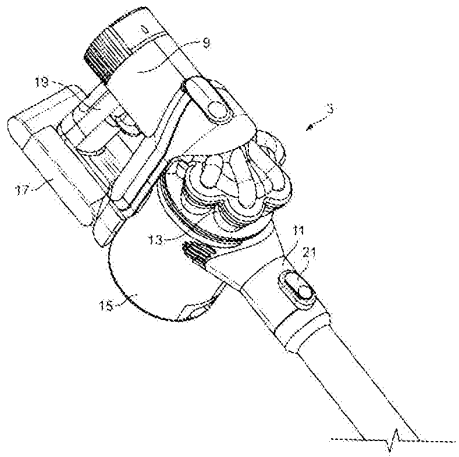
【００６９】

1　スティックバキューム掃除機
3　可搬型真空掃除機
5　細長ワンド
7　床ツール

【図１】



【図２】



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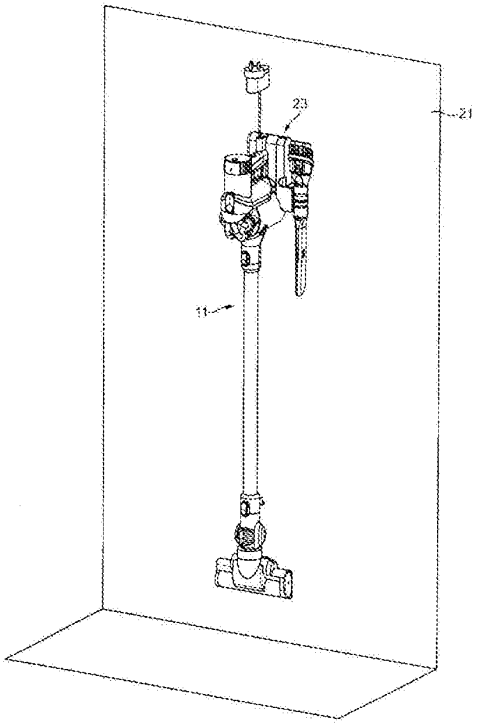
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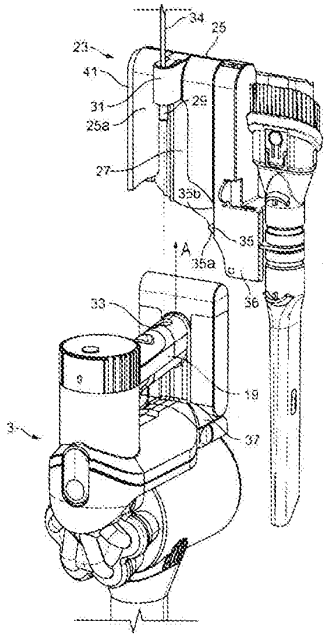
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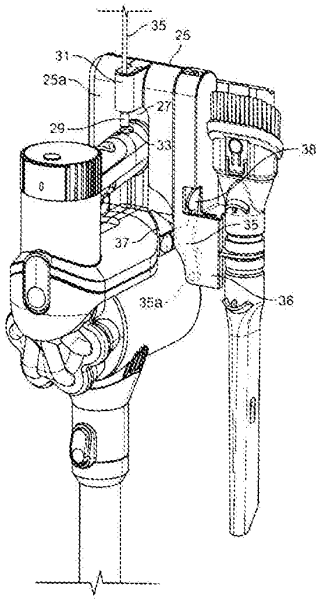
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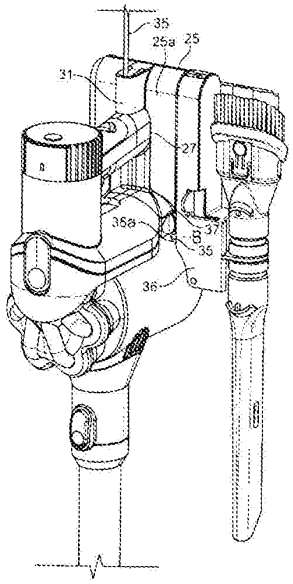
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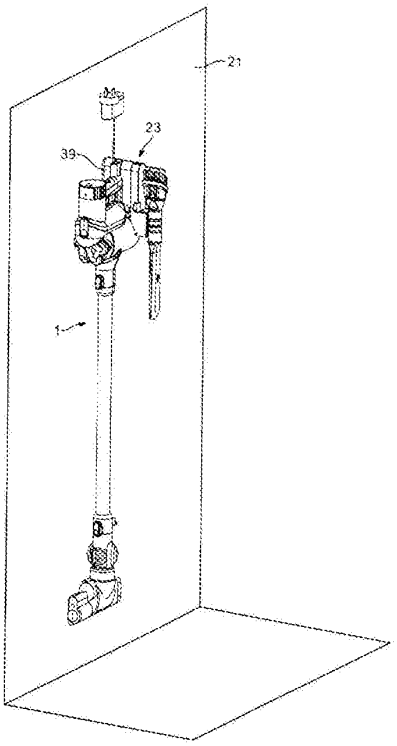
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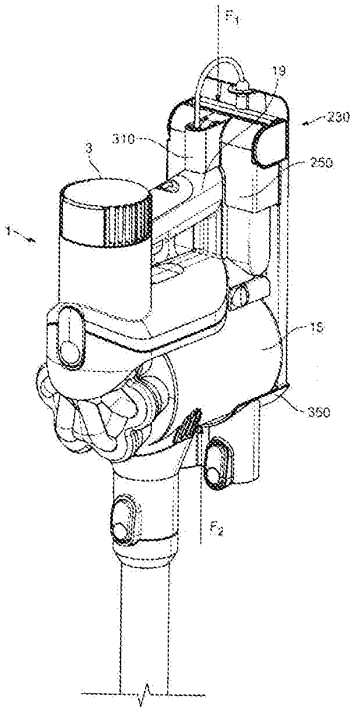
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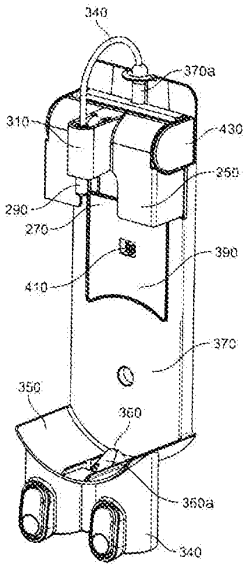
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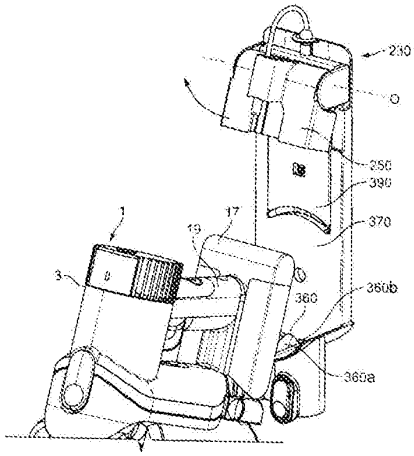
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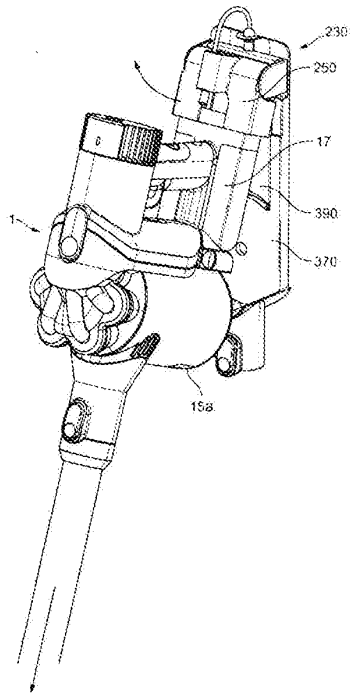
【図１１】



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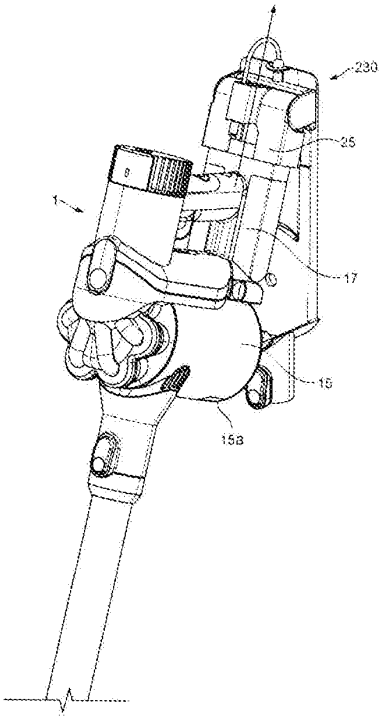

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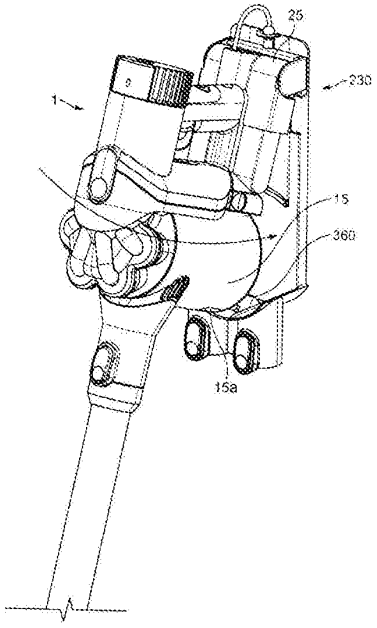

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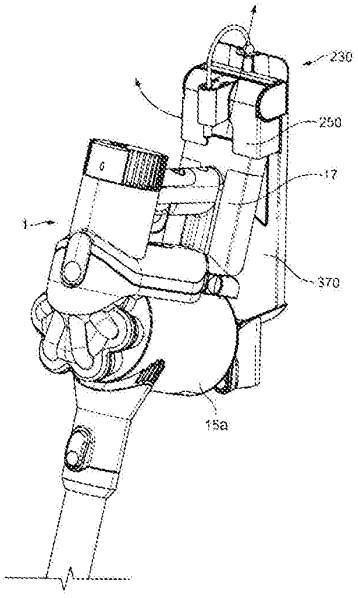

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(54) Title: ELECTRICAL CORD AND APPARATUS USING SAME

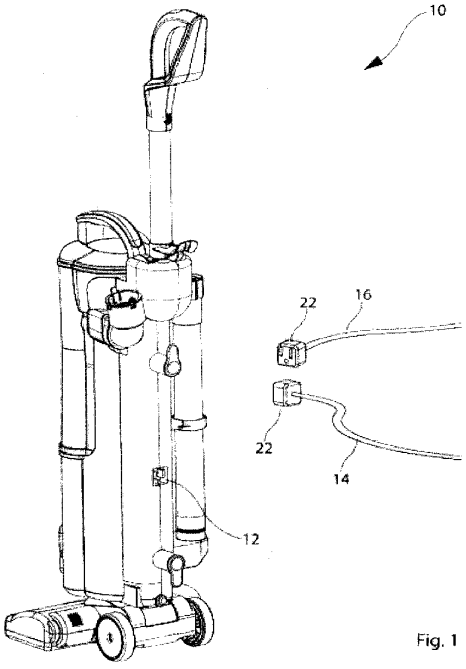

Fig. 1

(57) Abstract: An electricity conducting cord has first and second ends, one of the ends comprising an electrical connection member engageable with a power connection member of an apparatus having an apparatus power rating, at least one of the power connection member and the electrical connection member comprising electrical connectors and a physical cord identification member, the physical cord identification member is configured to inhibit the electricity conducting cord being electrically connected to the power connection member if the electricity conducting cord has a power rating lower than the apparatus power rating.

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TITLE: ELECTRICAL CORD AND APPARATUS USING SAME

FIELD

This invention relates to power cords, also referred to as electricity conducting cords, such as those that may be used with household appliances and a household appliance that is operated with a power cord.

INTRODUCTION

Household appliances such as surface cleaning apparatus (e.g. a vacuum cleaner, carpet extractor and the like), power tools, kitchen appliances, personal care products (e.g. hair driers, electric toothbrushes and the like) and lawn or garden tools typically are operated using household electric current. Accordingly, each appliance is sold with a power cord. Typically, the power cord is non-removably affixed to the appliance. When the appliance reaches the end of its life, the power cord is thrown away with the rest of the appliance. Typically, the appliance is disposed of (e.g., sent to landfill) as it has reached the end of its life as opposed to the electrical cord requiring replacement. Further, a significant percentage of small appliances are destroyed in the field by retailers when returned by customers as opposed to being sent back to the manufacturer or marketer for refurbishment.

It is known to provide some electronic devises, such as computers and electric kettles, with a removable power cord. However, a specific power cord may be designed for each appliance. Accordingly, while the power cord may be kept when the appliance is disposed of, the power cord may not be designed to mate with a replacement appliance (i.e. the plug of the power cord may not fit into a socket of the replacement appliance).

Extension cords for household use are commonly available. Extension cords typically have a standard single plug for insertion into a household electrical socket and one or more sockets into which the standard plug of an appliance may be inserted. Accordingly, the extension cords are generic and may be used with any appliance. For example, an appliance plug with a three-prong connector may be inserted into any extension cord having a three-prong socket. Similarly, an appliance having a two-prong connector may be inserted into any extension cord having two mating recesses for the prongs.

SUMMARY

In accordance with this invention, a reusable electricity conducting cord is provided. The electricity conducting cord is designed so that it may not be utilized with an appliance having a higher power rating (e.g. amperage rating) then that of the electricity conducting cord. Accordingly, either the appliance or the electricity conducting cord, and preferably both, are provided with a cord identification member. The cord identification member inhibits a cord from being plugged into an appliance if the cord is underrated for the appliance. Accordingly, one advantage of this design is that reusable cords may be provided. For example, a series of cords having various power ratings may be provided. These cords may be kept by a consumer and utilized with an appliance having a compatible (the same or lower) power rating. Therefore, when an appliance is disposed of, the electricity conducting cord may be kept and re-used for an appliance having a compatible power rating.

In an optional embodiment, a series of electricity conducting cords having different power ratings may be available (e.g., provided with a product or sold separately). The electricity conducting cords may have different cord identification members based on the power rating of the electricity conducting cord. The cord identification member inhibits an electricity conducting cord being electrically connected to an appliance and/or another electricity conducting cord,

if the electricity conducting cord has a power rating that is lower than the power rating of the appliance.

For example, an appliance may be sold by itself and the manufacturer or a third party may provide a series of electricity conducting cords, which may be sold separately or supplied with an appliance. Accordingly, if a user already has an electricity conducting cord, it is not necessary for the manufacturer to supply an electricity conducting cord with the appliance. The consumer may use an electricity conducting cord that the consumer already has. Alternately, if the consumer does not have a suitable electricity conducting cord, they may purchase one separately. Electricity conducting cords use a relatively large amount of copper. By providing a re-usable electricity conducting cord, the amount of copper which is utilized in the manufacture of an appliance, and which is eventually disposed of at the end of life of the appliance is reduced. By permitting the user to keep the electricity conducting cord, the amount of copper that is utilized is therefore reduced. Further, by providing the cord identification member, a user may not use an underrated cord on an appliance.

In another mode of operation, a user may have a number of the identical electricity conducting cords (i.e. an electricity conducting cord with the same electrical rating). The user may therefore keep the electricity conducting cord in various locations. When the appliance is to be used, the user need not move the electricity conducting cord with the appliance. Instead, the appliance may be moved to the required location and the electricity conducting cord at that location may be utilized. For example, a vacuum cleaner may be provided with an electricity conducting cord of about 25 feet. The electricity conducting cord may represent a significant amount of weight of the vacuum cleaner, particularly if the vacuum cleaner is a stick type vacuum cleaner. This added weight may increase the difficulty for an elderly or disabled person to carry the vacuum cleaner to another location. Accordingly, a consumer may have a first electricity conducting cord in one room or a first floor of a house and the same power rated

electricity conducting cord in another room or another floor of the house. Accordingly, when the vacuum cleaner is moved to the second location, an electricity conducting cord is available for use and the consumer has not had to carry the additional weight of the electricity conducting cord. Further, the vacuum cleaner may be easier to store without the cord attached.

It will be appreciated that the power rating of an electricity conducting cord is based upon the amount of electricity that the cord can provide. This will be based, *inter alia,* upon the gauge of the wire as well as the length of the cord.

Accordingly, in accordance with a first embodiment of the invention, there is provided an appliance having an appliance power rating the appliance comprising

(a) an electrically operated member;

(b) an electrical connection member; and,

(c) an electricity conducting cord having a first end connectable in electric communication with the electrical connection member and a second end connectable with a source of electricity

wherein at least one of the electrical connection member and the first end of the electricity conducting cord have at least one cord identification member configured and/or to prevent the first end of an electricity conducting cord having a power rating lower than the appliance power rating being electrically connected to the electrical connection member.

In some embodiments, the electrical connection member may have a first cord identification member and the first end of the electricity conducting cord may have a second cord identification member. Preferably, one of the first and second cord identification members comprises a male member and the other of the first and second cord identification members comprises a female member. Preferably,

the male member and the female member are sized, positioned and/or shaped, and/or the number of male members that are provided on the end having the male members, is based on the power rating of the respective part on which the male member and the female member is provided.

In some embodiments, the appliance may further comprise a plurality of electricity conducting cords of varying gauges and the male member provided on the end having the male member may increase in size as the gauge of the electricity conducting cord increases.

In some embodiments, the appliance may further comprise a plurality of electricity conducting cords of varying gauges and the female member provided on the end having the female member may decrease in size as the gauge of the electricity conducting cord increases.

In some embodiments, the first and second cord identification members may be inter-engageable only if the electricity conducting cord has a power rating the same as or higher than the appliance power rating.

In some embodiments, one of the first and second cord identification members may be a male engagement member and the other of the first and second cord identification members may be a female engagement member and the male engagement member may be positioned and configured to be engageable with a female engagement member only if the electricity conducting cord has a power rating the same as or higher than the appliance power rating.

In some embodiments, the appliance may have an appliance electric cord having a length of up to one foot. Preferably, the appliance electric cord has a length of up to 6 inches.

In some embodiments, the electricity conducting cord may have a length of at least 6 feet, preferably 6 - 300 feet and more preferably 25 - 50 feet.

In some embodiments, the cord identification member of the electrical connection member may be positioned or configured based on the power rating of the appliance and the cord identification member of the electricity conducting cord may have a power rating based on the length and gauge of the electricity conducting cord.

In some embodiments, the cord identification member of the electricity conducting cord may be positioned or configured based on the length and gauge of the electricity conducting cord.

In some embodiments, the electrical connection member may be a plug and the first end of an electricity conducting cord may be a socket.

In some embodiments, the electrical connection member may be a socket and the first end of an electricity conducting cord may be a plug.

In some embodiments, at least one of the electricity conducting cord and the electrical connection member may include a fuse. Preferably, the fuse is provided in at least one of the electrical connection member and the first end of the electricity conducting cord. More preferably, the appliance further comprises a visual signaling member indicative of the fuse being in operating condition or an audio signaling member indicative of the fuse being blown.

In some embodiments, the appliance may further comprise a visual signaling member indicative of the amount of power flowing through the electricity conducting cord. Preferably, the visual signaling member comprises at least one of a plurality of different coloured lights, a light having a variable colour, a light having a variable intensity or a meter.

In some embodiments, the fuse may comprise a fuse link member, the fuse link member is visible when the fuse is installed and the visual signaling member comprises the fuse link member.

In some embodiments, the fuse may be resettable and the position of a fuse reset member comprises the visual signaling member.

In some embodiments, the visual signaling member may comprise an illumination member that is illuminated when current flows through the electricity conducting cord.

In some embodiments, the appliance may further comprise an illumination member that is illuminated when current flows through the electricity conducting cord.

In some embodiments, the appliance may be selected from the group consisting of a surface cleaning apparatus, a power tool, a kitchen appliance, a kitchen appliance, a lawn or garden appliance and a personal care product.

In accordance with another embodiment of the invention, there is provided an electricity conducting cord having first and second ends, one of the ends comprising an electrical connection member engageable with a power connection member of an apparatus having an apparatus power rating, at least one of the power connection member and the electrical connection member comprising electrical connectors and a physical cord identification member, the physical cord identification member configured to inhibit the electricity conducting cord being electrically connected to the power connection member if the electricity conducting cord has a power rating lower than the apparatus power rating.

In accordance with another embodiment of the invention, there is provided an apparatus comprising an electrically powered unit having a first electrical connection member, the first electrical connection member comprising electrical connectors and a physical identifying member, the physical identifying member configured to permit a second electrical connection member to only engage the

first electrical connection member if the second electrical connection member has a power rating compatible with the apparatus.

The electricity conducting cord and the apparatus may use any one or more of the features of the alternate embodiments of the appliance.

DRAWINGS

These and other advantages will be more fully and clearly understood in connection with the following description of the preferred embodiments, which are shown in the following drawings:

Figure 1 is a perspective view of an appliance according to one embodiment of this invention;

Figure 2 is a perspective view of the appliance of Figure 1 in accordance with another embodiment of this invention;

Figure 3 is a perspective view of the appliance of Figure 1 in accordance with a further embodiment of this invention;

Figure 4 is a perspective view of the appliance of Figure 1 in accordance with a further embodiment of this invention;

Figure 5 is a perspective view of another appliance in accordance with an embodiment of this invention;

Figure 6 is a perspective view of an electricity conducting cord according to one embodiment of this invention showing a plurality of optional sockets and a plurality of optional plugs that may be utilized.

Figure 7 is a perspective view of two electricity conducting cords according to another embodiment of this invention showing alternate sockets and alternate plugs that may be utilized; and,

Figure 8 is a perspective view of a further electricity conducting cord according to another embodiment of this invention showing an alternate series of sockets and plugs that may be utilized.

DESCRIPTION OF VARIOUS EMBODIMENTS

Various apparatuses or methods will be described below to provide an example of each claimed invention. No example described below limits any claimed invention and any claimed invention may cover processes or apparatuses that are not described below. The claimed inventions are not limited to apparatuses or processes having all the features of any one apparatus or process described below or to features common to multiple or all of the apparatuses described below. It is possible that an apparatus or process described below is not an embodiment of any claimed invention.

In accordance with this invention, an electrically operated appliance 10 is utilized. The appliance, or apparatus, may be any apparatus, which requires an electricity conducting cord. Preferably, the appliance may be a vacuum cleaner or other surface cleaning apparatus (e.g. an extractor, carpet cleaner etc.), a power tool (such as a drill, skill saw, sander or the like), a kitchen appliance (such as an electric kettle, a toaster, a juicer or the like), a lawn or garden appliance (such as a lawn mower, hedge trimmers, or the like), or a personal care product (such as a hair dryer, electric tooth brush or the like). For example, as exemplified in Figures 1 – 4, appliance 10 is a vacuum cleaner. As exemplified in Figure 5, appliance 10 is a toaster. Each appliance has an electrically operated member. For example, in the case of a vacuum cleaner, the electrically operated member may be the suction motor, and, optionally, a light, a brush motor or the like. In the case of a toaster, the electrically operated member may be the heating elements provided in the toaster. Accordingly, the electrically operated member may be a member having a moving part or no moving part.

As exemplified in Figures 1 – 5, appliance 10 is provided with an electrical connection member 12. Electrical connection member may be provided

in the housing of appliance 10 itself (as exemplified in Figures 1 – 4) or may be provided at the end of a short electricity conducting cord, e.g. a pigtail cord, as exemplified in Figure 5. The pigtail cord may have a length of up to one foot and, preferably, up to only about six inches. If such a cord is provided, it may have an advantage of facilitating a user plugging an electricity conducting cord 14, 16, 18, 20, into first electrical connection member 12.

First electrical connection member 12 is a plug which may be recessed in a housing of appliance 10. In particular, a shown in Figure 5, first electrical connection number 12 has three electrical connectors, one of which is a ground, and a first cord identification member 26. In an alternate embodiment, it will be appreciated that electrical connection member 12 may only have two electrical connectors (i.e., a ground may not be required). In an alternate embodiment, it will be appreciated that electrical connection member 12 may be a socket as opposed to a plug. Further, the electrical connection member may be provided at any location that is desired on the appliance.

As shown in Figures 1 – 3 and 5, one or more electrical connection members 12, 14, 16 and 18 may be provided with appliance 10 or usable with appliance 10. For example, referring to Figure 1, appliance 10 may be provided with two electricity conducting cords 14 and 16. Cords 14 and 16 may be of varying lengths. Each cord is provided with a first end 22, which is insertable or mate able with first electrical connection member 12. Accordingly, as exemplified in Figure 5, first end 22 is a socket having a plurality of recesses 32 sized to receive electrical connectors 30. It will be appreciated that in an alternate embodiment, first electrical connection member 12 may be a socket and first end 22 may be a plug.

It will be appreciated that, in order to provide a required power level to appliance 10, the electricity conducting cord should be approved (e.g. by UL) to supply that particular level of power. Therefore, the gauge of the wire that is utilized for the electricity conducting cord may vary depending upon several

factors including the gauge of the wire and the length of the wire. For example, if a longer wire is utilized, then to supply the same power requirement, a heavier gauge (larger gauge) wire is utilized. For example, while a 16 gauge wire may be rated for 10 amps, if a longer electricity conducting cord is utilized, then an 18 gauge wire (which is typically rated 8 amps) may be required.

As exemplified in Figure 2, appliance 10 is provided with or is usable with an electricity conducting cord 18, which is a relatively long cord. For example, the cord may be at least 6 feet long, optionally from 6 to 300 feet long, and preferably from 25 to 50 feet long. Accordingly, due to the length of the cord, a heavier gauge wire may be utilized to provide the requisite power to appliance 10. As shown in Figure 3, appliance 10 is usable with an electricity conducting cord 20. Electricity conducting cord 20 is shorter and may accordingly be of a lighter gauge wire and still be rated to supply the power requirements of appliance 10.

As shown in Figures 2 and 3, electricity conducting cord 18, 20 has a second end 24. Second end 24 is preferably configured to plug into, for example, a household electrical outlet. Accordingly, second end 24 may be a standard plug (e.g. a two prong or a three prong plug depending whether the electricity conducting cord includes a ground pin). It will be appreciated that the configuration of first and second ends 22 and 24 may vary depending upon the standard prong configuration that is utilized in different countries.

The cord identification member is configured and/or positioned to prevent first end 22 of an electricity conducting cord having a power rating lower than the power rating of appliance 10 being electrically connected to first electrical connection member 12. In a preferred embodiment, it is preferred that each of electrical connection member 12 and first end 22 are provided with a cord identification member. Accordingly, as exemplified in Figure 5, electrical connection member 12 is provided with a first cord identification member 26 and first end 22 is provided with a second cord identification member 28. First and

second cord identification members 26, 28 are configured and/or positioned to permit first end 22 to be plugged into electrical connection member 12 if electricity conducting cord 14 has a power rating that is the same as or higher than that of appliance 10 and will prevent first end 22 plugging into electrical connection member 12 if electricity conducting cord 14 has a power rating lower than the power rating of appliance 10. Therefore, by varying, for example, one or more of the size, shape and position of one or both of the cord identification members 26, 28, a plurality of different first ends 22 and first electrical connection members 12 may be provided.

It will be appreciated that a cord which has a UL approval for a particular power rating (e.g. a 10 amp rating) may be used to supply power to an appliance having a power rating of 10 amps. Further, the same cord may be used to supply power to an appliance having a lower power rating (e.g. 8 amps or even 6 amps). However, the same cord should not be used to provide power to an appliance having a higher power rating (e.g. 14 amps). In such a case, the electricity passing through the electricity conducting cord may result in the cord, for example, overheating and failing. Accordingly, in one embodiment, the cord identification members may be configured to permit only an electricity conducting cord having the power rating identical to the power rating appliance being connected to the appliance. More preferably, the cord identification member or members are configured such that only electricity conducting cords having a power rating having the same as or higher than the power rating of the appliance may be connected to the appliance.

In accordance with another embodiment, the electricity conducting member may be an extension cord. An example of such an embodiment is shown in Figure 6. As shown therein, electricity conducting cord 34 is a heavy gauge ground wire having a first end comprising a socket 22 and a second end 24 comprising a plug. Figure 6 exemplifies a plurality of possible first ends 22a, 22b, 22c and 22d and a plurality of possible second ends 24a, 24b and 24c. In

each of these embodiments, the first cord identification member 26 is a male member and is exemplified as a protrusion having a constant diameter. It will be appreciated that the diameter may vary. In each of these embodiments, the second cord identification member 28 is a female member and is exemplified as a recess or opening having a constant diameter. It will be appreciated that the diameter may vary. In particular, first end 22a has a large round recess 28a to the bottom left for receiving a cord identification member 26. First end 22b is not provided with a cord identification member. First end 22c is provided with a small round recess 28c provided in the lower right hand corner. First end 22d is provided with a larger round recess 28d in the lower right hand corner. Similarly, second end 24a is not provided with a cord identification member. Second end 24b is provided with a small round protrusion 26b in the lower right hand corner and first end 24c is provided with a larger round protrusion 26c in the lower right hand corner.

It will be understood that the different configurations for first end 24 may be utilized as first electrical connection member 12 provided on appliance 10. Accordingly, proceeding on that basis, an exemplary method of using these differently shaped recesses and protrusions will now be described. Electrical connection member 12 may be configured the same as second end 24c. In such a case, a large round first cord identification member 26c is provided. In this case, only a cord having a recess 28 which is of at least the same diameter, if not larger, than first cord identification member 26c will permit a first end 22 to be inserted into first connection member 12. Accordingly, for example, appliance 10 may have a power rating of 15 amps. If electricity conducting cord 34 is provided with first end 22a, then electricity conducting cord 34 may be plugged into the appliance to provide power to the appliance. Accordingly, electricity conducting cord 34 is designed with a power rating of at least 15 amps.

In an alternate example, appliance 10 may be provided with a first electrical connection member 12, which is configured the same as second end

24b. In such a case, the appliance may have a lower power rating (e.g. 8 amps). In such a case, an electricity conducting cord 34 having a first end 22a and a power rating of, e.g. 15 amps, may be plugged into the appliance. In such a case, the cord is over rated but usable. Alternately, a cord having a lower power rating (e.g. 8 amps) may be provided with a first end 22c. Second cord identification member 28c is positioned and configured to receive first cord identification member 26b. Accordingly, first end 22 may be plugged into appliance 10 to supply power to appliance 10.

In another embodiment, an appliance may be provided with a first electrical connection member 12 configured the same as first end 24a. In such a case, no cord identification member is provided. In this example, appliance 10 may have the highest power rating for a series of electricity conducting cords. Accordingly, only a cord with no cord identification member on first end 22 may be inserted into the appliance (e.g. a cord with first end 22b). Any electricity conducting cord with a cord identification member (e.g. a protrusion 26) would not be able to plug into the appliance. Accordingly, if a series of electricity conducting cords are provided, then no cord identification member may be provided on the highest rated cord since it may be used with any appliance in the series.

In an alternate embodiment, it will be appreciated that a cord 34 may be provided with a first end 22d. In this case, first end 22d has a recess 28d which is of the same size as first cord identification member 26c. However, recess 28d is located in a different location (the bottom right corner as opposed to the bottom left corner). Accordingly, a first end 22d could not be plugged into appliance 10. Accordingly, it will be appreciated that a change in position may be used to prevent a lower rated cord being electrically connected to an appliance 10.

Figures 7 and 8 exemplify additional alternate embodiments. Figure 7 exemplifies two electricity conducting cords 36a and 36b, which have a square

or oval electricity conducting cord. Figure 8 exemplifies an electricity conducting cord 38 having a lower gauge round wire. A plurality of different configurations for first end 22 and second end 24 are provided. These exemplify different options for the position, configuration and number of cord identification members, which may be provided. As will be appreciated from first ends 22a – 22l and second ends 24a – 24g, a large variety of different combinations of position and configurations of the cord identification members 26, 28 may be provided. Further, these figures exemplify the use of cord identification members having a different cross-sectional shape.

In one embodiment, the electricity conducting member may be designed to plug into a household electrical outlet. Accordingly, second end 24 may be a standard electrical plug. In an alternate embodiment, electricity conducting member, such as electricity conducting members 34, 36a, 36b and 38 may be designed as extension cords to be connected to an appliance or another electricity conducting cord 12, 14, 16, 18, 20. In such a case, the cords may be designed so that two electricity conducting cords may only be electrically connected together if they have compatible power ratings.

In accordance with another embodiment, a fuse 40 may be provided as part of the electrical circuit. The purpose of the fuse is to prevent an underrated cord being mistakenly used if, for example, one of the cord identification members is damaged (e.g. protrusion 26 is broken off). If an underrated cord is mistakenly used, then the fuse will preferably blow to open the electrical circuit and prevent electricity flowing through the underrated cord to the appliance. Preferably, the fuse is provided in at lease one of electrical connection member 12 and first end 22 of the electricity conducting cord. Preferably, the fuse is located in the electricity conducting cord, such as first end 22 or second end 24 (as exemplified in Figures 6 – 8).

Preferably, the fuse 40 provides a visual signal to a user that the cord is operational. For example, the fuse 40 may have a fuse link member 40a,

which is designed to break if too much electricity flows through the cord. The fuse link member may accordingly be visible (positioned such that it may be seen when inserted into e.g. first or second ends 22, 24). Accordingly, when the fuse link member breaks, it provides a visual signal to a user that the cord is no longer operational. Alternately, the fuse may be re-settable (e.g. a circuit breaker or a GFI). In such a case, the position of the fuse reset member may provide a visual signaling member advising a user that the cord is no longer operational.

It will also be appreciated that the visual signaling member may be a light, e.g. LED 44 that illuminates when electricity flows through the cord. For example, it may a light as is used in a GFI. Accordingly, the visual signaling member may comprise an illumination member that is illuminated when current flows through the electricity conducting cord and/or when power is supplied to a cord or appliance having the light.

It will also be appreciated that the visual signaling member may advise a user of the amount of power which is flowing through a cord or to an appliance 10. For example, the cord may be provided with a series of lights, which may be differently coloured. The number of lights, which are illuminated, and/or the colour that is emitted, could be indicative of the amount of power, which is flowing through the cord. Alternately, or in addition, the intensity of a light may vary as the power flowing through a cord varies. Alternately, or in addition, the cord may be provided with a meter, which indicates the amount of electricity flowing through the cord. For example, the meter could be an analog meter or a digital meter (e.g. an LCD screen with a plurality of bars which are illuminated as more power flows through the cord).

All of the forgoing are examples of the visual signaling member that is indicative of a cord being in operating condition. It will be appreciated that in addition thereto or in lieu thereof, an audio signaling member may be provided , which preferably advises a user if a power is not supplied to an appliance 10.

Preferably, the audio signaling member emits a sound if the fuse is blown and requires replacement.

It will be appreciated that the cord identification members may accordingly be used with an electricity conducting member 14, 16, 18, 20, which is intended to be plugged into a standard household electrical outlet. In such a case, first end 22 of the electricity conducting cord may be provided with a first cord identification member. The second end 24 of the cord need not be provided with a second cord identification member.

In another embodiment as exemplified in Figures 6 – 8 an electricity conducting cord 34, 36a, 36b, 38 is provided with first and second ends 22, 24 each of which utilize a cord identification member. Accordingly, the electricity conducting cord may be utilized with an extension cord. For example, first end 22 of the electricity conducting cord 34, 36a, 36b and 38 may have cord identification member and may be usable with an appliance 10 (i.e., electrically contactable to first electrical connection member 12). The second end 24 is a second electrical connection member and is provided with a cord identification member, which controls the extension cord that may be plugged into second end 24. Accordingly, a further extension cord having a second end 24 comprising a standard plug may be plugged into the second end of the cord that is plugged into appliance 10.

It will be appreciated that an appliance or an electricity conducting cord may utilize one or more of the features disclosed herein. Further, what has been described above has been intended to be illustrative of the invention and not limiting and it will be understood by a person skilled in the art that other variants and modifications may be made without departing from the scope of the invention as defined in the claims appended hereto.

CLAIMS:

1. An appliance having an appliance power rating the appliance comprising
   (a) an electrically operated member;
   (b) an electrical connection member; and,
   (c) an electricity conducting cord having a first end connectable in electric communication with the electrical connection member and a second end connectable with a source of electricity
   wherein at least one of the electrical connection member and the first end of the electricity conducting cord have at least one cord identification member configured and/or to prevent the first end of an electricity conducting cord having a power rating lower than the appliance power rating being electrically connected to the electrical connection member.

2. The appliance of claim 1 wherein the electrical connection member has a first cord identification member and the first end of the electricity conducting cord has a second cord identification member.

3. The appliance of claim 2 wherein one of the first and second cord identification members comprises a male member and the other of the first and second cord identification members comprises a female member.

4. The appliance of claim 3 wherein the male member and the female member are sized, positioned, and/or shaped, and/or the number of male members that are provided on the end having the male members, is based on the power rating of the respective part on which the male member and the female member is provided.

5. The appliance of any of claims 2 - 3 further comprising a plurality of electricity conducting cords of varying gauges and the male member provided on

the end having the male member increases in size as the gauge of the electricity conducting cord increases.

6. The appliance of any of claims 2 - 3 further comprising a plurality of electricity conducting cords of varying gauges and the female member provided on the end having the female member decreases in size as the gauge of the electricity conducting cord increases.

7. The appliance of any of claims 2 - 6 wherein the first and second cord identification members are inter-engageable only if the electricity conducting cord has a power rating the same as or higher than the appliance power rating.

8. The appliance of claim 2 wherein one of the first and second cord identification members is a male engagement member and the other of the first and second cord identification members is a female engagement member and the male engagement member is positioned and configured to be engageable with a female engagement member only if the electricity conducting cord has a power rating the same as or higher than the appliance power rating.

9. The appliance of any of claims 1 - 8 wherein the appliance has an appliance electric cord having a length of up to one foot.

10. The appliance of claim 9 wherein the appliance electric cord has a length of up to 6 inches.

11. The appliance of any of claims 1 - 10 wherein the electricity conducting cord has a length of at least 6 feet.

12. The appliance of any of claims 1 - 10 wherein the electricity conducting cord has a length of 6 - 300 feet.

13. The appliance of any of claims 1 - 10 wherein the electricity conducting cord has a length of 25 - 50 feet.

14. The appliance of any of claims 2 - 13 wherein the cord identification member of the electrical connection member is positioned or configured based on the power rating of the appliance and the cord identification member of the electricity conducting cord has a power rating based on the length and gauge of the electricity conducting cord.

15. The appliance of any of claims 1 - 13 wherein the cord identification member of the electricity conducting cord is positioned or configured based on the length and gauge of the electricity conducting cord.

16. The appliance of any of claims 1 - 15 wherein the electrical connection member is a plug and the first end of an electricity conducting cord is a socket.

17. The appliance of any of claims 1 - 15 wherein the electrical connection member is a socket and the first end of an electricity conducting cord is a plug.

18. The appliance of any of claims 1 - 17 wherein at least one of the electricity conducting cord and the electrical connection member includes a fuse.

19. The appliance of claim 18 wherein the fuse is provided in at least one of the electrical connection member and the first end of the electricity conducting cord.

20. The appliance of claim 19 further comprising a visual signaling member indicative of the fuse being in operating condition or an audio signaling member indicative of the fuse being blown.

21. The appliance of any of claims 1 - 17 further comprising a visual signaling member indicative of the amount of power flowing through the electricity conducting cord.

22. The appliance of claim 21 wherein the visual signaling member comprises at least one of a plurality of different coloured lights, a light having a variable colour, a light having a variable intensity or a meter.

23. The appliance of claim 20 wherein the fuse comprises a fuse link member, the fuse link member is visible when the fuse is installed and the visual signaling member comprises the fuse link member.

24. The appliance of claim 20 wherein the fuse is resettable and the position of a fuse reset member comprises the visual signaling member.

25. The appliance of claim 21 wherein the visual signaling member comprises an illumination member that is illuminated when current flows through the electricity conducting cord.

26. The appliance of any of claims 1 - 17 further comprising an illumination member that is illuminated when current flows through the electricity conducting cord.

27. The appliance of any of claims 1 - 26 wherein the appliance is selected from the group consisting of a surface cleaning apparatus, a power tool, a kitchen appliance, a kitchen appliance, a lawn or garden appliance and a personal care product.

28. An electricity conducting cord having first and second ends, one of the ends comprising an electrical connection member engageable with a power connection member of an apparatus having an apparatus power rating, at least one of the power connection member and the electrical connection member comprising electrical connectors and a physical cord identification member, the physical cord identification member is configured to inhibit the electricity conducting cord being electrically connected to the power connection member if

the electricity conducting cord has a power rating lower than the apparatus power rating.

29. The electricity conducting cord of claim 28 wherein the electrical connection member has a first cord identification member adapted to mate with a second cord identification member provided on the power connection member if the electricity conducting cord has a power rating lower than the apparatus power rating.

30. The electricity conducting cord of claim 29 wherein one of the first and second cord identification members comprises a male member and the other of the first and second cord identification members comprises a female member.

31. The electricity conducting cord of claim 30 wherein each of the male member and the female member is sized, positioned and/or shaped, or the number of male members is based on the power rating of the respective part on which the protrusion and the recess is provided.

32. The electricity conducting cord of any of claims 30 - 31 further comprising a plurality of electricity conducting cords of varying gauges and the male member increases in size as the gauge of the electricity conducting cord increases.

33. The electricity conducting cord of any of claims 30 - 31 further comprising a plurality of electricity conducting cords of varying gauges and the female member decreases in size as the gauge of the electricity conducting cord increases.

34. The electricity conducting cord of any of claims 29 - 33 wherein the first and second cord identification members are inter-engageable only if the electricity conducting cord has a power rating the same as or higher than the apparatus power rating.

35. The electricity conducting cord of claim 29 wherein one of the first and second cord identification members is a male engagement member and the other of the first and second cord identification members is a female engagement member and the male engagement member is positioned and configured to be engageable with a female engagement member only if the electricity conducting cord has a power rating the same as or higher than the apparatus power rating.

36. The electricity conducting cord of claim 29 wherein the cord identification member of the electrical connection member is positioned or configured based on the power rating of the apparatus and the cord identification member of the electricity conducting cord has a power rating based on the length and gauge of the electricity conducting cord.

37. The electricity conducting cord of any of claims 28 - 36 wherein the cord identification member of the electricity conducting cord is positioned or configured based on the length and gauge of the electricity conducting cord.

38. The electricity conducting cord of any of claims 28 - 37 wherein the electrical connection member is a plug.

39. The electricity conducting cord of any of claims 28 - 37 wherein the electrical connection member is a socket.

40. The electricity conducting cord of any of claims 28 - 39 wherein the electricity conducting cord includes a fuse.

41. The electricity conducting cord of claim 40 wherein the fuse is provided in the electrical connection member.

42. The electricity conducting cord of claim 41 further comprising a visual signaling member indicative of the fuse being in operating condition or an audio signaling member indicative of the fuse being blown.

43. The electricity conducting cord of any of claims 28 - 41 further comprising a visual signaling member indicative of the amount of power flowing through the electricity conducting cord.

44. The electricity conducting cord of claim 43 wherein the visual signaling member comprises at least one of a plurality of different coloured lights, a light having a variable colour, a light having a variable intensity or a meter

45. The electricity conducting cord of claim 40 wherein the fuse comprises a fuse link member, the fuse link member is visible when the fuse is installed and the visual signaling member comprises the fuse link member.

46. The electricity conducting cord of claim 40 wherein the fuse is resettable and the position of a fuse reset member comprises the visual signaling member.

47. The electricity conducting cord of claim 42 wherein the visual signaling member comprises an illumination member that is illuminated when current flows through the electricity conducting cord.

48. The electricity conducting cord of any of claims 28 - 41 further comprising an illumination member that is illuminated when current flows through the electricity conducting cord.

49. The electricity conducting cord of any of claims 28 - 48 wherein the apparatus is selected from the group consisting of a surface cleaning apparatus, a power tool, a kitchen appliance, a kitchen appliance, a lawn or garden appliance and a personal care product.

50. An apparatus comprising an electrically powered unit having a first electrical connection member, the first electrical connection member comprising electrical connectors and a physical identifying member, the physical identifying member configured to permit a second electrical connection member to only

engage the first electrical connection member if the second electrical connection member has a power rating compatible with the apparatus.

51. The apparatus of claim 50 wherein the first electrical connection member has a first cord identification member and the second electrical connection member has a second cord identification member.

52. The apparatus of claim 51 wherein one of the first and second cord identification members comprises a male member and the other of the first and second cord identification members comprises a female member.

53. The apparatus of claim 52 wherein each of the male member and the female member is sized, positioned and/or shaped, or the number of male members is based on the power rating of the respective part on which the male member and the female member is provided.

54. The apparatus of any of claims 52 – 53 wherein the second electrical connection member is provided on an electricity conducting member and a plurality of electricity conducting cords of varying gauges are available and the male member increases in size as the gauge of the electricity conducting cord increases.

55. The apparatus of any of claims 52 – 53 wherein the second electrical connection member is provided on an electricity conducting member and a plurality of electricity conducting cords of varying gauges are available and the female member decreases in size as the gauge of the electricity conducting cord increases.

56. The apparatus of any of claims 51 - 55 wherein the first and second cord identification members are inter-engageable only if the second electrical connection member has a power rating the same as or higher than the apparatus power rating.

57. The apparatus of claim 51 wherein one of the first and second cord identification members is a male engagement member and the other of the first and second cord identification members is a female engagement member and the male engagement member is positioned and configured to be engageable with a female engagement member only if the second electrical connection member has a power rating the same as or higher than the apparatus power rating.

58. The apparatus of any of claims 51 - 57 wherein the second electrical connection member is provided on an electricity conducting cord and the cord identification member of the first electrical connection member is positioned or configured based on the power rating of the apparatus and the cord identification member of the second electrical connection member has a power rating based on the length and gauge of the electricity conducting cord.

59. The apparatus of any of claims 50 - 58 wherein at least one of the first and second electrical connection members includes a fuse.

60. The apparatus of claim 59 further comprising a visual signaling member indicative of the fuse being in operating condition or an audio signaling member indicative of the fuse being blown.

61. The apparatus of any of claims 50 - 60 further comprising a visual signaling member indicative of the amount of power flowing through the first electrical connection member.

62. The apparatus of claim 61 wherein the visual signaling member comprises at least one of a plurality of different coloured lights, a light having a variable colour, a light having a variable intensity or a meter

63. The apparatus of claim 59 wherein the fuse comprises a fuse link member, the fuse link member is visible when the fuse is installed and the visual signaling member comprises the fuse link member.

64. The apparatus of claim 59 wherein the fuse is resettable and the position of a fuse reset member comprises the visual signaling member.

65. The apparatus of claim 61 wherein the visual signaling member comprises an illumination member that is illuminated when current flows through the first electrical connection member.

66. The apparatus of any of claims 50 - 65 further comprising an illumination member that is illuminated when current flows through the first electrical connection member.

67. The apparatus of any of claims 50 - 66 wherein the apparatus is selected from the group consisting of a surface cleaning apparatus, a power tool, a kitchen appliance, a kitchen appliance, a lawn or garden appliance and a personal care product.

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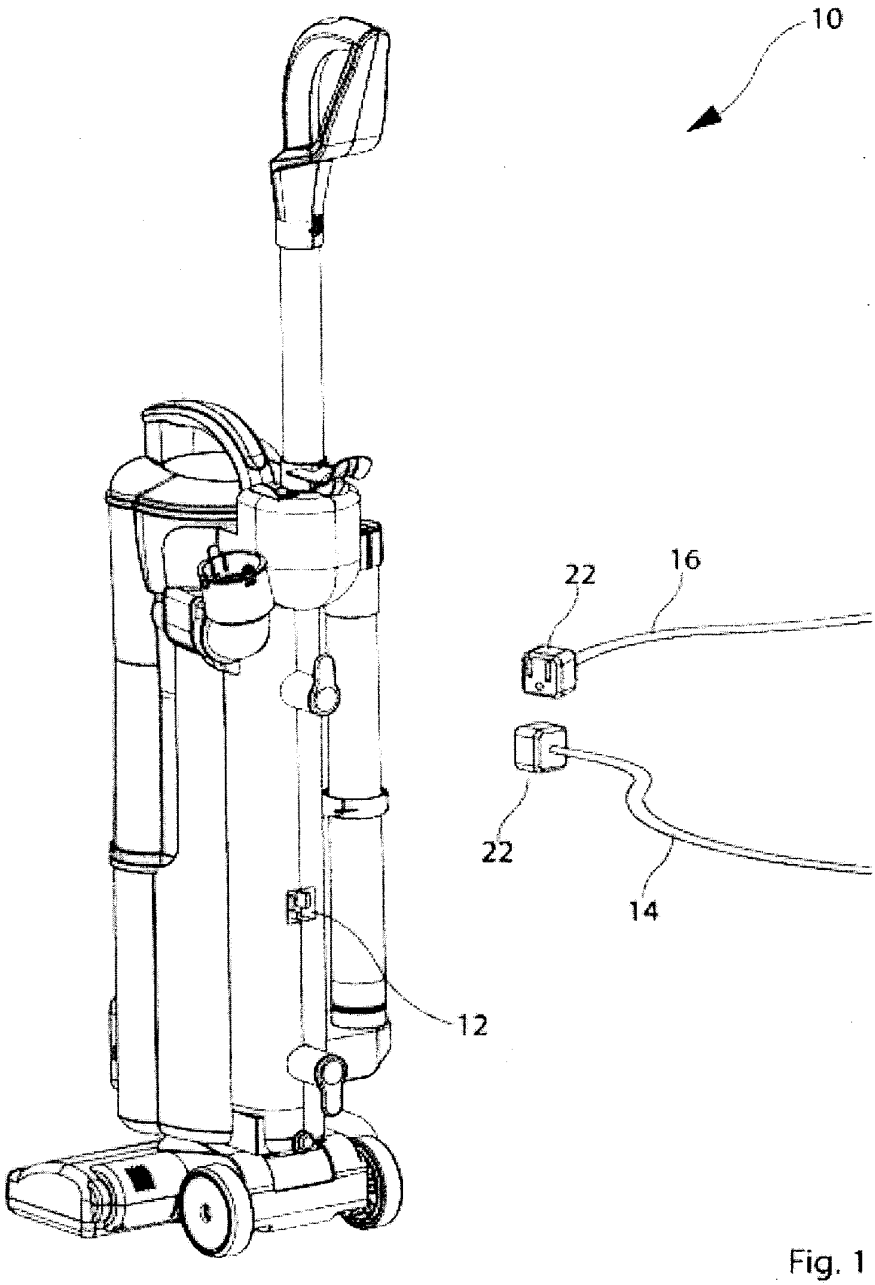


Fig. 1

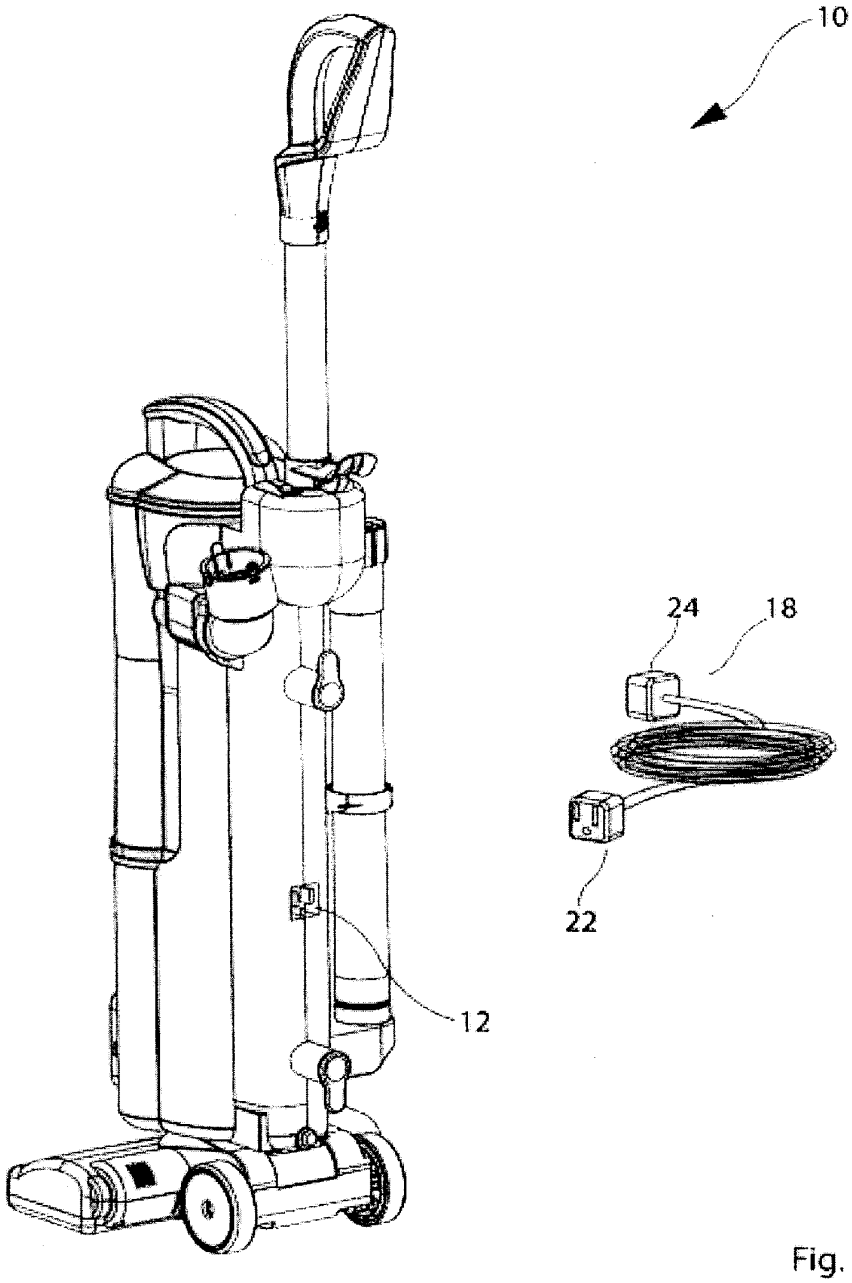


Fig. 2

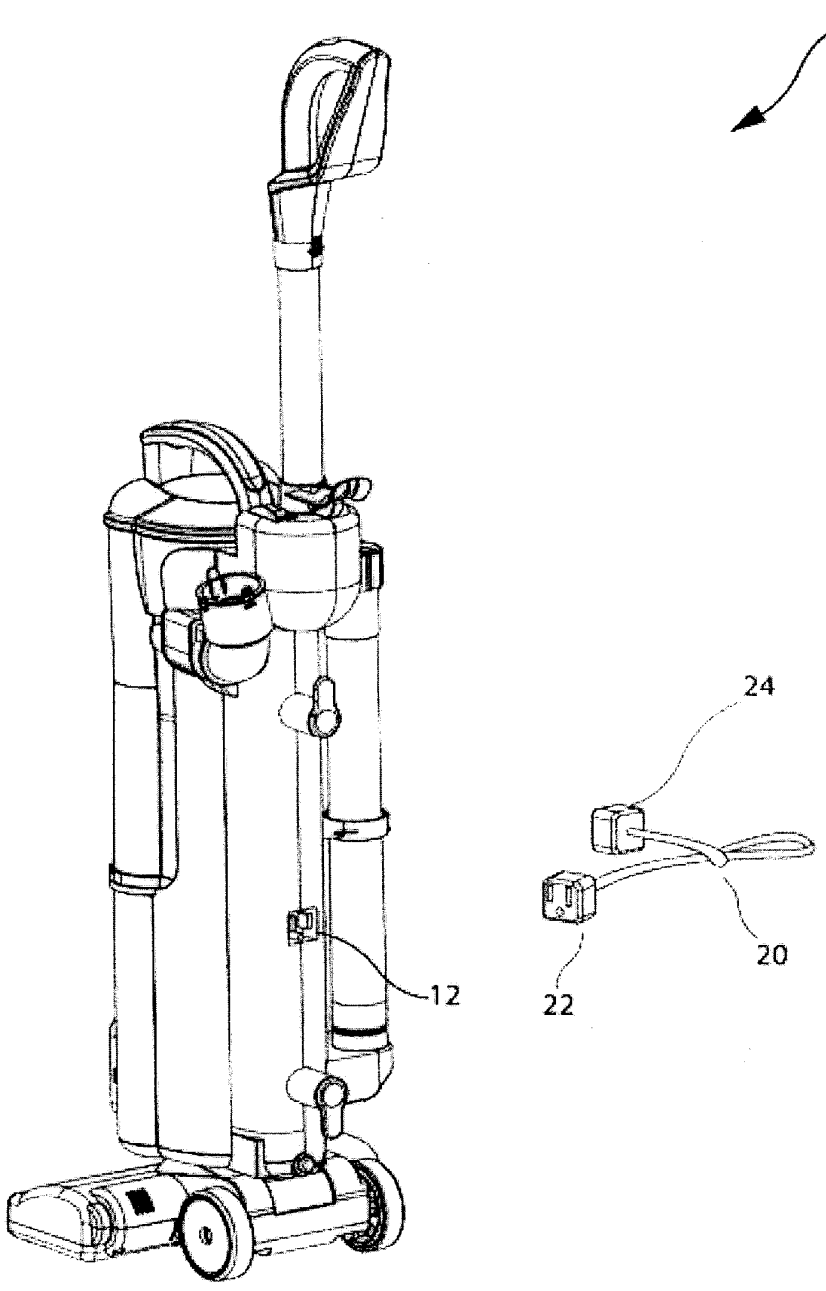


Fig. 3

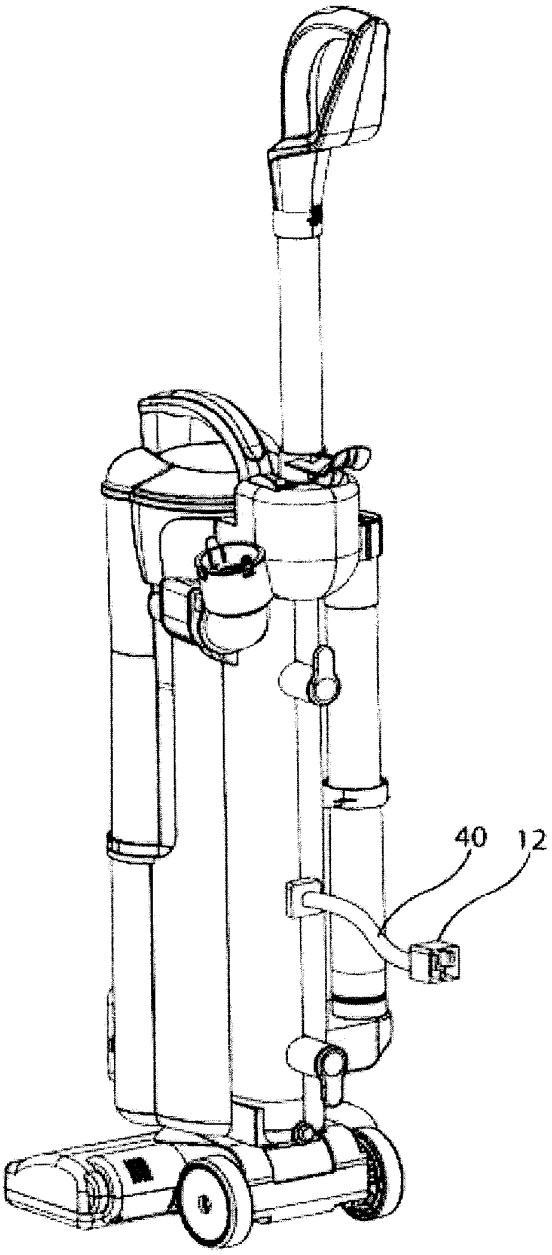


Fig. 4

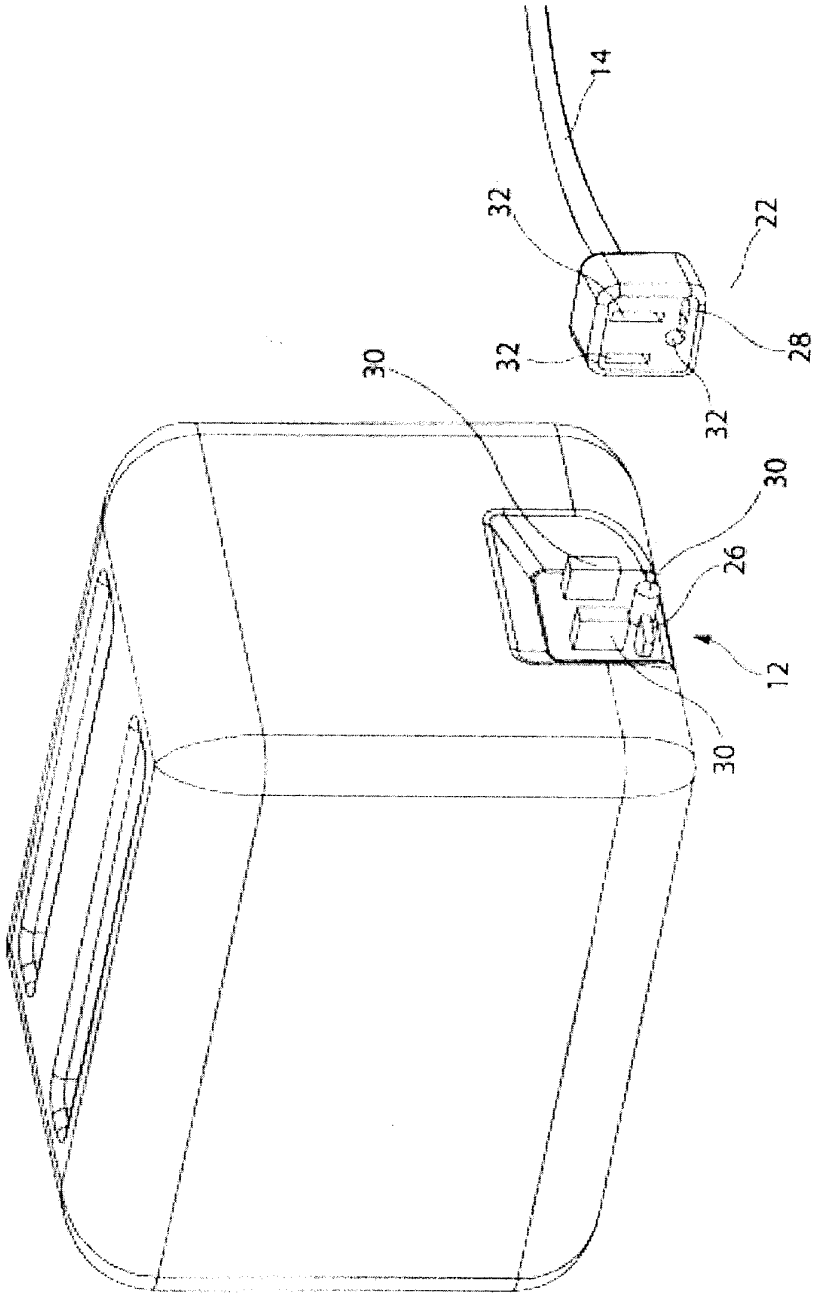
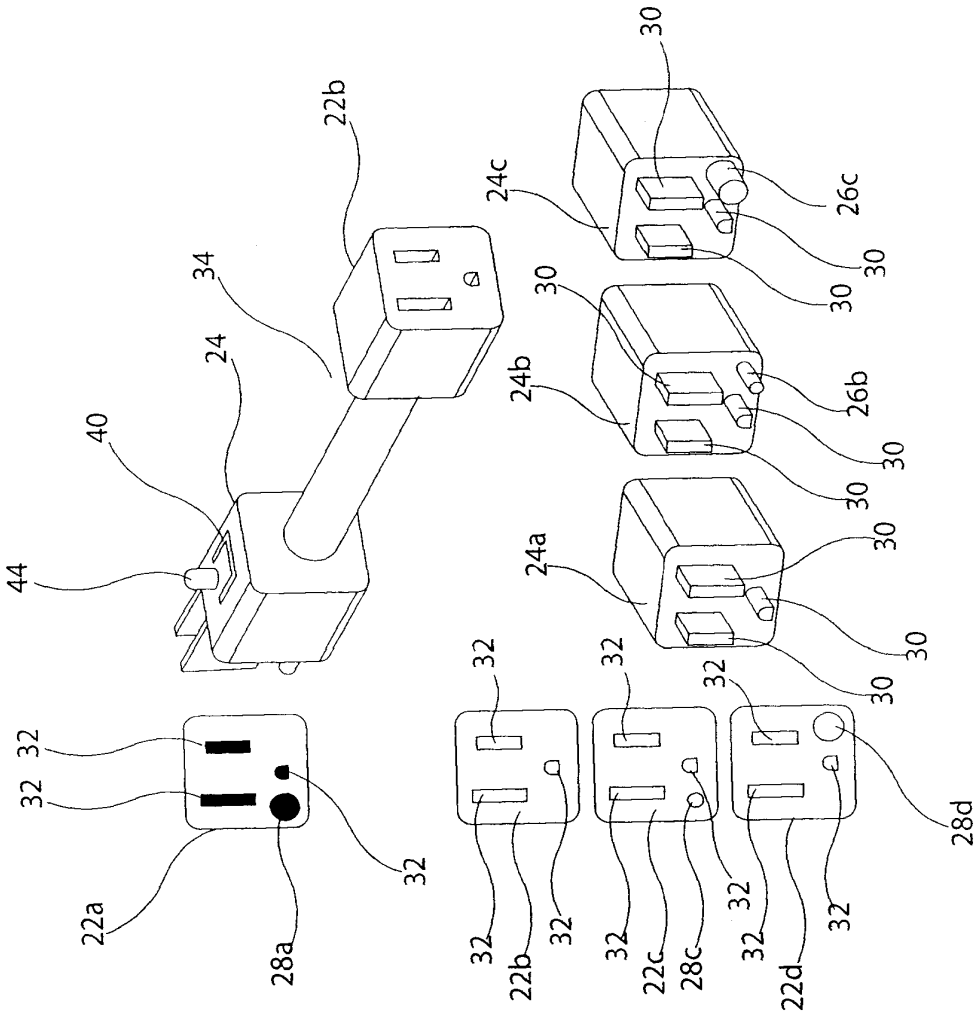


Fig. 5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28a
22b
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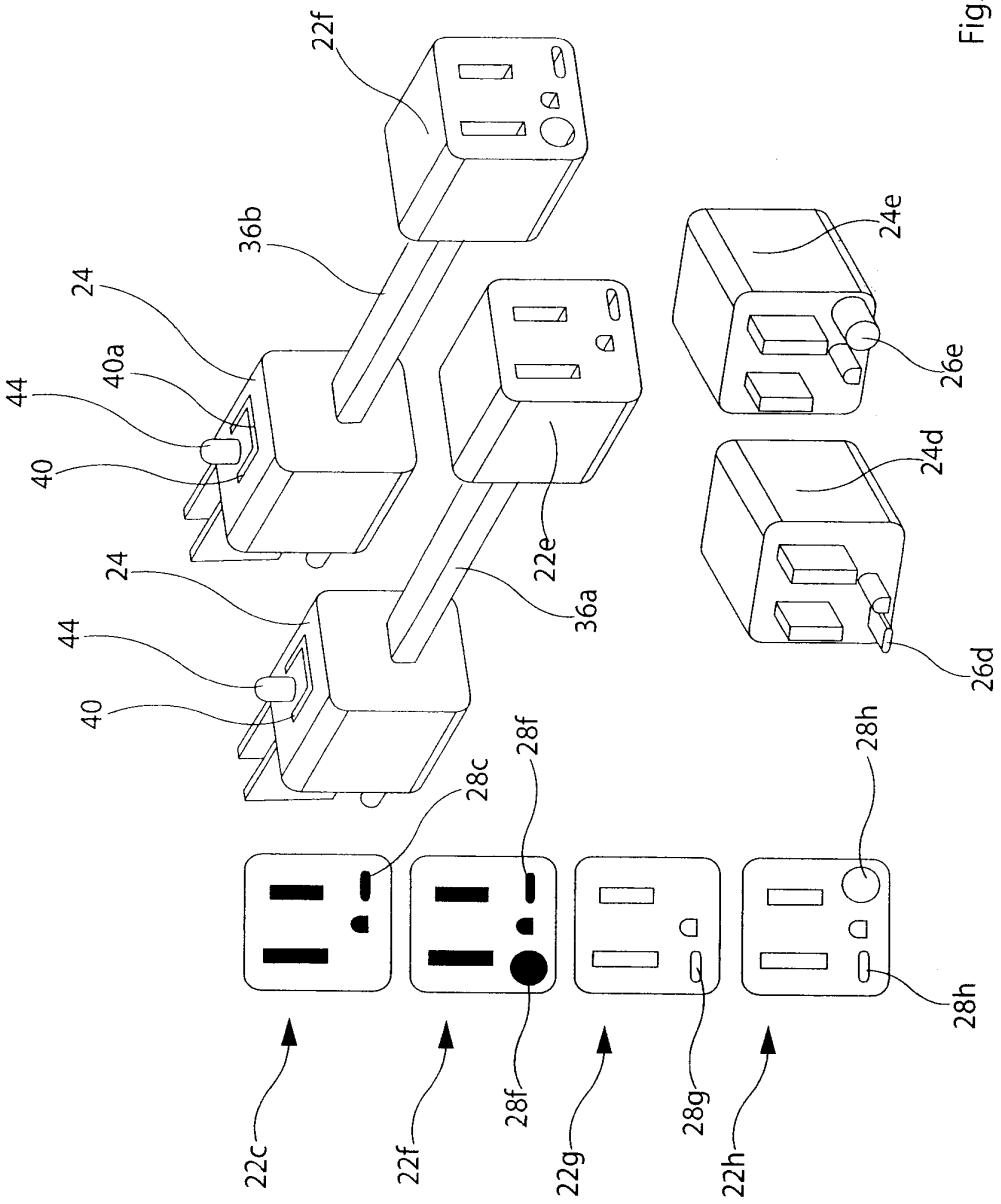
28c
22d
28d

Fig. 6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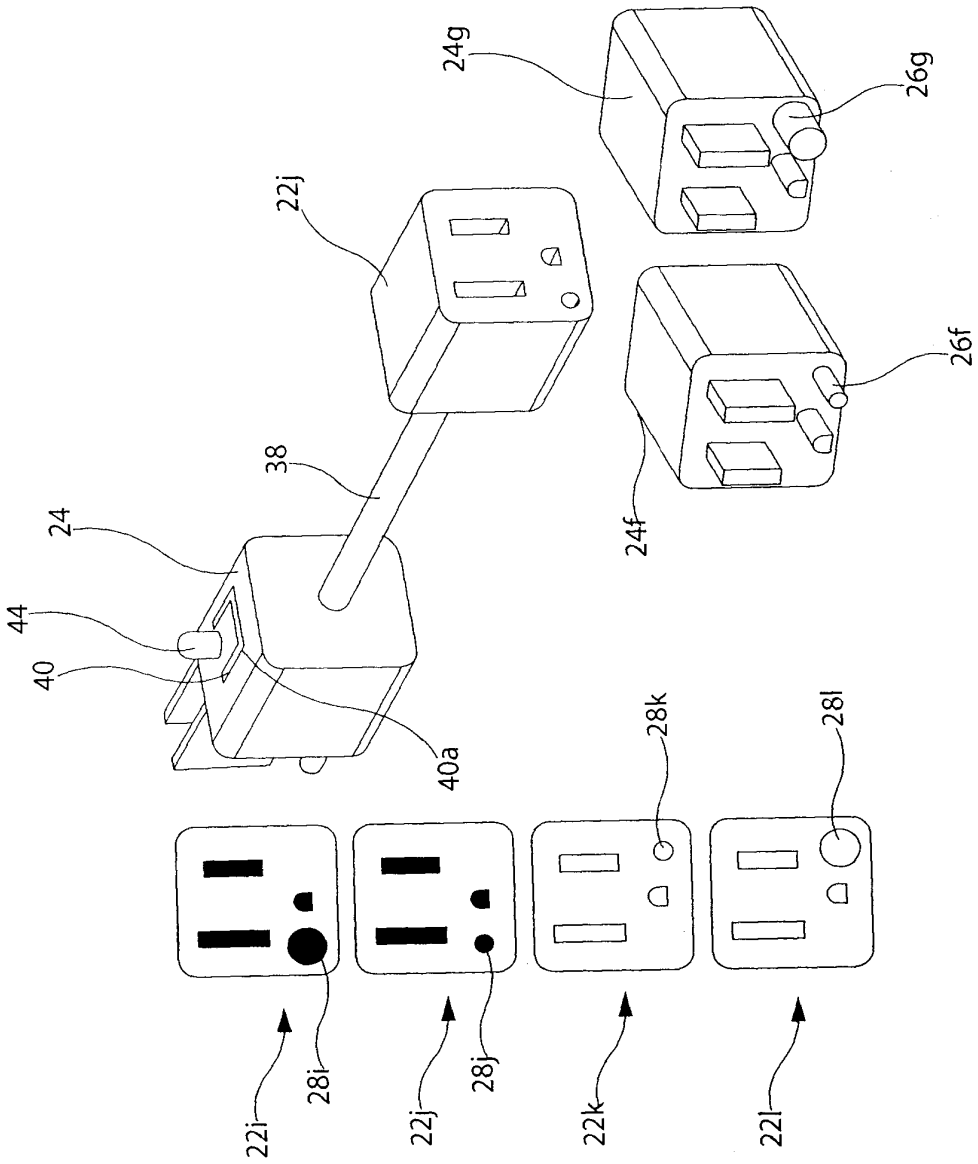
22c
22f
28f
22g
28g
22h
28h

Fig. 7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26f
24f
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40a
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28l
22i
28i
22j
28j
22k
22l

Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2010/001785

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***H01R 13/64*** (2006.01) , ***H01R 13/68*** (2011.01) , ***H01R 13/717*** (2006.01)
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: ***H01R 13/64*** (2006.01) , ***H01R 13/68*** (2011.01) , ***H01R 13/717*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Databases: EPOQUE (Epodoc, English Full-Text), Canadian Patents Database
Search terms: power, key, cord, connection, plug, mate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --------- Y	US6976885 B2 (Lord, C.) 20 December 2005 (20-12-2005) *col. 4, lines 5-49*	1-6, 7, 8, 14-26, 28-48 and 50-66 ---------- 9-13, 27, 49 and 67
		9-13, 27, 49 and 67
Y	US2007077810 A1 (Gogel, N. et al.) 5 April 2007 (05-04-2007) *(page 3, paragraph [0030], fig. 1*	1-67
A	US6929516 B2 (Bruchu, C. et al.) 16 August 2005 (16-08-2005) *Whole document*	1-67
A	US6080022 A (Shaberman, J. et al.) 27 June 2000 (27-06-2000) *Whole document*	1-67
A	US5254019 A (Noschese, R.) 19 October 1993 (19-10-1993) *Whole document*	1-67
A	US3085221 A (Kelly, J.) 09 April 1963 (09-04-1963) *Whole document*	

[ ] Further documents are listed in the continuation of Box C. [X] 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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search	Date of mailing of the international search report
20 January 2011 (21-01-2011)	2 February 2011 (02-02-2011)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Jim Triantafillou (819) 934-4268

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2010/001785

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US6976885B2	20 December 2005 (20-12-2005)	AT360901T	15 May 2007 (15-05-2007)
		AU2004208705A1	18 August 2005 (18-08-2005)
		AU2004208705B2	30 August 2007 (30-08-2007)
		CA2475060A1	02 September 2005 (02-09-2005)
		CN1736008A	15 February 2006 (15-02-2006)
		CN100367577C	06 February 2008 (06-02-2008)
		DE602004006116D1	06 June 2007 (06-06-2007)
		DE602004006116T2	03 January 2008 (03-01-2008)
		EP1627452A1	22 February 2006 (22-02-2006)
		EP1627452B1	25 April 2007 (25-04-2007)
		EP1811614A2	25 July 2007 (25-07-2007)
		EP1811614A3	05 September 2007 (05-09-2007)
		ES2281805T3	01 October 2007 (01-10-2007)
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		KR20060008838A	27 January 2006 (27-01-2006)
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		RU2004129604A	27 February 2006 (27-02-2006)
		RU2283521C2	10 September 2006 (10-09-2006)
		US2005197018A1	08 September 2005 (08-09-2005)
		US2006094302A1	04 May 2006 (04-05-2006)
		US7153169B2	26 December 2006 (26-12-2006)
		US2007015418A1	18 January 2007 (18-01-2007)
		US7201611B2	10 April 2007 (10-04-2007)
		US2007099519A1	03 May 2007 (03-05-2007)
		US7727031B2	01 June 2010 (01-06-2010)
		US2010273361A1	28 October 2010 (28-10-2010)
		WO2005096457A1	13 October 2005 (13-10-2005)
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US2007077810A1	05 April 2007 (05-04-2007)	None	
US6929516B2	16 August 2005 (16-08-2005)	CA2483876A1	28 April 2005 (28-04-2005)
		CA2483876C	07 April 2009 (07-04-2009)
		EP1527764A2	04 May 2005 (04-05-2005)
		EP1527764A3	13 July 2005 (13-07-2005)
		US2005090153A1	28 April 2005 (28-04-2005)
		US2005151425A1	14 July 2005 (14-07-2005)
		US7419406B2	02 September 2008 (02-09-2008)
US6080022A	27 June 2000 (27-06-2000)	None	
US5254019A	19 October 1993 (19-10-1993)	CA2099092A1	09 January 1994 (09-01-1994)
		EP0578180A1	12 January 1994 (12-01-1994)
US3085221A	09 April 1963 (09-04-1963)	None	

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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2010-220632
(P2010-220632A)
(43)公開日　平成22年10月7日(2010.10.7)

(51)Int.Cl.			F I			テーマコード（参考）
A47L	9/32	(2006.01)	A47L	9/32	Z	3B057
A47L	5/24	(2006.01)	A47L	5/24	A	

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(21)出願番号　特願2009-48246 (P2009-48246)
(22)出願日　平成21年3月2日 (2009.3.2)
(31)優先権主張番号　特願2009-45782 (P2009-45782)
(32)優先日　平成21年2月27日 (2009.2.27)
(33)優先権主張国　日本国 (JP)

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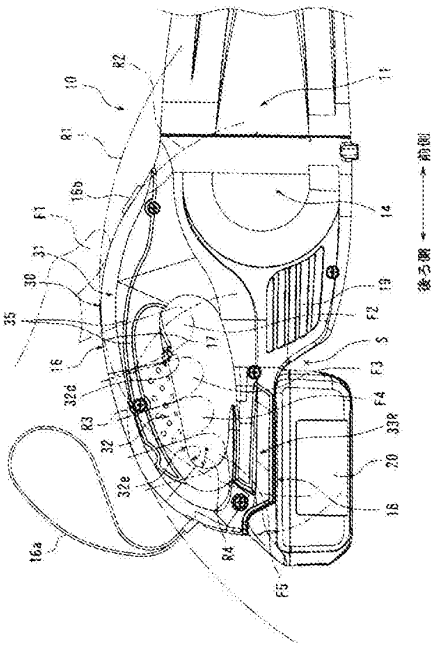
Fターム(参考) 3B057 FA01　FA14

(54)【発明の名称】ハンディクリーナ

(57)【要約】
【課題】片手に持って使用する小形軽量のハンディクリーナについて、充電式バッテリの取り付け形態に加えてハンドル部の機能性及び利便性を一層高める。
【解決手段】ループ形のハンドル部１６の表面をエラストマ樹脂製のカバー３０で覆うことにより、滑り止め機能を発揮させるとともに、エラストマ樹脂特有のしっくり感を手に持たせることにより、ハンディクリーナ１０の機能性及び利便性を高めるとともに、商品としての付加価値を高める。また、ハンドル部１６の上面を緩やかな円弧形状にし、小指側ほど細くするとともに、その内周後端部に小指ホールド部３２ｅを設けてそのホールド性を一層高める。
【選択図】図８



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【特許請求の範囲】
【請求項１】
手に持って使用するハンディクリーナであって、使用者が把持するループ形状のハンドル部を有し、該ハンドル部にエラストマ樹脂製のカバーを取り付けたハンディクリーナ。
【請求項２】
請求項１記載のハンディクリーナであって、前記カバーは、前記ハンドル部の上面を覆う上面部を有するハンディクリーナ。
【請求項３】
請求項２記載のハンディクリーナであって、前記上面部は、前記ハンドル部の長手方向全長にわたる範囲を覆うハンディクリーナ。
【請求項４】
請求項１～３のいずれか１項に記載したハンディクリーナであって、前記カバーは、前記ハンドル部の内周について後部側の半周に至る範囲を覆う内周部を有するハンディクリーナ。
【請求項５】
請求項４記載に記載したハンディクリーナであって、前記ハンドル部の内周側前部に、当該ハンディクリーナの起動操作をするためのスイッチレバーを備え、前記内周部は、該スイッチレバーの周囲に至る範囲を覆うハンディクリーナ。
【請求項６】
請求項１～５のいずれか１項に記載したハンディクリーナであって、前記ハンドル部の下部に沿って、当該ハンディクリーナの電源としてのバッテリパックを取り付けるためのバッテリ取り付け部を左右側方に張り出す状態で備え、前記カバーは、該バッテリ取り付け部の左右側部を覆う張り出し部を有するハンディクリーナ。
【請求項７】
請求項１～６のいずれか１項に記載したハンディクリーナであって、前記ハンドル部の上面が把持した手の平に合わせて前後方向に緩やかな円弧面に形成されたハンディクリーナ。
【請求項８】
請求項７記載のハンディクリーナであって、前記ハンドル部の上面中央について半径Ｒ１＝２０７ｍｍ、上面前部について半径Ｒ２＝９６ｍｍ、上面後部について半径Ｒ３＝７３ｍｍの円弧面を連続的に形成したハンディクリーナ。
【請求項９】
請求項１～８のいずれか１項に記載したハンディクリーナであって、前記ハンドル部の太さが後部側に至るほど細くなって、前部と後部の太さの比率が０．８６に設定されたハンディクリーナ。
【請求項１０】
請求項９記載のハンディクリーナであって、前記ハンドル部のループ内周側の後端部に、把持した手の小指の付け根に合わせて半径Ｒ４＝１１ｍｍの半円弧面をなす小指ホールド部を設けたハンディクリーナ。
【請求項１１】
手に持って使用するハンディクリーナであって、使用者が把持するループ形状のハンドル部を有し、該ハンドル部の上面が把持した手の平に合わせて前後方向に緩やかな円弧面に形成されるとともに後部側に至るほど細くなっており、かつループ内周側の後端部に、把持した手の小指の付け根に合わせた半円弧形状の小指ホールド部を設けたハンディクリーナ。

【発明の詳細な説明】
【技術分野】
【０００１】
この発明は、例えばハンディクリーナと称される小形の手持ち式掃除機に関する。

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【背景技術】
【０００２】
一般に、ハンディクリーナは、その利便性を考慮して直流電源式のものが多く提供されている。ハンディクリーナの電源には、充電して繰り返し使用可能なバッテリパックが用いられている。ハンディクリーナのバッテリパックに関する技術が例えば下記の特許文献に開示されている。
これら特許文献に開示されているように従来、バッテリパックは、本体ハウジングの後部に設けたバッテリ取り出し口を経て取り付け、取り外しすることができる。バッテリパックは、バッテリ取り出し口から差し込んで取り付ければ、本体ハウジング内の電源回路に電気的に接続される。この取り付け状態では、バッテリパックは駆動モータや回路基板等と同様内蔵（組み込み）部品として本体ハウジング内に組み込まれた状態となる。このため、バッテリ取り出し口は蓋で閉じられて、取り付けたバッテリパックは外部から見えない状態となる。逆に、このバッテリパックは、蓋を外して本体ハウジングから取り外し、別途用意した充電器で充電すれば繰り返し使用することができる。
この内部組み込み形式では、蓋の開閉操作が面倒で、取り外した蓋を紛失するおそれもあり、またバッテリパックを本体ハウジング内に収容する必要上クリーナの小型化を図ることが困難になる。このため、近年では例えばハンドル部の下部に沿ってスライドさせることにより着脱可能とするカートリッジ形式のものが提供されている。
また、この充電式のバッテリパックは、上記ハンディクリーナに限らず、例えば穴明け加工用の電気ドライバ等の電動工具の電源としても多数用いられている。近年、この種の電動工具のバッテリパックには、ニッケル－カドミウム電池に加えてより軽量なリチウムイオン電池が用いられるようになっている。
【先行技術文献】
【特許文献】
【０００３】
【特許文献１】実開昭６１－１９８６４６号公報
【特許文献２】特開昭６３－２４０８１５号公報
【特許文献３】特開昭６３－２９６７２１号公報
【発明の概要】
【発明が解決しようとする課題】
【０００４】
このように、従来ハンディクリーナのバッテリパックの取り付け形態について、様々な改良が施されており、これに合わせてハンドル部についてもより改良を施す必要がある。特に、バッテリパックの装着形態を上記のカートリッジ式とした場合に、当該装着形態により適合したハンドル部を提供することにより、当該ハンディクリーナの機能性及び利便性がより発揮され得るようにする必要がある。
そこで、本発明は、特にカートリッジ式のバッテリパックを備える場合に好適なハンドル部であって、ハンディクリーナの機能性及び利便性を一層発揮し得るハンドル部を提供することを目的とする。
【課題を解決するための手段】
【０００５】
このため、本発明は、特許請求の範囲の各請求項に記載した構成のハンディクリーナとした。
請求項１記載のハンディクリーナによれば、ハンドル部がループ形を有しているので、その使用時及び持ち運び時の双方についてその機能性及び利便性を発揮させることができる。しかも、このハンドル部の表面がエラストマ樹脂製のカバーで覆われているので、使用者の把持感を損なうことなく十分な滑り止め機能を持たせつつ、持った時に手にしっくり来るハンドル部とすることができ、この点で当該ハンディクリーナの機能性及び利便性を一層高めることができる。
カバーは、ハンドル部の全体を覆う状態に取り付ける場合の他、使用者の手の平や指先

が接触する部位について局部的に取り付ける構成とすることができる。

請求項２記載のハンディクリーナによれば、主として手の平が接触する部位について、把持したときの滑り止め機能を持たせ、またしっくり感を高めることができる。

請求項３記載のハンディクリーナによれば、親指を前方へ延ばして把持した時の手の平と親指の滑り止め機能及びしっくり感を持たせることができる。

請求項４記載のハンディクリーナによれば、把持した手の主として指先の滑り止め機能及びしっくり感を持たせることができる。

請求項５記載のハンディクリーナによれば、把持した手の例えば人差し指でスイッチレバーを引き操作することにより当該ハンディクリーナの起動停止操作をすることができ、かつその人差し指の引き操作時における滑り止め機能及びしっくり感を持たせることができる。

請求項６記載のハンディクリーナによれば、比較的重量の大きなバッテリパックの近傍で当該ハンディクリーナを支える（把持する）ため、使用者はさほど重量感を感ずることなく当該ハンディクリーナを取り扱いことができる。しかも、ハンドル部よりも左右に幅広のバッテリ取り付け部の両側部がエラストマ樹脂製のカバー（左右張り出し部）で覆われているので、当該ハンディクリーナを横倒し状態で置いた場合あるいはハンドル部を把持して持ち運ぶ場合の傷つきを防止することができる。さらに、バッテリパックの取り付け、取り外しをするために、使用者が一方の手でバッテリ取り付け部の左右側部を挟み込んで把持し、他方の手でバッテリパックをスライドさせる場合に、カバーの左右張り出し部に滑り止め機能を持たせることができ、この点でも当該ハンディクリーナの機能性及び利便性を一層高めることができる。

【０００６】

請求項７記載のハンディクリーナによれば、ハンドル部の把持しやすさ（機能性）を高めることができる。また、手の平に合わせた円弧面に形成されて把持しやくすなっていることから、長時間把持しても疲れが少なく、この点でも当該ハンディクリーナの機能性を高めることができる。

請求項８記載のハンディクリーナによれば、例えば一般的な成人の手に合わせた円弧面とすることができる。

請求項９記載のハンディクリーナによれば、当該ハンドル部のグリップ感を高めることができ、この点でハンディクリーナの機能性を一層高めることができる。

請求項１０記載のハンディクリーナによれば、ループ内周側に差し入れた小指の付け根が円弧形状のホールド部に受けられ、またこのホールド部のエラストマカバーにしっくりと押し付けられることにより、当該ハンドル部のホールド性を高めることができる。

請求項１１記載のハンディクリーナによれば、ハンドル部を把持した使用者の手の平になじみやすく、かつ後部側が細くなることにより小指も含めた５本の指でしっかりと握ることができるとともに、小指の付け根部分が内周後端部の小指ホールド部に受けられて使用者は一層良好なホールド感を持って把持することができ、これらの点で当該ハンドル部ひいてはハンディクリーナの機能性及び利便性を一層高めることができ、商品としての付加価値を高めることができる。

【図面の簡単な説明】

【０００７】

【図１】本発明の実施形態に係るハンディクリーナの全体斜視図である。

【図２】本発明の実施形態に係るハンディクリーナを図１中矢印(II)方向から見た左側面図である。本図では、ハンドル部を把持した使用者の右手が二点鎖線で示されている。

【図３】本発明の実施形態に係るハンディクリーナを図１中矢印(III)方向から見た右側面図である。

【図４】本発明の実施形態に係るハンディクリーナを図１中矢印(IV)方向から見た平面図である。

【図５】本発明の実施形態に係るハンディクリーナの全体側面図である。本図では、バッテリパックを取り外した状態で示されている。

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【図６】バッテリ取り付け部を図５中矢印(VI)方向から見た下面図である。
【図７】バッテリパック単体の斜視図である。
【図８】ハンドル部の拡大図である。
【発明を実施するための形態】
【０００８】
次に、本発明の実施形態を図１～図８に基づいて説明する。本実施形態に係るハンディクリーナ１０は、例えば自動車の室内清掃や小部屋の簡易な清掃等をする場合に、使用者が片手で持って簡単に使用することができる小形且つ軽量の充電式掃除機であり、主として使用者が把持するハンドル部１６に特徴を有している。クリーナ本体１１の内部構造等については従来公知の構成であり、本実施形態において特に変更を要しないので詳細な説明を省略する。

図１～図４は、本実施形態に係るハンディクリーナ１０を示している。このハンディクリーナ１０は、クリーナ本体１１から取り外して充電することにより再使用可能なバッテリパック２０を電源として備えている。クリーナ本体１１は、バッテリパック２０を電源として駆動する電動モータ（図示省略）とこの電動モータにより回転するファンを主体とする吸引機構（図示省略）を本体ハウジング１４に内蔵している。本体ハウジング１４の先端部に吸塵口１５を備えている。本体ハウジング１４の前側半分は、吸引したゴミ等を廃棄するために取り外すことができる。

本体ハウジング１４の後部には、使用者が把持するループ形のハンドル部１６が設けられている。このハンドル部１６の内周側には、使用者が指先で引き操作するスイッチレバー１７が設けられている。このスイッチレバー１７を図示上側へ引き操作すると、電動モータ１２が起動して吸塵口１５から粉塵等を吸引することができる。また、ハンドル部１６の後部には吊り下げ用のストラップ１６ａが取り付けられ、前部には暗所での清掃時に便利な照明具１６ｂが備え付けられている。図示するようにこの照明具１６ｂは、ハンドル部１６の前面であって前方に障害物がない部位に出っ張らない状態に組み込まれている。この照明具１６ｂによって主として吸塵口１５の周辺が明るく照らされる。この照明具１６ｂの光源にはＬＥＤ（発光ダイオード）が用いられている。ＬＥＤに代えて電球を用いてもよい。この照明具１６ｂの電源としてもバッテリパック２０が利用される。

このハンドル部１６の下面側に、バッテリパック２０を装着するためのバッテリ取り付け部１８が設けられている。このバッテリ取り付け部１８は、ハンドル部１６の下部に沿って左右に張り出す状態に設けられている。このバッテリ取り付け部１８の前側には、排気口１９が設けられている。
【０００９】
ハンドル部１６は、このバッテリ取り付け部１８の上面から上方へループ形に張り出す状態に設けられている。ハンドル部１６は、このバッテリ取り付け部１８の上面を含めてループ形状を有している。図示するように本実施形態のハンドル部１６は、前後方向にやや長い扁平ループ形（長円形）を有している。

ハンドル部１６の後部は、バッテリ取り付け部１８の後部上面から上方へ立ち上がっている。一方、ハンドル部１６の前部は、本体ケース１４の前後長手方向のほぼ中央部上面から上方へ立ち上がっている。ハンドル部１６の内周側は、使用者が手を差し入れて把持し、かつ人差し指Ｆ２でスイッチレバー１７を引き操作するために十分なスペースが確保されている。

このハンドル部１６には、主として滑り止め用のカバー３０が取り付けられている。このカバー３０は、素材としてのエラストマ樹脂をインサート成形して当該ハンドル部１６の表面に貼り付けた状態に取り付けられている。なお、接着剤による貼り付け、あるいはビス止めのその他の手段によって取り付ける構成であってもよい。

このカバー３０は、ハンドル部１６の上面を覆う上面部３１と、内周側を覆う内周部３２と、バッテリ取り付け部１８の左右側部を覆う張り出し部３３Ｌ，３３Ｒを備えている。上面部３１と内周部３２と左右張り出し部３３Ｌ，３３Ｒは全てハンドル部１６の後部において繋がっている。従って、ハンドル部１６の後部側はほぼすべての範囲がカバー３

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０で覆われている。

上面部３１は、ハンドル部１６の長手方向全長にわたる範囲に取り付けられている。従って、ハンドル部１６の上面前部であって照明具１６の周囲もこの上面部３１によって覆われている。図２に示すように使用者が例えば右手（二点鎖線で示されている。）でこのハンドル部１６を把持した場合に、主としてその手の平がこの上面部３１に押し当てられる。また、図示するように親指Ｆ１を前方へ延ばして把持した場合にも親指Ｆ１がこの上面部３１に押し当てられる。上面部３１は、エラストマ樹脂を素材とすることから、手の平及び指先の滑り止めがなされるとともに、使用者にとって手の平及び指先の接触感がしっくりときて握りやすくなっている。

【００１０】

内周部３２は、ハンドル部１６の内周について後部側のほぼ半周に至る範囲を覆う状態に取り付けられている。この内周部３２は、ハンドル部１６の内周上面側を覆う天板部３２ａと下面側であってバッテリ取り付け部１８の上面の一部を覆う底面部３２ｂを有している。図２に示すように使用者が当該ハンドル部１６を把持した場合に、指先が天板部３２ａに押し当てられ、指の甲が底面部３２ｂに向けられて、その滑り止めがなされる。特に、天板部３２ａには半球状の小突起３２ｃ～３２ｃが多数設けられて、その滑り止め機能が一層高められている。

また、天板部３２ａは、内周後部から前部に至る長い範囲に取り付けられて、スイッチレバー１７の周囲をも覆う状態に取り付けられている。このため、使用者が把持した手の人差し指Ｆ２で当該スイッチレバー１７を引き操作する場合においてもその滑り止め機能及びしっくり感を持たせることができる。特に、この天板部３２ａには、スイッチレバー１７の後ろ側に突き出す滑り止め突起３２ｄが一体に設けられている。この滑り止め突起３２ｄによって、スイッチレバー１７を引き操作した状態に保持する際の人差し指Ｆ２の滑り止めがなされる。また、この滑り止め突起３２ｄによってスイッチレバー１７の誤操作が防止される。

さらに、図２に示すようにハンドル部１６の内周側後部に当該カバー３０の内周部３２が取り付けられていることにより、把持した手の小指Ｆの付け根付近が当該内周部３２に押し付けられる。このため、特に当該ハンディクリーナ１０をハンドル部１６を把持して下向きにして持ち運ぶ場合に、小指Ｆの付け根付近が内周部３２にしっくりと押し当てられることから、この点でも使用者の良好な把持感が確保されている。

左右の張り出し部３３Ｌ，３３Ｒは、バッテリ取り付け部１８の左右側部に沿って取り付けられている。この左右の張り出し部３３Ｌ，３３Ｒによって、当該ハンディクリーナ１０を左側又は右側に横倒し状態で机上に置いた場合に、机の傷つきを防止することができる。また、バッテリパック２０をバッテリ取り付け部１８に対してスライドさせて取り付け、取り外しする場合に、使用者は例えば左手で当該バッテリ取り付け部１８の左右側部を挟み込むようにして把持することにより、この左右張り出し部３３Ｌ，３３Ｒを滑り止めとして機能させることができ、これによりクリーナ本体１１を確実に固定してバッテリパック２０の取り付け、取り外しを楽に行うことができる。

このカバー３０の周縁には、幅約１ｍｍ～１．５ｍｍで深さ約０．５ｍｍ～０．８ｍｍ程度の溝部３５が設けられている。本実施形態では、上面部３１と内周部３２と左右張り出し部３３Ｌ，３３Ｒの周囲全周（カバー３０の全周）に沿ってこの溝部３５が設けられている。この溝部３５の、特に上面部３１に沿った範囲及び天板部３２ａに沿った範囲によれば、当該溝部３５に指先が僅かに引っ掛かることによる滑り止め機能を持たせることができる。

【００１１】

図８には、ハンドル部１６の特徴についてさらに詳細に示されている。本実施形態に係るハンドル部１６の上面は、前後方向に緩やかな円弧面に形成されている。この円弧形状は、把持する使用者の手の平のグリップ感（ホールド感）を考慮して適切に設定されている。本実施形態では、ハンドル部１６の上面中央については、曲率半径Ｒ１＝約２０７ｍｍの円弧面に設定されている。また、その上面前部については、曲率半径Ｒ２＝約９６ｍ

mの円弧面に設定されている。さらに、その上面後部については、曲率半径Ｒ３＝約７３ｍｍの円弧面に設定されてる。これら３つの曲率半径Ｒ１，Ｒ２，Ｒ３について前後方向になめらかに連続した円弧面に形成されており，これにより手の平にしっくりと来るグリップ感が持たせられている。

特に、本実施形態では、ハンドル部１６の上面にエラストマ製のカバー３０（上面部３１）が取り付けられていることから、一層手の平がしっくりと押し付けられてそのホールド感が高められている。なお、曲率半径Ｒ１，Ｒ２，Ｒ３の実際の寸法設定については、当該上面部のホールド性を損なわない範囲で手の平に合わせて変更することができる。例えば、曲率半径Ｒ１，Ｒ２，Ｒ３は、各数値の前後１割程度の範囲（Ｒ１＝約１８０ｍｍ～２３０ｍｍ、Ｒ２＝約８５ｍｍ～１１０ｍｍ、Ｒ３＝約６０ｍｍ～８５ｍｍ）で変更することができる。

また、ハンドル部１６は、後部側へ向かって徐々に細くなっている。本実施形態では、把持した手の人差し指Ｆ２付近（前部側）の太さ（胴回り寸法）が約１１０ｍｍに設定され、小指Ｆ５付近（後部側）の太さ（胴回り寸法）が約９５ｍｍに設定されて、その比率（小指側太さ／人差し指側太さ）は約０．８６に設定されている。この前側の太さと後ろ側の太さの比率についても、前後１割程度の範囲（約０．７５～０．９５）で任意に変更することができる。

このようにハンドル部１６を把持した手の人差し指Ｆ２側が太く、小指Ｆ５側が細くなっていることから、使用者は小指Ｆ５も含めた５本の指Ｆ１～Ｆ５でしっかりとこのハンドル部１６を把持することができ、この点で当該ハンドル部１６のグリップ感及びホールド性を一層高めることができる。

【００１２】

さらに、ハンドル部１６の内周側の後端部についてもそのホールド感を高めるための工夫がなされている。ハンドル部１６の内周後端部には半円弧形状の小指ホールド部３２ｅが設けられている。この小指ホールド部３２ｅは、曲率半径Ｒ４＝約１１ｍｍの概ね半円弧面に形成されている。この曲率半径Ｒ４は、把持した手の小指Ｆ５の付け根付近の太さに合わせて設定されている。この曲率半径Ｒ４についても、約８ｍｍ～１５ｍｍの範囲で任意に変更することができる。

この小指ホールド部３２ｅに小指Ｆ５の付け根付近をしっかりと押し当てるようにして当該ハンドル部１６を把持することにより、一層そのグリップ性及びホールド感を高めることができる。本実施形態では、この小指ホールド部３２ｅについてもエラストマ製のカバー３０（内周部３２）が取り付けられている。このため、小指Ｆ５の付け根付近をカバー３０の内周部３２にしっくりと押し当てて、かつ小指ホールド部３２ｅにホールドされた状態で当該ハンドル部１６を把持することができ、この点でも当該ハンドル部１６のグリップ性及びホールド感が高められている。

また、本実施形態では、小指Ｆ５の付け根付近が常時この小指ホールド部３２ｅにホールドされ、この状態でスイッチレバー１７の引き操作等を行うことができるよう、当該内周部の主として前後寸法が適切に設定されている。

【００１３】

次に、バッテリパック２０は、バッテリ取り付け部１８に対して前側へスライドさせることにより取り付けることができる。逆に、バッテリパック２０は、バッテリ取り付け部１８から後ろ側へスライドさせることにより取り外すことができる。この際に、前記したようにカバー３０の左右張り出し部３３Ｌ，３３Ｒを滑り止めとして機能させることができる。

バッテリ取り付け部１８の詳細が図６に示されている。このバッテリ取り付け部１８の下面側の左右両側には、左右一対の案内レール部１８ａ，１８ａが一体に設けられている。この左右の案内レール部１８ａ，１８ａに対応して、バッテリパック２０の上面側の左右側部には左右一対の係合突部２０ａ，２０ａが一体に設けられている。バッテリ取り付け部１８に対してバッテリパック２０を前後にスライドさせて、左右の案内レール部１８ａ，１８ａに係合突部２０ａ，２０ａを係脱させることにより，当該バッテリパック２０

をバッテリ取り付け部１８に対して取り付け、取り外しすることができる。
図７には、バッテリ取り付け部１８から取り外した状態のバッテリパック２０が単体で示されている。このバッテリパック２０は、電圧１４．４Ｖの充電式リチウムイオンバッテリで、別途用意する充電器で充電して繰り返し使用することができる。
一般にリチウムイオンバッテリは、ニッケル水素バッテリに比して軽量である。例えば、市場で一般的に流通するニッケル水素バッテリで、電圧１４．４Ｖ、公称容量３．３Ａｈのものは重さ１０２０ｇであるのに対して、同じく電圧１４．４Ｖ、公称容量３．０Ａｈのリチウムイオンバッテリは重さ５００ｇ程度であり、約１／２に軽量化されている。従って、リチウムイオンバッテリを電源として用いることによりハンディクリーナ１０を全体として軽量化することができる。

【００１４】
このバッテリパック２０は概ね６面体のブロック体形状を有するもので、その上面には、プラス端子２０ｂとマイナス端子２０ｃをそれぞれ備えた前後に細長い２つの端子溝２０ｂ，２０ｃが設けられている。この端子溝２０ｂ，２０ｃに対応して、バッテリ取り付け部１８には、プラスの接続端子１８ｂとマイナスの接続端子１８ｃが設けられている。プラスの接続端子１８ｂを端子溝２０ｂ内に進入させ、マイナスの接続端子１８ｃを端子溝２０ｃ内に進入させた状態で当該バッテリパック２０をバッテリ取り付け部１８に取り付けることにより、当該バッテリパック２０がクリーナ本体１０の電源回路に電気的に接続される。
バッテリパック２０の上面後部には、上下に進退する係合爪２１が設けられている。この係合爪２１は、後面に設けた取り外しボタン２２を指先で下側へスライド操作することによって下方へ退避させることができる。この係合爪２１は、上方のロック位置側にばね付勢されている。また、この係合爪２１の前部は、当該バッテリパック２０の取り付け動作に伴って退避側へ変位するための傾斜面２１ａが設けられている。

【００１５】
この係合爪２１に対応してバッテリ取り付け部１８の後部には、係合爪２１が係合する係合凹部１８ｄが設けられている。この係合凹部１８ｄ内に係合爪２１が進入すると、バッテリパック２０の取り外し側（後ろ側）への変位が規制されて、バッテリ取り付け部１８に対して当該バッテリパック２０が取り付けた状態にロックされる。
この取り付け状態において、使用者が指先でバッテリパック２０の取り外しボタン２２を下側に移動操作すると、これに伴って係合爪２１が下方へ一体で変位し、係合凹部１８ｄ内から退出する。このため、バッテリパック２０を後ろ側へスライドさせてバッテリ取り付け部１８から取り外すことができる。この場合、使用者はバッテリ取り付け部１８を片手で左右両側から挟むように把持することにより、カバー３０の左右張り出し部３３Ｌ，３３Ｒを滑り止めとして機能させることができ、これによりクリーナ本体１１を確実に固定しておくことができる。
図２、図３及び図５に示すようにバッテリ取り付け部１８の前部から当該クリーナ本体１１の下部に至る範囲で本体ハウジング１４の外形はなだらかに傾斜している。このため、バッテリパック２０をバッテリ取り付け部１８に取り付けた状態では、当該バッテリパック２０の前側に使用者が指先を差し入れるためのスペースＳが発生する。使用者は、このスペースＳに指先を差し入れることによってバッテリパック２０を簡単に後ろ側へ押して取り外すことができる。

【００１６】
以上のように構成した本実施形態のハンディクリーナ１０によれば、ハンドル部１６がループ形を有していることから、その使用時及び持ち運び時の双方について楽に取り扱うことができる等、その機能性及び利便性を発揮させることができる。
しかも、ループ形のハンドル部１６の表面にエラストマ樹脂製のカバー３０が取り付けられているので、ハンドル部１６に十分な滑り止め機能を持たせることができるとともに、使用者は把持した手にしっくりとする感触を楽しみながらハンディクリーナ１０を使用することができ、この点で当該ハンディクリーナ１０の商品価値（付加価値）を高めるこ

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とができる。

また、カバー３０の上面部３１によって把持した手の主として手の平の滑り止めがなされ、内周部３２の天板部３２ａによって指先の滑り止めがなされるとともに、手の平及び各指先にエラストマ樹脂独特のしっくり感を持たせることができ、この点で当該ハンドル部１６の把持しやすさ（把持感）を一層高めることができ、ひいてはハンディクリーナ１０の付加価値を高めることができる。

特に、カバー３０の上面部３１がハンドル部１６の前部から後部に至るほぼ全範囲に取り付けられていることから、使用者は親指Ｆ１を前方へ延ばした状態で当該ハンドル部１６を把持した場合であっても、親指Ｆ１を上面部３１に押し当ててその滑り止め機能を発揮させることができる。

さらに、内周部３２の天板部３２ａに滑り止め用の小突起３２ｃ～３２ｃが設けられて滑り止め機能が一層高められるとともに、スイッチレバー１７の後ろ側に突起部３２ｄが設けられて例えば人差し指Ｆ２による引き操作時にその滑り止め機能及び引き操作保持機能を持たせることができる。

【００１７】

また、内周側の後部についてもエラストマ樹脂製のカバー３０（内周部３２）が取り付けられているので、小指Ｆ５を内周側後部に突き当てた状態でこのハンドル部１６を把持して当該ハンディクリーナ１０を下向きにして持ち運ぶ場合に、その重量が作用する小指Ｆ５について滑り止めをしつつしっくりとした接触感を持たせることができ、この点でも当該ハンドル部１６の使用感を高めることができる。

さらに、バッテリ取り付け部１８の左右両側部にカバー３０の張り出し部３３Ｌ，３３Ｒが取り付けられていることから、これを他部位に対する傷つき防止用のガードとして、あるいは当該ハンディクリーナ１０の落下時における衝撃吸収用のバンパーとして機能させることができる。また、バッテリパック２０の取り付け、取り外し時には、両張り出し部３３Ｌ，３３Ｒを介してバッテリ取り付け部１８を両側から挟むようにして把持することにより、当該両張り出し部３３Ｌ，３３Ｒを滑り止めとして機能させることによりクリーナ本体１１を楽に固定しておくことができ、これによりバッテリパック２０交換時の利便性を高めることができる。

なお、例示したカバー３０は、上面部３１と天板部３２ａと底面部３２ｂと左右の張り出し部３３Ｌ，３３Ｒがハンドル部１６の後部から分岐してそれぞれ前方へ延びる状態に設けられている点で、ハンドル部１６に外観上の精悍さを持たせることができ、この点でも当該ハンディクリーナ１０の商品価値を高めることができる。

【００１８】

また、ハンドル部１６の上面の主として中央が大きな曲率半径Ｒ１の円弧面に形成されて把持した手の平にしっくりとなじむ形状となっていることから、当該ハンドル部１６の把持しやすさ（機能性）が一層高められている。また、上面部にエラストマ製カバー３０（上面部３１）が取り付けられ、この上面部３１が手の平に合わせた円弧面に形成されて把持しやくすなっていることから、長時間把持しても疲れが少なく、この点でも当該ハンディクリーナ１０の機能性を高めることができる。

さらに、ハンドル部１６の前部側（人差し指Ｆ２側）が太く、後部側（小指Ｆ５側）がこれよりも細くなっている。このため、小指Ｆ５を含めて５本の指Ｆ１～Ｆ５でハンドル部１６をしっかりと握ることができ、この点で当該ハンディクリーナ１０の機能性を一層高めることができる。特に、小指Ｆ５側が細くなっていることから使用者は小指Ｆ５でのグリップ感も十分に感ずることができ、この点で使用時及び持ち運び時に使用者の安心感を高めることができる。

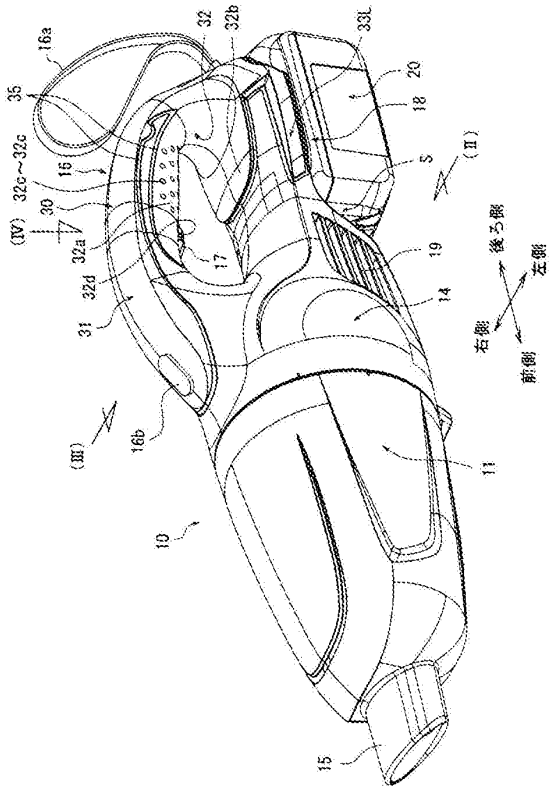
また、ハンドル部１６のループ内周側に差し入れた小指Ｆ５の付け根が半円弧形状の小指ホールド部３２ｅに受けられてしっかりとホールドされるので、この点でも使用者は把持状態の安定性を持つことができる。特に、本実施形態の場合、小指Ｆ５の付け根付近がこの小指ホールド部３２ｅに取り付けたエラストマカバー３０（内周部３２）にしっくりと押し付けられることにより、当該ハンドル部１６のホールド性を確実に高めることがで

きる。
このように、例示したハンドル部１６によれば、当該ハンドル部１６を把持した使用者の手の平になじみやすく、かつ後部側が細くなることにより小指Ｆ５も含めた５本の指Ｆ１～Ｆ５でしっかりと握ることができるとともに、小指Ｆ５の付け根部分が半円弧形の小指ホールド部３２ｅに受けられて使用者は一層良好なホールド感を持って把持することができ、これらの点で当該ハンドル部１６ひいてはハンディクリーナ１０の機能性及び利便性を一層高めることがてき、従って商品としての付加価値を高めることができる。

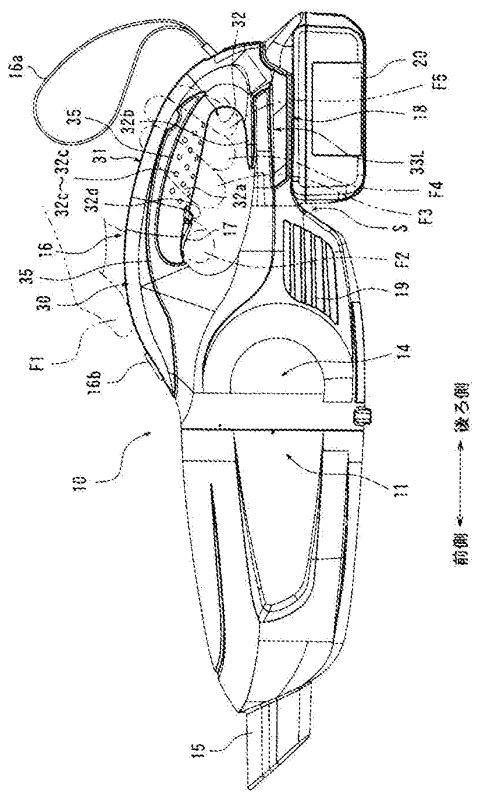
【００１９】
以上説明した実施形態には種々変更を加えることができる。例えば、カバー３０の上面部３１は、把持した手の手の平が接触する範囲についてのみ取り付けてより短くしてもよい。また、内周部３２の底面部３２ｂあるいは左右の張り出し部３３Ｌ，３３Ｒは省略してもよい。
また、上面部３１と内周部３２の天板部３２ａ、底面部３２ｂ及び左右張り出し部３３Ｌ，３３Ｒが当該ハンドル部１６の後部で繋がった形態を例示したが、それぞれ相互に繋がっていない状態に取り付ける構成としてもよい。
バッテリパック２０は例示したリチウムイオンバッテリの他，ニッケルカドミウム電池であってもよい。
また、例示したハンドル部１６のカバー３０は、直流電源式（充電バッテリ式）の他、交流電源タイプのハンディクリーナのループハンドルについても同様に適用することができる。

【符号の説明】
【００２０】
１０…ハンディクリーナ
１１…クリーナ本体
１２…電動モータ
１３…吸引機構
１４…本体ハウジング
１５…吸塵口
１６…ハンドル部、１６ａ…ストラップ
１７…スイッチレバー
１８…バッテリ取り付け部
１８ａ…案内レール部、１８ｂ，１８ｃ…接続端子，１８ｄ…係合凹部
１９…排気口
２０…バッテリパック，２０ａ…係合突部、２０ｂ，２０ｃ…端子溝
２１…係合爪、２１ａ…傾斜面
２２…取り外しボタン
３０…カバー
３１…上面部
３２…内周部
３２ａ…天板部、３２ｂ…底面部，３２ｃ…小突起，３２ｄ…滑り止め突起
３２ｅ…小指ホールド部
３３Ｌ…左側張り出し部、３３Ｒ…右側張り出し部
Ｒ１…ハンド部上面の曲率半径、Ｒ２…ハンドル部前部の曲率半径、Ｒ３…ハンドル部後部の曲率半径、Ｒ４…小指ホールド部の曲率半径
Ｆ１…親指、Ｆ２…人差し指、Ｆ３…中指、Ｆ４…薬指、Ｆ５…小指

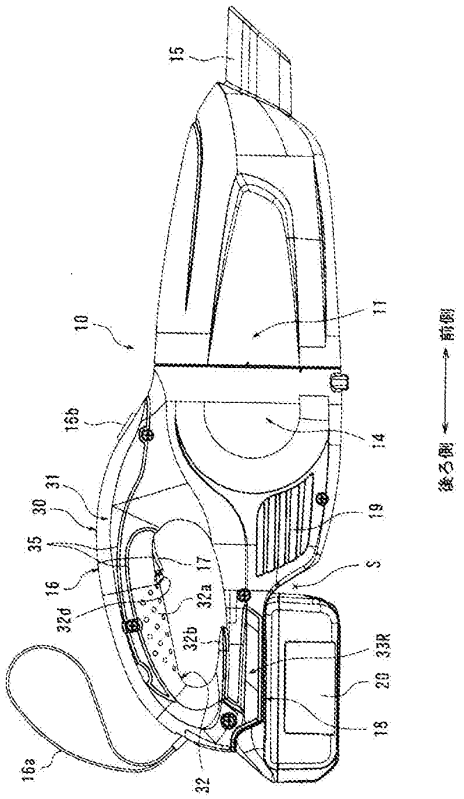
【図1】


16a
32
32b
33L
35
20
18
32c~32c
16
S
(II)
30
(IV)
32a
17
19
32d
14
31
後ろ側
左側
右側
前側
16b
(III)
11
10
15

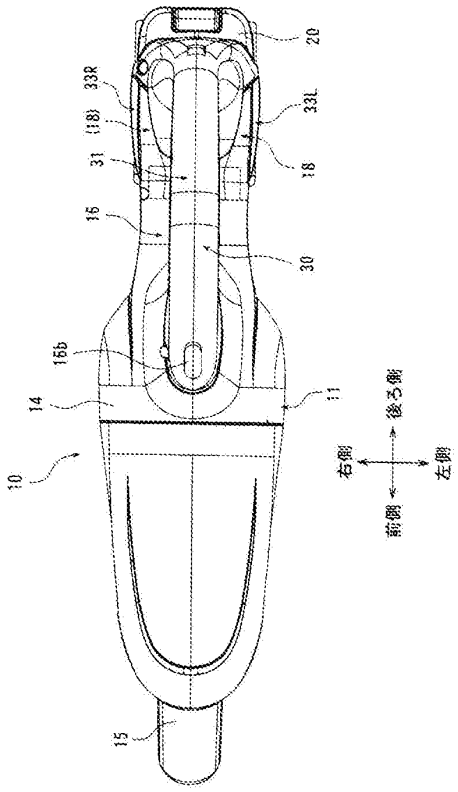
【図2】


32
16a
20
F5
35
32b
18
31
33L
32c~32c
32a
F4
32d
F3
S
16
17
F2
35
19
30
F1
14
16b
後ろ側
10
11
前側
15

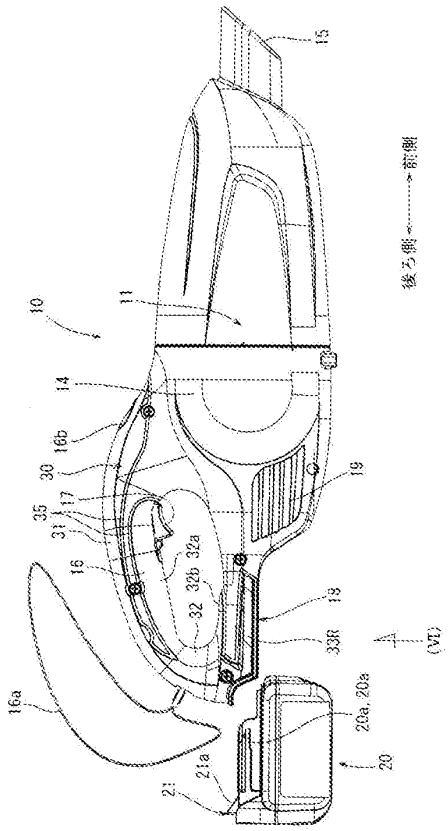
【図3】


15
10
11
前側
16b
14
後ろ側
31
30
19
35
17
S
16
32a
32d
32b
33R
20
18
16a
32

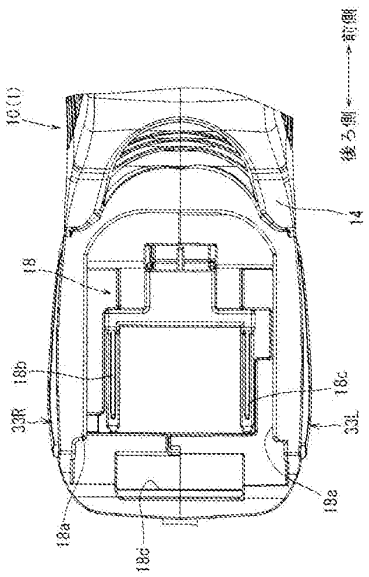
【図4】


20
33R
33L
(18)
31
18
16
30
16b
14
11
後ろ側
右側
左側
前側
10
15

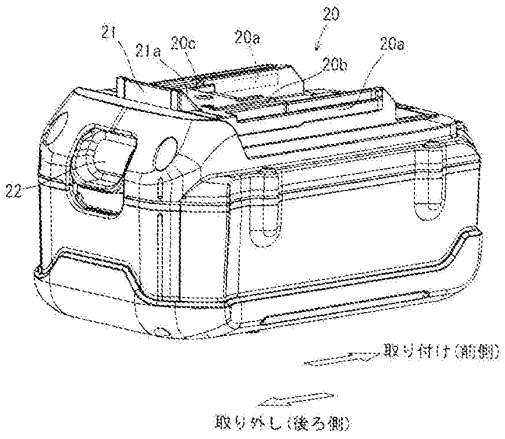
【図５】


15
後ろ側
前側
10
11
14
16b
30
35
17
31
19
32a
16
32b
32
18
33R
(VI)
16a
20a, 20a
20
21a
21

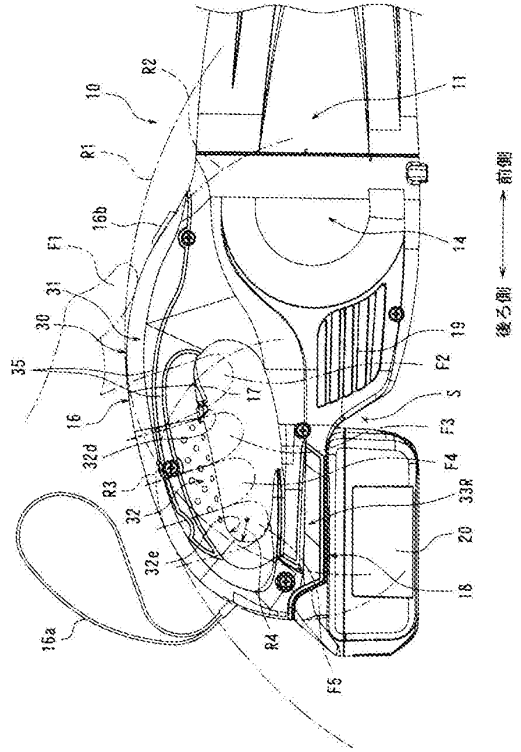
【図６】


前側
後ろ側
10(1)
14
18
18b
18c
33R
33L
18a
12a
18d

【図７】


20
21
21a
20c
20a
20b
20a
22
取り付け(前側)
取り外し(後ろ側)

【図８】


R2
10
11
R1
16b
14
F1
31
30
19
35
F2
S
16
17
F3
32d
F4
R3
33R
32
20
32e
18
16a
R4
F5
前側
後ろ側

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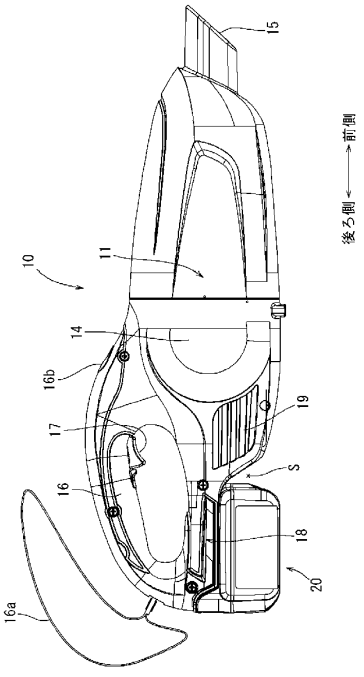
Ｆターム(参考)　3B057 DE06

(54)【発明の名称】ハンディクリーナ

(57)【要約】
【課題】片手に持って使用する小形軽量のハンディクリーナにおいて、従来充電式のバッテリパックがクリーナ本体内に組み込まれる構成であり、その取り付け、取り外し時にはバッテリ収容部を塞ぐ蓋を開閉する必要があり、この点で取り扱いが面倒で、蓋を紛失するおそれもあった。本発明では、バッテリパックの主としてクリーナ本体に対する取り付け、取り外し時等の取り扱い性を高めることを目的とする。
【解決手段】バッテリパック２０を内部組み込み式ではなく、その全体若しくは一部が露出された状態でクリーナ本体１１に装着されるカートリッジ式とする。これにより、従来の蓋を排除してバッテリパック２０の取り付け、取り外し時の取り扱い性をよくする。
【選択図】図１



【特許請求の範囲】
【請求項１】
手に持って使用するハンディクリーナであって、カートリッジ式のリチウムイオンバッテリを電源として備えるハンディクリーナ。
【請求項２】
請求項１記載のハンディクリーナであって、前記バッテリパックは、クリーナ本体に対して係脱する爪部と、該爪部を離脱側に操作するための取り外しボタンを備えたハンディクリーナ。
【請求項３】
請求項１又は２記載のハンディクリーナであって、クリーナ本体の後部に使用者が把持するハンドル部を備え、該ハンドル部の下部に沿って前記バッテリパックを取り付けるハンディクリーナ。
【請求項４】
請求項３記載のハンディクリーナであって、前記ハンドル部の下部に案内レール部を備え、該案内レール部に対して前記バッテリパックを前方にスライドさせて取り付け可能、後方へスライドさせて取り外し可能なハンディクリーナ。
【請求項５】
請求項４記載のハンディクリーナであって、前記バッテリパックを取り付けた状態において該バッテリパックの前部と前記クリーナ本体との間に使用者が指先を差し入れ可能なハンディクリーナ。

【発明の詳細な説明】
【技術分野】
【０００１】
この発明は、例えばハンディクリーナと称される小形の手持ち式掃除機に関する。
【背景技術】
【０００２】
一般に、ハンディクリーナは、その利便性を考慮して直流電源式のものが多く提供されている。ハンディクリーナの電源には、充電して繰り返し使用可能なバッテリパックが用いられている。ハンディクリーナのバッテリパックに関する技術が例えば下記の特許文献に開示されている。
これら特許文献に開示されているように従来、バッテリパックは、本体ハウジングの後部に設けたバッテリ取り出し口を経て取り付け、取り外しすることができる。バッテリパックは、バッテリ取り出し口から差し込んで取り付ければ、本体ハウジング内の電源回路に電気的に接続される。この取り付け状態では、バッテリパックは駆動モータや回路基板等と同様内蔵（組み込み）部品として本体ハウジング内に組み込まれた状態となる。このため、バッテリ取り出し口は蓋で閉じられて、取り付けたバッテリパックは外部から見えない状態となる。
一方、このバッテリパックは、蓋を外して本体ハウジングから取り外し、別途用意した充電器で充電すれば繰り返し使用することができる。
【先行技術文献】
【特許文献】
【０００３】
【特許文献１】実開昭６１－１９８６４６号公報
【特許文献２】特開昭６３－２４０８１５号公報
【特許文献３】特開昭６３－２９６７２１号公報
【発明の概要】
【発明が解決しようとする課題】
【０００４】
このように、従来ハンディクリーナのバッテリパックは、取り出し口を蓋で閉じれば内

部に組み込まれて見えない状態となり、充電等のためにこのバッテリパックを取り外すには蓋を外す必要があった。このため、蓋の開閉操作が面倒であるとともに、取り外した蓋を紛失するおそれもあった。また、バッテリパックを本体ハウジング内に収容する必要上、クリーナの小型化を図ることが困難であった。

なお、バッテリパックは、上記ハンディクリーナに限らず、例えば穴明け加工用の充電式電気ドライバ等の電動工具についても多数用いられている。近年、この種の電動工具のバッテリパックには、ニッケルーカドミウム電池に加えてより軽量なリチウムイオン電池が用いられるようになっている。

また、電動工具については、バッテリパックを本体ハウジング内に組み込む形態ではなく、ハンドル部の先端に簡単な操作で着脱可能とするカートリッジ形式のものが提供されている。

そこで、本発明は、バッテリパックの取り付け形態について、従来の内部組み込み形式における蓋の開閉操作を必要としない結果、その取り付け、取り外しの操作が楽なカートリッジ式のハンディクリーナを提供することを目的とする。

【課題を解決するための手段】

【０００５】

このため、本発明は、特許請求の範囲の各請求項に記載した構成のハンディクリーナとした。

請求項１記載のハンディクリーナによれば、バッテリパックの装着形態について従来の内部組み込み式ではなくカートリッジ式であるので蓋の開閉操作を必要としないことから、当該バッテリパックのクリーナ本体に対する取り付け、取り外し操作を簡単に行うことができる。

また、バッテリパックをカートリッジ式とすることにより、当該バッテリパックを他形式のハンディクリーナ若しくは電動工具と共通化（汎用電源化）しやすくなる。

請求項２記載のハンディクリーナによれば、クリーナ本体に対して確実に取り付けることができ、かつ取り外しボタンの簡単な操作で取り外すことができ、この点で当該バッテリパックの取り扱い性を一層高めることができる。

請求項３記載のハンディクリーナによれば、比較的重量の大きなバッテリパックをハンドル部の下側に沿って取り付けることにより、使用者が受ける当該バッテリパックの重量感を低減することができ、この点で当該ハンディクリーナの使い勝手を高めることができる。

請求項４記載のハンディクリーナによれば、バッテリパックを簡単なスライド操作によりクリーナ本体に取り付け、取り外しすることができ、この点で当該ハンディクリーナの使い勝手を高めることができる。

請求項５記載のハンディクリーナによれば、特別な滑り止め手段を用いることなくバッテリパックの取り外しを簡単に行うことができるようになる。

【図面の簡単な説明】

【０００６】

【図１】本発明の第１実施形態に係るハンディクリーナの全体側面図である。本図では、バッテリパックを装着した状態で示されている。

【図２】本発明の第１実施形態に係るハンディクリーナの全体側面図である。本図では、後部側の内部構造が示されている。

【図３】本発明の第１実施形態に係るハンディクリーナの全体側面図である。本図では、バッテリパックを取り外した状態で示されている。

【図４】バッテリパック取り付け部を図３中矢印(IV)方向から見た下面図である。

【図５】バッテリパック単体の斜視図である。

【図６】第２実施形態に係るハンディクリーナの全体側面図である。

【図７】第２実施形態に係るハンディクリーナの全体側面図である。本図では、後部側の内部構造が示されている。

【図８】第２実施形態に係るハンディクリーナの全体側面図である。本図では、バッテリ

パックを取り外した状態で示されている。
【図９】バッテリパック取り付け部を図８中矢印(IX)方向から見た後面図である。
【図１０】第３実施形態に係るハンディクリーナの全体側面図である。本図では、バッテリパックを装着した状態で示されている。
【図１１】第３実施形態に係るハンディクリーナの全体側面図である。本図では、バッテリパックを取り外した状態で示されている。
【図１２】第３実施形態に係るバッテリパック単体の斜視図である。
【図１３】バッテリパック取り付け部を図１１中矢印(XIII)方向から見た後面図である。
【発明を実施するための形態】
【０００７】
次に、本発明の３つの実施形態を図１～図１３に基づいて説明する。各実施形態に係るハンディクリーナ１０，３０，５０は、例えば自動車の室内清掃や小部屋の簡易な清掃等をする場合に、使用者が片手で持って簡単に使用することができる小形且つ軽量の充電式掃除機であり、それぞれクリーナ本体１１，３１，５１に対するバッテリパック２０，３０，６０の装着形態に特徴を有している。クリーナ本体１１，３１，５１については従来公知の構成であり、各実施形態において特に変更を要しないので詳細な説明を省略する。
図１～図３は、第１実施形態に係るハンディクリーナ１０を示している。このハンディクリーナ１０は、クリーナ本体１１から取り外して充電することにより再使用可能なバッテリパック２０を電源として備えている。クリーナ本体１１は、バッテリパック２０を電源として駆動する電動モータ１２とこの電動モータ１２により回転するファンを主体とする吸引機構１３を本体ハウジング１４に内蔵している。本体ハウジング１４の先端部に吸塵口１５を備えている。本体ハウジング１４の前側半分は、吸引したゴミ等を廃棄するために取り外すことができる。
本体ハウジング１４の後部には、使用者が把持するループ形のハンドル部１６が設けられている。このハンドル部１６の内周側には、使用者が指先で引き操作するスイッチレバー１７が設けられている。このスイッチレバー１７を図示上側へ引き操作すると、電動モータ１２が起動して吸塵口１５から粉塵等を吸引することができる。また、ハンドル部１６の後部には吊り下げ用のストラップ１６ａが取り付けられ、前部には暗所での清掃時に便利な照明具１６ｂが備え付けられている。図２に示すようにこの照明具１６ｂは、ハンドル部１６の前面であって前方に障害物がない部位に出っ張らない状態に組み込まれている。この照明具１６ｂによって主として吸塵口１５の周辺が明るく照らされる。この照明具１６ｂの光源にはＬＥＤ（発光ダイオード）が用いられている。ＬＥＤに代えて電球を用いてもよい。この照明具１６ｂの電源としてもバッテリパック２０が利用される。
このハンドル部１６の下面側に、バッテリパック２０を装着するためのバッテリ取り付け部１８が設けられている。このバッテリ取り付け部１８の前側には、排気口１９が設けられている。
バッテリパック２０は、バッテリ取り付け部１８に対して前側へスライドさせることにより取り付けることができる。逆に、バッテリパック２０は、バッテリ取り付け部１８から後ろ側へスライドさせることにより取り外すことができる。
【０００８】
バッテリ取り付け部１８の詳細が図４に示されている。このバッテリ取り付け部１８の左右両側には、左右一対の案内レール部１８ａ，１８ａが一体に設けられている。この左右の案内レール部１８ａ，１８ａに対応して、バッテリパック２０の上面側の左右側部には左右一対の係合突部２０ａ，２０ａが一体に設けられている。バッテリ取り付け部１８に対してバッテリパック２０を前後にスライドさせて、左右の案内レール部１８ａ，１８ａに係合突部２０ａ，２０ａを係脱させることにより、当該バッテリパック２０をバッテリ取り付け部１８に対して取り付け、取り外しすることができる。
図５には、バッテリ取り付け部１８から取り外した状態のバッテリパック２０が単体で示されている。このバッテリパック２０は、電圧１４．４Ｖの充電式リチウムイオンバッテリで、別途用意する充電器で充電して繰り返し使用することができる。

一般にリチウムイオンバッテリは、ニッケル水素バッテリに比して軽量である。例えば、市場で一般的に流通するニッケル水素バッテリで、電圧１４．４Ｖ、公称容量３．３Ａｈのものは重さ１０２０ｇであるのに対して、同じく電圧１４．４Ｖ、公称容量３．０Ａｈのリチウムイオンバッテリは重さ５００ｇ程度であり、約１／２に軽量化されている。従って、リチウムイオンバッテリを電源として用いることによりハンディクリーナ１０を全体として軽量化することができる。

このバッテリパック２０は概ね６面体のブロック体形状を有するもので、その上面には、プラス端子２０ｂとマイナス端子２０ｃをそれぞれ備えた前後に細長い２つの端子溝２０ｂ，２０ｃが設けられている。この端子溝２０ｂ，２０ｃに対応して、バッテリ取り付け部１８には、プラスの接続端子１８ｂとマイナスの接続端子１８ｃが設けられている。プラスの接続端子１８ｂを端子溝２０ｂ内に進入させ、マイナスの接続端子１８ｃを端子溝２０ｃ内に進入させた状態で当該バッテリパック２０をバッテリ取り付け部１８に取り付けることにより、当該バッテリパック２０がクリーナ本体１０の電源回路に電気的に接続される。

バッテリパック２０の上面後部には、上下に進退する係合爪２１が設けられている。この係合爪２１は、後面に設けた取り外しボタン２２を指先で下側へスライド操作することによって下方へ退避させることができる。この係合爪２１は、上方のロック位置側にばね付勢されている。また、この係合爪２１の前部は、当該バッテリパック２０の取り付け動作に伴って退避側へ変位するための傾斜面２１ａが設けられている。

【０００９】

この係合爪２１に対応してバッテリ取り付け部１８の後部には、係合爪２１が係合する係合凹部１８ｄが設けられている。この係合凹部１８ｄ内に係合爪２１が進入すると、バッテリパック２０の取り外し側（後ろ側）への変位が規制されて、バッテリ取り付け部１８に対して当該バッテリパック２０が取り付けた状態にロックされる。

この取り付け状態において、使用者が指先でバッテリパック２０の取り外しボタン２２を下側に移動操作すると、これに伴って係合爪２１が下方へ一体で変位し、係合凹部１８ｄ内から退出する。このため、バッテリパック２０を後ろ側へスライドさせてバッテリ取り付け部１８から取り外すことができる。

図１及び図２に示すようにバッテリ取り付け部１８の前部から当該クリーナ本体１１の下部に至る範囲で本体ハウジング１４の外形はなだらかに傾斜している。このため、バッテリパック２０をバッテリ取り付け部１８に取り付けた状態では、当該バッテリパック２０の前側に使用者が指先を差し入れるためのスペースＳが発生する。使用者は、このスペースＳに指先を差し入れることによってバッテリパック２０を簡単に後ろ側へ押して取り外すことができる。

【００１０】

以上のように構成した第１実施形態のハンディクリーナ１０によれば、ハンドル部１６の下部に設けたバッテリ取り付け部１８に対してバッテリパック２０を前後にスライドさせて取り付け、取り外しすることができる。バッテリパック２０を取り付ける場合には、その係合突部２０ａ，２０ａをバッテリ取り付け部１８の左右の案内レール部１８ａ，１８ａに沿って係合させつつ前側へスライドさせると、後部の係合爪２１がその傾斜面２１ａの作用により下方へ退避する。バッテリパック２０が取り付け位置に至って電気的に接続されると係合爪２１がバッテリ取り付け部１８の係合凹部１８ｄ内に進入する。これにより、バッテリパック２０の取り外し方向へ変位が規制されて当該バッテリパック２０がハンドル部１６の下面側に沿って取り付けられた状態にロックされる。

バッテリパック２０を取り外すには、使用者は指先で取り外しボタン２２を押し下げ操作して、係合爪２１を係合凹部１８ｄ内から退避させ、この状態で当該バッテリパック２０を後ろ側へスライドさせればよい。

このように、従来の本体組み込み式とは異なって、当該ハンディクリーナ１０の外形（外観）の一部を構成（露出）する装着形態であるカートリッジ式であるため、バッテリパック２０の取り付け、取り外しに際して蓋を開閉する必要がなく、この点で当該バッテリ

パック２０の取り付け、取り外し操作についてハンディクリーナ１０の使い勝手（操作性）を高めることができる。

また、本実施形態のハンディクリーナ１０によればバッテリパック２０を取り付けた状態において、当該バッテリパック２０の前部に使用者が指先を差し入れるスペースＳが発生するため、当該バッテリパック２０の取り外し操作を楽に行うことができる。このスペースＳを利用して簡単に取り外すことができるので、当該バッテリパック２０の例えば左右側部に突起部等の特別な滑り止め手段を設ける必要がない。

さらに、係合爪２１が係合凹部１８ｄに係合することにより確実な取り付け状態を維持することができるとともに、取り外しボタン２２を押し下げ操作すれば簡単に取り外すことができ、この点でも当該バッテリパック１０の良好な取り扱い性が確保されている。

また、ニッケル水素バッテリに比して約半分に軽量化できるもののクリーナ本体１側の各構成部品に比して依然として重量の大きなバッテリパック２０が使用者が把持するハンドル部１６の直下に取り付けられる構成であるので、当該クリーナ本体１１の例えば先端部に装着する場合に比して使用者は当該バッテリパック２０の重さをさほど感ずることなく持ち運ぶことができる。

さらに、バッテリパック２０を本体ハウジング１４内に収容する組み込み式ではなく、クリーナ本体１１に対して露出した状態に取り付けるカートリッジ式であるので、クリーナ本体１１のバッテリ取り付け部１８に対する取り付け寸法関係についてのみ一致させれば、そのサイズを問わず他形態のハンディクリーナ若しくは電動工具との間でバッテリパックを共通化することができる。

また、広範囲の電圧に対する電動モータあるいは変換回路により、例えば１２Ｖ、１４．４Ｖあるいは１８Ｖといったように異なる電圧のバッテリパックを使用できるようになる。

【００１１】

次に、図６～図９には第２実施形態のハンディクリーナ３０が示されている。この第２実施形態も、クリーナ本体３１に対するバッテリパック４０の装着形態に特徴を有している。第１実施形態と同様、クリーナ本体３１は、本体ハウジング３４に電動モータ３２とこれにより動作する吸引機構３３を内蔵した構成を備えている。本体ハウジング３４の前部に吸塵口３５が設けられている。

クリーナ本体３１の後部には、使用者が把持するループ形のハンドル部３６が設けられている。ハンドル部３６の内周側には、使用者が指先で引き操作するためのスイッチレバー３７が設けられている。このスイッチレバー３７を引き操作すると、電動モータ３２が起動して吸塵口３５から粉塵等を吸引することができる。

吸引機構３３の周囲であって本体ハウジング３４の左右側部には、排気口３９が設けられている。吸引に伴う排気がこの排気口３９を経て放射方向に吹き出される。

第１実施形態と同様、ハンドル部３６の下面側にバッテリ取り付け部３８が設けられている。このバッテリ取り付け部３８は、第１実施形態とは異なって概ね筒体形を有している。このバッテリ取り付け部３８は、図９に示すように後方に開口されている。このバッテリ取り付け部３８の奥部（底部）に、プラスの接続端子３８ａとマイナスの接続端子３８ｂが配置されている。このバッテリ取り付け部３８に対して後方からバッテリパック４０を抜き差しすることにより、当該バッテリパック４０をクリーナ本体３１に対して取り付け、取り外しすることができる。このバッテリ取り付け部３８にバッテリパック４０を差し込めば、当該バッテリパック４０の端子孔（図では見えていない）に接続端子３８ａ，３８ｂが挿入されて当該バッテリパック４０がクリーナ本体３１の電源回路に電気的に接続される。

【００１２】

第２実施形態に係るバッテリパック４０は、第１実施形態のバッテリパック２０よりも小形で７．２Ｖのリチウムイオンバッテリが用いられている。このバッテリパック４０は、断面小判形（長円形）の本体部４０ａと、この本体部４０ａの後部に若干大径に形成された頭部４０ｂを備えている。本体部４０ａには、４本のバッテリセルが内装されている

。

図８に示すようにバッテリパック４０の頭部４０ｂの左右両側部には、係合爪４１，４１とこれを離脱側に操作するための押しボタン４２，４２が設けられている。この両係合爪４１，４１に対応して、バッテリ取り付け部３８の口元内側には、図９に示すように左右一対の係合突部３８ｃ，３８ｃが設けられている。この両係合突部３８ｃ，３８ｃに対して係合爪４１，４１は、それぞれバッテリパック４０の取り外し方向にのみ係合し、取り付け方向については両係合爪４１，４１が弾性力に抗して退避する。このため、バッテリパック４０をバッテリ取り付け部３８に差し込むと、左右の係合爪４１，４１がそれぞれバッテリ取り付け部３８側の係合突部３８ｃに係合して当該バッテリパック４０が取り付け位置にロックされる。

この取り付け状態において、左右の押しボタン４２，４２を指先で両側から挟むようにして押し操作すると、両係合突部３８ｃ，３８ｃに対する係合爪４１，４１の係合状態が解除されるため、当該バッテリパック４０をバッテリ取り付け部３８から後方へ抜き出すようにして取り外すことができる。図８は、バッテリパック４０を取り外した状態を示している。

以上のように構成した第２実施形態のハンディクリーナ３０によっても、従来のバッテリパック組み込み式とは異なって、ハンディクリーナ３０のバッテリ取り付け部３８に対してバッテリパック４０を抜き差しすることにより取り付け、取り外しすることができ、取り付けた状態では主としてその頭部４０ｂが当該ハンディクリーナ３０の外形の一部を構成（露出）する装着形態であるカートリッジ式であるので、当該バッテリパック４０の取り付け、取り外しに際して従来のような蓋を開閉操作する必要がなく、この点で当該ハンディクリーナ３０の取り扱い性を高めることができる。

また、比較的重量の大きなバッテリパック４０がハンドル部３６の下部に取り付けられる構成であるので、持ち運び時等の重量バランスがよい。

【００１３】

図１０～図１３には、バッテリパック６０について前記第２実施形態とは異なる第３実施形態のハンディクリーナ５０が示されている。クリーナ本体５１については概ね第２実施形態に係るクリーナ本体３１と同様に構成されており、その前端部に吸塵口５５を備え、本体ハウジング５４の後部には使用者が把持するループ形のハンドル部５６が設けられている。このハンドル部５６の内周側に使用者が指先で引き操作するスイッチレバー５７が設けられている。また、本体ハウジング５４の長手方向ほぼ中央の左右両側部には、排気口５９～５９が設けられている。

ハンドル部５６の下部に沿ってバッテリ取り付け部５８が設けられている。このバッテリ取り付け部５８も、第２実施形態と同様概ね筒体形に形成されており、後方に向けて開口されている。このバッテリ取り付け部５８の奥部（底部）に、プラスの接続端子５８ａとマイナスの接続端子５８ａが配置されている。このバッテリ取り付け部５８に後方からバッテリパック６０を抜き差しすることにより、当該バッテリパック６０をクリーナ本体５１に対して取り付け、取り外しすることができる。

図１２に示すように第３実施形態のハンディクリーナ５０に装着されるバッテリパック６０は、断面三角形の本体部６０ａと、この本体部６０ａの後部にやや大径に形成された頭部６０ｂを備えている。本体部６０ａに３本のバッテリセルが内装されている。本体部６０ａの前端面に、プラスとマイナスの端子孔６０ｃ，６０ｄが設けられている。この本体部６０ａをバッテリ取り付け部５８に差し込めば、端子孔６０ｃ，６０ｄに上記接続端子５８ａ，５８ｂが挿入されて当該バッテリパック６０がクリーナ本体５１側の電源回路に電気的に接続される。

頭部６０ｂの左右両側部に係合爪６１，６１とこれを離脱側に操作するための押しボタン６２，６２が設けられている。この両係合爪６１，６１に対応して、バッテリ取り付け部５８の口元内側には、図１３に示すように左右一対の係合突部５８ｃ，５８ｃが設けられている。この両係合突部５８ｃ，５８ｃに対して係合爪６１，６１は、それぞれバッテリパック６０の取り外し方向にのみ係合し、取り付け方向については両係合爪６１，６１

が弾性力に抗して退避する。このため、バッテリパック６０をバッテリ取り付け部５８に差し込むと、左右の係合爪６１，６１がそれぞれバッテリ取り付け部５８側の係合突部５８ｃ，５８ｃに係合して当該バッテリパック６０が取り付け位置にロックされる。

この取り付け状態において、左右の押しボタン６２，６２を指先で両側から挟むようにして押し操作すると、両係合突部５８ｃ，５８ｃに対する係合爪６１，６１の係合状態が解除されるため、当該バッテリパック６０をバッテリ取り付け部５８から後方へ抜き出すようにして取り外すことができる。図１１は、バッテリパック６０を取り外した状態を示している。

以上のように構成した第３実施形態のハンディクリーナ５０によっても、バッテリパック６０をバッテリ取り付け部５８に対して抜き差しするだけで取り付け、取り外しすることができ、従来の本体組み込み式とは異なって蓋を開閉操作する必要がないカートリッジ式であるので、この点で当該ハンディクリーナ５０の操作性及び取り扱い性を高めることができる。

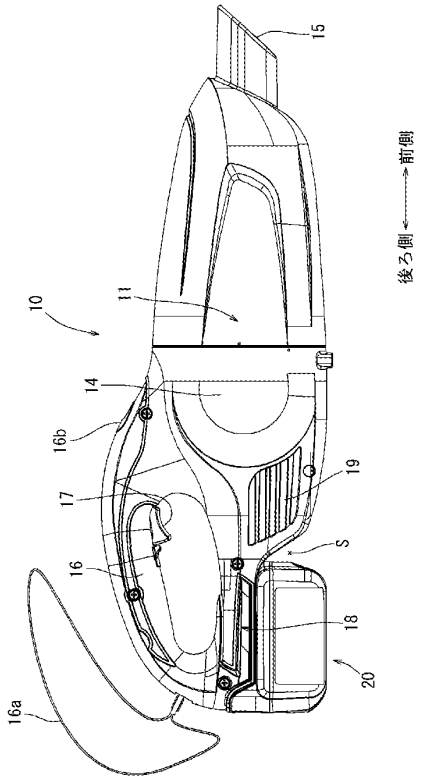
【符号の説明】

【００１４】

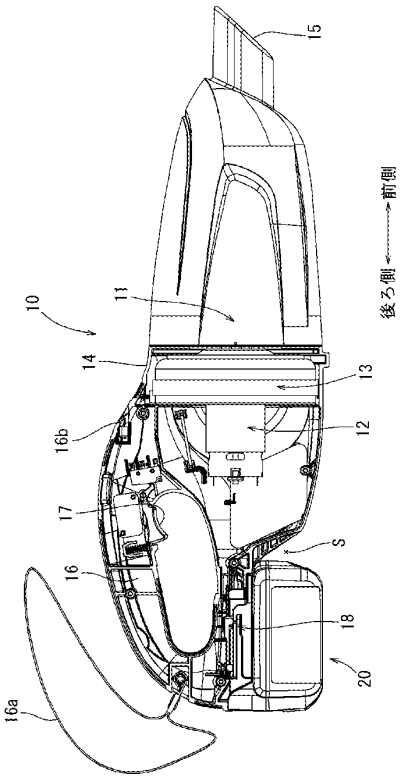
１０…ハンディクリーナ（第１実施形態）
１１…クリーナ本体
１２…電動モータ
１３…吸引機構
１４…本体ハウジング
１５…吸塵口
１６…ハンドル部、１６ａ…ストラップ
１７…スイッチレバー
１８…バッテリ取り付け部
１８ａ…案内レール部、１８ｂ，１８ｃ…接続端子、１８ｄ…係合凹部
１９…排気口
２０…バッテリパック、２０ａ…係合突部、２０ｂ，２０ｃ…端子溝
２１…係合爪、２１ａ…傾斜面
２２…取り外しボタン
３０…ハンディクリーナ（第２実施形態）
３１…クリーナ本体
３２…電動モータ
３３…吸引機構
３４…本体ハウジング
３５…吸塵口
３６…ハンドル部
３７…スイッチレバー
３８…バッテリ取り付け部、３８ａ，３８ｂ…接続端子、３８ｃ…係合突部
３９…排気口
４０…バッテリパック、４０ａ…本体部、４０ｂ…頭部
４１…係合爪
４２…押しボタン
５０…ハンディクリーナ（第３実施形態）
５１…クリーナ本体
５４…本体ハウジング
５５…吸塵口
５６…ハンドル部
５７…スイッチレバー
５８…バッテリ取り付け部、５８ａ，５８ｂ…接続端子、５８ｃ…係合突部
５９…排気口

６０…バッテリパック
６０ａ…本体部、６０ｂ…頭部、６０ｃ，６０ｄ…端子孔
６１…係合爪
６２…押しボタン

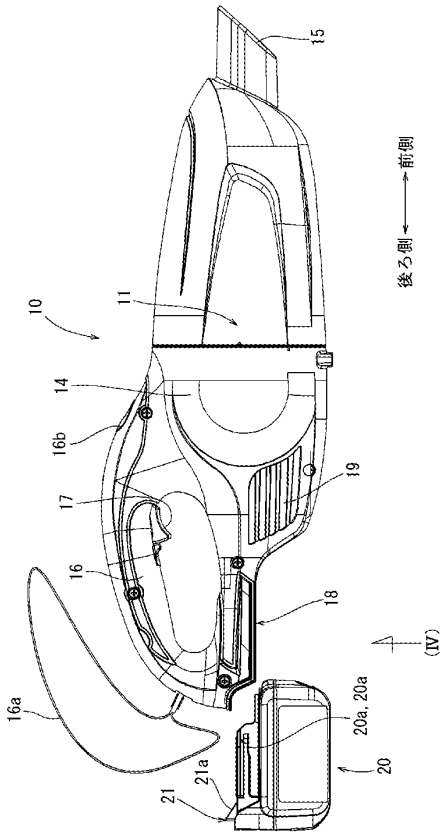
【図１】



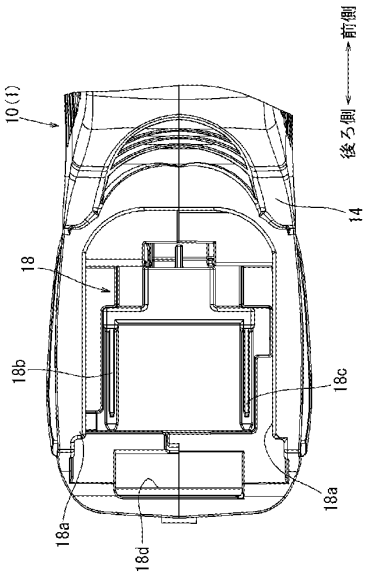
【図２】



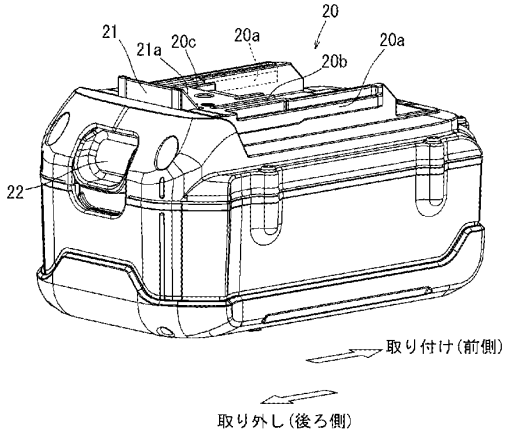
【図３】


15
前側
後ろ側
10
11
14
16b
19
17
16
18
(IV)
16a
20a, 20a
21a
20
21

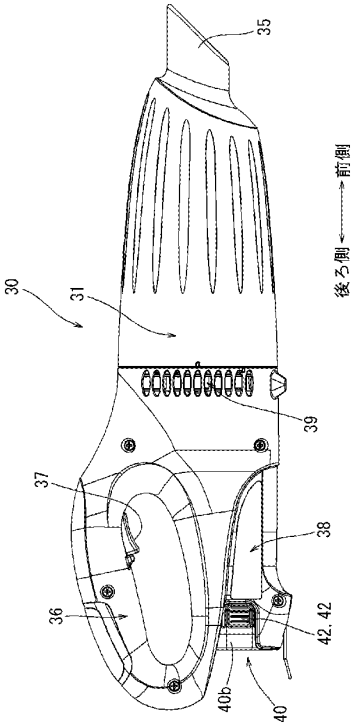
【図４】


前側
後ろ側
10(1)
14
18
18b
18c
18a
18a
18d

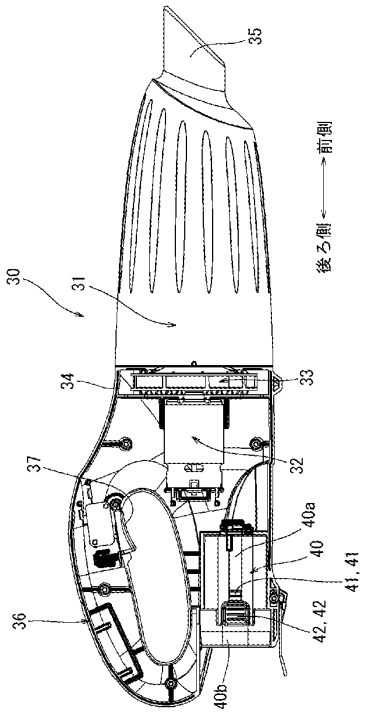
【図５】


20
21
21a
20c
20a
20b
20a
22
取り付け(前側)
取り外し(後ろ側)

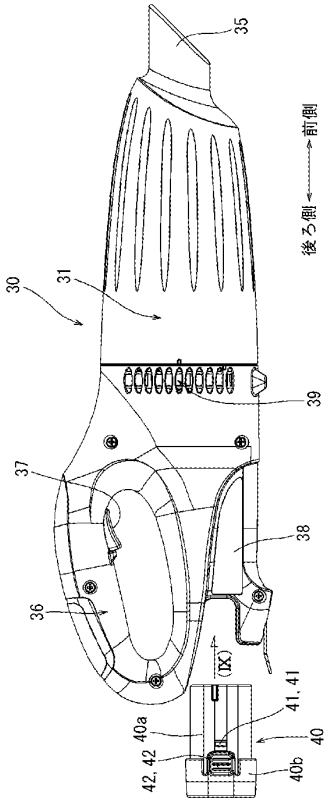
【図６】


35
前側
後ろ側
30
31
39
37
38
36
42, 42
40b
40

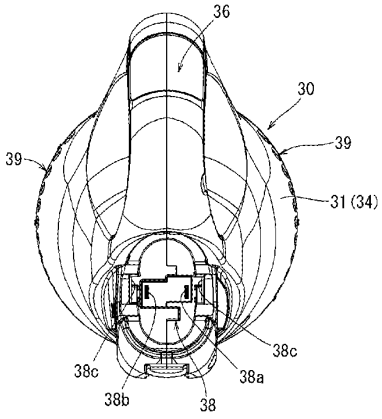
【図７】


35
前側
後ろ側
30
31
34
33
32
37
40a
40
41, 41
36
42, 42
40b

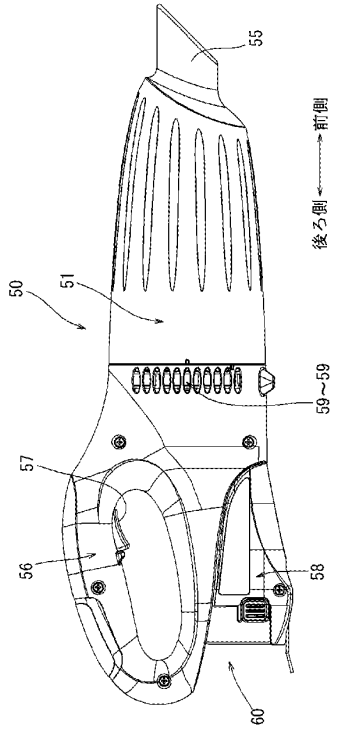
【図８】


35
前側
後ろ側
30
31
39
37
38
36
(IX)
41, 41
40a
40
42, 42
40b

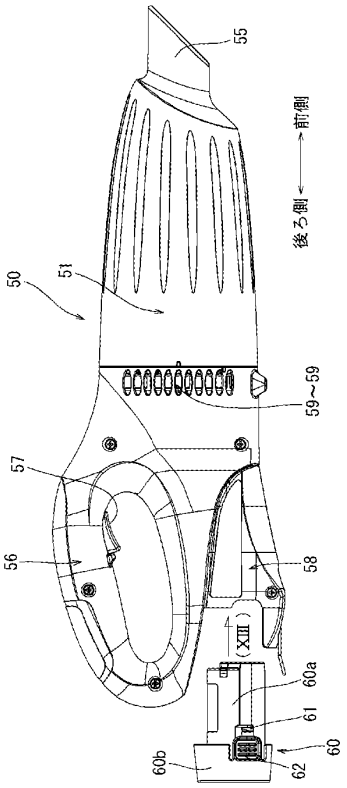
【図９】


36
30
39
39
31 (34)
38c
38c
38a
38b
38

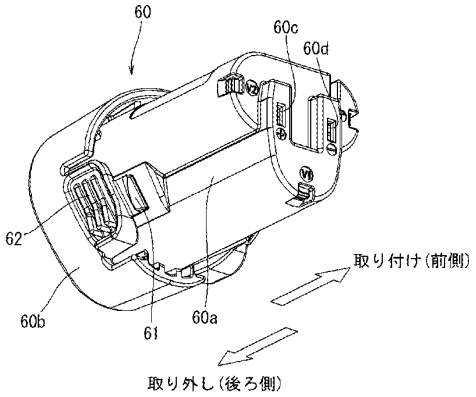
【図１０】


55
前側
後ろ側
50
51
59～59
57
56
58
60

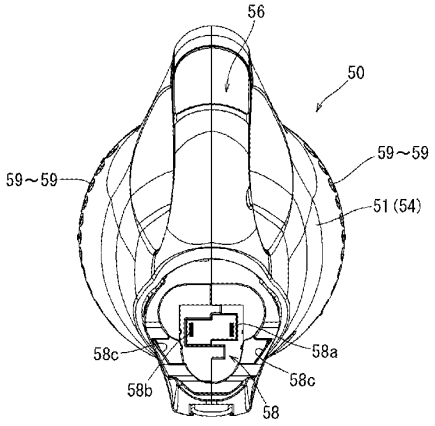
【図１１】


55
前側
後ろ側
50
51
59～59
57
56
58
XIII
60a
61
60
60b
62

【図１２】


60
60c
60d
62
取り付け(前側)
60b
61
60a
取り外し(後ろ側)

【図１３】


56
50
59～59
59～59
51(54)
58c
58a
58c
58b
58

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Published:
— *with international search report (Art. 21(3))*

(54) **Title**: A CLEANER HEAD

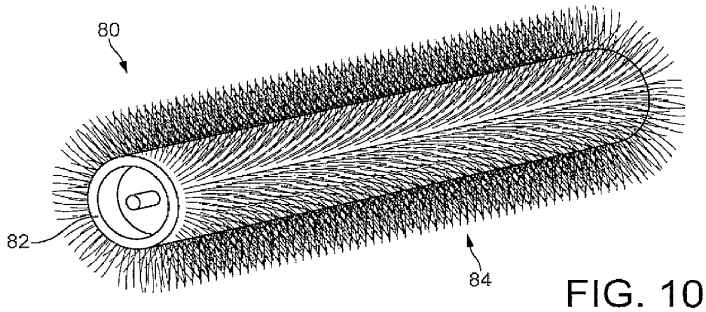

FIG. 10

(57) **Abstract**: Agitating apparatus (80) for a surface treating appliance comprises a rotatable body (82) having an outer surface comprising an electrically conductive pile (84) formed from filaments having a surface resistivity in the range from $1x10^{-5}$ to$1x10^{12}$ Ω/sq.

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A Cleaner Head

The present invention relates to agitating apparatus for a surface treating appliance, and to a cleaner head for a surface treating appliance. In its preferred embodiment, the present invention relates to a cleaner head for a vacuum cleaning appliance.

A vacuum cleaner typically comprises a main body containing dirt and dust separating apparatus, a cleaner head connected to the main body and having a suction opening, and a motor-driven fan unit for drawing dirt-bearing air through the suction opening. The dirt-bearing air is conveyed to the separating apparatus so that dirt and dust can be separated from the air before the air is expelled to the atmosphere.

The suction opening is directed downwardly to face the floor surface to be cleaned. The separating apparatus can take the form of a filter, a filter bag or, as is known, a cyclonic arrangement. The present invention is not concerned with the nature of the separating apparatus and is therefore applicable to vacuum cleaners utilizing any of the above arrangements or another suitable separating apparatus.

A driven agitator, usually in the form of a brush bar, is supported in the cleaner head so as to protrude to a small extent from the suction opening. The brush bar is activated mainly when the vacuum cleaner is used to clean carpeted surfaces. The brush bar comprises an elongate cylindrical core bearing bristles which extend radially outward from the core. The brush bar may be driven by an air turbine or by an electric motor powered by a power supply derived from the main body of the cleaner. The brush bar may be driven by the motor via a drive belt, or may be driven directly by the motor, so as to rotate within the suction opening. Rotation of the brush bar causes the bristles to sweep along the surface of the carpet to be cleaned to loosen dirt and dust, and pick up debris. The suction of air causes air to flow underneath the sole plate and around the brush bar to help lift the dirt and dust from the surface of the carpet and then carry it from the suction opening through the cleaner head towards the separating apparatus.

The bristles of the brush bar are usually formed from nylon. While the use of nylon bristles provides an acceptable cleaning performance on carpeted floor surfaces, we have found that the use of nylon bristles generates static electricity when the floor tool is used on some hard floor surfaces, such as laminate, wood and vinyl surfaces, which attracts fine dust and powders, such as talcum powder, on to the floor surface. This can impair the cleaning performance on the cleaner head on such floor surfaces, as the sweeping action of the nylon bristles is insufficient to overcome the force attracting the fine dust to the floor surface.

In a first aspect, the present invention provides agitating apparatus for a surface treating appliance, comprising a rotatable body having an outer surface comprising an electrically conductive pile.

Providing the rotatable body with an electrically conductive outer surface can enable static electricity residing on a floor surface to be cleaned to be discharged upon contact between the body and the floor surface. This enables fine dust and powder which would otherwise be attracted to the floor surface to be dislodged from the floor surface by the body. Having an outer surface comprising a pile, which is preferably similar to the raised or fluffy surface of a carpet, rug or cloth, can inhibit scratching or other marking of the floor surface upon contact with the rotating body.

The surface resistivity of the pile is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq (ohms per square). Values of surface resistivity discussed herein are as measured using the test method ASTM D257. The selection of material having a surface resistivity in this range can ensure that any static electricity on the floor surface is effectively discharged by the agitating apparatus.

The pile preferably covers at least half of the outer surface of the body, more preferably at least 80% of the outer surface, and even more preferably substantially covers the outer surface of the body so that no patterns of dirt or dust are formed on the floor surface as a cleaner head including the apparatus is manoeuvred over a floor surface.

Therefore, in a second aspect the present invention provides agitating apparatus for a surface treating appliance, comprising a rotatable body having an outer surface which is substantially covered with filaments having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

The apparatus preferably comprises filaments formed from one of metallic, carbon fibre, carbon composite, conductive acrylic, such as Thunderon®, or other composite material. For example, material comprising carbon particles and carbon fibres generally has a surface resistivity in the range from $1x10^{3}$ to $1x10^{6}$ Ω/sq, whereas metallic material generally has a much lower surface resistivity, generally lower than 1 Ω/sq. Other static dissipative materials generally have a surface resistivity in the range from $1x10^{5}$ to $1x10^{12}$ Ω/sq.

The filaments are preferably woven on to a flexible carrier member located about the body. For example, the carrier member may be in the form of a strip which is wound about the body, preferably so that there are substantially no gaps between the turns of the carrier member. The carrier member is preferable attached to the body using an adhesive.

The length of the filaments is preferably in the range from 4 to 10 mm. Preferably, the filaments have a diameter in the range from 5 to 20 μm.

The rotatable body may comprise further surface agitating means. The further surface agitating means may be configured to agitate dirt and dust from a carpeted floor surface, and so is preferably relatively stiff in comparison to the electrically conductive pile or filaments. For example, bristles or filaments of the further surface agitating means may have a greater diameter than bristles or filaments of the electrically conductive pile.

The further surface agitating means may be formed from electrically insulating, plastics material, such as nylon, and so may have a surface resistivity which is different to that of the electrically conductive pile or filaments. The surface resistivity of the further

surface agitating means is preferably in the range from $1x10^{12}$ to $1x10^{16}$ Ω/sq. Alternatively, the further surface agitating means may be formed from a similar material as the electrically conductive pile or filaments.

The further surface agitating means may be dispersed within the filaments of the electrically conductive pile. The further surface agitating means is preferably arranged in a plurality of rows along the body, with these rows being preferably discontinuous. For example, where the further surface agitating means comprises a plurality of bristles these bristles are preferably arranged in one or more rows of clusters or tufts of bristles connected to and spaced along the body.

The agitating apparatus is preferably in the form of a rotatable brush bar.

In a third aspect, the present invention provides a cleaner head for a surface treating appliance, the cleaner head comprising a housing and apparatus as aforementioned. Where the agitating apparatus is in the form of a rotatable brush bar, the cleaner head may comprise two such brush bars. The brush bars are preferably rotatable in opposing directions.

In a fourth aspect, the present invention provides a surface treating appliance comprising a cleaner head or agitating apparatus as aforementioned.

The term "surface treating appliance" is intended to have a broad meaning, and includes a wide range of machines having a main body and a head for travailing over a surface to clean or treat the surface in some manner. It includes, inter alia, machines which simply agitate the surface, such as carpet sweepers, machines which only apply suction to the surface, such as vacuum cleaners (dry, wet and wet/dry), so as to draw material from the surface, and machines which apply material to the surface, such as polishing/waxing machines, pressure washing machines and shampooing machines.

Features described above in connection with the first aspect of the invention are equally applicable to any of the second to fourth aspects of the invention, and vice versa.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a front perspective view, from above of a floor tool;

Figure 2 is a front perspective view, from below, of the floor tool of Figure 1;

Figure 3 is a bottom view of the floor tool of Figure 1;

Figure 4 is an exploded view of the brush bar of the floor tool of Figure 1;

Figure 5 is a perspective view of the brush bar of Figure 4;

Figure 6 is a top view of the brush bar of Figure 4;

Figure 7 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a carpeted floor surface;

Figure 8 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a hard floor surface;

Figure 9 is a perspective view of a modified version of the brush bar of Figure 4; and

Figure 10 is a perspective view of an alternative brush bar for use with the floor tool of Figure 1.

With reference first to Figures 1 to 3, a floor tool 10 comprises a cleaner head 12 rotatably attached to a coupling 14. The free end of the coupling 14 is attachable to a

wand, hose or other such duct of a cleaning appliance (not shown). The cleaner head 12 comprises a housing 16 and a lower plate, or sole plate 18, comprising a suction opening 20 through which a dirt-bearing fluid flow enters the cleaner head 12. The housing 16 defines a suction passage extending from the suction opening 20 to an outlet duct 22 located at the rear of the housing 16. The housing 16 preferably comprises a front bumper 23. The sole plate 18 comprises a plurality of support members 24 in the form of rolling elements mounted within recessed portions of the sole plate 18 for supporting the cleaner head 12 on a floor surface. With reference to Figures 7 and 8, the support members 24 are preferably arranged to support the sole plate 18 above the floor surface when the cleaner head 12 is located on a hard floor surface 66, and, when the cleaner head 12 is located on a carpeted floor surface 64, to sink into the pile of the carpet to enable the bottom surface of the sole plate 18 to engage the fibres of the carpet. The sole plate 18 is preferably pivotable relative to the housing 16 to allow the sole plate 18 to ride smoothly over the carpeted floor surface 64 during cleaning.

The coupling 14 comprises a conduit 26 supported by a pair of wheels 28, 30. The conduit 26 comprises a forward portion 32 connected to the outlet duct 22, a rearward portion 34 pivotably connected to the forward portion 32 and connectable to a wand, hose or other such duct of a cleaning appliance which comprises dirt and dust separating apparatus and a motor-driven fan unit for drawing dirt-bearing air through the suction opening 20 from the floor surface. A flexible hose 36 is held within and extends between the forward and the rearward portions 32, 34 of the conduit 26.

The cleaner head 12 comprises agitating apparatus for agitating dirt and dust located on the floor surface. In this example the agitating apparatus comprises a rotatable brush bar 40 which is mounted within a brush bar chamber 42 of the housing 16. The brush bar chamber 42 is partially defined by a generally semi-cylindrical portion 43 of the housing 16, which is preferably formed from transparent material. The brush bar 40 is driven by a motor (not shown) located in a motor housing 44 of the housing 16. The motor is electrically connected to a terminal located in the rearward portion 34 of the

conduit 26 for connection with a conformingly profiled terminal located in a duct of the cleaning appliance to enable electrical power to be supplied to the motor.

The brush bar 40 is connected to the motor by a drive mechanism located, at least in part, within a drive mechanism housing 46 so that the drive mechanism is isolated from the air passing through the suction passage. One end of the brush bar 40 is connected to the drive mechanism to enable the brush bar 40 to be driven by the motor, whereas the other end of the brush bar 40 is rotatably supported by an end cap 48 mounted on a side wall of the brush bar chamber 42.

The brush bar 40 is illustrated in more detail in Figures 4 to 6. The brush bar 40 comprises an elongate body 50 bearing two different types of agitating means for agitating dirt and dust from the floor surface as the brush bar 40 is rotated by the motor. Each of the different types of agitating means protrudes from the suction opening 20 in the sole plate 18 as the brush bar 40 is rotated by the motor. A spindle 51 is mounted on one end of the body 50, with the spindle 51 being in turn connected to the end cap 48.

A first agitating means mounted on the body 50 of the brush bar 40 comprises relatively short, preferably relatively stiff, bristles 52. These bristles 52 are preferably formed from nylon. In this embodiment the relatively short bristles 52 are arranged in two angularly spaced, helical rows extending along the body 50. Within each row, the relatively short bristles 52 are arranged in a series of clusters or tufts 53 regularly spaced along the row. Each tuft 53 preferably comprises around 100 to 150 bristles, with each tuft 53 having a diameter in the range from 2 to 4 mm. The diameter of each bristle 52 is preferably in the range from 100 to 200 μm. The length of the relatively short bristles 52 is chosen so that, when the floor tool 50 is assembled, the tips of these bristles 52 do not protrude beneath a plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

A second agitating means mounted on the body 50 of the brush bar 40 comprises relatively long, preferably relatively soft, bristles 54. As illustrated in Figure 7, the

relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52. During rotation of the body 50, the relatively short bristles 52 sweep a cylindrical volume having a diameter D1, whereas the relatively long bristles 54 sweep a cylindrical volume having a diameter D2 which is greater than D1. The difference between D1 and D2 is preferably in the range from 1 to 10 mm, more preferably in the range from 2 to 6 mm. In contrast to the relatively short bristles 52, the length of the relatively long bristles 54 is chosen so that the relatively long bristles 54 protrude beyond the plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

The relatively long bristles 54 are formed from material having a lower surface resistivity than the material from which the relatively short bristles 52 are formed. The surface resistivity of the relatively long bristles 54 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. In comparison, the surface resistivity of the relatively short bristles 52 is preferably higher than $1x10^{12}$ Ω/sq. The relatively long bristles 54 may be formed from electrically conductive material. The bristles may be formed from metallic, graphite, conductive acrylic or other composite material, but in this example the relatively long bristles 54 comprise carbon fibre bristles. The diameter of each bristle 54 is preferably in the range from 5 to 20 μm.

The body 50 comprises a plurality of angularly spaced, continuous rows of the relatively long bristles 54, which preferably also extend helically along the body 50. In this embodiment the body 50 comprises four continuous rows of the relatively long bristles 54, with each row being angularly spaced from a row of tufts 53 formed from the relatively short bristles 52. Each row of the relatively long bristles 54 preferably contains in the range from 20 to 100 bristles per mm length, and has a thickness in the range from 0.25 to 2 mm.

With particular reference to Figure 4, in this embodiment adjacent rows of the relatively long bristles 54 are formed from a single strip 56 of bristles. Each strip 56 is preferably formed by attaching an elongate, generally rectangular flexible carrier member to a row

of bristles so that each row of bristles 54 protrudes outwardly from a respective long side edge of the carrier member. The carrier member may be attached to the row of bristles by stitching or by using an adhesive. Each strip 56 is then located within a respective helical groove 58 formed in the body 50 so that the ends of the bristles protrude outwardly from the body 50. The strips 56 are connected to the body 50 by helical connectors 60 which are mounted on the strips 56 and connected to the body 50 using screws 62 into apertures formed in the connectors 60. The screws 62 may be pushed through the carrier member, or inserted through apertures formed in the carrier member. An adhesive tape may be applied to at least one side of each carrier member to allow the strips 56 to be aligned within the grooves 58 so that the ends of the bristles protrude from the body 50 by a regular amount along the length of the body 50.

With reference to Figure 7, when the cleaner head 12 is located on a carpeted floor surface 64 the support members 24 sink into the pile of the carpet so that the bottom surface of the sole plate 18 engages the fibres of the carpet. As both the relatively short bristles 52 and the relatively long bristles 54 protrude from the suction opening 20 as the brush bar 40 rotates, both the different types of bristles are able to agitate dirt and dust from the floor surface. When an air flow is generated through the suction passage of the cleaner head 12, this dirt and dust becomes entrained within the air flow and is conveyed through the floor tool 10 to the cleaning appliance.

When the cleaner head 12 is moved from the carpeted floor surface 64 on to a hard floor surface 66, as illustrated in Figure 8, the sole plate 18 becomes spaced from the hard floor surface 66. As the tips of the relatively short bristles 52 do not protrude beneath the plane extending between the lowermost extremities of the support members 24, these bristles do not come into contact with the hard floor surface 66, thereby preventing scratching or other marking of the hard floor surface 66 by these bristles. However, as the relatively long bristles 54 protrude beyond this plane, these bristles engage, and are swept across, the hard floor surface 66 with rotation of the brush bar 40. Due to the relatively low surface resistivity of the relatively long bristles 54, any static electricity residing on the hard floor surface 66 is discharged upon contact with the

relatively long bristles 54, thereby enabling fine dust and powder which would otherwise be attracted to the hard floor surface 66 to be dislodged from the floor surface by these bristles and entrained within the air flow.

The invention is not limited to the detailed description given above. Variations will be apparent to the person skilled in the art.

For example, in the embodiment described above, the cleaner head 12 includes a brush bar 40 that is driven by a motor. However, the cleaner head 12 may include alternative means for agitating or otherwise working a surface to be cleaned. By way of example, the brush bar 40 may be driven by an air turbine rather than a motor.

The relatively short bristles 52 may be formed from similar material as the relatively long bristles 54 in order to discharge any static material residing on a carpeted floor surface, and so may also have a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

Each strip 56 may be modified so that the bristles protrude from only one of the relatively long side edges of the carrier member. Thus, each strip 56 may be in the form of a brush, with bristles extending outwardly from only one side of the brush. A modified version of the brush bar 40', in which each strip 56 has been modified as discussed above, is illustrated in Figure 9. This modification of the strips 56 results in the bristles 54 protruding outwardly from one side only of each connecting member 60. Consequently, this brush bar 40' contains only two continuous rows of relatively long bristles 54, with the rows of tufts 53 and the rows of relatively long bristles 54 being alternately arranged about the body 50 of the brush bar 40'. As with the brush bar 40, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52.

The different types of bristles 52, 54 need not be spaced apart. The brush bar 40 may comprise a plurality of rows, clumps or tufts of bristles, with each row, clump or tuft

comprising both types of bristles. For example, relatively short bristles 52 may be dispersed within each row of relatively long bristles 54. Alternatively, relatively long bristles 54 may be dispersed within each tuft 53 of relatively short bristles 52.

The agitating means may take forms other than bristles, such as flexible or rigid strips of material mounted on the body 50, or filaments sewn into a backing material connected to the body 50.

In the event that the floor tool 10 is not to be used on a carpeted surface, the relatively short bristles 52 may be dispensed with so that the brush bar 40 comprises only electrically conductive agitating members. Consequently, the brush bar 40 may comprise solely the continuous rows of surface agitating members defined by the relatively long bristles 54 illustrated in Figures 2 to 8. Alternatively, the brush bar 40 may comprise a different arrangement of surface agitating members for discharging static electricity residing on a floor surface.

For example, with reference to Figure 10 an alternative brush bar 80 for use in the floor tool 10 comprises a rotatable body 82 having an outer surface comprising an electrically conductive pile 84. In this example, the pile 84 is similar to the raised or fluffy surface of a carpet, rug or cloth, and comprises filaments woven on to a fabric carrier member 86 attached to the body 82, for example using an adhesive. The length of the filaments of the pile 84 is preferably in the range from 4 to 15 mm, and the filaments have a diameter which is preferably in the range from 5 to 20 μm.

These filaments are preferably formed from carbon fibres, but alternatively they may be formed from metallic material, conductive acrylic material or other composite material. Consequently, the surface resistivity of the filaments of the pile 84 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. The fabric carrier member 86 may be in the form of a strip wound on to the body 82 so that the pile 84 is substantially continuous, substantially covering the outer surface of the body 82. Alternatively, the carrier

member 86 may be in the form of a cylindrical sleeve into which the body 82 is inserted.

If so desired, clumps of relatively stiff bristles may be dispersed within the pile 84. Alternatively, a strip of the pile 84 may be wound around one or more helical rows of relatively stiff bristles previously attached to the body 82. These bristles may be similar to the relatively short bristles 52 of the brush bar 40, and so may be arranged so as to not protrude radially outwardly beyond the filaments of the pile 84.

CLAIMS

1. Agitating apparatus for a surface treating appliance, comprising a rotatable body having an outer surface which is substantially covered with filaments having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

2. Apparatus as claimed in claim 1, wherein the filaments are formed from one of metallic, carbon fibre, conductive acrylic and composite material.

3. Apparatus as claimed in claim 1 or claim 2, wherein the filaments are woven on to a flexible carrier member located about the body.

4. Apparatus as claimed in claim 3, wherein the carrier member is wound about the body.

5. Apparatus as claimed in claim 4, wherein the carrier member is adhered to the body.

6. Apparatus as claimed in any of the preceding claims, wherein the body is substantially cylindrical.

7. Apparatus as claimed in any of the preceding claims, wherein the filaments have a diameter in the range from 5 to 20 μm.

8. Apparatus as claimed in any of the preceding claims, in the form of a rotatable brush bar.

9. A cleaner head for a surface treating appliance comprising apparatus as claimed in any of the preceding claims.

10. Agitating apparatus for a surface treating appliance substantially as hereinbefore described with reference to the accompanying drawings.

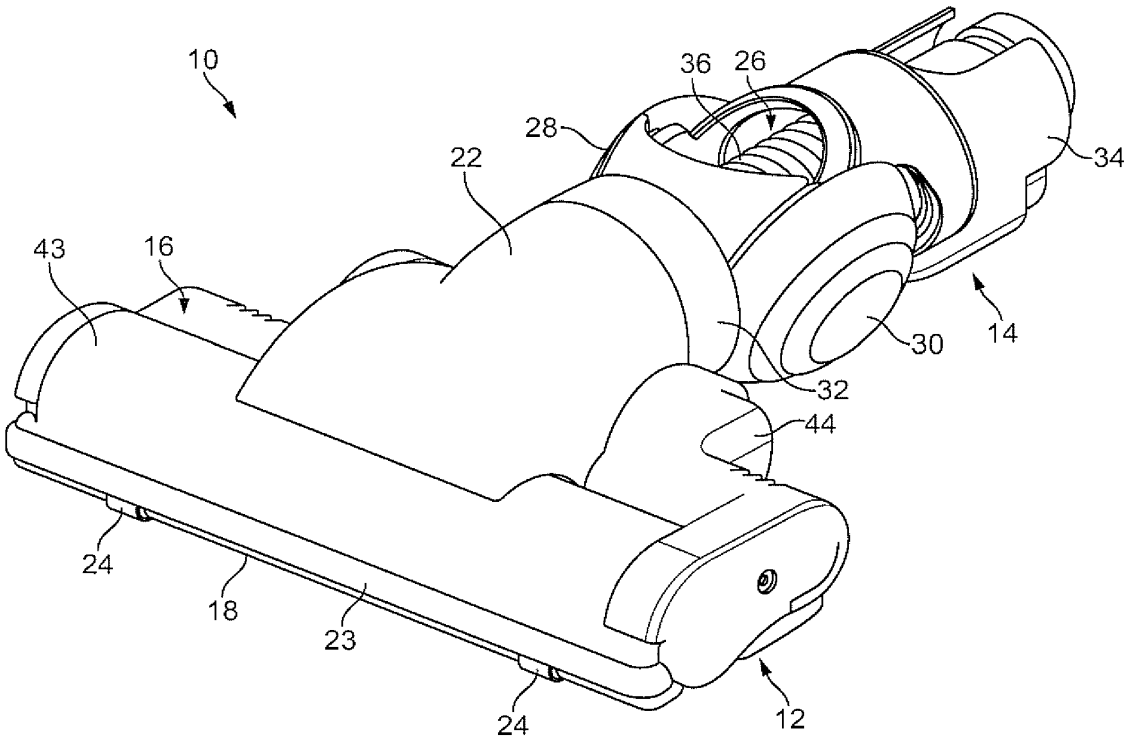

FIG. 1

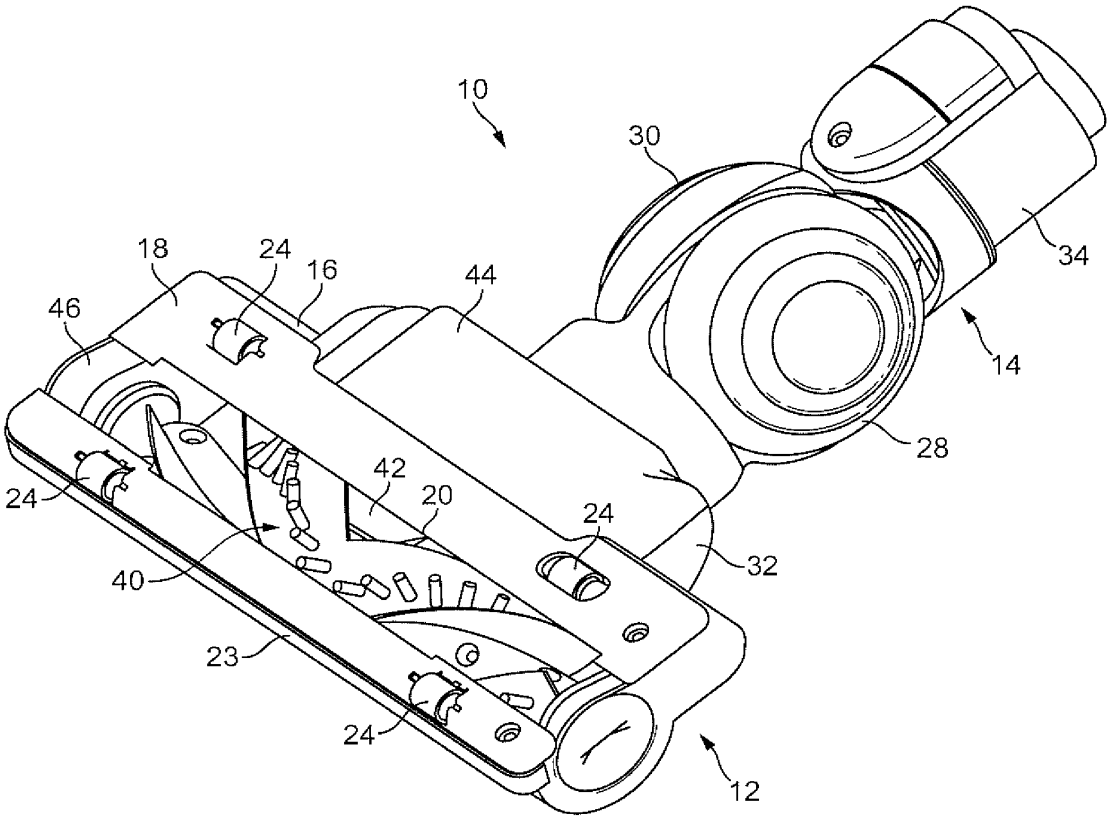

FIG. 2

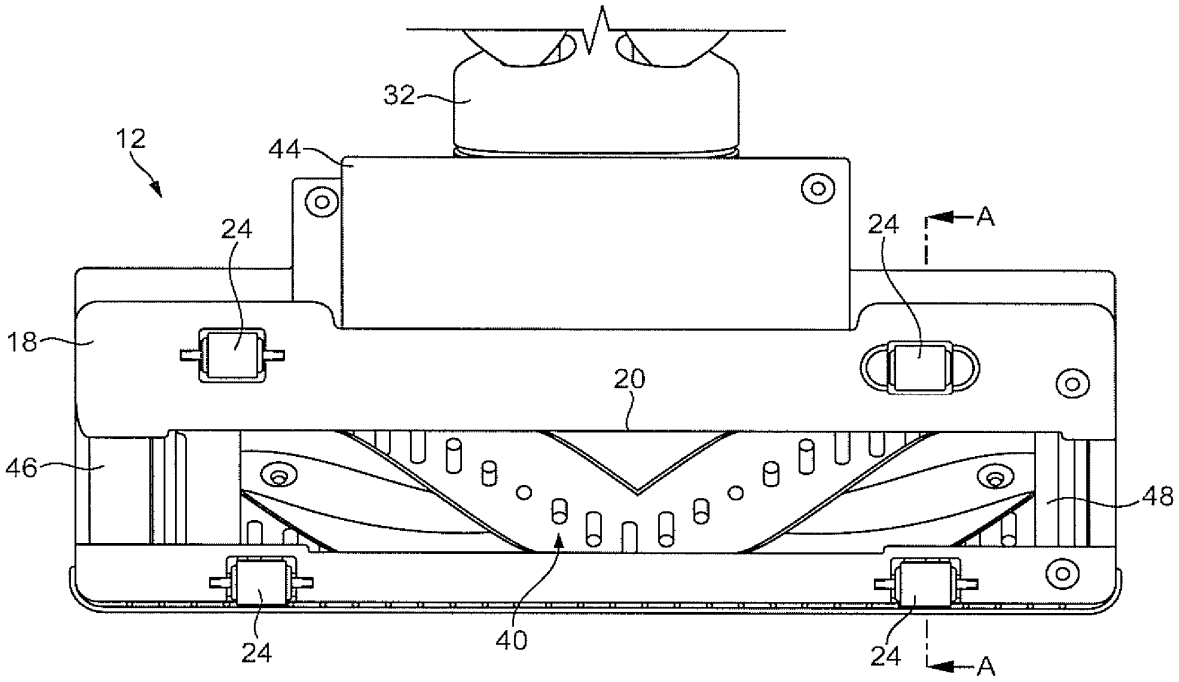

FIG. 3

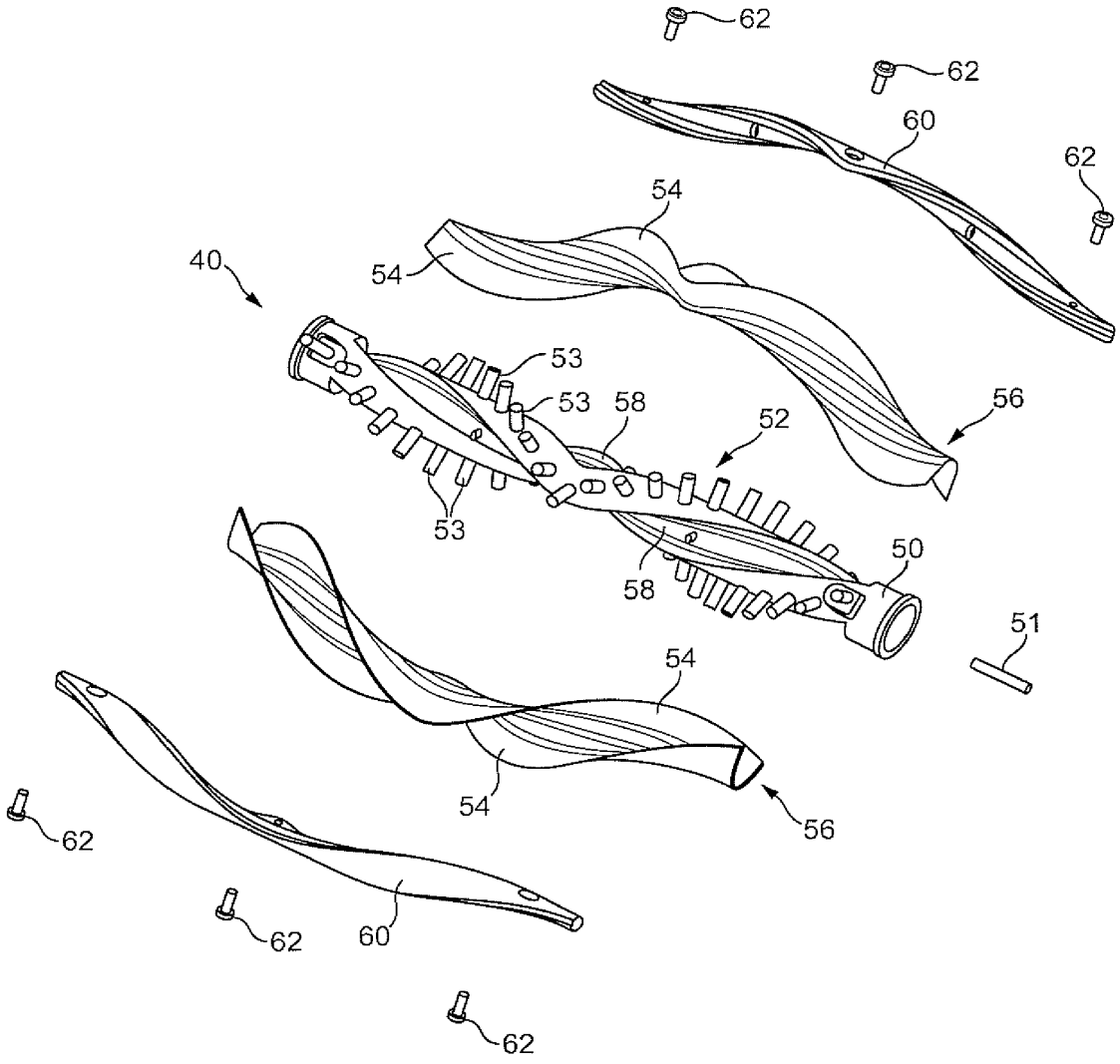

FIG. 4

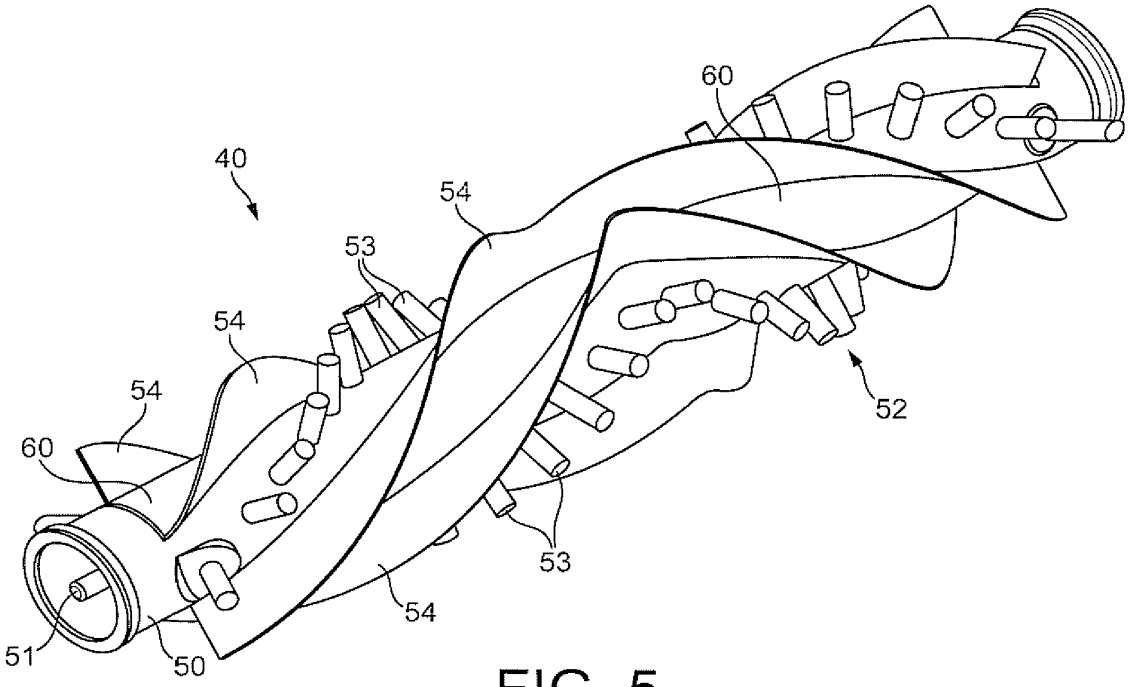

FIG. 5

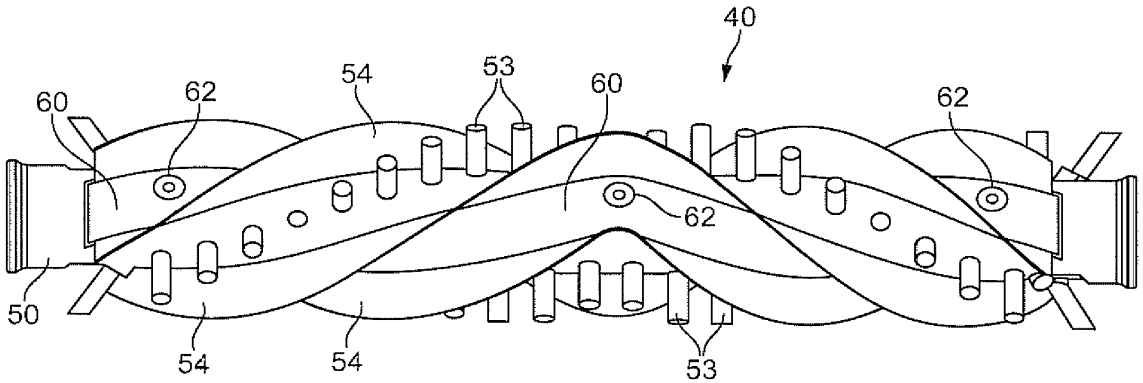

FIG. 6

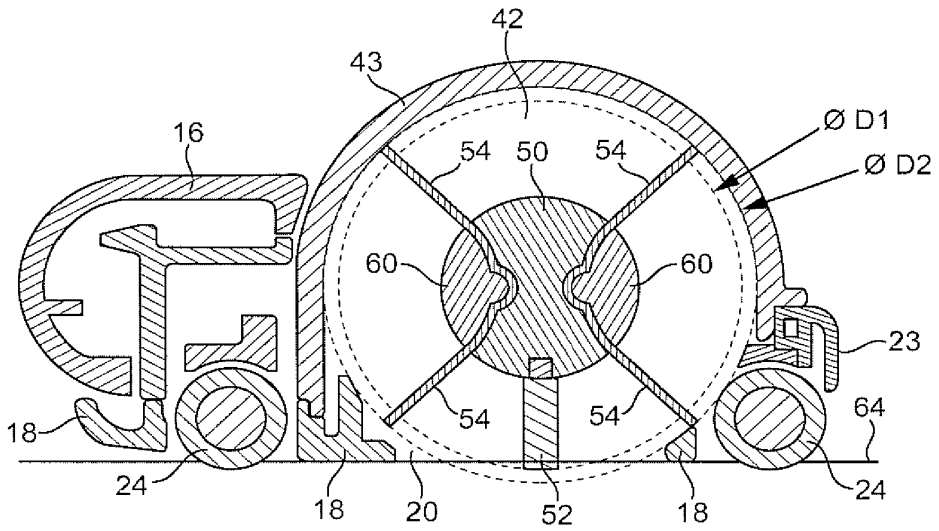
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FIG. 7

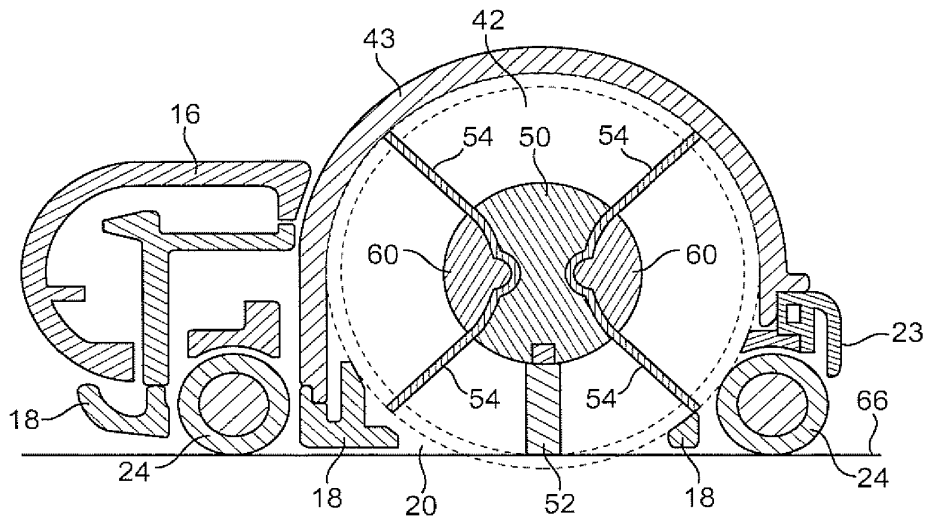
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FIG. 8

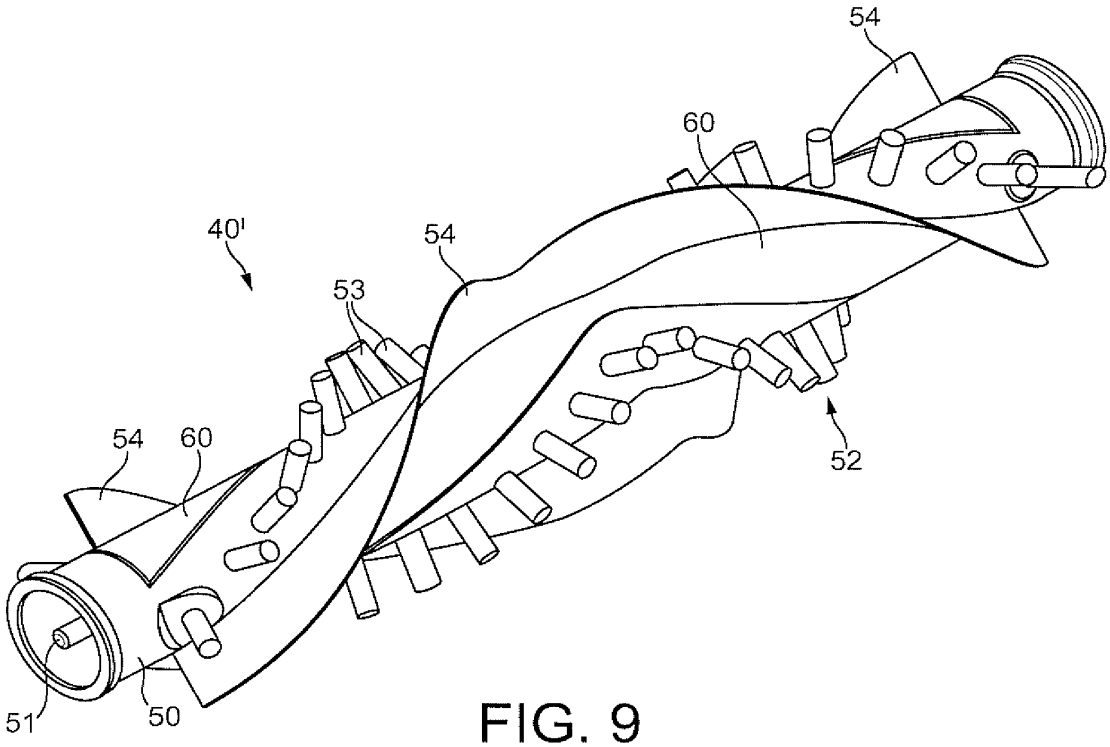

FIG. 9

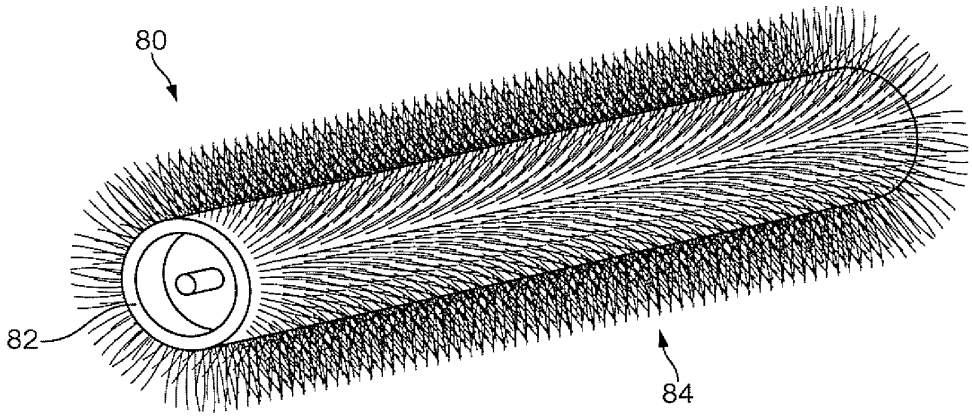

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050854

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L13/40 A47L9/04
ADD.

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)
A47L A46B

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 425 715 A (BISSELL HOMECARE INC [US]) 8 November 2006 (2006-11-08) page 5, line 18 - page 6, line 12; figures 1-4	1,2,6,8, 9
X,P	WO 2009/149722 A1 (KAERCHER GMBH & CO KG ALFRED [DE]; EGLER CHRISTIAN [DE]; ROPPELT BRUNH) 17 December 2009 (2009-12-17) page 3 - page 5; figures page 21	1-6,8,9
X	WO 99/27834 A1 (NOTETRY LTD [GB]; DYSON JAMES [GB]; JONES GARETH [GB]) 10 June 1999 (1999-06-10) page 3, line 21 - line 25; figures	1,2,6,8, 9

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 July 2010	02/08/2010

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, Fax: (+31-70) 340-3016	Masset, Markus

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050854

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, ot the relevant passages	Relevant to claim No.
X	EP 0 992 211 A2 (VORWERK CO INTERHOLDING [DE]) 12 April 2000 (2000-04-12) paragraph [0018] - paragraph [0019]; figures 1-4 page 6	1,2,6-9

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2010/050854

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 10
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10

Present claim 10 relates to an agitating apparatus by reference to the drawings of the application. Therefore, claim 10 lacks clarity (Art. 6 and Rule 6.2(a) PCT). This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

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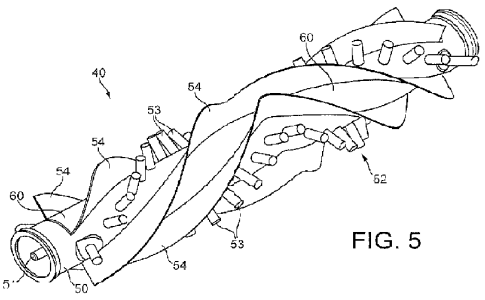

FIG. 5

(57) Abstract: Agitating apparatus (40) for a surface treating appliance comprises a rotatable body(50) having a plurality of grooves (58) formed therein, an agitating member (56) located within each groove so that at least one side edge of the agitating member protrudes outwardly from the body, and a connecting member (60) located within each groove for connecting the agitating member to the body.

A Cleaner Head

The present invention relates to agitating apparatus for a surface treating appliance, and to a cleaner head for a surface treating appliance. In its preferred embodiment, the present invention relates to a cleaner head for a vacuum cleaning appliance.

A vacuum cleaner typically comprises a main body containing dirt and dust separating apparatus, a cleaner head connected to the main body and having a suction opening, and a motor-driven fan unit for drawing dirt-bearing air through the suction opening. The dirt-bearing air is conveyed to the separating apparatus so that dirt and dust can be separated from the air before the air is expelled to the atmosphere.

The suction opening is directed downwardly to face the floor surface to be cleaned. The separating apparatus can take the form of a filter, a filter bag or, as is known, a cyclonic arrangement. The present invention is not concerned with the nature of the separating apparatus and is therefore applicable to vacuum cleaners utilizing any of the above arrangements or another suitable separating apparatus.

A driven agitator, usually in the form of a brush bar, is supported in the cleaner head so as to protrude to a small extent from the suction opening. The brush bar is activated mainly when the vacuum cleaner is used to clean carpeted surfaces. The brush bar comprises an elongate cylindrical core bearing bristles which extend radially outward from the core. The brush bar may be driven by an air turbine or by an electric motor powered by a power supply derived from the main body of the cleaner. The brush bar may be driven by the motor via a drive belt, or may be driven directly by the motor, so as to rotate within the suction opening. Rotation of the brush bar causes the bristles to sweep along the surface of the carpet to be cleaned to loosen dirt and dust, and pick up debris. The suction of air causes air to flow underneath the sole plate and around the brush bar to help lift the dirt and dust from the surface of the carpet and then carry it from the suction opening through the cleaner head towards the separating apparatus.

The bristles of the brush bar are usually formed from nylon, and are usually arranged in tufts arranged about the core of the brush bar. While the use of nylon bristles provides an acceptable cleaning performance on carpeted floor surfaces, we have found that the use of nylon bristles generates static electricity when the floor tool is used on some hard floor surfaces, such as laminate, wood and vinyl surfaces, which attracts fine dust and powders, such as talcum powder, on to the floor surface. This can impair the cleaning performance on the cleaner head on such floor surfaces, as the sweeping action of the nylon bristles is insufficient to overcome the force attracting the fine dust to the floor surface.

The bristle tufts have conventionally been mechanically secured to the brush bar core by individual staples. As a brush bar normally comprises at least forty bristle tufts, the use of staples can increase undesirably the cost of manufacture of the brush bar, particularly when it is desired to increase the number of bristle tufts to improve the agitating performance of the brush bar. It is therefore, desirable to provide an alternative, cheaper technique for attaching at least some of the agitating members, such as bristles, to a brush bar or other agitating apparatus.

In a first aspect, the present invention provides agitating apparatus for a surface treating appliance, comprising a rotatable body having a plurality of grooves formed therein, an agitating member located within each groove so that at least one side edge of the agitating member protrudes outwardly from the body, and a connecting member located within each groove for connecting the agitating member to the body.

The surface resistivity of the agitating members is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq (ohms per square). Values of surface resistivity discussed herein are as measured using the test method ASTM D257. The selection of material having a surface resistivity in this range can ensure that any static electricity on the floor surface is effectively discharged by the agitating members upon contact between the agitating members and the floor surface. This enables fine dust and powder which would

otherwise be attracted to the floor surface to be dislodged from the floor surface by the agitating members.

Each agitating member is preferably formed from one of metallic, carbon fibre, carbon composite, conductive acrylic, or other composite material. For example, material comprising carbon particles and carbon fibres generally has a surface resistivity in the range from $1x10^3$ to $1x10^6$ Ω/sq, whereas metallic material generally has a much lower surface resistivity, generally lower than 1 Ω/sq. Other static dissipative materials generally have a surface resistivity in the range from $1x10^5$ to $1x10^{12}$ Ω/sq.

Each agitating member is preferably flexible and is preferably in the form of a strip which may comprise a plurality of bristles, filaments or one or more strips of flexible material. Where the agitating members comprise at least one strip of material, each row is preferably formed from a single strip of material, or from a plurality of adjoining strips. Where the agitating members comprise a plurality of bristles or filaments, the bristles are arranged within each strip so that tips of the bristles are located along said at least one side edge. The bristles are preferably formed from carbon fibre or conductive acrylic fibres, such as Thunderon®. The bristles are preferably arranged in a closely packed formation so that each row of bristles is substantially continuous. For example, each strip preferably contains in the range from 20 to 100 bristles per mm length of the strip, and preferably has a thickness in the range from 0.25 to 2 mm. The diameter of each bristle is preferably in the range from 5 to 20 μm.

The bristles may be connected, for example by stitching or using an adhesive, to an elongate carrier member so that individual or clumps of bristles do not come loose from the strip. For example, each agitating member may be in the form of a brush, with the bristles of each brush extending outwardly from the body, preferably so that the tips of the bristles are evenly spaced from the outer surface of the body.

As mentioned above, the rotatable body has a plurality of grooves formed therein, and the apparatus comprises a plurality of connecting members, each of which is received

within a respective groove to connect an agitating member to the body so that at least one side edge of the agitating member protrudes outwardly from the body. This can simplify manufacture of the agitating apparatus, and so reduce costs, as only one connecting member is required for, for example, a row of agitators extending along the brush bar. When the agitating members are formed from flexible material, the shape of the grooves defines the shape adopted by the portions of the agitating members which protrude outwardly from the body. For example, the grooves are preferably curved, more preferably at least partially helical, and so the agitating members adopt a shape which is at least partially helical when they are located within the grooves.

Each agitating member is preferably sandwiched between the body and a respective connecting member along its length. When the agitating members are formed from strips of bristles or filaments, this can prevent individual or clumps of bristles from being pulled out of the body. The connecting members preferably have substantially the same shape as the grooves, and preferably have an outer surface which is substantially flush with the outer surface of the body. For example, if the body is in the form of a cylinder then the outer surfaces of the connecting members preferably have substantially the same radius of curvature as the outer surface of the body. The connecting members may be connected to the body by one of a variety of different techniques, for example by using screws, interference fits or an adhesive.

Each agitating member may be located within its respective groove so that only one of the side edges protrudes outwardly from the body, or so that both of the opposing side edges of the agitating member protrude outwardly from the body. This can enable, for example, the number of times that the agitating member engages a floor surface with each revolution of the body to be increased without having to increase the number of agitating members. In this latter case, the angle between the side edges of the agitating members, when connected to the body, is preferably less than 180°, and is preferably in the range from 45 to 135°.

The rotatable body may comprise further surface agitating means. The agitating apparatus may thus comprise two different surface agitating means. The further surface agitating means are preferably located between the grooves of the body. Preferably, the agitating members protrude radially outwardly from the body beyond the further surface agitating mean, for example by a distance in the range from 0.5 to 5 mm, more preferably by a distance in the range from 1 to 3 mm.

The relatively short, further surface agitating means may be configured to agitate dirt and dust from a carpeted floor surface, whereas the agitating members may be configured to sweep dirt and dust from a hard floor surface. The further surface agitating means is thus preferably relatively stiff in comparison to the agitating members. For example, bristles or filaments of the further surface agitating means may have a greater diameter than bristles or filaments of the agitating members. Alternatively, one or more strips of material forming the further surface agitating means may have a greater thickness than strips of material forming the agitating members.

The further surface agitating means may be formed from electrically insulating, plastics material, such as nylon, and so may have a surface resistivity which is different to that of the agitating members. The surface resistivity of the further surface agitating means is preferably in the range from $1x10^{12}$ to $1x10^{16}$ Ω/sq. Alternatively, the further surface agitating means may be formed from a similar material as the agitating members, and so may have a surface resistivity within the aforementioned range for the agitating members, in order to discharge any static electricity residing on a carpeted floor surface.

The further surface agitating means is preferably arranged in a plurality of rows along the body, with these rows being preferably discontinuous. For example, where the further surface agitating means comprises a plurality of bristles these bristles are preferably arranged in one or more rows of clusters or tufts of bristles connected to and spaced along the body. However, the further surface agitating means may be located within, or otherwise in contact with, the agitating members. For example, each of the agitating means may comprises a plurality of bristles or filaments, with the bristles or

filaments of the further surface agitating means being located adjacent, or amongst, bristles or filaments of the agitating members.

The agitating apparatus is preferably in the form of a rotatable brush bar.

In a second aspect, the present invention provides a cleaner head for a surface treating appliance, the cleaner head comprising a housing and apparatus as aforementioned. The cleaner head preferably comprises a sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and through which the agitating members protrude as the body is rotated during use of the cleaner head, and a plurality of support members, preferably in the form of rolling elements, such as wheels or rollers, rotatably mounted on the sole plate, for supporting the cleaner head on a surface to be cleaned.

In a third aspect, the present invention provides a surface treating appliance comprising a cleaner head or agitating apparatus as aforementioned.

The term "surface treating appliance" is intended to have a broad meaning, and includes a wide range of machines having a main body and a head for travailing over a surface to clean or treat the surface in some manner. It includes, inter alia, machines which simply agitate the surface, such as carpet sweepers, machines which only apply suction to the surface, such as vacuum cleaners (dry, wet and wet/dry), so as to draw material from the surface, and machines which apply material to the surface, such as polishing/waxing machines, pressure washing machines and shampooing machines.

Features described above in connection with the first aspect of the invention are equally applicable to any of the second to third aspects of the invention, and vice versa.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a front perspective view, from above of a floor tool;

Figure 2 is a front perspective view, from below, of the floor tool of Figure 1;

Figure 3 is a bottom view of the floor tool of Figure 1;

Figure 4 is an exploded view of the brush bar of the floor tool of Figure 1;

Figure 5 is a perspective view of the brush bar of Figure 4;

Figure 6 is a top view of the brush bar of Figure 4;

Figure 7 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a carpeted floor surface;

Figure 8 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a hard floor surface;

Figure 9 is a perspective view of a modified version of the brush bar of Figure 4; and

Figure 10 is a perspective view of an alternative brush bar for use with the floor tool of Figure 1.

With reference first to Figures 1 to 3, a floor tool 10 comprises a cleaner head 12 rotatably attached to a coupling 14. The free end of the coupling 14 is attachable to a wand, hose or other such duct of a cleaning appliance (not shown). The cleaner head 12 comprises a housing 16 and a lower plate, or sole plate 18, comprising a suction opening 20 through which a dirt-bearing fluid flow enters the cleaner head 12. The housing 16 defines a suction passage extending from the suction opening 20 to an outlet duct 22 located at the rear of the housing 16. The housing 16 preferably comprises a front bumper 23. The sole plate 18 comprises a plurality of support members 24 in the form of rolling elements mounted within recessed portions of the sole plate 18 for

supporting the cleaner head 12 on a floor surface. With reference to Figures 7 and 8, the support members 24 are preferably arranged to support the sole plate 18 above the floor surface when the cleaner head 12 is located on a hard floor surface 66, and, when the cleaner head 12 is located on a carpeted floor surface 64, to sink into the pile of the carpet to enable the bottom surface of the sole plate 18 to engage the fibres of the carpet. The sole plate 18 is preferably pivotable relative to the housing 16 to allow the sole plate 18 to ride smoothly over the carpeted floor surface 64 during cleaning.

The coupling 14 comprises a conduit 26 supported by a pair of wheels 28, 30. The conduit 26 comprises a forward portion 32 connected to the outlet duct 22, a rearward portion 34 pivotably connected to the forward portion 32 and connectable to a wand, hose or other such duct of a cleaning appliance which comprises dirt and dust separating apparatus and a motor-driven fan unit for drawing dirt-bearing air through the suction opening 20 from the floor surface. A flexible hose 36 is held within and extends between the forward and the rearward portions 32, 34 of the conduit 26.

The cleaner head 12 comprises agitating apparatus for agitating dirt and dust located on the floor surface. In this example the agitating apparatus comprises a rotatable brush bar 40 which is mounted within a brush bar chamber 42 of the housing 16. The brush bar chamber 42 is partially defined by a generally semi-cylindrical portion 43 of the housing 16, which is preferably formed from transparent material. The brush bar 40 is driven by a motor (not shown) located in a motor housing 44 of the housing 16. The motor is electrically connected to a terminal located in the rearward portion 34 of the conduit 26 for connection with a conformingly profiled terminal located in a duct of the cleaning appliance to enable electrical power to be supplied to the motor.

The brush bar 40 is connected to the motor by a drive mechanism located, at least in part, within a drive mechanism housing 46 so that the drive mechanism is isolated from the air passing through the suction passage. One end of the brush bar 40 is connected to the drive mechanism to enable the brush bar 40 to be driven by the motor, whereas the

other end of the brush bar 40 is rotatably supported by an end cap 48 mounted on a side wall of the brush bar chamber 42.

The brush bar 40 is illustrated in more detail in Figures 4 to 6. The brush bar 40 comprises an elongate body 50 bearing two different types of agitating means for agitating dirt and dust from the floor surface as the brush bar 40 is rotated by the motor. Each of the different types of agitating means protrudes from the suction opening 20 in the sole plate 18 as the brush bar 40 is rotated by the motor. A spindle 51 is mounted on one end of the body 50, with the spindle 51 being in turn connected to the end cap 48.

A first agitating means mounted on the body 50 of the brush bar 40 comprises relatively short, preferably relatively stiff, bristles 52. These bristles 52 are preferably formed from nylon. In this embodiment the relatively short bristles 52 are arranged in two angularly spaced, helical rows extending along the body 50. Within each row, the relatively short bristles 52 are arranged in a series of clusters or tufts 53 regularly spaced along the row. Each tuft 53 preferably comprises around 100 to 150 bristles, with each tuft 53 having a diameter in the range from 2 to 4 mm. The diameter of each bristle 52 is preferably in the range from 100 to 200 μm. The length of the relatively short bristles 52 is chosen so that, when the floor tool 50 is assembled, the tips of these bristles 52 do not protrude beneath a plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

A second agitating means mounted on the body 50 of the brush bar 40 comprises relatively long, preferably relatively soft, bristles 54. As illustrated in Figure 7, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52. During rotation of the body 50, the relatively short bristles 52 sweep a cylindrical volume having a diameter D1, whereas the relatively long bristles 54 sweep a cylindrical volume having a diameter D2 which is greater than D1. The difference between D1 and D2 is preferably in the range from 1 to 10 mm, more preferably in the range from 2 to 6 mm. In contrast to the relatively short bristles 52, the length of the relatively long bristles 54 is chosen so that the relatively long bristles

54 protrude beyond the plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

The relatively long bristles 54 are formed from material having a lower surface resistivity than the material from which the relatively short bristles 52 are formed. The surface resistivity of the relatively long bristles 54 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. In comparison, the surface resistivity of the relatively short bristles 52 is preferably higher than $1x10^{12}$ Ω/sq. The relatively long bristles 54 may be formed from electrically conductive material. The bristles may be formed from metallic, graphite, conductive acrylic or other composite material, but in this example the relatively long bristles 54 comprise carbon fibre bristles. The diameter of each bristle 54 is preferably in the range from 5 to 20 μm.

The body 50 comprises a plurality of angularly spaced, continuous rows of the relatively long bristles 54, which preferably also extend helically along the body 50. In this embodiment the body 50 comprises four continuous rows of the relatively long bristles 54, with each row being angularly spaced from a row of tufts 53 formed from the relatively short bristles 52. Each row of the relatively long bristles 54 preferably contains in the range from 20 to 100 bristles per mm length, and has a thickness in the range from 0.25 to 2 mm.

With particular reference to Figure 4, in this embodiment adjacent rows of the relatively long bristles 54 are formed from a single strip 56 of bristles. Each strip 56 is preferably formed by attaching an elongate, generally rectangular flexible carrier member to a row of bristles so that each row of bristles 54 protrudes outwardly from a respective long side edge of the carrier member. The carrier member may be attached to the row of bristles by stitching or by using an adhesive. Each strip 56 is then located within a respective helical groove 58 formed in the body 50 so that the ends of the bristles protrude outwardly from the body 50. The strips 56 are connected to the body 50 by helical connectors 60 which are mounted on the strips 56 and connected to the body 50 using screws 62 into apertures formed in the connectors 60. The screws 62 may be

pushed through the carrier member, or inserted through apertures formed in the carrier member. An adhesive tape may be applied to at least one side of each carrier member to allow the strips 56 to be aligned within the grooves 58 so that the ends of the bristles protrude from the body 50 by a regular amount along the length of the body 50.

With reference to Figure 7, when the cleaner head 12 is located on a carpeted floor surface 64 the support members 24 sink into the pile of the carpet so that the bottom surface of the sole plate 18 engages the fibres of the carpet. As both the relatively short bristles 52 and the relatively long bristles 54 protrude from the suction opening 20 as the brush bar 40 rotates, both the different types of bristles are able to agitate dirt and dust from the floor surface. When an air flow is generated through the suction passage of the cleaner head 12, this dirt and dust becomes entrained within the air flow and is conveyed through the floor tool 10 to the cleaning appliance.

When the cleaner head 12 is moved from the carpeted floor surface 64 on to a hard floor surface 66, as illustrated in Figure 8, the sole plate 18 becomes spaced from the hard floor surface 66. As the tips of the relatively short bristles 52 do not protrude beneath the plane extending between the lowermost extremities of the support members 24, these bristles do not come into contact with the hard floor surface 66, thereby preventing scratching or other marking of the hard floor surface 66 by these bristles. However, as the relatively long bristles 54 protrude beyond this plane, these bristles engage, and are swept across, the hard floor surface 66 with rotation of the brush bar 40. Due to the relatively low surface resistivity of the relatively long bristles 54, any static electricity residing on the hard floor surface 66 is discharged upon contact with the relatively long bristles 54, thereby enabling fine dust and powder which would otherwise be attracted to the hard floor surface 66 to be dislodged from the floor surface by these bristles and entrained within the air flow.

The invention is not limited to the detailed description given above. Variations will be apparent to the person skilled in the art.

For example, in the embodiment described above, the cleaner head 12 includes a brush bar 40 that is driven by a motor. However, the cleaner head 12 may include alternative means for agitating or otherwise working a surface to be cleaned. By way of example, the brush bar 40 may be driven by an air turbine rather than a motor.

The relatively short bristles 52 may be formed from similar material as the relatively long bristles 54 in order to discharge any static material residing on a carpeted floor surface, and so may also have a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

Each strip 56 may be modified so that the bristles protrude from only one of the relatively long side edges of the carrier member. Thus, each strip 56 may be in the form of a brush, with bristles extending outwardly from only one side of the brush. A modified version of the brush bar 40', in which each strip 56 has been modified as discussed above, is illustrated in Figure 9. This modification of the strips 56 results in the bristles 54 protruding outwardly from one side only of each connecting member 60. Consequently, this brush bar 40' contains only two continuous rows of relatively long bristles 54, with the rows of tufts 53 and the rows of relatively long bristles 54 being alternately arranged about the body 50 of the brush bar 40'. As with the brush bar 40, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52.

The different types of bristles 52, 54 need not be spaced apart. The brush bar 40 may comprise a plurality of rows, clumps or tufts of bristles, with each row, clump or tuft comprising both types of bristles. For example, relatively short bristles 52 may be dispersed within each row of relatively long bristles 54. Alternatively, relatively long bristles 54 may be dispersed within each tuft 53 of relatively short bristles 52.

The agitating means may take forms other than bristles, such as flexible or rigid strips of material mounted on the body 50, or filaments sewn into a backing material connected to the body 50.

In the event that the floor tool 10 is not to be used on a carpeted surface, the relatively short bristles 52 may be dispensed with so that the brush bar 40 comprises only electrically conductive agitating members. Consequently, the brush bar 40 may comprise solely the continuous rows of surface agitating members defined by the relatively long bristles 54 illustrated in Figures 2 to 8. Alternatively, the brush bar 40 may comprise a different arrangement of surface agitating members for discharging static electricity residing on a floor surface.

For example, with reference to Figure 10 an alternative brush bar 80 for use in the floor tool 10 comprises a rotatable body 82 having an outer surface comprising an electrically conductive pile 84. In this example, the pile 84 is similar to the raised or fluffy surface of a carpet, rug or cloth, and comprises filaments woven on to a fabric carrier member 86 attached to the body 82, for example using an adhesive. The length of the filaments of the pile 84 is preferably in the range from 4 to 15 mm, and the filaments have a diameter which is preferably in the range from 5 to 20 μm.

These filaments are preferably formed from carbon fibres, but alternatively they may be formed from metallic material, conductive acrylic material or other composite material. Consequently, the surface resistivity of the filaments of the pile 84 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. The fabric carrier member 86 may be in the form of a strip wound on to the body 82 so that the pile 84 is substantially continuous, substantially covering the outer surface of the body 82. Alternatively, the carrier member 86 may be in the form of a cylindrical sleeve into which the body 82 is inserted.

If so desired, clumps of relatively stiff bristles may be dispersed within the pile 84. Alternatively, a strip of the pile 84 may be wound around one or more helical rows of relatively stiff bristles previously attached to the body 82. These bristles may be similar to the relatively short bristles 52 of the brush bar 40, and so may be arranged so as to not protrude radially outwardly beyond the filaments of the pile 84.

CLAIMS

1. Agitating apparatus for a surface treating appliance, comprising a rotatable body having a plurality of grooves formed therein, an agitating member located within each groove so that at least one side edge of the agitating member protrudes outwardly from the body, and a connecting member located within each groove for connecting the agitating member to the body.

2. Apparatus as claimed in claim 1, wherein the surface resistivity of each agitating member is in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

3. Apparatus as claimed in claim 1 or claim 2, wherein each agitating member is formed from one of metallic, carbon fibre, conductive acrylic and composite material.

4. Apparatus as claimed in any of the preceding claims, wherein each groove is at least partially helical.

5. Apparatus as claimed in any of the preceding claims, wherein each agitating member is sandwiched between the body and a respective connecting member along the length thereof.

6. Apparatus as claimed in any of the preceding claims, wherein the outer surface of the connecting member is substantially flush with the outer surface of the body.

7. Apparatus as claimed in any of the preceding claims, wherein each agitating member is located within its respective groove so that opposing side edges of the agitating member protrude outwardly from the body.

8. Apparatus as claimed in any of the preceding claims, wherein each agitating member is flexible.

9. Apparatus as claimed in any of the preceding claims, wherein each agitating member is in the form of a strip.

10. Apparatus as claimed in claim 9, wherein each strip is formed from a plurality of bristles.

11. Apparatus as claimed in claim 10, wherein each strip contains in the range from 20 to 100 bristles per mm length of the strip.

12. Apparatus as claimed in claim 10 or claim 11, wherein the bristles have a diameter in the range from 5 to 20 μm.

13. Apparatus as claimed in any of claims 9 to 12, wherein each strip has a thickness in the range from 0.25 to 2 mm.

14. Apparatus as claimed in any of the preceding claims, wherein the rotatable body comprises further surface agitating means.

15. Apparatus as claimed in claim 14, wherein the further surface agitating means are located between the grooves of the body.

16. Apparatus as claimed in claim 14 or claim 15, wherein the further agitating means is arranged in a plurality of rows along the body.

17. Apparatus as claimed in claim 16, wherein the rows of further agitating means are discontinuous.

18. Apparatus as claimed in any of claims 14 to 17, wherein the surface resistivity of the further surface agitating means is different than the surface resistivity of the agitating members.

19. Apparatus as claimed in any of claims 14 to 18, wherein the stiffness of the further surface agitating means is different than the stiffness of the agitating members.

20. Apparatus as claimed in any of claims 14 to 19, wherein the further surface agitating means comprises one of a plurality of bristles, a plurality of filaments, and at least one strip of material.

21. Apparatus as claimed in any of the preceding claims, in the form of a rotatable brush bar.

22. A cleaner head for a surface treating appliance comprising apparatus as claimed in any of the preceding claims.

23. Agitating apparatus for a surface treating appliance substantially as hereinbefore described with reference to the accompanying drawings.

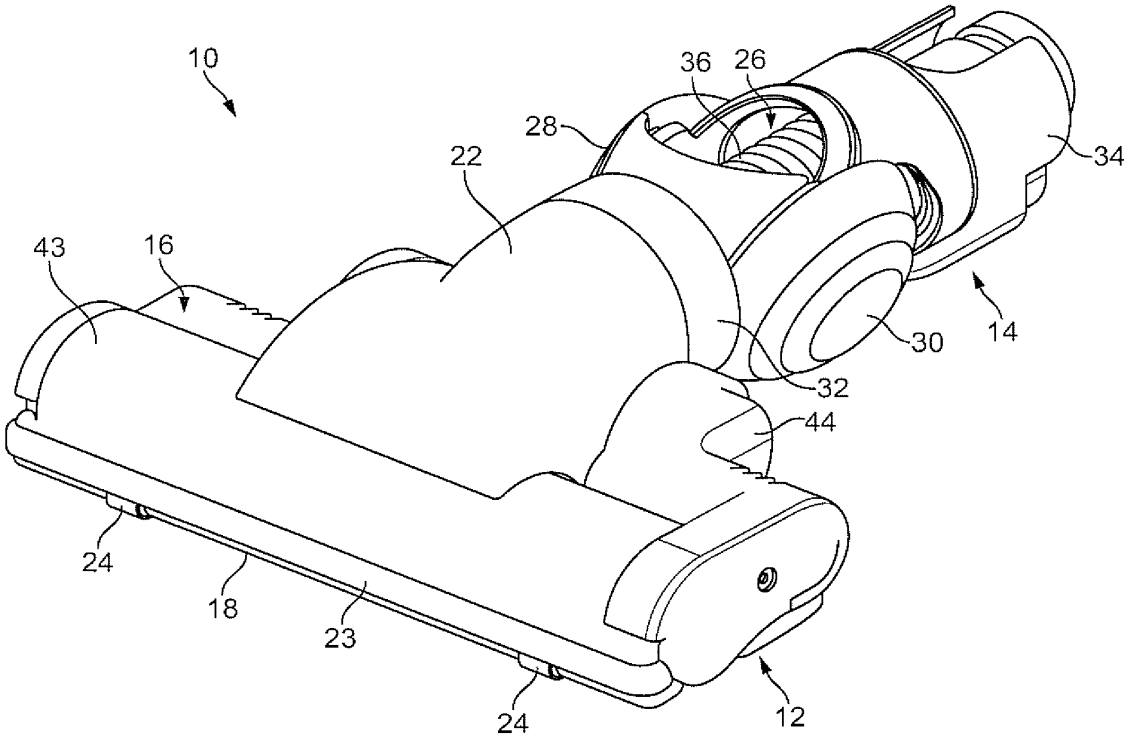

FIG. 1

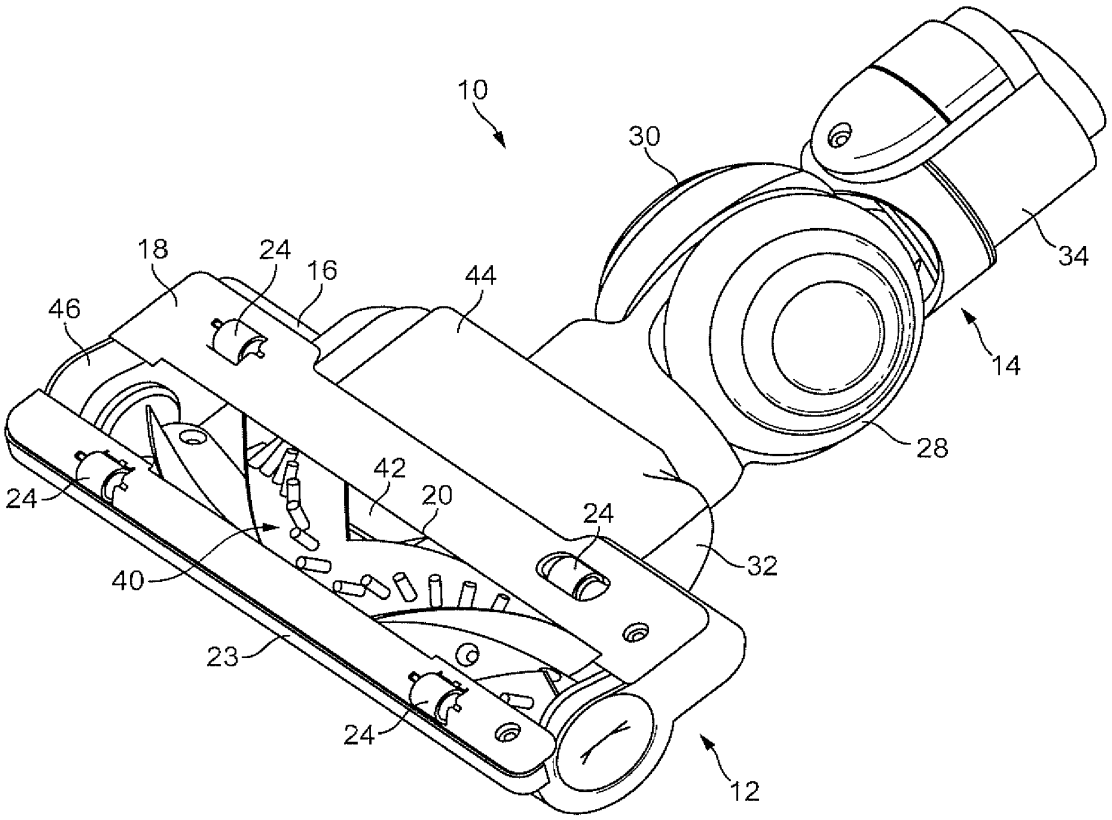

FIG. 2

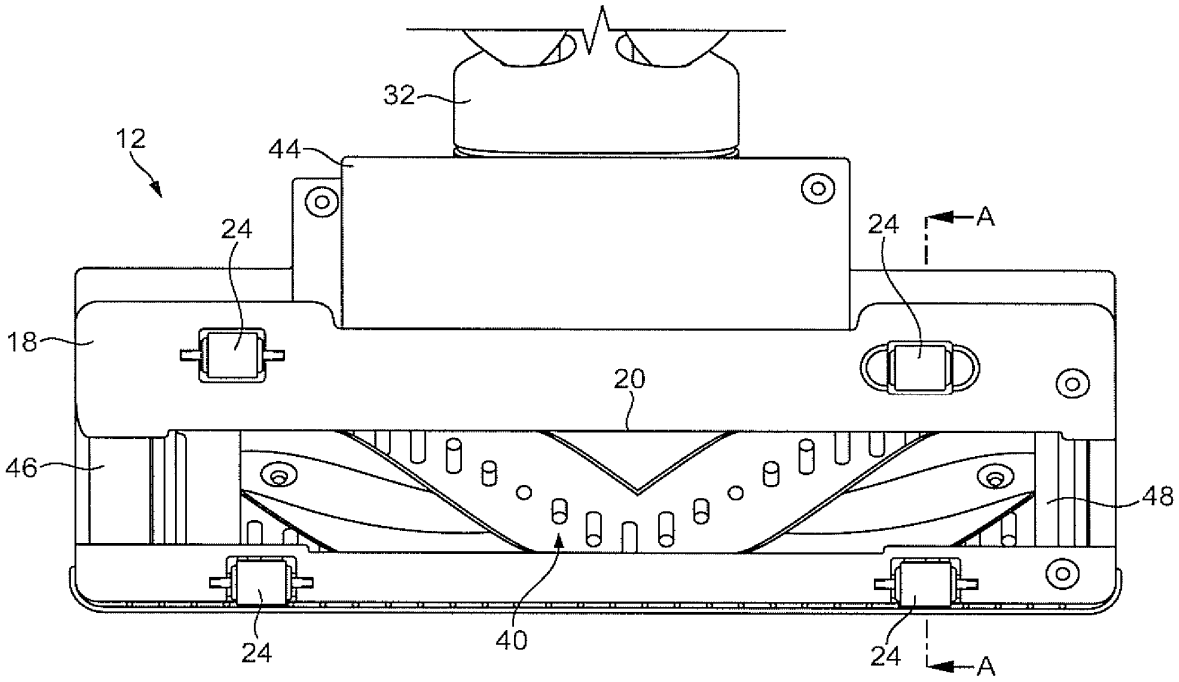

FIG. 3

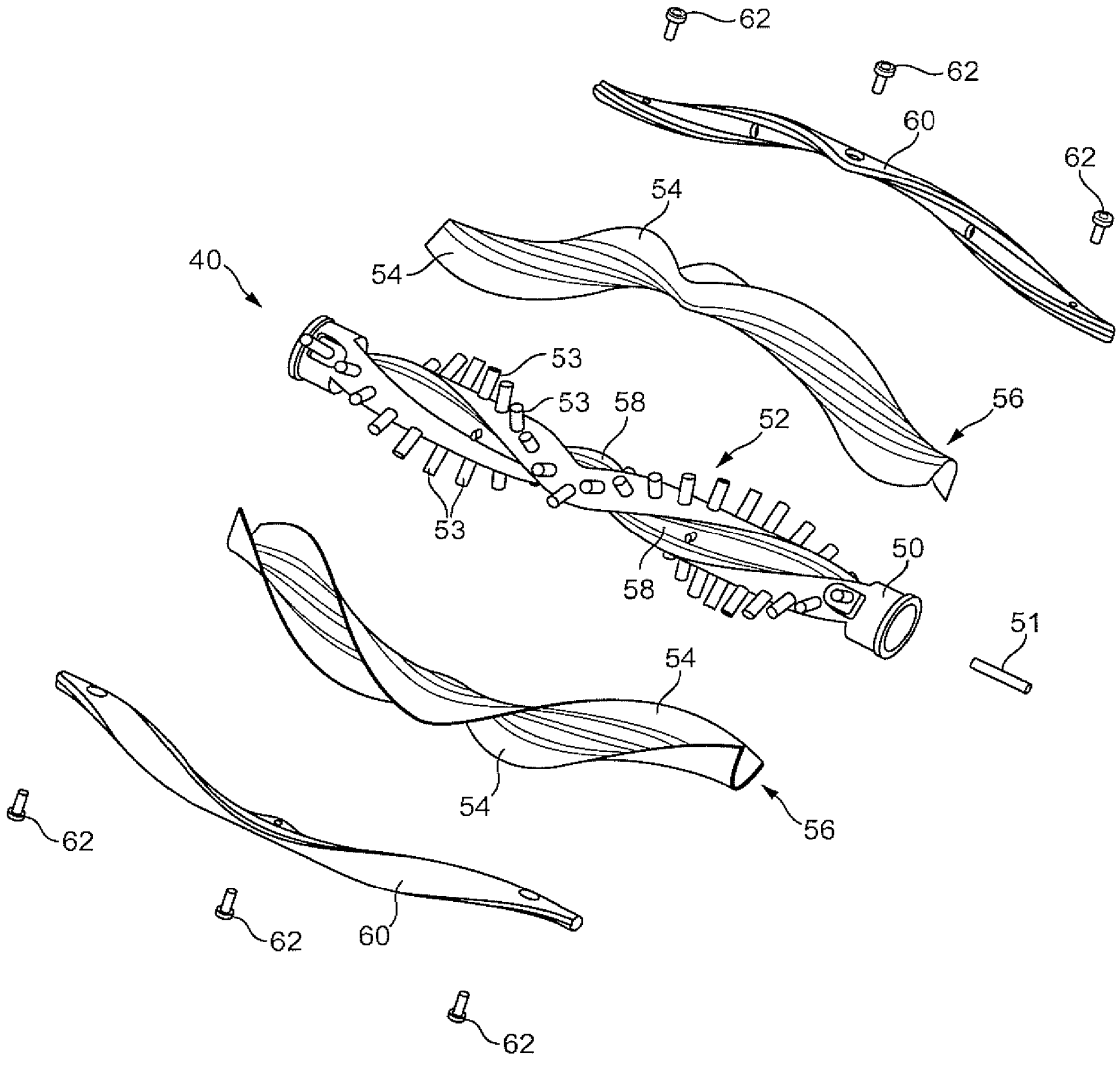

FIG. 4

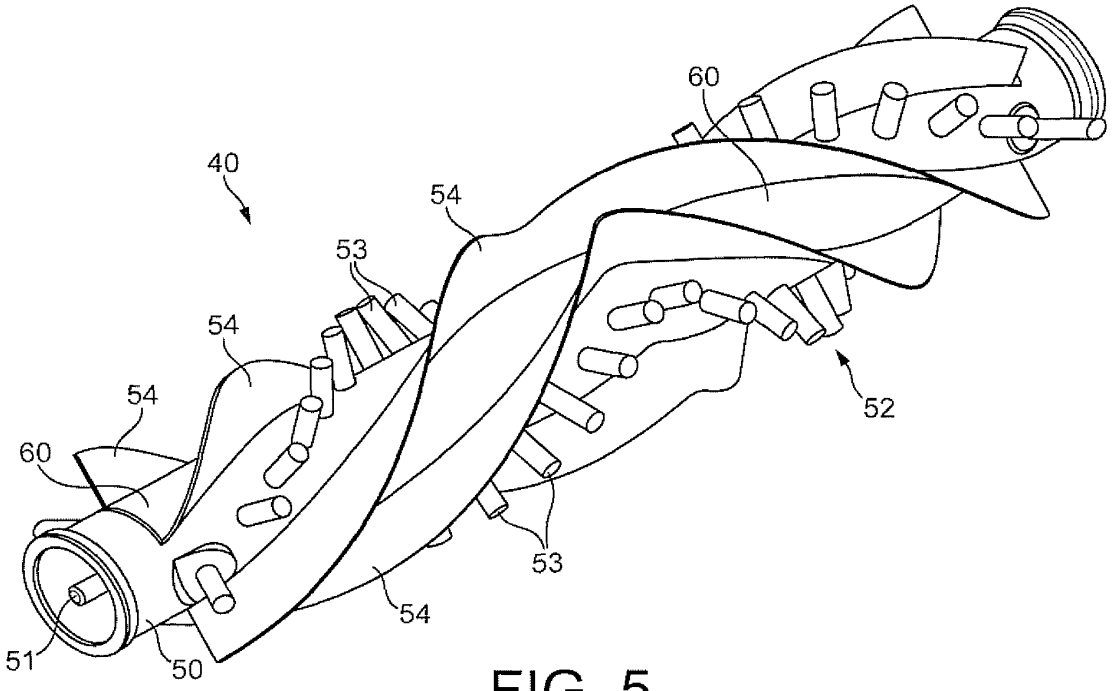

FIG. 5

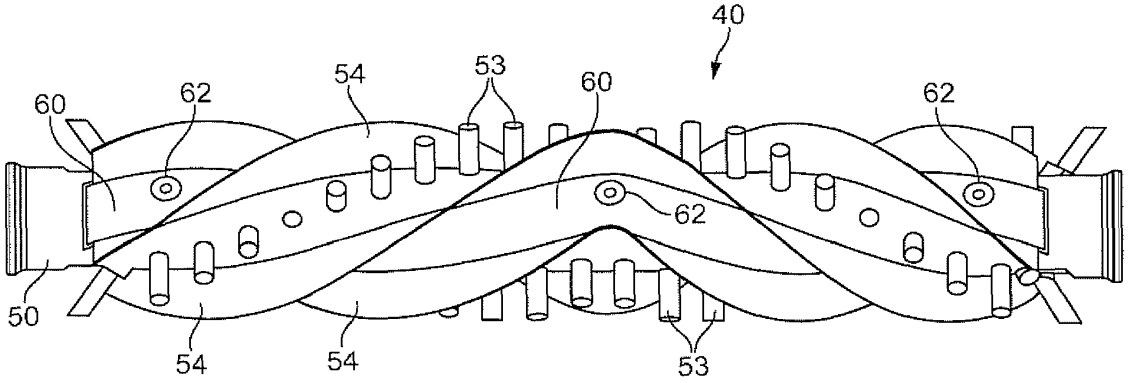

FIG. 6

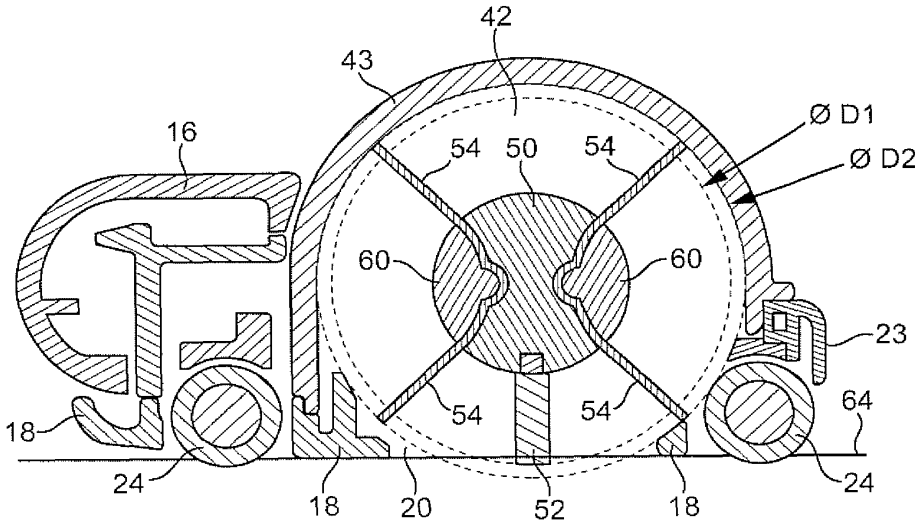
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FIG. 7

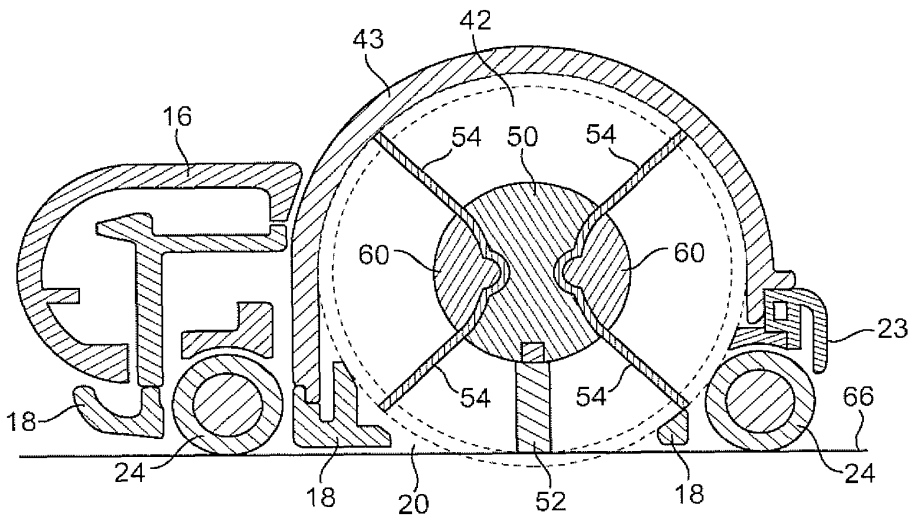
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FIG. 8

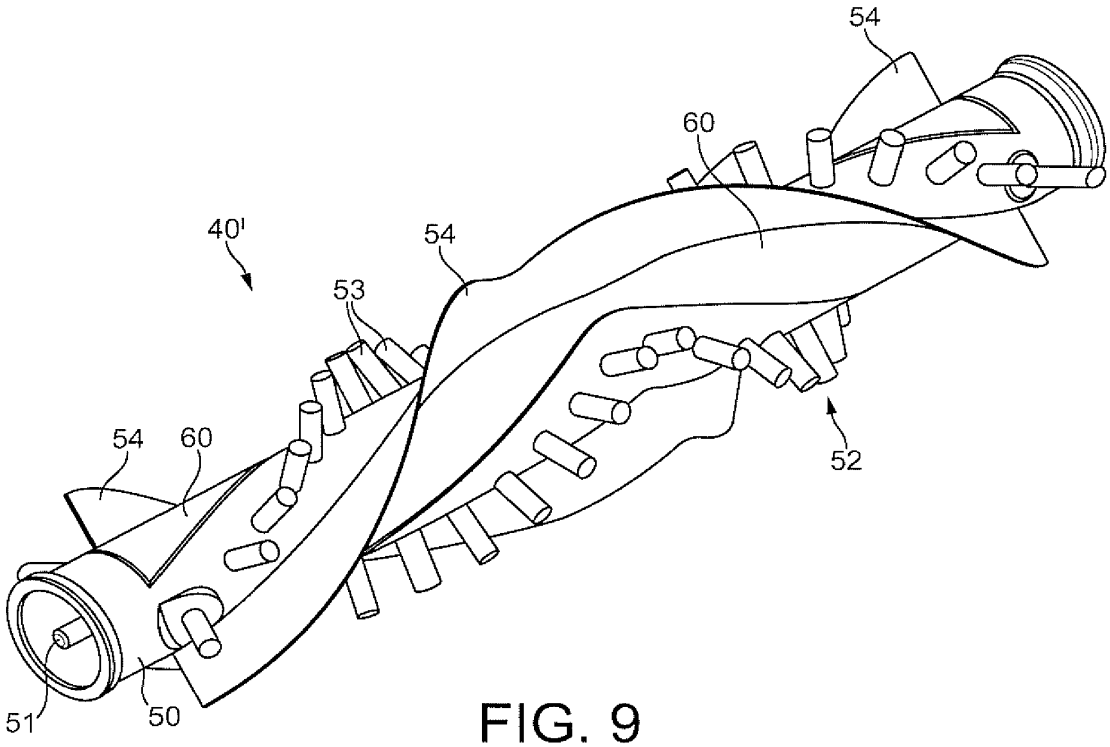

FIG. 9

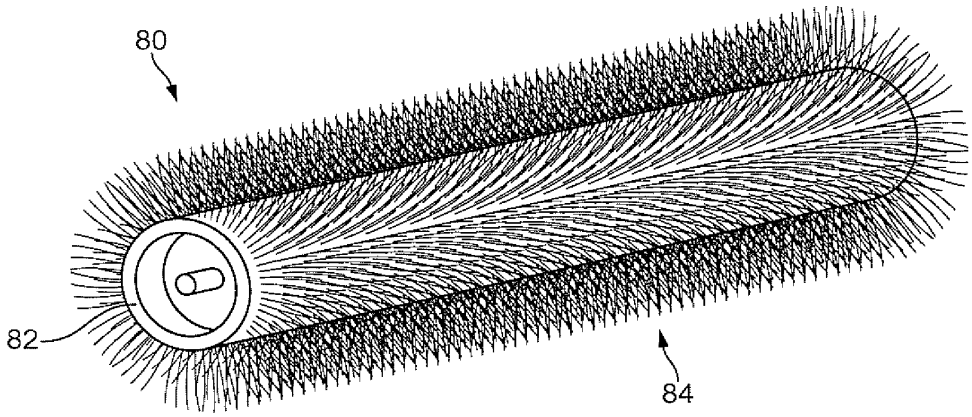

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050853

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/04
ADD.

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)
A47L

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	WO 2006/080383 A1 (TOSHIBA TEC KK [JP]; TAKAI YASUSHI [JP]; MORISHITA ATSUSHI [JP]; ICHIN) 3 August 2006 (2006-08-03) paragraph [0025] - paragraph [0026]; figures 2,4 * abstract	1,4,6, 8-13,21, 22 2,3, 14-17 5,7, 18-20
Y A	US 6 199 244 B1 (HILGERS STEFAN [DE] ET AL) 13 March 2001 (2001-03-13) column 3, line 17 - line 22 column 6, line 15 - line 17; claim 6	2,3 1,4-22
Y A	GB 2 150 422 A (HOOVER LTD) 3 July 1985 (1985-07-03) * abstract	14-17 1-13, 18-22

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 September 2010	13/09/2010

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, Fax: (+31-70) 340-3016	Clarke, Alister

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050853

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 313 403 A2 (MATSUSHITA ELECTRIC IND CO LTD [JP]) 26 April 1989 (1989-04-26) column 1, line 36 - column 2, line 26; figures 1,2,3,5,6	1-22
A	JP 2003 339590 A (HITACHI HOME & LIFE SOLUTIONS) 2 December 2003 (2003-12-02) * abstract	2,3
A	JP 2002 136457 A (MATSUSHITA ELECTRIC IND CO LTD) 14 May 2002 (2002-05-14) * abstract	2

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 23

Present claim 23 relates to a device defined by reference "substantially" to the drawings, contrary to the requirements of Rule 6.2(a) PCT. The use of this unusual reference in the present context is considered to lead to a lack of clarity because the claim does not clearly identify the devices encompassed by it. This makes it impossible to compare the claim to the prior art. As a result, the application further does not comply with the requirements of clarity under Article 6 PCT.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2010/050853

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 23
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2010/050853

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 2006080383	A1	03-08-2006	CN	101090660 A	19-12-2007
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			KR	20070072915 A	06-07-2007
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			US	5029361 A	09-07-1991
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JP 2002136457	A	14-05-2002	NONE		

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(19) World Intellectual Property Organization
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16 December 2010 (16.12.2010)

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(10) International Publication Number
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(51) International Patent Classification:
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(21) International Application Number:
PCT/GB2010/050852

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25 May 2010 (25.05.2010)

(25) Filing Language: English

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(30) Priority Data:
0909897.1 9 June 2009 (09.06.2009) GB

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(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **FOLLOWS, Thomas** [GB/GB]; c/o Dyson Technology Limited, Tetbury Hill, Malmesbury Wiltshire SN16 0RP (GB). **COURTNEY, Stephen** [GB/GB]; c/o Dyson Technology Limited, Tetbury Hill, Malmesbury Wiltshire SN16 0RP (GB).

(74) Agents: **BOOTH, Andrew** et al.; Dyson Technology Limited, Intellectual Property Department, Tetbury Hill, Malmesbury Wiltshire SN16 0RP (GB).

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(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: A CLEANER HEAD

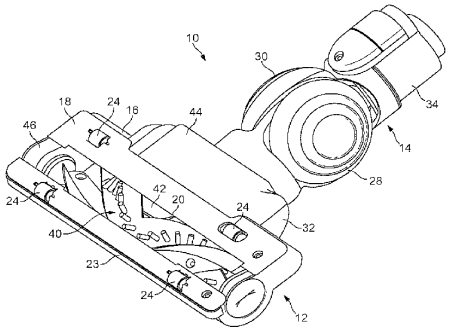

FIG. 2

(57) **Abstract**: Agitating apparatus (40) for a surface treating appliance includes a rotatable body (50) having at least one substantially continuous row of bristles (54) extending outwardly therefrom, the bristles having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq so that static electricity residing on a floor surface to be cleaned is discharged upon contact with the bristles.

WO 2010/142969 A1

A Cleaner Head

The present invention relates to agitating apparatus for a surface treating appliance, and to a cleaner head for a surface treating appliance. In its preferred embodiment, the present invention relates to a cleaner head for a vacuum cleaning appliance.

A vacuum cleaner typically comprises a main body containing dirt and dust separating apparatus, a cleaner head connected to the main body and having a suction opening, and a motor-driven fan unit for drawing dirt-bearing air through the suction opening. The dirt-bearing air is conveyed to the separating apparatus so that dirt and dust can be separated from the air before the air is expelled to the atmosphere.

The suction opening is directed downwardly to face the floor surface to be cleaned. The separating apparatus can take the form of a filter, a filter bag or, as is known, a cyclonic arrangement. The present invention is not concerned with the nature of the separating apparatus and is therefore applicable to vacuum cleaners utilizing any of the above arrangements or another suitable separating apparatus.

A driven agitator, usually in the form of a brush bar, is supported in the cleaner head so as to protrude to a small extent from the suction opening. The brush bar is activated mainly when the vacuum cleaner is used to clean carpeted surfaces. The brush bar comprises an elongate cylindrical core bearing bristles which extend radially outward from the core. The brush bar may be driven by an air turbine or by an electric motor powered by a power supply derived from the main body of the cleaner. The brush bar may be driven by the motor via a drive belt, or may be driven directly by the motor, so as to rotate within the suction opening. Rotation of the brush bar causes the bristles to sweep along the surface of the carpet to be cleaned to loosen dirt and dust, and pick up debris. The suction of air causes air to flow underneath the sole plate and around the brush bar to help lift the dirt and dust from the surface of the carpet and then carry it from the suction opening through the cleaner head towards the separating apparatus.

The bristles of the brush bar are usually formed from nylon. While the use of nylon bristles provides an acceptable cleaning performance on carpeted floor surfaces, we have found that the use of nylon bristles generates static electricity when the floor tool is used on some hard floor surfaces, such as laminate, wood and vinyl surfaces, which attracts fine dust and powders, such as talcum powder, on to the floor surface. This can impair the cleaning performance on the cleaner head on such floor surfaces, as the sweeping action of the nylon bristles is insufficient to overcome the force attracting the fine dust to the floor surface.

In a first aspect, the present invention provides agitating apparatus for a surface treating appliance, comprising a rotatable body having at least one substantially continuous row of bristles extending outwardly therefrom, the bristles having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

Providing the rotatable body with bristles having a surface resistivity of the agitating means is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq (ohms per square) can enable static electricity residing on a floor surface to be cleaned to be discharged upon contact between the bristles and the floor surface. Values of surface resistivity discussed herein are as measured using the test method ASTM D257. This enables fine dust and powder which would otherwise be attracted to the floor surface to be dislodged from the floor surface by the bristles. The bristles are preferably arranged in at least one substantially continuous row so that no patterns of dirt or dust are formed on the floor surface as each row of bristles is swept thereover.

The bristles are preferably formed from one of metallic, carbon fibre, carbon composite, conductive acrylic fibres such as Thunderon® fibres or other composite material. For example, material comprising carbon particles and carbon fibres generally has a surface resistivity in the range from $1x10^{3}$ to $1x10^{6}$ Ω/sq, whereas metallic material generally has a much lower surface resistivity, generally lower than 1 Ω/sq. Other static dissipative materials generally have a surface resistivity in the range from $1x10^{5}$ to $1x10^{12}$ Ω/sq.

The at least one row of bristles may be arranged in any desired pattern, or randomly, on the body. In a preferred embodiment, the bristles are arranged in at least one helical formation along the body.

The bristles are preferably arranged in a plurality of rows along the body. The bristles are arranged in a closely packed formation so that the, or each, row of bristles is substantially continuous. For example, each row of bristles preferably contains in the range from 20 to 100 bristles per mm length, and preferably has a thickness in the range from 0.25 to 2 mm. The diameter of each bristle is preferably in the range from 5 to 20 μm.

At least two rows of the bristles may be in electrical contact. In one embodiment, adjacent rows of bristles are in electrical contact. For example, a continuous row of bristles may be sandwiched between the rotatable body and a connecting member connected to the body so that the ends of the bristles protrude from the body to define respective rows of bristles. This can simplify manufacture of the agitating apparatus, and reduce costs.

In a preferred embodiment the rotatable body comprises further surface agitating means. The agitating apparatus may thus comprise two different surface agitating means. Preferably, the bristles protrude radially outwardly from the body beyond the further surface agitating means. The relatively short, further surface agitating means may be configured to agitate dirt and dust from a carpeted floor surface, whereas the relatively long bristles may be configured to sweep dirt and dust from a hard floor surface. The further surface agitating means is thus preferably relatively stiff in comparison to the bristles. For example, the bristles may have a smaller diameter than bristles or filaments of the further surface agitating means. For example, the further surface agitating means may be formed from bristles having a diameter in the range from 100 to 200 μm.

The further surface agitating means may be formed from electrically insulating, plastics material, such as nylon, and so may have a surface resistivity which is different to that of the bristles. The surface resistivity of the further surface agitating means is preferably in the range from $1x10^{12}$ to $1x10^{16}$ Ω/sq. Alternatively, the further surface agitating means may be formed from a similar material as the bristles, and so may have a surface resistivity within the aforementioned range for the bristles, in order to discharge any static electricity residing on a carpeted floor surface.

The further surface agitating means is preferably spaced from the bristles. The further surface agitating means is preferably arranged in a plurality of rows along the body, with these rows being preferably discontinuous. For example, where the further surface agitating means comprises a plurality of bristles these bristles are preferably arranged in one or more rows of clusters or tufts of bristles connected to and spaced along the body. However, the further surface agitating means may be located within, or otherwise in contact with, the continuous row of bristles.

Preferably, the continuous row of bristles protrudes outwardly beyond the further surface agitating means by a distance in the range from 0.5 to 5 mm, more preferably by a distance in the range from 1 to 3 mm.

The agitating apparatus is preferably in the form of a rotatable brush bar. Alternatively, the body may be in the form of a disc or plate.

In a second aspect, the present invention provides a cleaner head for a surface treating appliance, the cleaner head comprising a housing and apparatus as aforementioned. The cleaner head preferably comprises a sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and through which the bristles protrude as the body is rotated during use of the cleaner head, and a plurality of support members, preferably in the form of rolling elements, such as wheels or rollers, rotatably mounted on the sole plate, for supporting the cleaner head on a surface to be cleaned.

In a third aspect, the present invention provides a surface treating appliance comprising a cleaner head or agitating apparatus as aforementioned.

The term "surface treating appliance" is intended to have a broad meaning, and includes a wide range of machines having a main body and a head for travailing over a surface to clean or treat the surface in some manner. It includes, inter alia, machines which simply agitate the surface, such as carpet sweepers, machines which only apply suction to the surface, such as vacuum cleaners (dry, wet and wet/dry), so as to draw material from the surface, and machines which apply material to the surface, such as polishing/waxing machines, pressure washing machines and shampooing machines.

Features described above in connection with the first aspect of the invention are equally applicable to any of the second to third aspects of the invention, and vice versa.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a front perspective view, from above of a floor tool;

Figure 2 is a front perspective view, from below, of the floor tool of Figure 1;

Figure 3 is a bottom view of the floor tool of Figure 1;

Figure 4 is an exploded view of the brush bar of the floor tool of Figure 1;

Figure 5 is a perspective view of the brush bar of Figure 4;

Figure 6 is a top view of the brush bar of Figure 4;

Figure 7 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a carpeted floor surface;

Figure 8 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a hard floor surface;

Figure 9 is a perspective view of a modified version of the brush bar of Figure 4; and

Figure 10 is a perspective view of an alternative brush bar for use with the floor tool of Figure 1.

With reference first to Figures 1 to 3, a floor tool 10 comprises a cleaner head 12 rotatably attached to a coupling 14. The free end of the coupling 14 is attachable to a wand, hose or other such duct of a cleaning appliance (not shown). The cleaner head 12 comprises a housing 16 and a lower plate, or sole plate 18, comprising a suction opening 20 through which a dirt-bearing fluid flow enters the cleaner head 12. The housing 16 defines a suction passage extending from the suction opening 20 to an outlet duct 22 located at the rear of the housing 16. The housing 16 preferably comprises a front bumper 23. The sole plate 18 comprises a plurality of support members 24 in the form of rolling elements mounted within recessed portions of the sole plate 18 for supporting the cleaner head 12 on a floor surface. With reference to Figures 7 and 8, the support members 24 are preferably arranged to support the sole plate 18 above the floor surface when the cleaner head 12 is located on a hard floor surface 66, and, when the cleaner head 12 is located on a carpeted floor surface 64, to sink into the pile of the carpet to enable the bottom surface of the sole plate 18 to engage the fibres of the carpet. The sole plate 18 is preferably pivotable relative to the housing 16 to allow the sole plate 18 to ride smoothly over the carpeted floor surface 64 during cleaning.

The coupling 14 comprises a conduit 26 supported by a pair of wheels 28, 30. The conduit 26 comprises a forward portion 32 connected to the outlet duct 22, a rearward portion 34 pivotably connected to the forward portion 32 and connectable to a wand, hose or other such duct of a cleaning appliance which comprises dirt and dust separating apparatus and a motor-driven fan unit for drawing dirt-bearing air through the suction

opening 20 from the floor surface. A flexible hose 36 is held within and extends between the forward and the rearward portions 32, 34 of the conduit 26.

The cleaner head 12 comprises agitating apparatus for agitating dirt and dust located on the floor surface. In this example the agitating apparatus comprises a rotatable brush bar 40 which is mounted within a brush bar chamber 42 of the housing 16. The brush bar chamber 42 is partially defined by a generally semi-cylindrical portion 43 of the housing 16, which is preferably formed from transparent material. The brush bar 40 is driven by a motor (not shown) located in a motor housing 44 of the housing 16. The motor is electrically connected to a terminal located in the rearward portion 34 of the conduit 26 for connection with a conformingly profiled terminal located in a duct of the cleaning appliance to enable electrical power to be supplied to the motor.

The brush bar 40 is connected to the motor by a drive mechanism located, at least in part, within a drive mechanism housing 46 so that the drive mechanism is isolated from the air passing through the suction passage. One end of the brush bar 40 is connected to the drive mechanism to enable the brush bar 40 to be driven by the motor, whereas the other end of the brush bar 40 is rotatably supported by an end cap 48 mounted on a side wall of the brush bar chamber 42.

The brush bar 40 is illustrated in more detail in Figures 4 to 6. The brush bar 40 comprises an elongate body 50 bearing two different types of agitating means for agitating dirt and dust from the floor surface as the brush bar 40 is rotated by the motor. Each of the different types of agitating means protrudes from the suction opening 20 in the sole plate 18 as the brush bar 40 is rotated by the motor. A spindle 51 is mounted on one end of the body 50, with the spindle 51 being in turn connected to the end cap 48.

A first agitating means mounted on the body 50 of the brush bar 40 comprises relatively short, preferably relatively stiff, bristles 52. These bristles 52 are preferably formed from nylon. In this embodiment the relatively short bristles 52 are arranged in two angularly spaced, helical rows extending along the body 50. Within each row, the

relatively short bristles 52 are arranged in a series of clusters or tufts 53 regularly spaced along the row. Each tuft 53 preferably comprises around 100 to 150 bristles, with each tuft 53 having a diameter in the range from 2 to 4 mm. The diameter of each bristle 52 is preferably in the range from 100 to 200 μm. The length of the relatively short bristles 52 is chosen so that, when the floor tool 50 is assembled, the tips of these bristles 52 do not protrude beneath a plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

A second agitating means mounted on the body 50 of the brush bar 40 comprises relatively long, preferably relatively soft, bristles 54. As illustrated in Figure 7, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52. During rotation of the body 50, the relatively short bristles 52 sweep a cylindrical volume having a diameter D1, whereas the relatively long bristles 54 sweep a cylindrical volume having a diameter D2 which is greater than D1. The difference between D1 and D2 is preferably in the range from 1 to 10 mm, more preferably in the range from 2 to 6 mm. In contrast to the relatively short bristles 52, the length of the relatively long bristles 54 is chosen so that the relatively long bristles 54 protrude beyond the plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

The relatively long bristles 54 are formed from material having a lower surface resistivity than the material from which the relatively short bristles 52 are formed. The surface resistivity of the relatively long bristles 54 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. In comparison, the surface resistivity of the relatively short bristles 52 is preferably higher than $1x10^{12}$ Ω/sq. The relatively long bristles 54 may be formed from electrically conductive material. The bristles may be formed from metallic, graphite, conductive acrylic or other composite material, but in this example the relatively long bristles 54 comprise carbon fibre bristles. The diameter of each bristle 54 is preferably in the range from 5 to 20 μm.

The body 50 comprises a plurality of angularly spaced, continuous rows of the relatively long bristles 54, which preferably also extend helically along the body 50. In this embodiment the body 50 comprises four continuous rows of the relatively long bristles 54, with each row being angularly spaced from a row of tufts 53 formed from the relatively short bristles 52. Each row of the relatively long bristles 54 preferably contains in the range from 20 to 100 bristles per mm length, and has a thickness in the range from 0.25 to 2 mm.

With particular reference to Figure 4, in this embodiment adjacent rows of the relatively long bristles 54 are formed from a single strip 56 of bristles. Each strip 56 is preferably formed by attaching an elongate, generally rectangular flexible carrier member to a row of bristles so that each row of bristles 54 protrudes outwardly from a respective long side edge of the carrier member. The carrier member may be attached to the row of bristles by stitching or by using an adhesive. Each strip 56 is then located within a respective helical groove 58 formed in the body 50 so that the ends of the bristles protrude outwardly from the body 50. The strips 56 are connected to the body 50 by helical connectors 60 which are mounted on the strips 56 and connected to the body 50 using screws 62 into apertures formed in the connectors 60. The screws 62 may be pushed through the carrier member, or inserted through apertures formed in the carrier member. An adhesive tape may be applied to at least one side of each carrier member to allow the strips 56 to be aligned within the grooves 58 so that the ends of the bristles protrude from the body 50 by a regular amount along the length of the body 50.

With reference to Figure 7, when the cleaner head 12 is located on a carpeted floor surface 64 the support members 24 sink into the pile of the carpet so that the bottom surface of the sole plate 18 engages the fibres of the carpet. As both the relatively short bristles 52 and the relatively long bristles 54 protrude from the suction opening 20 as the brush bar 40 rotates, both the different types of bristles are able to agitate dirt and dust from the floor surface. When an air flow is generated through the suction passage of the cleaner head 12, this dirt and dust becomes entrained within the air flow and is conveyed through the floor tool 10 to the cleaning appliance.

When the cleaner head 12 is moved from the carpeted floor surface 64 on to a hard floor surface 66, as illustrated in Figure 8, the sole plate 18 becomes spaced from the hard floor surface 66. As the tips of the relatively short bristles 52 do not protrude beneath the plane extending between the lowermost extremities of the support members 24, these bristles do not come into contact with the hard floor surface 66, thereby preventing scratching or other marking of the hard floor surface 66 by these bristles. However, as the relatively long bristles 54 protrude beyond this plane, these bristles engage, and are swept across, the hard floor surface 66 with rotation of the brush bar 40. Due to the relatively low surface resistivity of the relatively long bristles 54, any static electricity residing on the hard floor surface 66 is discharged upon contact with the relatively long bristles 54, thereby enabling fine dust and powder which would otherwise be attracted to the hard floor surface 66 to be dislodged from the floor surface by these bristles and entrained within the air flow.

The invention is not limited to the detailed description given above. Variations will be apparent to the person skilled in the art.

For example, in the embodiment described above, the cleaner head 12 includes a brush bar 40 that is driven by a motor. However, the cleaner head 12 may include alternative means for agitating or otherwise working a surface to be cleaned. By way of example, the brush bar 40 may be driven by an air turbine rather than a motor.

The relatively short bristles 52 may be formed from similar material as the relatively long bristles 54 in order to discharge any static material residing on a carpeted floor surface, and so may also have a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

Each strip 56 may be modified so that the bristles protrude from only one of the relatively long side edges of the carrier member. Thus, each strip 56 may be in the form of a brush, with bristles extending outwardly from only one side of the brush. A

modified version of the brush bar 40', in which each strip 56 has been modified as discussed above, is illustrated in Figure 9. This modification of the strips 56 results in the bristles 54 protruding outwardly from one side only of each connecting member 60. Consequently, this brush bar 40' contains only two continuous rows of relatively long bristles 54, with the rows of tufts 53 and the rows of relatively long bristles 54 being alternately arranged about the body 50 of the brush bar 40'. As with the brush bar 40, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52.

The different types of bristles 52, 54 need not be spaced apart. The brush bar 40 may comprise a plurality of rows, clumps or tufts of bristles, with each row, clump or tuft comprising both types of bristles. For example, relatively short bristles 52 may be dispersed within each row of relatively long bristles 54. Alternatively, relatively long bristles 54 may be dispersed within each tuft 53 of relatively short bristles 52.

The agitating means may take forms other than bristles, such as flexible or rigid strips of material mounted on the body 50, or filaments sewn into a backing material connected to the body 50.

In the event that the floor tool 10 is not to be used on a carpeted surface, the relatively short bristles 52 may be dispensed with so that the brush bar 40 comprises only electrically conductive agitating members. Consequently, the brush bar 40 may comprise solely the continuous rows of surface agitating members defined by the relatively long bristles 54 illustrated in Figures 2 to 8. Alternatively, the brush bar 40 may comprise a different arrangement of surface agitating members for discharging static electricity residing on a floor surface.

For example, with reference to Figure 10 an alternative brush bar 80 for use in the floor tool 10 comprises a rotatable body 82 having an outer surface comprising an electrically conductive pile 84. In this example, the pile 84 is similar to the raised or fluffy surface of a carpet, rug or cloth, and comprises filaments woven on to a fabric carrier member

attached to the body 82, for example using an adhesive. The length of the filaments of the pile 84 is preferably in the range from 4 to 15 mm, and the filaments have a diameter which is preferably in the range from 5 to 20 μm.

These filaments are preferably formed from carbon fibres, but alternatively they may be formed from metallic material, conductive acrylic material or other composite material. Consequently, the surface resistivity of the filaments of the pile 84 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. The fabric carrier member may be in the form of a strip wound on to the body 82 so that the pile 84 is substantially continuous, substantially covering the outer surface of the body 82. Alternatively, the carrier member may be in the form of a cylindrical sleeve into which the body 82 is inserted.

If so desired, clumps of relatively stiff bristles may be dispersed within the pile 84. Alternatively, a strip of the pile 84 may be wound around one or more helical rows of relatively stiff bristles previously attached to the body 82. These bristles may be similar to the relatively short bristles 52 of the brush bar 40, and so may be arranged so as to not protrude radially outwardly beyond the filaments of the pile 84.

CLAIMS

1. Agitating apparatus for a surface treating appliance, comprising a rotatable body having at least one substantially continuous row of bristles extending outwardly therefrom, the bristles having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

2. Apparatus as claimed in claim 1, wherein the bristles are formed from one of metallic, carbon fibre, conductive acrylic and composite material.

3. Apparatus as claimed in claim 1 or claim 2, wherein said at least one substantially continuous row is helical.

4. Apparatus as claimed in any of the preceding claims, wherein said at least one substantially continuous row comprises a plurality of substantially continuous rows along the body.

5. Apparatus as claimed in any of the preceding claims, wherein the bristles have a diameter in the range from 5 to 20 μm.

6. Apparatus as claimed in any of the preceding claims, wherein each row of bristles contains in the range from 20 to 100 bristles per mm length.

7. Apparatus as claimed in any of the preceding claims, wherein the rotatable body comprises further surface agitating means.

8. Apparatus as claimed in claim 7, wherein the surface resistivity of the further surface agitating means is different to the surface resistivity of the bristles.

9. Apparatus as claimed in claim 7 or claim 8, wherein the stiffness of the further surface agitating means is different to the stiffness of the bristles.

10. Apparatus as claimed in any of claims 7 to 9, wherein the further surface agitating means is arranged in at least one helical formation along the body.

11. Apparatus as claimed in claim 10, wherein the further surface agitating means is arranged in a plurality of rows along the body.

12. Apparatus as claimed in claim 11, wherein the rows of further surface agitating means are discontinuous.

13. Apparatus as claimed in any of claims 7 to 12, wherein the further surface agitating means comprises one of a plurality of bristles, a plurality of filaments, and at least one strip of material.

14. Apparatus as claimed in any of the preceding claims, in the form of a rotatable brush bar.

15. A cleaner head for a surface treating appliance comprising apparatus as claimed in any of the preceding claims.

16. A cleaner head as claimed in claim 15, comprising a sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and a plurality of support members mounted on the sole plate for supporting the cleaner head on a surface to be cleaned.

17. A surface treating appliance comprising a cleaner head as claimed in any of claims 15 to 16 or agitating apparatus as claimed in any of claims 1 to 14.

18. Agitating apparatus for a surface treating appliance substantially as hereinbefore described with reference to the accompanying drawings.

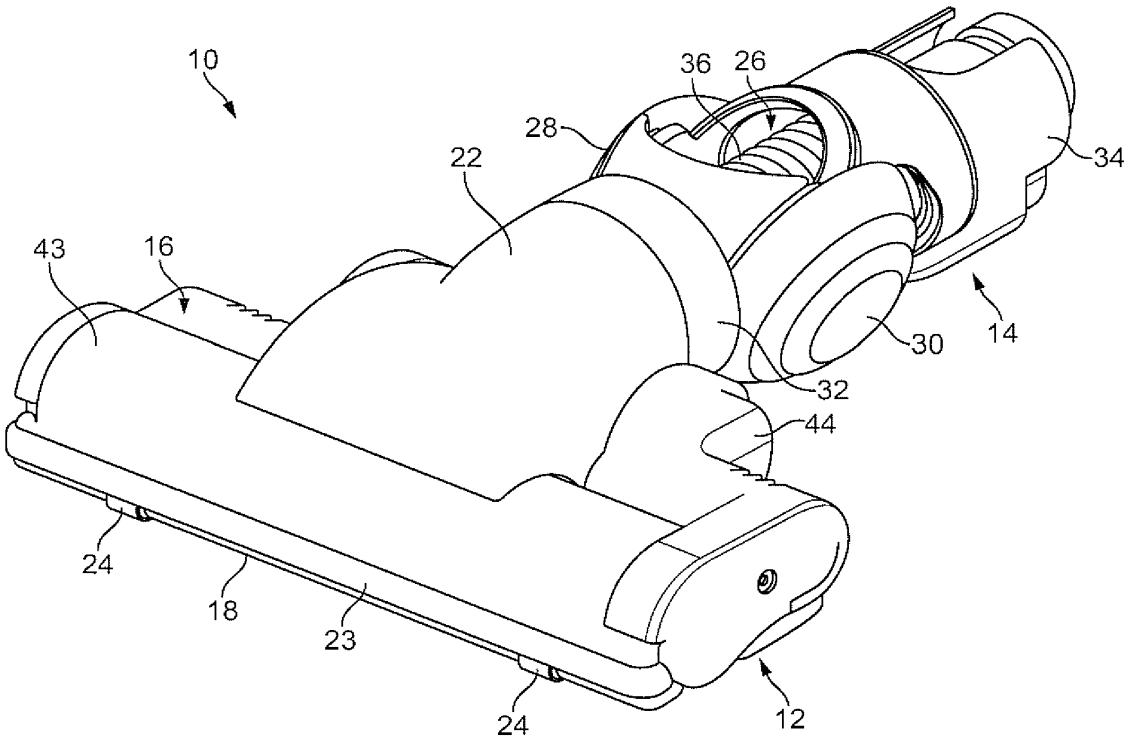

FIG. 1

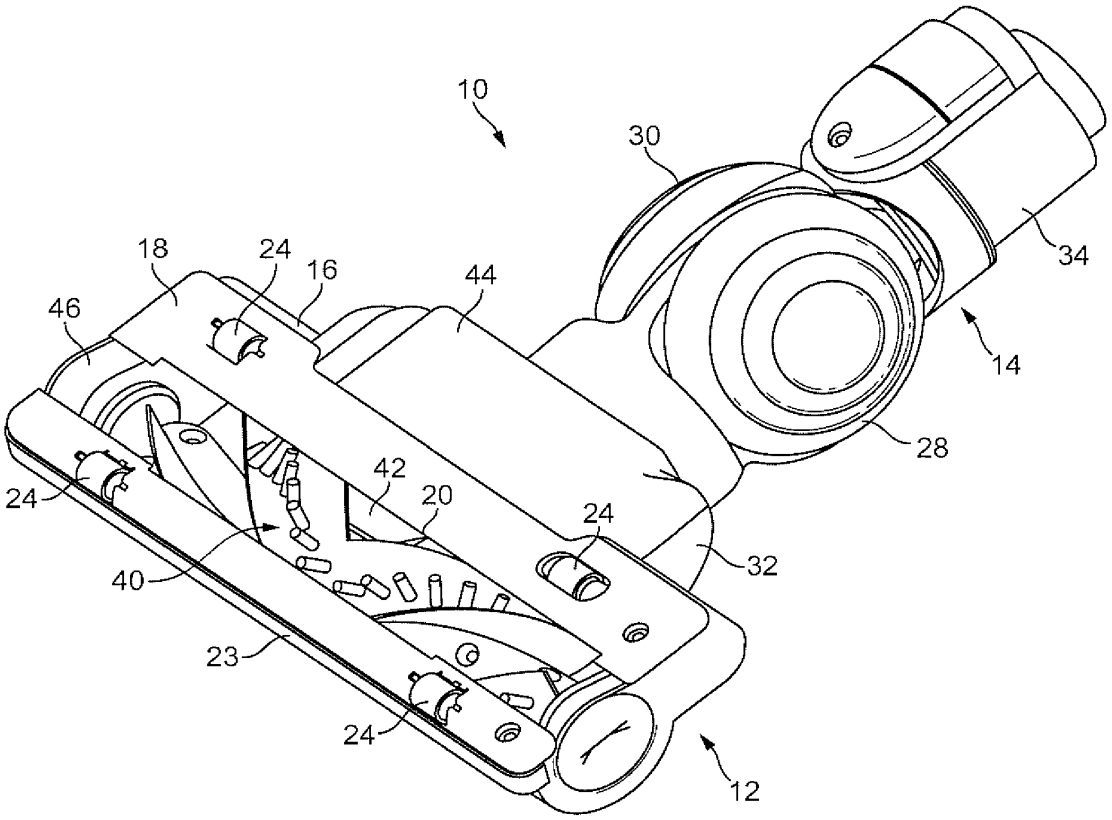

FIG. 2

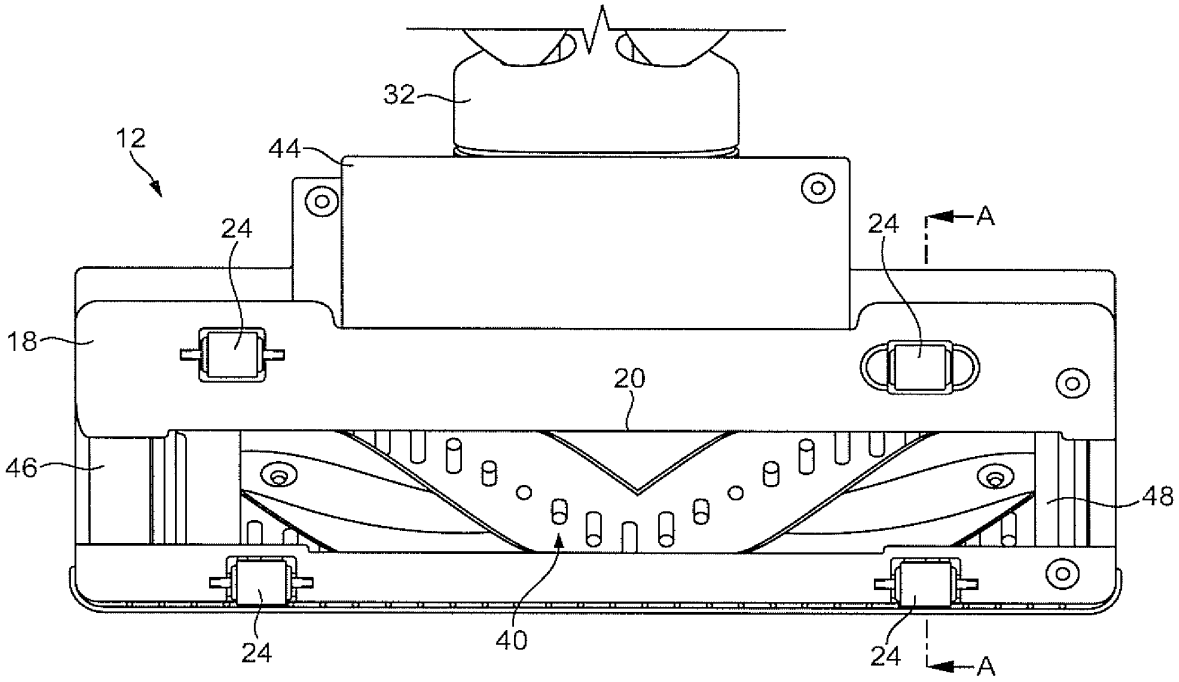

FIG. 3

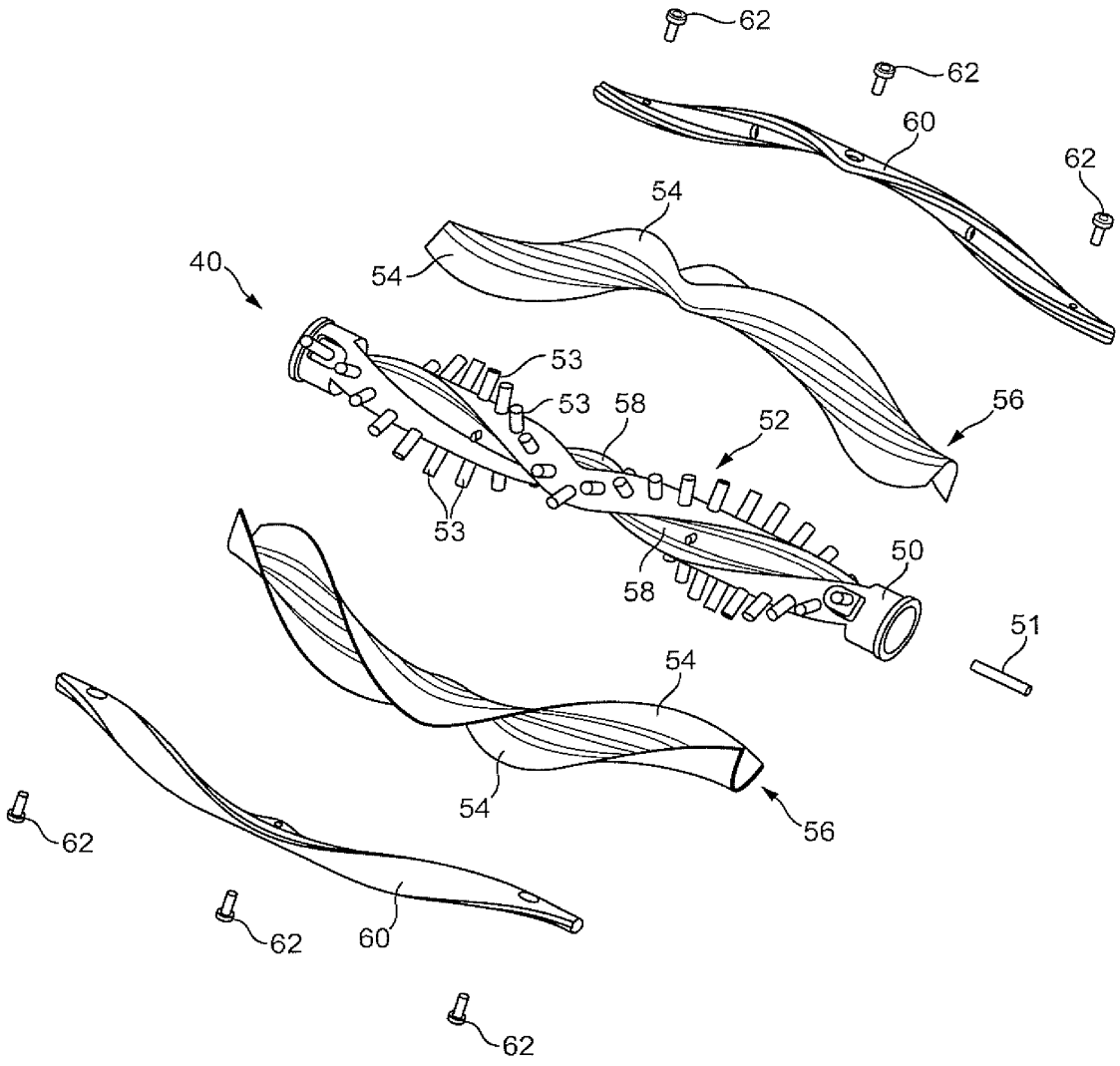

FIG. 4

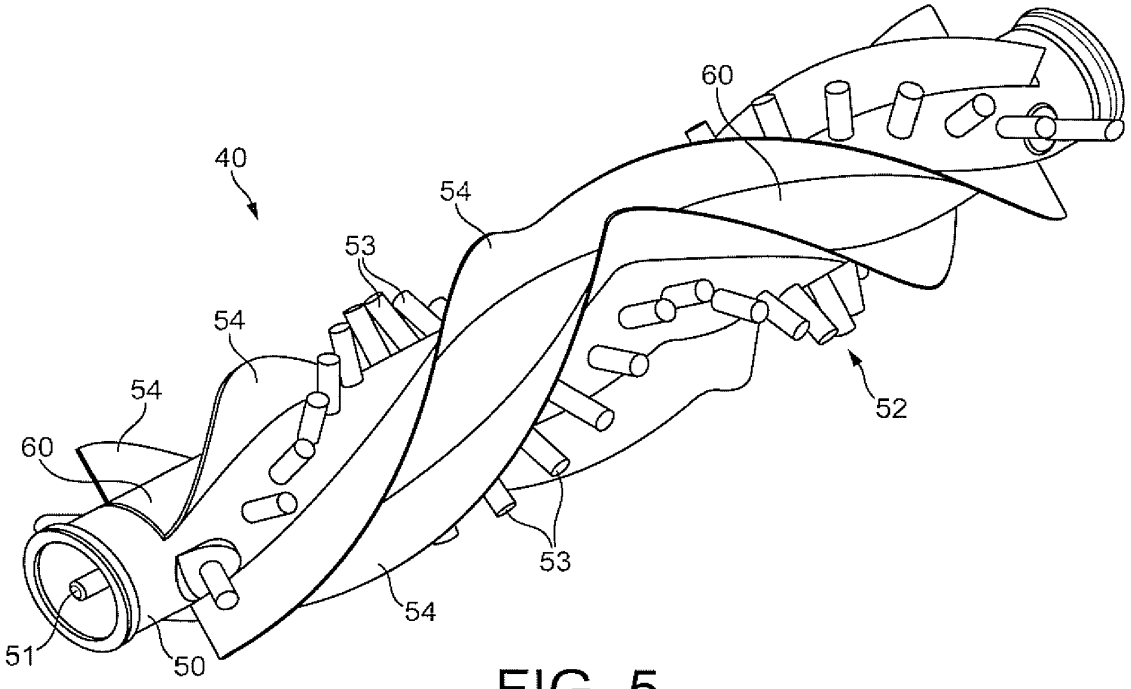

FIG. 5

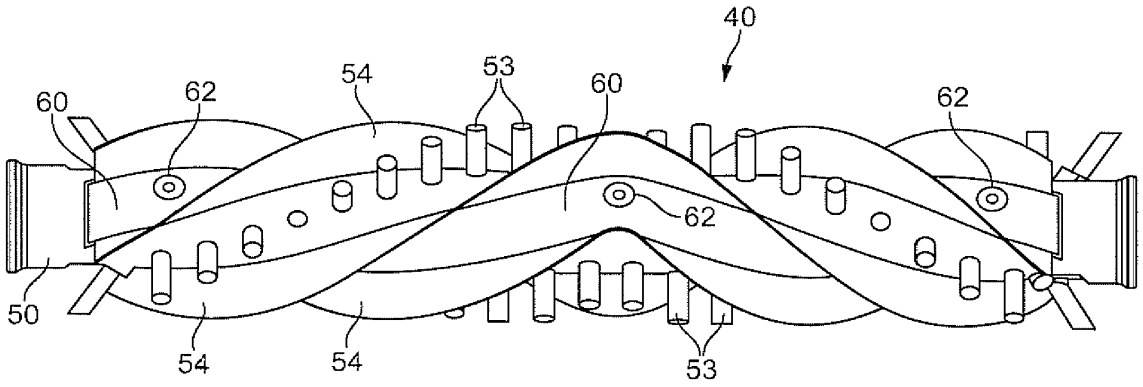

FIG. 6

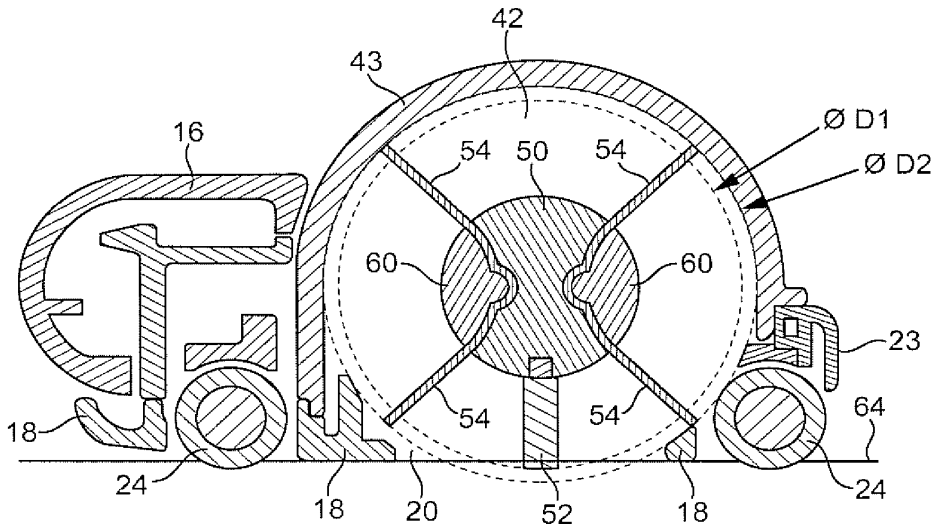
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FIG. 7

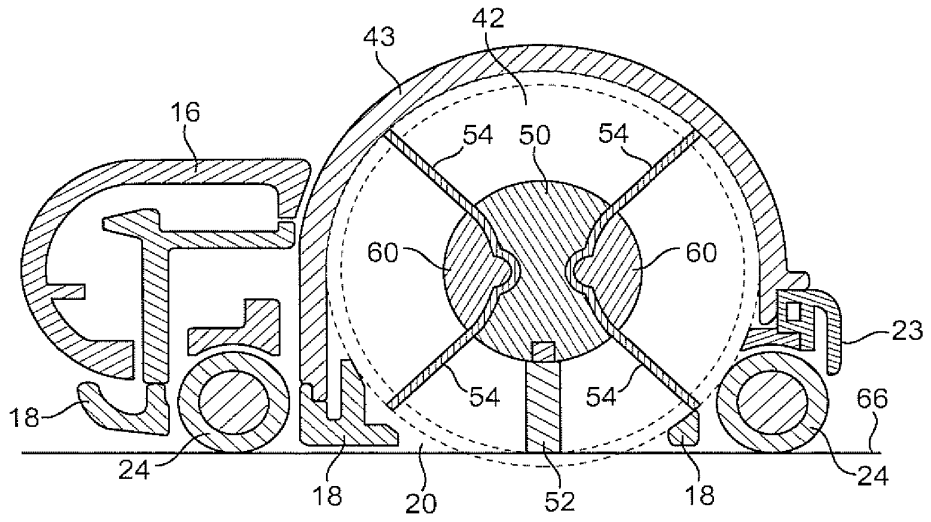
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FIG. 8

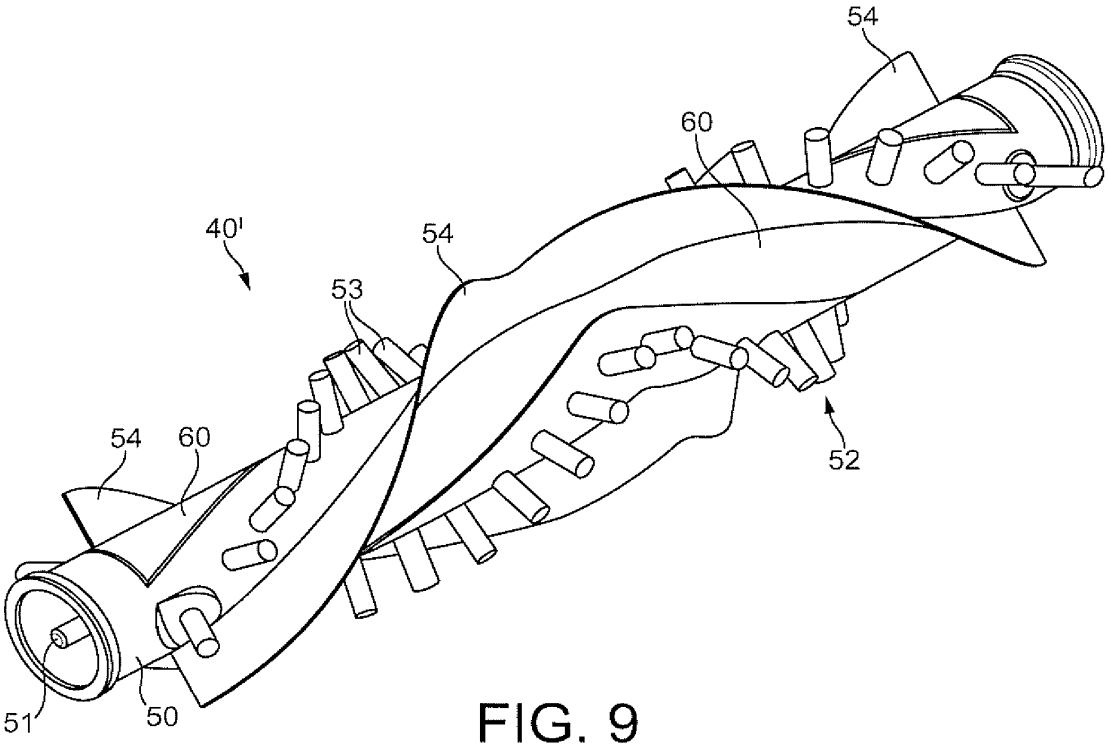

FIG. 9

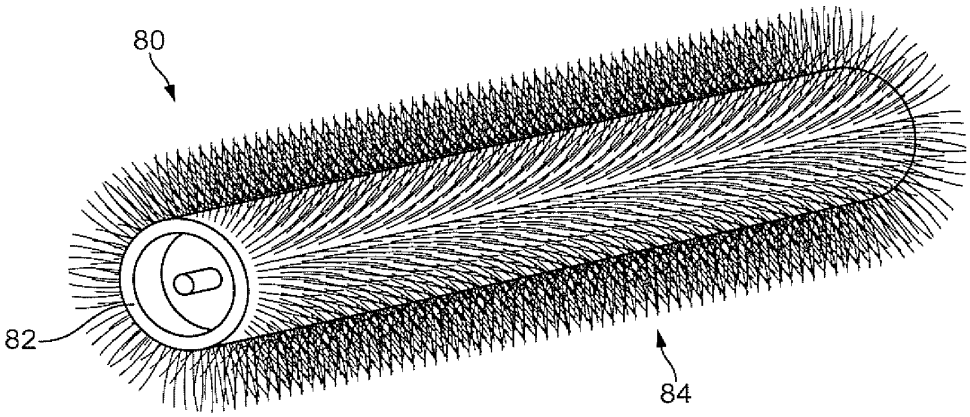

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050852

A. CLASSIFICATION OF SUBJECT MATTER
INV. A46B13/00 A47L9/04
ADD.

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)
A46B A47L A46D

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	DE 43 06 734 A1 (HEIDELBERGER DRUCKMASCH AG [DE]) 8 September 1994 (1994-09-08) column 1, lines 1-8,22-39; figure 1	1,2,4-6, 14,15,17 3,7-13, 16
Y	US 2 659 921 A (OSBORN RALPH C) 24 November 1953 (1953-11-24) column 3, lines 1-40; figures 1-4	3,7-13, 16
A	US 2008/000043 A1 (FREDERICKSON CLIVE J [GB] FREDERICKSON CLIVE JAMES [GB]) 3 January 2008 (2008-01-03) paragraph [0022]; figure 2	1,3, 10-16
A	US 2005/039282 A1 (PATERSON CHRISTOPHER M [US] ET AL) 24 February 2005 (2005-02-24) paragraph [0008]; figures 1-7	7

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 October 2010	13/10/2010

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, Fax: (+31-70) 340-3016	Roche, Olivier

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050852

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 34 18 224 A1 (DRESSER IND [US]) 22 November 1984 (1984-11-22) page 9, lines 4-15 page 11, lines 21-23	1
A	US 2 426 315 A (LOUIS MARICK) 26 August 1947 (1947-08-26) column 2, lines 46-54 column 4, lines 12-18	1
X	US 2005/153558 A1 (KOH SIONG H [SG] ET AL KOH SIONG HONG [SG] ET AL) 14 July 2005 (2005-07-14) paragraph [0075]; figure 3	1

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

Dyson Ex1020
Page 372

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 18

Claim 18 contains only references to the description and the drawings. According to Rule 6.2(a) PCT, no claims should be drafted as such except where absolutely necessary, which is not the case here.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2010/050852

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 18
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2010/050852

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP 2007521666 T	02-08-2007
		KR 20060135750 A	29-12-2006
		WO 2005072036 A1	04-08-2005

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(19) World Intellectual Property Organization
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16 December 2010 (16.12.2010)

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A47L 9/04 (2006.01) *A46B 9/06* (2006.01)

(21) International Application Number:
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(22) International Filing Date:
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(26) Publication Language: English

(30) Priority Data:
0909896.3 9 June 2009 (09.06.2009) GB

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(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **FOLLOWS, Thomas** [GB/GB]; c/o Dyson Technology Limited, Tetbury Hill, Malmesbury, Wiltshire SN16 0RP (GB). **COURTNEY, Stephen** [GB/GB]; c/o Dyson Technology Limited, Tetbury Hill, Malmesbury, Wiltshire SN16 0RP (GB).

(74) Agents: **BOOTH, Andrew** et al.; Dyson Technology Limited, Intellectual Property Department, Tetbury Hill, Malmesbury, Wiltshire SN16 0RP (GB).

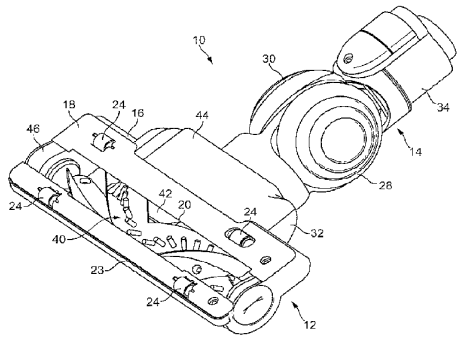
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) **Title**: A CLEANER HEAD

FIG. 2



(57) **Abstract**: A cleaner head (12) for a surface treating appliance includes a housing (16) and a rotatable brush bar (40) located within the housing (16). The brush bar includes a first plurality of bristles (52) and a second plurality of bristles (54) which protrude radially outwardly beyond the first plurality of bristles (52). The second plurality of bristles (54) has a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq so that static electricity residing on a floor surface to be cleaned is discharged upon contact with the conductive bristles.

WO 2010/142968 A1

A Cleaner Head

The present invention relates to agitating apparatus for a surface treating appliance, and to a cleaner head for a surface treating appliance. In its preferred embodiment, the present invention relates to a cleaner head for a vacuum cleaning appliance.

A vacuum cleaner typically comprises a main body containing dirt and dust separating apparatus, a cleaner head connected to the main body and having a suction opening, and a motor-driven fan unit for drawing dirt-bearing air through the suction opening. The dirt-bearing air is conveyed to the separating apparatus so that dirt and dust can be separated from the air before the air is expelled to the atmosphere.

The suction opening is directed downwardly to face the floor surface to be cleaned. The separating apparatus can take the form of a filter, a filter bag or, as is known, a cyclonic arrangement. The present invention is not concerned with the nature of the separating apparatus and is therefore applicable to vacuum cleaners utilizing any of the above arrangements or another suitable separating apparatus.

A driven agitator, usually in the form of a brush bar, is supported in the cleaner head so as to protrude to a small extent from the suction opening. The brush bar is activated mainly when the vacuum cleaner is used to clean carpeted surfaces. The brush bar comprises an elongate cylindrical core bearing bristles which extend radially outward from the core. The brush bar may be driven by an air turbine or by an electric motor powered by a power supply derived from the main body of the cleaner. The brush bar may be driven by the motor via a drive belt, or may be driven directly by the motor, so as to rotate within the suction opening. Rotation of the brush bar causes the bristles to sweep along the surface of the carpet to be cleaned to loosen dirt and dust, and pick up debris. The suction of air causes air to flow underneath the sole plate and around the brush bar to help lift the dirt and dust from the surface of the carpet and then carry it from the suction opening through the cleaner head towards the separating apparatus.

The bristles of the brush bar are usually formed from nylon. While the use of nylon bristles provides an acceptable cleaning performance on carpeted floor surfaces, we have found that the use of nylon bristles generates static electricity when the floor tool is used on some hard floor surfaces, such as laminate, wood and vinyl surfaces, which attracts fine dust and powders, such as talcum powder, on to the floor surface. This can impair the cleaning performance on the cleaner head on such floor surfaces, as the sweeping action of the nylon bristles is insufficient to overcome the force attracting the fine dust to the floor surface.

In a first aspect, the present invention provides agitating apparatus for a surface treating appliance, comprising first surface agitating means and second surface agitating means extending outwardly from the apparatus beyond the first surface agitating means and having a lower surface resistivity than the first surface agitating means.

The agitating apparatus thus comprises two surface agitating means. The relatively short, first agitating means may be configured to agitate dirt and dust from a carpeted floor surface, whereas the relatively long, second agitating means may be configured to sweep dirt and dust from a hard floor surface. Forming this second agitating means from material having a lower surface resistivity than that from which the first agitating means is formed can enable static electricity residing on a floor surface to be cleaned to be discharged upon contact between the second agitating means and the floor surface. This enables fine dust and powder which would otherwise be attracted to the floor surface to be dislodged from the floor surface by the second agitating means.

The surface resistivity of the second agitating means is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq (ohms per square). Values of surface resistivity discussed herein are as measured using the test method ASTM D257. The selection of material having a surface resistivity in this range can ensure that any static electricity on the floor surface is effectively discharged by the second agitating means. Therefore, in a second aspect the present invention provides agitating apparatus for a surface treating appliance, comprising first surface agitating means and second surface agitating means extending

outwardly from the apparatus beyond the first surface agitating means and having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

The second agitating means is preferably formed from one of metallic, carbon fibre, carbon composite or other composite material. For example, material comprising carbon particles and carbon fibres generally has a surface resistivity in the range from $1x10^{3}$ to $1x10^{6}$ Ω/sq, whereas metallic material generally has a much lower surface resistivity, generally lower than 1 Ω/sq. Other static dissipative materials generally have a surface resistivity in the range from $1x10^{5}$ to $1x10^{12}$ Ω/sq.

The first agitating means may be formed from electrically insulating, plastics material, such as nylon, and so may have a surface resistivity in the range from $1x10^{12}$ to $1x10^{16}$ Ω/sq. Alternatively, the first agitating means may be formed from a similar material as the second agitating means, and so may have a surface resistivity within the aforementioned range for the second agitating means, in order to discharge any static electricity residing on a carpeted floor surface.

The first agitating means is preferably spaced from the second agitating means. However, the first agitating means may be located within, or otherwise in contact with, the second agitating means. For example, each of the agitating means may comprises a plurality of bristles or filaments, with the bristles or filaments of the first agitating means being located adjacent, or amongst, bristles or filaments of the second agitating means.

Preferably, the second agitating means protrudes outwardly beyond the first agitating means by a distance in the range from 0.5 to 5 mm, more preferably by a distance in the range from 1 to 3 mm.

The first agitating means may be moveable relative to the second agitating means. For example the first and second agitating means may be mounted on or otherwise comprise respective bodies which are moveable relative to each other. By way of example, the

first agitating means may be mounted on a first body which is rotated about a first axis or translated in a first direction, and the second agitating means may be mounted on a second body which is rotated about a second axis or translated in a second direction. In a preferred embodiment, however, the first agitating means and the second agitating means are rotatable about a common axis, and are preferably mounted on a common rotatable body. This body may be in the form of a disc or plate, with the first and second agitating means being mounted on the same side of that disc or plate so that the second agitating means protrudes outwardly from that side beyond the first agitating means. Preferably though, the second agitating means protrudes radially outwardly from the body beyond the first agitating means. The agitating means may be arranged in any desired pattern, or randomly, on the body. In a preferred embodiment, each of the agitating means is arranged in at least one helical formation along the body.

One, or both, of the agitating means may comprise a plurality of bristles, filaments or other agitating members. For example, one or both agitating means may comprise at least one strip of material mounted on the body. Where the first agitating means comprises a plurality of bristles, these bristles are preferably arranged in one or more rows of clusters or tufts of bristles connected to the body. The second agitating means is preferably arranged in a plurality of rows along the body. However, where the second agitating means comprises a plurality of bristles or filaments, each row of bristles or filaments is preferably continuous so that no patterns of dirt or dust are formed on the floor surface as each row is swept thereover. Similarly, where the second agitating means comprises at least one strip of material, each row is preferably formed from a single strip of material, or from a plurality of adjoining strips. For example, bristles of the second agitating means may be formed from carbon fibres or conductive acrylic fibres such as Thunderon® fibres.

At least two rows of the second agitating means may be in electrical contact. In a preferred embodiment, adjacent rows of the second agitating means are in electrical contact. For example, at least one agitating member of one row may also form at least one agitating member of another row. Such agitating members may pass through one or

more apertures formed in the rotatable body of the agitating apparatus, or may be otherwise connected to the body so that two rows each comprise a respective end of an agitating member. In a preferred embodiment, a row of bristles or filaments is sandwiched between the rotatable body and a connecting member connected to the body so that the ends of the bristles or filaments protrude from the body to define respective rows of the second agitating means. A strip of material may be similarly connected to the rotatable body so that portions of the strip form respective rows of the second agitating means. This can simplify manufacture of the agitating apparatus, and reduce costs.

The first agitating means is preferably relatively stiff in comparison to the second agitating means. For example, bristles or filaments of the first agitating means may have a greater diameter than bristles or filaments of the second agitating means. Bristles of the first agitating means preferably have a diameter in the range from 100 to 200 μm. Bristles of the second agitating means preferably have a diameter in the range from 5 to 20 μm.

The agitating apparatus is preferably in the form of a rotatable brush bar. The present invention thus also provides a cleaner head for a surface treating appliance comprising a housing and a rotatable brush bar located within the housing, the brush bar comprises a first plurality of bristles and a second plurality of bristles which protrude radially outwardly beyond the first plurality of bristles. The second plurality of bristles preferably has a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq so that static electricity residing on a floor surface to be cleaned is discharged upon contact with the conductive bristles. The second plurality of bristles may comprise carbon fibre bristles,

In a third aspect, the present invention provides a cleaner head for a surface treating appliance, the cleaner head comprising a housing and apparatus as aforementioned. The cleaner head preferably comprises a plurality of support members, preferably in the form of rolling elements such as wheels or rollers, for supporting the cleaner head on a surface to be cleaned. Preferably, the first agitating means does not protrude beneath a

plane extending between the lowermost extremities of the support members so that when the cleaner head is located on a hard floor surface the first agitating means does not come into contact with that floor surface. This can inhibit scratching or marking of the floor surface by this agitating means, especially when the first agitating means is formed from relatively stiff material. When the cleaner head is located on a carpeted surface, the support members may sink into the fibres of the carpet to bring the first agitating means into contact with the carpet.

The cleaner head preferably comprises a sole plate having a suction opening through which dirt-bearing air enters the cleaner head, and through which the agitating means protrude as the agitating apparatus is rotated or otherwise moved during use of the cleaner head, and the support members are preferably rotatably mounted on the sole plate.

In a fourth aspect, the present invention provides a surface treating appliance comprising a cleaner head or agitating apparatus as aforementioned.

The term "surface treating appliance" is intended to have a broad meaning, and includes a wide range of machines having a main body and a head for travailing over a surface to clean or treat the surface in some manner. It includes, inter alia, machines which simply agitate the surface, such as carpet sweepers, machines which only apply suction to the surface, such as vacuum cleaners (dry, wet and wet/dry), so as to draw material from the surface, and machines which apply material to the surface, such as polishing/waxing machines, pressure washing machines and shampooing machines.

Features described above in connection with the first aspect of the invention are equally applicable to any of the second to fourth aspects of the invention, and vice versa.

An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a front perspective view, from above of a floor tool;

Figure 2 is a front perspective view, from below, of the floor tool of Figure 1;

Figure 3 is a bottom view of the floor tool of Figure 1;

Figure 4 is an exploded view of the brush bar of the floor tool of Figure 1;

Figure 5 is a perspective view of the brush bar of Figure 4;

Figure 6 is a top view of the brush bar of Figure 4;

Figure 7 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a carpeted floor surface;

Figure 8 is a section taken along line A-A illustrated in Figure 3 when the floor tool is located on a hard floor surface;

Figure 9 is a perspective view of a modified version of the brush bar of Figure 4; and

Figure 10 is a perspective view of an alternative brush bar for use with the floor tool of Figure 1.

With reference first to Figures 1 to 3, a floor tool 10 comprises a cleaner head 12 rotatably attached to a coupling 14. The free end of the coupling 14 is attachable to a wand, hose or other such duct of a cleaning appliance (not shown). The cleaner head 12 comprises a housing 16 and a lower plate, or sole plate 18, comprising a suction opening 20 through which a dirt-bearing fluid flow enters the cleaner head 12. The housing 16 defines a suction passage extending from the suction opening 20 to an outlet duct 22 located at the rear of the housing 16. The housing 16 preferably comprises a front bumper 23. The sole plate 18 comprises a plurality of support members 24 in the

form of rolling elements mounted within recessed portions of the sole plate 18 for supporting the cleaner head 12 on a floor surface. With reference to Figures 7 and 8, the support members 24 are preferably arranged to support the sole plate 18 above the floor surface when the cleaner head 12 is located on a hard floor surface 66, and, when the cleaner head 12 is located on a carpeted floor surface 64, to sink into the pile of the carpet to enable the bottom surface of the sole plate 18 to engage the fibres of the carpet. The sole plate 18 is preferably pivotable relative to the housing 16 to allow the sole plate 18 to ride smoothly over the carpeted floor surface 64 during cleaning.

The coupling 14 comprises a conduit 26 supported by a pair of wheels 28, 30. The conduit 26 comprises a forward portion 32 connected to the outlet duct 22, a rearward portion 34 pivotably connected to the forward portion 32 and connectable to a wand, hose or other such duct of a cleaning appliance which comprises dirt and dust separating apparatus and a motor-driven fan unit for drawing dirt-bearing air through the suction opening 20 from the floor surface. A flexible hose 36 is held within and extends between the forward and the rearward portions 32, 34 of the conduit 26.

The cleaner head 12 comprises agitating apparatus for agitating dirt and dust located on the floor surface. In this example the agitating apparatus comprises a rotatable brush bar 40 which is mounted within a brush bar chamber 42 of the housing 16. The brush bar chamber 42 is partially defined by a generally semi-cylindrical portion 43 of the housing 16, which is preferably formed from transparent material. The brush bar 40 is driven by a motor (not shown) located in a motor housing 44 of the housing 16. The motor is electrically connected to a terminal located in the rearward portion 34 of the conduit 26 for connection with a conformingly profiled terminal located in a duct of the cleaning appliance to enable electrical power to be supplied to the motor.

The brush bar 40 is connected to the motor by a drive mechanism located, at least in part, within a drive mechanism housing 46 so that the drive mechanism is isolated from the air passing through the suction passage. One end of the brush bar 40 is connected to the drive mechanism to enable the brush bar 40 to be driven by the motor, whereas the

other end of the brush bar 40 is rotatably supported by an end cap 48 mounted on a side wall of the brush bar chamber 42.

The brush bar 40 is illustrated in more detail in Figures 4 to 6. The brush bar 40 comprises an elongate body 50 bearing two different types of agitating means for agitating dirt and dust from the floor surface as the brush bar 40 is rotated by the motor. Each of the different types of agitating means protrudes from the suction opening 20 in the sole plate 18 as the brush bar 40 is rotated by the motor. A spindle 51 is mounted on one end of the body 50, with the spindle 51 being in turn connected to the end cap 48.

A first agitating means mounted on the body 50 of the brush bar 40 comprises relatively short, preferably relatively stiff, bristles 52. These bristles 52 are preferably formed from nylon. In this embodiment the relatively short bristles 52 are arranged in two angularly spaced, helical rows extending along the body 50. Within each row, the relatively short bristles 52 are arranged in a series of clusters or tufts 53 regularly spaced along the row. Each tuft 53 preferably comprises around 100 to 150 bristles, with each tuft 53 having a diameter in the range from 2 to 4 mm. The diameter of each bristle 52 is preferably in the range from 100 to 200 μm. The length of the relatively short bristles 52 is chosen so that, when the floor tool 50 is assembled, the tips of these bristles 52 do not protrude beneath a plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

A second agitating means mounted on the body 50 of the brush bar 40 comprises relatively long, preferably relatively soft, bristles 54. As illustrated in Figure 7, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52. During rotation of the body 50, the relatively short bristles 52 sweep a cylindrical volume having a diameter D1, whereas the relatively long bristles 54 sweep a cylindrical volume having a diameter D2 which is greater than D1. The difference between D1 and D2 is preferably in the range from 1 to 10 mm, more preferably in the range from 2 to 6 mm. In contrast to the relatively short bristles 52, the length of the relatively long bristles 54 is chosen so that the relatively long bristles

54 protrude beyond the plane extending between the lowermost extremities of the support members 24 during rotation of the brush bar 40.

The relatively long bristles 54 are formed from material having a lower surface resistivity than the material from which the relatively short bristles 52 are formed. The surface resistivity of the relatively long bristles 54 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. In comparison, the surface resistivity of the relatively short bristles 52 is preferably higher than $1x10^{12}$ Ω/sq. The relatively long bristles 54 may be formed from electrically conductive material. The bristles may be formed from metallic, graphite, conductive acrylic or other composite material, but in this example the relatively long bristles 54 comprise carbon fibre bristles. The diameter of each bristle 54 is preferably in the range from 5 to 20 μm.

The body 50 comprises a plurality of angularly spaced, continuous rows of the relatively long bristles 54, which preferably also extend helically along the body 50. In this embodiment the body 50 comprises four continuous rows of the relatively long bristles 54, with each row being angularly spaced from a row of tufts 53 formed from the relatively short bristles 52. Each row of the relatively long bristles 54 preferably contains in the range from 20 to 100 bristles per mm length, and has a thickness in the range from 0.25 to 2 mm.

With particular reference to Figure 4, in this embodiment adjacent rows of the relatively long bristles 54 are formed from a single strip 56 of bristles. Each strip 56 is preferably formed by attaching an elongate, generally rectangular flexible carrier member to a row of bristles so that each row of bristles 54 protrudes outwardly from a respective long side edge of the carrier member. The carrier member may be attached to the row of bristles by stitching or by using an adhesive. Each strip 56 is then located within a respective helical groove 58 formed in the body 50 so that the ends of the bristles protrude outwardly from the body 50. The strips 56 are connected to the body 50 by helical connectors 60 which are mounted on the strips 56 and connected to the body 50 using screws 62 into apertures formed in the connectors 60. The screws 62 may be

pushed through the carrier member, or inserted through apertures formed in the carrier member. An adhesive tape may be applied to at least one side of each carrier member to allow the strips 56 to be aligned within the grooves 58 so that the ends of the bristles protrude from the body 50 by a regular amount along the length of the body 50.

With reference to Figure 7, when the cleaner head 12 is located on a carpeted floor surface 64 the support members 24 sink into the pile of the carpet so that the bottom surface of the sole plate 18 engages the fibres of the carpet. As both the relatively short bristles 52 and the relatively long bristles 54 protrude from the suction opening 20 as the brush bar 40 rotates, both the different types of bristles are able to agitate dirt and dust from the floor surface. When an air flow is generated through the suction passage of the cleaner head 12, this dirt and dust becomes entrained within the air flow and is conveyed through the floor tool 10 to the cleaning appliance.

When the cleaner head 12 is moved from the carpeted floor surface 64 on to a hard floor surface 66, as illustrated in Figure 8, the sole plate 18 becomes spaced from the hard floor surface 66. As the tips of the relatively short bristles 52 do not protrude beneath the plane extending between the lowermost extremities of the support members 24, these bristles do not come into contact with the hard floor surface 66, thereby preventing scratching or other marking of the hard floor surface 66 by these bristles. However, as the relatively long bristles 54 protrude beyond this plane, these bristles engage, and are swept across, the hard floor surface 66 with rotation of the brush bar 40. Due to the relatively low surface resistivity of the relatively long bristles 54, any static electricity residing on the hard floor surface 66 is discharged upon contact with the relatively long bristles 54, thereby enabling fine dust and powder which would otherwise be attracted to the hard floor surface 66 to be dislodged from the floor surface by these bristles and entrained within the air flow.

The invention is not limited to the detailed description given above. Variations will be apparent to the person skilled in the art.

For example, in the embodiment described above, the cleaner head 12 includes a brush bar 40 that is driven by a motor. However, the cleaner head 12 may include alternative means for agitating or otherwise working a surface to be cleaned. By way of example, the brush bar 40 may be driven by an air turbine rather than a motor.

The relatively short bristles 52 may be formed from similar material as the relatively long bristles 54 in order to discharge any static material residing on a carpeted floor surface, and so may also have a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

Each strip 56 may be modified so that the bristles protrude from only one of the relatively long side edges of the carrier member. Thus, each strip 56 may be in the form of a brush, with bristles extending outwardly from only one side of the brush. A modified version of the brush bar 40', in which each strip 56 has been modified as discussed above, is illustrated in Figure 9. This modification of the strips 56 results in the bristles 54 protruding outwardly from one side only of each connecting member 60. Consequently, this brush bar 40' contains only two continuous rows of relatively long bristles 54, with the rows of tufts 53 and the rows of relatively long bristles 54 being alternately arranged about the body 50 of the brush bar 40'. As with the brush bar 40, the relatively long bristles 54 protrude radially outwardly from the body 50 beyond the relatively short bristles 52.

The different types of bristles 52, 54 need not be spaced apart. The brush bar 40 may comprise a plurality of rows, clumps or tufts of bristles, with each row, clump or tuft comprising both types of bristles. For example, relatively short bristles 52 may be dispersed within each row of relatively long bristles 54. Alternatively, relatively long bristles 54 may be dispersed within each tuft 53 of relatively short bristles 52.

The agitating means may take forms other than bristles, such as flexible or rigid strips of material mounted on the body 50, or filaments sewn into a backing material connected to the body 50.

In the event that the floor tool 10 is not to be used on a carpeted surface, the relatively short bristles 52 may be dispensed with so that the brush bar 40 comprises only electrically conductive agitating members. Consequently, the brush bar 40 may comprise solely the continuous rows of surface agitating members defined by the relatively long bristles 54 illustrated in Figures 2 to 8. Alternatively, the brush bar 40 may comprise a different arrangement of surface agitating members for discharging static electricity residing on a floor surface.

For example, with reference to Figure 10 an alternative brush bar 80 for use in the floor tool 10 comprises a rotatable body 82 having an outer surface comprising an electrically conductive pile 84. In this example, the pile 84 is similar to the raised or fluffy surface of a carpet, rug or cloth, and comprises filaments woven on to a fabric carrier member 86 attached to the body 82, for example using an adhesive. The length of the filaments of the pile 84 is preferably in the range from 4 to 15 mm, and the filaments have a diameter which is preferably in the range from 5 to 20 μm.

These filaments are preferably formed from carbon fibres, but alternatively they may be formed from metallic material, conductive acrylic material or other composite material. Consequently, the surface resistivity of the filaments of the pile 84 is preferably in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq. The fabric carrier member 86 may be in the form of a strip wound on to the body 82 so that the pile 84 is substantially continuous, substantially covering the outer surface of the body 82. Alternatively, the carrier member 86 may be in the form of a cylindrical sleeve into which the body 82 is inserted.

If so desired, clumps of relatively stiff bristles may be dispersed within the pile 84. Alternatively, a strip of the pile 84 may be wound around one or more helical rows of relatively stiff bristles previously attached to the body 82. These bristles may be similar to the relatively short bristles 52 of the brush bar 40, and so may be arranged so as to not protrude radially outwardly beyond the filaments of the pile 84.

CLAIMS

1. Agitating apparatus for a surface treating appliance, comprising first surface agitating means and second surface agitating means extending outwardly from the apparatus beyond the first surface agitating means and having a lower surface resistivity than the first surface agitating means.

2. Apparatus as claimed in claim 1, wherein the surface resistivity of the second agitating means is in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

3. Agitating apparatus for a surface treating appliance, comprising first surface agitating means and second surface agitating means extending outwardly from the apparatus beyond the first surface agitating means and having a surface resistivity in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

4. Apparatus as claimed in claim 3, wherein the first agitating means is formed from one of metallic, carbon fibre, and composite material.

5. Apparatus as claimed in claim 3 or claim 4, wherein the surface resistivity of the first agitating means is in the range from $1x10^{-5}$ to $1x10^{12}$ Ω/sq.

6. Apparatus as claimed in any of claims 1 to 3, wherein the first agitating means is formed from plastics material.

7. Apparatus as claimed in any of the preceding claims, wherein the second agitating means is formed from one of metallic, carbon fibre, conductive acrylic and composite material.

8. Apparatus as claimed in any of the preceding claims, wherein the first agitating means is spaced from the second agitating means.

10. Apparatus as claimed in any of the preceding claims, wherein the first agitating means and the second agitating means are rotatable about a common axis.

11. Apparatus as claimed in any of the preceding claims, wherein the first agitating means and the second agitating means are mounted on a rotatable body.

12. Apparatus as claimed in claim 11, wherein the second agitating means extends radially outwardly from the body beyond the first surface agitating means.

13. Apparatus as claimed in claim 12, wherein each of the first agitating means and the second agitating means is arranged in at least one helical formation along the body.

14. Apparatus as claimed in any of claims 11 to 13, wherein the second agitating means is arranged in a plurality of rows along the body.

15. Apparatus as claimed in any of the preceding claims, wherein the first agitating means comprises one of a plurality of bristles, a plurality of filaments, and at least one strip of material.

16. Apparatus as claimed in any of the preceding claims, wherein the second agitating means comprises one of a plurality of bristles, a plurality of filaments, and at least one strip of material.

17. Apparatus as claimed in any of the preceding claims, wherein the second agitating means comprises one of carbon fibres and conductive acrylic fibres.

18. Apparatus as claimed in any of the preceding claims, wherein the first agitating means has a higher stiffness than the second agitating means.

19. Apparatus as claimed in any of the preceding claims, in the form of a rotatable brush bar.

20. A cleaner head for a surface treating appliance comprising apparatus as claimed in any of the preceding claims.

21. A cleaner head as claimed in claim 20, comprising a plurality of support members for supporting the cleaner head on a surface to be cleaned.

22. A cleaner head as claimed in claim 21, wherein the first agitating means does not protrude beneath a plane extending between the lowermost extremities of the support members.

23. A surface treating appliance comprising a cleaner head as claimed in any of claims 20 to 22 or agitating apparatus as claimed in any of claims 1 to 19.

24. Agitating apparatus for a surface treating appliance substantially as hereinbefore described with reference to the accompanying drawings.

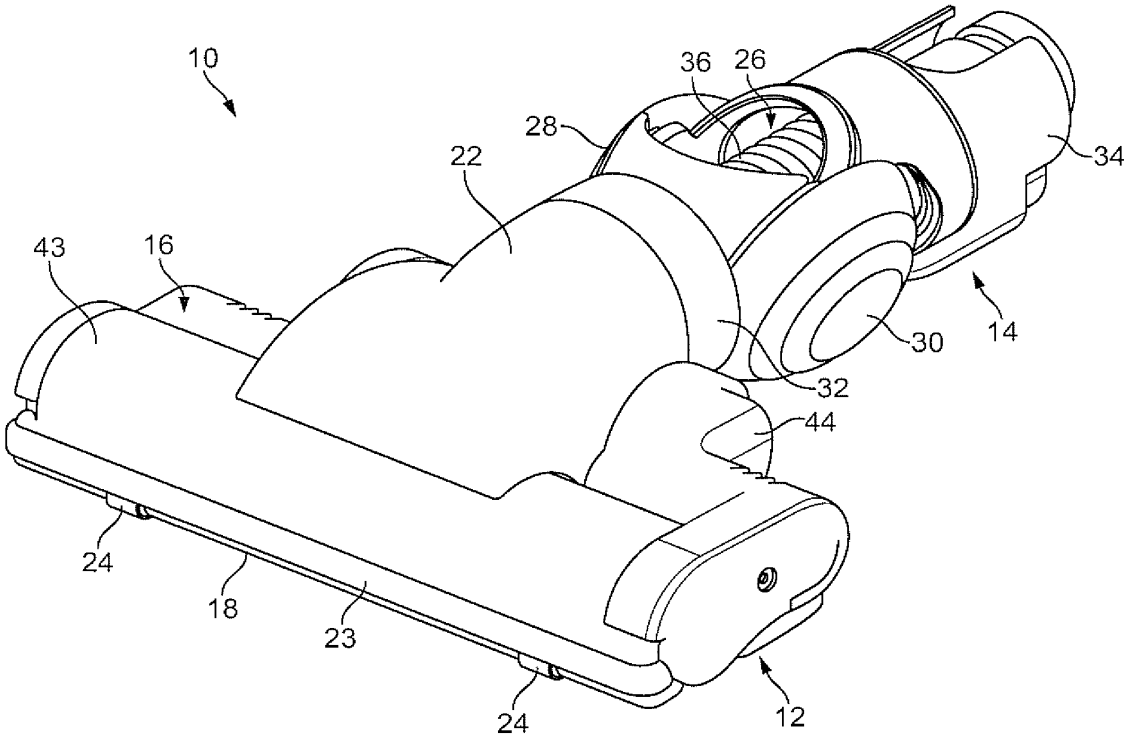


FIG. 1

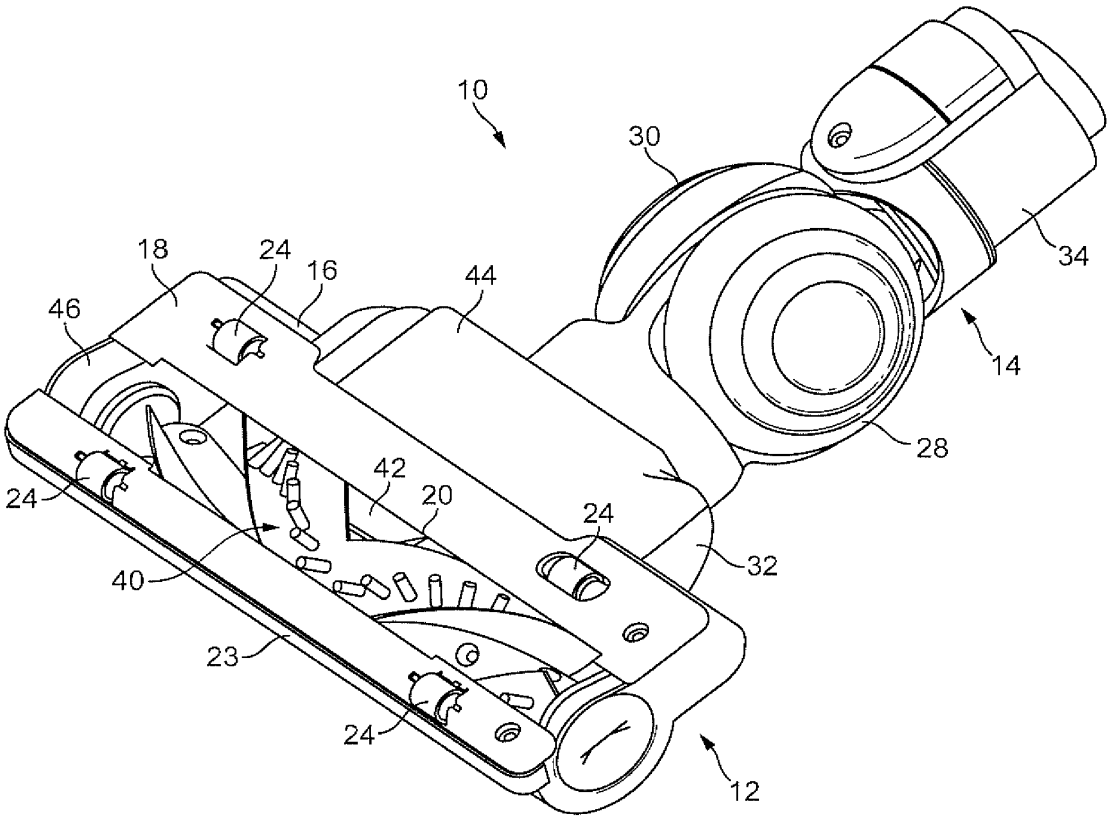


FIG. 2

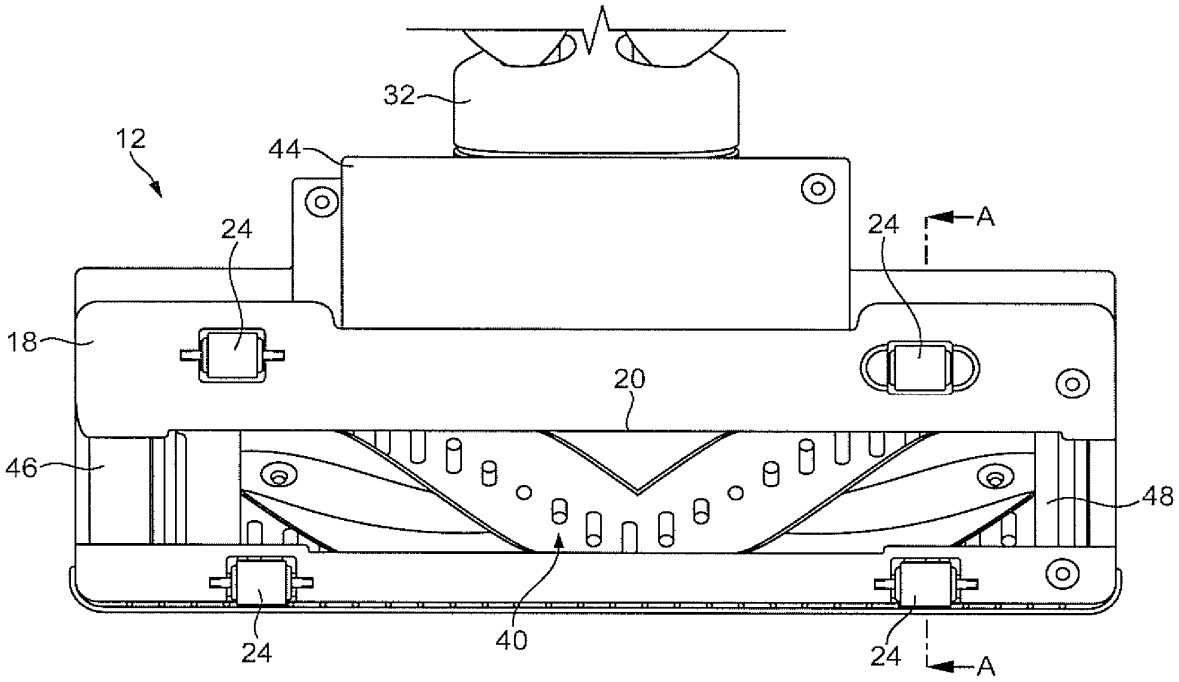


FIG. 3

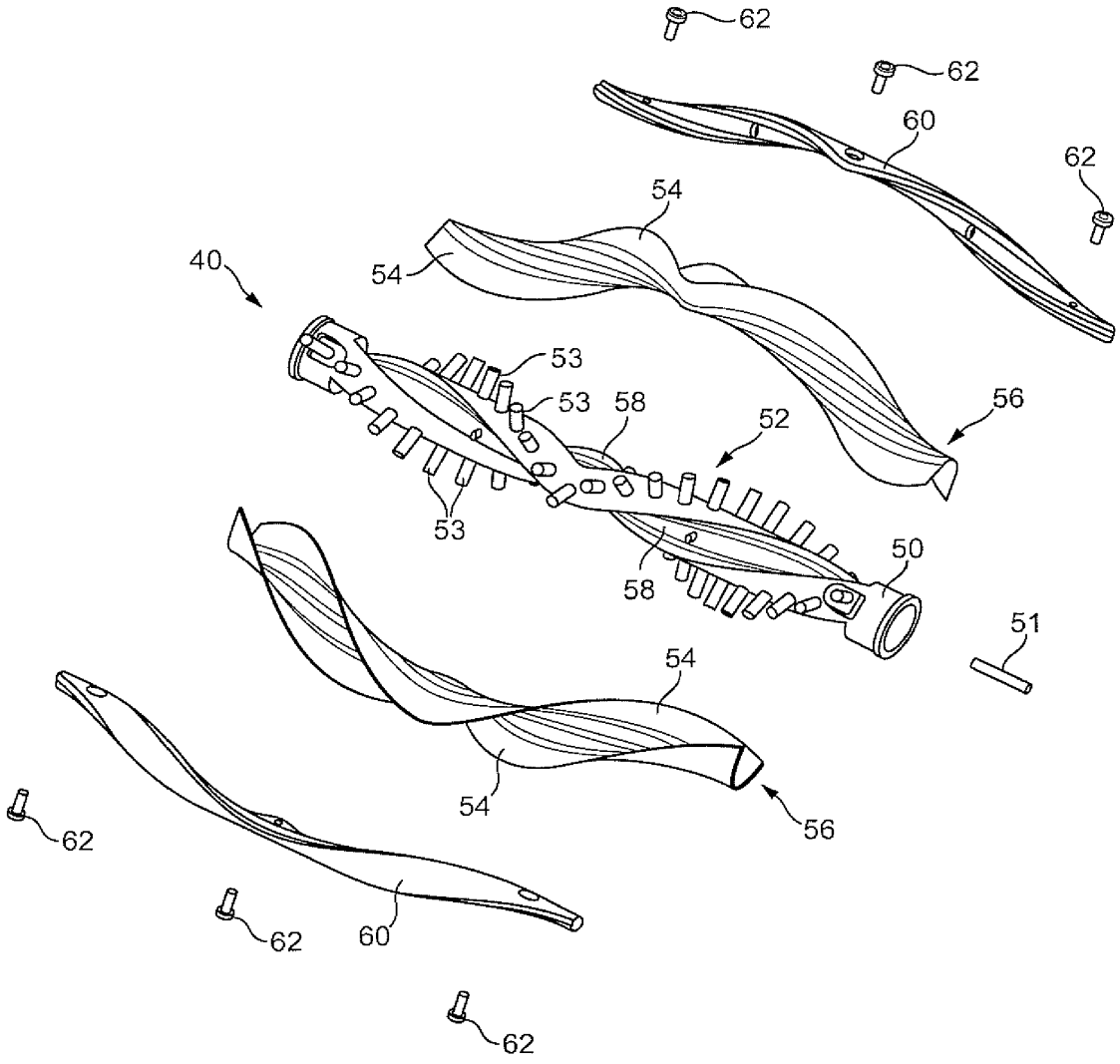


FIG. 4

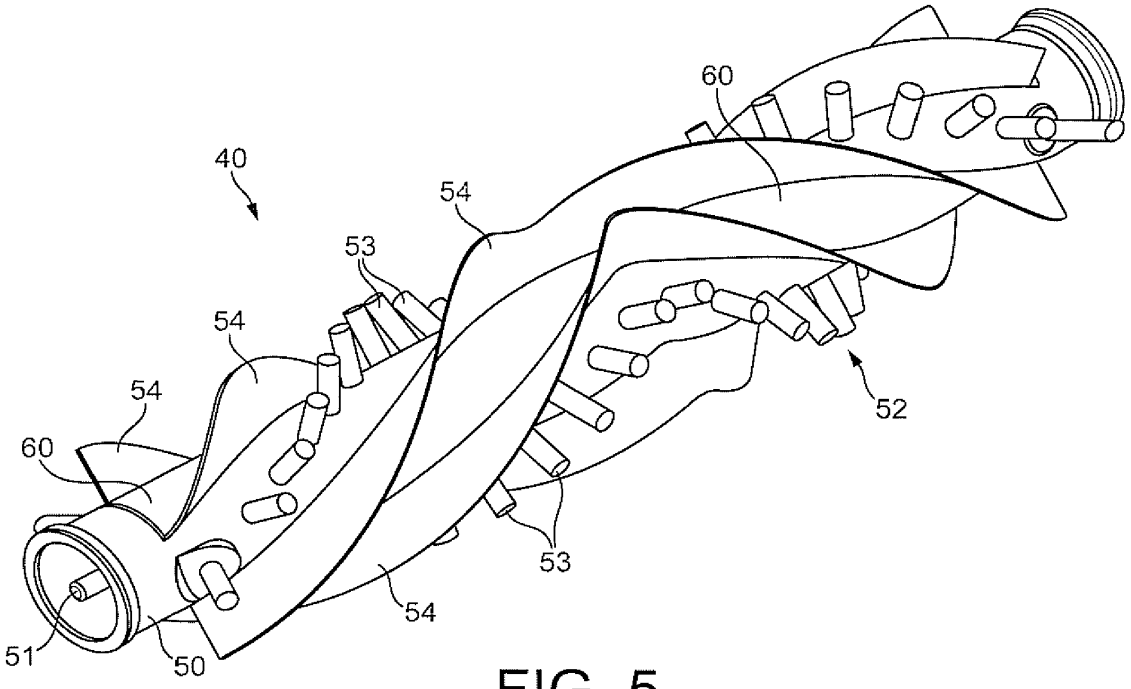


FIG. 5

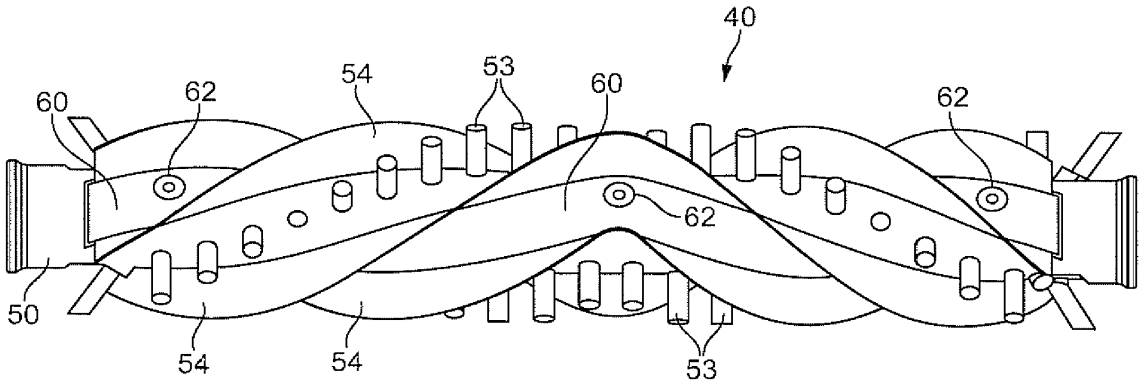


FIG. 6

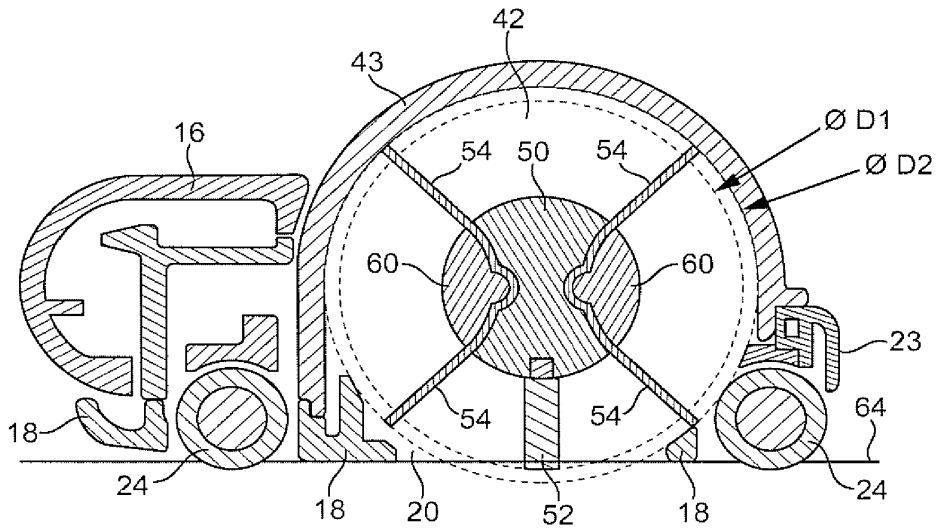

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FIG. 7

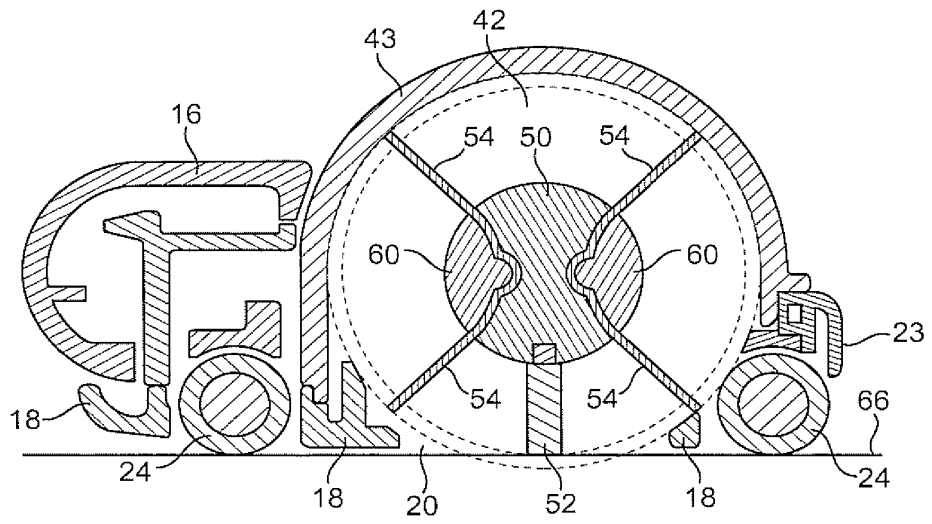
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FIG. 8

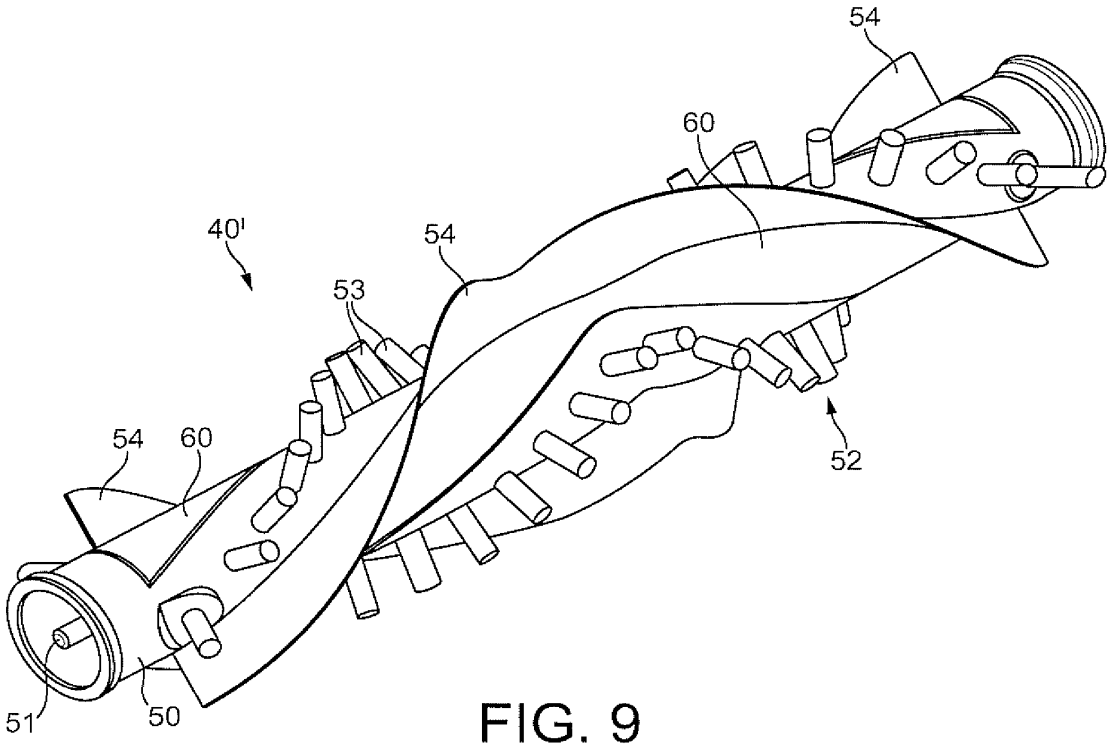

FIG. 9

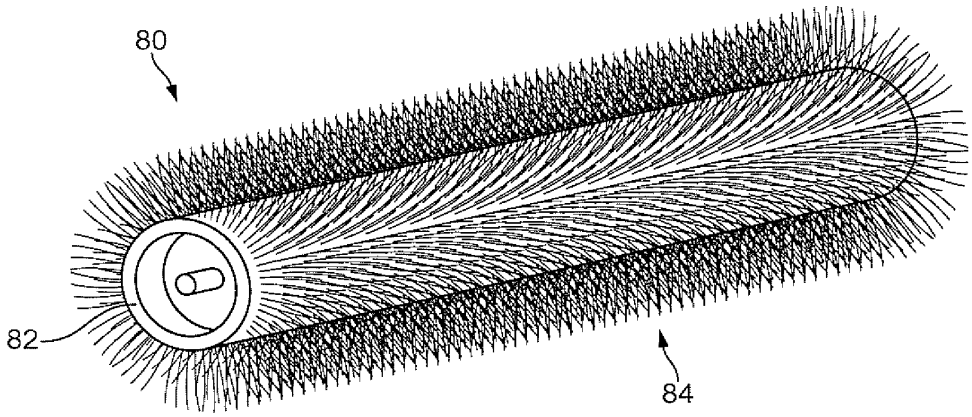

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050851

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/04 A46B9/06
ADD.

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)
A47L A46B A46D

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004 267452 A (SHARP KK) 30 September 2004 (2004-09-30) * abstract; figures 4,5	1-23
A	US 4 186 030 A (ARMSTRONG JOHN L [US]) 29 January 1980 (1980-01-29) column 2, line 31 - column 4, line 19; figures 1,2	1-23
A	WO 2006/098965 A1 (TENNANT CO [US]; FIELD BRUCE F [US]) 21 September 2006 (2006-09-21) the whole document	1-23
A	US 5 150 499 A (BERFIELD ROBERT C [US]) 29 September 1992 (1992-09-29) figure 1	1-23

-/--

[X] Further documents are listed in the continuation of Box C.

[X] 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

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 August 2010	06/09/2010

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, Fax: (+31-70) 340-3016	Blumenberg, Claus

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2010/050851

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 135 869 A (HUKUBA KOGYO KK) 12 September 1984 (1984-09-12) * abstract; figures 1,7	1-23

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2010/050851

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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GB 2135869 A	12-09-1984	DE 3344629 A1	14-06-1984

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WO 2010/102396 A1

(54) **Title**: SURFACE CLEANING APPARATUS

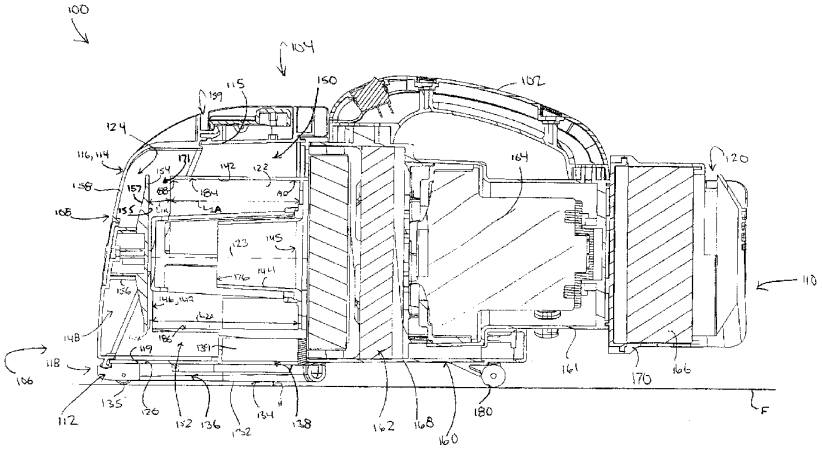

Fig. 6

(57) **Abstract**: A surface cleaning apparatus comprises a cyclone having an open end dirt outlet and a plate facing the open end, the height of a gap between the plate the open end is not constant.

TITLE: SURFACE CLEANING APPARATUS

FIELD

The specification relates to surface cleaning apparatuses. More specifically, the specification relates to cyclonic surface cleaning apparatuses.

INTRODUCTION

The following is not an admission that anything discussed below is prior art or part of the common general knowledge of persons skilled in the art.

Cyclonic vacuum cleaners utilize one or more cyclones that have an associated dirt collection chamber. The dirt collection chamber may be formed in the bottom of a cyclone chamber. A disc or divider may be positioned in the cyclone casing to divide the cyclone casing into an upper cyclone chamber and a lower dirt collection chamber. In it also known to position a dirt collection chamber exterior to a cyclone casing, such as surrounding the cyclone chamber.

SUMMARY

The following introduction is provided to introduce the reader to the more detailed discussion to follow. The introduction is not intended to limit or define the claims.

According to one broad aspect, a surface cleaning apparatus is provided that utilizes a cyclone having an open end, wherein the open end comprises the dirt outlet of the cyclone. A plate, that preferably has a planar surface facing the open end, is positioned facing the open end. For example, the plate may line in a plane that is perpendicular to the longitudinal axis extending through a cyclone chamber and may be spaced from the open end. Accordingly, a gap is provided between the plate and the open and defines a dirt outlet of the cyclone. In accordance with this aspect, the gap has a non uniform length.

For example, the cyclone casing may have a variable length. The portion that have a shorter length define a gap having a increased height. Alternately, or in addition, the plate may be provided with a sidewall on the side of the plate facing the open end of the cyclone. The sidewall may extend part way around the plate. The height of the wall maybe constant or may be variable.

The sidewall is preferably provided on the periphery of the plate. The diameter of the plate is preferably about the same as the diameter of the open end of the cyclone.

In some embodiments, the sidewall of the plate has a constant length. In other embodiments, the sidewall of the plate has a variable length.

In some embodiments, the sidewall of the cyclone has a first end at the open end, the first end has a perimeter, and the gap has a first portion having a first length and a second portion having a second length greater than the first length. The first length and the second length may be constant. Alternately, the first length and the second length may be variable.

In some embodiments, one of the portions extends up to 210° of the perimeter. For example, the second portion may extend up to 210° of the perimeter. In other embodiments, the second portion extends up to 240° of the perimeter.

According to another broad aspect, a surface cleaning apparatus is provided. The surface cleaning apparatus comprises an air flow passage extending from a dirty air inlet to a clean air outlet. A suction motor is positioned in the air flow passage. A cyclone is positioned in the air flow passage. The cyclone comprises an air inlet, an air outlet, an open end, a longitudinal axis and a longitudinally extending sidewall. The side wall has a variable length. A dirt collection chamber is in flow communication with the open end.

In some embodiments, a first portion of the sidewall is longer than a second portion of the sidewall.

In some embodiments, the sidewall has a first end at the open end, the first end has a perimeter, and the first portion comprises up to 240°of the perimeter and the second portion comprises from up to 120° of the perimeter.

In some embodiments, the surface cleaning apparatus further comprises a plate facing the open end. The plate may be spaced from a front end wall of the surface cleaning apparatus. A first portion of the dirt collection chamber may be provided between the plate and the front end wall. Preferably, a second portion of the dirt collection chamber surrounds at least a portion of the cyclone.

According to another broad aspect, another surface cleaning apparatus is provided. The surface cleaning apparatus comprises an air flow passage extending from a dirty air inlet to a clean air outlet. A suction motor is positioned in the air flow passage. A cyclone is positioned in the air flow passage. The cyclone comprises an air inlet, an air outlet, an open end, a longitudinal axis and a longitudinally extending sidewall. A plate is provided having a cyclone side facing the open end. The plate is positioned to define a gap between the plate and the open end of the cyclone. The plate has a plate sidewall extending towards the open end. A dirt collection chamber is in flow communication with the open end.

In some embodiments, the plate sidewall extends part way around the plate. In some embodiments, the sidewall of the plate has a constant length. In other embodiments, the sidewall of the plate has a variable height.

Any of the surface cleaning apparatuses described herein may comprise a portable vacuum cleaner, and preferably, a hand vacuum cleaner. The portable vacuum cleaner may be removably mountable to an upright vacuum cleaner.

It will be appreciated that an embodiment may contain one or more of features set out in the examples.

DRAWINGS

In the detailed description, reference will be made to the following drawings, in which:

Figure 1 is a side plan view of an example of a hand vacuum cleaner;

Figure 2 is a top plan view of the hand vacuum cleaner of Figure 1;

Figure 3 is a front plan view of the hand vacuum cleaner of Figure 1;

Figure 4 is a partially exploded rear perspective view of the hand vacuum cleaner of Figure 1;

Figure 5 is a partially exploded front perspective view of the hand vacuum cleaner of Figure 1;

Figure 6 is a cross section taken along line 6-6 in Figure 2;

Figure 7 is a bottom perspective view of the hand vacuum cleaner of Figure 1;

Figure 8 is a perspective illustration of the surface cleaning apparatus of Figure 1 mounted to an upright vacuum cleaner;

Figure 9 is a partially exploded front perspective view of an alternate embodiment of a hand vacuum cleaner; and,

Figure 10 is a cross section taken along line 10-10 in Figure 9.

DESCRIPTION OF VARIOUS EXAMPLES

Various apparatuses or methods will be described below to provide an example of each claimed invention. No example described below limits any claimed invention and any claimed invention may cover processes or apparatuses that are not described below. The claimed inventions are not limited to apparatuses or processes having all of the features of any one apparatus or

process described below or to features common to multiple or all of the apparatuses described below. It is possible that an apparatus or process described below is not an embodiment of any claimed invention.

Referring to Figures 1 to 7, a first example of a surface cleaning apparatus 100 is shown. Preferably, the surface cleaning apparatus 100 (also referred to herein as cleaner 100 or vacuum cleaner 100) is a portable vacuum cleaner 100, such as a hand vacuum cleaner 100 as shown. The hand vacuum cleaner 100 is movable along a surface to be cleaned by gripping and maneuvering handle 102. In alternate embodiments, the surface cleaning apparatus 100 may be another type of surface cleaning apparatus, such as a stick-vac, an upright vacuum cleaner, or a canister vacuum cleaner.

The exemplified embodiments are hand vacuum cleaners. The design for a cyclone and facing plate having a gap therebetween of non-uniform height may be used in any cyclonic cleaning apparatus. If the feature is used with a portable surface cleaning apparatus such as a hand vacuum cleaner, then the portable surface cleaning apparatus may be of any design. For example, as exemplified, the vacuum cleaner includes an upper portion 104, a lower portion 106, a front 108, and a rear 110. In the example shown, handle 102 is provided at the upper portion 104. In alternate examples, handle 102 may be provided elsewhere on the vacuum cleaner 100, for example at the rear 110 and may be of any design. The vacuum cleaner 100 may be of various configurations (e.g., different positioning and orientation of the cyclone unit and the suction motor and differing cyclone units that may comprise one or more cyclones and one or more filters) and may use any type of nozzle or position of the nozzle.

In the example shown, the vacuum cleaner 100 comprises a nozzle 112, which may be of any design, and a cyclone unit 114, which together form a surface cleaning head 116 of the vacuum cleaner 100. As exemplified, the surface cleaning head 116 is preferably provided at the front 108 of the vacuum cleaner 100.

Nozzle 112 engages a surface to be cleaned, and comprises a dirty air inlet 118, through which dirty air is drawn into the vacuum cleaner 100. An airflow passage extends from the dirty air inlet 118 to a clean air outlet 120 of the cleaner 100. In the example shown, clean air outlet 120 is at the rear 110 of the cleaner 100.

Cyclone unit 114 is provided in the airflow passage, downstream of the dirty air inlet 118. In the example shown, the cyclone unit 114 comprises one cyclone 122 positioned in the airflow passage, and one dirt chamber 124. In alternate examples, the cyclone unit 110 may include more than one cyclonic stage, wherein each cyclonic stage comprising one or more cyclones and one or more dirt chambers. Accordingly, the cyclones may be arranged in parallel and/or in sequence.

In the example shown, the nozzle 112 is positioned at the lower portion 106 of the vacuum cleaner 100. Preferably, as exemplified, nozzle 112 is positioned at the bottom of the vacuum cleaner 100, and, preferably, beneath the cyclone unit 114. Accordingly, as exemplified, nozzle 112 may be on lower surface 117 of cyclone unit 114. In a particularly preferred design, the upper wall of the nozzle may be a lower wall of the cyclone unit 114. As shown in figure 6, dirt chamber 124 surrounds the lower portion of cyclone 122. Accordingly, the upper wall of nozzle 112 may be part of the lower wall of the dirt chamber. It will be appreciated that if dirt chamber 124 does not extend around the lower portion of cyclone 122, then the upper wall of nozzle 112 may be part of a lower wall of cyclone 122.

Preferably, in the example shown, the nozzle 112 is fixedly positioned at the lower portion 106 of the vacuum cleaner 100. That is, the nozzle 112 is not movable (e.g., rotatable) with respect to the remainder of the vacuum cleaner 100, and is fixed at the lower portion 106 of the vacuum cleaner 100.

As shown in Figures 3 and 5, nozzle 112 has a width WN, and cyclone unit 114 has a width WC. In the example shown, WN, and WC are about the same. An advantage of this design is that the nozzle may have a cleaning path that is essentially as wide as the hand vacuum itself.

Preferably, nozzle 112 comprises an airflow chamber wherein at least a portion, and preferably a majority, of the lower surface of the chamber is open. In an alternate design , the nozzle may comprise a lower wall, which closes the lower end. Accordingly, nozzle 112 may be of various design and may be an open sided passage or a closed passage.

Nozzle 112 may also share a common wall with another component of cyclone unit 114. As exemplified in Figure 7, nozzle 112 comprises an upper nozzle wall 126, which defines a closed upper end of the airflow chamber 136. In the example shown, the upper nozzle wall 126 comprises a lower portion 119 of a wall 115 of the cyclone unit.

Preferably, one or more depending walls 128 extend downwardly from the upper nozzle wall 126. The depending wall is preferably generally U-shaped. In one embodiment, depending wall is provided rearward of opening 138. In other embodiments, depending walls may alternately or in addition be provided on the lateral sides of opening 138. It is preferred that depending walls are provided on each lateral side of opening 138 and rearward thereof. Further, depending walls 128 may extend a substantial distance to the front end 108 and, preferably, essentially all the way to front end 108. The depending walls may be continuous to define a single wall as shown, or may be discontinuous. The depending walls are preferably rigid (e.g., integrally molded with cyclone unit 114). However, they may be flexible (e.g., bristles or rubber) or moveably mounted to cyclone unit 114 (e.g., hingedly mounted).

Preferably, the lower end 132 of depending wall 128 is spaced above the surface being cleaned when the hand vacuum cleaner is placed on a

surface to be cleaned. As exemplified in Figure 6, when vacuum cleaner 100 is placed on floor F, lower end 132 of depending wall 128 is spaced a distance H above the floor. Preferably distance H is from 0.01 to 0.175 inches, more preferably from 0.04 to 0.08 inches.

The height of the depending wall (between upper nozzle wall 126 and lower end 132) may vary. In some examples, the depending wall may have a height of between about 0.05 and about 0.875 inches, preferably between about 0.125 and about 0.6 inches and more preferably between about 0.2 and about 0.4 inches. The height of depending wall may vary but is preferably constant.

As exemplified, the open end of the U-shape defines an open side 130 of the nozzle 112, and forms the dirty air inlet 118 of the cleaner 100. In the example shown, the open side 130 is provided at the front of the nozzle 112. In use, when optional wheels 135 are in contact with a surface, the open side 130 sits above and is adjacent a surface to be cleaned (e.g. floor F). Preferably, lower end 132 of depending walls 128 is spaced above floor F. Accordingly, some air may enter nozzle 112 by passing underneath depending wall 132. In such a case, the primary air entry to nozzle 112 is via open side 130 so that dirty air inlet 118 is the primary air inlet, with a secondary air inlet being under depending wall 128. In the example shown, the lower end 132 of the depending wall 128 defines an open lower end 134 of the nozzle 112. The open lower end 134 preferably extends to the front 108 of the cleaner 108, and merges with the open side 130.

In use, the exemplified nozzle has an open lower end 134 that faces a surface to be cleaned. In the example shown, a plurality of wheels 135 are mounted to the depending wall 128, and extend lower than the lower end 132 of the depending wall 128. Accordingly, in use, when wheels 135 are in contact with a surface, the lower end 132 of the depending wall 128 is spaced from a surface to be cleaned, and the space between the lower end of the depending wall 128 and the surface to be cleaned form a secondary dirty air inlet to the

vacuum cleaner 100. It will be appreciated that wheels 135 are optional. Preferably, wheels 135 are positioned exterior to the airflow path through nozzle 112, e.g., laterally outwardly from depending wall 128. Preferably a pair of front wheels 135 is provided. Preferably, the wheels are located adjacent front 108. Optionally, one or more rear wheels 108 may be provided. In an alternate embodiment, no wheels may be provided.

The upper nozzle wall 126, depending wall 128, and open lower end 134 of the nozzle 112 define an open sided airflow chamber 136 of the nozzle. In use, when wheels 135 are in contact with a horizontal surface, the nozzle 112 and the airflow chamber 136 extend generally horizontally, and preferably linearly along a nozzle axis 113 (see Figure 7).

An opening 138 is provided in the upper nozzle wall 126, and is in communication with the airflow chamber 136. Opening 138 may be of any size and configuration and at various locations in upper nozzle wall 126. In use, when wheels 135 are in contact with a surface, the opening 138 faces a surface to be cleaned, air enters the dirty air inlet 118, passes horizontally through the airflow chamber 136, and passes into the opening 138. Opening 138 is in communication with a cyclone inlet passage 139, which is in communication with an air inlet 140 of cyclone 122.

Referring to Figures 5 and 6, cyclone 122 comprises a longitudinally extending sidewall 142. In the example shown, the longitudinally extending sidewall 142 is substantially cylindrical. The cyclone chamber is located inside chamber wall 142. The cyclone 122 extends along a longitudinal axis 123. Preferably, as shown, axis 123 is parallel to the nozzle axis, and extends generally horizontally when cleaner 100 is in use and wheels 135 are seated on a surface.

Cyclone 122 further comprises an air inlet 140, and an air outlet 145. The cyclone air inlet and cyclone air outlet may be of any configuration

known in the art. The cyclone 122 further comprises an open end 147. The open end 147 comprises a dirt outlet 146 of the cyclone 122.

As exemplified, the cyclone air inlet 140 is defined by an aperture in the chamber wall 142. As can be seen in Figure 5, the inlet passage 139 is at configured such that air enters the cyclone 122 in a tangential flow path, e.g., passage 139 may be arcuate. The air travels in a cyclonic path in the cyclone, and dirt in the air is separated from the air. The air exits the cyclone via an outlet passage 144, which is in communication with outlet 145. The dirt that is separated from the air exits the cyclone via dirt outlet 146 defined by open end 147, and enters dirt chamber 124.

As exemplified in Figure 6, a shroud 174 may be provided adjacent outlet passage 144, spaced from and facing the inlet 176 to outlet passage 144. Shroud 174 may be mounted to cyclone 122 via legs 178. In the example shown, shroud 174, and legs 178 form an assembly 182 that is removably mounted in cyclone 122. In some examples, a screen may be mounted around legs 178. Shroud 174 may be of any design.

As noted hereinabove, the open end 147 of the cyclone 122 is in communication with a dirt chamber 124. In the example shown, dirt chamber 124 comprises two portions. A first portion 148 is provided forwardly of the dirt outlet 146. A second portion 150 is concentric with the cyclone 122, and surrounds at least a portion of the cyclone 122. A lower portion 152 of the second portion 150 is below the cyclone. As exemplified, nozzle 112 is positioned below first portion 148, and lower portion 152.

Preferably, the surface cleaning apparatus comprises a plate 154 facing the open end 147 of the cyclone. Preferably, the plate 154 has a cyclone side 155 facing the open end 147, and a dirt bin side 157 facing front wall 158. The cyclone side 155 is preferably planar. For example, as exemplified, cyclone side may be oriented to be perpendicular to the cyclone axis 123. Preferably,

plate 123 is spaced for the open end of the cyclone. Preferably, the diameter of plate 154 and the diameter of the open end are about the same. The plate may be slightly smaller and/or slightly larger (e.g., +/- 10%).

As shown, plate 154 may be provided in the dirt chamber 124, and is spaced from a front wall 158 at the front 108 of the cleaner. Accordingly, the first portion 148 of dirt chamber 124 is provided between dirt bin side 157 of plate 154 and a front end wall 158 of the surface cleaning apparatus.

Preferably, the plate is positioned to define a gap 171 between the plate 154 and the open end 147 of the cyclone 122. More preferably, the gap has a variable length in the direction of the longitudinal axis 123 of the cyclone 122.

For example, as shown in Figures 5 and 6, the sidewall 142 of cyclone 122 has a variable length. That is, as shown, a first portion 184 of the sidewall 142 is longer than a second portion 186 of the sidewall. Accordingly, in this embodiment, the variable length of the sidewall of the cyclone provides the variable length of the gap.

In the embodiment shown, first portion 184 of the sidewall 142 has a first length L1A, and second portion 186 of the sidewall 142 has a second length L2A. Accordingly, the gap has a first length L1B adjacent the first portion 184 of the sidewall, and a second length L2B adjacent the second portion 186 of the sidewall. In the embodiment shown, the second length L2A is greater than the first length L1A. Accordingly, the first length L1B of the gap 171 is greater than the second length L2B of the gap 171.

Preferably, the first length L1A of the first portion 184 and the first length L2A of the second portion are constant. More preferably, the first length L1B of the gap 171 and the second length L2B of the gap 171 are constant. In alternate embodiments, however, one or both of the first length L1B of the gap 171 and the second length L2B of the gap 171 may be variable.

In the exemplified embodiment, sidewall 142 has a first end 188 at open end 147, and a second end 190 opposed to the first end. The first end has a perimeter. Preferably, in embodiments wherein the first length L1A and the second length L2A are constant, one of first portion 184 and second portion 186 extends up to 210o of the perimeter. For example, the first portion 184 may extend up to 210o of the perimeter. For example, as shown, first portion 184 extends for about 180o of the perimeter (indicated by arrow P1) and the second portion 186 extends for about 180o of the perimeter (indicated by arrow P2).

In alternate embodiments, wherein the first length L1A and/or the second length L2B are variable, one of first portion 184 and second portion 186 preferably extends up to 240o of the perimeter. For example, the first portion may comprise 240o of the perimeter, and the second portion may comprise 120o of the perimeter. In such an embodiment, the face of the wall facing the open end of the cyclone may extend upwardly at an angle.

It will be appreciated that in alternate embodiments, a cyclone 122 having a variable length may be useful, even if a plate 154 is not provided.

Alternately or in addition, as exemplified in Figures 9 and 10, the plate 154 may have a plate sidewall 153 extending towards the open end 147. Preferably, the plate sidewall 153 is at the periphery of the plate. In the embodiment shown, the plate sidewall 153 extends part way around the plate 154. Accordingly, in this embodiment, the space between the plate sidewall and the open end of the cyclone defines the variable length of the gap, and gap 171 has a first length L1B between the plate 154 and the end 188 of cyclone 122, and a second length L2B between the sidewall 153 and the end 188 of cyclone 122 that is less than the first length L1B

In some embodiments, as shown, the sidewall 153 of the plate 154 has a constant length.

In a alternate embodiments, the plate sidewall 154 may extend all the way around the plate 154, and may have a variable length.

Plate 154 may be mounted by any means to any component in cyclone unit 114. As exemplified, the separation plate is mounted on an arm 156, which extends from a front wall 158 at the front 108 of the cleaner 100.

Cyclone unit 114 may be emptied by any means known in the art. For example, one of the ends of the cyclone unit 114 may be openable. As exemplified in Figures 4 and 5, front wall 158 is pivotably mounted to the cyclone unit wall 115, such that cyclone unit 114 may be opened, and dirt chamber 124 may be emptied. When front wall 158 is pivoted away from the remainder of the cyclone unit 114, separation plate 154 and arm 156 also pivot away from the remainder of the cyclone unit. A latch 159 is provided, which secures front wall 158 to wall 115. In alternate examples, front wall 158 may be removable from cyclone unit wall 115 or the opposed end of the cyclone unit 114 may be openable.

The clean air exiting cyclone 122 passes through outlet passage 144, exits surface cleaning head 116, and passes into the cleaner body 160. The air exiting the cyclone may be subjected to one or more treatment stages (e.g., cyclonic and/or filtration). In the example shown, a cleaner body 160 is positioned rearward of the surface cleaning head 116. The cleaner body comprises a housing 161, which preferably houses an optional pre-motor filter assembly 162, a suction motor 164, and an optional post-motor filter 166.

In the exemplified embodiments, the vacuum cleaner has a linear configuration. Accordingly, pre-motor filter assembly 162 is preferably provided in the airflow path adjacent and downstream of the outlet passage 144. Pre-motor filter assembly 162 serves to remove remaining particulate matter from air exiting the cyclone 122, and may be any type of filter, such as a foam filter. One or more filters may be used, as shown. If the vacuum cleaner is of a non-linear

configuration, then pre-motor filter assembly 162 need not be located adjacent outlet passage 144.

Suction motor 164 is provided in the airflow path preferably adjacent and downstream of the pre-motor filter 162. The suction motor draws air into the dirty air inlet 118 of the cleaner 100, through the airflow path past the suction motor 164, and out of the clean air outlet 120. The suction motor 164 has a motor axis 165. In the example shown, the motor axis 165 and the cyclone axis 122 extend in the same direction and are generally parallel. The suction motor 164 may be any type of suction motor. If the vacuum cleaner is of a non-linear configuration, then motor 164 need not be located adjacent pre-motor filter 162.

Post motor filter 166 is provided in the airflow path downstream of, and preferably adjacent, the suction motor 164. Post motor filter serves to remove remaining particulate mater from air exiting the cleaner 100. Post-motor filter 166 may be any type of filter, such as a HEPA filter.

Clean air outlet 120 is provided downstream of post-motor filter 166. Clean air outlet 120 comprises a plurality of apertures preferably formed in housing 161.

Preferably, as in the example shown, cleaner body 160 is removably mounted to surface cleaning head 116. For example, cleaner body 160 may be entirely removable from surface cleaning head 116, or pivotably mounted to surface cleaning head 116. Accordingly, cleaner body 160 and surface cleaning head 116 may be separated in order to provide access to the interior of cleaner body 160 or surface cleaning head 116. This may allow pre-motor filter assembly 162 to be cleaned, changed, or serviced, or motor 164 to be cleaned, changed or serviced. Alternately, or in addition, surface cleaning head 116 may be cleaned or serviced. For example, any dirt stuck in outlet passage 144 may be removed. Alternately, a replacement cleaner body 160 or

surface cleaning head 116 may be provided, and may be mounted to an existing surface cleaning head 116 or cleaner body 160, respectively. If no filter element is fixedly mounted to cleaning head 116, then cleaning head 116 may be removed and washed with water.

As can be seen in Figure 6, housing 161 preferably comprises a first portion 168 housing pre-motor filter assembly 162, and suction motor 164, and a second portion 170 housing post-motor filter 166. Second portion 170 is openable, such as by being removably mounted to first portion 168, such that post-motor filter 166 may be cleaned, changed, or serviced.

One or more additional rear wheels 180 may be mounted to housing 161, preferably at lower portion 106, and may be used in conjunction with wheels 135. Preferably, a single rear wheel 180 is provided. Preferably, rear wheel 180 is located on a centre line of the vacuum cleaner and rearward of the depending wall 128.

As mentioned hereinabove, surface cleaning apparatus 100 is a preferably a portable vacuum cleaner 100, as shown in Figures 1 to 7.

CLAIMS:

1. A surface cleaning apparatus comprising:
(a) an air flow passage extending from a dirty air inlet to a clean air outlet;
(b) a suction motor positioned in the air flow passage;
(c) a cyclone positioned in the air flow passage, the cyclone comprising an air inlet, an air outlet, an open end, a longitudinal axis and a longitudinally extending sidewall;
(d) a plate having a cyclone side facing the open end, the plate positioned to define a gap between the plate and the open end of the cyclone wherein the gap has a variable length in the direction of the longitudinal axis; and,
(e) a dirt collection chamber in flow communication with the open end.

2. The surface cleaning apparatus of claim 1 wherein the sidewall of the cyclone has a variable length.

3. The surface cleaning apparatus of any of claims 1-2 wherein the plate has a plate side wall extending towards the open end and the side wall extends part way around the plate.

4. The surface cleaning apparatus of claim 3 wherein the sidewall of the plate has a constant length.

5. The surface cleaning apparatus of claim 4 wherein the sidewall of the plate has a variable length.

6. The surface cleaning apparatus of any of claims 1-5 wherein the sidewall of the cyclone has a first end at the open end, the first end has a perimeter, the gap has a first portion having a first length and a second portion having a second

length greater than the first length, and the first length and the second length are constant.

7. The surface cleaning apparatus of claim 6 wherein one of the portions extends up to 210° of the perimeter.

8. The surface cleaning apparatus of claim 7 wherein the second portion extends up to 210° of the perimeter.

9. The surface cleaning apparatus of any of claims 1-5 wherein the sidewall of the cyclone has a first end at the open end, the first end has a perimeter, the gap has a first portion having a first length and a second portion having a second length, and the first length is variable.

10. The surface cleaning apparatus of claim 9 wherein the second portion extends up to 240° of the perimeter

11. A surface cleaning apparatus comprising:

(f) an air flow passage extending from a dirty air inlet to a clean air outlet;

(g) a suction motor positioned in the air flow passage;

(h) a cyclone positioned in the air flow passage, the cyclone comprising an air inlet, an air outlet, an open end, a longitudinal axis and a longitudinally extending sidewall, the side wall having a variable length; and,

(i) a dirt collection chamber in flow communication with the open end.

12. The surface cleaning apparatus of claim 11 wherein a first portion of the sidewall is longer than a second portion of the sidewall.

13. The surface cleaning apparatus of claim 12 wherein the sidewall has a first end at the open end, the first end has a perimeter and the first portion comprises up to 240 degrees of the perimeter and the second portion comprises from up to 120 degrees of the perimeter.

14. The surface cleaning apparatus of any of claims 11-13 further comprising a plate facing the open end.

15. The surface cleaning apparatus of claim 14 wherein the plate is spaced from a front end wall of the surface cleaning apparatus.

16. The surface cleaning apparatus of claim 15 wherein a first portion of the dirt collection chamber is provided between the plate and the front end wall.

17. The surface cleaning apparatus of any of claims 15-16 wherein a second portion of the dirt collection chamber surrounds at least a portion of the cyclone.

18. A surface cleaning apparatus comprising:

(j) an air flow passage extending from a dirty air inlet to a clean air outlet;

(k) a suction motor positioned in the air flow passage;

(l) a cyclone positioned in the air flow passage, the cyclone comprising an air inlet, an air outlet, an open end, a longitudinal axis and a longitudinally extending sidewall;

(m)a plate having a cyclone side facing the open end, the plate positioned to define a gap between the plate and the open end of the cyclone, the plate having a plate sidewall extending towards the open end; and,

(n) a dirt collection chamber in flow communication with the open end.

19. The surface cleaning apparatus of claim 18 wherein the plate sidewall extends part way around the plate.

20. The surface cleaning apparatus of any of claims 18-19 wherein the sidewall of the plate has a constant length.

21. The surface cleaning apparatus of any of claims 18-19 wherein the sidewall of the plate has a variable height.

22. The surface cleaning apparatus of any of claims 1-21 wherein the surface cleaning apparatus comprises a portable vacuum cleaner.

23. The surface cleaning apparatus of claim 22 wherein the portable vacuum cleaner is removably mountable to an upright vacuum cleaner.

24. The surface cleaning apparatus of any of claims 1-23 wherein the surface cleaning apparatus comprises a hand vacuum cleaner.

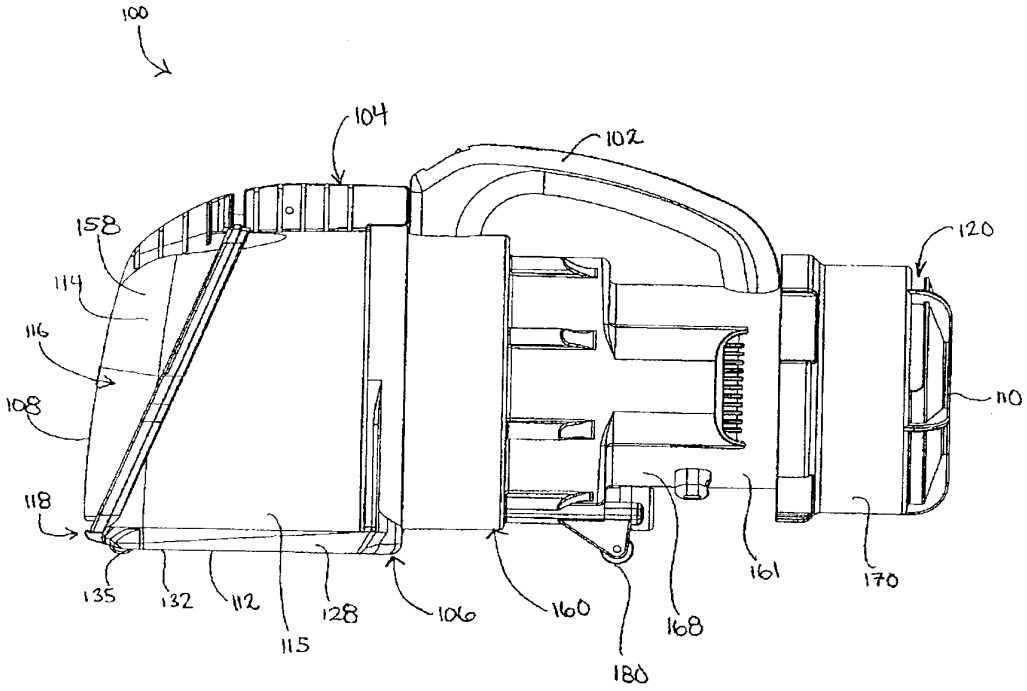
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FIG. 1

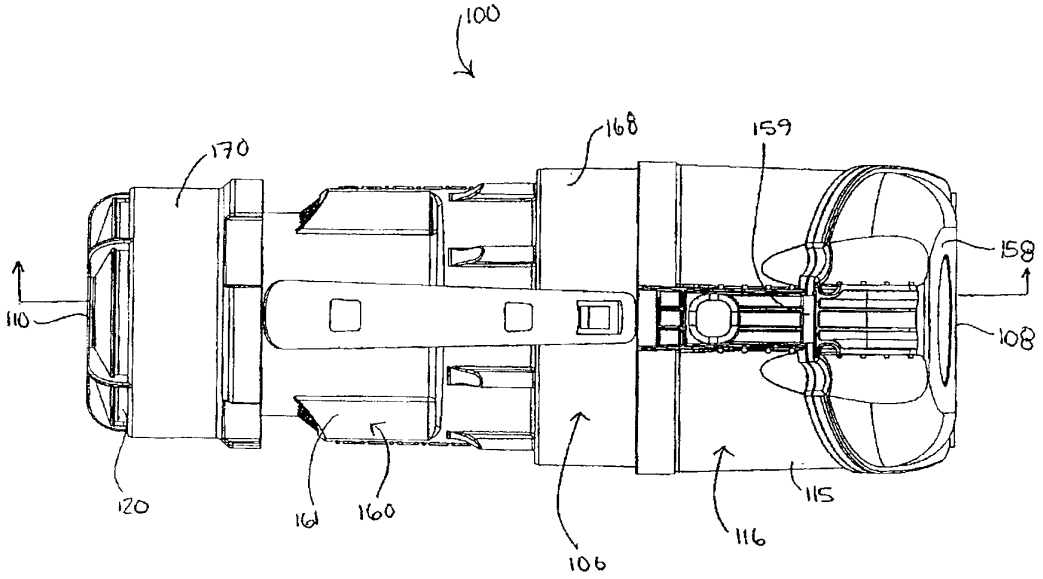

Fig. 2

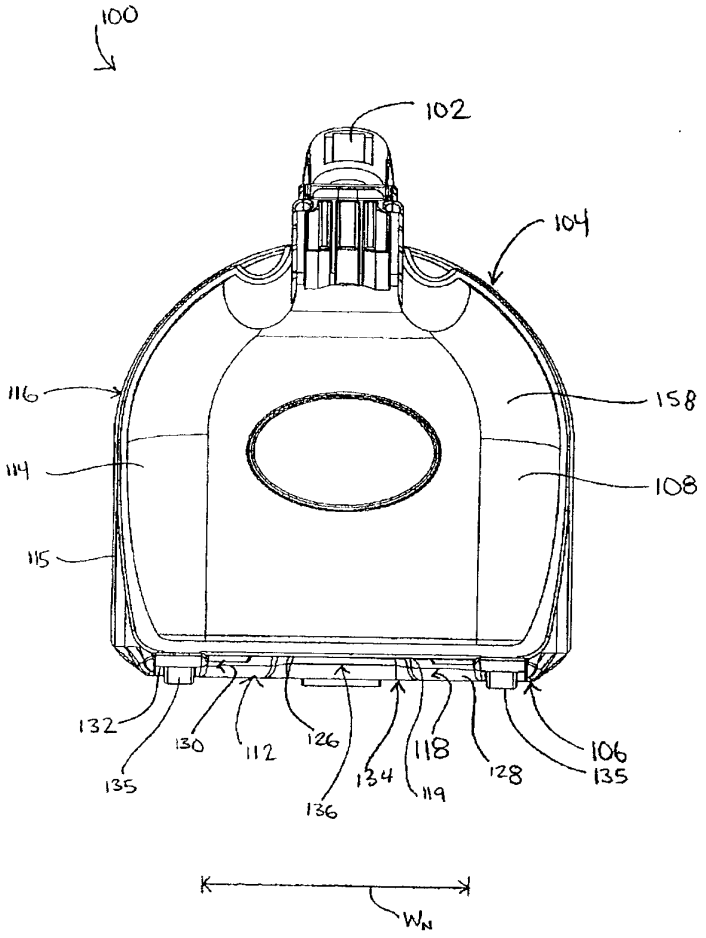
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Fig. 3

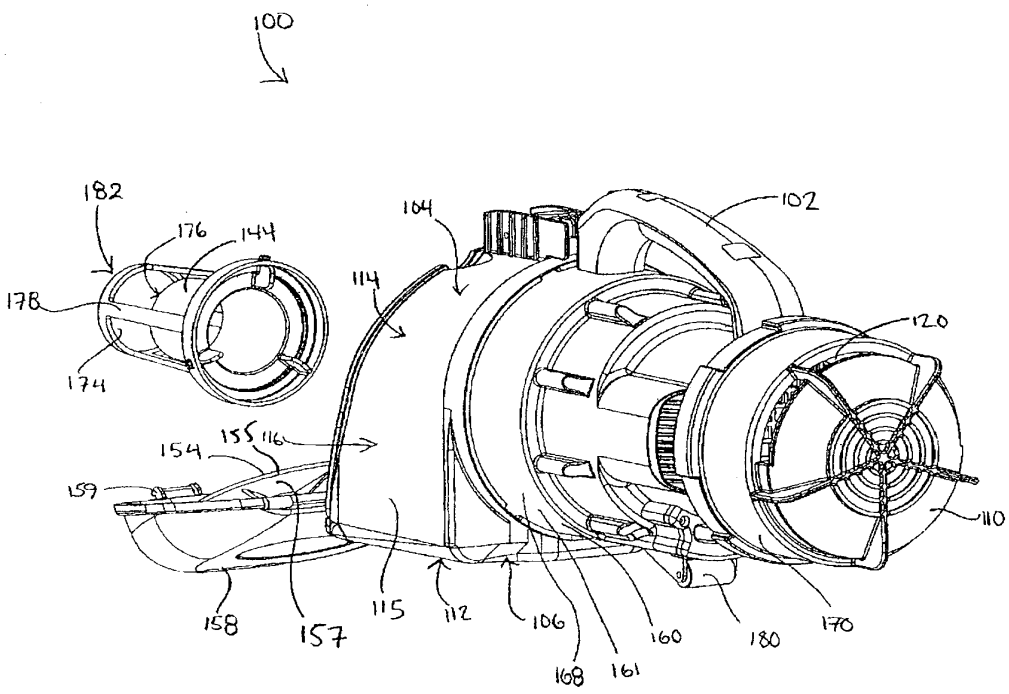
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FIG.4

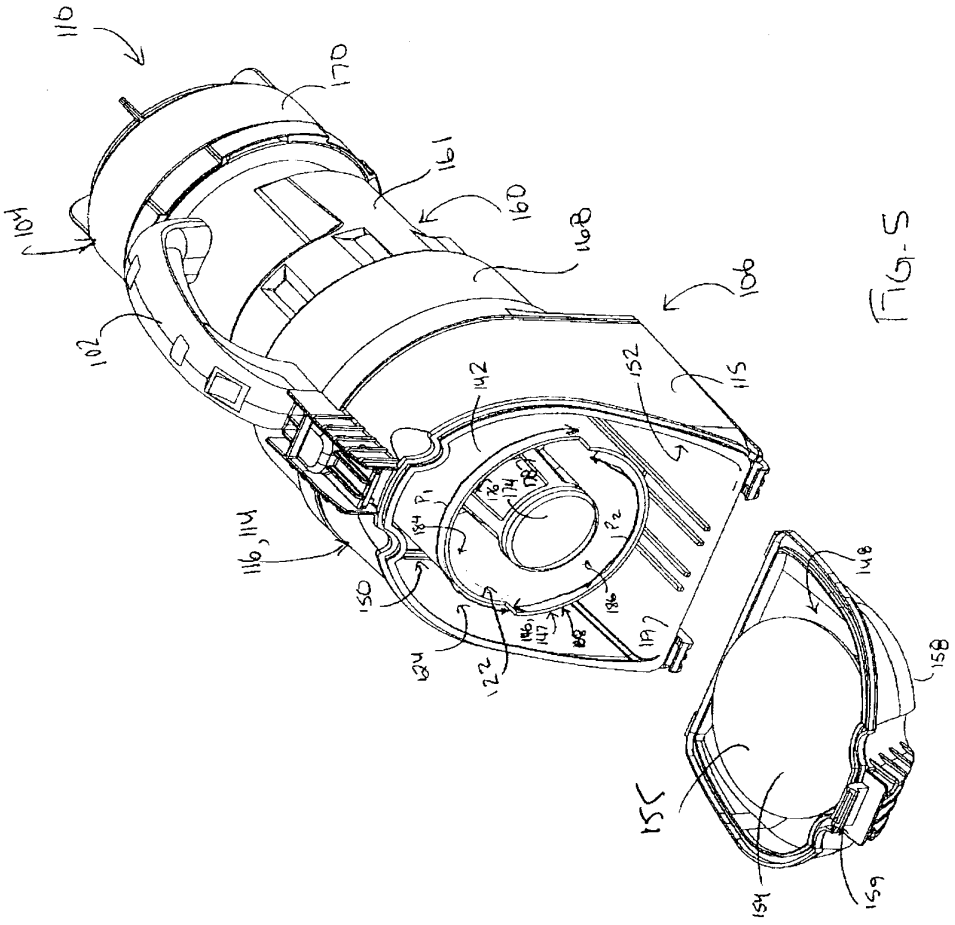
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FIG. 5

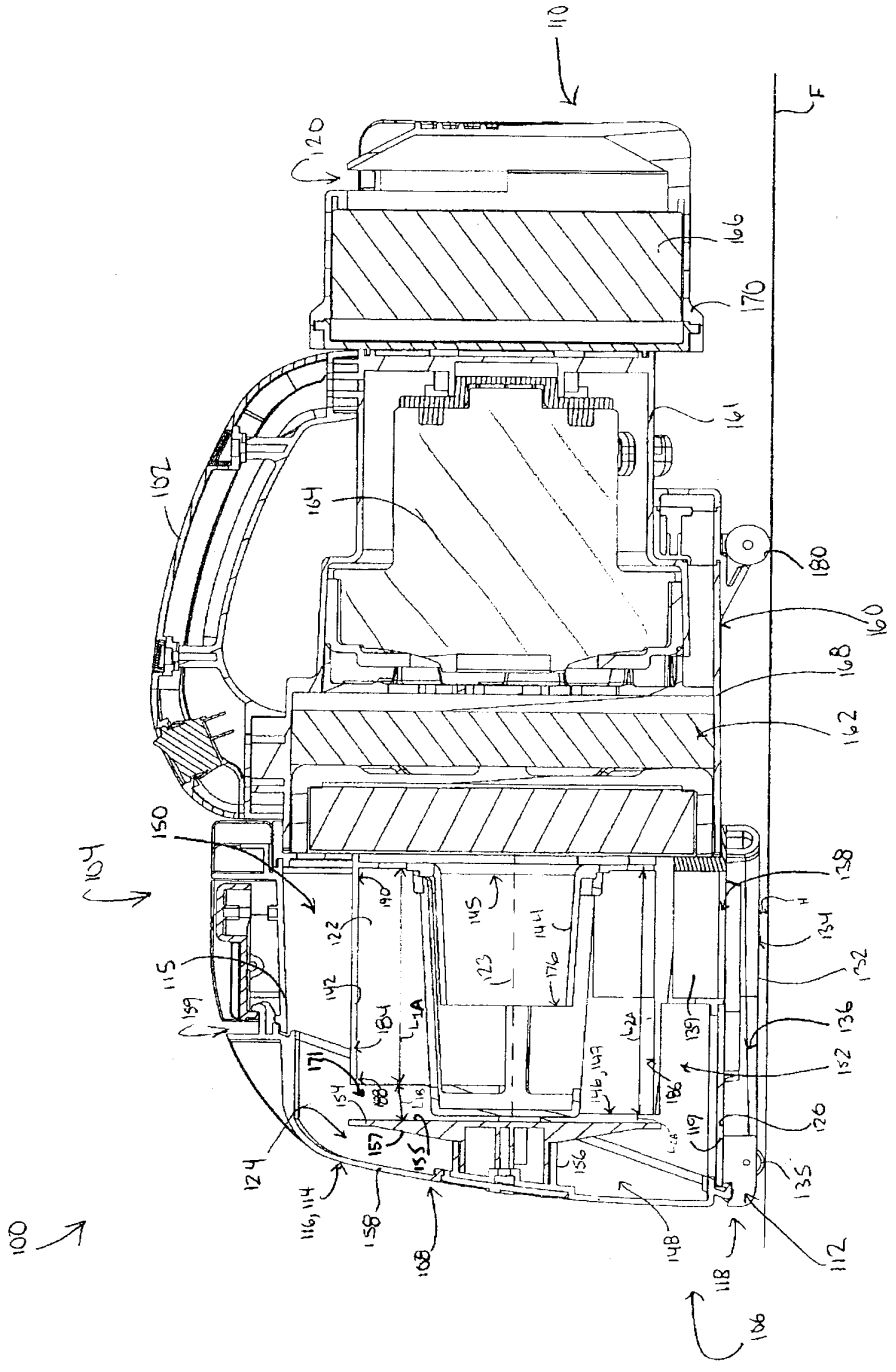
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FIG. 6

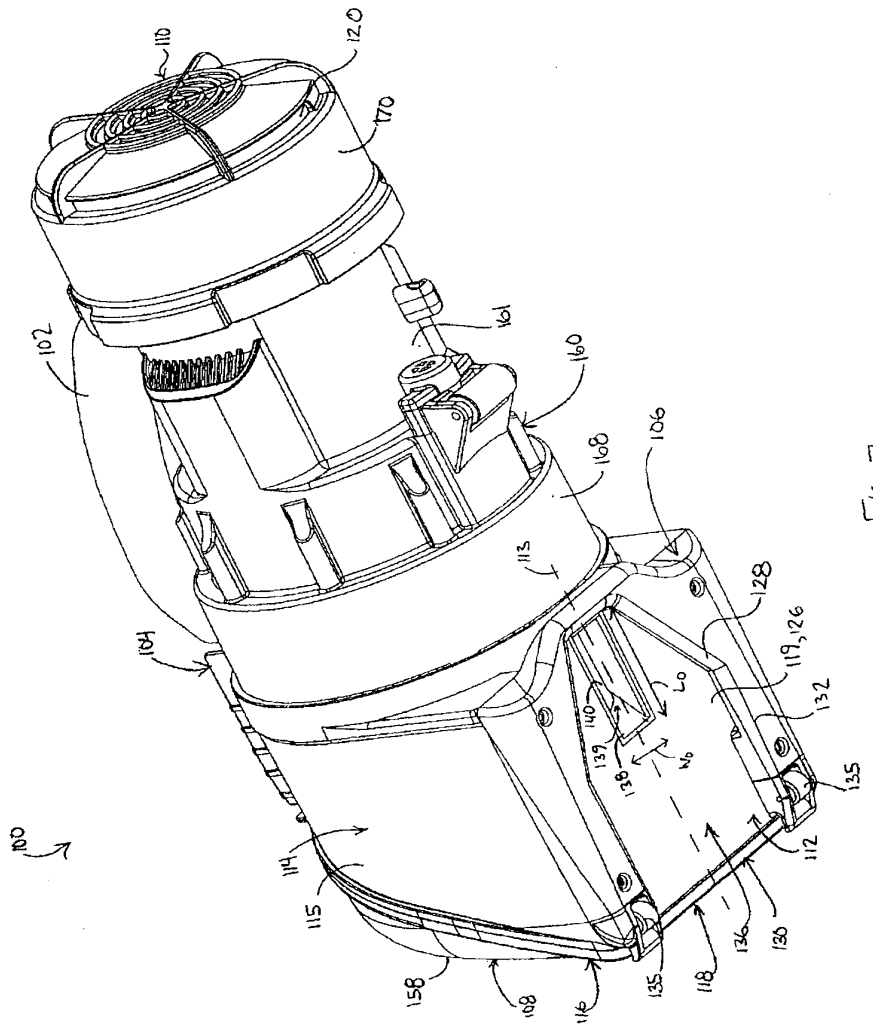
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FIG. 7

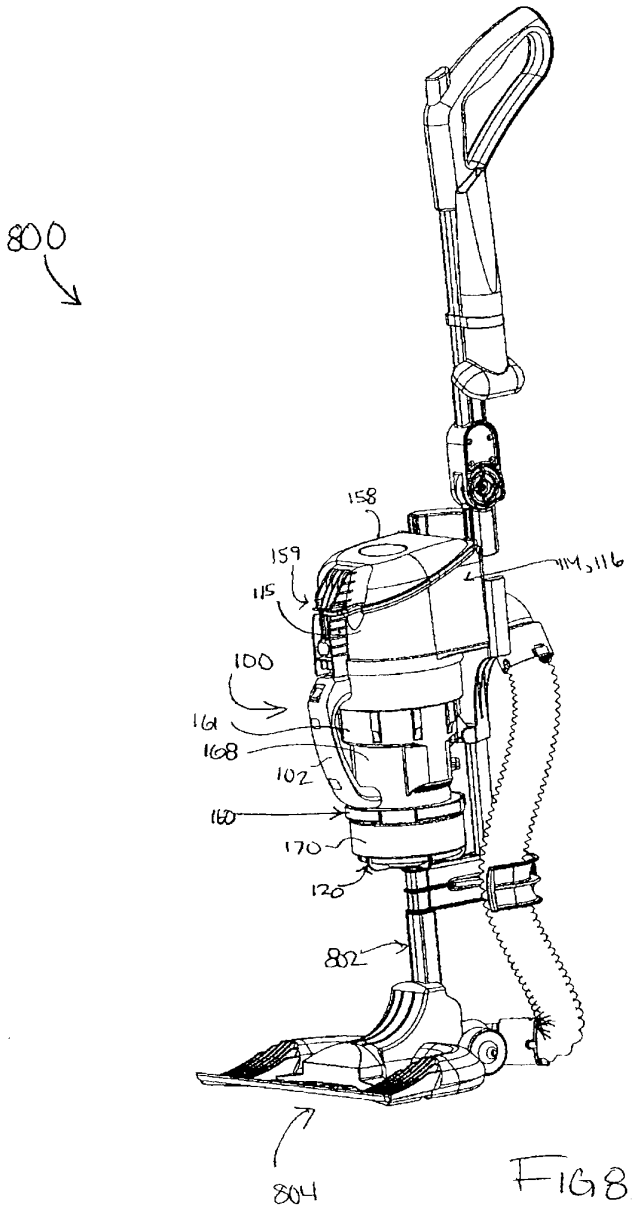

FIG 8

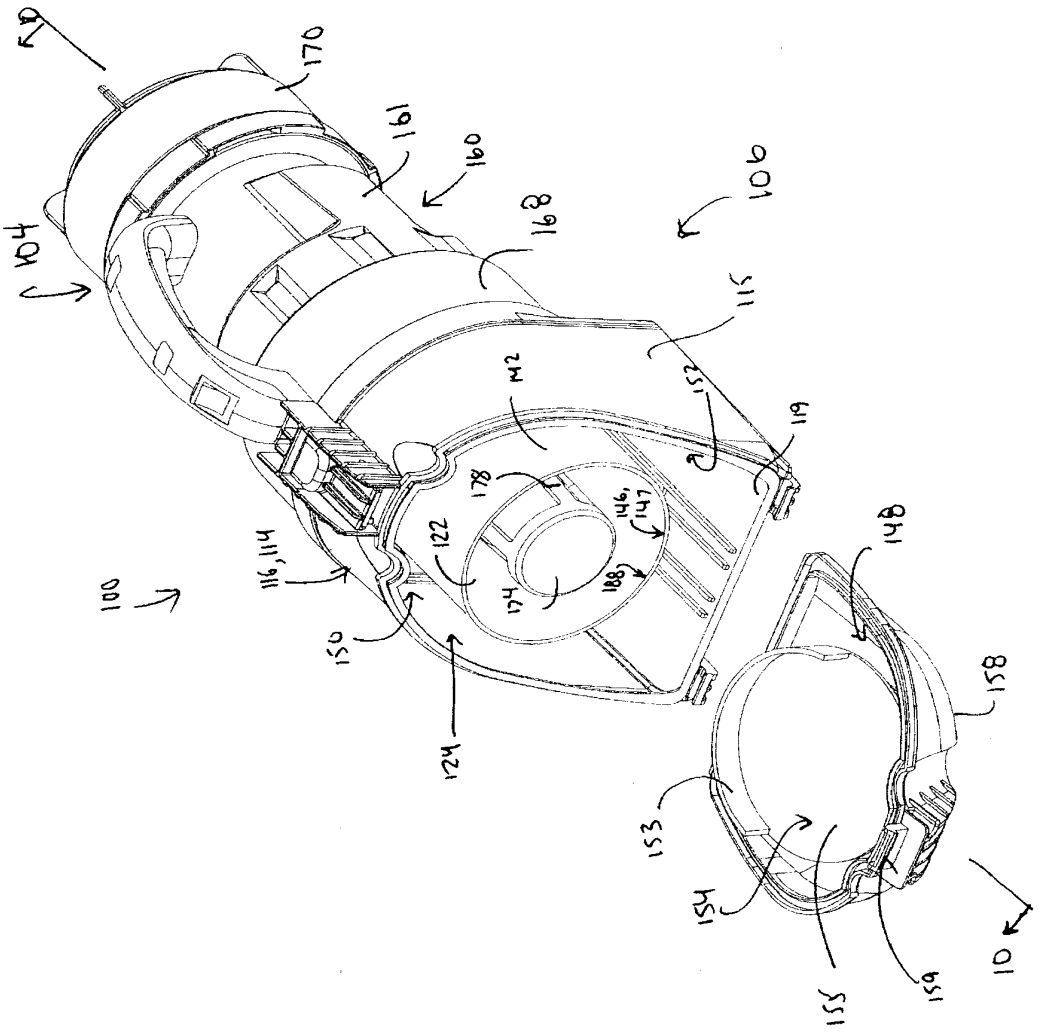
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FIG. 9

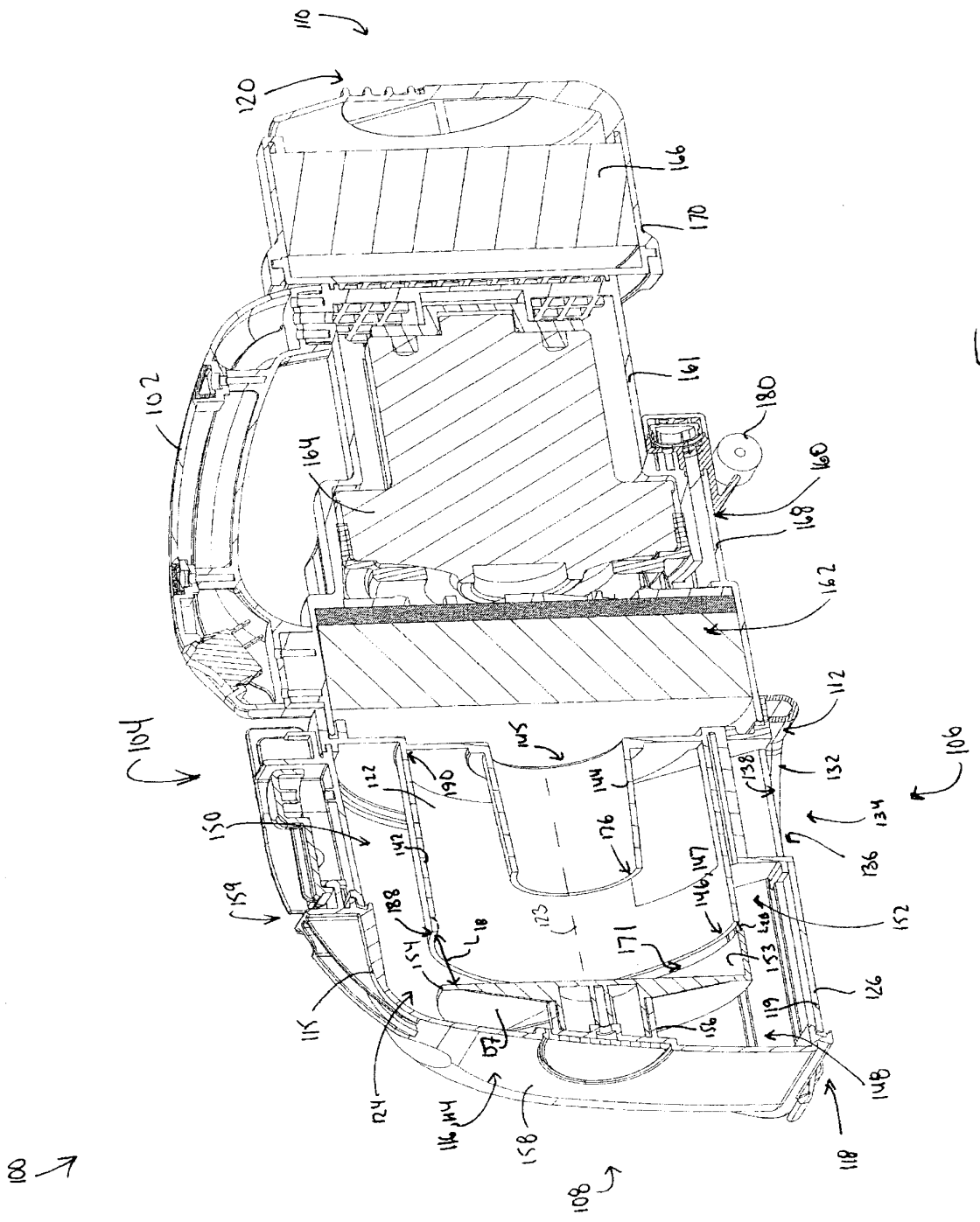
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FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2010/000342

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***A47L 9/16*** (2006.01) , ***A47L 5/24*** (2006.01)
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: A47L 9/16, A47L 5/24, A47L 9*, A47L*
US: 15/350

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Epoque (Epodoc), Canadian Patent Database, Total Patent (full text): Keywords-vacuum, cyclone, gap, plate or deflect*, dirt cup or dirt collection chamber, side wall.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 966912 A1 (Tuvin, L) 29 Dec. 1999 (29.12.1999) * Abstract; Fig. 10; paragraph 36*	1-3, 5-19 and 21-24
X	WO 2007/104138 A1 (Conrad, W) 20 Sept. 2007 (20.09.2007) *Abstract; Fig. 7a; Fig. 6d*	1-4, 6-16, 18-20 and 22-24
X	US 6782583 B2 (Oh, J) 31 Aug. 2004 (31.08.2004) *Abstract; Fig. 3*	1, 3, 5-10, 18-19 and 21-24
X	WO 96/19294 A1 (Dyson, J et al.) 27 June 1996 (27.06.1996) *Abstract; Fig. 4b*	1, 3-4, 6-10, 18-20 and 22-24

[ ] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 June 2010 (08.06.2010)	17 June 2010 (17-06-2010)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Sean Wilkinson (819) 934-9086

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2010/000342

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons :

1. [ ] Claim Nos. :
because they relate to subject matter not required to be searched by this Authority, namely :

2. [ ] Claim Nos. :
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically :

3. [ ] Claim Nos. :
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows :

The claims are directed to a plurality of inventive concepts as follows:

Group A - Claims 1-17 and 22-24 are directed to a cyclone unit with a variable length outlet passage.
Group B - Claims 18-24 are directed to a cyclone output plate with side walls.

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [X] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos. :

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos. :

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
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PCT

(10) International Publication Number
WO 2009/026709 A1

(51) International Patent Classification:
A47L 9/16 (2006.01) *A47L 9/20* (2006.01)
A47L 5/12 (2006.01)

(21) International Application Number:
PCT/CA2008/001530

(22) International Filing Date: 28 August 2008 (28.08.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2,599,303 29 August 2007 (29.08.2007) CA

(71) Applicant *(for all designated States except US)*: **GBD CORP.** [BS/BS]; 1st Floor, Charlotte House, Charlotte Street, Nassau, Bahamas (BS).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **CONRAD, Wayne, Ernest** [CA/CA]; 9 King Lane, Hampton, Ontario L0B 1J0 (CA).

(74) Agent: **Bereskin & Parr**; 40 King Street West, 40th Floor, Toronto, Ontario M5H 3Y2 (CA).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, 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*

(54) **Title:** CYCLONIC SURFACE CLEANING APPARATUS WITH EXTERNALLY POSITIONED DIRT CHAMBER

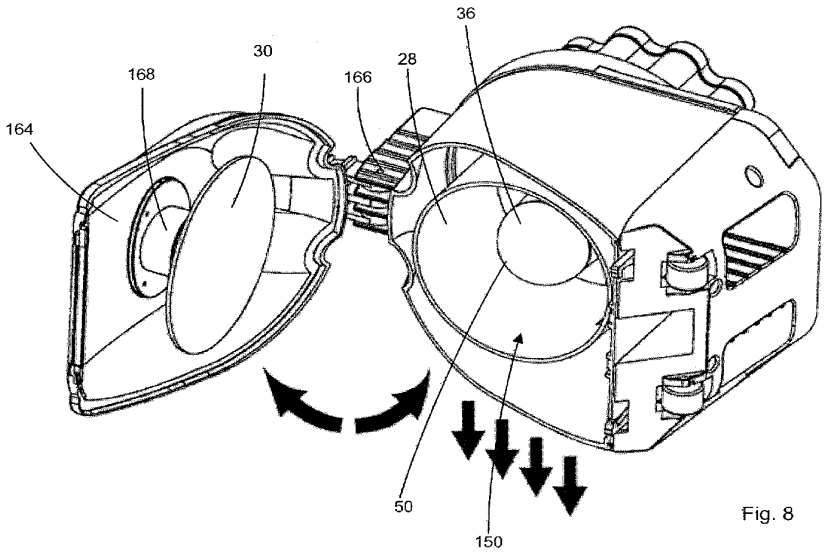

Fig. 8

(57) **Abstract:** (a) A surface cleaning apparatus comprises a filtration apparatus comprising a cyclone and an openable dirt collection chamber in communication with the cyclone dirt outlet. The dirt collection chamber has an openable end portion that comprises a wall that is intersected by the longitudinally extending axis, and when the end portion is in an open position, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder whereby the dirt collection chamber and the cyclone are concurrently emptyable when the dirt collection chamber is opened.

WO 2009/026709 A1

TITLE: CYCLONIC SURFACE CLEANING APPARATUS WITH EXTERNALLY POSITIONED DIRT CHAMBER

FIELD

This application relates to surface cleaning apparatus, such as vacuum cleaners.

BACKGROUND

The use of a cyclone, or multiple cyclones connected in parallel or series, is known to be advantageous in the separation of particulate matter from a fluid stream. Currently, many vacuum cleaners, which are sold for residential applications, utilize at least one cyclone as part of the air filtration mechanism.

US 4,826,515 (Dyson) discloses a cyclonic vacuum cleaner having two cyclonic stages, namely a first stage for separating larger particulate matter from an air stream and a second stage for separating finer particulate matter from the same air stream. Each cyclonic stage comprised a single cyclone wherein separated particulate matter was collected in the bottom of the cyclones.

A difficulty experienced with cyclonic separators is the re-entrainment of the separated particulate matter back into the outgoing fluid flow. Deposited particles exposed to a high-speed cyclonic flow have a tendency to be re-entrained. One approach to resolve this issue is to use a plate positioned in a cyclone container to divide the cyclone container into an upper cyclone chamber, which is positioned above the plate, and a lower dirt collection chamber, which is positioned below the plate. See for example Conrad (US 6,221,134). Accordingly, the portion of the cyclone casing below the plate functions as a dirt collection chamber wherein re-entrainment of separated particulate matter is impeded.

SUMMARY

In accordance with this invention, a filtration apparatus for a surface cleaning apparatus comprises a cyclone and a dirt collection chamber for the cyclone that is separate from the cyclone, and preferably external to the cyclone chamber. The dirt collection chamber is openable and, when opened, material collected therein may be removed. Similarly, the cyclone is openable. When opened, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder. Therefore, when the cyclone is opened, material collected therein may be also removed. For example, a vortex finder with a large diameter shroud, or a deflector disc positioned around a vortex finder or air outlet, are not located in the cyclone when it is opened and therefore do not create an impediment to dirt falling out of the cyclone when a cyclone is opened and positioned with the opening over a garbage can. Preferably, both the cyclone and the dirt collection chamber are openable at the same time. Preferably, the vortex finder is also removed from the cyclone chamber when the cyclone is opened.

An advantage of this design is that, from time to time, material may accumulate in a cyclone. In some embodiments, the cyclone may be configured such that heavier material is collected in the cyclone itself. For example, the cyclone may be inverted and have an upper dirt outlet. Material that is too heavy to be entrained in an air stream and carried upwardly through the cyclone and through the dirt outlet will accumulate in the cyclone. Accordingly, the interior of the cyclone could be used as a dirt collection chamber. If the dirt collection chamber associated with the cyclone is not the bottom of the cyclone casing, but a separate chamber, then by opening the cyclone, material that collects in the cyclone may be removed, e.g., the opened portion of the cyclone may be held over a garbage can and the accumulated material in the cyclone may be poured out.

Typically, cyclones have an efficiency to separate particulate matter having a targeted size range. By using the interior of the cyclone as a dirt collection chamber, the cyclone may be designed to separate particulate matter having a smaller targeted size range. The material that is dis-

entrained from the airflow by the cyclone and which exits the cyclone dirt outlet may accumulate in a separate dirt collection chamber in flow communication with the cyclone dirt outlet. For example, in a preferred embodiment, the cyclone or the cyclonic cleaning stages combined, may achieve a separation efficiency for IEC dirt as specified as IEC 60312, which is representative of household dirt, of 98% of particles that are from 3 to 5 microns and at least 96.5% of particles that are from 1 – 2 microns. Such a cyclone, while using a relatively high fluid velocity, may result in heavier or larger material remaining in the cyclone.

Accordingly, for example, a surface cleaning apparatus may include an inverted cyclone having a floor and an upper dirt outlet. A lower air inlet is provided and an air outlet is provided through the floor or a sidewall of the cyclone. In operation, air will enter through the air inlet and cyclone upwardly. Some of the dirt will exit upwardly through the dirt outlet. The air will then travel downwardly and exit the cyclone through the cyclone outlet (e.g., a vortex finder). Some of the dirt will accumulate on the floor of the cyclone. The dirt collection chamber may surround at least a portion of the cyclone and, preferably, all of the cyclone. The dirt collection chamber has a floor on which dirt entering the dirt collection chamber will accumulate. The floor of the cyclone and the floor of the dirt collection chamber may concurrently open so that the dirt collected in the cyclone and the dirt collected in the dirt collection chamber are emptied concurrently. An advantage of this design is that fewer steps are required for a user to empty the dirt collection areas of the vacuum cleaner.

In some embodiments, a vortex finder may be provided on the portion of the cyclone that opens. For example, if the cyclone is inverted, the vortex finder may be positioned on the bottom opening floor of the cyclone. Accordingly, when the cyclone is opened, the vortex finder is removed from the cyclone leaving an open cyclone chamber.

Alternately, or in addition, in some other embodiments, the cyclone may have an interior shroud or screen that may need cleaning from time to

time. Accordingly a consumer may use a single step to open the cyclone to access a shroud, filter or screen that requires cleaning or replacement and, at the same time, have access to the dirt collection chamber so as to empty the dirt collection chamber.

In accordance with the instant invention, there is provided a surface cleaning apparatus comprising:

(a) a dirty air inlet;

(b) a filtration apparatus comprising a cyclone downstream from the dirty air inlet, the cyclone having a cyclone chamber, a vortex finder, a dirt outlet and a longitudinally extending axis;

(c) an openable dirt collection chamber in communication with the dirt outlet, the dirt collection chamber having an openable end portion that comprises a wall that is intersected by the longitudinally extending axis, and when the end portion is in an open position, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder whereby the dirt collection chamber and the cyclone are concurrently emptyable when the dirt collection chamber is opened;

(d) a suction motor; and,

(e) a clean air outlet downstream from the suction motor.

In any embodiment, the end portion may be pivotally openable.

In any embodiment, the end portion may comprise a dirt collection surface.

In any embodiment, the end portion may be at an end of the dirt collection chamber distal to the dirt outlet.

In any embodiment, the end portion may further comprise the vortex finder.

In any embodiment, the end portion may face the dirt outlet.

In any embodiment, the cyclone may have an openable portion and the end portion of the dirt collection chamber may be openable concurrently with the openable portion of the cyclone.

In any embodiment, the openable portion of the cyclone may comprise a cyclone dirt collection surface, the dirt collection chamber may have a moveable dirt collection chamber surface, and the dirt collection chamber surface may be moveable concurrently with the cyclone dirt collection surface.

In any embodiment, the end portion may comprise a dirt collection surface, the cyclone may have a moveable cyclone dirt collection surface, the moveable cyclone dirt collection surface may be a floor of the cyclone and the dirt collection surface may be a floor of the dirt collection chamber. Preferably, the dirt collection surface and the cyclone dirt collection surface comprise a pivoting bottom of the filtration apparatus.

In some embodiments, the vortex finder is mounted to the cyclone floor.

In any embodiment, the vortex finder may have an upstream end in the cyclone chamber and an absence of any filtration member in covering relationship thereto.

In any embodiment, the dirt collection chamber may be positioned around at least a portion of the cyclone and preferably surrounds the cyclone.

In any embodiment, the filtration apparatus may comprise a plurality of cyclonic cleaning stages and the cyclone comprises a portion of one such stage.

In any embodiment, the cyclone may comprise a first cyclonic cleaning stage and the filtration apparatus may comprise a second cyclonic cleaning stage comprising a plurality of cyclones in parallel.

In some embodiments, the cyclone is inverted and the dirt outlet is in an upper portion of the cyclone. In such an embodiment, the cyclone preferably has a lower air inlet and a lower air outlet.

In any embodiment, the cyclone may have an air inlet at one end of the cyclone and the dirt outlet is provided in a sidewall of the cyclone spaced from the air inlet, the cyclone has an cyclone dirt collection surface that is openable concurrently with the end portion. In such an embodiment, the cyclone preferably has as an upper air inlet and an upper air outlet.

In any embodiment, a filtration member may be positioned downstream from, e.g., beneath, the vortex finder. More preferably, the end of the vortex finder in the cyclone is unobstructed, e.g., there is no screen, shroud or filter overlying or surrounding the inlet to the vortex finder.

It will be appreciated by those skilled in the art that any of these alternate embodiments may be used individually or in combination in a single surface cleaning apparatus, as exemplified in a preferred embodiment described herein, or in any particular sub-combination. Accordingly, any two or more alternate embodiments may be used in a single surface cleaning apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the instant invention will be more fully and completely understood in conjunction with the following description of the preferred embodiments of the invention in which:

Figure 1 is a side elevational view of a preferred embodiment of a vacuum cleaner in accordance with this design wherein the outer casing surrounding the cyclone and forming an outer wall of a dirt collection chamber is optionally transparent;

Figure 2 is a perspective view from the front and the right side of the vacuum cleaner of Figure 1;

Figure 3 is a cross-section along the line 3 – 3 in Figure 2;

Figure 4 is a schematic drawing of the vacuum cleaner of Figure 1 showing the airflow passage therethrough;

Figure 5 is a perspective view from the bottom of the vacuum cleaner of Figure 1 wherein the bottom of the first and second housings is open;

Figure 6 is a perspective view of the bottom of the vacuum cleaner of Figure 1 wherein the first and second housings are closed but an access door is open;

Figure 7 is a longitudinal section through an alternate embodiment of a vacuum cleaner in accordance with this invention;

Figure 8 is a perspective end view of the vacuum cleaner of Figure 8 wherein the dirt collection chamber and the cyclone are open;

Figure 9 is a perspective cross-section view of a further alternate embodiment of a cyclone and dirt collection chamber in accordance with this invention;

Figure 10 is an exploded perspective view of the alternate embodiment shown in Figure 9; and,

Figure 11 is a perspective view from the bottom of the cyclone and dirt collection chamber shown in Figure 9 wherein the bottom panel is open;

Figure 12 is a cross-section through a further alternate embodiment of a cyclone and dirt collection chamber in accordance with this invention; and,

Figure 13 is a cross-section through the alternate embodiment shown in Figure 12 wherein the cyclone floor and dirt collection chamber floor are open;

DETAILED DESCRIPTION

As shown in Figures 1 – 6, a surface cleaning apparatus comprises a vacuum cleaner 10 having at least one cyclone and a dirt collection chamber

in communication with the cyclone dirt outlet. The filtration apparatus may be of any design or configuration. As exemplified, surface cleaning apparatus 10 has a first housing 12 and a second housing 14. First housing 12 comprises at least one cyclone 16 and a dirt collection chamber 18 and second housing 14 houses the filtration members and the suction motor. As shown in Figure 7, a surface cleaning apparatus 10 has a first cyclonic cleaning stage comprising a single cyclone 150 having a dirt collection chamber 152 and a second cyclonic cleaning stage comprising a plurality of second stage cyclones 154 in parallel.

As exemplified in Figures 1-6, vacuum cleaner 10 comprises a hand held vacuum cleaner. Accordingly, vacuum cleaner 10 may be provided with handle 54, which is affixed to lid 32 and lid 58 of second housing 14. Handle 54 may alternately be affixed to any other portion or portions of vacuum cleaner 10 as is known in the art. Optionally, as exemplified, on/off switch 56 may be provided on handle 54. On/off switch 56 may alternately be provided on any other portion of vacuum cleaner 10.

As exemplified in Figure 3, suction motor 26 is positioned in second housing 14, preferably with a suction fan provided below the electric motor. Clean air outlet 60 is provided downstream from suction motor 26. An optional post-motor filter may be provided downstream from suction motor 26, such as in post-motor filter housing 62, which may be accessible via post motor filter housing door 64, which could be pivotally mounted to second housing 14.It will be appreciated that, surface cleaning apparatus may be a vacuum cleaner, a carpet extractor, a bare floor cleaner or the like. As exemplified, the surface cleaning apparatus is hand held. However the surface cleaning apparatus may be configured as an upright vacuum cleaner, a stick vacuum cleaner, a canister vacuum cleaner, a backpack or shoulder strap vacuum cleaner or other configuration known in the art. The surface cleaning apparatus may have a single cyclonic cleaning stage, which may be of any construction known in the art, or a plurality of cyclonic

cleaning stages, each of which may be of any construction known in the art, e.g. they may comprise a single cyclone or a plurality of cyclones in parallel.

In accordance with this invention, an openable dirt collection chamber 18 is provided that is in communication with the dirt outlet 28. Dirt collection chamber 18 has an openable end portion that comprises a wall that is intersected by the longitudinally extending axis of the cyclone. For example, the openable end portion may be floor 44 of cyclone 16 as exemplified in Figures 1-6, impingement member 30 and the floor of dirt collection chamber 18 to which impingement member 30 may be mounted as exemplified in Figures 7-8 or opposed wall 164 of dirt collection chamber 18 of Figures 12-13 or bottom 66 comprising cyclone floor 42 and dirt collection chamber floor 44 of Figures 9-11. When the end portion is in an open position as exemplified in Figures 5, 8 and 11 and 13, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder whereby dirt collection chamber 18 and the cyclone 16 may be concurrently emptyable with dirt collection chamber 18.

A first embodiment of this invention is shown in Figures 1-6, which exemplifies the use of an inverted cyclone. However, as shown in other embodiments, it will be appreciated that the cyclone 16 may be of any configuration and orientation and need not be inverted (e.g., cyclone 16 may be a horizontally mounted cyclone or a vertically mounted upright cyclone with an upper air inlet, an upper air out and a lower dirt outlet). Accordingly, the reference to "upper" and "lower" and "floor" are for convenience in the following discussion and relate to a preferred embodiment.

Referring to Figures 1-6, cyclone 16 has a dirt outlet 28 and an impingement surface 30 in dirt collection chamber 18 spaced from and facing dirt outlet 28. As shown in Figure 3, optional impingement surface 30 is preferably spaced a distance D from outlet 28 wherein distance D may be up to 50 mm, preferably from 8 to 30 millimeters and, and more preferably from 12 to 25 millimeters. It will be appreciated that impingement member 30 may be mounted to lid 32 of dirt collection chamber 18 as exemplified. Alternately,

impingement member may be mounted to a sidewall of dirt collection chamber 18 and/or cyclone 16. It will be appreciated that cyclone 16 may be in any particular orientation and/or any particular configuration. As exemplified in Figure 7, cyclone 150 may have a longitudinally extending axis A that extends generally horizontally when the surface cleaning apparatus is in use. In such a case, impingement surface 30 may be positioned facing dirt outlet 28 and accordingly, in use, extends generally vertically, (i.e. transverse to longitudinal axis A). Alternately, as shown in Figures 12 to 13, an impingement surface may not be provided.

As exemplified in Figure 3, cyclone 16 is an inverted cyclone. Accordingly, cyclone 16 has a lower air inlet 34 and a lower air outlet 36. Air inlet 34 is positioned downstream from dirty air inlet 38 of surface cleaning nozzle 40. Surface cleaning nozzle 40 may be any surface cleaning nozzle known in the art. Air inlet 34 of cyclone 16 may be in airflow communication with surface cleaning nozzle 40 in any manner known in the art. The exact structure of surface cleaning nozzle 40 and the communication passage between surface cleaning nozzle 40 and air inlet 34 will vary depending if the surface cleaning apparatus is an upright vacuum cleaner, canister vacuum cleaner or, as exemplified, a portable hand held vacuum cleaner. In operation, air will enter cyclone 16 through inlet 34 and travel upwardly, as exemplified in Figure 4. The air will then travel downwardly to exit cyclone 16 via outlet 36. As shown in Figure 4 by the hatched arrows, dirt will exit upwardly through outlet 28 and deposit on dirt collection chamber floor 42. In addition, some of the heavier particulate matter may not be entrained in the air stream and may be deposited on cyclone floor 44.

In this embodiment, cyclone 16 has a longitudinally extending axis that extends through the centre of cyclone 16. The longitudinal axis is aligned with, and extends through, air outlet 36 and accordingly intersects floor 44 and door 82. In an alternate embodiment, it will be appreciated that cyclone 16 need not be inverted but may be of any configuration or orientation. As exemplified in Figures 7 and 8, cyclones 150, 154 may be

oriented such that longitudinal axis A of the cyclones extends horizontally when the surface cleaning apparatus is in use. As exemplified in Figure 7, cyclone 150 has an impingement member 30 that is generally vertical and faces dirt outlet 28 and is intersected by longitudinal axis A. Alternately, the cyclone may be an upright cyclone (see for example Figures 12 to 13) or a cyclone having a single direction of travel of the air. As exemplified in Figures 12 and 13, cyclone 16 has a longitudinal axis that intersects dirt collection chamber floor 42 and cyclone floor 44. As exemplified in Figures 9-11, cyclone 16 has a longitudinal axis that intersects cyclone floor 44.

As exemplified, cyclone 16 is a frustoconical cyclone having cylindrical portion 46 and frustoconical portion 48. Alternately, or in addition to the orientation of cyclone 16, it will be appreciated that cyclone 16 may be cylindrical, entirely frustoconical or any other shape known in the art. As shown in Figures 9-13, cyclone 16 may be closed, i.e. have a portion that closes the dirt outlet end of the cyclone chamber, and is provided with at least one dirt outlet 28. The dirt exit end may be bowl shaped, e.g., rounded.

As exemplified in Figure 3, outlet 36 of cyclone 16 comprises a vortex finder that extends inwardly into the cyclone chamber defined by cyclone 16. Outlet 36 preferably comprises a generally cylindrical passage having an inlet 50 and an outlet 52. It will be appreciated that, in an alternate embodiment any outlet or vortex finder known in the art for cyclones may be utilized.

In any embodiment, inlet 50 may be covered by a screen, shroud or filter as is known in the art. However, it is preferred that vortex finder 36 is unobstructed, i.e., no screen, shroud or filter is provided on inlet 50. Accordingly, as exemplified in Figure 3, vortex finder 36 is not surrounded by a screen, shroud or filter and no physical separation member is positioned in the cyclone chamber of cyclone 16. Accordingly, no filtration or screen member interior of cyclone 16 requires cleaning. Elongate material such as hair or fibre can become adhered to a shroud, requiring the shroud to be manually cleaned. Preferably, a screen is positioned downstream from

cyclone 16 and upstream from the pre-motor filter. For example, a screen 78 is preferably provided (see for example Figure 3). The material that would otherwise clog a screen or shroud that surrounds inlet 50 may be retained by optional screen 78 which may be larger than a screen in a cyclone chamber.

While the use of the impingement member is exemplified in a surface cleaning apparatus having side-by-side housings 12, 14, it will be appreciated that this design may be used in any vacuum cleaner configuration, such as shown in Figure 7. In other embodiments, an impingement member may not be provided. For example, in the example of Figures 1-6, an impingement member may not be provided. See also Figures 9-13 wherein an impingement member is not provided.

In accordance with a preferred embodiment of this invention, dirt collection chamber 18 surrounds at least a portion of and, as exemplified, preferably all of cyclone 16 and is preferably external to the cyclone chamber defined by cyclone 16. Accordingly, cyclone 16 may be positioned in dirt collection chamber 18 and, preferably, generally centrally therein. An advantage of this design is that the bottom of cyclone 16 (e.g., floor 44) may be continuous with the bottom of dirt collection chamber 18 (e.g., floor 44) so that a simplified construction is provided that permits both cyclone 16 and dirt collection chamber 18 to be opened at the same time.

The following description refers to the embodiment of Figures 1-6 wherein the openable end of the dirt collection camber is the dirt collection surface (floor 42). However, in an alternate embodiment, it will be appreciated that the openable portion need not be the dirt collection surface. For example, if cyclone 16 is mounted horizontally, then the openable portion may be opposed wall 164 of dirt collection chamber 18 facing dirt outlet 28 to which impingement member 30 is attached. In such a case, the dirt collection surface will be a sidewall of dirt collection chamber 18.

In accordance with the preferred embodiment of Figures 1-6, vacuum cleaner 10 is preferably configured such that floor 44 forms an openable end

portion of cyclone 16 and floor 42 forms an openable end portion of dirt collection chamber 18. Floor 44 is a moveable cyclone dirt collection surface and floor 42 is a moveable dirt collection chamber surface. The openable portion of cyclone 16 is accordingly opened when the openable portion of dirt collection chamber 18 is opened. Accordingly, dirt collected on floor 44 of cyclone 16 is emptied at the same time as dirt collected on floor 42 of dirt collection chamber 18. Accordingly, floor 42 and floor 44 are both moveable and connected to each other whereby both floor 42 and 44 are concurrently moveable such that dirt collection chamber 18 and cyclone 16 are concurrently emptied.

As exemplified in Figure 5, floors 42 and 44 comprise a wall intersecting the longitudinally extending axis of the dirt collection chamber 18 and cyclone 16. Floors 42 and 44 may comprise a pivoting bottom or end portion of first housing 12 and, alternately, of the filtration apparatus (e.g. housings 12 and 14 of this embodiment). It will be appreciated that in other embodiments, floors 42 and 44 may be otherwise openable and may be removably mounted. For example, they may be slidably, translatably or removably mounted (e.g., by a screw mount, a bayonet mount or a snap fit) to cyclone 16 and dirt collection chamber 18.

As exemplified in Figure 5, outlet 36 is in some embodiments preferably provided as part of floor 42, and is preferably integrally molded therewith. Accordingly, when floors 42 and 44 are in the open position, vortex finder 36, and any shroud or the like mounted thereon, is removed from cyclone 16. Accordingly, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder therein. Accordingly, the dirt will fall out of collection chamber 16 and cyclone 16 and will fall downwardly off of floors 42 and 44.

Accordingly, as seen in Figure 5, both cyclone 16 and dirt collection chamber 18 are openable and may be emptied concurrently when floors 42 and 44 are in the open position by holding vacuum cleaner 10 in the upright position (as shown in Figure 1).

It will be appreciated that dirt collection chamber 18 may be spaced from cyclone 16 provided dirt outlet 28 is in communication with dirt collection chamber 18 so that dirt which is disentrained from the fluid flow in cyclone 16 is conveyed to dirt collection chamber 18. It will be appreciated that floor 42 may open separately from floor 44, such that cyclone 16 and dirt collection chamber 18 may be individually opened.

As shown in Figure 5, housings 12 and 14 may have a pivoting bottom 66, which is secured to each of housings 12 and 14 by a pivot 68. In the closed position exemplified in Figures 1 and 4, pivoting bottom 66 is secured in position by latch 70. Latch 70 may have a button 72 which, when pressed, causes arm 74 to move outwardly thereby disengaging a flange provided on the bottom end of arm 74 from flange 76 provided on pivoting bottom 66. A gasket or other sealing member may be provided at the interface of housings 12 and 14 and pivoting bottom 66 to provide an air tight or fluid tight seal. It will be appreciated that bottom 66 may be moveable in any other direction by any other means known in the art and may optionally be removable from housings 12, 14. Further, bottom 66 may be moveably secured in position by any other means known in the art and need not be connected to surface cleaning apparatus 10 for relative motion thereto.

In an alternate embodiment of Figures 1-6, it will be appreciated that only floors 42 and 44 may be pivotally mounted to housing 12. In such an embodiment, foam filter 20 may remain sealed when cyclone 16 and dirt collection chamber 18 are emptied. In an alternate embodiment, a side-by-side housing design as exemplified in Figure 1 need not be utilized. In such a case, floor 42 and floor 44 may comprise the entire floor of the filtration assembly, see for example, Figures 9-11.

If bottom 66 opens both housings 12 and 14, then it will be appreciated that dirt positioned on the upstream surface of filter 20 will be emptied when bottom 66 is opened.

In the alternate embodiment of Figures 7 and 8, impingement member 30 is removed from the vicinity of dirt outlet 28 when opposed wall is opened, e.g., by pivoting about pivot pin 66. As exemplified, impingement member 30 is mounted to support 166 that is preferably mounted to opposed wall 164. It will be appreciated that impingement member 30 may be otherwise moveably mounted. When opposed wall is opened, the cyclone chamber is opened and both cyclone 150 and dirt collection chamber 152 may be concurrently emptied. In this embodiment, vortex finder 36 remains in position in the cyclone chamber. While a screen may be positioned to overlie inlet end 50 of vortex finder 36, it will be appreciated that a member having a diameter larger than vortex finder 36 is absent from the interior of cyclone 150 thereby permitting dirt to be unimpeded when cyclone 150 is held open over a garbage can.

In the alternate embodiment of Figures 9-11, cyclone 16 has a closed end and is opened at the closed dirt outlet end for emptying. As exemplified, in Figures 9-11, cyclone 16 has tangential passage 172 that is in airflow communication with a surface cleaning nozzle (not shown). Tangential passage 172 is connected to air inlet 34 of cyclone 16. Cyclone 16 has a clean air outlet 36 in floor 44, similar to the embodiment of Figures 1-6. Cyclone 16 has a closed end wall 174 with at least one dirt outlet 28 in a side wall thereof. Dirt outlet 28 opens to dirt collection chamber 18. The outer walls of dirt collection chamber 18 are formed from sidewall 186 and end wall 188. Bottom wall 182 comprises floors 44 and 42. A gasket 180 may be provided at the interface of dirt collection chamber 18, cyclone 16 and bottom panel 182 to provide an air tight or fluid tight seal.

In operation, dirty air enters cyclone 16 tangentially via air inlet 34 and swirls upwardly. Heavier dirt particles fall out of the air stream and are deposited on floor 44 of bottom panel 182. Some dirt particles will exit cyclone 16 via dirt outlet 28, fall downwardly in dirt collection chamber 18 and deposit on floor 42 of bottom panel 182.

As exemplified in Figures 9-11, bottom panel 182 comprises a wall intersecting the longitudinally extending axis A of dirt collection chamber 18 and cyclone 16. Accordingly, bottom panel 182 forms the end portion of dirt collection chamber 18 and cyclone 16. Bottom panel 182 may have a flange 184 connected to a flange 190 on sidewall 186. Accordingly, bottom panel 182 is rotatably moveable such that cyclone 16 and dirt collection chamber 18 may be opened to empty deposited dirt particles. When bottom panel 182 is in the open position, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder.

In the alternate embodiment of Figures 12-13, floors 42 and 44 comprise the openable end portion. Cyclone floor 44 is mounted to dirt collection chamber 18, such as by support 176. Accordingly, when dirt collection chamber 18 is opened, such as by rotating about pivot 170, cyclone 16 is also opened.

In any embodiment as exemplified in Figures 1-6, a filtration member may be provided adjacent outlet 36 and, preferably, in sealing engagement with outlet 52. Referring to Figure 3, filtration member 78 may be positioned on rear surface 84 of floor 44 and overlies outlet 52. Accordingly, air that exits outlet 36 travels through filtration member 78. The air then travels through filtration chamber 80 and travels laterally to outlet 86, which is in air flow communication with headspace 88 below filter 20. An advantage of such an embodiment is that a screen, shroud or filter need not be provided inside cyclone 16 overlying inlet 52 of vortex finder 36. Accordingly, if a vortex finder remains in cyclone 16 when it is opened, such as in Figures 7-8 and 12-13, then a large diameter member that may impede dirt from falling out need not be provided in cyclone 16.

Preferably, filtration member 78 preferably comprises a screen, such as an open mesh screen, e.g., a wire mesh screen or, alternately, a plastic mesh screen.

An access door 82 may be provided to permit access to filtration member 78 such that filtration member 78 may be cleaned. Access door may be any door that is movably mounted in overlying relationship to filtration chamber 80. As exemplified in Figure 6, access door 82 is pivotally mounted by pivot 90 to pivoting bottom 66, and is secured in position by a latch 120. Latch 120, for example, may have a button 122 which, when pressed, causes arm 124 to move outwardly thereby disengaging a flange on the bottom end of arm 124 from flange 92 provided on the front end of access door 82. A sealing gasket or other sealing member known in the art may be utilized to provide an air tight or fluid tight seal for filtration chamber 80. Any other securing member known in the art may be used. Further, door 82 may be removable and need not be connected to surface cleaning apparatus 10 for relative motion thereto.

Preferably, filtration member 78 is mounted and, more preferably, movably mounted and, most preferably, removably mounted to access door 82. As shown in Figure 6, filtration member 78 is pivotally mounted to the inner surface of access door 82. Accordingly, when a user desires to clean filtration member 78, it may be pivoted in the direction shown by arrow A in Figure 6 to an open or cleaning position. It will be noticed that access door 82 may be opened independently of pivoting bottom 66. In an alternate embodiment, it will be appreciated that a pivoting bottom 66 need not be provided.

Preferably, at least a portion of and, more preferably, all of access door 82 is transparent. Accordingly, a user may lift the vacuum cleaner, invert the vacuum cleaner or tilt the vacuum cleaner on its side to view filtration member 78 and determine whether filtration 78 requires cleaning or, alternately, replacement.

In accordance with any embodiment of this invention, a series of screening and filtration members may be used in series downstream from the cyclone chamber of cyclone 16. In accordance with this preferred embodiment, the screening and filtration members comprise a screen 78,

which is preferably positioned adjacent outlet 36, a foam filter 22 downstream from screen 78, a felt filter 22 downstream from foam 20 and a HEPA filter 24 downstream from felt filter 22. Preferably, all of these filters are positioned upstream from suction motor 26. Alternately, one or more of these filters may be positioned downstream from suction motor 26. In particular HEPA filter 24 may be downstream from suction motor 26. Accordingly, a plurality of screening and filtration members, each of which have a finer filtration capacity (e.g. smaller pores) are provided in series in the downstream direction. Optionally, a shroud (e.g. a perforated or apertured plastic cover) may be provided surrounding or overlying inlet 50 of outlet 36.

It will be appreciated that the end portion may be openable by any means known in the art. For example, it may be translatable, slidable or removably mounted, such as by a screw or bayonet mount or a snap fit. Preferably, it is not removably mounted, but remains affixed to the filtration housing when opened, such as by being pivotally mounted as exemplified.

It will be appreciated that the end portion may be oriented such that it is the lower portion of the dirt collection chamber 18 (e.g. Figures 1-6 and 9-13) and accordingly comprises a dirt collection surface. However, it need not be, provided that it intersects the longitudinal axis of the cyclone (e.g. Figures 7-8).

It will be appreciated that the end portion may be distal to dirt outlet 28 (e.g., Figures 1-6 and 9-11) or may face dirt outlet 28 (e.g., Figures 7-10).

It will also be appreciated that any of the aforementioned embodiments may be used singly or in any particular combination or sub-combination of the remaining features listed above.

Although the invention has been described in conjunction with specific embodiments thereof, if is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that

fall within the spirit and broad scope of the appended claims. In addition, citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the present invention.

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CLAIMS:

1. A surface cleaning apparatus comprising:
   (a) a dirty air inlet;
   (b) a filtration apparatus comprising a cyclone downstream from the dirty air inlet, the cyclone having a cyclone chamber, a vortex finder, a dirt outlet and a longitudinally extending axis;
   (c) an openable dirt collection chamber in communication with the dirt outlet, the dirt collection chamber having an openable end portion that comprises a wall that is intersected by the longitudinally extending axis, and when the end portion is in an open position, the cyclone chamber has an absence of any member having a larger diameter than the vortex finder whereby the dirt collection chamber and the cyclone are concurrently emptyable when the dirt collection chamber is opened;
   (d) a suction motor; and,
   (e) a clean air outlet downstream from the suction motor.
2. The surface cleaning apparatus of claim 1 wherein the end portion is pivotally openable.
3. The surface cleaning apparatus of claim 1 or 2 wherein the end portion comprises a dirt collection surface.
4. The surface cleaning apparatus of any of claims 1-3 wherein the end portion is at an end of the dirt collection chamber distal to the dirt outlet.
5. The surface cleaning apparatus of any of claims 1-4 wherein the end portion further comprises the vortex finder.
6. The surface cleaning apparatus of any of claims 1-3 wherein the end portion faces the dirt outlet.
7. The surface cleaning apparatus of any of claims 1-6 wherein the cyclone has an openable portion and the end portion of the dirt collection chamber is openable concurrently with the openable portion of the cyclone.
8. The surface cleaning apparatus of claim 7 wherein the openable portion of the cyclone comprises a cyclone dirt collection surface, the dirt

collection chamber has a moveable dirt collection chamber surface, and the dirt collection chamber surface is moveable concurrently with the cyclone dirt collection surface.

9. The surface cleaning apparatus of claim 1 wherein the end portion comprises a dirt collection surface, the cyclone has a moveable cyclone dirt collection surface, the moveable cyclone dirt collection surface is a floor of the cyclone and the dirt collection surface is a floor of the dirt collection chamber.

10. The surface cleaning apparatus of claim 9 wherein the dirt collection surface and the cyclone dirt collection surface comprise a pivoting bottom of the filtration apparatus.

11. The surface cleaning apparatus of any of claims 9-10 wherein the vortex finder is mounted to the cyclone floor.

12. The surface cleaning apparatus of any of claims 1-11 wherein the vortex finder has an upstream end in the cyclone chamber and an absence of any filtration member in covering relationship thereto.

13. The surface cleaning apparatus of any of claims 1-12 wherein the dirt collection chamber is positioned around at least a portion of the cyclone.

14. The surface cleaning apparatus of claim 13 wherein the dirt collection chamber surrounds the cyclone.

15. The surface cleaning apparatus of any of claims 1-14 wherein the filtration apparatus comprises a plurality of cyclonic cleaning stages and the cyclone comprises a portion of one such stage.

16. The surface cleaning apparatus of any of claims 1-15 wherein the cyclone comprises a first cyclonic cleaning stage and the filtration apparatus comprises a second cyclonic cleaning stage comprising a plurality of cyclones in parallel.

17. The surface cleaning apparatus of any of claims 1-16 wherein the cyclone is inverted and the dirt outlet is in an upper portion of the cyclone.

18. The surface cleaning apparatus of any of claims 1-17 wherein the cyclone has an air inlet at one end of the cyclone and the dirt outlet is provided in a sidewall of the cyclone spaced from the air inlet, the cyclone has an

cyclone dirt collection surface that is openable concurrently with the end portion.

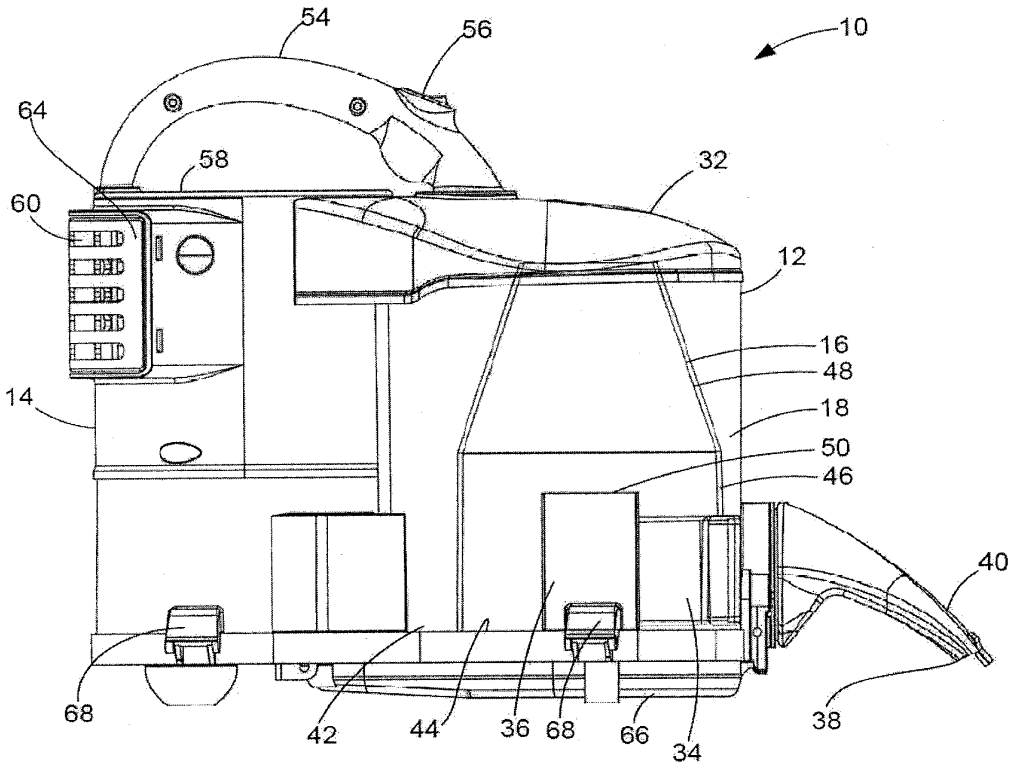

Figure 1

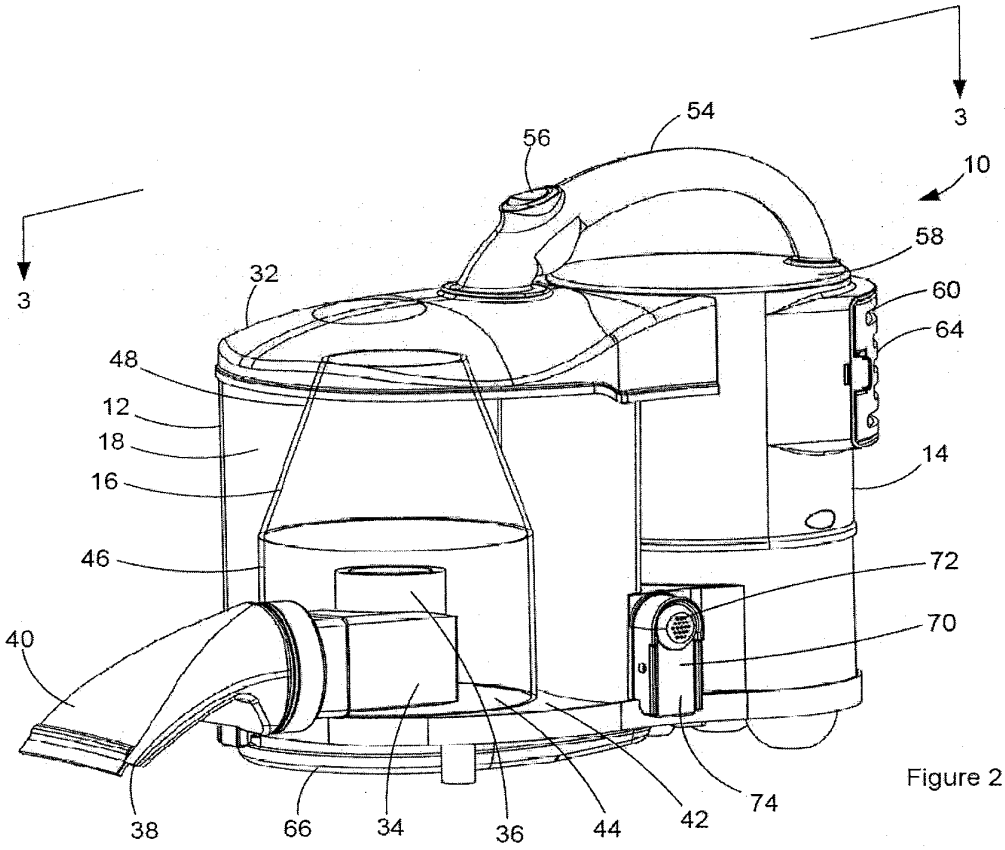

Figure 2

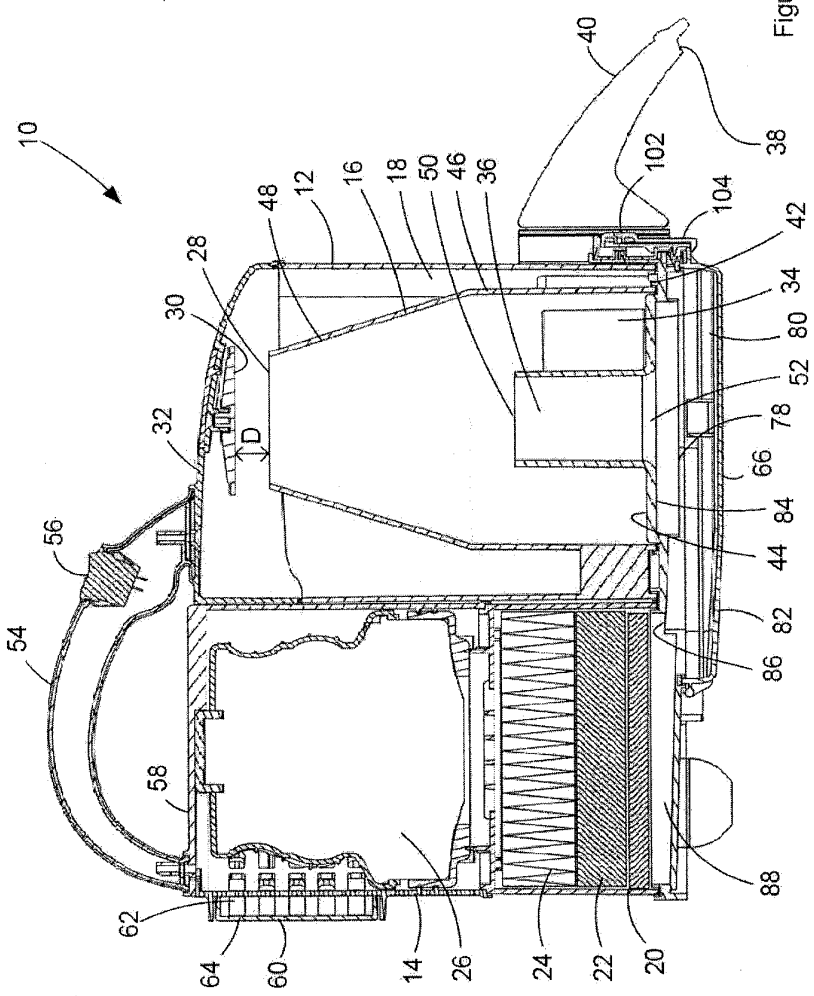
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Figure 3

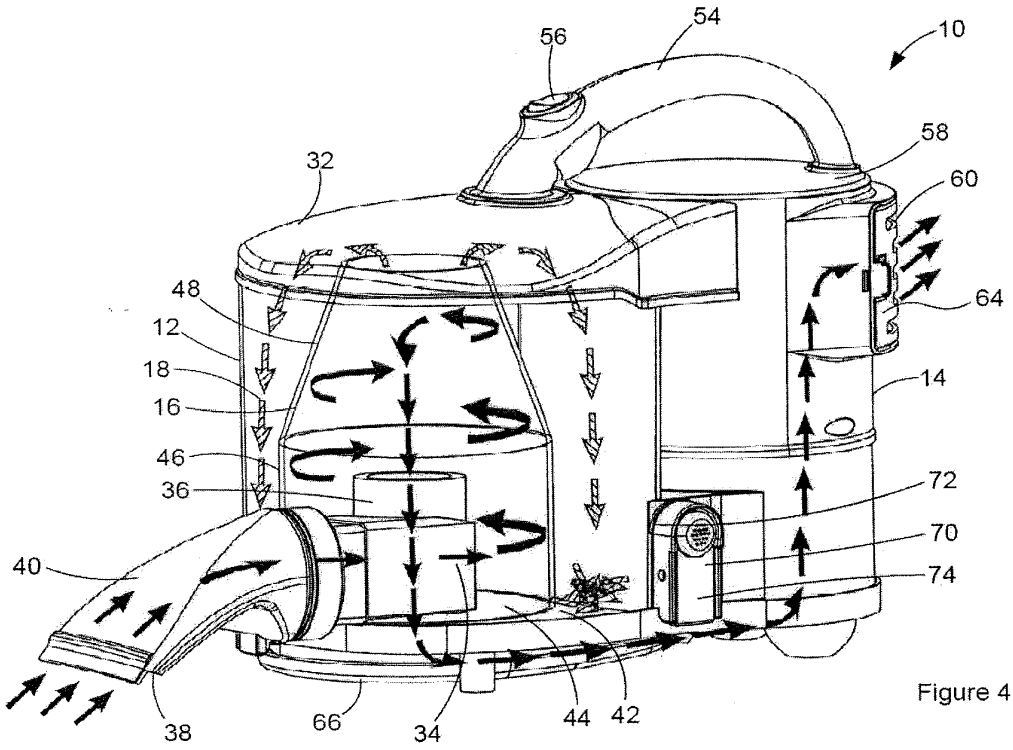


Figure 4

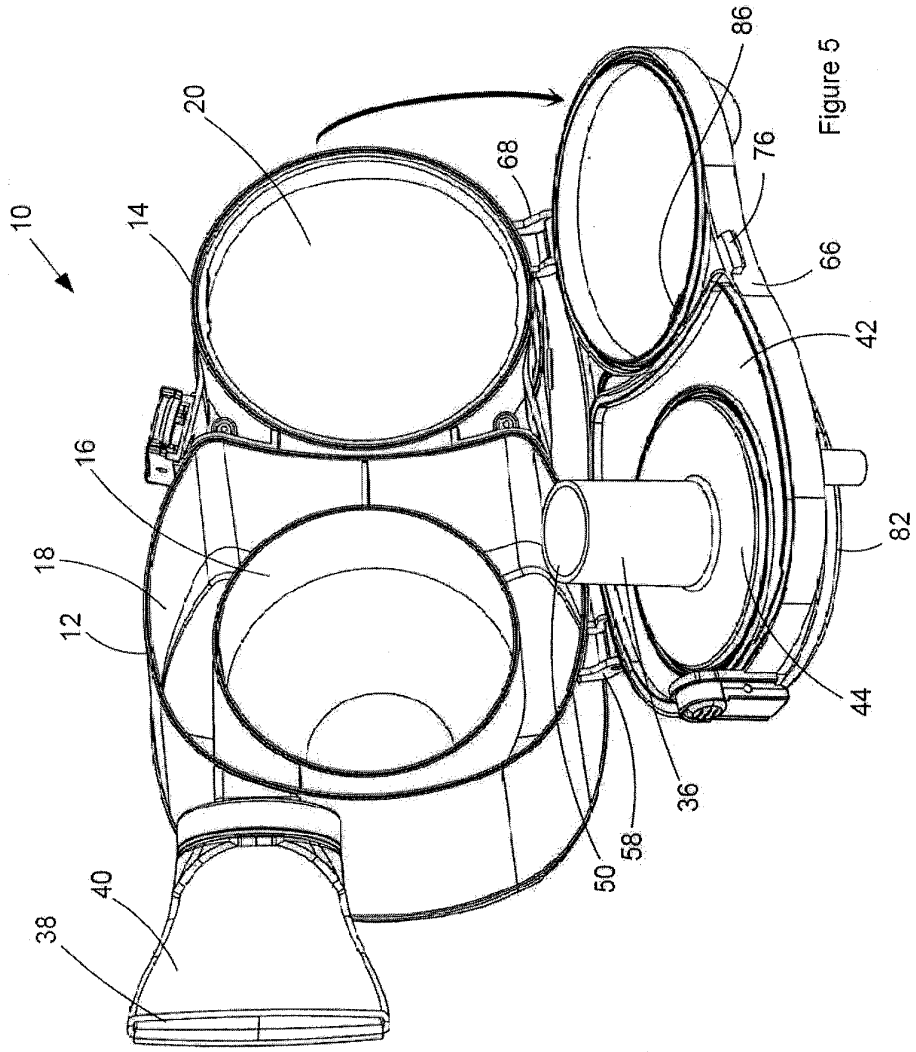


Figure 5

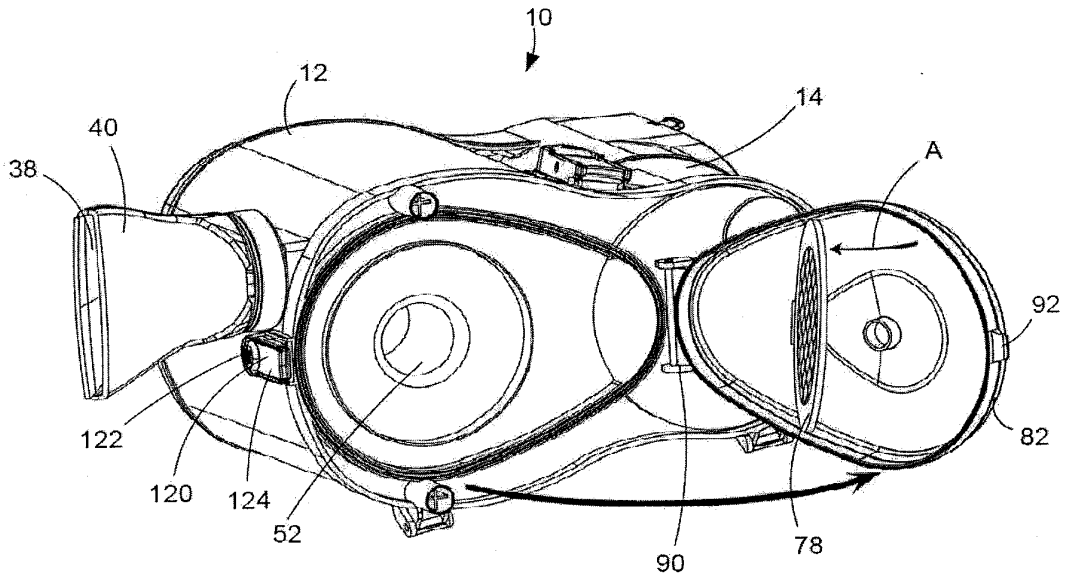


Figure 6

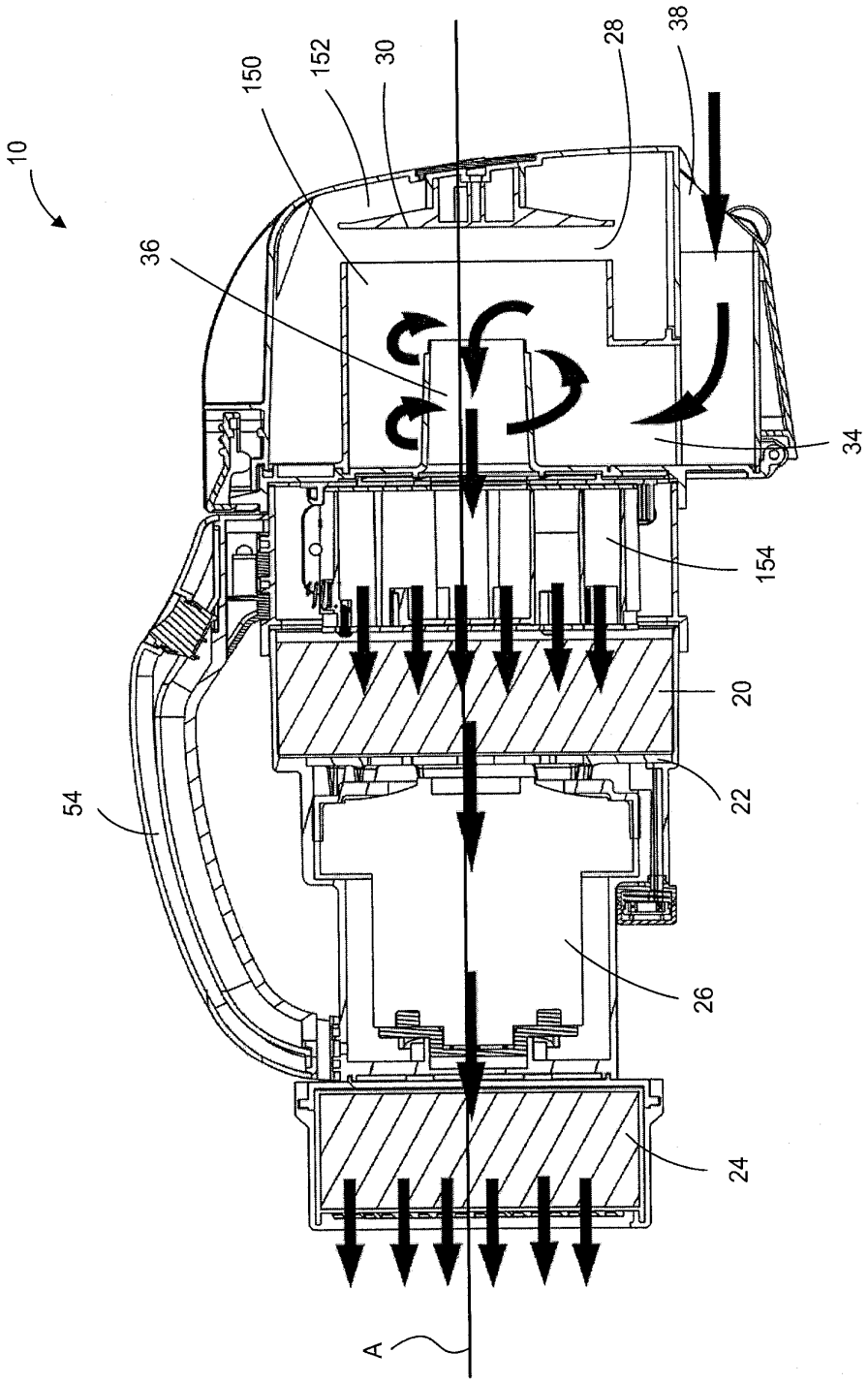


Fig. 7

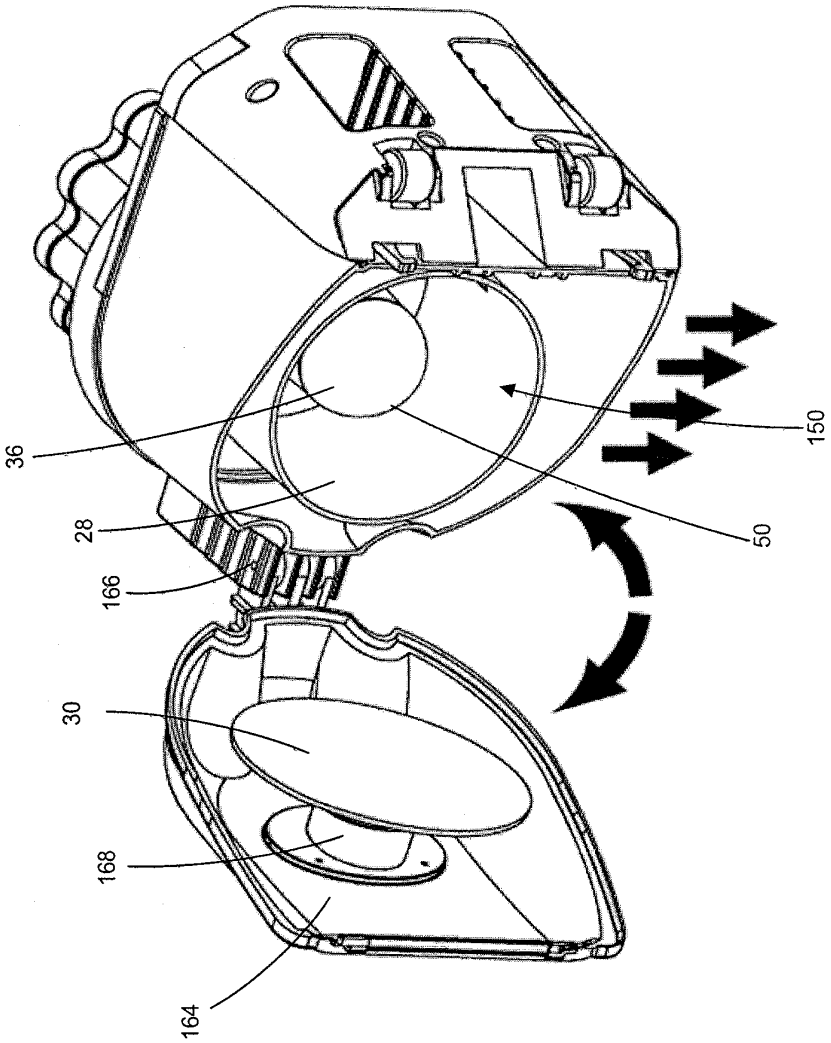


Fig. 8

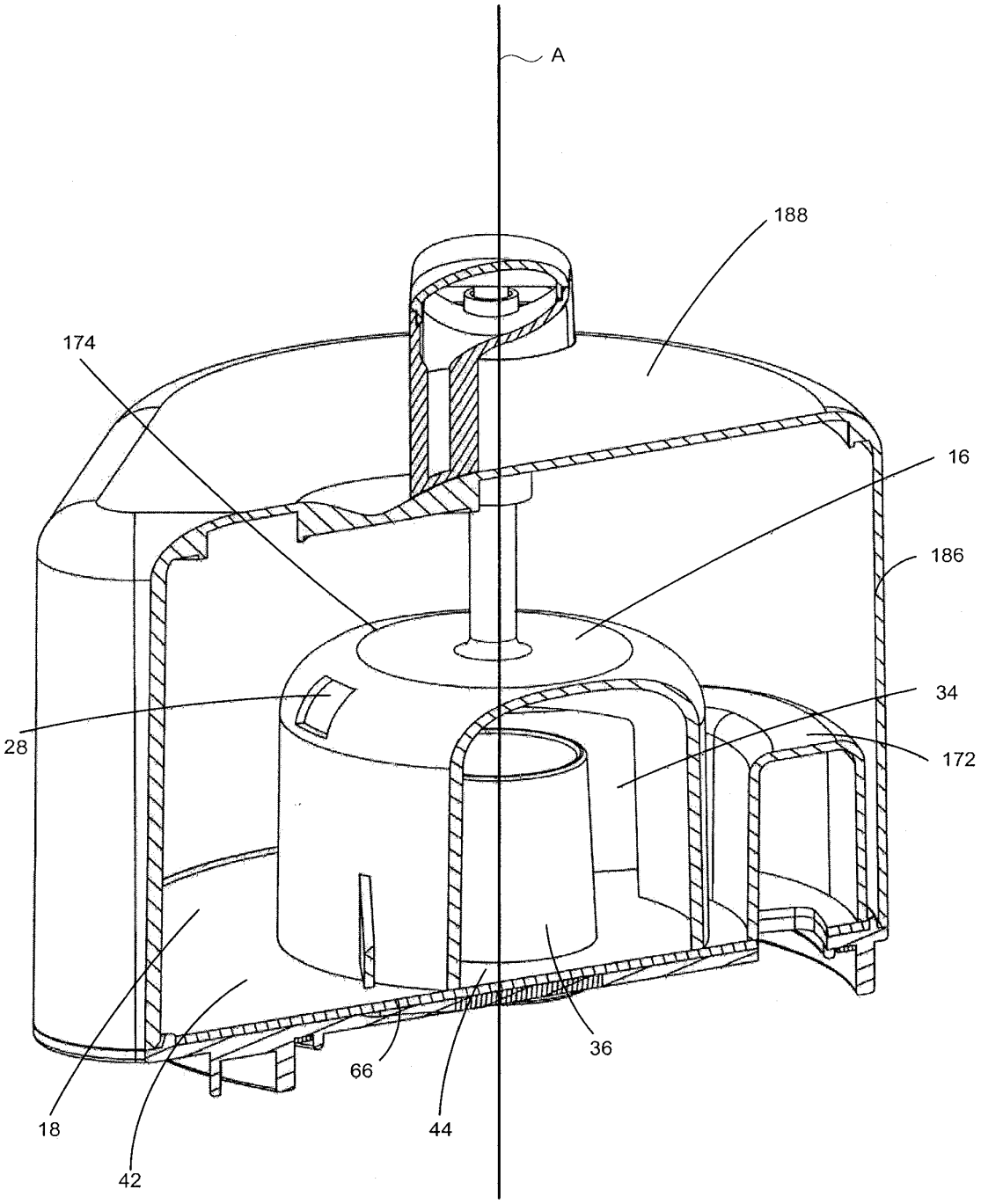


Fig. 9

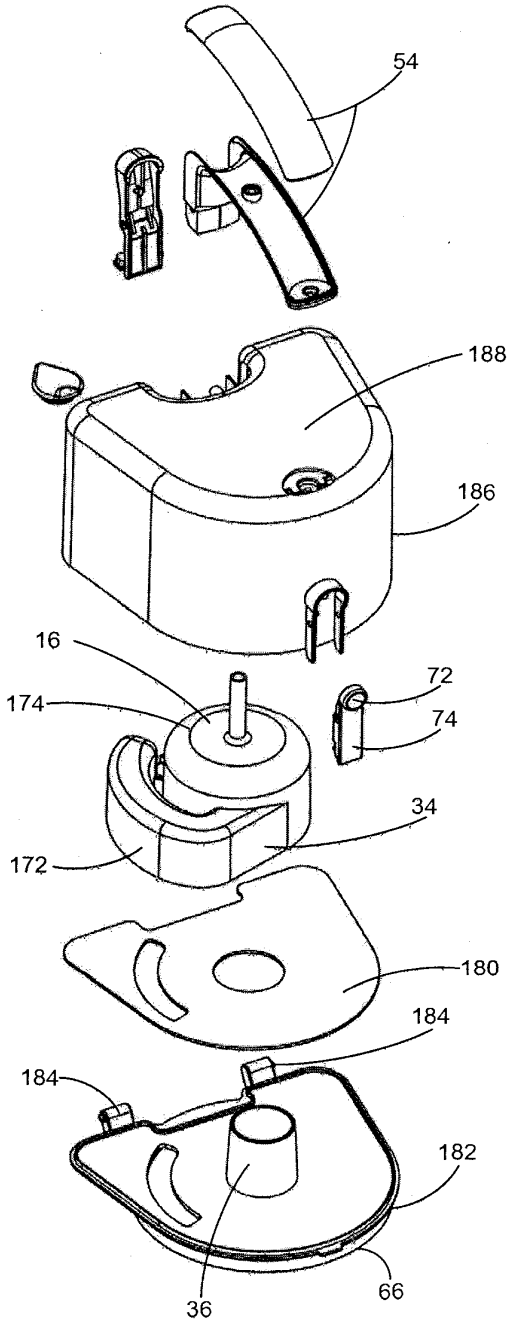


Fig. 10

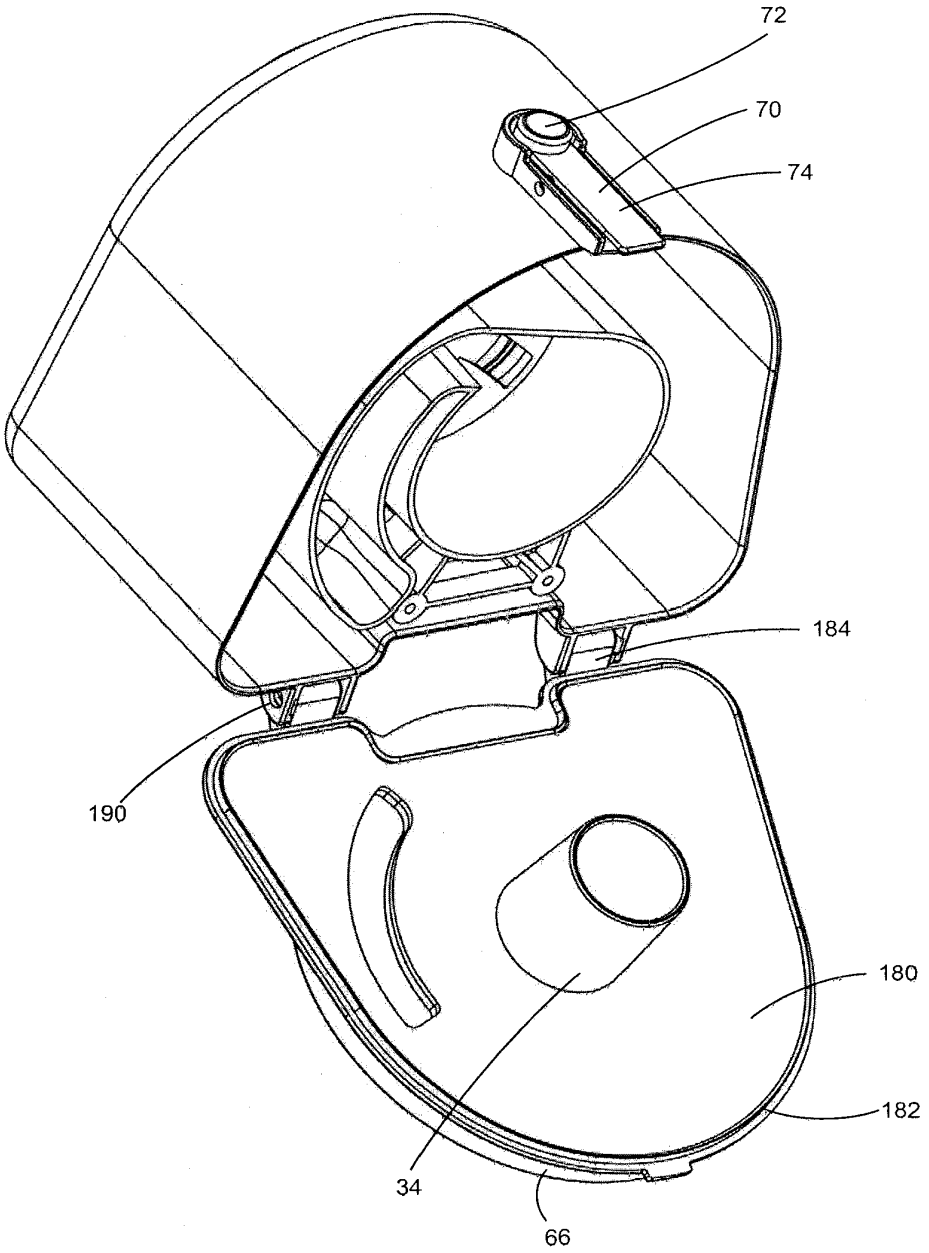


Fig. 11

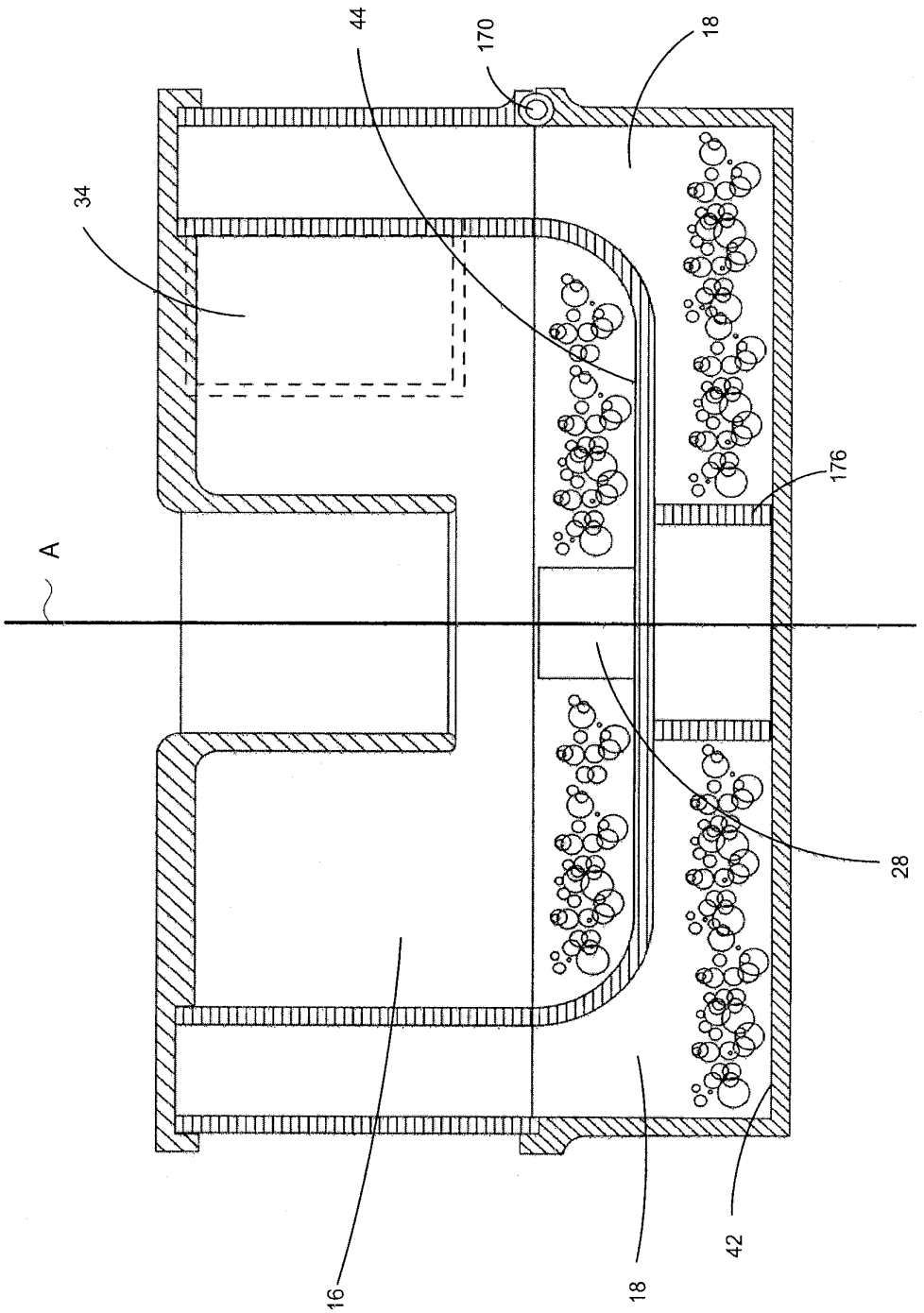
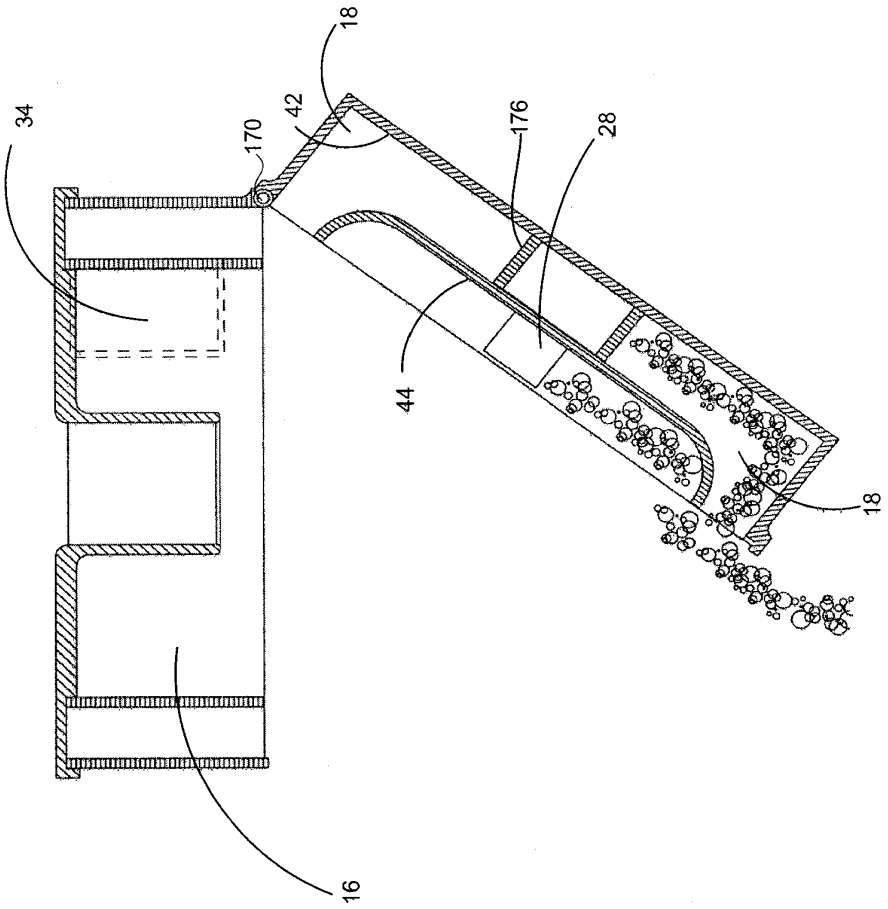


Fig. 12

Fig. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2008/001530

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***A47L 9/16*** (2006.01) , ***A47L 5/12*** (2006.01) , *A47L 9/20* (2006.01)
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: ***A47L 9/16*** (2006.01), ***A47L 9/10*** (2006.01), ***A47L 9/00*** (2006.01)
USPC: 15/353, 15/340, 15/350

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
"dirt" and "collection", "cyclone"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3320727 B1 (FARLEY ET AL.) 23 May 1967 (23-05-1967) whole specification	1 to 4, 6, 10, 12 to 16

[ ] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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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
5 December 2008 (05-12-2008)	11 December 2008 (11-12-2008)

Name and mailing address of the ISA/CA	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Mark Janczarski 819- 953-8842

Dyson Ex1020
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2008/001530

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US 3320727A	23-05-1967	None	

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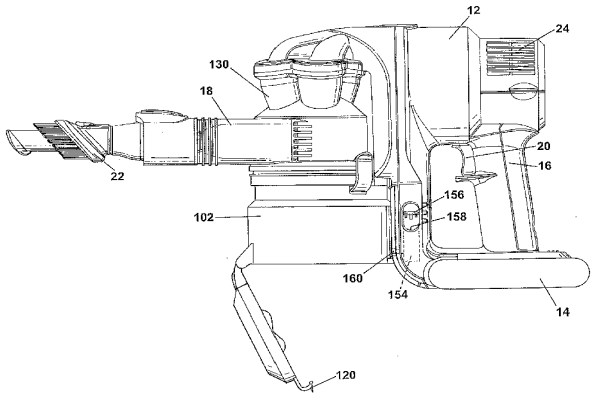
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HANDHELD CLEANING APPLIANCE



(57) Abstract: The invention provides a handheld cleaning appliance (10) comprising a dirty air inlet (18), a clean air outlet (24) and separating apparatus (100) for separating dirt and dust from an airflow in an airflow path leading from the air inlet (18) to the air outlet (24). The separating apparatus (100) comprises a cyclonic separator having at least one cyclone (102) and a collector (105). The collector (105) has a wall (104) and a base member (116), the base member (116) being held in a closed position by means of a catch (120) and being pivotably connected to the wall (104). The appliance further includes a main body (12) which incorporates an actuator (152) for operating the catch (120). The actuator (152) comprises a slidably mounted rod (154) which is movable between an inoperative position and an actuating position in which the rod (154) contacts part of the catch (120) so as to allow the collector (105) to be opened for emptying purposes. This arrangement allows the catch (120) to be released without the user actually touching the collector (105). It also provides a compact, reliable mechanism for remotely emptying the collector (105) in a cost-efficient manner.

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Handheld Cleaning Appliance

The invention relates to a handheld cleaning appliance particularly, but not exclusively, to a handheld vacuum cleaner. More particularly, the invention relates to a handheld cleaning appliance having a cyclonic separator.

Handheld vacuum cleaners are well known and have been manufactured and sold by various manufacturers for several years. Typically, a handheld vacuum cleaner comprises a casing which houses a motor and fan unit for drawing air into the cleaner via an inlet, and a separation device such as a filter or bag for separating dirt and dust from the incoming airflow. An example of such a vacuum cleaner is shown in GB1207278.

Handheld vacuum cleaners have more recently been developed to incorporate cyclonic separation systems which are capable of removing larger items of debris from the airflow before removing finer particles using a filter or other barrier means. An example of such a device is sold by Black & Decker under the trade name DUSTBUSTER®. Further examples of handheld vacuum cleaners incorporating cyclonic separators are shown in GB2035787A and WO2006/076363.

A disadvantage of known handheld vacuum cleaners which utilise cyclonic separators is that emptying the appliance of dirt and dust collected therein can be awkward, inconvenient and messy. In some cases, a compartment of the appliance must be physically removed from the rest of the appliance, transported to a suitable receptacle, emptied and then replaced on the appliance. Removal of a portion of the appliance inevitably carries with it a risk that the portion will not be replaced correctly and this can adversely affect the performance of the appliance. In other arrangements, the opening of the compartment in which the dirt and dust is collected involves awkward manipulation of the appliance as a whole. When the appliance has been designed for ease of handling during the cleaning operation, the emptying process can increase the

risk of the appliance being inadvertently dropped and broken during emptying. It is therefore an object of the invention to provide a handheld cleaning appliance which is easier and more convenient to empty than known handheld vacuum cleaners.

The invention provides a handheld cleaning appliance comprising a dirty air inlet, a clean air outlet and separating apparatus for separating dirt and dust from an airflow in an airflow path leading from the air inlet to the air outlet, the separating apparatus comprising a cyclonic separator having at least one cyclone and a collector having a wall and a base member, the base member being held in a closed position by means of a catch and being pivotably connected to the wall, the appliance further including a main body which incorporates an actuator for operating the catch, characterized in that the actuator comprises a slidably mounted rod which is movable between an inoperative position and an actuating position in which the rod contacts part of the catch so as to allow the collector to be opened for emptying purposes.

This arrangement allows the catch to be released without the user actually touching the collector. It also provides a compact, reliable mechanism for remotely emptying the collector in a cost-efficient manner.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a handheld cleaning appliance according to the invention;

Figure 2 is a side view of the appliance of Figure 1;

Figure 3 is a side view of the appliance of Figure 1 showing the collector base in an open position; and

Figure 4 is a longitudinal cross section through the cyclonic separating apparatus forming part of the appliance of Figure 1.

Figures 1 to 3 show a handheld vacuum cleaner 10. The handheld vacuum cleaner 10 has a main body 12 which houses a motor and fan unit (not shown). The main body 12 also includes a power source 14 such as a battery. A handle 16 is provided on the main body 12 for manipulating the handheld vacuum cleaner 10 in use. A cyclonic separator 100 is attached to the main body 12. A dirty air inlet 18 extends from a portion of the cyclonic separator 100 remote from the main body 12. A brush tool 22 is slidably mounted on the distal end of the dirty air inlet 18. A set of exhaust vents 24 are provided on the main body 12 for exhausting air from the handheld vacuum cleaner 10.

The cyclonic separator 100 is located between the main body 12 and the dirty air inlet 18. Consequently, the cyclonic separator 100 is located between the handle 16 and the dirty air inlet 18. The cyclonic separator 100 has a longitudinal axis 26 which extends in a generally upright direction so that the axis 26, and therefore the cyclonic separator 100, lies substantially parallel to the direction in which the handle 16 extends.

The orientation of the handle 16 is such that, when the user grips the handle 16, the user's hand forms a fist in a manner similar to that adopted when gripping a saw. This ensures that the user's wrist is not strained more than necessary when manipulating the handheld vacuum cleaner 10 for cleaning purposes. The cyclonic separator 100 is positioned close to the handle 16 which also reduces the moment applied to the user's wrist when the handheld vacuum cleaner 10 is in use. The handle 16 carries an on/off switch 20 in the form of a trigger for turning the vacuum cleaner motor on and off.

The cyclonic separating apparatus 100 forming part of the handheld vacuum cleaner 10 is shown in more detail in Figure 4. The cyclonic separating apparatus 100 comprises a first cyclone 102 which has a longitudinal axis X-X and a collector 105 having a wall 104. An inlet 110 is formed in the upper portion of the wall 104. The inlet 110 is in communication with the dirty air inlet 18 and forms a communication path between the dirty air inlet 18 and the interior of the first cyclone 102. The air inlet 110 is arranged

tangentially to the first cyclone 102 so that the incoming air is forced to follow a helical path around the interior of the first cyclone 102.

A base 116 closes the collector 105 at one end of the first cyclone 102. The base 116 is pivotably mounted on the lower end of the wall 104 by means of a hinge 118. The base 116 is retained in a closed position (as shown Figures 1, 2 and 4) by means of a catch 120 which interengages with a lip 150 located on the wall 104. The catch 120 is resiliently deformable so that, in the event that downward pressure is applied to the uppermost portion of the catch 120, the catch will move away from the lip 150 and become disengaged therefrom. In this event, the base 116 will drop away from the wall 104.

An actuator 152 is provided in the main body 12. It is shown schematically in Figures 3 and 4. Essentially, the actuator 152 comprises a rod 154 which is slidably mounted inside a part of the main body 12 so as to be movable between a first, inoperative position and a second, operative or actuating position. The first position is shown in Figure 4. The rod 154 is biased into the first position by a spring or other resilient means which are not shown in the drawings. At or near its upper end, the rod 154 carries a projection 156 which extends laterally away from the rod 154 and projects through an aperture 158 in the main body 12 (see Figures 2 and 3). The rod 154 also carries, at its lower end, another projection 160 which extends towards the collector 105 and the catch 120. It also projects through another aperture in the main body 12 so that, when the rod 154 is moved into the second position, the projection 160 comes into contact with the catch 120 and presses it downwardly so that the catch 120 is released from the lip 150.

The rod 154 is moved from the first position to the second position manually by means of the user pressing the projection 156 in a downwards direction against the action of the spring. This causes the catch 120 to be released from the lip 150 and the base 116 then swings away from the wall 104. The catch 120 can also be arranged so that further downward movement of the rod 154 will apply an opening force to the catch 120. This

is advantageous in that the seal between the base 116 and the wall 104 will then be broken to allow the base to swing open more freely.

Upon release of the pressure applied by the user to the projection 156, the rod 154 returns to the first position under the action of the spring. The base 116 can be returned to the closed position manually by the user whereupon the catch will re-engage with the lip 150. The presence of the hinge 118 means that the base 116 remains automatically aligned with the wall 104 so that there is little or no risk that the base 116 will be incorrectly positioned when it is returned to the closed position.

A shroud 121 is located inwardly of the wall 104 of the first cyclone 102. The shroud 121 comprises a part-cylindrical, part-frustoconical wall 122 having a plurality of through-holes 123. The shroud 121 surrounds an outlet 124 from the first cyclone 102. The outlet 124 provides a communication path between the first cyclone 102 and a second cyclone assembly 126. A lip 128 is provided at the base of the shroud 121. The lip 128 has a plurality of through-holes 129 which are designed to allow air to pass through but to capture dirt and dust.

The second cyclone assembly 126 comprises a plurality of second cyclones 130 arranged in parallel with one another. In this embodiment, six second cyclones 130 are provided. The second cyclones 130 are arranged around the axis X-X of the first cyclone 102. The arrangement of the second cyclones 130 is such that the second cyclones 130 are spaced equi-angularly around the axis X-X. Each second cyclone 130 has a tangentially-arranged air inlet and an air outlet (not shown) located at a first end of the respective second cyclone 130. A cone opening 136 is located at a second end of each second cyclone 130. The plane of the cone opening 136 of each second cyclone 130 is inclined with respect to a longitudinal axis (not shown) of the respective further cyclone 130. The cone opening 136 of each of the second cyclones 130 is in communication with a passageway 138 defined by a wall 140 located inwardly of the shroud 121.

The second end of each second cyclone 130 projects into the interior of the first cyclone 102. However, the first end of each second cyclone 130 lies outside the envelope of the first cyclone 102. In the orientation shown, it is the lower end of each second cyclone 130 which projects into the upper end of the first cyclone 102. The inlet 110 is also arranged at the upper end of the first cyclone 102 so that the inlet 110 is located in the region of the cyclonic separator 100 in which the first and second cyclones 102, 130 overlap. Because the first ends of the second cyclones 130 lie outside the envelope of the first cyclone 102, this region of the cyclone separator 100 lies intermediate the upper end of the cyclone separator 100 and the lower end of the cyclone separator 100. Connecting the dirty air inlet 18 to the cyclone separator 100 at an intermediate portion thereof is beneficial for the manipulation of the handheld vacuum cleaner 10 and avoids the lower extremities of the appliance being accidentally knocked on surfaces away from the area being cleaned.

A collector 142 is located at the lower end of the passageway 138. The collector 142 comprises a frustoconical first portion 144 and a cylindrical second portion 146. The interior of the collector 142 is delimited by the base 116 and the sides of the first and second portions 144, 146 of the collector 142.

Each of the air outlets of the second cyclones 130 is in communication with a duct 150. The duct 150 provides an airflow path from the cyclonic separating apparatus 100 into other parts of the handheld vacuum cleaner 10. Located at the downstream end of the duct 150 is a pre-motor filter 152. The pre-motor filter 152 comprises a porous material such as foam and can also include a fine filter material. The pre-motor filter 152 is designed to prevent any fine dust particles from entering the motor and causing damage thereto.

In use, when the on/off switch 20 is depressed, the motor and fan unit draws a flow of dirt-laden air into the dirty air inlet 18 and then into the cyclonic separator 100. Dirt-laden air enters the cyclonic separator 100 through the inlet 110. Due to the tangential arrangement of the inlet 110, the airflow is forced to follow a helical path around the

interior of the wall 104. Larger dirt and dust particles are separated by cyclonic motion around the wall 104. These particles are then collected at the base 116 of the first cyclone 102.

The partially-cleaned airflow then flows back up the interior of the first cyclone 102 and exits the first cyclone 102 via the through-holes 123 in the shroud 121. Once the airflow has passed through the shroud 121, it enters the outlet 124 and from there is divided between the tangential inlets of each of the second cyclones 130. Each of the second cyclones 130 has a diameter which is smaller than that of the first cyclone 102. Therefore, the second cyclones 130 are able to separate smaller particles of dirt and dust from the partially-cleaned airflow than the first cyclone 102. Separated dirt and dust exits the second cyclones 130 via the cone openings 136. Thereafter, the separated dirt and dust passes down the passageway 138 and into the collector 142. The separated dirt and dust eventually settles at the bottom of the collector 142 on the base 116.

Cleaned air then flows back up the second cyclones 130, exits the second cyclones 130 through the air outlets and enters the duct 150. The cleaned air then passes from the duct 150 sequentially through the pre-motor filter 152, the motor and fan unit, and a post-motor filter before being exhausted from the vacuum cleaner 10 through the air vents 24.

The first cyclone 102 and the collector 142 can be emptied simultaneously by releasing the catch 120 to allow the base 116 to pivot about the hinge 118 so that the separated dirt and dust can fall away from the cyclonic separator 100. This is done by the user pressing the projection 156 in a downwards direction against the biasing action of the spring so as to cause the other projection 160 to come into contact with the catch 120. The catch 120 is resiliently deformed away from the lip 150 and is this released therefrom. Further downward movement of the projection 156 ensures that the seal between the base 116 and the wall 104 is broken and the base 116 then swings downwardly away from the wall 104. The dirt and dust collected in the cyclonic separator 100 then falls out of the first cyclone 102 and the collector 142. By

positioning the cleaning appliance 10 above a suitable dirt receptacle such as a dustbin, the dirt and dust collected in the cyclonic separator can be efficiently and reliably emptied.

When the cyclonic separator 100 has been emptied as described above, the user may close the cyclonic separator 100 by moving the base 116 back into the closed position shown in Figures 1 and 2 by hand. Alternatively, the cleaning appliance may be manipulated so as to swing the base 116 into the closed position. A further alternative would be to place the appliance onto a surface so as to apply a closing force to the base 116 and thereby bring the base 116 into latching contact with the lip 150. The presence of the hinge 118 enables the cyclonic separator 100 to be emptied and subsequently closed without any serious risk of misalignment of the base 116. Misalignment of the base 116 would jeopardise the performance of the appliance.

The invention is not limited to the precise details of the embodiment described above. For example, the number of first and second cyclones can be varied, as can the detail of their design, such as their cone angle, axis inclination and cone opening inclination. The shape of the collector and base can be altered, as can the precise location of the hinge and catch and the location of the actuator. The location of the on/off switch may also be varied.

CLAIMS

1. A handheld cleaning appliance comprising a dirty air inlet, a clean air outlet and separating apparatus for separating dirt and dust from an airflow in an airflow path leading from the air inlet to the air outlet, the separating apparatus comprising a cyclonic separator having at least one cyclone and a collector having a wall and a base member, the base member being held in a closed position by means of a catch and being pivotably connected to the wall, the appliance further including a main body which incorporates an actuator for operating the catch, characterized in that the actuator comprises a slidably mounted rod which is movable between an inoperative position and an actuating position in which the rod contacts part of the catch so as to allow the collector to be opened for emptying purposes.

2. A handheld cleaning appliance as claimed in claim 1, wherein the base is hinged to the wall on a first side thereof.

3. A handheld cleaning appliance as claimed in claim 2, wherein the catch is provided at a location which is diametrically opposed to the hinge.

4. A handheld appliance as claimed in any one of the preceding claims, wherein the rod is biased into the inoperative position

5. A handheld appliance as claimed in any one of the preceding claims, wherein the rod comprises a projection which is manually movable with respect to the main body.

6. A handheld appliance as claimed in any one of the preceding claims, wherein the rod is located inside a part of the main body.

7. A handheld appliance as claimed in any one of the preceding claims, wherein a portion of the collector lies adjacent a portion of the main body.

8. A handheld cleaning appliance substantially as hereinbefore described with reference to the accompanying drawings.

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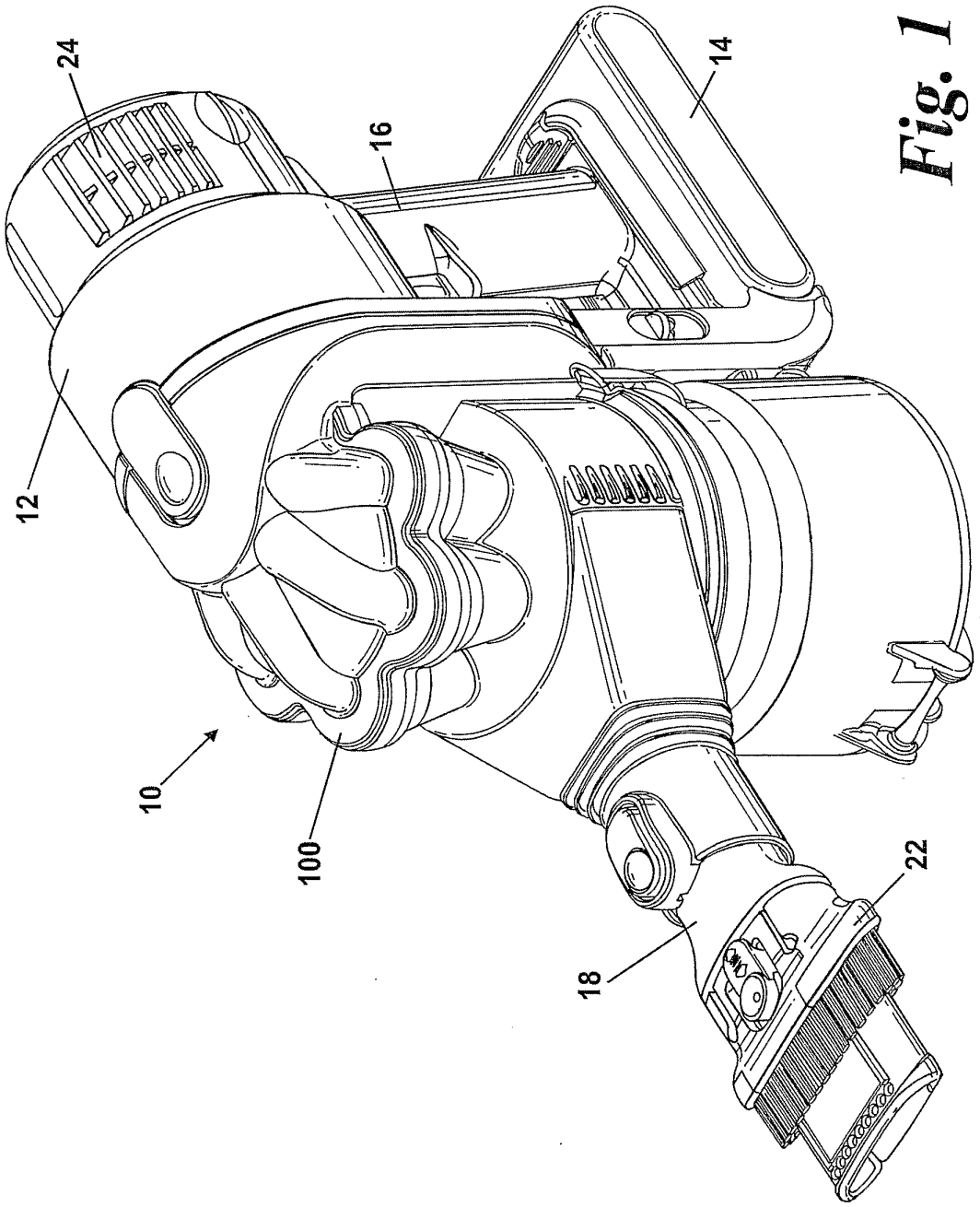

Fig. 1

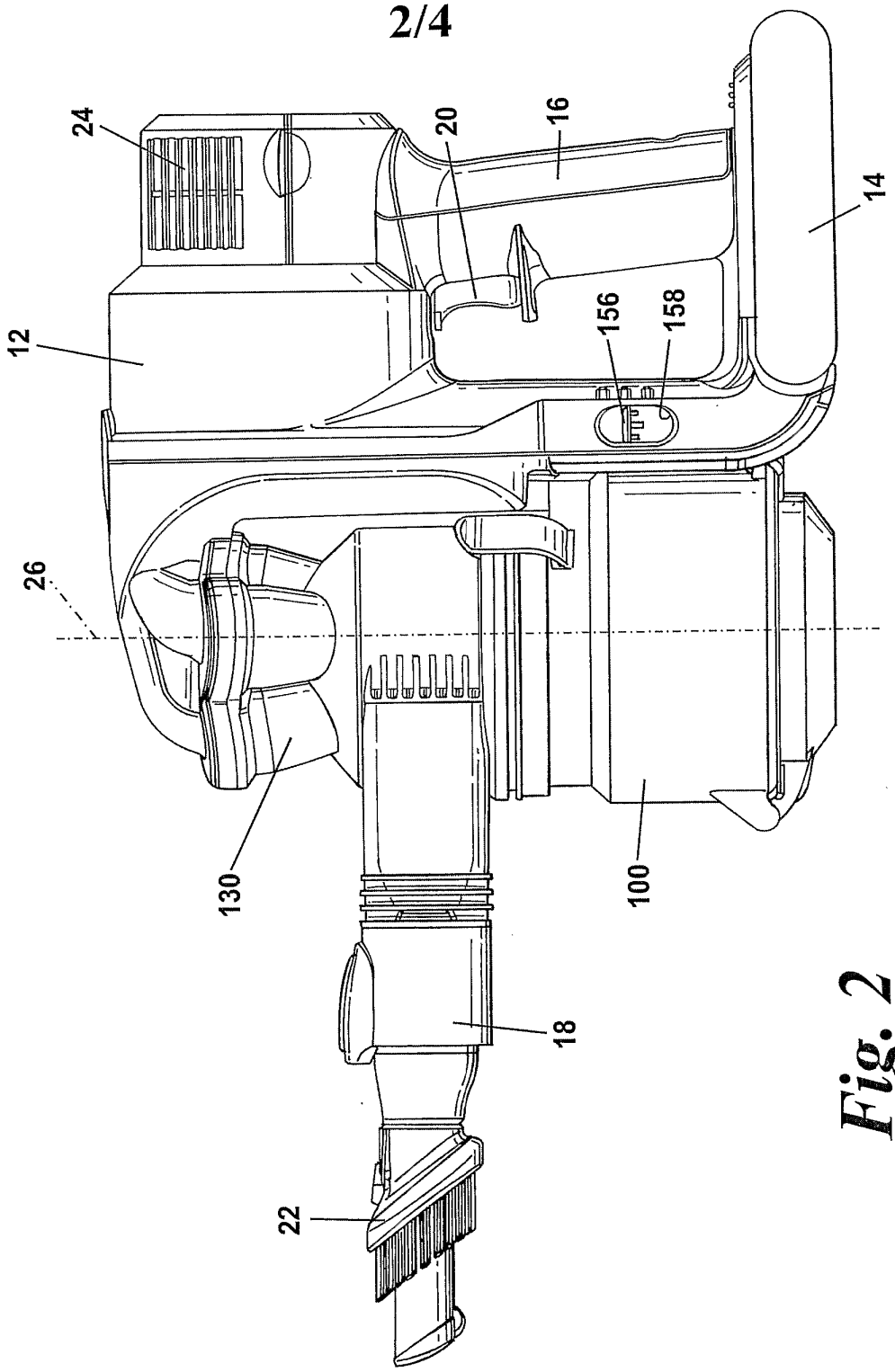

Fig. 2

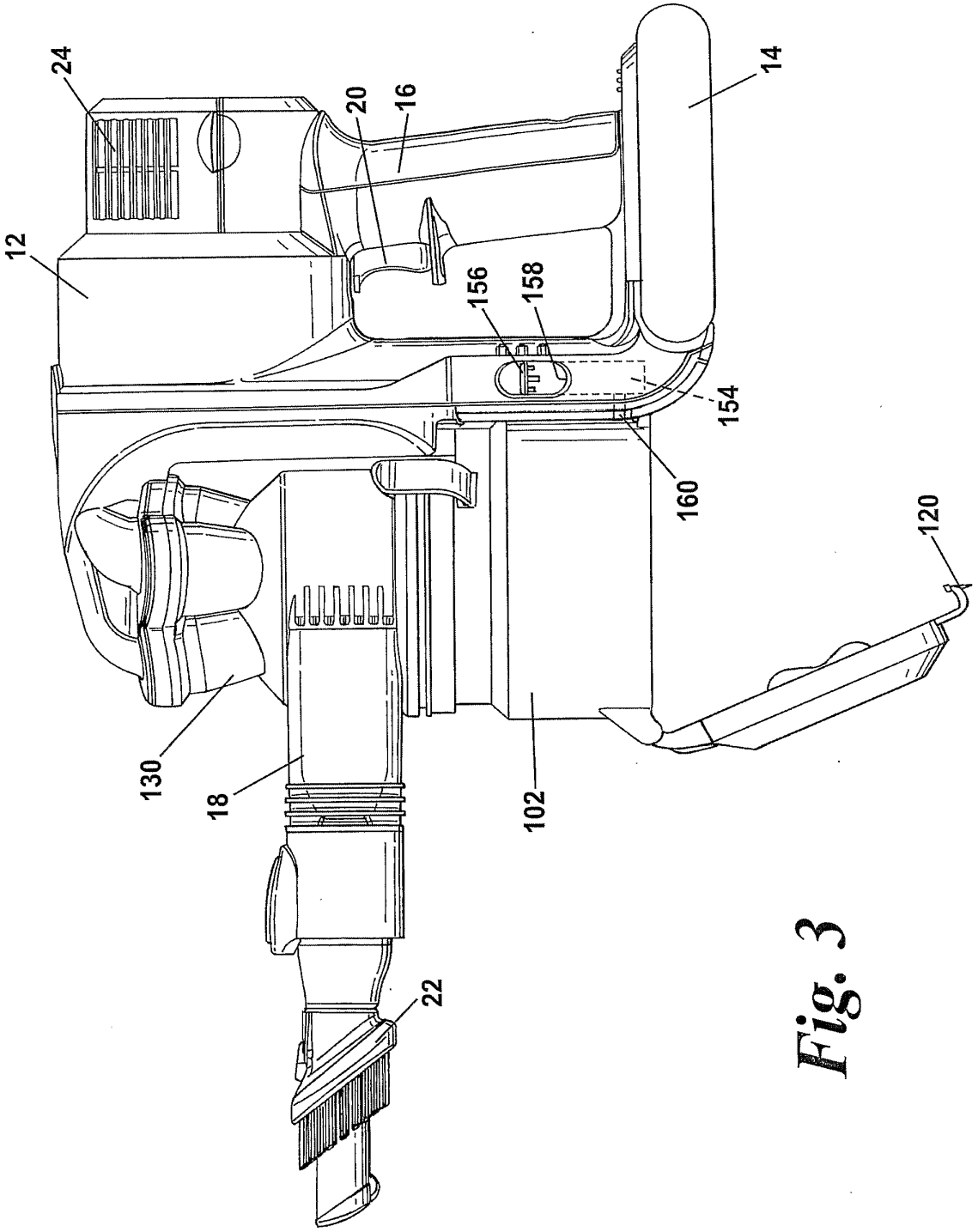

Fig. 3

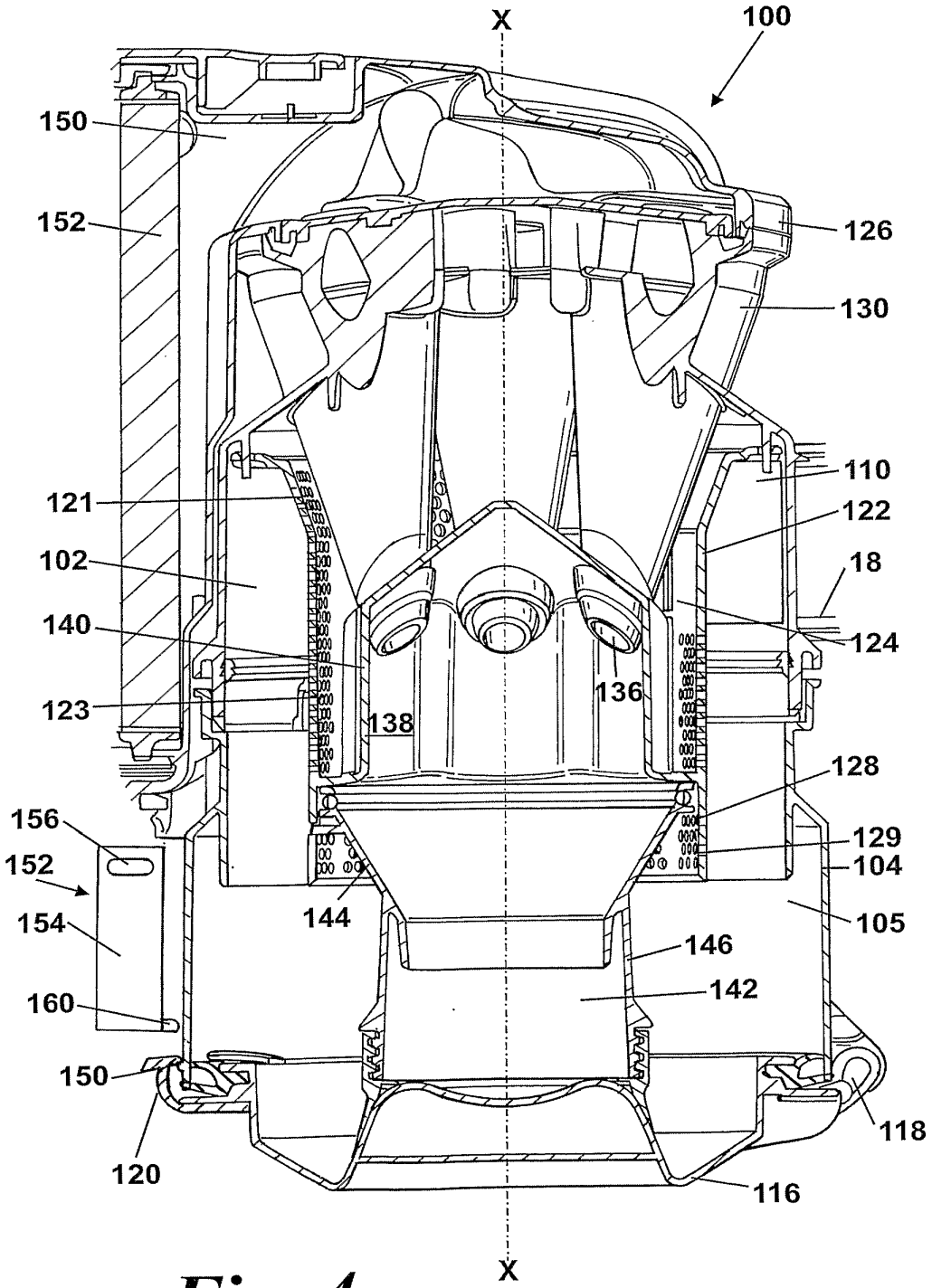
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Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002543

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24 A47L9/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 035 787 A (L & H DESIGNS LTD & MERRITT H) 25 June 1980 (1980-06-25) cited in the application page 1, line 24 - line 57; figure 3 page 2, line 61 - line 66	1-8
Y	US 2005/229355 A1 (CROUCH JAMES T [US] ET AL) 20 October 2005 (2005-10-20) paragraph [0033] paragraph [0035]; figures 2b,3,4b	1-8
A	GB 1 207 278 A (NEMEJANSKI ARIANE SABINE [FR]) 30 September 1970 (1970-09-30) cited in the application the whole document	1-8

☐ 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

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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

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"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.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 September 2007	08/10/2007

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	Clarke, Alister

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2007/002543

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2035787 A	25-06-1980	NONE	
US 2005229355 A1	20-10-2005	NONE	
GB 1207278 A	30-09-1970	BE 724560 A	02-05-1969
		CH 479231 A	30-09-1969
		DE 1812748 A1	21-08-1969
		ES 160126 Y	16-05-1971
		FR 1554851 A	24-01-1969
		LU 57453 A1	21-04-1969
		NL 6817505 A	10-06-1969

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(19) World Intellectual Property Organization
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24 January 2008 (24.01.2008)

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(10) International Publication Number
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A47L 5/24 (2006.01) *A47L 9/16* (2006.01)

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PCT/GB2007/002540

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0614235.0 18 July 2006 (18.07.2006) GB
0618492.3 20 September 2006 (20.09.2006) GB

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(74) Agents: **SMITH, Gillian Ruth** et al.; Dyson Technology Limited, Intellectual Property Department, Tetbury Hill, Malmesbury Wiltshire SN16 0RP (GB).

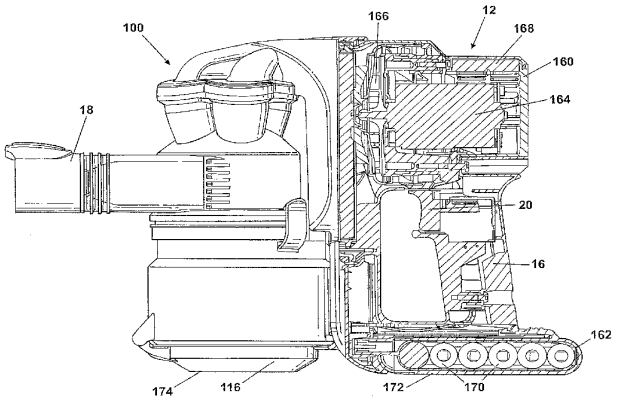
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, 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, MT, 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.

(54) Title: HANDHELD CLEANING APPLIANCE



(57) Abstract: The invention provides a handheld cleaning appliance (10) comprising a main body (12), a dirty air inlet (18), a clean air outlet (24) and a cyclonic separator (100) for separating dirt and dust from an airflow located in an airflow path leading from the air inlet (18) to the air outlet (24). The cyclonic separator (100) is arranged in a generally upright orientation. A base surface (172) of the main body (12) and a base surface (174) of the cyclonic separator (100) together form a base surface of the appliance (10) for supporting the appliance (10) on a surface. By providing a base surface of the appliance (10), which is made up of the base surface (172) of the main body (12) and the base surface (174) of the cyclonic separator (100), the appliance (10) is provided with a substantial base surface on which the appliance (10) can be stably and reliably supported. This is also achieved without substantially increasing the size of the appliance (10) as a whole.

WO 2008/009890 A1

Handheld Cleaning Appliance

The invention relates to a handheld cleaning appliance particularly, but not exclusively, to a handheld vacuum cleaner. More particularly, the invention relates to a handheld cleaning appliance having a cyclonic separator.

Handheld vacuum cleaners are well known and have been manufactured and sold by various manufacturers for several years. Typically, a handheld vacuum cleaner comprises a casing which houses a motor and fan unit for drawing air into the cleaner via an inlet, and a separation device such as a filter or bag for separating dirt and dust from the incoming airflow. An example of such a vacuum cleaner is shown in GB1207278.

Handheld vacuum cleaners have more recently been developed to incorporate cyclonic separation systems which are capable of removing larger items of debris from the airflow before removing finer particles using a filter or other barrier means. An example of such a device is sold by Black & Decker under the trade name DUSTBUSTER®. These vacuum cleaners are generally elongate in shape with a handle at or near a first end and a dirty air inlet located at the end remote from the handle. The cyclonic separator is therefore commonly arranged generally in a horizontal direction. This can affect the performance of the cyclonic separator or its capacity to collect dirt and dust.

A further example of a handheld vacuum cleaner incorporating a cyclonic separator is shown in GB2035787A. In this arrangement, the cyclonic separator is arranged in an upright configuration and has a base surface on which the appliance can be supported. However, the base surface of the cyclonic separator is relatively small in comparison to the appliance as a whole and the appliance is therefore relatively unstable when balanced on the base surface of the cyclonic separator.

It is therefore an object of the present invention to provide a handheld cleaning appliance incorporating a cyclonic separator which is oriented in a generally upright configuration for improved capacity and performance, the appliance being more convenient and stable to store on a flat surface.

The invention provides a handheld cleaning appliance comprising a main body, a dirty air inlet, a clean air outlet and a cyclonic separator for separating dirt and dust from an airflow located in an airflow path leading from the air inlet to the air outlet, the cyclonic separator being arranged in a generally upright orientation, wherein a base surface of the main body and a base surface of the cyclonic separator together form a base surface of the appliance for supporting the appliance on a surface.

By providing a base surface of the appliance, which is made up of a base surface of the main body and a base surface of the cyclonic separator, the appliance is provided with a substantial base surface on which the appliance can be stably and reliably supported. This is also achieved without substantially increasing the size of the appliance as a whole.

Preferably, the base surface of the main body and the base surface of the cyclonic separator are each substantially planar. More preferably, the base surface of the main body lies adjacent the base surface of the cyclonic separator. Still more preferably, the base surface of the main body lies in the plane of the base surface of the cyclonic separator.

In a preferred embodiment, the main body includes a motor and/or battery unit arranged above the base surface of the main body. In this arrangement, the centre of gravity of the motor and/or battery unit passes through the base surface of the main body which enhances the stability of the main body when it is supported on the base surface thereof. More preferably, the motor and/or battery unit is arranged immediately above the base surface of the main body for further enhancing the stability of the main body.

It is also preferred that the width of the base surface of the main body is at least one half of the width of the cyclonic separator. This provides further increased stability of the base surface of the appliance.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 shows a handheld cleaning appliance according to the invention;

Figure 2 is a side view of the appliance of Figure 1;

Figure 3 is a longitudinal cross section through the cyclonic separating apparatus forming part of the appliance of Figure 1;

Figure 4 is a side view similar to Figure 2 but with the main body shown in section; and

Figure 5 is a rear view of the appliance of Figure 1.

Figures 1 and 2 show a handheld vacuum cleaner 10. The handheld vacuum cleaner 10 has a main body 12 which houses a motor and fan unit (not shown). The main body 12 also includes a power source 14 such as a battery. A handle 16 is provided on the main body 12 for manipulating the handheld vacuum cleaner 10 in use. A cyclonic separator 100 is attached to the main body 12. A dirty air inlet 18 extends from a portion of the cyclonic separator 100 remote from the main body 12. A brush tool 22 is slidably mounted on the distal end of the dirty air inlet 18. A set of exhaust vents 24 are provided on the main body 12 for exhausting air from the handheld vacuum cleaner 10.

The cyclonic separator 100 is located between the main body 12 and the dirty air inlet 18. Consequently, the cyclonic separator 100 is located between the handle 16 and the dirty air inlet 18. The cyclonic separator 100 has a longitudinal axis 26 which extends

in a generally upright direction so that the axis 26, and therefore the cyclonic separator 100, lies substantially parallel to the direction in which the handle 16 extends.

The orientation of the handle 16 is such that, when the user grips the handle 16, the user's hand forms a fist in a manner similar to that adopted when gripping a saw. This ensures that the user's wrist is not strained more than necessary when manipulating the handheld vacuum cleaner 10 for cleaning purposes. The cyclonic separator 100 is positioned close to the handle 16 which also reduces the moment applied to the user's wrist when the handheld vacuum cleaner 10 is in use. The handle 16 carries an on/off switch 20 in the form of a trigger for turning the vacuum cleaner motor on and off.

The cyclonic separating apparatus 100 forming part of the handheld vacuum cleaner 10 is shown in more detail in Figure 3. The cyclonic separating apparatus 100 comprises a first cyclone 102 which has a longitudinal axis X-X and a collector 105 having a wall 104. An inlet 110 is formed in the upper portion of the wall 104. The inlet 110 is in communication with the dirty air inlet 18 and forms a communication path between the dirty air inlet 18 and the interior of the first cyclone 102. The air inlet 110 is arranged tangentially to the first cyclone 102 so that the incoming air is forced to follow a helical path around the interior of the first cyclone 102.

A base 116 closes the collector 105 at one end of the first cyclone 102. The base 116 is pivotably mounted on the lower end of the wall 104 by means of a hinge 118. The base 116 is retained in a closed position (as shown Figures 1, 2 and 3) by means of a catch 120 which interengages with a lip 150 located on the wall 104. When the catch 120 is released, the base 116 will drop away from the wall 104.

A shroud 121 is located inwardly of the wall 104 of the first cyclone 102. The shroud 121 comprises a part-cylindrical, part-frustoconical wall 122 having a plurality of through-holes 123. The shroud 121 surrounds an outlet 124 from the first cyclone 102. The outlet 124 provides a communication path between the first cyclone 102 and a second cyclone assembly 126. A lip 128 is provided at the base of the shroud 121. The

lip 128 has a plurality of through-holes 129 which are designed to allow air to pass through but to capture dirt and dust.

The second cyclone assembly 126 comprises a plurality of second cyclones 130 arranged in parallel with one another. In this embodiment, six second cyclones 130 are provided. The second cyclones 130 are arranged around the axis X-X of the first cyclone 102. The arrangement of the second cyclones 130 is such that the second cyclones 130 are spaced equi-angularly around the axis X-X. Each second cyclone 130 has a tangentially-arranged air inlet and an air outlet (not shown) located at a first end of the respective second cyclone 130. A cone opening 136 is located at a second end of each second cyclone 130. The plane of the cone opening 136 of each second cyclone 130 is inclined with respect to a longitudinal axis (not shown) of the respective further cyclone 130. The cone opening 136 of each of the second cyclones 130 is in communication with a passageway 138 defined by a wall 140 located inwardly of the shroud 121.

A collector 142 is located at the lower end of the passageway 138. The collector 142 comprises a frustoconical first portion 144 and a cylindrical second portion 146. The interior of the collector 142 is delimited by the base 116 and the sides of the first and second portions 144, 146 of the collector 142.

Each of the air outlets of the second cyclones 130 is in communication with a duct 150. The duct 150 provides an airflow path from the cyclonic separating apparatus 100 into other parts of the handheld vacuum cleaner 10. Located at the downstream end of the duct 150 is a pre-motor filter 152. The pre-motor filter 152 comprises a porous material such as foam and can also include a fine filter material. The pre-motor filter 152 is designed to prevent any fine dust particles from entering the motor and causing damage thereto.

In use, when the on/off switch 20 is depressed, the motor and fan unit draws a flow of dirt-laden air into the dirty air inlet 18 and then into the cyclonic separator 100. Dirt-

laden air enters the cyclonic separator 100 through the inlet 110. Due to the tangential arrangement of the inlet 110, the airflow is forced to follow a helical path around the interior of the wall 104. Larger dirt and dust particles are separated by cyclonic motion around the wall 104. These particles are then collected at the base 116 of the first cyclone 102.

The partially-cleaned airflow then flows back up the interior of the first cyclone 102 and exits the first cyclone 102 via the through-holes 123 in the shroud 121. Once the airflow has passed through the shroud 121, it enters the outlet 124 and from there is divided between the tangential inlets of each of the second cyclones 130. Each of the second cyclones 130 has a diameter which is smaller than that of the first cyclone 102. Therefore, the second cyclones 130 are able to separate smaller particles of dirt and dust from the partially-cleaned airflow than the first cyclone 102. Separated dirt and dust exits the second cyclones 130 via the cone openings 136. Thereafter, the separated dirt and dust passes down the passageway 138 and into the collector 142. The separated dirt and dust eventually settles at the bottom of the collector 142 on the base 116.

Cleaned air then flows back up the second cyclones 130, exits the second cyclones 130 through the air outlets and enters the duct 150. The cleaned air then passes from the duct 150 sequentially through the pre-motor filter 152, the motor and fan unit, and a post-motor filter before being exhausted from the vacuum cleaner 10 through the air vents 24.

The first cyclone 102 and the collector 142 can be emptied simultaneously by releasing the catch 120 to allow the base 116 to pivot about the hinge 118 so that the separated dirt and dust can fall away from the cyclonic separator 100. By positioning the cleaning appliance 10 above a suitable dirt receptacle such as a dustbin, the dirt and dust collected in the cyclonic separator can be efficiently and reliably emptied. The user may close the cyclonic separator 100 by moving the base 116 back into the closed position shown in Figures 1 and 2 by hand.

Figure 4 shows the vacuum cleaner 10 in side view with the main body 12 in section. The remainder of the appliance is as shown in Figure 2 except that the distal end of the dirty air inlet 18 and the brush tool 22 have been omitted. The main body 12 includes the handle 16 (which carries the on/off switch 20), an upper portion 160 and a lower portion 162. The upper portion 160 houses the motor 164 and fan 166 by means of which dirty air is drawn into the appliance when the on/off switch is depressed. A post-motor filter 168 is also provided between the air outlet of the motor and the exhaust vents 24. The lower portion 162 houses a plurality of battery cells 170 for powering the motor 164 when the on/off switch 20 is depressed. Suitable connections between the switch 20, the batteries 170 and the motor 164 are provided within the main body 12.

The lower portion 162 is shaped so as to include a base surface 172 which is planar and faces downwardly away from the handle 16 and away from the upper portion 164. The lower portion 162 is also generally rectangular in shape as can be seen from Figure 1. The base surface 172 of the lower portion 164 forms a base surface of the main body 12. The motor 164 is positioned so that it lies vertically above the base surface 172 and the battery cells 170 are positioned immediately above the base surface 172.

The cyclonic separator 100 also has a base surface 174 which is formed by the lowermost extremity of the base 116. This base surface 174 of the cyclonic separator 100 in this embodiment is shaped as an annular ring as can be seen in Figure 3. The annular ring defines the planar base surface 174. Naturally, the base 116 could have been shaped so that the area inside the annular ring forming the base surface 174 was planar but this makes no difference to the invention.

As can be seen in Figure 4, the base surface 172 of the main body 12 and the base surface 174 of the cyclonic separator 100 lie in the same plane. Together they comprise a base surface of the handheld vacuum cleaner 10. The base surface 172 of the main body 12 lies adjacent the base surface 174 of the cyclonic separator 100 as can also be seen in Figure 4.

The base surface of the handheld vacuum cleaner 10 provides the vacuum cleaner 10 with a surface on which the appliance can be placed at intervals between periods of use or for storage. Because the base surface extends beyond the area of one or the other of the base surface 172 and the base surface 174, the base surface provided for the entire machine is more stable than would otherwise be the case. This is important because the handheld cleaning appliance 10 has a height which exceeds that of many known handheld vacuum cleaners due to the upright configuration of the cyclonic separator 100.

The positioning of one or the other of the motor 164 and the battery cells 170 vertically above the base surface 172 of the main body 12 enhances the stability of the handheld vacuum cleaner 10 when it is placed on the base surface. This is because the centre of gravity of the motor 164 and/or the battery cells 170, which are relatively heavy components of the handheld vacuum cleaner 10, passes through the base surface 172 of the main body.

The rectangular shape of the lower portion 162 also assists in enhancing the stability of the vacuum cleaner when it is supported on the base surface formed by the base surface 172 of the main body 12 and the base surface 174 of the cyclonic separating apparatus 100. This is because an inadvertent knock to the vacuum cleaner 10 need not cause the vacuum cleaner 10 to topple over if the width of the lower portion 162 is sufficiently wide to provide stability. As can be seen in Figure 5, the width b of the lower portion 172 is approximately two thirds of the width B of the widest part of the cyclonic separator 100, which is the collector 105. The width b of the lower portion 172 can be as little one half of the width B of the cyclonic separator 100 if preferred.

The invention is not limited to the precise details of the embodiment described above. For example, the number of first and second cyclones can be varied, as can the detail of their design, such as their cone angle, axis inclination and cone opening inclination. The shape of the collector and base can be altered, as can the precise location of the hinge and catch and the location of the actuator. The location of the on/off switch may

also be varied. What is important is the presence of a base surface on each of the cyclonic separator and the main body which together form a base surface for the handheld vacuum cleaner in a manner which allows the vacuum cleaner to be placed stably on a surface.

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CLAIMS

1. A handheld cleaning appliance comprising a main body, a dirty air inlet, a clean air outlet and a cyclonic separator for separating dirt and dust from an airflow located in an airflow path leading from the air inlet to the air outlet, the cyclonic separator being arranged in a generally upright orientation, wherein a base surface of the main body and a base surface of the cyclonic separator together form a base surface of the appliance for supporting the appliance on a surface.

2. A handheld cleaning appliance as claimed in claim 1, wherein the base surface of the main body is substantially planar and the base surface of the cyclonic separator is also substantially planar.

3. A handheld cleaning appliance as claimed in claim 2, wherein the base surface of the main body lies in the plane of the base surface of the cyclonic separator.

4. A handheld cleaning appliance as claimed in any one of claims 1 to 3, wherein the base surface of the main body lies adjacent the base surface of the cyclonic separator.

5. A handheld cleaning appliance as claimed in any one of the preceding claims, wherein the main body includes a motor and/or a battery unit.

6. A handheld cleaning appliance as claimed in claim 5, wherein the motor and/or battery unit is arranged above the base surface of the main body.

7. A handheld cleaning appliance as claimed in claim 6, wherein the battery unit is arranged immediately above the base surface of the main body.

8. A handheld cleaning appliance as claimed in any one of the preceding claims, wherein the base surface of the main body is substantially rectangular in shape.

9. A handheld cleaning appliance as claimed in any one of the preceding claims, wherein the width of the base surface of the main body is at least one half of the width of the cyclonic separator.

10. A handheld cleaning appliance substantially as hereinbefore described with reference to the accompanying drawings.

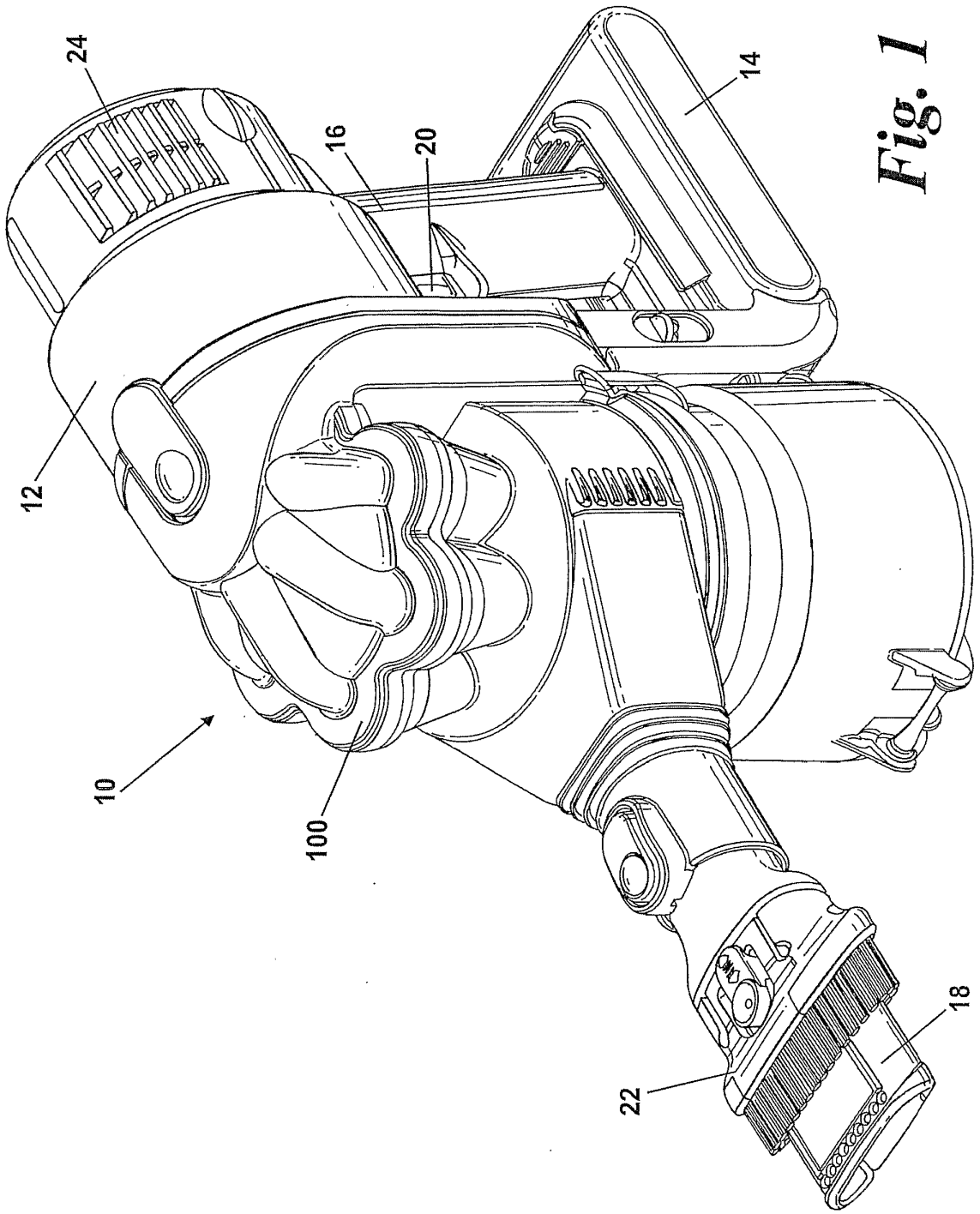

Fig. 1

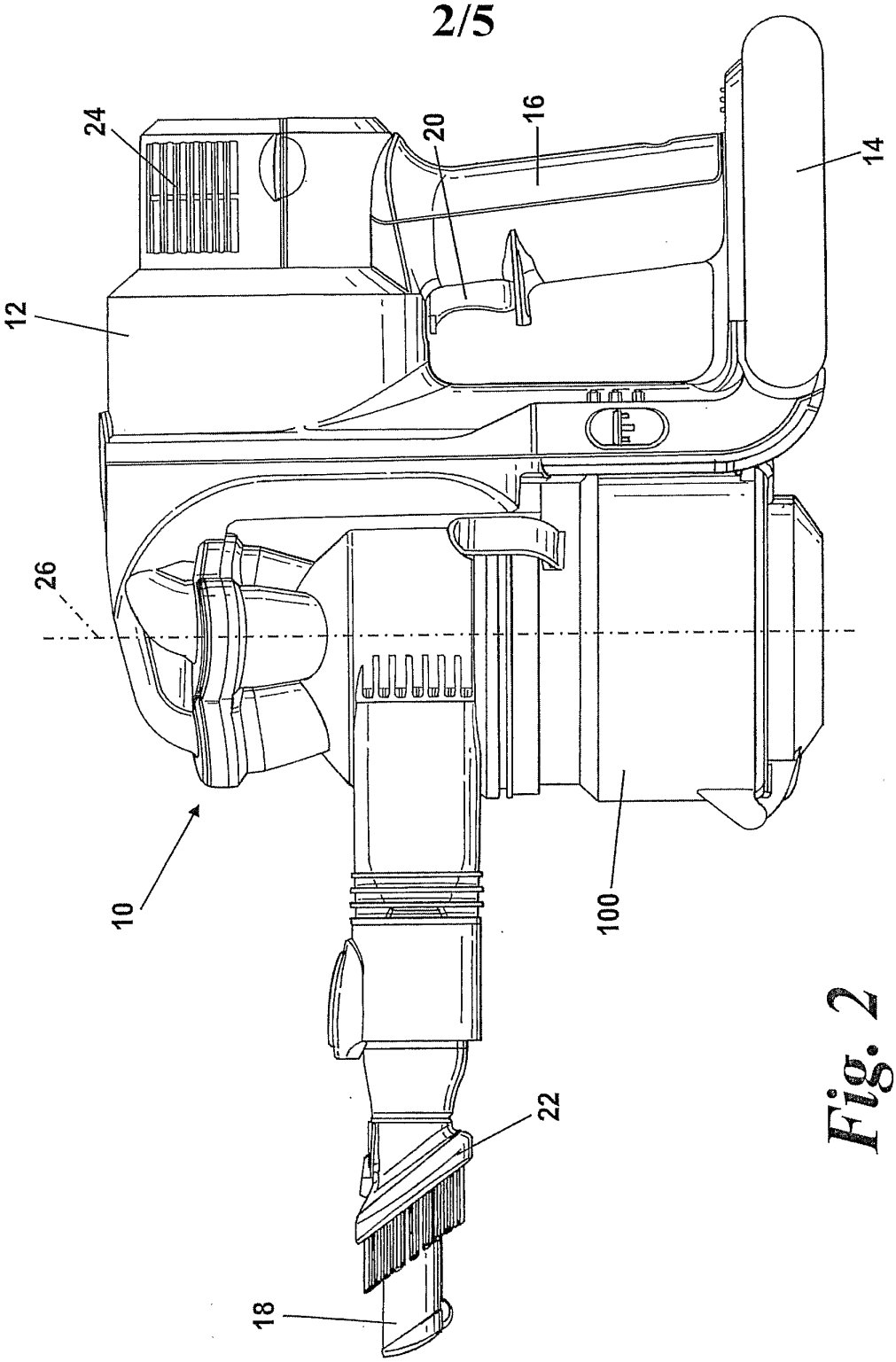

Fig. 2

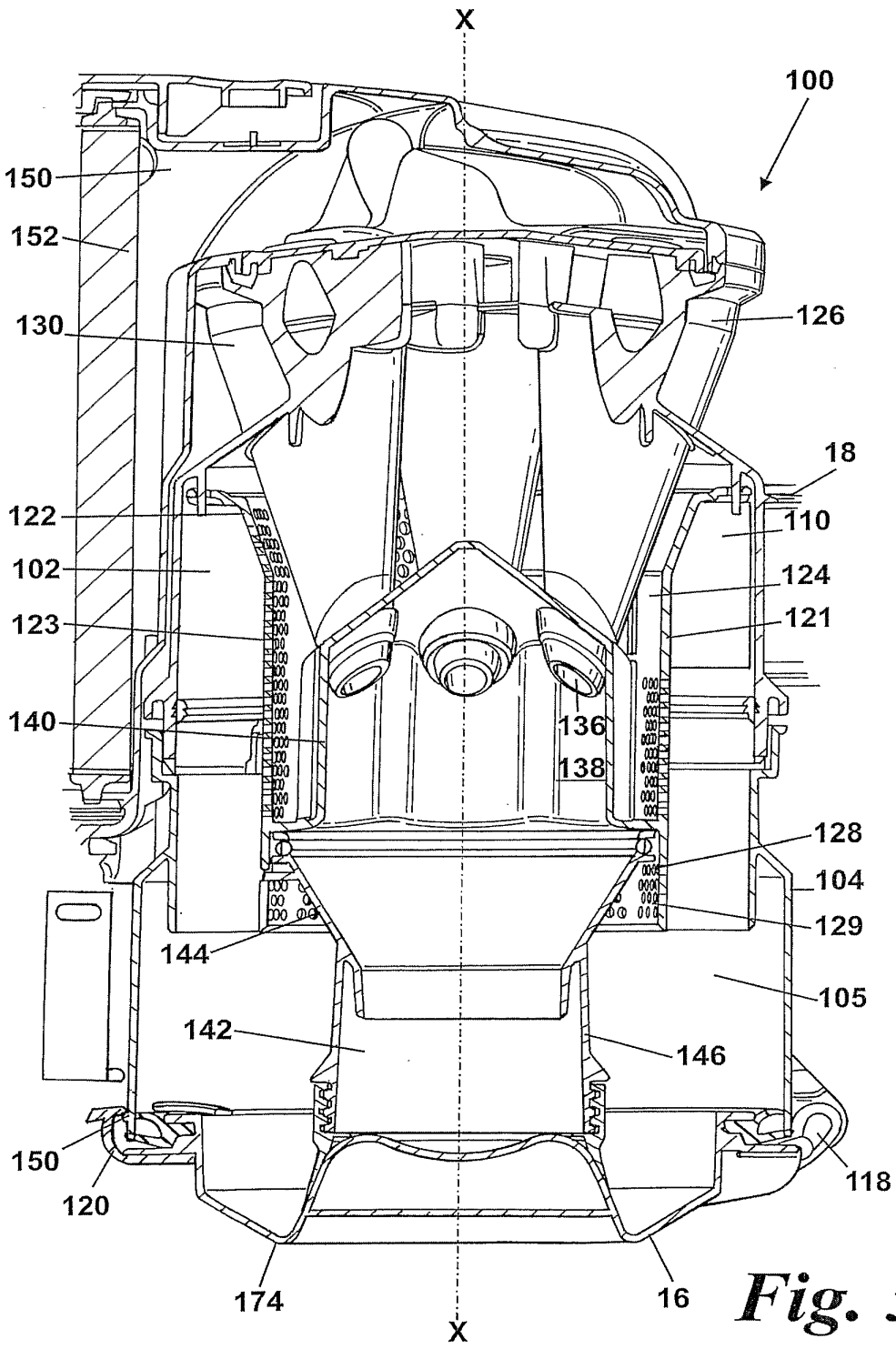
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Fig. 3

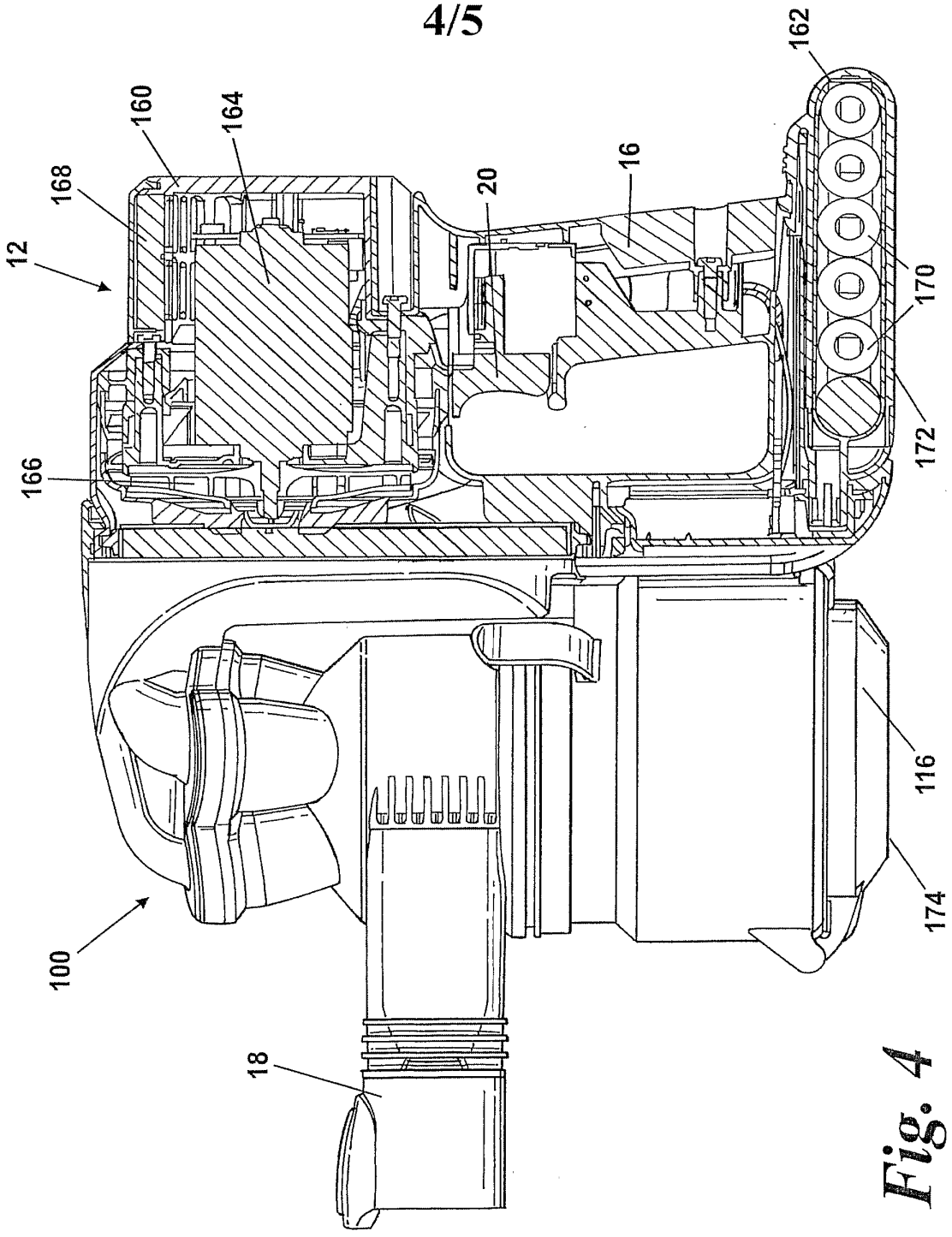

Fig. 4

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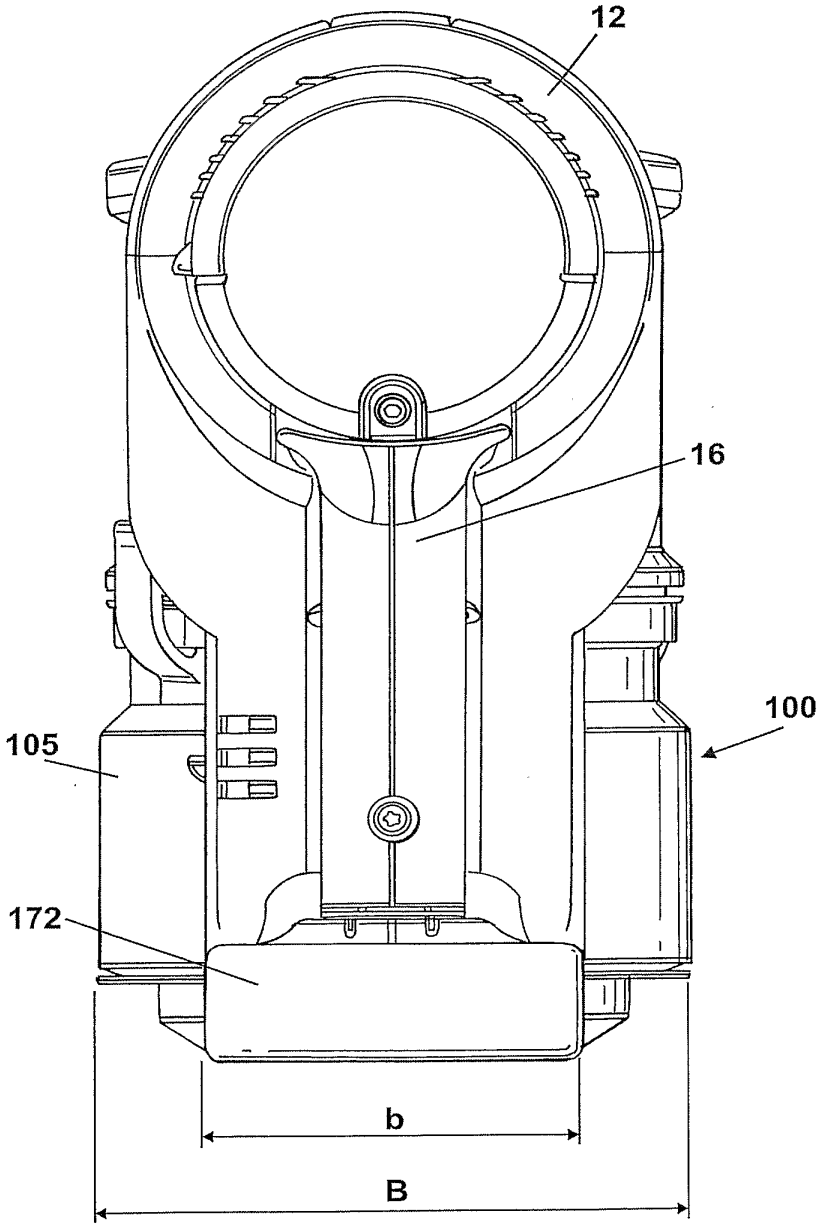

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002540

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24 A47L9/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L

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	GB 2 035 787 A (L & H DESIGNS LTD & MERRITT H) 25 June 1980 (1980-06-25) cited in the application the whole document	1,2,4-9
A	US 2002/189048 A1 (MARUYAMA KANAME [JP] ET AL) 19 December 2002 (2002-12-19) paragraphs [0006] - [0014]	1-9
A	US 5 367 740 A (MCCRAY KIMOTHY R [US]) 29 November 1994 (1994-11-29) column 1, line 37 - column 2, line 15	1-9
A	US 2006/137132 A1 (ORUBOR LAWRENCE [CA]) 29 June 2006 (2006-06-29) paragraphs [0021] - [0047]	1-9

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 September 2007	26/09/2007

Name and mailing address of the ISA/
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2007/002540

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 10
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10

The general references to the description and drawings used in claim 10 are vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claim so unclear (Article 6 PCT) that no meaningful search can be carried out for said claim.

Furthermore, according to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2007/002540

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2035787 A	25-06-1980	NONE	
US 2002189048 A1	19-12-2002	JP 3674031 B2	20-07-2005
		JP 2003000497 A	07-01-2003
US 5367740 A	29-11-1994	NONE	
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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

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PCT

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(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0614235.0 18 July 2006 (18.07.2006) GB

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(72) Inventors; and
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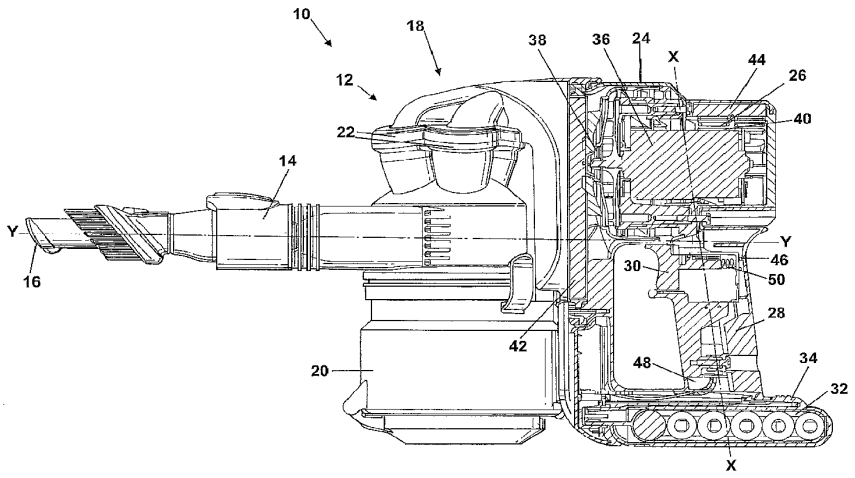
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, 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, MT, 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.

(54) **Title:** A HAND-HELD CLEANING APPLIANCE



(57) **Abstract:** The invention provides a hand-held cleaning appliance (10) comprising a suction conduit (14) having a longitudinal axis (Y-Y), an airflow generator (36) for generating an airflow along the suction conduit (14), separating apparatus (18) arranged in communication with the suction conduit (14) for separating dirt and dust from the airflow, a power source (32) for supplying power to the airflow generator (36) and an elongate handle (28) disposed between the airflow generator (36) and the power source (32). The elongate handle (28) is dimensioned and arranged to be gripped by a user's hand and the elongate handle (28) lies transverse to the longitudinal axis (Y-Y) of the suction conduit. By providing a hand-held vacuum cleaner (10) with such an arrangement, the hand-held vacuum cleaner (10) is easier and more comfortable to manipulate in use.

WO 2008/009888 A1

A Cleaning Appliance

The invention relates to a hand-held cleaning appliance. More particularly, the invention relates to a hand-held vacuum cleaner.

Hand-held vacuum cleaners are known from, for example, GB 1 207 278. This document discloses a hand-held vacuum cleaner having an elongate main body with an air inlet, a suction conduit and a dust bag for separating dirt and dust from an airflow. A motor and fan assembly is provided in the main body together with a power source. A handgrip is located on the upper part of the hand-held vacuum cleaner. The handgrip extends parallel to the elongate main body at a shallow angle to the suction conduit, and both the airflow generator and the power source are located in the main body underneath the handgrip. JP 2004-041760 discloses a hand-held vacuum cleaner having a similar handgrip arrangement. However, in this case, the motor and fan assembly and the power source of the hand-held vacuum cleaner are arranged so that the centre of gravity of the machine is located at the centre of the handgrip.

An alternative arrangement of handgrip is shown in US 1,871,624. This document discloses a hand-held vacuum cleaner having a cylindrical main body and a handgrip arranged at one end. A curved suction conduit is located at an end opposite to the handgrip. The handgrip is arranged transversely to the longitudinal axis of the cylindrical main body and approximately parallel to the suction conduit. This arrangement may give the user a stronger wrist position in use than the handgrip arrangements disclosed in GB 1 207 278 and JP 2004-041760. However, the heavy components of the vacuum cleaner (for example, the motor and fan assembly) are located forwardly of the handgrip relative to a user's hand when the vacuum cleaner is in use. Therefore, the centre of mass of the respective hand-held vacuum cleaner will be located forwardly of the handgrip. This may result in the hand-held vacuum cleaner described above being tiring and uncomfortable to use because the user will have to

exert additional effort in order to maintain the hand-held vacuum cleaner in a fixed orientation.

It is an object of the present invention to provide a hand-held vacuum cleaner which is easier to manipulate in use than known arrangements. It is a further object of the present invention to provide a hand-held vacuum cleaner in which the arrangement of the handgrip, the motor and fan assembly and the power source allow the hand-held vacuum cleaner to be manipulated easily and comfortably.

The invention provides a hand-held cleaning appliance comprising a suction conduit having a longitudinal axis, an airflow generator for generating an airflow along the suction conduit, separating apparatus arranged in communication with the suction conduit for separating dirt and dust from the airflow, a power source for supplying power to the airflow generator and an elongate handle disposed between the airflow generator and the power source and dimensioned and arranged to be gripped by a user's hand, wherein the elongate handle lies transverse to the longitudinal axis of the suction conduit. By providing a hand-held cleaning appliance with such an arrangement, a user is able to maintain a comfortable wrist position and movement of the hand-held vacuum cleaner feels comfortable.

Preferably, the elongate handle lies at an angle to the longitudinal axis in the range of 80 to 90°. More preferably, the elongate handle lies at an angle to the longitudinal axis which is close to a right angle.

Preferably, the separating apparatus is located between the suction conduit and the elongate handle. This arrangement improves the weight balance of the hand-held vacuum cleaner.

Preferably, the suction conduit has a suction opening and the longitudinal axis passes through the suction opening. This arrangement feels natural for a user and is easy to use.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of a hand-held vacuum cleaner according to the invention;

Figure 2 is a partially cut-away side view of the hand-held vacuum cleaner of Figure 1; and

Figure 3 is a plan view of the hand-held vacuum cleaner of Figure 1.

Figure 1 shows a hand-held vacuum cleaner 10. The hand-held vacuum cleaner 10 comprises a main body 12. The main body 12 includes a suction conduit 14 having a suction opening 16. The main body 12 also includes cyclonic separating apparatus 18 for separating dirt and dust from an airflow drawn in through the suction opening 16. The cyclonic separating apparatus 18 is in communication with the suction conduit 14 and the suction opening 16. The cyclonic separating apparatus 18 comprises an upstream cyclone 20 and a plurality of downstream cyclones 22 but further detail is not material to the invention and therefore will not be described.

The main body 12 further includes a motor housing 24 having a plurality of exhaust vents 26 formed therein. A flowpath extends from the suction opening 16, through the suction conduit 14, the cyclonic separating apparatus 18 and the motor housing 24 to the exhaust vents 26. A handgrip 28 is located below the motor housing 24 for manipulating the hand-held vacuum cleaner 10 when in use. The handgrip 28 is arranged so that the cyclonic separating apparatus 18 is located between the handgrip 28 and the suction opening 16. The handgrip 28 includes a trigger switch 30 which is positioned on the side of the handgrip 28 closest to the suction opening 16 such that the trigger switch 30 can be manipulated by a user's index finger. A power source 32 is connected to the handgrip 28 through a mounting portion 34.

Figure 2 shows the hand-held vacuum cleaner 10 in more detail. An airflow generator 36 is located in the motor housing 24. In this embodiment, the airflow generator 36 takes the form of a motor and fan assembly. The airflow generator 36 has an inlet 38 and an outlet 40. A pre-motor filter 42 is located upstream of the inlet 38 for filtering fine particulates from the airflow. A post-motor filter 44 is located downstream of the outlet 40. The pre-motor filter 42 and the post-motor filter 44 are located in the flowpath.

The handgrip 28 takes the form of an elongate handle and has a first end 46, a second end 48 and an axis X-X. The first end 46 of the handgrip 28 is connected to the motor housing 24. The airflow generator 36 is located adjacent the first end 46 of the handgrip 28. In this embodiment, the handgrip 28 and the airflow generator 36 are arranged such that the axis X-X of the handgrip 28 passes through at least a part of the airflow generator 36.

The mounting portion 34 removably receives the power source 32. When fitted to the hand-held vacuum cleaner 10, the power source 32 is located directly adjacent the second end 48 of the handgrip 28. In this embodiment, the power source 32 and the handgrip 28 are arranged so that the axis X-X passes through at least a part of the power source 32.

In other words, the handgrip 28 is arranged to lie between the airflow generator 36 and the power source 32. In this embodiment, the axis X-X passes through at least a part of each of the airflow generator 36 and the power source 32. Further, the axis X-X of the handgrip 28 lies transverse to a longitudinal axis Y-Y of the suction conduit 12. The longitudinal axis Y-Y passes through the suction opening 16. In this embodiment, the axis X-X is arranged at an angle to the longitudinal axis Y-Y which is close to 90°. This arrangement feels comfortable for a user.

The trigger switch 30 is located towards the first end 46 of the handgrip 28. The trigger switch 30 is located between the power source 32 and the airflow generator 36 and is

capable of switching the airflow generator 36 on or off. The trigger switch has on and off positions. The trigger switch moves from left to right as seen in Figure 2. The off position is located to the left, and the on position to the right. In the off position the trigger switch 30 is in an open state and the airflow generator 36 will be switched off. In the on position the trigger switch 30 will be closed and the airflow generator 36 will be switched on. The trigger switch 30 includes a spring 50 which biases the trigger switch 30 towards a normally open state. This arrangement allows the trigger switch 30 to be operated easily by a user's index finger. This in turn allows the hand-held vacuum cleaner 10 to be operated with one hand.

In use, a user grips the handgrip 28 to manipulate the hand-held vacuum cleaner 10 in use. When the user squeezes the trigger switch 30, the airflow generator 36 operates. The user must maintain pressure on the trigger switch 30 in order to keep the airflow generator 36 operating. This means that the user is likely to release the trigger switch 30 when he or she does not require a cleaning action, e.g. when moving from one room to another. If the user releases the trigger switch 30, the spring 50 will bias the trigger switch 30 to the off position and operation of the airflow generator 36 will cease. This reduces unnecessary use of the airflow generator 36 and results in a saving of battery life and motor life.

When operating, the airflow generator 36 draws a flow of dirt- and dust-laden air into the suction opening 16, through the suction conduit 14 and into the cyclonic separating apparatus 18. Dirt- and dust-laden air enters the upstream cyclone 20 and larger dirt and dust particles are separated by cyclonic motion. These particles are then collected in the upstream cyclone 20.

The partially-cleaned airflow then enters the plurality of downstream cyclones 22. The downstream cyclones 22 are able to separate smaller particles of dirt and dust from the partially-cleaned airflow than the upstream cyclone 20. The cleaned air exits the cyclonic separating apparatus 16 and passes sequentially through the pre-motor filter 42,

the airflow generator 36 and the post-motor filter 44 before being exhausted from the hand-held vacuum cleaner 10 through the exhaust vents 26.

In use, a user may wish to clean a variety of surfaces which may be orientated at different angles. Therefore, a user will need to lift and move the hand-held vacuum cleaner 10 into a variety of positions and orientations in order to clean effectively. The location of the handgrip 28 between the airflow generator 36 and the power source 32 allows the hand-held vacuum cleaner 10 to be manipulated easily in use. This is because the user's hand will be located between the two heaviest components of the hand-held vacuum cleaner 10. This results in a "dumbbell-like" configuration in which the weight of the hand-held vacuum cleaner 10 is distributed on both sides of the user's hand.

The transverse arrangement of the longitudinal axis Y-Y of the suction conduit 14 with respect to the axis X-X of the handgrip 28 results in the suction conduit 12 forming a substantially straight extension of the user's forearm when the user's wrist is essentially straight. This arrangement feels comfortable for the user, especially when the hand held vacuum cleaner 10 is used for a period of time. Further, the location of the longitudinal axis Y-Y of the suction conduit 14 close to the centre of the hand-held vacuum cleaner 10 means that the longitudinal axis Y-Y of the suction conduit 14 will be coincident, or close to, the longitudinal axis of rotation of the user's forearm. This results in little or no axial displacement of the suction opening 14 when the hand-held vacuum cleaner 10 is rotated.

The invention is not limited to the features of the specific embodiment described above. Variations will be apparent to the person skilled in the art. For example, the specific locations of the airflow generator or power source may be varied. The airflow generator may lie directly adjacent the first end of the handgrip. The airflow generator may lie above or below the handgrip. Additionally, the power source may lie directly adjacent the second end of the handgrip. The power source may lie above or below the handgrip. What is important is that the airflow generator lies adjacent a first end of the handgrip and the power source lies adjacent a second end of the handgrip.

The angular relationship between the longitudinal axis of the suction conduit and the axis of the handgrip can be varied. It is preferred that the angle between the longitudinal axis of the suction conduit and the axis of the handgrip is in the range of 80 to 90°. However, what is important is that these axes are transverse to one another such that the manipulation of the hand-held vacuum cleaner by a user feels comfortable.

A cyclonic separating unit need not be used. Other separating apparatus such as a bag-type filter could be used. Further, the hand-held vacuum cleaner need not be fitted with a rechargeable power source. Standard batteries or a power lead could be used. Further, the invention is not limited to hand-held vacuum cleaners. Other types of hand-held cleaning appliances could be used, for example, carpet shampooers, wet and dry machines or blower vacuum devices.

CLAIMS

1. A hand-held cleaning appliance comprising a suction conduit having a longitudinal axis, an airflow generator for generating an airflow along the suction conduit, separating apparatus arranged in communication with the suction conduit for separating dirt and dust from the airflow, a power source for supplying power to the airflow generator and an elongate handle disposed between the airflow generator and the power source and dimensioned and arranged to be gripped by a user's hand, wherein the elongate handle lies transverse to the longitudinal axis of the suction conduit.

2. A hand-held cleaning appliance according to claim 1, wherein the elongate handle lies at an angle to the longitudinal axis in the range of 80 to 90°.

3. A hand-held cleaning appliance according to claim 1 or 2, wherein the elongate handle lies at an angle to the longitudinal axis which is close to a right angle.

4. A hand-held cleaning appliance according to claim any one of claims 1 to 3, wherein the separating apparatus is located between the suction conduit and the elongate handle.

5. A hand-held cleaning appliance according to any one of the preceding claims, wherein the suction conduit has a suction opening and the longitudinal axis passes through the suction opening.

6. A hand-held cleaning appliance according to claim 5, wherein the suction opening is remote from the elongate handle.

7. A hand-held cleaning appliance according to any one of the preceding claims, wherein a trigger switch is located on the elongate handle for switching the airflow generator on or off.

8. A hand-held cleaning appliance according to claim 6 and 7, wherein the trigger switch is located on the side of the elongate handle which is closest to the suction opening.

9. A hand-held cleaning appliance according to claim 7 and 8, wherein the trigger switch includes resilient means for biasing the trigger switch into an off position.

10. A hand-held cleaning appliance according to any one of the preceding claims, wherein the separating apparatus comprises a cyclonic separator.

11. A hand-held cleaning appliance according to any one of the preceding claims, wherein the hand-held cleaning appliance is a hand-held vacuum cleaner.

12. A hand-held cleaning appliance substantially as hereinbefore described with reference to the accompanying drawings.

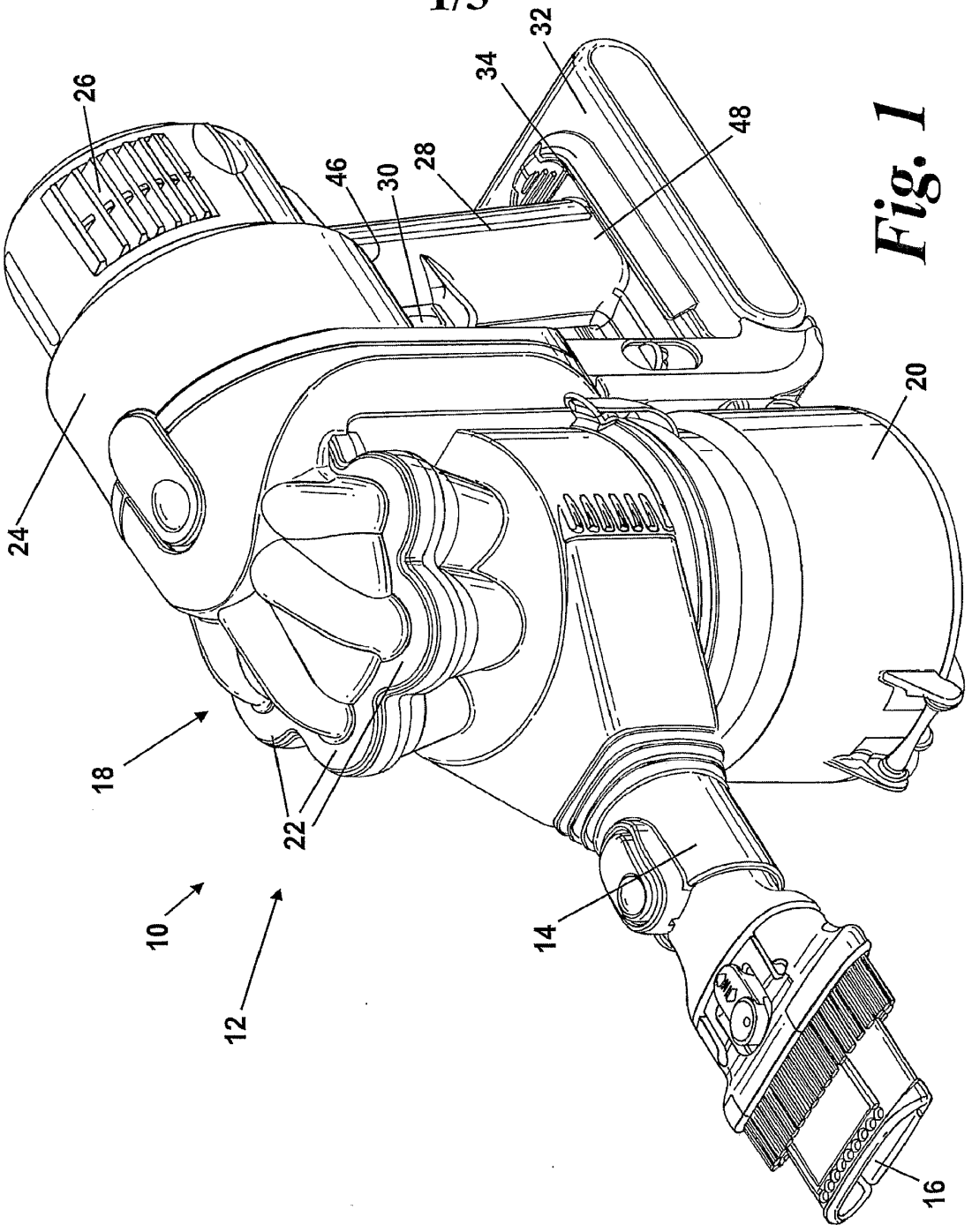


Fig. 1

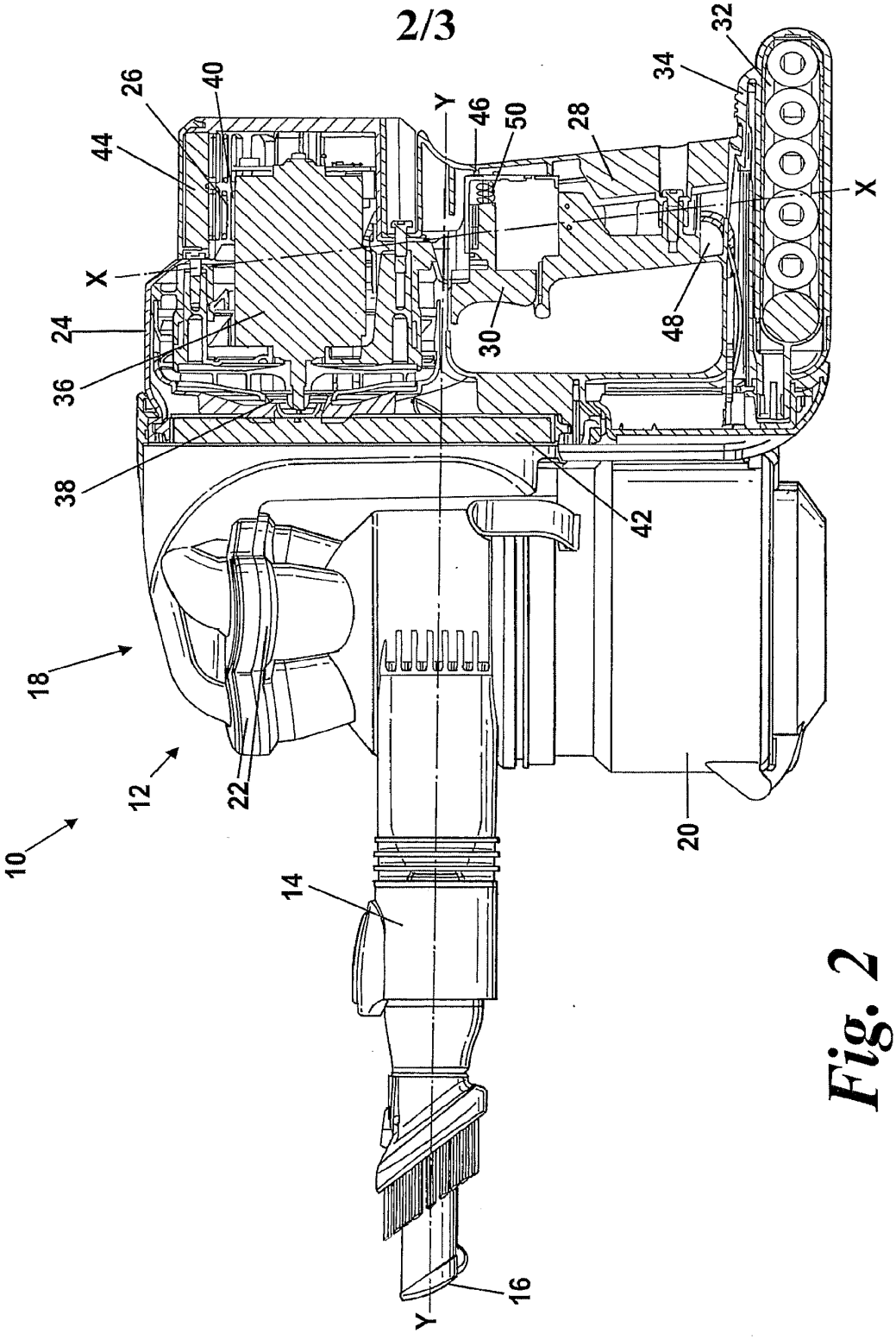


Fig. 2

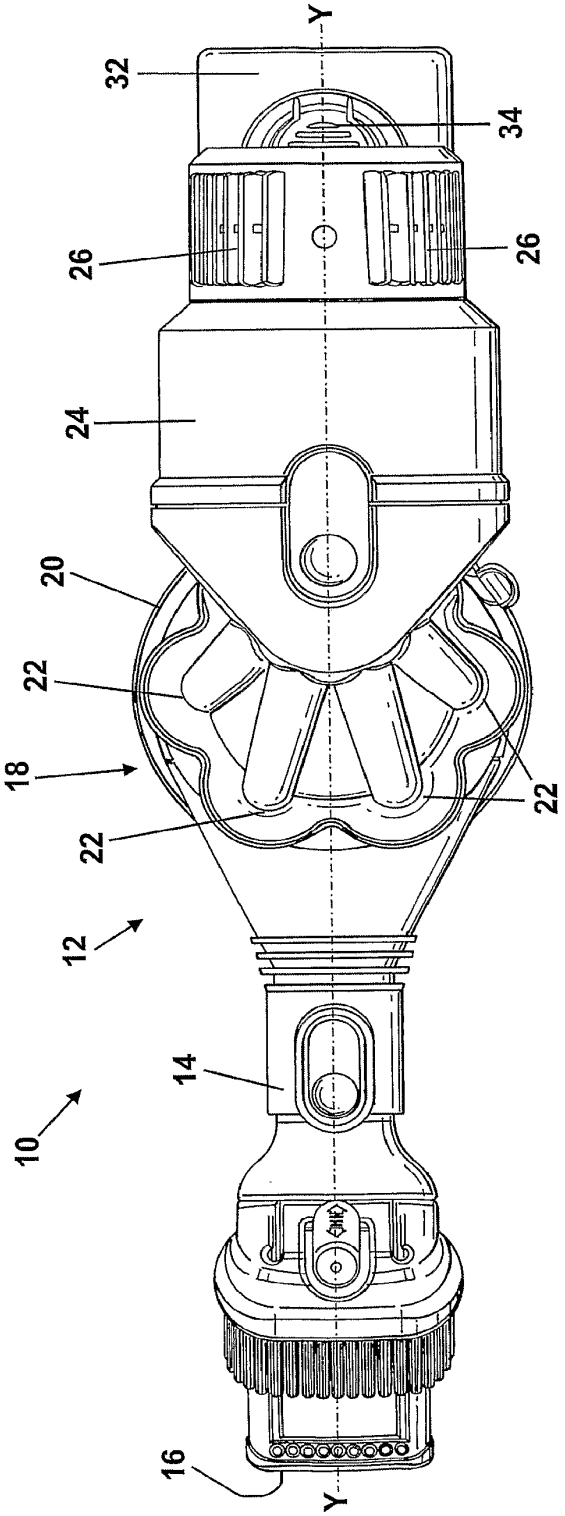


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002536

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24

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)
A47L B60S B25F

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 914 820 A (HANKEL ROBERT WILLIAM) 28 October 1975 (1975-10-28) figures 1,3,5	1-7,11, 12
Y		9
X	FR 1 508 452 A (MOBES NACHF W) 5 January 1968 (1968-01-05) the whole document	1-3,5-8, 11,12
X	JP 2004 041760 A (MATSUSHITA ELECTRIC IND CO LTD) 12 February 2004 (2004-02-12) cited in the application abstract; figure 1	1,4,11, 12
Y		10
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 September 2007	19/09/2007

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	PAPADIMITRIOU, S

Form PCT/ISA/210 (second sheet) (April 2005)

Dyson Ex1020
Page 526

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002536

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 1 207 278 A (NEMEJANSKI ARIANE SABINE [FR]) 30 September 1970 (1970-09-30) cited in the application page 1, lines 32-45 page 2, lines 63-111; figures	9
Y	US 2002/189048 A1 (MARUYAMA KANAME [JP] ET AL) 19 December 2002 (2002-12-19) paragraph [0014]	10
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A	JP 50 147166 A (-) 26 November 1975 (1975-11-26) figure 2	
A	US 2004/144070 A1 (GAMMACK PETER DAVID [GB] ET AL) 29 July 2004 (2004-07-29) figures 3-5	
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		NL 9100006 A	01-08-1991
		SE 465211 B	12-08-1991
		SE 9000080 A	11-07-1991

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International Bureau

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PCT

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A47L 9/22 (2006.01) *A47L 9/32* (2006.01)

(21) International Application Number:
PCT/GB2007/002524

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(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0614235.0 18 July 2006 (18.07.2006) GB

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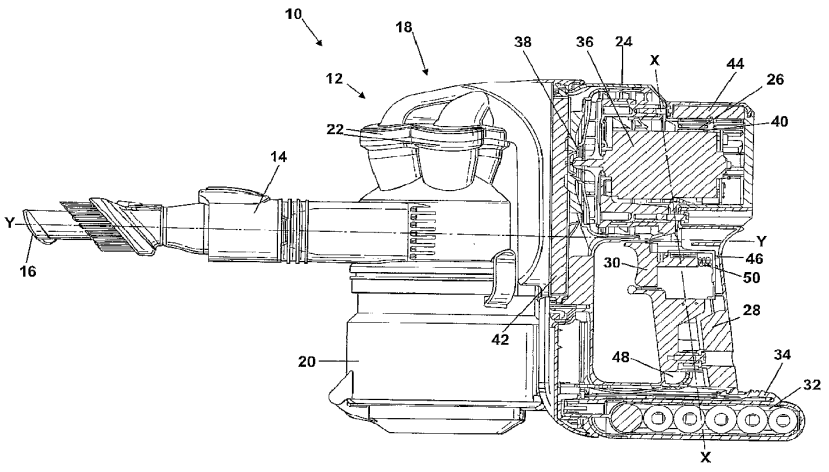
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, 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, MT, 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.

(54) Title: A CLEANING APPLIANCE



(57) Abstract: The invention provides a hand-held cleaning appliance (10) comprising a suction conduit (14), an airflow generator (36) for generating an airflow along the suction conduit (14), separating apparatus (18) in communication with the suction conduit (14) for separating dirt and dust from the airflow, a power source (32) for supplying power to the airflow generator (36) and a handgrip (28) for enabling a user to manoeuvre the hand-held cleaning appliance. The handgrip (28) has a first end (46) and a second end (48). The airflow generator (36) is arranged directly adjacent the first end (46) of the handgrip (28) and the power source (32) is arranged adjacent the second end (48) of the handgrip (28). By providing a hand-held vacuum cleaner (10) with such an arrangement, the hand-held vacuum cleaner (10) is easier and more comfortable to manipulate in use.

WO 2008/009883 A1

A Cleaning Appliance

The invention relates to a hand-held cleaning appliance. More particularly, the invention relates to a hand-held vacuum cleaner.

Hand-held vacuum cleaners are known from, for example, GB 1 207 278. This document discloses a hand-held vacuum cleaner having an elongate main body with an air inlet, a suction conduit and a dust bag for separating dirt and dust from an airflow. A motor and fan assembly is provided in the main body together with a power source. A handgrip is located on the upper part of the hand-held vacuum cleaner. The handgrip extends parallel to the elongate main body at a shallow angle to the suction conduit, and both the airflow generator and the power source are located in the main body underneath the handgrip. JP 2004-041760 discloses a hand-held vacuum cleaner having a similar handgrip arrangement. However, in this case, the motor and fan assembly and the power source of the hand-held vacuum cleaner are arranged so that the centre of gravity of the machine is located at the centre of the handgrip.

An alternative arrangement of handgrip is shown in US 1,871,624. This document discloses a hand-held vacuum cleaner having a cylindrical main body and a handgrip arranged at one end. A curved suction conduit is located at an end opposite to the handgrip. The handgrip is arranged transversely to the longitudinal axis of the cylindrical main body and approximately parallel to the suction conduit. This arrangement may give the user a stronger wrist position in use than the handgrip arrangements disclosed in GB 1 207 278 and JP 2004-041760. However, the heavy components of the vacuum cleaner (for example, the motor and fan assembly) are located forwardly of the handgrip relative to a user's hand when the vacuum cleaner is in use. Therefore, the centre of mass of the respective hand-held vacuum cleaner will be located forwardly of the handgrip. This may result in the hand-held vacuum cleaner described above being tiring and uncomfortable to use because the user will have to

exert additional effort in order to maintain the hand-held vacuum cleaner in a fixed orientation.

It is an object of the present invention to provide a hand-held vacuum cleaner which is easier to manipulate in use than known arrangements. It is a further object of the present invention to provide a hand-held vacuum cleaner in which the arrangement of the handgrip, the motor and fan assembly and the power source allow the hand-held vacuum cleaner to be manipulated easily and comfortably.

The invention provides a hand-held cleaning appliance comprising a suction conduit, an airflow generator for generating an airflow along the suction conduit, separating apparatus in communication with the suction conduit for separating dirt and dust from the airflow, a power source for supplying power to the airflow generator and a handgrip for enabling a user to manoeuvre the hand-held cleaning appliance, the handgrip having a first end and a second end, wherein the airflow generator is arranged directly adjacent the first end of the handgrip and the power source is arranged adjacent the second end of the handgrip. By providing such an arrangement, when a user grips the handgrip, the small resulting moment between the centre of mass of each of these components and the user's hand results in a hand-held vacuum cleaner which is easier to manipulate in use.

Preferably, the power source is arranged directly adjacent the second end of the handgrip. This arrangement allows the hand-held vacuum cleaner to be used easily and comfortably by a user.

Preferably, the handgrip has a longitudinal axis which passes through at least a part of the airflow generator. More preferably, the handgrip has a longitudinal axis which passes through at least a part of the power source.

Preferably, the suction conduit has a suction opening which is located remote from the handgrip. More preferably, the separating apparatus is located between the suction opening and the handgrip. Such an arrangement is compact and convenient to use.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is an isometric view of a hand-held vacuum cleaner according to the invention;

Figure 2 is a partially cut-away side view of the hand-held vacuum cleaner of Figure 1; and

Figure 3 is a plan view of the hand-held vacuum cleaner of Figure 1.

Figure 1 shows a hand-held vacuum cleaner 10. The hand-held vacuum cleaner 10 comprises a main body 12. The main body 12 includes a suction conduit 14 having a suction opening 16. The main body 12 also includes cyclonic separating apparatus 18 for separating dirt and dust from an airflow drawn in through the suction opening 16. The cyclonic separating apparatus 18 is in communication with the suction conduit 14 and the suction opening 16. The cyclonic separating apparatus 18 comprises an upstream cyclone 20 and a plurality of downstream cyclones 22 but further detail is not material to the invention and therefore will not be described.

The main body 12 further includes a motor housing 24 having a plurality of exhaust vents 26 formed therein. A flowpath extends from the suction opening 16, through the suction conduit 14, the cyclonic separating apparatus 18 and the motor housing 24 to the exhaust vents 26. A handgrip 28 is located below the motor housing 24 for manipulating the hand-held vacuum cleaner 10 when in use. The handgrip 28 is arranged so that the cyclonic separating apparatus 18 is located between the handgrip 28 and the suction opening 16. The handgrip 28 includes a trigger switch 30 which is positioned on the side of the handgrip 28 closest to the suction opening 16 such that the trigger switch 30 can be manipulated by a user's index finger. A power source 32 is connected to the handgrip 28 through a mounting portion 34.

Figure 2 shows the hand-held vacuum cleaner 10 in more detail. An airflow generator 36 is located in the motor housing 24. In this embodiment, the airflow generator 36 takes the form of a motor and fan assembly. The airflow generator 36 has an inlet 38 and an outlet 40. A pre-motor filter 42 is located upstream of the inlet 38 for filtering fine particulates from the airflow. A post-motor filter 44 is located downstream of the outlet 40. The pre-motor filter 42 and the post-motor filter 44 are located in the flowpath.

The handgrip 28 takes the form of an elongate handle and has a first end 46, a second end 48 and an axis X-X. The first end 46 of the handgrip 28 is connected to the motor housing 24. The airflow generator 36 is located adjacent the first end 46 of the handgrip 28. In this embodiment, the handgrip 28 and the airflow generator 36 are arranged such that the axis X-X of the handgrip 28 passes through at least a part of the airflow generator 36.

The mounting portion 34 removably receives the power source 32. When fitted to the hand-held vacuum cleaner 10, the power source 32 is located directly adjacent the second end 48 of the handgrip 28. In this embodiment, the power source 32 and the handgrip 28 are arranged so that the axis X-X passes through at least a part of the power source 32.

In other words, the handgrip 28 is arranged to lie between the airflow generator 36 and the power source 32. In this embodiment, the axis X-X passes through at least a part of each of the airflow generator 36 and the power source 32. Further, the axis X-X of the handgrip 28 lies transverse to a longitudinal axis Y-Y of the suction conduit 12. The longitudinal axis Y-Y passes through the suction opening 16. In this embodiment, the axis X-X is arranged at an angle to the longitudinal axis Y-Y which is close to 90°. This arrangement feels comfortable for a user.

The trigger switch 30 is located towards the first end 46 of the handgrip 28. The trigger switch 30 is located between the power source 32 and the airflow generator 36 and is

capable of switching the airflow generator 36 on or off. The trigger switch has on and off positions. The trigger switch moves from left to right as seen in Figure 2. The off position is located to the left, and the on position to the right. In the off position the trigger switch 30 is in an open state and the airflow generator 36 will be switched off. In the on position the trigger switch 30 will be closed and the airflow generator 36 will be switched on. The trigger switch 30 includes a spring 50 which biases the trigger switch 30 towards a normally open state. This arrangement allows the trigger switch 30 to be operated easily by a user's index finger. This in turn allows the hand-held vacuum cleaner 10 to be operated with one hand.

In use, a user grips the handgrip 28 to manipulate the hand-held vacuum cleaner 10 in use. When the user squeezes the trigger switch 30, the airflow generator 36 operates. The user must maintain pressure on the trigger switch 30 in order to keep the airflow generator 36 operating. This means that the user is likely to release the trigger switch 30 when he or she does not require a cleaning action, e.g. when moving from one room to another. If the user releases the trigger switch 30, the spring 50 will bias the trigger switch 30 to the off position and operation of the airflow generator 36 will cease. This reduces unnecessary use of the airflow generator 36 and results in a saving of battery life and motor life.

When operating, the airflow generator 36 draws a flow of dirt- and dust-laden air into the suction opening 16, through the suction conduit 14 and into the cyclonic separating apparatus 18. Dirt- and dust-laden air enters the upstream cyclone 20 and larger dirt and dust particles are separated by cyclonic motion. These particles are then collected in the upstream cyclone 20.

The partially-cleaned airflow then enters the plurality of downstream cyclones 22. The downstream cyclones 22 are able to separate smaller particles of dirt and dust from the partially-cleaned airflow than the upstream cyclone 20. The cleaned air exits the cyclonic separating apparatus 16 and passes sequentially through the pre-motor filter 42,

the airflow generator 36 and the post-motor filter 44 before being exhausted from the hand-held vacuum cleaner 10 through the exhaust vents 26.

In use, a user may wish to clean a variety of surfaces which may be orientated at different angles. Therefore, a user will need to lift and move the hand-held vacuum cleaner 10 into a variety of positions and orientations in order to clean effectively. The location of the handgrip 28 between the airflow generator 36 and the power source 32 allows the hand-held vacuum cleaner 10 to be manipulated easily in use. This is because the user's hand will be located between the two heaviest components of the hand-held vacuum cleaner 10. This results in a "dumbbell-like" configuration in which the weight of the hand-held vacuum cleaner 10 is distributed on both sides of the user's hand.

The transverse arrangement of the longitudinal axis Y-Y of the suction conduit 14 with respect to the axis X-X of the handgrip 28 results in the suction conduit 12 forming a substantially straight extension of the user's forearm when the user's wrist is essentially straight. This arrangement feels comfortable for the user, especially when the hand held vacuum cleaner 10 is used for a period of time. Further, the location of the longitudinal axis Y-Y of the suction conduit 14 close to the centre of the hand-held vacuum cleaner 10 means that the longitudinal axis Y-Y of the suction conduit 14 will be coincident, or close to, the longitudinal axis of rotation of the user's forearm. This results in little or no axial displacement of the suction opening 14 when the hand-held vacuum cleaner 10 is rotated.

The invention is not limited to the features of the specific embodiment described above. Variations will be apparent to the person skilled in the art. For example, the specific locations of the airflow generator or power source may be varied. The airflow generator may lie above or below the handgrip. Additionally, the power source may lie directly adjacent the second end of the handgrip. The power source may lie above or below the handgrip. What is important is that the airflow generator lies directly adjacent a first end of the handgrip and the power source lies adjacent a second end of the handgrip.

The angular relationship between the longitudinal axis of the suction conduit and the axis of the handgrip can be varied. It is preferred that the angle between the longitudinal axis of the suction conduit and the axis of the handgrip is in the range of 80 to 90°. However, what is important is that these axes are transverse to one another such that the manipulation of the hand-held vacuum cleaner by a user feels comfortable.

A cyclonic separating unit need not be used. Other separating apparatus such as a bag-type filter could be used. Further, the hand-held vacuum cleaner need not be fitted with a rechargeable power source. Standard batteries or a power lead could be used. Further, the invention is not limited to hand-held vacuum cleaners. Other types of hand-held cleaning appliances could be used, for example, carpet shampooers, wet and dry machines or blower vacuum devices.

CLAIMS

1. A hand-held cleaning appliance comprising a suction conduit, an airflow generator for generating an airflow along the suction conduit, separating apparatus in communication with the suction conduit for separating dirt and dust from the airflow, a power source for supplying power to the airflow generator and a handgrip for enabling a user to manoeuvre the hand-held cleaning appliance, the handgrip having a first end and a second end, wherein the airflow generator is arranged directly adjacent the first end of the handgrip and the power source is arranged adjacent the second end of the handgrip.

2. A hand-held cleaning appliance according to claim 1, wherein the power source is arranged directly adjacent the second end of the handgrip.

3. A hand-held cleaning appliance according to claim 1 or 2, wherein the handgrip has a longitudinal axis which passes through at least a part of the airflow generator.

4. A hand-held cleaning appliance according to any one of claims 1 to 3, wherein the handgrip has a longitudinal axis which passes through at least a part of the power source.

5. A hand-held cleaning appliance according to any one of the preceding claims, wherein the airflow generator is arranged above the handgrip and the power source is arranged below the handgrip.

6. A hand-held cleaning appliance according to any one of the preceding claims, wherein the suction conduit has a suction opening which is located remote from the handgrip.

7. A hand-held cleaning appliance according to claim 6, wherein the separating apparatus is located between the suction opening and the handgrip.

8. A hand-held cleaning appliance according to any one of the preceding claims, wherein a trigger switch is located on the handgrip for switching the airflow generator on or off.

9. A hand-held cleaning appliance according to claims 6 and 8, wherein the trigger switch is located on the side of the handgrip which is closest to the suction opening.

10. A hand-held cleaning appliance according to claim 8 or 9, wherein the trigger switch includes resilient means for biasing the trigger switch into an off position.

11. A hand-held cleaning appliance according to any one of the preceding claims, wherein the power source is removably attached to the second end of the handgrip.

12. A hand-held cleaning appliance according to any one of the preceding claims, wherein the separating apparatus comprises a cyclonic separator.

13. A hand-held cleaning appliance according to any one of the preceding claims, wherein the hand-held cleaning appliance is a hand-held vacuum cleaner.

14. A hand-held cleaning appliance substantially as hereinbefore described with reference to the accompanying drawings.

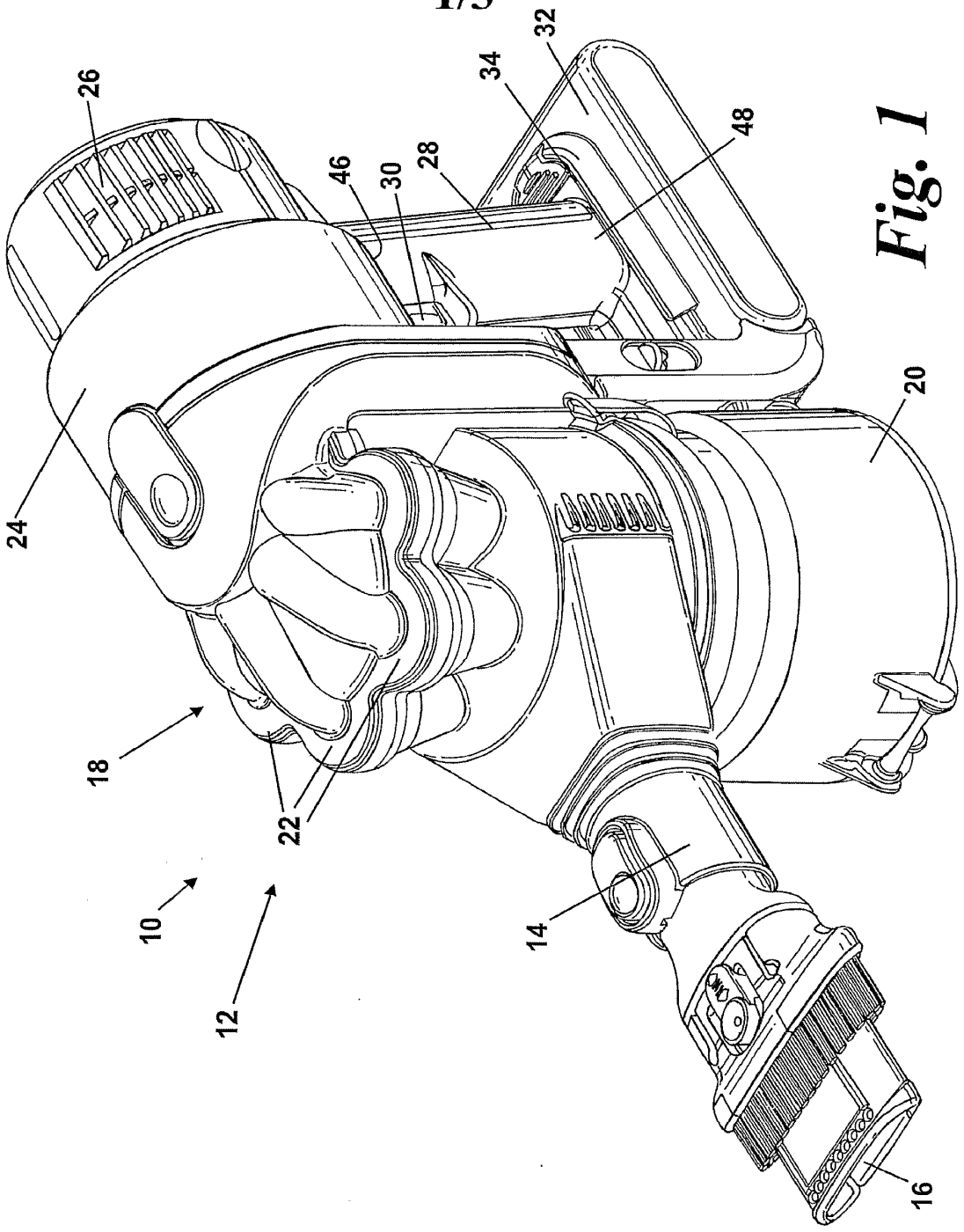


Fig. 1

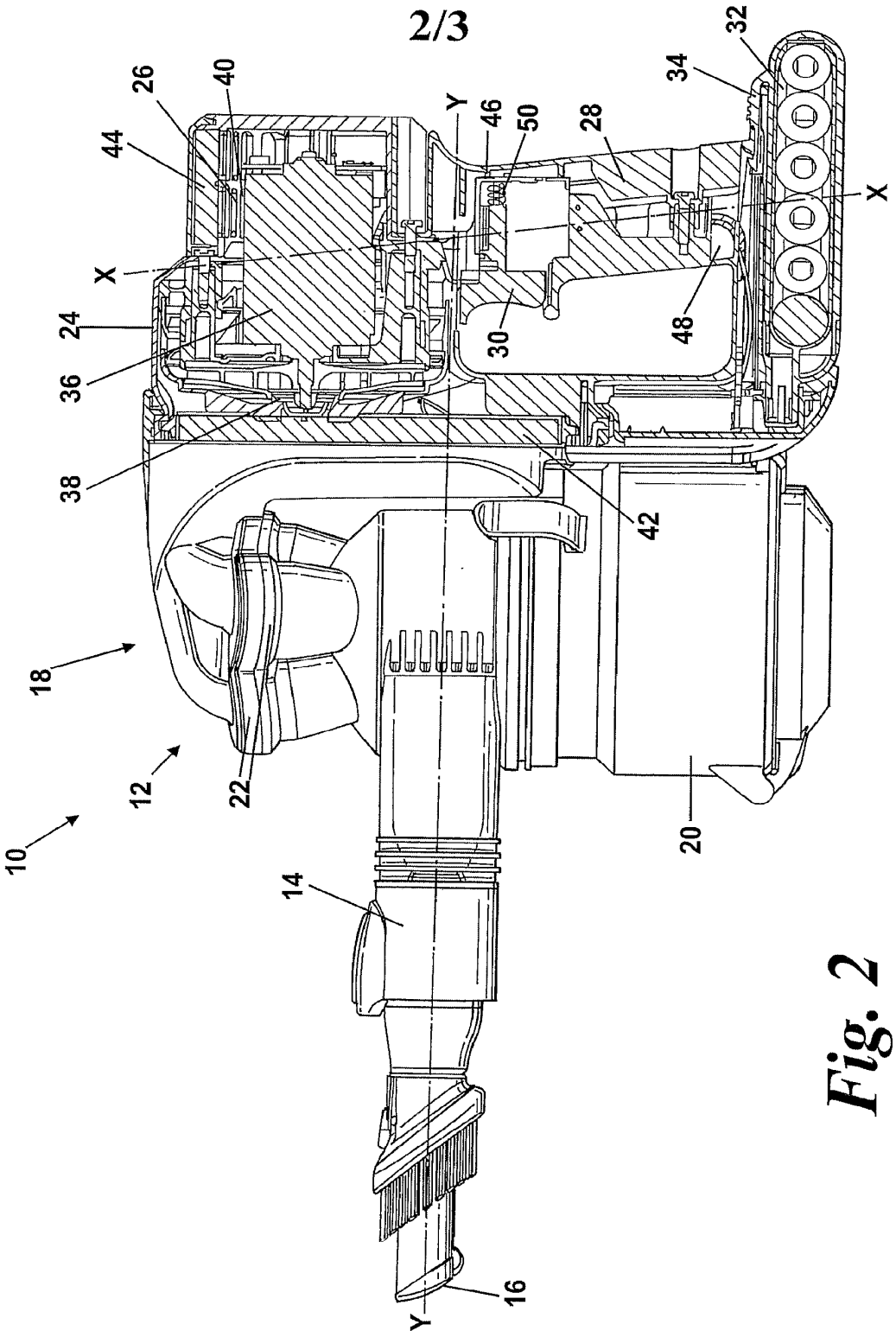


Fig. 2

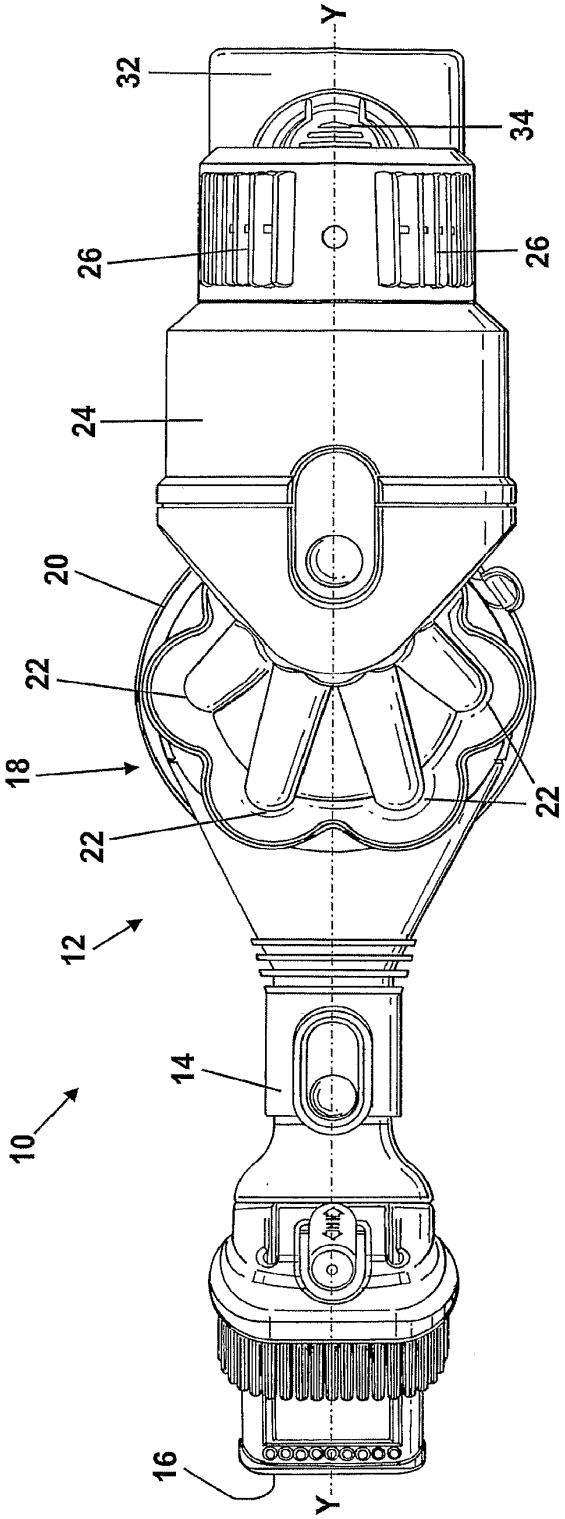


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002524

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L5/24 A47L9/22 A47L9/28 A47L9/32

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)
A47L

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	GB 795 118 A (SALO DAVID RAND) 14 May 1958 (1958-05-14) page 1, line 90 - page 3, line 111	1,2,6-8, 11-13
X	JP 2004 041760 A (MATSUSHITA ELECTRIC IND CO LTD) 12 February 2004 (2004-02-12) cited in the application abstract; figure 8	1,2,4-7, 11,13
X	JP 63 296718 A (TOKYO ELECTRIC CO LTD) 2 December 1988 (1988-12-02) the whole document	1-4,6-10
X	JP 05 192270 A (MATSUSHITA ELECTRIC IND CO LTD) 3 August 1993 (1993-08-03) abstract	1

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 September 2007	19/09/2007

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	MARTIN GONZALEZ, G

Form PCT/ISA/210 (second sheet) (April 2005)

Dyson Ex1020
Page 542

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/002524

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 62 290431 A (TOKYO ELECTRIC CO LTD) 17 December 1987 (1987-12-17) the whole document	1-3
A	GB 2 276 311 A (LOZENSTAR CORP [JP]) 28 September 1994 (1994-09-28) page 2, line 6 - page 3, line 7	1-13

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

Dyson Ex1020
Page 543

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2007/002524

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 14
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 14

The general references to the description and drawings used in claim 14 are vague and unclear and leave the reader in doubt as to the meaning of the technical features to which they refer, thereby rendering the definition of the subject-matter of said claim so unclear (Article 6 PCT) that no meaningful search can be established.

Furthermore, according to Rule 6.2(a) PCT, claims should not contain such references except where absolutely necessary, which is not the case here.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2007/002524

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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			JP	2511565 Y2	25-09-1996
			JP	6068654 U	27-09-1994

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11/083,481	18 March 2005 (18.03.2005)	US

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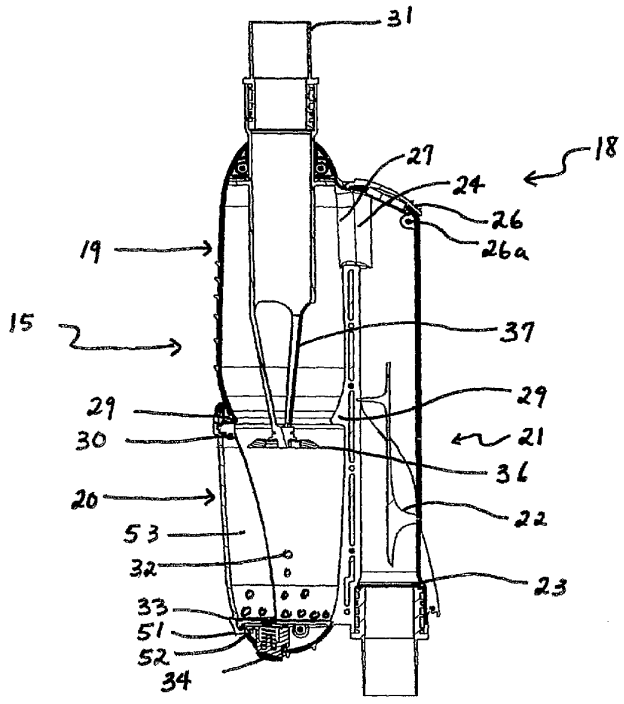
[Continued on next page]

(54) Title: CYCLONIC SEPARATION DEVICE FOR A VACUUM CLEANER



(57) Abstract: [0091] A cyclonic separation device for a vacuum cleaner has an elongated housing with an inlet opening, an upper separation portion and a lower dirt collection portion with a side opening door. A central outlet tube assembly extends into at least the upper portion of the separation portion of the housing. A decoupling or disrupter ring is positioned on the inside wall of the housing between the separation portion and the collection portion to assist in the separation. The decoupling ring or short section of an inverted frusto-conical cone is positioned mid-way down the container wall at the lower end of the separation zone. A second stage fine dust separating cyclone may be coaxially mounted within the cylindrical container with a conical shroud surrounding the cone to allow air to travel to the large cone opening.

WO 2006/026414 A3

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).

Declarations under Rule 4.17:
— *as to the identity of the inventor (Rule 4.17(i))*
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report*

(88) Date of publication of the international search report:
2 August 2007

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.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/030373

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A47L

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/42198 A (ARNOLD, ADRIAN, CHRISTOPHER; ARNOLD, ARTHUR, JOHN) 26 August 1999 (1999-08-26) cited in the application page 1, paragraph 1-3 page 5, paragraph 3-5; figure 1	1
Y		3
X	WO 02/069778 A (FORTUM OYJ; HILTUNEN, JYRKI; SUPPOLA, KAUKO) 12 September 2002 (2002-09-12) page 4, paragraph 3; figure 2	1

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 January 2006	10. 05. 2006

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	Papadimitriou, S

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2005/030373

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1, 2-3

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,2-3

   A readily cleanable cyclonic separation and collection device

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2. claims: 4-14

   An in-series, multi-stage cyclonic separation device and a vacuum cleaner comprising same

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3. claims: 15-39

   A readily cleanable, low turbulence cyclonic separation device

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/030373

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 192 550 B1 (HAMADA ATSUO ET AL) 27 February 2001 (2001-02-27) cited in the application column 1, lines 46-49 column 5, lines 57-63 column 6, lines 1-10 column 7, lines 45-53 column 8, lines 53-56 figures 6-9	2
Y		3
X	US 2004/074213 A1 (ORGAN STEPHEN PAUL) 22 April 2004 (2004-04-22) paragraphs [0006], [0031], [0034]; figures 1,3-5,8	2
A	US 2003/121121 A1 (NAKAI KOICHI ET AL) 3 July 2003 (2003-07-03) paragraph [0005]; figure 8	2
A	EP 1 042 981 A (AKTIEBOLAGET ELECTROLUX) 11 October 2000 (2000-10-11) paragraphs [0005], [0010]; figures 4,8	2
A	US 5 779 745 A (KILSTROEM ET AL) 14 July 1998 (1998-07-14) column 4, paragraph 2; figure 4	2

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2005/030373

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
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(74) Agent: **SCHMERER, Sven, Erik**; AB Electrolux, Group Intellectual Property, S-105 45 Stockholm (SE).

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Published:
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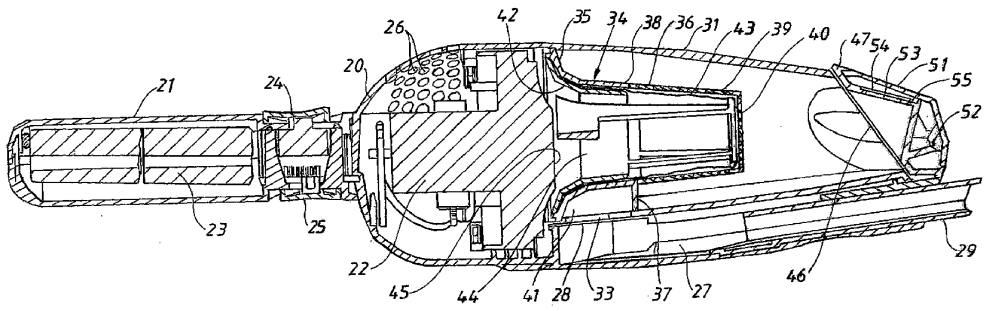
(54) Title: HAND HELD VACUUM CLEANER



(57) Abstract: This invention relates to a hand held vacuum cleaner comprising a housing (20) supporting a motor-fan unit (22), a dust container (31) and an air passage (27) opening into the dust container through which dust laden air is directed into the dust container. The vacuum cleaner also comprises at least one filter (39) arranged after the dust container as seen in the flow direction. The dust container (31) is provided with a first emptying opening (46) normally being covered by a lid (47) the opening having such a size that it, when the lid is opened, allows the dust collected in the dust container to fall out through the opening. The dust container constitutes a part of a cyclone separator arranged between the air passage (27) and the filter (39).

WO 2004/069021 A1

Hand held vacuum cleaner

This invention relates to a hand held vacuum cleaner comprising a housing supporting a motor-fan unit, a dust container and an air passage ending in the dust container through which dust laden air is directed into the dust container, the vacuum cleaner also comprising at least one filter arranged after the dust container as seen in the flow direction, the dust container constituting a part of a cyclone separator arranged between the air passage and the filter.

Hand held vacuum cleaners which are battery powered as well as powered by mains supply, are previously known, see for instance US 4967443, and are used for fast cleaning of small surfaces. It is important that such vacuum cleaners are easily accessible and user friendly designed. These vacuum cleaners are usually designed such that the dust container together with the filter can be removed from the remaining part of the vacuum cleaner housing that contains the fan unit. In order to empty the vacuum cleaner also the filter has to be removed from the dust container before the content can be emptied through the opening which is established when the filter has been taken away. Removal of the dust from the dust container is hence troublesome, dirty and time consuming. It should in this connection be mentioned that the volume of the dust container for this type of vacuum cleaners is very limited and that the filter is rapidly clogged which means lost suction efficency and that emptying has to be done with short intervals.

It is further known, see EP 914795, to provide a hand held vacuum cleaner of the type mentioned above with a large opening covered by a pivotable lid in order to facilitate emptying but since the dust usually get stuck to the filter the dust can not be easily poured out of the opening. Moreover since the conventional filter system is quickly clogged the suction efficiency is still not sufficient.

It is also previously known to use the type of hand held vacuum cleaner described above in combination with a shaft part whose lower portion supports a nozzle (so called stick cleaner), see for instance SE 9701543-2. The shaft part is provided with a tube connection by means of which dust laden air is transferred from the nozzle to the air inlet of the hand held vacuum cleaner which is removably secured to the shaft part. This means that the combined stick cleaner in a comfortable way can be used for floor cleaning purpose. Of course this type of vacuum cleaners also has the same disadvantages as the hand held vacuum cleaner described above with respect to filter clogging and handling when being emptied.

The purpose of this invention is to create an arrangement which eliminates a too fast clogging of the filter and which fascilitates emptying of the vacuum cleaner at the vacuum cleaner types described above. This is achieved by means of a device having the characteristics mentioned in the claims.

An embodiment of the invention will now be described with reference to the accompanying drawings on which Fig. 1 is a perspective view of the vacuum cleaner in question together with a shaft part, Fig. 2 is a schematic sectional view through the shaft part shown in Fig. 1, Fig. 3 is a perspective view of the vacuum cleaner being removed, Fig. 4 is a sectional view through the vacuum cleaner, Fig. 5 is an exploded view showing the vacuum cleaner being separated and at the emptying procedure, Fig. 6 is a perspective view of the vacuum cleaner showing a different method for emptying the vacuum cleaner whereas Fig. 7 in a perspective view shows a further method for emptying the vacuum cleaner.

As appears from Fig. 1 the shown vacuum cleaner comprises an elongated shaft part 10 in which a hand held vacuum cleaner 11 is removably arranged. The lower end of the shaft part supports a floor nozzle 12 enclosing an electrically driven brush roll 13, not described in detail, and which is turnably secured to the shaft part 10. The nozzle has an elongated suction opening 14 extending in the length direction of the nozzle and the suction opening is via a flexible tube passage 15 connected to the hand held vacuum cleaner 11 in a manner which will be described below. The upper portion of the shaft part 10 is shaped as a handle 16 and has an operating knob 17 that via an electric circuit, not shown in detail, is connected to the hand held vacuum cleaner when it is secured to the shaft part. The shaft part might also enclose one or several batteries 18 which are connected to the electric circuit.

The nozzle 12 is provided with a supporting part 12a having one end that via a shaft is pivotally arranged about a first axis A extending mainly horizontally and mainly parallel to the suction opening 14. The other end of the supporting part 12a is pivotally secured to the lower portion of the shaft part 10 about a second axis B that is mainly perpendicular to the length direction of the shaft part 10 and to the first axis A. This means that there is a double link arrangement between the shaft part 10 and the nozzle 11which gives an excellent manoeuvrability of the vacuum cleaner when being used as a stick cleaner. This arrangement also makes it possible to easily hide the electric wires between the shaft part 10 and the nozzle within the support arm 12a. In order to create a reliable nozzle link the

shaft ends defining the axis A are supported by two shaft supports comprising separate units that are removably inserted into pockets in the nozzle.

The hand held vacuum cleaner 11 comprises a housing 20 with a handle 21 and the housing encloses a motor-fan unit 22 driven by one or several batteries 23 placed in the handle 21. The motor-fan unit is controlled by means of a control knob 24 placed at the handle and the part of the electric circuit which is placed in the hand held vacuum cleaner is via a connection 25 connected to the part of the circuit which is placed in the shaft part 10 when the hand held vacuum cleaner is fixed to the shaft part 10. The housing is provided with several openings 26 through which the air flowing through the fan unit leaves the housing. The housing also has an inlet channel 27 extending from the front part of the housing to an outlet opening 28 arranged at the middle part of the housing. In the channel 27 a tube part 29 is slidably arranged the outer end of the tube part being shaped as a nozzle. When the hand held vacuum cleaner is fastened to the shaft part the tube part 29 is pushed into the channel 27 and is thereby a direct continuation of the tube passage 15 of the shaft part. The tube part can also be pulled out to an extended position and by means of a retaining mechanism, not shown, be locked temporarely in the extended position.

The housing is provided with a recess 30 in which a dust container 31 is removably arranged the dust container being removed by means of locking knobs 32 arranged at each side of the container. The dust container 31 is shaped as an elongated body with an open end and is partly made of transparent material. Close to the open end of the dust container there is an inlet 33 that is coaxially to the outlet opening 28 of the channel 27. The open end is partly covered by a filter liner 34 that follows the dust container when it is removed from the housing but which is removably arranged with respect to the dust container. The filter liner comprises a collar shaped portion 35 resting against a seat arranged at the wall of the dust container the collar shaped portion continuing into a sleeve shaped portion 36 centrally arranged in the dust container. The sleeve shaped portion has a flange 37 overbridging the distance between the sleeve shaped portion 36 and the surrounding container wall and extends around a part of the circumference of the sleeve shaped portion. The part 38 of the sleeve shaped portion which is placed at one side of the flange 37 is together with the collar shaped portion 35 made by homogenous material whereas the part which is placed at the other side of the flange comprises a grating structure which is covered by a coarse filter 39 that also extends over the end 40 of the sleeve shaped portion. The coarse filter 39 preferably comprises a washable fine meshed plastic net. Further the filter liner 34 is provided with a radially extending wall 41 that streches between the flange

37 and the collar shaped portion 35 close to the inlet 33. The wall 41 prevents the dust in the dust container from falling out through the inlet 33 if the vacuum cleaner should be turned up-side-down and also limits an annular flow channel around a part of the circumference of the filter liner 34. When dust laden air flows through this channel it contributes to the creation of a vortex in the dust container which will thus operate as a cyclone separator in which larger particles are separated from the air flow at the same time as the process is visualized through the transparent container wall. Thus, the cyclone prevents the filter from being clogged by means of larger dust particles and dirt. By means of the transparent container wall it is also possible to see the dust level in the container and hence also to establish when it is time to empty the container.

The filter liner 34 encloses a removable support body 42 for a fine filter 43 for instance a flat circular paper filter that can be clamped between the support body 42 and the filter liner 34. The support body 42 mainly has the same sleeve shape as the filter liner 34 but is somewhat smaller and forms a flow passage 44 for the air which flows through the coarse filter 39 and the fine filter 43 to the inlet opening 45 of the fan unit. Alternatively the fine filter can be replaced by a body of foamed plastic or the like to separate finer particles after the coarse filter whereby the body is secured in a suitable way in the filter liner.

The dust container has a large emptying opening 46 extending over the entire bottom part of the dust container and the opening is normally covered by a lid 47 supported by a yoke 48 turnably secured at each side of the dust conatiner the yoke being acted on by two springs 49 normally pressing the lid against a sealing 50 surrounding the opening 46.

The lid 47 supports a flap 51, that is turnably fastened to the lid 47 by means of dowels 52, and is normally hiding a small, circular emptying opening 53 which is connected to the inside of the dust container. This opening might be covered by a tongue 54 of elastic material which is fastened at one of its sides and rests against a seat 55 surrounding the opening 53 the tongue serving as a check valve that opens when a tube 56 connected to an outer vacuum source is pressed against the seat 55 or is inserted into the opening 53. Instead of using an elastic tongue it is of course possible to provide the seat 55 or the flap 51 with a sealing that prevents air from flowing through the emptying opening 53 into the dust container when the flap is closed.

The hand held vacuum cleaner is used and operates in the following manner. At normal use the hand held vacuum cleaner 11 is removed from the shaft part 10 after which the tube part 29 is pulled out to the outer position. Then the motor fan unit is started by

acting on the operating knob 24. This means that air together with dirt particles are sucked in through the tube part 29 and the inlet channel 27. The dust laden air flows through the outlet opening 28 and the inlet 33 of the dust container 31 after which the dust laden air flows into the channel which is limited by the filter liner 34, the flange 37 and the wall of the dust container and extending around the sleeve sheped portion 36. Thereby a vortex is created in the dust container the vortex separating heavier particles from the air flow such that they can be collected at the bottom of the container. The air then flows further through the coarse filter 39 and the fine filter 43 to the flow passage 44 from which the cleaned air leaves to the inlet opening 45 of the fan unit. After having passed the fan unit the air then leaves to atmosphere via the openings 26.

In order to empty the hand held vacuum cleaner there are three different alternatives. By manually opening the lid 46 against the action of the springs 49 the operator can uncover the emptying opening 46 and the collected dust is allowed to fall freely out of the opening or to be shaken out through it. This means a quick emptying function whithout the need for removing the dust container from the hand held vacuum cleaner. A second quick emptying alternative is, when the operator uses a lager type of vacuum cleaner during a conventional vacuum cleaning operation, to open the flap 51 and press the inlet opening of the tube handle 56 of the larger vacuum cleaner against the seat 55. This means that the tongue 54 beacause of the vacuum created by the larger vacuum cleaner will uncover the opening 53 and the content in the dust container 31 will be sucked over to the dust container of the larger vacuum cleaner. Thereby also the coarse filter 39 and the fine filter 43 will be cleaned by the air that flows backwards through the hand held vacuum cleaner. A further emptying alternative is to remove the dust container 31 from the housing 20 by acting on the locking knobs 32. Thereby the dust container is removed together with the filter liner 34, the fine filter 43 and the support body 42. By removing the lastmentioned three parts from the dust container it can be emptied and the dust container 31, the filter liner 34 with the coarse filter 39 and the support body 42 can be cleaned separately and a new fine filter 43 can then be applied on the support body 43 before it is again inserted into the filter liner 34. The flat fine filter will then be folded such that it achieves a large filter area. The filter liner 34 can then again be inserted into the dust container 31 before the dust container is locked in the housing 20.

The hand held vacuum cleaner 11 can, if the operator so desires, be fixed to the shaft part 10 whereby the tube part 29 is moved to its retracted position at the same time as the electrical circuit of the hand held vacuum cleaner via the connection 25 is connected to

the electrical circuit in the shaft part. This means that the motor fan unit of the hand held vacuum cleaner and the electric motor of the brush roll 13 now can be cativated by means of the operating knob 17 whereby additional energy is supplied by means of the batteries 18 in the shaft part. The shaft part can then be used as a normal so called stick cleaner for cleaning larger surfaces such as a floor whereby dust laden air is sucke in through the nozzle 12. This air via the flexible tube passage 15 passes to the inlet channel 27 of the hand held vacuum cleaner after which the dust particles are separated in the dust container 31 in a manner described above.

It should be stressed that the hand held vacuum cleaner and/or the shaft part in a conventional manner is provided with a connection, not shown, for an electrical charger to charge the batteries which are placed in the shaft part and/ or the hand held vacuum cleaner. The vacuum cleaner might of course also be mains supplied.

Claims

1. Hand held vacuum cleaner having a housing (20) comprising a motor-fan unit (22), a dust container (31) and an air passage (27) opening into the dust container through which dust laden air is directed into the dust container, the vacuum cleaner also comprising at least one filter (39) arranged after the dust container as seen in the flow direction, the dust container (31) being provided with a first emptying opening (46) normally being covered by a lid (47) and having such a size that the opening, allows the dust collected in the dust container to fall out through the opening when the lid is opened **characterized in** that the dust container constitutes a part of or communicates with a cyclone separator arranged between the air passage (27) and the filter (39).
2. Vacuum cleaner according to claim 1 **characterized in** that the dust container (31) is provided with a second emptying opening (53) that is adapted to be connected to an external vacuum source via a connection (56).
3. Vacuum cleaner according to claim 1 or 2 **characterized in** that the dust container (31) i removably arranged in the housing.
4. Vacuum cleaner according to any of claims 1-3 **characterized in** that the dust container (31) is provided with a removable filter liner (34) comprising an end wall part (35) continuing into a sleeve shaped portion (36) extending into the dust container and through which the air leaving the dust container flows towards the motor fan unit (22).
5. Vacuum cleaner according to claim 4 **characterized in** that the filter liner (34) supports a coarse filter (39).
6. Vacuum cleaner according to claim 4 or 5 **characterized in** that the filter liner (34) encloses a foamed plastic body serving as a separator of finer particles.
7. Vacuum cleaner according to claim 4 or 5 **characterized in** that the filter liner (34) encloses a coaxially arranged, removable support body (42) for a fine filter (43) arranged between the filter liner (34) and the support body (42).
8. Vacuum cleaner according to claim 7 **characterized in** that the fine filter (43) comprises a thin, flat filter blank which is applied on the filter body (42) such that it, when the filter body is inserted into the filter liner (34) becomes a folded shape.

9. Vacuum cleaner according to any of claims 4-8 **characterized in** that the filter liner (34) at its outside supports a flange (37) to overbridge the distance between the filter liner (34) and the surrounding dust container wall the flange extending around a part of the circumference of the liner.
10. Vacuum cleaner according to any of the preceding claims **characterized in** that the dust container (31), at least partly, is made of transparent material.
11. Vacuum cleaner according to any of the preceding claims **characterized in** that it is removably secured to a shaft part (10) supporting a floor nozzle (12) having an elongated suction opening (14) extending in the length direction of the nozzle, the floor nozzle via a tube connection (15) being connected to the air passage (27) of the vacuum cleaner.
12. Vacuum cleaner according to claim 11 **characterized in** that the floor nozzle (12) and the shaft part (10) are connected to one another via a double link arrangement comprising a first pivot axis (A) that is arranged mainly horizontally and parallel to the suction opening of the floor nozzle and a second pivot axis (B) that is perpendicular to a longitudinal axis of the shaft part as well as to said first pivot axis (A).
13. Vacuum cleaner according to claim 11 or 12 **characterized in** that the tube connection (15) at least partly comprises a flexible hose.
14. Vacuum cleaner according to any of claims 12-13 **characterized in** that the floor nozzle (12) comprises an electrically driven brush roll (13) that via an electric circuit is connected to one or several batteries.

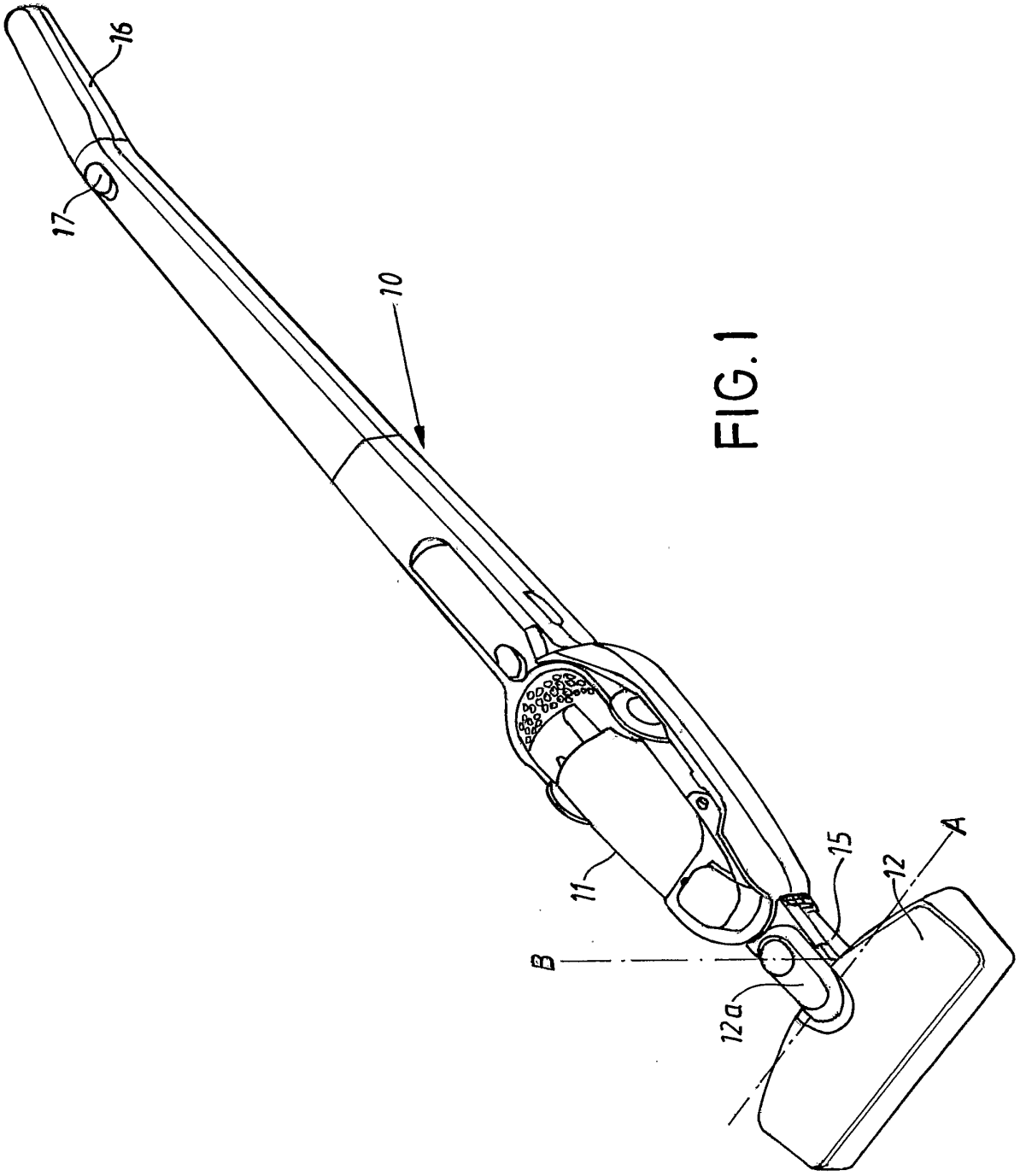


FIG. 1

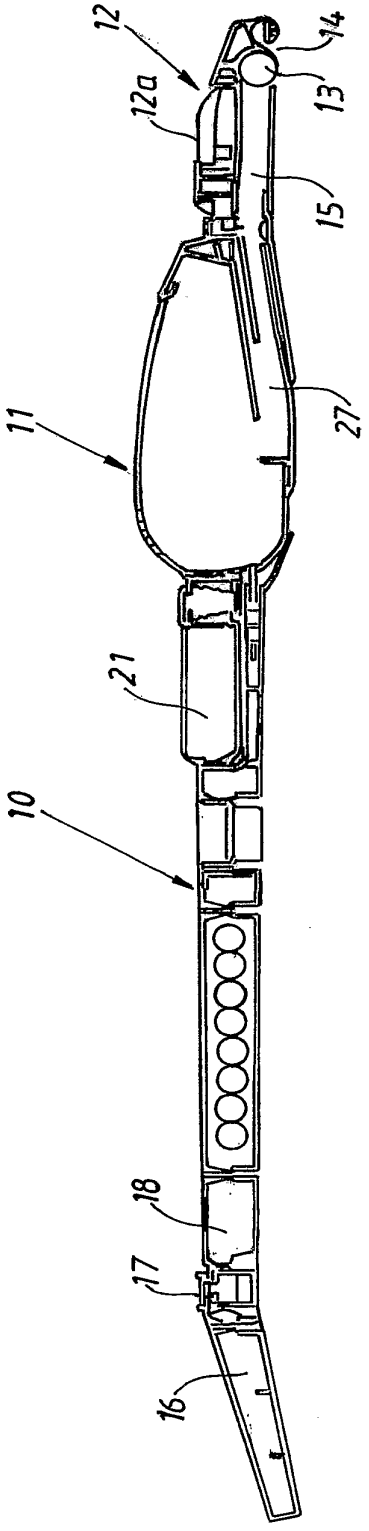


FIG. 2

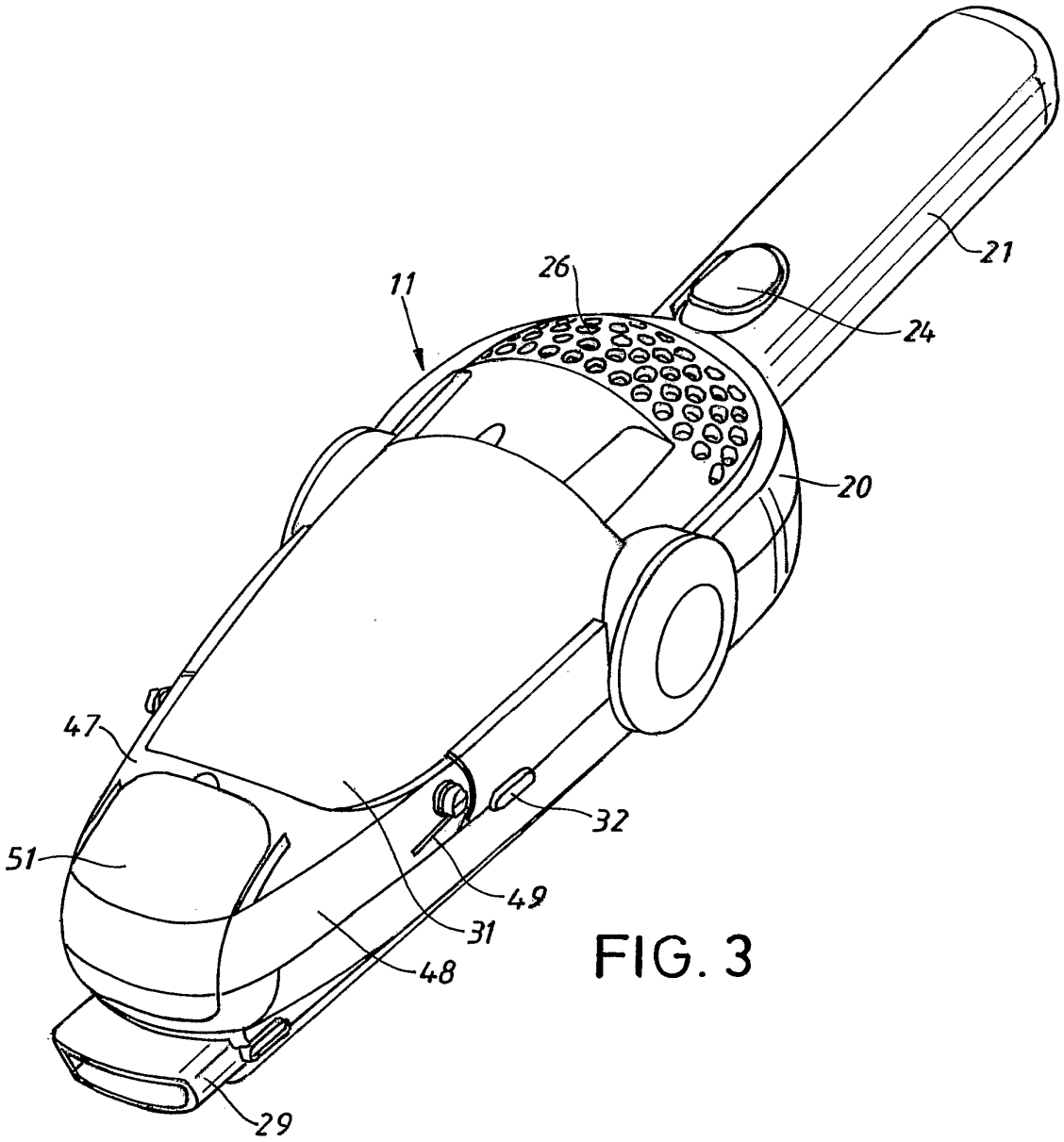


FIG. 3

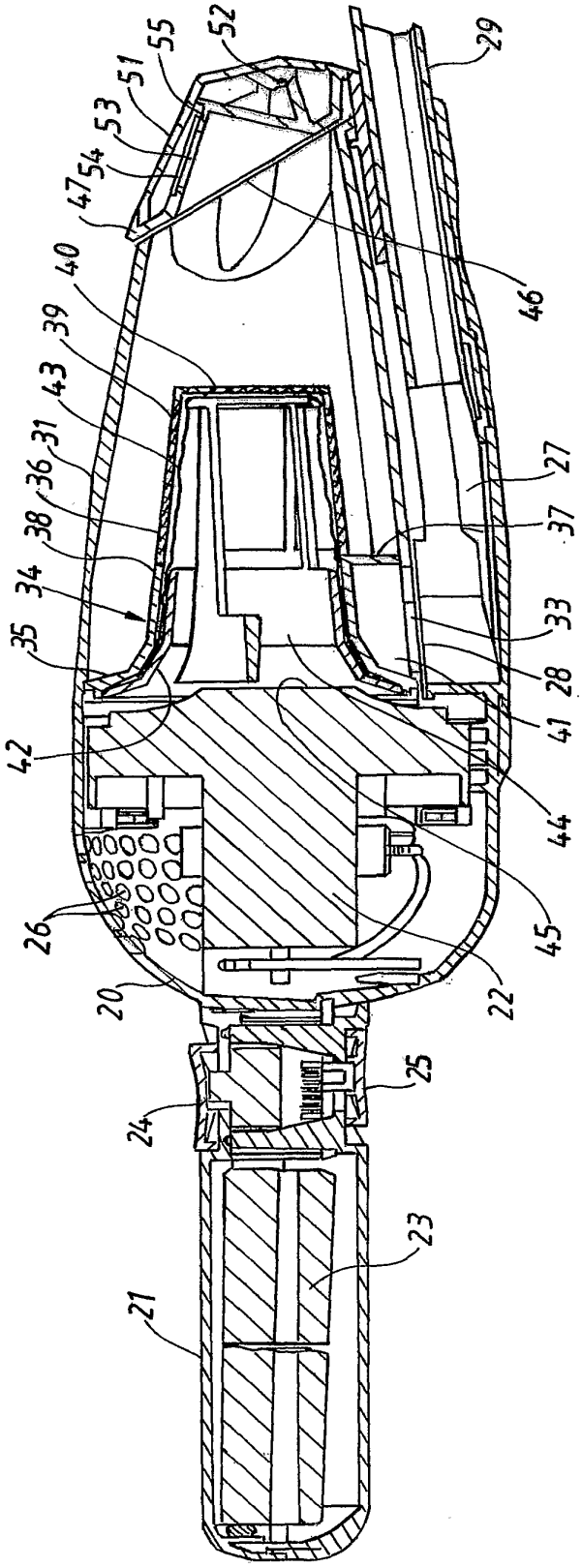

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FIG. 4

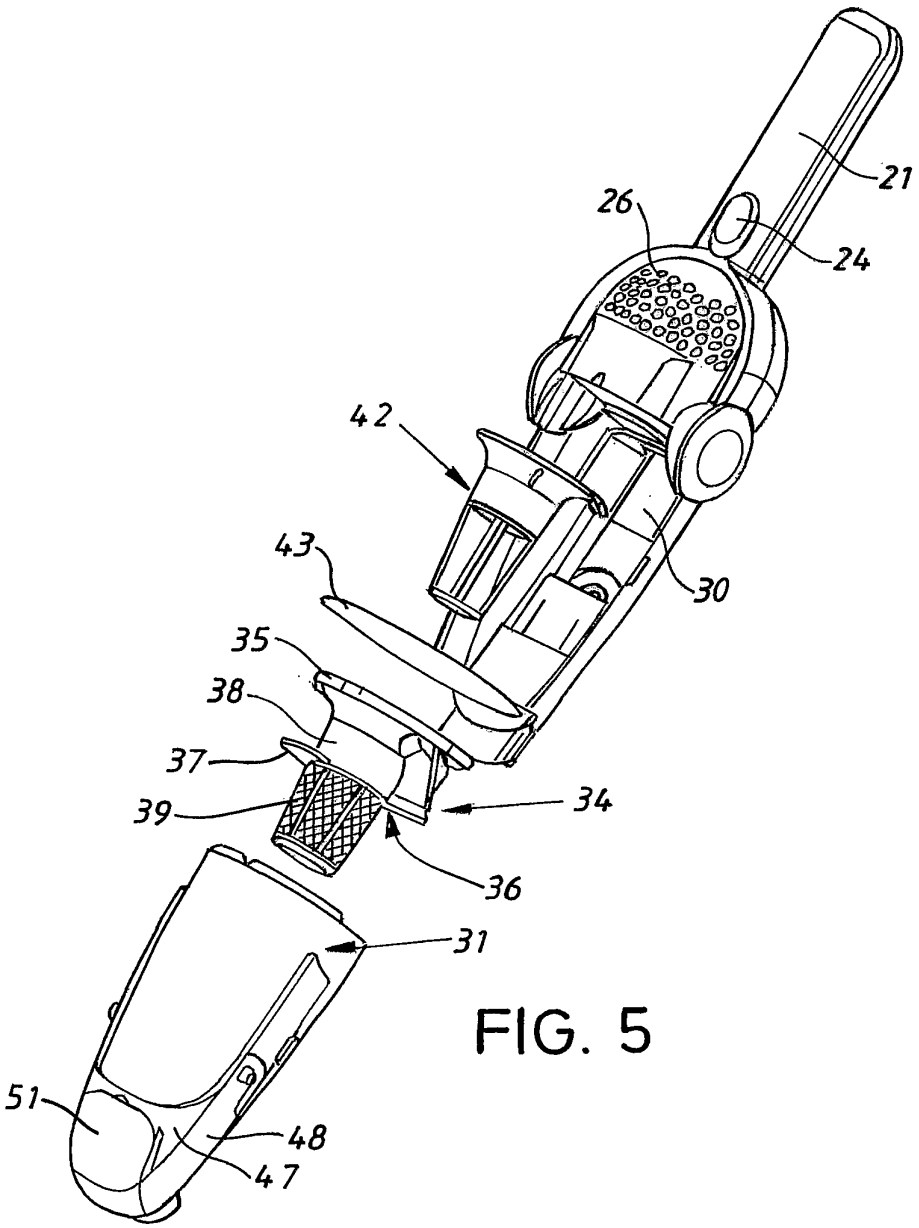

FIG. 5

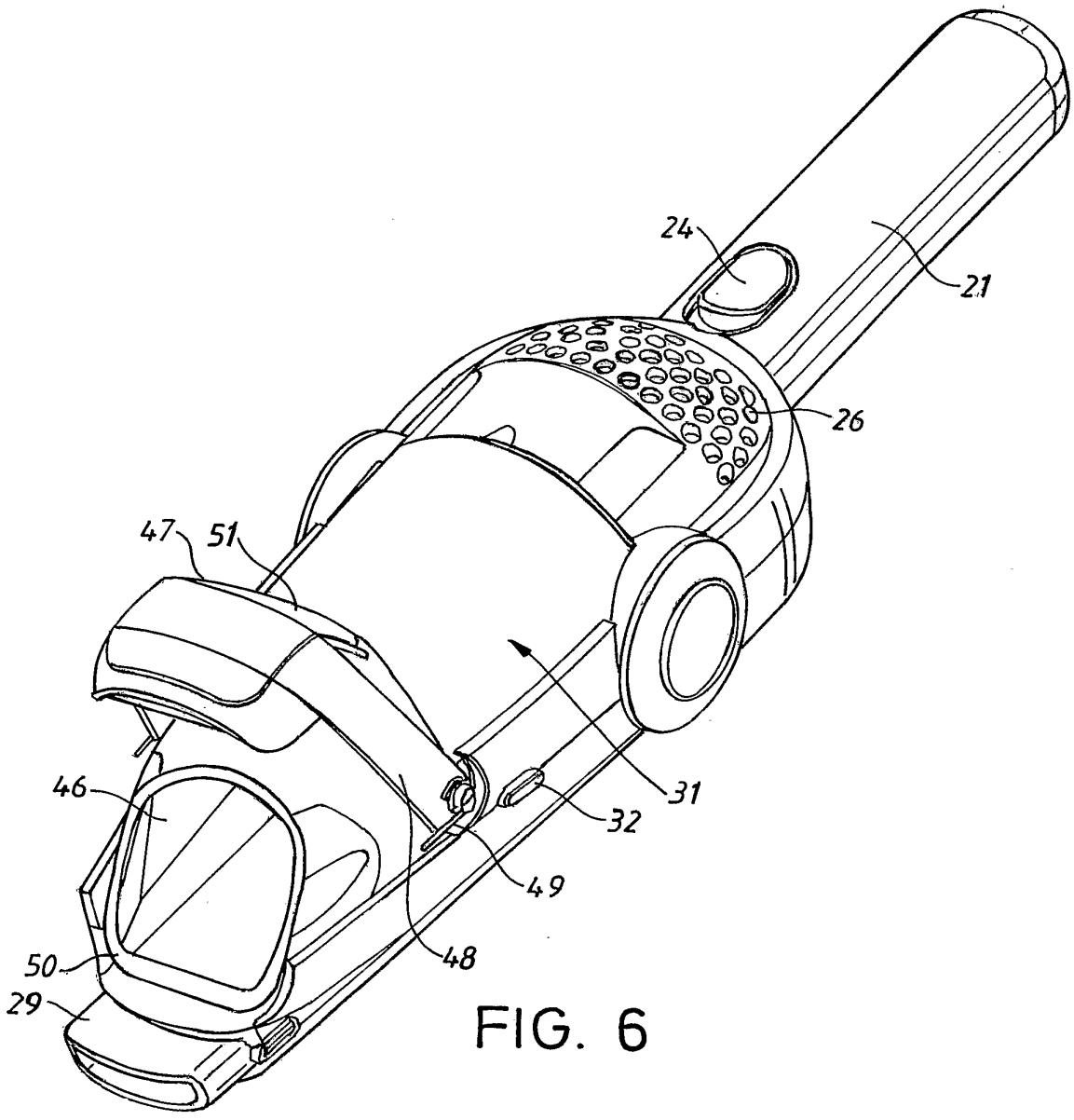

FIG. 6

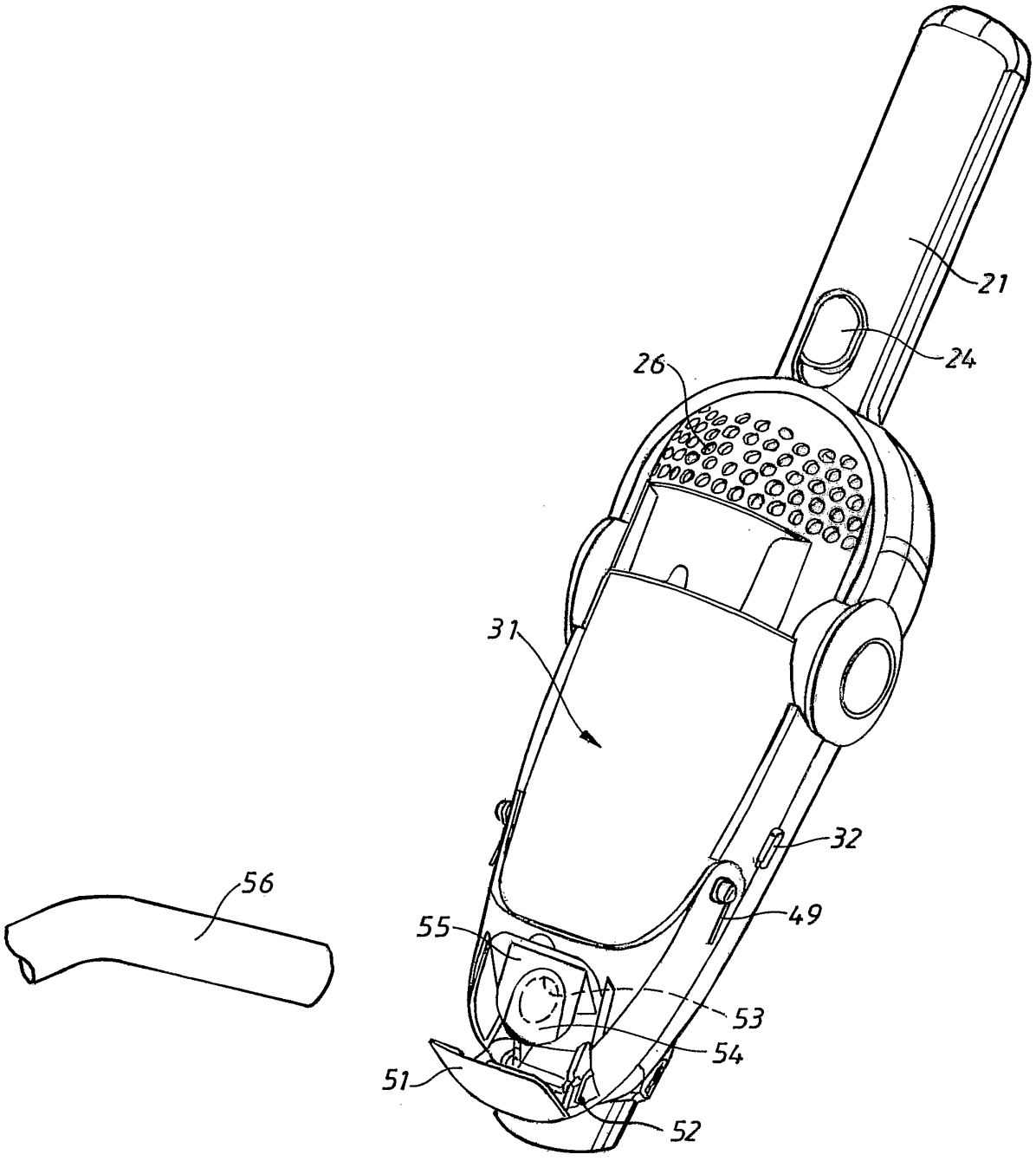

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/000136

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A47L 5/24, A47L 9/16
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A47L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, 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.
Y	EP 0914795 A2 (BLACK & DECKER INC.), 12 May 1999 (12.05.1999), figures 1,2, abstract --	1-14
Y	GB 2035787 A (L & H DESIGNS LIMITED ET AL), 25 June 1980 (25.06.1980), figure 3, details 2,5 --	1-14
Y	SE 514314 C2 (AB ELECTROLUX), 12 February 2001 (12.02.2001), details 20,22 -- --------	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 but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 April 2004	28 -04- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Jan-Axel Ylivainio / JA A Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (January 2004)

EP	0914795	A2	12/05/1999	SE	0914795	T3	
				DE	69721271	D,T	26/02/2004
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GB	2035787	A	25/06/1980	NONE			
SE	514314	C2	12/02/2001	AU	726494	B	09/11/2000
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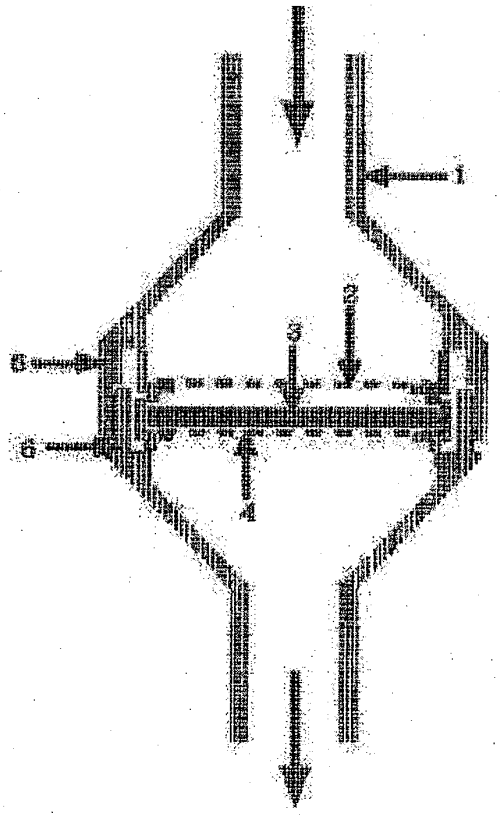
				PL	182813	B	29/03/2002
				PL	327064	A	23/11/1998
				SE	9603114	A	01/03/1998
				US	6122796	A	26/09/2000
				WO	9720492	A	12/06/1997

FILTER FOR CAPTURING/SEPARATING FINE DUST AND CAPTURING/ SEPARATING OF FINE DUST USING THIS FILTER

Publication number: JP2000140533 (A)
Publication date: 2000-05-23
Inventor(s): UEHARA KOZO; TERASAKI MARIKO
Applicant(s): SHINTOO FINE KK
Classification:
- international: ***A47L9/12; B01D39/16;*** **A47L9/10; B01D39/16;** (IPC1-7): B01D39/16; A47L9/12
- European:
Application number: JP19980336585 19981110
Priority number(s): JP19980336585 19981110

Abstract of **JP 2000140533 (A)**

PROBLEM TO BE SOLVED: To enable the easy capturing/separation of fine dust which can be the cause for allergy and contains a tick, a mildew and the like in a room by using a felt which shows the respective specific values of thickness and density as a filter to be mounted in the suction process of a suction device such as a vacuum cleaner.
SOLUTION: A guide 1 is fitted to a pipe part in the suction process of a suction device such as a vacuum cleaner, and a filter 3 is mounted on the guide 1. The method for mounting the filter 3 is preferably to sandwich it between filters 2, 4 of nylon or the like having 10-70 mesh and 10-250 mesh, respectively. The filter 3 to be used is made of a felt with 1-3 mm thickness and 0.1-0.4 g/cm3 density. The felt material to be used is not particularly limited but is preferably a polyester needle punch felt.; In the practical use application of the filter, the three filters 2-4 are, for example, fitted into the guide 1 and fixed with screws 5, 6, and further, the guide 1 is mounted on the pipe part in the suction process of the vacuum cleaner.



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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2000－140533
（P2000－140533A）
(43)公開日　平成12年５月23日(2000.5.23)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード（参考）
Ｂ０１Ｄ　39/16		Ｂ０１Ｄ　39/16	Ａ	３Ｂ０６２
Ａ４７Ｌ　9/12		Ａ４７Ｌ　9/12	Ｚ	４Ｄ０１９

審査請求　未請求　請求項の数４　ＦＤ　（全４頁）

(21)出願番号　特願平10－336585

(22)出願日　平成10年11月10日(1998.11.10)

(71)出願人　397070417
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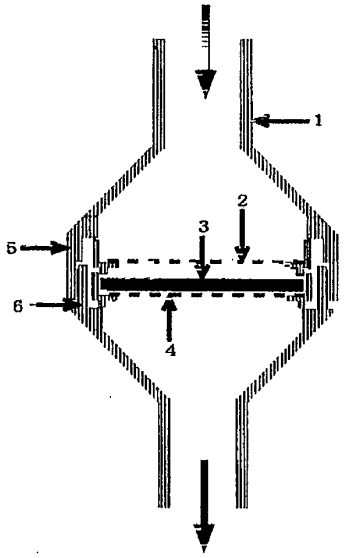
大阪市東淀川区小松２丁目15番52号　シントーファイン株式会社内

Ｆターム(参考)　3B062 AA02 AA08 AA13 AB01 AC02 AC11 AC21
4D019 AA01 BA13 BB02 BB03 BD01 CA05 CB04

(54)【発明の名称】　微細塵捕集分離用フィルター及びそれを用いる微細塵の捕集分離方法

(57)【要約】
【課題】　アレルギーの原因となるダニやカビ等を含む屋内微細塵を効率よく容易に捕集し、分離するフィルター及びそれを用いて捕集及び分離する方法を提供する。
【解決手段】　厚さ１～３ｍｍ、密度０．１～０．４ｇ／ｃｍ^3 のフェルトを用いてなる微細塵捕集分離用のフィルター及びそのフィルターを用いる微細塵の捕集分離方法。



【特許請求の範囲】
【請求項１】　厚さ１～３ｍｍ、密度０．１～０．４ｇ／ｃｍ^3 のフェルトを用いてなる微細塵捕集分離用フィルター。
【請求項２】　フェルトの素材が化学合成繊維のニードルパンチフェルトである請求項１記載の微細塵捕集分離用フィルター。
【請求項３】　厚さ１～３ｍｍ、密度０．１～０．４ｇ／ｃｍ^3 のフェルトを微細塵捕集分離用フィルターとして用いて微細塵を捕集分離する方法。
【請求項４】　電気掃除機等の吸引装置の吸引過程のパイプ部に請求項１に記載のフィルターを取り付ける微細塵の捕集分離方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明はハウスダスト中の、ダニやカビ等を含むアレルギーの原因になりうる微細塵の捕集及び分離に用いるフィルター及びそれを用いる微細塵の捕集分離方法に関するものである。
【０００２】
【従来の技術】従来、微細塵の捕集分離方法としては、電気掃除機等の吸引装置の吸引過程にフィルターを設け、そのフィルターとして、㋑隙間１００μｍ以下の高密度繊維を利用したもの　㋺種類の異なる二枚の不織布等を重ねた、二重三層構造を利用したもの　㋩目の大きさの異なる（例えば、１６メッシュと２００メッシュ等）フィルターを複数重ねたもの（特開昭６４－３０５３１）等が知られている。
【０００３】
【発明が解決しようとする課題】しかしながら、前記㋑、㋺の方法では、電気掃除機の吸込仕事率が極度に低下し、実用的でない上に、電気掃除機のモーターに過度の負荷をかけることになる。一方、㋩の方法では、電気掃除機の吸込仕事率の低下は回避できるものの、微細塵の抜け及びフィルターの目詰まりという問題があった。
【０００４】
【課題を解決するための手段】そこで本発明者らは、ハウスダスト中の微細塵を捕集分離できる手段について鋭意研究を重ねた結果、電気掃除機等の吸引装置の吸引過程にフィルターを設け、そのフィルターとして、厚さ１～３ｍｍ、密度０．１～０．４ｇ／ｃｍ^3 のフェルトを使用することにより、きわめて容易に微細塵を捕集分離できることを見いだし、本発明の完成に至った。すなわち、本発明は、厚さ１～３ｍｍ、密度０．１～０．４ｇ／ｃｍ^3 のフェルトを用いてなる微細塵捕集用フィルターであり、好ましくは、素材がポリエステルをはじめとする化学合成繊維のニードルパンチフェルトを用いることを特徴とする微細塵の捕集分離用フィルターである。また、上記フィルターを用いて微細塵を捕集分離する方法であり、電気掃除機等の吸引装置の吸引過程のパイプ部分に上記フィルターをとりつける微細塵の捕集分離方法である。本発明は、フィルター部分に厚みを持たせることにより、微細塵によるフィルターの目詰まりを軽減し、さらに電気掃除機のモーターへの負荷も少なくできた。さらにポリエステル等化学合成繊維の帯びるマイナス電荷がダストの帯びるプラス電荷と引き合う性質を利用するので、微細塵をほとんど逃すことなく吸着することができる。
【０００５】
【発明の実施の形態】本発明においては、電気掃除機等の吸引装置の吸引過程のパイプ部に図１～２に示すような漏斗上のガイドを取り付け、そこへ本発明のフィルターを取り付ける。本発明のフィルターの使用例として、ナイロン等からなる１０～７０メッシュの第一フィルターとナイロン等からなる１０～２５０メッシュの最終フィルターの間にはさむ形で取り付ける方法が好ましい。本発明のフィルターは、厚さ１～３ｍｍ、密度０．１～０．４ｇ／ｃｍ^3 のフェルトからなる。厚さが１ｍｍ未満のときは微細塵の抜けが多いため好ましくなく、３ｍｍを越えるときは吸込仕事率が低下するため好ましくない。また、密度が０．１ｇ／ｃｍ^3 未満のときは、微細塵の抜けが多いため好ましくなく、０．４ｇ／ｃｍ^3 を越えるときは吸込仕事率が低下するため好ましくない。使用するフェルトの素材は特に制限されないがポリエステルのニードルパンチフェルトが好ましい。本発明においては、かかるフィルターを用いてダニやカビ等を含み、アレルギーの原因になりうる微細塵を含むハウスダストを前記の電気掃除機等にて吸引する。この時、第一のフィルター上には粗い塵が、本発明のフィルターには目的の微細塵が捕集分離される。また、最終フィルターは本発明フィルターの保持が主目的である。
【０００６】
【実施例】次に、本発明の実施例をあげて説明するが、本発明はこれらに限定されるものではない。図１に示した漏斗状のガイドに、図２に示した２，３，４の３個のフィルター（２：ナイロン製１０～７０メッシュ、３：本発明のフィルター、４：ナイロン製１０～２５０メッシュ）をはめ込み、５，６のネジで固定した上で電気掃除機の吸引過程のパイプ部に取り付けた。また、比較例１として、２，４の２個のフィルターのみをはめ込んだもの、比較例２として３の本発明フィルターの代わりに、隙間１００μｍ　以下の高密度繊維をはめ込んだもの、比較例３として３の本発明フィルターの代わりに厚さ０．５ｍｍ（密度０．０５ｇ／ｃｍ^3 ）のフェルトをはめ込んだもの、比較例４として３の本発明フィルターの代わりに厚さ４ｍｍ（密度０．５ｇ／ｃｍ^3 ）のフェルトをはめ込んだもの、比較例５として３の本発明フィルターの代わりに密度０．０５ｇ／ｃｍ^3 （厚さ０．５ｍｍ）のフェルトをはめ込んだもの、比較例６として３の本発明フィルターの代わりに密度０．５ｇ／ｃｍ

^{3}（厚さ４mm）のフェルトをはめ込んだものを用意し、同じく５，６のネジで固定した上でそれぞれを電気掃除機の吸引過程のパイプ部に取り付けた。あらかじめ採取し、２００メッシュのふるいにかけた微細塵（およそ５０μm以下）を供試塵とし、床１m^2 に１ｇをまんべんなくまき、前記電気掃除機にて２０秒間吸引した。比較例１，２についても同様に行った。その結果、表１に示すように、本発明のフィルターを用いた場合は微細塵捕集率が８０％であったが、比較例１を用いた場合は微細塵捕集率が１０％であった。また、比較例２のフィルターを用いた場合は、吸引しなかった。比較例３と比較例５は同一のものであり、微細塵捕集率は４０％以下であった。比較例４と比較例６は同一のものであり、吸引力が極度に低下したため、微細塵捕集率は測定不可能であった。

【０００７】

【表１】

実施例の結果	
	微細塵捕集率（％）
本発明フィルターを使用	８０
比較例１を使用	１０
比較例２を使用	吸引せず
比較例３を使用	＜４０
比較例４を使用	吸引力が極度に低下
比較例５を使用	＜４０
比較例６を使用	吸引力が極度に低下

【０００８】

【発明の効果】本発明により、電気掃除機等の吸引装置を利用し、室内塵中のダニやカビ等を含み、アレルギーの原因になりうる微細塵を捕集分離することが極めて容易にできるようになった。

【図面の簡単な説明】

【図１】フィルターを取り付けたパイプ部の縦断面図である。

【図２】実施例に示した３個のフィルター（２：ナイロン製１０～７０メッシュ、３：本発明のフィルター、４：ナイロン製１０～２５０メッシュ）を示す図である。

【符号の説明】

１　ガイド

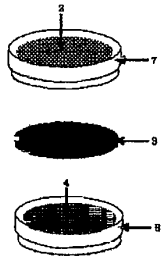
２，３，４　フィルター

５　メスネジ

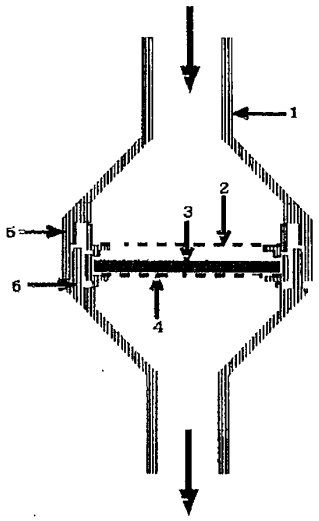
６　オスネジ

７，８　フィルター保持部

【図２】



【図1】



⑲日本国特許庁（JP）　⑪特許出願公開

⑫公開特許公報（A）　昭61－131720

⑤1Int.Cl.⁴　識別記号　庁内整理番号　⑬公開　昭和61年(1986)6月19日
A 47 L 5/24　A－7715－3B

審査請求　未請求　発明の数 1　(全7頁)

⑤4発明の名称　電気掃除機

⑳特　願　昭59－253296
㉒出　願　昭59(1984)11月30日

⑦2発明者　井口　稔夫　東京都目黒区中目黒2丁目6番13号　東京電気株式会社東京工場内
⑦1出願人　東京電気株式会社　東京都目黒区中目黒2丁目6番13号
⑦4代理人　弁理士　樺沢　襄　外2名

明　細　書

1．発明の名称

電気掃除機

2．特許請求の範囲

（1）　一側に吸込口を有するとともに、内部に電動送風機を有するハンディタイプの掃除機本体と、この掃除機本体を着脱自在に取付ける取付部を有し、この取付部の一端に前記掃除機本体の吸込口に連通する延長管を接続するとともに、嵌合部の他端に把手を取付け、前記延長管の先端に吸込口体を接続した支持体とを備え、前記掃除機本体に前記支持体を中継した交流電源により充電される充電式電池を設けるとともに、この直流電源と前記交流電源との切替えによって前記電動送風機を交流電源および直流電源のいずれでも作動可能とし、前記支持体の取付部とは別の面に、前記支持体に設けられ交流電源を供給する電気コードの巻着部を設けたことを特徴とする電気掃除機。

（2）　支持体の取付部はこの支持体の一面側に形成し、取付部の背面に電気コードの巻着部を設けたことを特徴とする特許請求の範囲第1項記載の電気掃除機。

（3）　支持体の電気コードが巻回される面で、かつこの巻回される電気コードの間の位置に、前記支持体を支持する掛着具に係合される掛着部を設けたことを特徴とする特許請求の範囲第2項記載の電気掃除機。

3．発明の詳細な説明

〔産業上の利用分野〕

本発明は電気掃除機に係り、いわゆるステッキタイプの電気掃除機に関するものである。

〔従来の技術〕

従来のステッキタイプの電気掃除機では、小形の掃除機本体に延長管を取付けるとともに、この延長管の先端に吸込口体を取付けた構造をしている。

〔発明が解決しようとする問題点〕

しかし、このような構造のものでは、床面やそれに近い低い所の掃除には適しているが、壁やテーブル上等の床面よりかなり高い所の掃除には先

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端が長すぎたりまた、重すぎたりして適していない。

一方、充電式の掃除機では、壁やテーブル等の掃除には適しているが、大きさ、重量など操作性の観点から、充電式電池として容量の大きなものを使えないため、低入力かつ小出力の掃除機しか得られず、広い面積を有する床面などの掃除には適していない。

そこで、ステッキタイプの掃除機及び充電式の掃除機の両者の機能を有する電気掃除機として、一側に吸込口を有するとともに、内部に電動送風機と充電式電池とを有するハンディタイプの掃除機本体と、この掃除機本体を着脱自在に取付ける取付部を有し、この取付部の一端に前記掃除機本体の吸込口に連通する延長管を接続するとともに、嵌合部の他端に把手を取付け、前記延長管の先端に吸込口体を接続した支持体とを備え、前記電動送風機は切替えにより、交流電源および直流電源のいずれでも作動可能とした電気掃除機が提案されている（特願昭５９－１９７５５４号）。

しかし、このような電気掃除機は掃除機本体を支持体の取付部に着脱自在に取着、抜脱するので、例えば、掃除機の不使用時に電気コードを掃除機本体および支持体の周囲に巻回する構造を採ると、掃除機本体のみを使用する場合でも、このとき、この掃除機本体が充電式電池によって駆動されるにもかかわらず、前記電気コードを解かなくてはならず、また、ステッキタイプであるため、電気コード巻着用の巻着部としての突起などの設定位置によっては、操作時にこの突起が衣服に引掛るなどの問題がある。

本発明はこのような問題点を解決するためになされたもので、上記のようなハンディタイプの掃除機本体と、この掃除機本体を着脱自在に嵌合する支持体とを備えたステッキタイプの電気掃除機において、支持体の電気コードが掃除機本体の着脱の際に障害になったり、或いは操作時に前記電気コードの巻着部が衣服に引掛ったりしないようにすることを目的とするものである。

〔問題点を解決するための手段〕

本発明は、一側に吸込口を有するとともに、内部に電動送風機を有するハンディタイプの掃除機本体と、この掃除機本体を着脱自在に取付ける取付部を有し、この取付部の一端に前記掃除機本体の吸込口に連通する延長管を接続するとともに、嵌合部の他端に把手を取付け、前記延長管の先端に吸込口体を接続した支持体とを備え、前記掃除機本体に前記支持体を中継した交流電源により充電される充電式電池を設けるとともに、この直流電源と前記交流電源との切替えによって前記電動送風機を交流電源および直流電源のいずれでも作動可能とし、前記支持体の取付部とは別の面に、前記支持体に設けられ交流電源を供給する電気コードの巻着部を設けたことを特徴とするものである。

〔作用〕

本発明は、電気掃除機の不使用時には、支持体の電気コードを、この支持体に設けられた掃除機本体の取付部とは別の面に形成した巻着部に巻回し、前記掃除機本体のみを用いて掃除を行なう際に、この掃除機本体の着脱に巻回されたコードが障害にならないようにし、また例えば、前記取付部を支持体の前面に設けかつ巻着部をその背面に設けることで、掃除機本体を支持体の取付部に取付け、前記電気コードを解いて掃除を行なう際に、前記掛着部が衣服などに引掛らないようにするものである。

〔実施例〕

以下、本発明の一実施例を図面に基づいて説明する。

１はハンディタイプの小型の掃除機本体で、この掃除機本体１は電動送風機２を内蔵した本体ケース３と、前記電動送風機２の吸込み側となる本体ケース３の前側に着脱自在に取付けられる集塵ケース４とで形成されている。

そして、前記本体ケース３の後側に前記電動送風機２からの排気を排出する排気口11が形成されているとともに、その上方に係止凹部12が形成されており、また、本体ケース３の上部に取手13が形成されているとともに、その近傍に第１のスイ

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ッチ釦14が設けられている。さらに、本体ケース3の前側下縁に、前記集塵ケース4の後側下縁に向かって突出した凹状の係合受部15が設けられ、また、本体ケース3の前側上縁部分に係合孔16が設けられ、本体ケース3の前側上縁からこの係合孔16側に向かって係合爪17が突設されている。また、本体ケース3の下面にばね18で付勢されて突出した第2のスイッチ釦19が設けられている。

そして、前記集塵ケース4は前側に吸込口21を有しているとともにこの吸込口21の内部に開閉弁22を有し、また、上面にこの吸込口21に接続されるノズル23を収納するノズル収納凹部24が設けられ、かつ、内部の後縁にフィルタ装置25を嵌合してあり、また、後側下縁に前記本体ケース3の係合受部15に係合する係合突起26が突設されているとともに後側上縁に前記本体ケース3の係合孔16に挿入されて係合爪17に係脱するクランプ27が回動自在に設けられている。

そして、この掃除機本体1は単独で使用される場合と、支持体31に取付けて使用する場合とがある。

また、前記取付部32の底面に、前記第1及び第2のフック39，40と同一直線上で前後方向に延びる溝状の係合凹部41が外方に突出して形成され、掃除機本体1の支持体31への取着時には、この係合凹部41に掃除機本体1の係合受部15が嵌合され、この係合受部15が案内されるようになっている。そして、前記係合凹部41の底面に掛着部としてのフック孔41aが形成され、このフック孔41aに係合する掛着具としての第3のフック42が例えば室内の壁面43等に取付けられている。

さらに、前記把手35の前端部から電気コード44が導出され、この電気コード44は、通常、前記第1及び第2のフック39，40に巻回されている。

そして、この電気掃除機の電気回路は、第6図に示す回路図のように、掃除機本体1内に設けられる本体内回路部51と、支持体31内に設けられる支持体内回路部52とに分けられ、この両回路51，52は掃除機本体1の取付部32への取付けにより接続されるようになっている。

り、この支持体31は前記掃除機本体1の前面、底面、後面を嵌合保持する箱体状の取付部32を有し、この取付部32の前側壁を貫通して、前記掃除機本体1の吸込口21に基端が接続する細長い延長管33を前方に延出して設けるとともに、この延長管33の先端に吸込口体34を着脱自在に接続し、さらに、取付部32の後側上部に把手35を後方に向けて突設したものである。

さらに、前記取付部32の後側壁に、前記把手35の下方部分に前記掃除機本体1の排気口11に連通する通風口36が形成されているとともに、後側壁の上部に取付部32の内側に向かってばね37で付勢され前記掃除機本体1の係止凹部12内に挿入されて係脱する係合杆38が設けられている。

さらに、前記取付部32の背面に巻着部としての第1及び第2のフック39，40が底面の前側と後側とにそれぞれ突設され、この第1及び第2のフック39，40はそれぞれ略L字状に形成され、第1のフック39は掃除機本体1の前方に向いて折曲形成され、第2のフック40は回転自在に取付けられて

前記本体内回路51は前記電動送風機2に交流電流を供給する交流回路53と、前記電動送風機2に直流電流を供給する直流電源回路54とを有している。

そして、前記交流回路53は、一対の交流端子55間に第1のスイッチ釦14で切替えられる第1の切替スイッチ56、第1のコイル57、前記電動送風機2及び第2のコイル58を直列に接続して形成されている。

また、前記直流電源回路54は、一対の直流端子59間に抵抗60及びこの抵抗60側に（－）端を向けた直流電源としての充電式電池61を直列に接続し、さらに、この充電式電池61の（－）端を前記第2のスイッチ釦19で開閉される第2の切替スイッチ62と前記第1の切替スイッチ56とを介して前記第1のコイル57の中間部に接続するとともに、前記充電式電池61の（＋）端を前記第2のコイル58の中間部に接続している。

また、前記支持体内回路部52は外部の交流電源71から前記電気コード44を介して前記本体内回路

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51の交流回路53に交流電流を通電する交流電源回路72と、前記交流電源71からの交流電流を受けて前記本体内回路51の直流電源回路54に直流充電電流を供給する充電回路73とで形成されている。

前記交流電源回路72は掃除機本体1の取付部32への嵌合時に前記交流回路53の一対の交流端子55に接続される一対の交流電源端子74を有しており、前記充電回路73は交流電源71に接続されるトランス75を有するとともに、このトランス75の2次側コイル76の両端にそれぞれ2つのダイオード77,78が逆方向に接続され、この2つのダイオード77,78に(−)側の充電端子79が接続されているとともに前記2次側コイルの中間位置に(＋)側の充電端子79が接続されている。

次に、この実施例の電気掃除機の作用について説明する。

この電気掃除機を使用して床面等の低い所を掃除する時は、支持体31の取付部32に掃除機本体1を嵌合して取付けた状態で使用する。

取付部32に掃除機本体1を取付けると、掃除機本体1内に設けた本体内回路部51の各一対の交流端子55、及び一対の直流端子59が支持体31に設けた支持体内回路部52の一対の直流電源端子74、及び一対の充電端子79にそれぞれ対応して接続し、交流回路53と交流電源回路72とが接続するとともに、直流電源回路54と充電回路73とが接続する。

また、取付部32に掃除機本体1を取付けることにより第2のスイッチ釦19が押されて第2の切替スイッチ62がオフし、直流電源回路54が開かれる。

従って、第1の切替スイッチ56を直流電源回路54側に入れても電動送風機2は作動しない。一方、第1の切替スイッチ56を交流回路53側に入れ、交流電源71を投入すると電動送風機2が作動するので、この状態で掃除をする。

ところで、掃除機本体1を取付部32に嵌合している時、充電回路73と直流電源回路54の充電式電池61が接続されるので、充電式電池61への充電が行われる。そして、この充電は、交流電源回路72と交流回路53からの交流電流で電動送風機2を作動している間にも行われているので充電効率がよい。

次に、テーブルの上等やや高い所を掃除する場合、支持体31の延長管33が長すぎて掃除しにくいので、掃除機本体1を支持体31の取付部32から外す。支持体31の取付部32から掃除機本体1を外すと第2のスイッチ釦19が突出して第2の切替スイッチ62がオンするので、直流電源としての充電式電池61の使用が可能になり、第1の切替スイッチ56を直流電源回路54側に入れると、充電式電池61により電動送風機2が作動するのでこの状態で掃除をする。この場合ノズル収納凹部24からノズル23を外して吸込口21に挿入しておく。

ところで、電気掃除機の電気回路は、掃除機本体1側の本体内回路部51と支持体31内の支持体内回路部52とに分けられ掃除機本体1内に充電用のトランス75等がないので、掃除機本体1自体の重量が軽くなり、掃除機本体1を持ち易く、掃除が容易にできる。

また、前記ノズル23は、掃除機本体1を支持体31に取着して掃除を行なうときには、ノズル収納凹部24に嵌着されているので、前記ノズル23を紛失するようなことがなく、また、掃除機本体1のみで掃除を行なうときには、ノズル23を収納凹部24から外して、すぐに吸込口21に取付けることができ、ノズル23を別の収納場所から持ってくるような手間がいらない。

また、掃除機の不使用時には、電気コード44を第1及び第2のフック39,40に巻回して収納し、掃除機本体1を支持体31の取付部32に嵌合して室内の壁面43に設けた第3のフック42にフック孔41aを係合して支持体31と掃除機本体1と一体になったこの電気掃除機を掛けておく。

このようにして、掃除機を壁面43などに掛けておくことができるので、掃除機の置き場所に広いスペースを必要としないとともに、手軽にこの掃除機を使用することができる。そして、第3のフック42に係合されるフック孔41aが、支持体31の取付部32の背面に、巻回された電気コード44の内側に位置するように設けてあるので、掃除機は掃除機本体1及び電気コード44などのもっとも重量

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のある部分で支持されることになり、掃除機は安定して掛着される。

また、電気コード44の巻着部であるフック39，40及びフック孔41aは、支持体31の取付部32の背面に設けてあるので、掃除機を掛着した状態で、電気コード44が壁面43側に位置しているから外観上の体裁が良く、また、取付部32は外面側に位置することになるから、掃除機本体1のみを使って掃除を行なうときには、支持体31を壁面43に掛けたまま、掃除機本体1を着脱することができる。さらに、電気コード44のプラグをコンセントに差込んだまま掃除機をかければ、この状態で充電式電池61の充電を行なうことできる。

そして、第1及び第2のフック39，40に巻回されて収納された電気コード44を再び使用するときは、第2のフック40が回動自在になっているので、回動によりL字形の折曲方向を内側に向けると、この第2のフック40に引掛かっていた電気コードが一度に外れるので、巻回を解くより素早く外すことができる。

また、掃除機本体1を支持体31に取着して掃除を行なう場合には、第1及び第2のフック39，40が下面側に位置することになるので、操作中にこれらフック39，40が衣服などに引掛ることがない。

なお、この実施例では第2の切替スイッチ62を設け、掃除機本体1を取付部32に取付けたときにはこの第2の切替スイッチ62がオフとなり、充電式電池61が使用できないようになっているが、この第2の切替スイッチ62を設けなければ、掃除機本体1を支持体31の取付部32に取付けて使用する場合、第1の切替スイッチ56による選択により、交流・直流いずれでも使用可能となる。従って、電気コード44の長さが足りず、支持体31の吸込口体34の届かない場所でも直流電源回路54からの直流電流で作動するようにすれば、電気コード44を室内のコンセントから外して、届かない場所まで行くことにより掃除をすることができる。

（発明の効果）

本発明によれば、ハンディタイプの掃除機本体と、この掃除機本体が取付けられる取付部を有する支持体とを備えたステッキタイプの電気掃除機において、支持体の電気コードを、この支持体の取付部とは別の面に形成した巻着部に巻回して収納する構造としたので、前記コードの収納、取外しが容易であるとともに体裁良く収納することができ、また、掃除機本体のみを使用する際にこの掃除機本体の着脱に前記コードが障害となることがなく、さらに、例えば取付部を支持体の前面に設けかつ巻着部をその背面に設ければ、掃除機本体を支持体の取付部に取着して使用する際、前記巻着部が衣服などに引掛ることがないものである。

4．図面の簡単な説明

第1図は本発明の電気掃除機の一実施例を示す縦断面図、第2図はその斜視図、第3図は支持体の取付部部分と掃除機本体の縦断面図、第4図は掃除機本体の使用状態を示す縦断面図、第5図は第2のスイッチ釦部分の拡大縦断面図、第6図は電気掃除機の電気回路を示す回路図である。

1・・掃除機本体、2・・電動送風機、21・・吸込口、31・・支持体、32・・取付部、33・・延長管、34・・吸込口体、35・・把手、39・・巻着部としての第1のフック、40・・巻着部としての第2のフック、41a・・掛着部としてのフック孔、42・・掛着具としての第3のフック、43・・壁面、44・・電気コード、61・・充電式電池、71・・交流電源。

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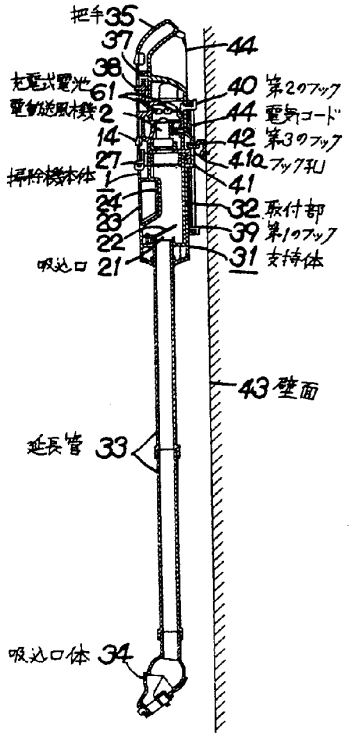
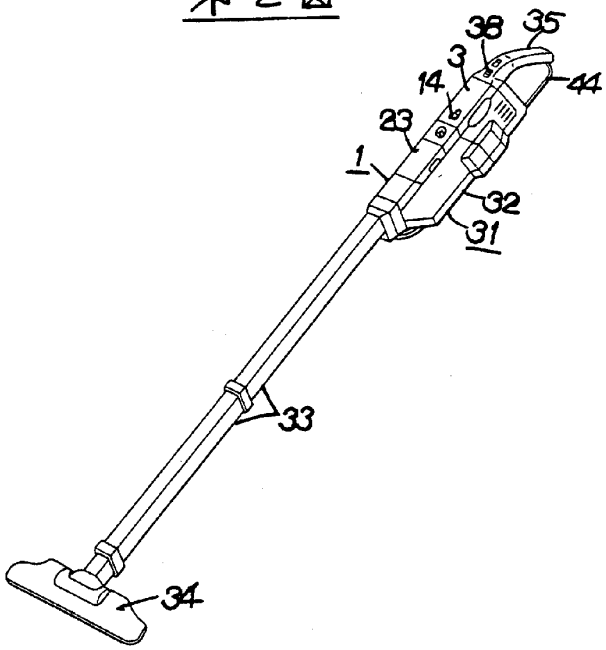
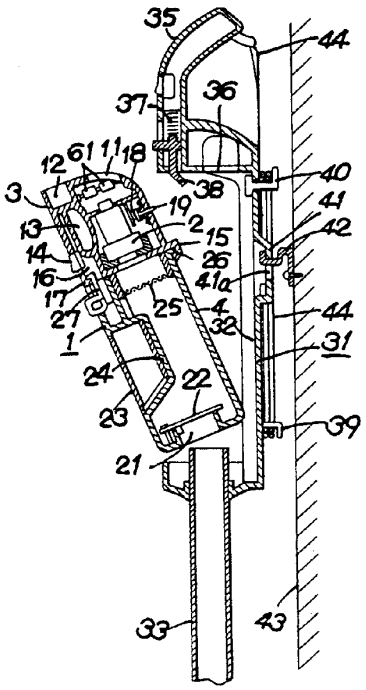
第1図



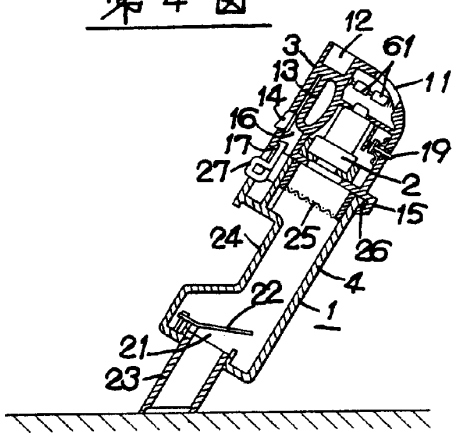
第2図



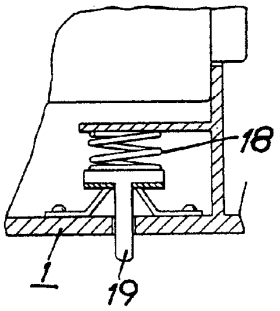
第3図



第4図



第5図



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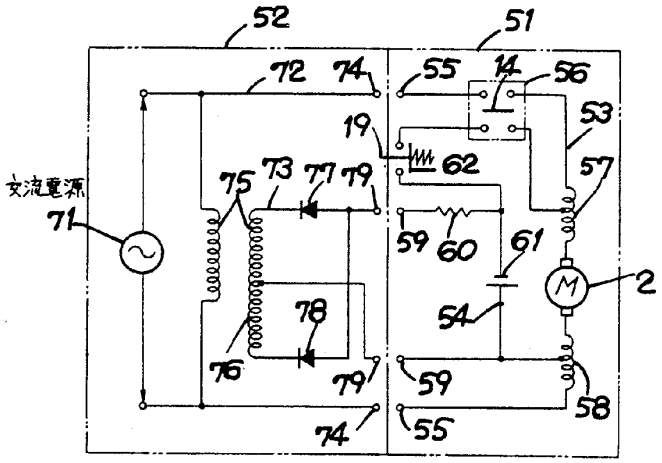
第6図



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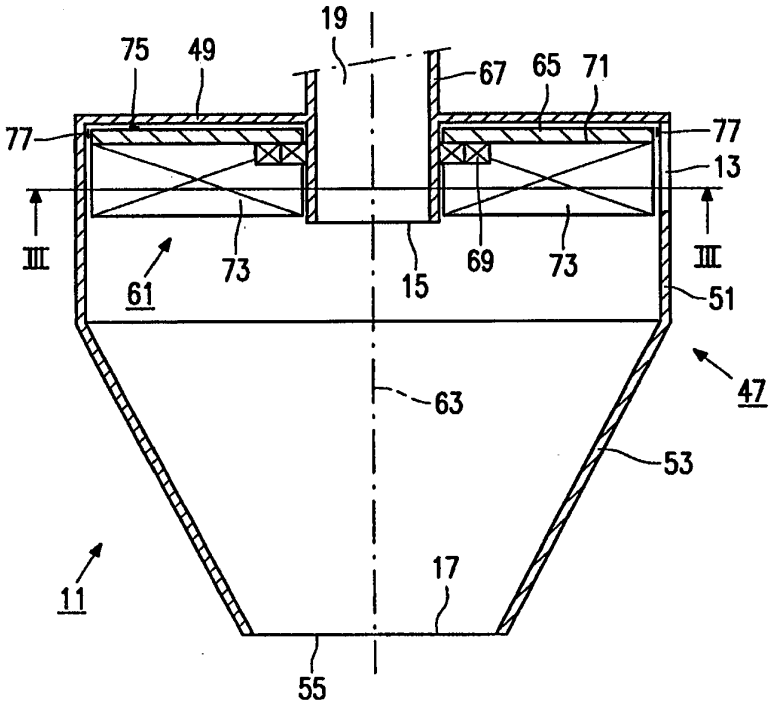
(54) Title: SEPARATOR DEVICE PROVIDED WITH A CYCLONE CHAMBER WITH A CENTRIFUGAL UNIT, AND VACUUM CLEANER PROVIDED WITH SUCH A SEPARATOR DEVICE

(57) Abstract

A separator device (3) provided with a cyclone chamber (11, 79) for separating solid and/or liquid particles from a gas flow. The cyclone chamber (11, 79) has an upper wall (49) in which an outlet opening (15) is present, and a substantially rotationally symmetrical side wall (47, 81) in which an inlet opening (13) is present adjacent the upper wall (49). A discharge opening (17, 85) for the separated solid and/or liquid particles is present at a side (55, 83) of the cyclone chamber (11, 79) remote from the upper wall (49). According to the invention, a rotatable annular centrifugal unit (61, 87) is arranged in the cyclone chamber (11, 79) around the outlet opening (15) near the upper wall (49), by means of which unit a short-circuit flow running directly from the inlet opening (13) to the outlet opening (15) in the cyclone chamber (11, 79) is prevented. The efficiency of the separator device (3) is considerably improved thereby. In a first embodiment, the centrifugal unit (61) comprises a rotatable annular disc (65) positioned adjacent and parallel to the upper wall (49). In a second embodiment, the centrifugal unit (87) comprises a rotatable rim of blades (89) which is partly countersunk into a recess (95) in the upper wall (49). The separator device (3) can be used in a cyclone vacuum cleaner (1).



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Separator device provided with a cyclone chamber with a centrifugal unit, and vacuum cleaner provided with such a separator device.

The invention relates to a separator device for separating solid and/or liquid particles from a gas flow, which separator device is provided with a cyclone chamber with a substantially rotationally symmetrical side wall, an upper wall, at least one inlet opening for the gas flow provided in the side wall adjacent the upper wall, an outlet opening for the gas flow provided in the upper wall, and a discharge opening for the separated solid and/or liquid particles provided at a side of the cyclone chamber remote from the upper wall.

The invention also relates to a vacuum cleaner provided with a housing in which a separator device is accommodated for separating solid and/or liquid particles from a gas flow, which separator device is provided with a cyclone chamber with a substantially rotationally symmetrical side wall, an upper wall, at least one inlet opening provided in the side wall adjacent the upper wall and capable of being coupled to a suction attachment, an outlet opening provided in the upper wall and connected to an electrical suction unit arranged in the housing, and a discharge opening provided at a side of the cyclone chamber remote from the upper wall, which discharge opening is connected to a holder for the separated solid and/or liquid particles.

A vacuum cleaner of the kind mentioned above and provided with a separator device of the kind mentioned in the opening paragraph is generally known as a cyclone vacuum cleaner. Such a separator device is provided with an inlet channel which issues into the inlet opening of the cyclone chamber and which is approximately tangentially oriented relative to the rotationally symmetrical side wall of the cyclone chamber. An underpressure is generated in the cyclone chamber by the suction unit of the vacuum cleaner during operation, so that a gas flow arises in the cyclone chamber from the inlet opening to the outlet opening. Since the inlet channel is oriented approximately tangentially relative to the side wall, the gas flow in the cyclone chamber comprises a spiraling portion starting from the inlet opening and merging into a core flow which is present in the center of the cyclone chamber and is directed towards the outlet opening. Solid and/or liquid particles present in the gas flow are separated from the gas flow in said spiraling portion of the gas flow under the influence of centrifugal forces and deposited against the side wall of the cyclone chamber, whereupon said particles are removed through the discharge opening of the cyclone

chamber under the influence of the force of gravity.

A problem in such separator devices which has long been known is the so-called short-circuit flow which is present in the cyclone chamber in addition to the spiraling portion of the gas flow and the core flow and which is aimed from the inlet opening directly at the outlet opening. Solid and/or liquid particles in the short-circuit flow practically do not enter the spiraling portion of the gas flow and are accordingly badly separated from the gas flow in the cyclone chamber. The efficiency of the separator device is adversely affected by said short-circuit flow. In particular, comparatively light solid and/or liquid particles are not separated from the short-circuit flow. Besides comparatively light solid and/or liquid particles, foam particles especially fail to be separated from the short-circuit flow when such a separator device is used in a vacuum cleaner, in particular a combined dry and wet vacuum cleaner provided with a shampooing device.

A cyclone vacuum cleaner is known from NL-A-7613475 in which the outlet opening of the cyclone chamber comprises a tubular outlet channel in which a fan is journaled, capable of being driven into rotation by a motor. A secondary spiraling flow is generated in the outlet channel by the fan, so that comparatively light solid and/or liquid particles not separated from the gas flow in the cyclone chamber are separated from the gas flow in the outlet channel. Downstream of the outlet channel, there is a further fan which can be driven by a motor and which generates a clearing suction along the inner wall of the outlet channel. The particles separated from the secondary spiraling gas flow in the outlet channel are carried along by said clearing suction and finally removed towards the discharge opening of the cyclone chamber. The construction of this known cyclone vacuum cleaner as described above is comparatively complicated and occupies comparatively much space.

It is an object of the invention to provide a separator device of the kind mentioned in the opening paragraph and a vacuum cleaner of the kind mentioned in the second paragraph in which the adverse effect of the short-circuit flow on the efficiency of the separator device as described above is prevented as much as possible by comparatively simple means which occupy little space.

According to the invention, the separator device is for this purpose characterized in that the separator device is provided with an annular centrifugal unit which is positioned in the cyclone chamber adjacent the upper wall around the outlet opening and is rotatable about a centerline of the cyclone chamber.

The vacuum cleaner according to the invention is for this purpose characterized in that the separator device used therein is a separator device according to the

invention.

The invention is based on the recognition that the short-circuit flow between the inlet opening and the outlet opening of the cyclone chamber occurs mainly through a boundary layer of the spiraling portion of the gas flow present along the upper wall of the cyclone chamber. In said boundary layer, the gas flow has a comparatively low flow velocity owing to friction between the upper wall and the gas flow, so that the centrifugal forces acting on the solid and/or liquid particles present in the boundary layer are comparatively small. The comparatively small centrifugal forces in the boundary layer have the result that, unless further measures are taken, in particular the comparatively light solid and/or liquid particles will be carried along by the gas flow in the boundary layer and conducted directly to the outlet opening. The centrifugal forces acting on the solid and/or liquid particles in the boundary layer along the upper wall are strongly increased in that the separator device according to the invention is provided with said centrifugal unit which is positioned in the cyclone chamber adjacent the upper wall around the outlet opening, so that also comparatively light solid and/or liquid particles are separated from said boundary layer by the centrifugal forces, and the efficiency of the separator device is considerably enhanced. Since said centrifugal unit is positioned inside the cyclone chamber around the outlet opening, the dimensions of the separator device need not be increased, and no constructional adaptations of the separator device need be carried out outside the cyclone chamber.

A special embodiment of a separator device according to the invention is characterized in that the centrifugal unit is rotatable during operation by means of a gas flow which enters the cyclone chamber through the inlet opening. Since the centrifugal unit is rotatable by means of the gas flow which enters the cyclone chamber, the separator device need not be provided with separate driving means for rotating the centrifugal unit, so that the construction of the separator device is further simplified.

A further embodiment of a separator device according to the invention is characterized in that the centrifugal unit is provided with an annular rotatable disc which is arranged adjacent and parallel to the upper wall around an outlet pipe which comprises the outlet opening. The positioning of the annular disc as close to the upper wall as possible has the result that a comparatively narrow, disc-shaped gap is present between the upper wall and the annular disc. When the annular disc rotates during operation, a so-called Couette flow with a comparatively great velocity gradient arises in said gap as a result of the friction between the upper wall and the gas in the gap and the friction between the annular disc and the gas in the gap. Owing to the great velocity gradient, comparatively great centrifugal

forces are exerted on the solid and/or liquid particles present in said Couette flow, so that a strong separation of the solid and/or liquid particles from the Couette flow takes place in said gap.

A yet further embodiment of a separator device according to the invention is characterized in that the annular disc is provided with a rim of blades at a side facing away from the upper wall. The use of the rim of blades renders the annular disc rotatable by means of the gas flow which enters the cyclone chamber through the inlet opening in a simple and practical manner.

A special embodiment of a separator device according to the invention is characterized in that the centrifugal unit is provided with a rotatable rim of blades which is partly countersunk into a disc-shaped recess provided in the upper wall. Said rim of blades rotates during operation under the influence of the gas flow entering the cyclone chamber through the inlet opening. The boundary layer present during operation along the upper wall between the inlet opening and the outlet opening is disturbed by said recess and the rim of blades rotating therein. Solid and/or liquid particles present in said boundary layer are carried along by the rim of blades in its rotation, so that a centrifugal force is exerted on said solid and/or liquid particles under the influence of which said particles are separated from the gas flow.

A further embodiment of a separator device according to the invention is characterized in that the rim of blades is provided on a side of an annular disc facing away from the upper wall, which disc is provided at a side facing the upper wall with at least one raised annular threshold, while an annular groove mating with the annular threshold is provided in the recess of the upper wall, in which groove the annular threshold is rotatable. The annular threshold provided on the disc in combination with the annular groove provided in the upper wall forms a so-called labyrinth seal by means of which a possible leakage flow between the disc and the recess in the upper wall is prevented as much as possible.

The invention will be explained in more detail below with reference to the drawing, in which

Fig. 1 diagrammatically shows a vacuum cleaner according to the invention provided with a separator device according to the invention,

Fig. 2 diagrammatically and in cross-section shows a first embodiment of a cyclone chamber of the separator device used in the vacuum cleaner of Fig. 1,

Fig. 3 is a cross-section taken on the line III-III in Fig. 2,

Fig. 4 diagrammatically shows an air flow present during operation in the

cyclone chamber of Fig. 2, and

Fig. 5 diagrammatically and in cross-section shows a second embodiment of a cyclone chamber of the separator device used in the vacuum cleaner of Fig. 1.

The vacuum cleaner 1 according to the invention which is diagrammatically shown in Fig. 1 is a so-called cyclone vacuum cleaner which is provided with a separator device 3 according to the invention for separating solid and/or liquid particles from an air flow which is present in the vacuum cleaner 1 during operation. The separator device 3, which is indicated diagrammatically only in Fig. 1 and will be explained in more detail below, is positioned in a housing 5 of the vacuum cleaner 1 which is displaceable over a surface 9 to be cleaned by means of wheels 7. The separator device 3 comprises a cyclone chamber 11 with an inlet opening 13 for the air flow, an outlet opening 15 for the air flow, and a discharge opening 17 for the solid and/or liquid particles which are separated from the air flow in the cyclone chamber 11 during operation. The outlet opening 15 of the cyclone chamber 11 is connected via an air channel 19 to an electrical suction unit 21 which is also arranged in the housing 5 and which is provided with a turbine 23 which is rotatable by means of an electric motor 25. The suction unit 21 is connected to an air outlet 29 provided in the housing 5 via a further air channel 27. The inlet opening 13 of the cyclone chamber 11 is connected via an inlet channel 31 to a coupling member 33 which is provided on the housing 5 and to which a suction attachment 35 of the vacuum cleaner 1 can be coupled. In the vacuum cleaner 1 shown in Fig. 1, the suction attachment 35 comprises a suction nozzle 37, a hollow tube 39, a hollow handle 41, and a flexible hose 43 which can be coupled to the coupling member 33. The discharge opening 17 of the cyclone chamber 11 is connected to a holder 45, also positioned in the housing 5, for the solid and/or liquid particles which have been separated from the air flow in the cyclone chamber 11 during operation.

As Fig. 2 shows in detail, the cyclone chamber 11 of the separator device 3 in a first embodiment comprises a substantially rotationally symmetrical side wall 47 and an upper wall 49. The side wall 47 comprises a substantially circular-cylindrical upper portion 51 and a conical lower portion 53. It is noted that the cyclone chamber 11 according to the invention may alternatively be provided with a rotationally symmetrical side wall of a different shape, for example an exclusively circular-cylindrical side wall. The inlet opening 13 of the cyclone chamber 11 is provided in the circular-cylindrical portion 51 of the side wall 47 adjacent the upper wall 49, while the outlet opening 15 is provided approximately centrally in the upper wall 49. The discharge opening 17 of the cyclone chamber 11 is at a

side 55 of the cyclone chamber 11 which is remote from the upper wall 49. It is noted that the cyclone chamber 11 according to the invention may alternatively be provided with more than one inlet opening 13, for example three inlet openings which are provided with equal mutual interspacings in the side wall 47 adjacent the upper wall 49 and which are connected to a common inlet channel via a distributor channel.

During operation, the suction unit 21 generates an underpressure in a flow channel of the vacuum cleaner 1 which comprises, in that order, the suction nozzle 37, the tube 39, the handle 41, the hose 43, the inlet channel 31, the cyclone chamber 11, and the air channel 19. Owing to this underpressure, an air flow arises in said flow channel from the suction nozzle 37 to the suction unit 21. Solid and/or liquid particles present on the surface 9 to be cleaned are carried along by said air flow and substantially separated from the air flow in the cyclone chamber 11 in a manner to be described in more detail below.

As Fig. 3 shows, the inlet channel 31, which issues into the inlet opening 13 of the cyclone chamber 11, is oriented substantially tangentially with respect to the rotationally symmetrical side wall 47. Since the inlet channel 31 is oriented substantially tangentially with respect to the side wall 47, the air flow in the cyclone chamber 11, as shown diagrammatically in Fig. 4, has a spiraling portion 57 starting from the inlet opening 13 which merges into a core flow 59 which is present in the center of the cyclone chamber 11 and which is directed towards the outlet opening 15. The solid and/or liquid particles present in the air flow are substantially separated from the air flow in the spiraling portion 57 of the air flow owing to the centrifugal forces acting on said particles and are deposited against the side wall 47, whereupon said particles are transported to the holder 45 through the discharge opening 17 under the influence of the force of gravity acting on said particles.

As Fig. 2 further shows, an annular centrifugal unit 61 is arranged in the cyclone chamber 11 of the separator device 3 adjacent the upper wall 49 around the outlet opening 15, which unit is rotatable about a centerline 63 of the cyclone chamber 11. In the first embodiment of the cyclone chamber 11 shown in Fig. 2, the centrifugal unit 61 comprises an annular disc 65 which is rotatable about the centerline 63 and is arranged adjacent and parallel to the upper wall 49 around an outlet pipe 67 which comprises the outlet opening 15. The annular disc 65 is journaled by means of a ball bearing 69, depicted diagrammatically only in Fig. 2, so that it can rotate relative to the outlet pipe 67. At a side 71 facing away from the upper wall 49, a rim of blades 73 is provided on the annular disc 65 by means of which the annular disc 65 is rotatable about the centerline 63 under the influence of the air flow entering the cyclone chamber 11 through the inlet opening 13 during

operation. The annular disc 65 is positioned so close to the upper wall 49 that a comparatively narrow disc-shaped gap 75 is present between the upper wall 49 and the annular disc 65. When the annular disc 65 is rotated during operation, a so-called Couette flow having a comparatively great velocity gradient arises in the gap 75 as a result of the friction between the upper wall 49 and the air in the gap 75 and the friction between the disc 65 and the air in the gap 75. Owing to this great velocity gradient, comparatively great centrifugal forces are exerted on the solid and/or liquid particles present in the Couette flow, so that a strong separation of the solid and/or liquid particles from the Couette flow takes place in the gap 75. The solid and/or liquid particles thus separated pass through an annular gap 77 present between the disc 65 and the side wall 47 and enter the spiraling portion of the air flow in the cyclone chamber 11, from which said particles are separated in the manner described further above.

The use of the centrifugal unit 61 described above prevents the formation of a boundary layer of the spiraling portion 57 of the air flow in the cyclone chamber 11 which would be present along the upper wall 49 without the use of the centrifugal unit 61 as a result of frictional forces between the upper wall 49 and the spiraling portion 57 of the air flow. Owing to said frictional forces, the air flow in said boundary layer would have a comparatively low flow velocity, so that the air flow in the boundary layer would go directly from the inlet opening 13 to the outlet opening 15, and the centrifugal forces acting on the solid and/or liquid particles in the boundary layer would be comparatively small. Owing to the comparatively small centrifugal forces in the boundary layer, the comparatively light solid and/or liquid particles in particular would be mainly carried along directly from the inlet opening 13 to the outlet opening 15 by the air flow in the boundary layer, and would accordingly not be separated from the air flow in the cyclone chamber 11. The air flow described above which would be present in the boundary layer along the upper wall 49 without the use of the centrifugal unit 61 thus forms a so-called short-circuit flow between the inlet opening 13 and the outlet opening 15 which would seriously detract from the efficiency of the separator device 3. As was described above, the rotatable annular disc 65 of the centrifugal unit 61 used in the cyclone chamber 11 generates a Couette flow along the upper wall 49 in which comparatively great centrifugal forces occur, so that comparatively light solid and/or liquid particles present in the flow along the upper wall 49, for example foam particles, are also separated from said flow as much as possible. The use of the centrifugal unit 61 thus considerably increases the number of solid and/or liquid particles separated from the air flow in the cyclone chamber 11, so that the efficiency of the separator

device 3 is substantially improved. The dimensions of the separator device 3 are not increased by the use of the centrifugal unit 61 because the centrifugal unit 61 is positioned entirely inside the cyclone chamber 11. The centrifugal unit 61 need not be provided with separate driving means for the annular disc 65 such as, for example, an electric drive motor positioned in or outside the cyclone chamber 11, because the annular disc 65 of the centrifugal unit 61 can be driven into rotation by the air flow entering the cyclone chamber 11 thanks to the use of the rim of blades 73. It is noted, however, that the invention also covers an embodiment in which the centrifugal unit 61 can be driven by such a drive motor or by alternative driving means.

Fig. 5 shows a second embodiment of a cyclone chamber 79 suitable for use in the separator device 3 of the vacuum cleaner 1 instead of the cyclone chamber 11 described above. Components of the cyclone chamber 79 corresponding in essence to components of the cyclone chamber 11 described above have been given the same reference numerals in Fig. 5. The following description only deals with those components of the cyclone chamber 79 which are essentially different from those of the cyclone chamber 11.

The cyclone chamber 79 comprises a substantially circular-cylindrical side wall 81. A disc-shaped table 83 is arranged in the cyclone chamber 79, bounding the cyclone chamber 79 at a side remote from the upper wall 49. An annular opening forming a discharge opening 85 of the cyclone chamber 79 is present between the disc-shaped table 83 and the side wall 81. An annular centrifugal unit 87 rotatable about the centerline 63 of the cyclone chamber 79 is arranged adjacent the upper wall 49 and around the outlet opening 15 in the cyclone chamber 79, as was the case in the cyclone chamber 11. The centrifugal unit 87 comprises a rim of blades 89 provided on a side 91 of an annular disc 93 of the centrifugal unit 87 which faces away from the upper wall 49. The annular disc 93 is present in a disc-shaped recess 95 provided in the upper wall 49. The annular disc 93 is provided with a bearing pin 97 by means of which the annular disc 93 is journaled in a bearing bush 99 which is centrally arranged in the outlet pipe 67 and which is suspended in the outlet pipe 67 by means of a number, for example three, of spokes 101. The rim of blades 89 provided on the annular disc 93 is partly countersunk into the disc-shaped recess 95 in the upper wall 49.

During operation, the rim of blades 89 with the annular disc 93 is rotated in the recess 95 by the air flow entering the cyclone chamber 79 through the inlet opening 13. The boundary layer discussed further above, which would be present along the upper wall 49 without the use of the centrifugal unit 87 and which would result in said short-circuit

flow between the inlet opening 13 and the outlet opening 15, is disturbed by the recess 95 in the upper wall 49 and the rim of blades 89 rotating therein during operation. The solid and/or liquid particles which are present in the air flow along the upper wall 49 are carried along in rotation by the rim of blades 89, so that a centrifugal force is exerted on said particles under the influence of which the particles are separated from the air flow and deposited on the side wall 81. The separated particles are subsequently removed through the discharge opening 85 of the cyclone chamber 79 under the influence of the force of gravity acting on the separated particles.

As Fig. 5 further shows, the annular disc 93 of the centrifugal unit 87 is positioned as deep as possible in the recess 95 in the upper wall 49, so that only a very narrow gap is present between the annular disc 93 and the upper wall 49. Furthermore, the annular disc 93 is provided with a number, for example three, of raised annular thresholds 105 at a side 103 facing the upper wall 49, while a number of annular grooves 107 corresponding with the annular thresholds 105 is provided in the recess 95 of the upper wall 49, in which grooves the annular thresholds 105 are rotatable. Said annular thresholds 105 and the corresponding annular grooves 107 form a so-called labyrinth seal by means of which a possible leakage flow through said gap between the upper wall 49 and the annular disc 93 is prevented as much as possible.

As was described above, the use of the centrifugal unit 87 considerably increases the number of solid and/or liquid particles separated from the air flow in the cyclone chamber 79, as did the use of the centrifugal unit 61 in the cyclone chamber 11 described earlier, so that the efficiency of the separator device 3 is considerably improved also when the cyclone chamber 79 with the centrifugal unit 87 is used.

The vacuum cleaner 1 described above is a floor-type vacuum cleaner, the housing 5 being displaceable over the surface 9 to be cleaned by means of the wheels 7. It is noted that a separator device according to the invention can also be used in an upright, hand-held vacuum cleaner. Furthermore, the invention relates to vacuum cleaners designed for removing exclusively solid dust particles as well as to vacuum cleaners designed for removing liquid particles, or a combination of solid and liquid particles. The properties of a separator device according to the invention are particularly advantageous when the separator device is used in a vacuum cleaner suitable for removing solid as well as liquid particles and in addition provided with a shampooing device for the supply of shampoo to the surface to be cleaned. Such a vacuum cleaner usually sucks up foam particles during operation, which particles are substantially separated from the air flow by the separator device according to

the invention.

It is further noted that a separator device according to the invention may be provided with a centrifugal unit of a type different from the centrifugal units 61 and 87 described above. An example of this is an embodiment in which the upper wall of the cyclone chamber is rotatable about the centerline of the cyclone chamber, so that the boundary layer along the upper wall is made to rotate. Another example is an embodiment in which the annular disc 65 of the centrifugal unit 61 is positioned not immediately adjacent the upper wall 49, as shown in Fig. 2, but is positioned at such a distance near the upper wall 49 around the outlet pipe 67 that the boundary layer along the upper wall 49 is not disturbed by the disc 65 rotating during operation and merges into a boundary layer along the outside of the outlet pipe 67. Said boundary layer along the outside of the outlet pipe 67 and the short-circuit flow occurring therein are interrupted in such an embodiment by the rotating disc 65 during operation.

It is finally noted that a separator device according to the invention may find an application in devices or appliances other than a cyclone vacuum cleaner. An example of this is a particle separator for use in a material manufacturing process.

CLAIMS:

1. A separator device for separating solid and/or liquid particles from a gas flow, which separator device is provided with a cyclone chamber with a substantially rotationally symmetrical side wall, an upper wall, at least one inlet opening for the gas flow provided in the side wall adjacent the upper wall, an outlet opening for the gas flow provided in the upper wall, and a discharge opening for the separated solid and/or liquid particles provided at a side of the cyclone chamber remote from the upper wall, characterized in that the separator device is provided with an annular centrifugal unit which is positioned in the cyclone chamber adjacent the upper wall around the outlet opening and is rotatable about a centerline of the cyclone chamber.

2. A separator device as claimed in claim 1, characterized in that the centrifugal unit is rotatable during operation by means of a gas flow which enters the cyclone chamber through the inlet opening.

3. A separator device as claimed in claim 1 or 2, characterized in that the centrifugal unit is provided with an annular rotatable disc which is arranged adjacent and parallel to the upper wall around an outlet pipe which comprises the outlet opening.

4. A separator device as claimed in claims 2 and 3, characterized in that the annular disc is provided with a rim of blades at a side facing away from the upper wall.

5. A separator device as claimed in claim 1 or 2, characterized in that the centrifugal unit is provided with a rotatable rim of blades which is partly countersunk into a disc-shaped recess provided in the upper wall.

6. A separator device as claimed in claim 5, characterized in that the rim of blades is provided on a side of an annular disc facing away from the upper wall, which disc is provided at a side facing the upper wall with at least one raised annular threshold, while an annular groove mating with the annular threshold is provided in the recess of the upper wall, in which groove the annular threshold is rotatable.

7. A vacuum cleaner provided with a housing in which a separator device is accommodated for separating solid and/or liquid particles from a gas flow, which separator device is provided with a cyclone chamber with a substantially rotationally symmetrical side wall, an upper wall, at least one inlet opening provided in the side wall adjacent the upper

wall and capable of being coupled to a suction attachment, an outlet opening provided in the upper wall and connected to an electrical suction unit arranged in the housing, and a discharge opening provided at a side of the cyclone chamber remote from the upper wall, which discharge opening is connected to a holder for the separated solid and/or liquid particles, characterized in that the separator device is a separator device according to the invention.

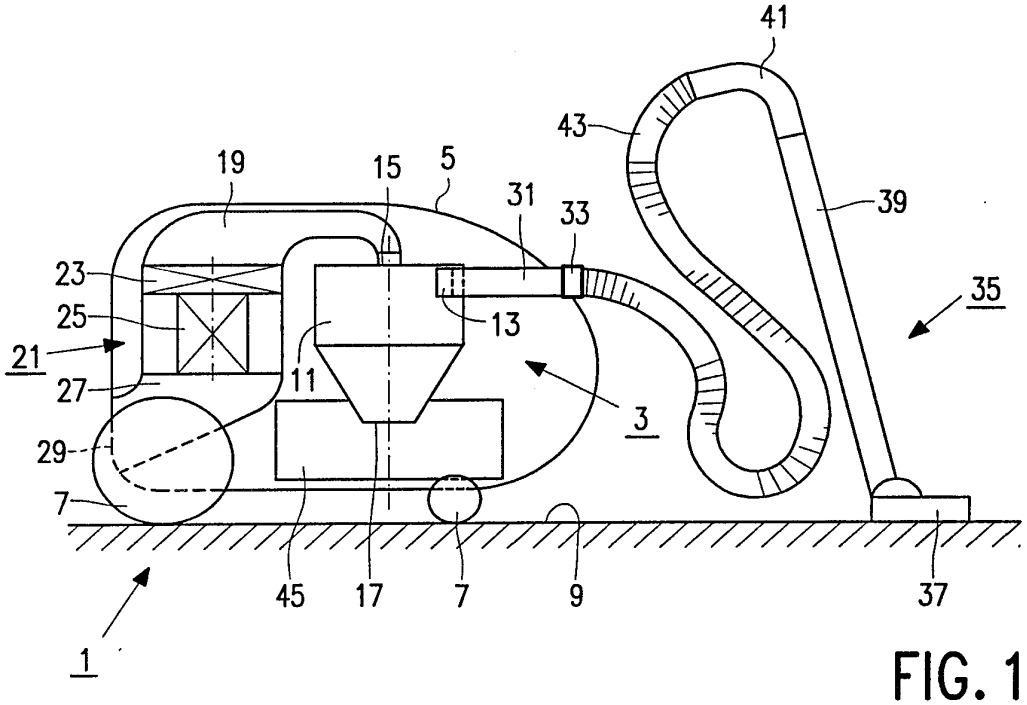
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FIG. 1

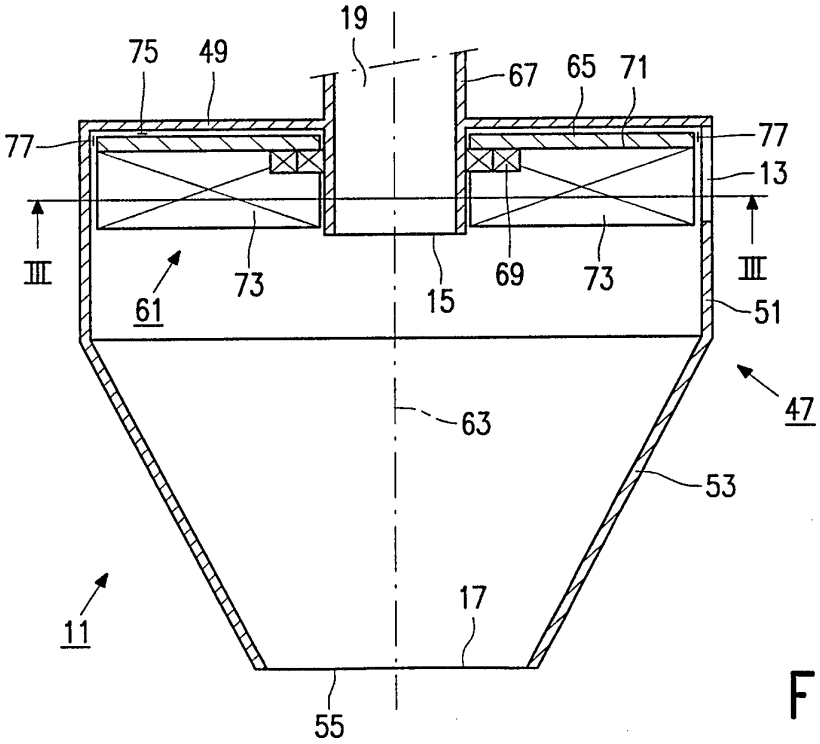
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FIG. 2

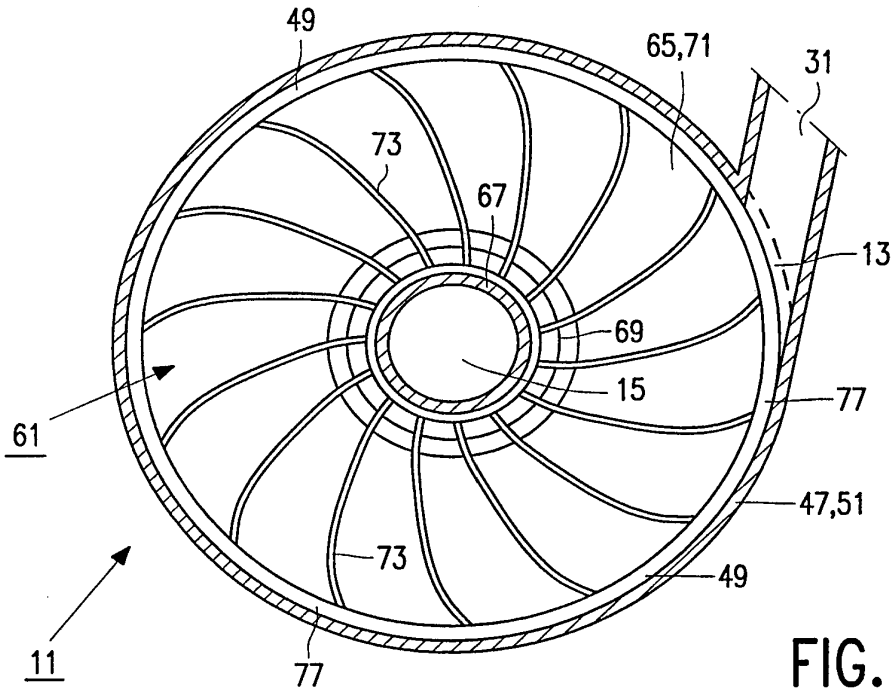
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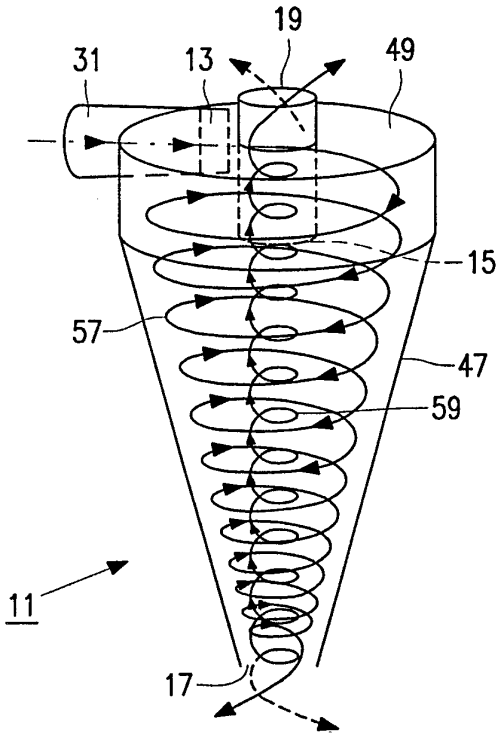
FIG. 3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15
57
47
59
11
17

FIG. 4

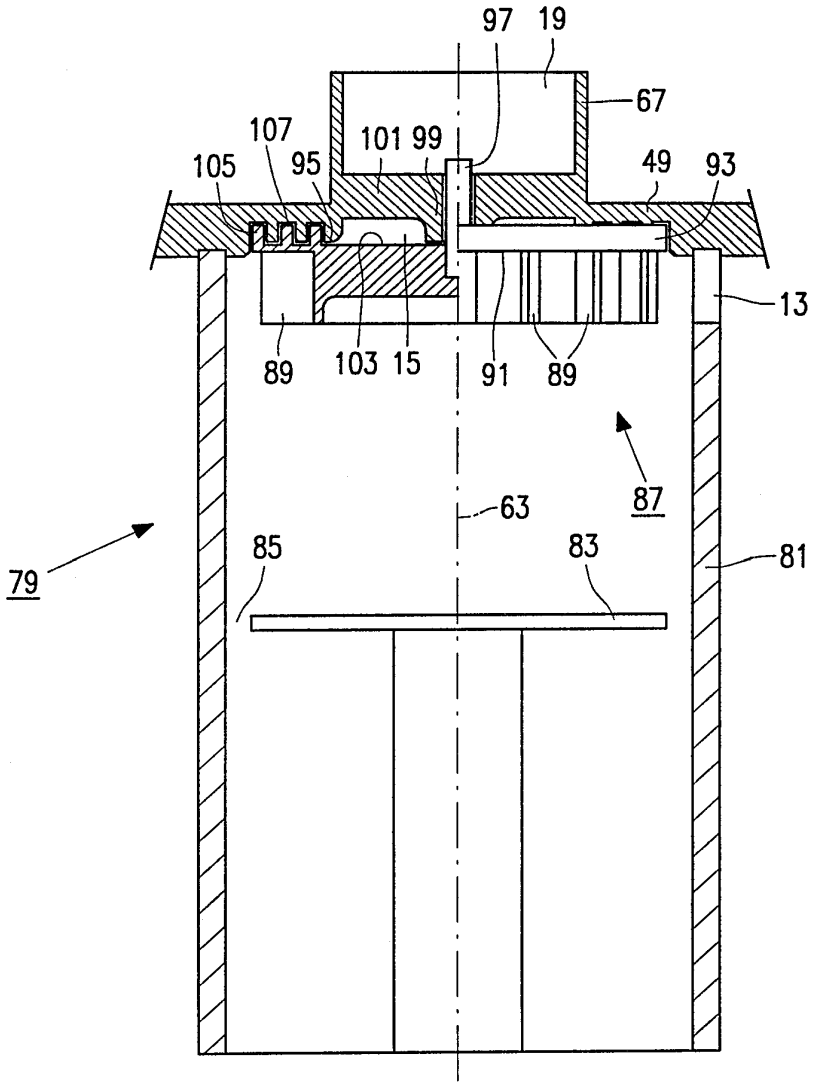

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 98/00283

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B01D 45/12, B04C 5/103, B04C 9/00, A47L 9/10
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)

IPC6: B01D, B04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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	DE 825538 C (COMPAGNIE DES METAUX D´ OVERPELT-LOMMEL ET DE CORPHALIE), 20 December 1951 (20.12.51), page 2, line 102 - line 108, figure 3	1,3,4
Y	--	7
X	CH 495767 B (THE ENGLISH ELECTRIC COMPANY LIMITED), 30 October 1970 (30.10.70), column 2, line 35 - column 3, line 57, figures 1,2	1,2
	--	
Y	NL 7613475 A (N.V. PHILIPS´ GLOEILAMPENFABRIEKEN TE EINDHOYEN), 3 December 1976 (03.12.76), figures 1,2, claim 1	7
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 July 1998	06 -07- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Ulf Nyström Telephone No. +46 8 782 25 00

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Information on patent family members

09/06/98

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		FR 1012887 A	00/00/00
		NL 72364 C	00/00/00
CH 495767 B	30/10/70	NONE	
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		JP 53072374 A	27/06/78
		SE 7713531 A	04/06/78
		US 4172710 A	30/10/79

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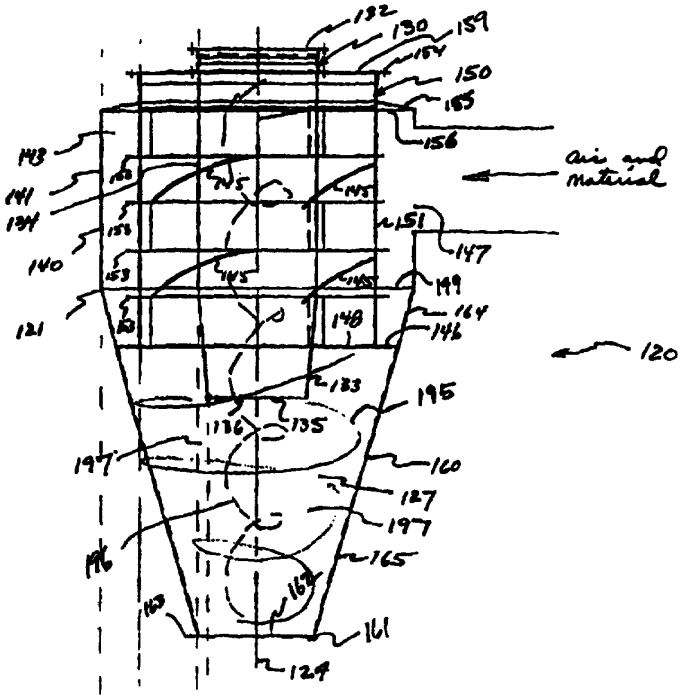
(54) Title: IMPROVED CYCLONIC DRYER

(57) Abstract

An improved cyclone dryer (120) is disclosed, having an outer cylinder (140), an inner cylinder (150), and a cone-shaped chamber (160). The outer cylinder has a tangential airstream orifice (147) for injecting a high speed stream of material and air, or other gases, into the dryer. The inner cylinder has a plurality of apertures (152) and a plurality of deflectors (144) that deflect air and material into a cavity defined by the inner cylinder and the cone-shaped chamber. The cone-shaped chamber, the outer cylinder, and the inner cylinder define an annular chamber. An exhaust assembly is attached proximate the inner and outer cylinders, and is in fluid communication with the cavity.



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SPECIFICATION

IMPROVED CYCLONIC DRYER

Field of Invention

This application relates to the field of industrial drying equipment, particularly cyclonic dryers used for drying, among other things, paper pulp and industrial and municipal sludge.

Background

Cyclonic chambers are well known in the art and have been used in many applications, such as in separating, comminuting, mixing, and drying materials. In isolation, a cyclone is a simple mechanical device that can accomplish the above-listed tasks by using the force of gravity, centrifugal forces and pressure differentials at various points. Generally, cyclone chambers (hereinafter also referred to merely as "cyclones") are formed at least partially in the shape of an inverted cone, with the base (largest diameter) of the cone generally on top. Depending on their dimensions, the cyclones may also be in the shape of an inverted frustum, which is generally a cone shape where the small, tapered end has been cut off parallel to the base. Because cone-shaped cyclones and frustum-shaped cyclones are operationally similar, reference will be made herein primarily to a cone-shaped cyclone.

Cyclones may come in a variety of configurations that are intended for different applications. For example, as shown in FIG. 1, a cyclone is shown having a body 10 that comprises an upper, cylindrical shaped portion 12, and a lower, cone-shaped portion 11. FIG. 1 is described in the Handbook of Industrial

Drying, pp. 728-733, at Figure 11 (2nd Edition, Arun S. Mujumdar, editor, 1995). The cyclone shown and described there has three orifices for dust particles and air to enter and exit the cyclone. In the application described therein, an airstream containing dust particles enters the cyclone at an airstream input orifice 13, at a high velocity in a direction tangential to a center axis 14. The velocity is high enough so that the entering airstream is forced against the outside wall of the cyclone due to centrifugal forces. Gravity forces denser material (dust particles in this illustration) to fall, thereby resulting in a circular, downward vortex, as shown at 15. Gravity forces the dust particles eventually to escape through a bottom orifice 16 of the cyclone.

At the same time, a circular vortex is created that draws air upward inside the cyclone. This upward vortex 17 carries air and other particles up and out through an exit orifice 18. A number of factors determine which particles escape through the bottom orifice 16 or through the exit orifice 18. Among these factors are the pressures at each of the orifices, the velocity of the entering airstream and the velocity of each of the vortexes, the size and density of particles, the dimensions of the cyclone, and the interior structure of the cyclone. Generally, particles are carried upward via the upward vortex 17 when buoyant forces overcome the gravitational forces.

A cyclone such as that described above may be used to dry a wet substance as the substance is passed through the cyclone. Various methods have been used to effect the drying of the substance. For example, a wet substance may be introduced through the same tangential port where the high velocity airstream enters the cyclone. The substance is dried as the high

velocity air impacts individual particles of the substance. Often, the air is heated to effect more efficient drying. Alternatively, the wet substance could be inserted separately at a point near where the tangential air stream enters the orifice, so that the air immediately impacts the substance and forces the substance to flow in a circular vortex. Another similar drying method uses a variant on the cyclone chamber, and is commonly called a spray dryer. A spray dryer operates by reducing the material to be dried into small droplets, then subjecting those small droplets to a large amount of hot air, thereby supplying the heat necessary to evaporate the liquid.

None of these prior dryers are able to efficiently dry large volumes of sticky, pasty material, such as paper pulp and municipal sludge. One of the problems with the prior dryers is that the sticky and pasty materials tend to stick to the sides of the cyclone. A second problem with prior dryers is their limited ability to suspend the wet material or otherwise keep it in the cyclone for a sustained period of time in order to most efficiently dry the material, resulting in an inadequate resonance time (alternatively known as retention time). Because of their structure, such prior dryers are limited in their operating parameters, such as the velocity of the incoming airstream and material feed, the volume of air allowed into the dryers and the pressure applied at the various inlets, particularly the airstream inlet. A third problem is that, in order to create a tangential flow of air in prior dryers, the fans and or ducting supplying the air need to be oriented in such a manner as to create a tangential flow. This can cause problems when installing the dryers, because the site may have to be

modified to allow for specialized fans and ducting. Also, prior dryers are not as efficient as they could be.

Current environmental regulations and space constraints make it desirable to be able to dry sludge, paper pulp, and other wet materials, prior to removing them from their source. The efficiency of prior dryers, however, often is not high enough to make their use economical. The cost of drying and removing the material is generally compared to the cost of simply transporting and dumping the wet material.

The prior art dryers often are inefficient because the air inside the cyclone, even if it is heated and spinning rapidly, can only affect a small part of the surface area of the substance to be dried. Often, the air and the material to be dried create a smooth flowing mass, with little turbulence. While this creates a smooth airflow, it does not promote optimum drying. Their design limits the amount of pressure and inlet velocity that can be used efficiently. While it may be possible for spray dryers to be adapted to handle sticky and pasty material, their inefficiency and reliability is a drawback.

Summary of the Invention

The present invention provides an improvement on the forementioned dryers by creating an efficient apparatus and process for drying large quantities of sticky or pasty substances. Such substances include, among others, paper slurry that is left over from paper manufacturing, and municipal and industrial sludge. Some prior attempts at drying material with a cyclonic chamber, as described above, used high velocity air or other gases and forced the wet material to the outside diameter of the cyclone, due to centrifugal forces. The air and the wet

material is then generally forced to swirl downward and outward, against an outer surface, as shown in FIG. 1 and described above. The present invention, however, introduces the air and wet material into an annular air chamber that is substantially separate from the cyclone cavity. The annular air chamber thus allows the wet material to be at least partially dried prior to entering the cyclone cavity and increases the retention time in the dryer. The improved dryer has an inner cylinder with deflectors to channel the flow of air and material into the cavity, deflecting small parts of the overall flow through individual apertures in the inner cylinder. Further, the improved dryer has a series of vanes that direct the air and material flow upward and create a turbulent flow within the cavity, thereby enhancing the efficiency of the dryer.

After passing through the apertures and into the cavity, the air and material eventually form a downward vortex, and an inner, upward vortex, similar to those of the prior art. The downward vortex is created due to centrifugal forces and gravitational forces, resulting in a generally circular and downward vortex. The upward vortex is created due to the shape of the cyclonic chamber. The downward vortex forces air and material into the lower portions of the cyclonic chamber, which is the smallest portion of the chamber. This results in the creation of a high pressure zone that forces the air upward, thereby creating a collapsing force in an upward direction. Momentum from the downward vortex makes the air and some of the lighter particles spin in the same direction about the cyclonic axis. The result is an inner, upward vortex about the center axis.

The intersection of the outer (downward) and inner (upward) vortexes creates a turbulent boundary layer. The preferred dryer

additionally dries wet material by at least partially suspending the material in the boundary layer between the outer and inner vortexes. The material is suspended due to the countervailing forces acting on it. Centrifugal force and gravity act to push the material downward, yet the collapsing forces keep the material from immediately being forced to the outside and downward, effectively counteracting the centrifugal and gravitational forces. The time that the material is suspended in the cyclonic chamber is proportional to the rate of drying. The dimensions of the cyclonic chamber and the operating parameters can be varied to adjust the time that the material is suspended, with a resultant variation in the amount of drying.

The preferred dryer adds a number of other novel features to increase retention time and optimize drying efficiency. The various features each affect at least one of the performance factors such as pressure differential(s), speed of the airstream and material feed, temperature, and turbulence inside the dryer. The preferred dryer is also constructed so as to enable flexibility in configuring single or multiple dryers into systems for drying.

The preferred dryer may operate at a higher pressure differential than prior dryers. The preferred dryer may operate with a pressure of 10-30 inches of water at the air inlet, compared to a maximum of approximately 12 inches of water in existing dryers. The preferred dryer may also operate with greater material and air flow than the prior dryers, measured both in terms of quantity of flow and velocity. Further, the preferred dryer may be operated at geometric positions not used before, including varying body angles for the vacuum chamber.

Accordingly, it is an object of the present invention to provide an improved cyclonic dryer.

Brief Description of the Drawings

These and other objects of the present invention will become better understood through a consideration of the following description taken in conjunction with the drawings in which:

FIG. 1 is a perspective view of a prior art cyclone, illustrating a flow of material through the cyclone;

FIG. 2 is a perspective view of a preferred cyclone dryer according to the present invention, illustrating the major components and the flow of air and material through the cyclone;

FIG. 3 is a top view of the preferred cyclone dryer shown in FIG. 2;

FIG. 4 is a bottom view of the preferred cyclone dryer shown in FIG. 2;

FIG. 5 is a perspective view of a preferred inner cylinder;

FIG. 6 is a perspective view of a preferred inner cylinder surface;

FIG. 7 is a top view of the preferred inner cylinder;

FIG. 8 is a side view of the preferred inner cylinder; and

FIG. 9 is an exploded view of the preferred cyclone dryer according to the present invention, illustrating the major components and their structural relationships.

Detailed Description

Turning now to the drawings, FIG. 2 depicts a preferred cyclone dryer 120 for drying various sticky substances. The preferred dryer 120 comprises multiple interior structural elements which generally form a cavity 127. Viewed from the outside, the basic construction of a preferred cyclone chamber

121 is similar to those known in the art. For example, the cyclone body 10 described as representative of the prior art has an upper, cylindrical portion 12 and a lower, cone-shaped portion 11. A preferred outer cylinder 140 and cone-shaped chamber 160 are thus similar from the outside. For clarity, the preferred dryer 120 will be described in two general sections. First, the structure of the preferred embodiment will be described, followed by a description of the operation of the preferred embodiment. The structure will be described generally in the same sequence as the operation, beginning with the components related to the air inlet.

Structure of the Preferred Embodiment

Turning now to the drawings, FIG. 2 illustrates a second preferred cyclone dryer 120 for drying various sticky substances. The preferred dryer 120 comprises a cyclone chamber 121 having a cone-shaped chamber 160, an outer cylinder 140, an inner cylinder 150, and an exhaust assembly 130, all of which are preferably in fluid communication with a cavity 127. Viewed from the outside, the basic construction of the second preferred cyclone chamber 121 is similar to the first preferred chamber 21 and others known in the art. For example, the cyclone body 10 described as representative of the prior art has an upper, cylindrical portion 12 and a lower, cone-shaped portion 11. Similarly, the preferred dryer 120 has an upper cylinder, described below as an outer cylinder 140, and has a cone-shaped chamber 160. However, the inner structure and the operation of the preferred dryer 120 are different from other dryers known in the art.

Preferably, a high velocity airstream enters the cyclone chamber at an airstream inlet orifice 147, generally proximate

the outer cylinder 140. The preferred outer cylinder 140 comprises an outer surface 141 and a cap 155. The cap 155 is disk-shaped and attached to the top of the outer cylinder 141 and to a surface 151 of the inner cylinder 150. As shown in FIG. 2, the cap 155 may be oriented at a slight angle from the outer cylinder 140 to the inner cylinder 150. The lower edge of the outer cylinder 140 is attached to an upper surface 164 of the cone-shaped chamber 160. The cap 155 and the cone-shaped chamber 160 are preferably welded to the outer cylinder 140, forming seams as shown at 149 and 156.

The inner cylinder 150, which is described in detail below, has a smaller diameter than the outer cylinder 140, and is preferably mounted inside the outer cylinder 140 and partially inside the cone-shaped chamber 160. The outer cylinder 140, the inner cylinder 150, and the cone-shaped chamber 160 all share the same axis 124. The bottom of the inner surface 151 is attached to a disk-shaped lower surface 146, preferably with a welded joint. The disk-shaped lower surface 146 is then preferably attached, via a welded joint, to the upper surface 164 of the cone-shaped chamber 160. The outer surface 141, the cap 155, the inner cylinder surface 151, the disk-shaped lower surface 146, and the upper surface 164 of the cone-shaped chamber 160, generally define a disk-shaped annular air chamber 143. The purpose of this chamber 143 is to allow for heated or ambient air (or gas or other fluids – reference hereinafter to air includes other gases) to be introduced into the cyclone chamber 121. The novel structure of the preferred embodiment allows flexibility in positioning the ducting and fans necessary to input air into the cyclone chamber 121. As shown in FIGs. 2, 3 and 9, air and material may be introduced into the annular air chamber 143 in a

single port, as shown at the airstream inlet orifice 147. The inlet orifice 147 preferably has a collar 182 that is adapted to be connected to ducting or other means connected to the source of the air and material that is to enter the dryer 120. Preferably, curved vanes 181 are positioned in the inlet orifice 147 to direct the flow of air and material in a tangential direction. As shown in FIGs. 3 and 9, the vanes 181 are oriented to cause the air and material to flow in a clockwise direction. The vanes 181 alternatively could be oriented so as to direct the air and material in a counter-clockwise direction. Generally, the material to be dried comprises sludge or paper pulp, although other materials may be dried in the preferred embodiment. Reference hereinafter to "wet material" is intended to include sludge and paper pulp, and other material that has some threshold moisture content. Alternatively, the wet material may be input through a separate port, as long the wet material enters the annular air chamber 143 proximate the airstream inlet orifice 147.

The inner cylinder 150 is specifically shown in FIGs. 5-8. The inner surface 151 comprises the major structural element of the inner cylinder. The inner surface 151 is constructed of a flat sheet of metal, preferably steel, that is rolled into the shape of a cylinder. As partially shown in FIG. 6, there are twelve apertures 152 in the inner surface 151. The apertures 152 are lined up in four vertical columns, each column preferably having three apertures 152. Alternatively, the apertures 152 may be described as forming three rows, with four apertures 152 in each row. The number, spacing, and size of the apertures 152 can be varied based on the particular requirements in a particular

situation. The apertures 152 allow air and material to pass from the annular air chamber 143 to the inner cavity 127.

Additionally, the inner cylinder 150 may have a set of deflectors 144 mounted proximate individual apertures 152, and a set of ribs 153 mounted proximate individual rows of apertures 152. The deflectors 144 are oriented so that they "knife" into the annular air chamber 143 so as to divert some of the air and material that is spinning therein. The ribs 153 are disk-shaped and preferably are attached on the outside of the inner cylinder surface 151 and extend radially. As shown in FIG. 2, the ribs 153 extend only partially into the annular air chamber 143, so as to allow room for material to move downward and outward in the annular air chamber 143. The disk-shaped lower surface 146 is shaped similarly to the ribs 153, except that it extends radially further and contacts the surface of the cone-shaped chamber 160. Individual deflectors 144 are preferably attached to one side of each aperture 152, as shown in FIG. 6, and also attached to one or more ribs 153.

Preferably, there are four ribs 153 attached to the inner cylinder 150. The uppermost rib 153 is attached proximate the uppermost set of apertures 152. The bottom edges 157 of individual deflectors 144 are attached to individual ribs, for each of the top two rows of apertures 152 and deflectors 144. The top edges 158 of individual deflectors 144 are attached to individual ribs, for each of the bottom two rows of apertures 152 and deflectors 144.

Vanes 145 are attached on the inside of the inner cylinder surface 151. Individual vanes 145 are constructed of generally flat members that are formed in the shape of partial disks that rotate about the center axis 124. Each vane 145 extends only

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partially around the circumference of the inner surface 151. Each vane 145 preferably extends at right angles inwardly from any adjacent point on the inner surface 151. From an axial perspective, the individual vanes 145 extend upwardly and clockwise. The actual length and upward progression of individual vanes 145 may vary according to specific applications. Preferably, each vane 145 extends axially a distance equal to the spacing between adjacent ribs 153 (see FIG. 8). As shown in FIG. 5, a pair of vanes 145 are sketched (partially in phantom), that extend from the second highest rib 153 to the bottom of the aperture 144 that is immediately above and in a clockwise direction from the origin of each vane 145.

As described above, a disk-shaped lower surface 146 is attached to the inner cylinder surface 151, as shown in FIG. 5. The lower surface 146 is also attached to the inside of the cone-shaped chamber 160, preferably by a welded seam. FIG. 9 shows an exploded view of the cyclone dryer 120, as it would appear prior to final assembly. The entire inner cylinder 150 may be lowered into the outer cylinder 140, and attached to the cone-shaped chamber 160.

The cone-shaped chamber 160 is a typical configuration for cyclones dryers, as is known in the art. The chamber 160 tapers from its largest circumference at the seam 149 proximate the upper surface 164, to its smallest circumference at the tip 161 proximate the lower surface 165. An output port 162 is formed at the tip 161, and has an output collar 163 which is generally used to connect other devices to the chamber 160. The preferred dryer 120 may have additional attachments thereon, as shown in FIG. 9. These attachments are generally known in the art and used for a variety of purposes. For instance, the configuration of the

adapter 170 helps keep solid material from flowing out of the bottom of the dryer 120.

The exhaust assembly 130 preferably is mounted adjacent the inner cylinder 150. The preferred exhaust assembly 130 has a smaller diameter than the inner cylinder 150, and is mounted in the interior of the inner cylinder 150 in the cavity 127. The exhaust assembly 130 and the inner cylinder 150 share the same center axis 124. As shown in FIG. 9, the exhaust assembly 130 preferably comprises an exhaust cap 137 (the exhaust cap 137 is not shown in FIG. 2), a cylindrical middle portion 134, and a frustum-shaped lower portion 133. The frustum-shaped lower portion 133 has a circular bottom edge 135 that defines an opening 136. The opening 136 permits the exhaust assembly 130 to be in fluid communication with the cavity 127. The lower portion 133 is substantially located in the interior space defined by the cone-shaped chamber 160, as best shown in FIG. 2.

The lower portion 133 is preferably attached to the middle portion 134 via a welded joint. Two collars are preferably welded to the middle portion 134, and may be adapted for attachment of the middle portion 134 to other components. A lower collar 132 is attached proximate the top edge of the middle portion 134, and is adapted for attachment to a mounting disk 159. As shown in FIG. 9, the mounting disk 159 may be lowered on to an upper collar 154 of the inner cylinder 150. The outer edge of the mounting disk 159 preferably mates with the upper collar 154, and may be attached with screws, bolts, rivets, welding, or other means known in the art. The inner edge of the mounting disk 159 preferably also mates with the lower collar 132, and may be attached with screws, bolts, rivets, welding, or other means known in the art. When assembled, the majority of the middle

portion 134 (below the lower collar 132) extends below the mounting disk 159.

An upper collar 131 is adapted for attachment to the exhaust cap 137, which has a cap collar 139. The upper collar 131 and the cap collar 139 preferably are similarly sized, and may be attached with screws, bolts, rivets, welding, or other means known in the art. When viewed from the top, the exhaust cap 137 is preferably substantially circular, with an exhaust port 138 extending tangentially from the outer surface of the cap 137, adapted to allow gases (or other material) to escape from the dryer 120. As shown in FIG. 9, the exhaust port 138 is oriented to allow gases to flow out of the dryer in a clockwise fashion. The orientation of the exhaust cap 137 would preferably be reversed in the event that the material in the dryer is oriented to flow in a counter-clockwise direction.

In order to create a lower pressure at the exhaust port 138, and thus enhance flow out of the port 138, the preferred cyclone dryer 120 may be attached to ducting attached to a fan, to help move air or material out of the dryer.

Operation of the Preferred Embodiment

The preferred dryer works as described below . The preferred cyclone dryer 120 is constructed so as to create a downward, circular vortex, and then an upward, circular exhaust vortex. This is done in the following manner. First, an air stream containing a wet material that is to be dried is introduced into the annular air chamber 143. This air stream and the wet material are preferably injected tangentially, and at a high velocity, through the airstream inlet orifice 147 of the preferred dryer 120.

Prior to entering the dryer, the air and wet material are mixed, in ways known in the art. The preferred dryer does not require that the incoming air (or other gas) be heated.

The tangential flow of air and material is preferably created by injecting an airstream through the airstream inlet orifice 147, as shown in FIGs. 2, 3 and 9. The preferred airstream containing air and wet material is injected, using a static pressure at the inlet generally between 10-30 inches of water. Attached to the outer cylinder 140 at the airstream inlet orifice 147 is an air inlet duct that preferably provides heated air (or other fluid or gases) and wet material at a high velocity. Preferably, the preferred dryer is adapted to operate with an airstream that enters the airstream inlet orifice at 5,000-6,000 standard cubic feet per minute (SCFM), and at a velocity of 6,000 feet per minute. The preferred dryer is further adapted to operate at a range of 4,000-12,000 SCFM and at a velocity range of 3,000-6,000 feet per minute. For simplicity, the air flow containing wet material will sometimes be described herein simply as an air stream, although other fluids or gases may be considered to be included. A fan or other device for supplying the high velocity, tangential air stream is well known in the art and is not shown.

The air stream may enter the cyclone dryer 120 while the dryer 120 is set at a variety of angles. The curved vanes 181 and the airstream inlet orifice 147 channel the air stream into the annular air chamber 143. At that point, the airstream generally flows tangentially to the center axis 124 at a high rate of angular velocity. Use of the annular air chamber 143 eases the installation of the dryer 120 by allowing variability in the orientation of inlet ducting, fans, and other devices

necessary to provide a high speed, tangential flow of air. It is thus possible, because of the annular air chamber 143, to position the airstream inlet orifice 147 at any location on the outer surface 141 of the outer cylinder 140. As shown in FIGs. 3 and 5-9, the structure of the preferred embodiment causes the air and material to flow in a clockwise direction. As illustrated in FIG. 2, the air would be flowing up and out of the page on the right side of the annular air chamber 143, and down, into the page on the left side of the annular air chamber 143. Alternatively, the airstream may be introduced in a counter-clockwise direction. If so, the flows described below would be reversed, and many of the structural components, such as the deflectors 144 and vanes 145 would need to be reversed.

The air and material swirls in a clockwise direction in the annular air chamber 143. In the preferred dryer 120, the only place where the air and material can escape from the annular air chamber 143 is through the apertures 152. In general, gravitational and centrifugal forces are acting on the air stream, forcing the air and material downward and outward. To aid in the movement of material through the preferred dryer, the deflectors 144 are attached to the outer surface 141 of the inner cylinder 150. The deflectors 144 act to deflect a portion of the tangential airstream, forcing part of the airstream into the cavity 127. As the air and material spin in the annular air chamber 143, the material naturally begins to separate and the heavier material is forced downward and outward. The preferred dryer is adapted to have enough energy to keep the material spinning, even while a layer of material is beginning to build up. As more and more material is added to the preferred dryer, the layer of material builds up, and is forced upwards and toward

the inside. When the layer of material reaches far enough inwardly, the deflectors 144 "knife" into the spinning material and deflect a part of the material through the apertures 152 and into the cavity 127. Each individual deflector 144 reaches into the annular air chamber 143 and deflects a certain portion of the airstream and material. The air and material that passes individual deflectors continues in a generally downward and outward direction until it reached the disk-shaped lower surface 146, which defines the bottom of the annular air chamber 143. At this point, the air and material is either swept inward via the bottom row of deflectors 144 and apertures 152, or is forced to move in an upward direction. Any upward flow is resisted by the downward and outward flow created by the tangential air stream, so the majority of the remaining air and material is forced into the cavity 127 through the bottom row of apertures 152. The ribs 153 preferably restrict the vertical flow of material, so that the deflectors have an enhanced chance of diverting the air and material into the cavity 127. The preferred structure, whereby at least some of the deflectors 144 are attached to individual ribs, creates a funneling effect where air and material are channeled into the apertures 152.

Once the air and material passes through the apertures 152, it preferably continues rotating in a clockwise direction inside the cavity 127. Initially, the air and material rotates tangentially between the inner cylinder surface 151, and the sides of the middle exhaust portion 134 and the frustum lower portion 132 of the exhaust assembly 130. As above, gravitational and centrifugal forces continue to encourage a downward and outward flow. The vanes 145 located on the inner cylinder surface 151 are preferably shaped to direct some of the flow

upward, resulting in turbulence within the cavity 127. Further, the preferred vanes 145 are constructed so as to end proximate individual apertures 152. This orientation forces air and material on the inside of the inner cylinder 150 which is directed upward and outward, to interact with the air and material that is passing through the apertures 152, which is generally moving inward and downward. The resulting turbulence, which is enhanced by this interaction, may be a positive phenomenon, because the turbulence tends to increase the retention time of the dryer. As is known in the art, the amount of drying is proportional to the time that a material is dried.

The air and material continue to spin tangentially and downward, past the bottom of the inner cylinder 150, through the orifice 148 formed between the frustum lower portion 133 of the exhaust 130, and the lower edge of the inner cylinder 150. This orifice 148 is part of the cavity 127. Due to the physical configuration of the cavity 127, the high-velocity air is forced to spiral downward and against the side of the lower, cone-shaped chamber 160, thereby creating a downward vortex 195, as shown by the swirling pattern in FIG. 2. Centrifugal forces make the air stream hug the sides of the cone-shaped chamber 160, thereby creating an area of low pressure in the center of the cavity 127. As the air approaches the output port 162, the cross-section of the cone-shaped chamber 160 gets smaller and smaller, which causes air to begin to swirl upward in the same rotational (angular) direction as the downward vortex 195. This results in the creation of a second vortex 196 (shown by the dashed lines in FIG. 2) that moves in an upward, circular direction proximate the center of the cavity 127. Air and other material in the upward vortex 196 are eventually carried through the cavity 127, then

enter the exhaust assembly 130 and are expelled through the exhaust port 138.

An irregular boundary region is created between the downward vortex 195 and the upward vortex 196. The downward vortex 195 is situated generally within the outer parts of the cavity 127, the upward vortex 196 is located generally in the inner parts of the cavity 127, and the boundary region is shown as area 197, an irregular-shaped area generally existing between the two vortexes. This boundary region 197 is another region of turbulence that further enhances the efficiency of the preferred dryer, by keeping wet material suspended for a longer period of time.

Different pressures, flow rates, and temperatures may be used by one of skill in the art to further maximize the efficiency of the preferred dryer.

While embodiments of the present invention have been shown and described, various modifications may be made without departing from the scope of the present invention, and all such modifications and equivalents are intended to be covered.

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I claim:

1. A cyclone dryer comprising

an outer cylinder having an airstream orifice and a center axis,

an inner cylinder mounted proximate said outer cylinder and said center axis and having a smaller diameter than said outer cylinder, said inner cylinder further having a plurality of apertures,

a cone-shaped chamber attached proximate lower portions of said outer cylinder and said inner cylinder,

said cone-shaped chamber, said outer cylinder, and said inner cylinder defining an annular air chamber,

said cone-shaped chamber and said inner cylinder defining a cyclone cavity, and

an exhaust assembly attached proximate said inner cylinder and said outer cylinder, and in fluid communication with said cavity.

2. The cyclone dryer of claim 1, wherein said inner cylinder further comprises a plurality of deflectors mounted proximate said apertures.

3. The cyclone dryer of claim 1, wherein said inner cylinder further comprises a plurality of ribs mounted proximate said apertures.

4. The cyclone dryer of claim 1, wherein said inner cylinder further comprises a plurality of vanes mounted proximate said apertures.

5. The cyclone dryer of claim 1, wherein said inner cylinder further comprises a plurality of deflectors mounted proximate said apertures, a plurality of ribs mounted proximate said apertures, and a plurality of vanes mounted proximate said apertures.

6. The cyclone dryer of claim 1, wherein said annular air chamber is adapted for an incoming air and material stream having a velocity of between 3,000 and 6,000 feet per minute.

7. The cyclone dryer of claim 1, wherein said annular air chamber is adapted for an incoming air and material stream having a flow of between 5,000 and 6,000 standard cubic feet per minute and a velocity of up to 6,000 feet per minute.

8. The cyclone dryer of claim 1, wherein said annular air chamber is adapted for an incoming airstream having an incoming pressure of between 10 and 30 inches of water.

9. The cyclone dryer of claim 1, wherein said annular air chamber is adapted for an incoming air and material stream having a flow of between 4,000 and 12,000 standard cubic feet per minute.

10. A cyclone dryer comprising

an outer cylinder having an airstream orifice and a center axis,

an inner cylinder mounted proximate said outer cylinder and said center axis and having a smaller diameter than said

outer cylinder, said inner cylinder further having at least one aperture,

a cone-shaped chamber attached proximate lower portions of said outer cylinder and said inner cylinder,

said cone-shaped chamber, said outer cylinder, and said inner cylinder defining an annular air chamber,

said cone-shaped chamber and said inner cylinder defining a cyclone cavity, and

an exhaust assembly attached proximate said inner cylinder and said outer cylinder, and in fluid communication with said cavity.

11. The cyclone dryer of claim 10, wherein said inner cylinder further comprises a deflector mounted proximate said at least one aperture.

12. The cyclone dryer of claim 10, wherein said inner cylinder further comprises a rib mounted proximate said at least one aperture.

13. The cyclone dryer of claim 10, wherein said inner cylinder further comprises a vane mounted proximate said at least one aperture.

14. The cyclone dryer of claim 10, wherein said inner cylinder further comprises a deflector, a rib and a vane mounted proximate said at least one aperture.

15. The cyclone dryer of claim 10, wherein said annular air chamber is adapted for an incoming air and material stream having a velocity of up to 6,000 feet per minute.

16. The cyclone dryer of claim 10, wherein said annular air chamber is adapted for an incoming air and material stream having a flow of between 5,000 and 6,000 standard cubic feet per minute and a velocity of up to 6,000 feet per minute.

17. The cyclone dryer of claim 10, wherein said annular air chamber is adapted for an incoming airstream having an incoming pressure of between 10 and 30 inches of water.

18. The cyclone dryer of claim 10, wherein said annular air chamber is adapted for an incoming air and material stream having a flow of between 4,000 and 12,000 standard cubic feet per minute.

19. A method of drying wet material, comprising the steps of

providing a cyclone dryer having coaxial inner and outer cylinders, a cone-shaped chamber attached proximate the lower portions of said inner and outer cylinders, and an exhaust assembly attached proximate said inner and outer cylinders,

injecting an airstream including air and material into an annular air chamber of said cyclone dryer, said annular air chamber being defined by said inner and outer cylinders and said cone-shaped chamber,

deflecting a portion of said airstream through an aperture in said inner cylinder to a cyclone cavity defined by said inner cylinder and cone-shaped chamber,

drying said material, and

exhausting the dried material and air through said exhaust assembly.

20. The method of claim 19 further comprising the steps of

spinning said air and material in said annular air stream tangentially to the center axis of said annular air chamber,

building a layer of spinning material, and

funneling a portion of said layer of spinning material through said aperture.

21. The method of claim 19, further comprising the steps of

directing a portion of said airstream upward in said cyclone chamber proximate said aperture causing turbulence in said cyclone chamber.

22. The method of claim 19, further comprising the step of creating an irregular boundary between downward and upward vortices of spinning air and material.

23. The method of claim 19 further comprising the step of injecting said airstream of air and material into said annular air chamber at a pressure in a range of about 10 to 30 inches of water.

24. The method of claim 19 further comprising the step of injecting said airstream of air and material into said annular

air chamber at a flow rate in a range of about 4,000 to 12,000 standard cubic feet per minute.

25. The method of claim 19 further comprising the step of injecting said airstream of air and material into said annular air chamber at a velocity of up to 6,000 feet per minute.

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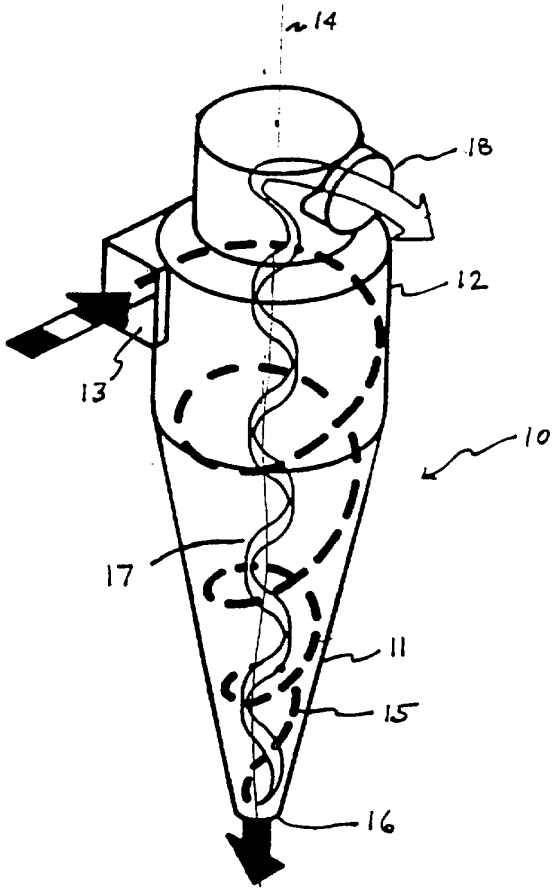

PRIOR ART

FIG. 1

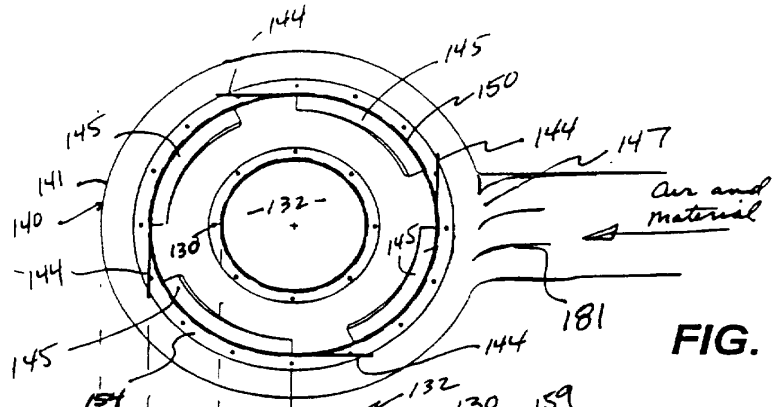

FIG. 3

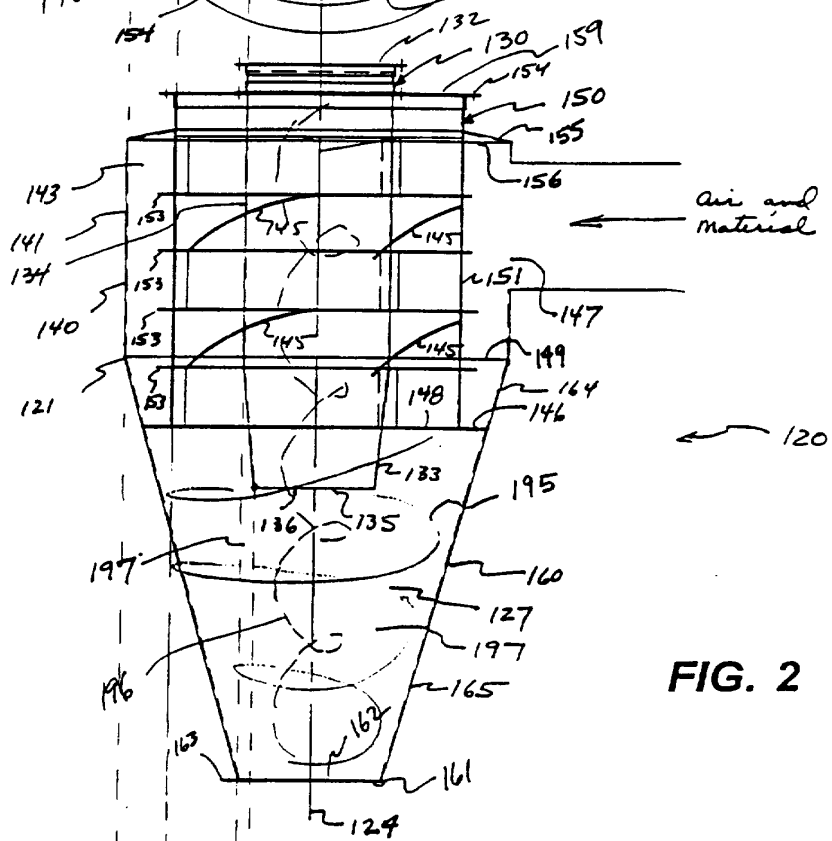

FIG. 2

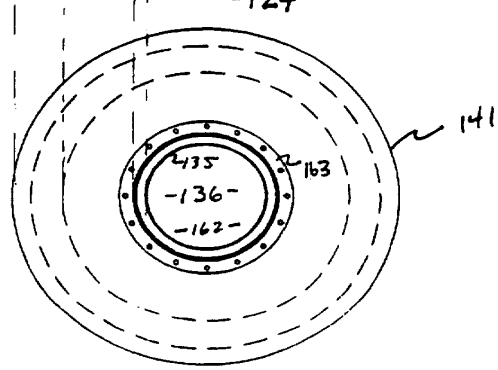

FIG. 4

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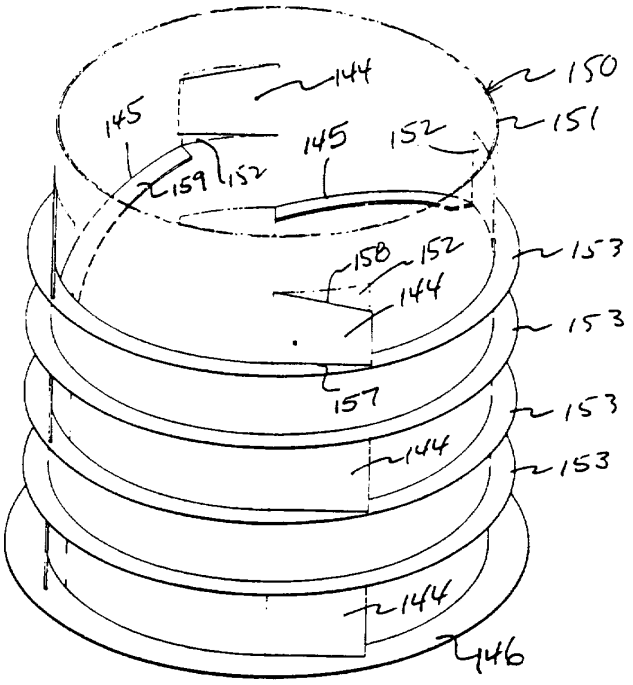

FIG. 5

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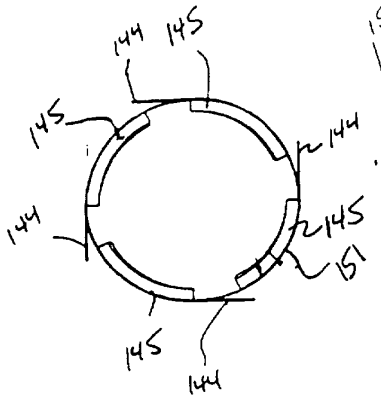

FIG. 7

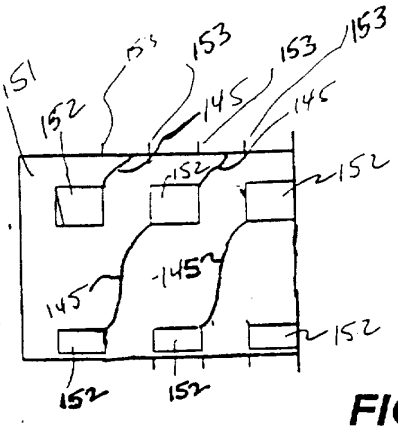

FIG. 8

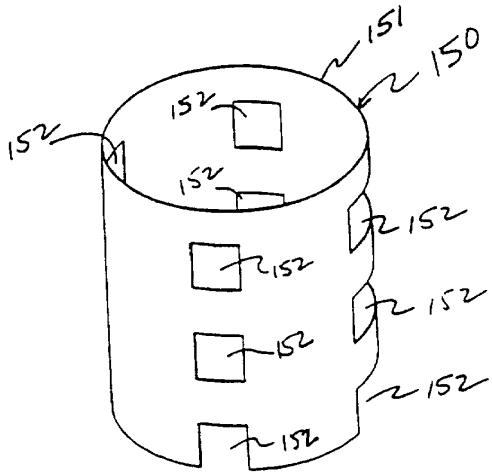

FIG. 6

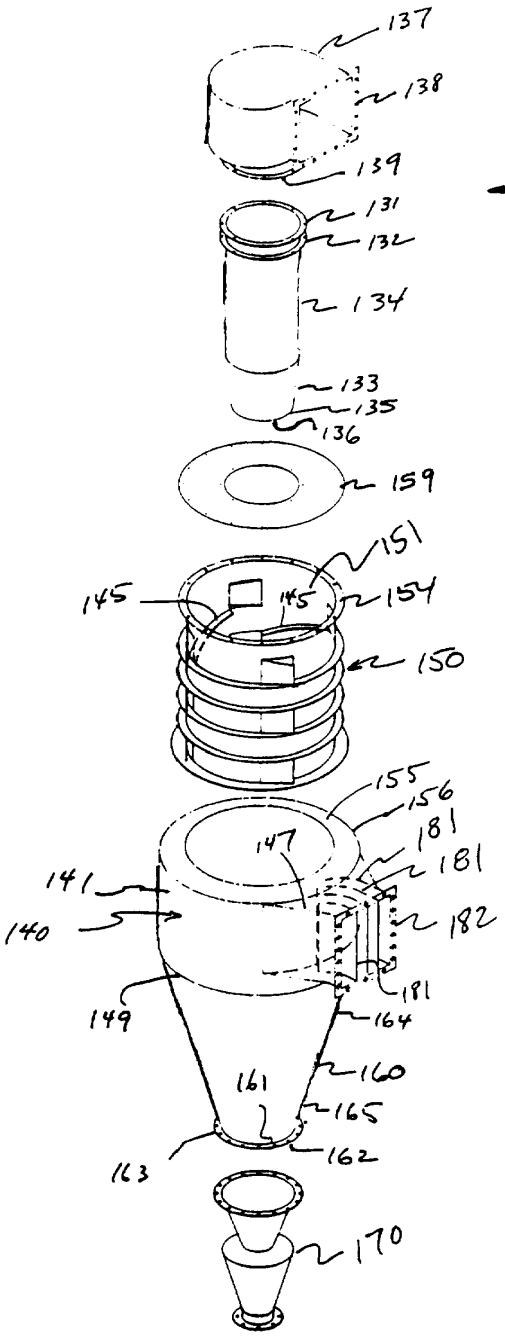
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FIG. 9

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :F26B 5/08, 11/02, 17/12; B01B 1/00
US CL :34/314, 326, 327, 136, 137, 166, 168, 173; 159/4.01
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. : 34/314, 326, 327, 136, 137, 166, 168, 173; 159/4.01

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)

APS, CAS ONLINE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2,724,686 A (NICHOLSON) 22 November 1955, col. 3, lines 3-70.	1-25
Y	US 4,101,263 A (LUMPKIN, Jr) 18 July 1978, col. 3, lines 37-45.	1-5, 12-16, 25
A	US 4,052,255 A (HACKBARTH et al) 4 October 1977, col. 4, lines 5-49.	1-25
A	US 3,766,661 A (BAYENS et al) 23 October 1973, col. 2, lines 16-61.	1-25

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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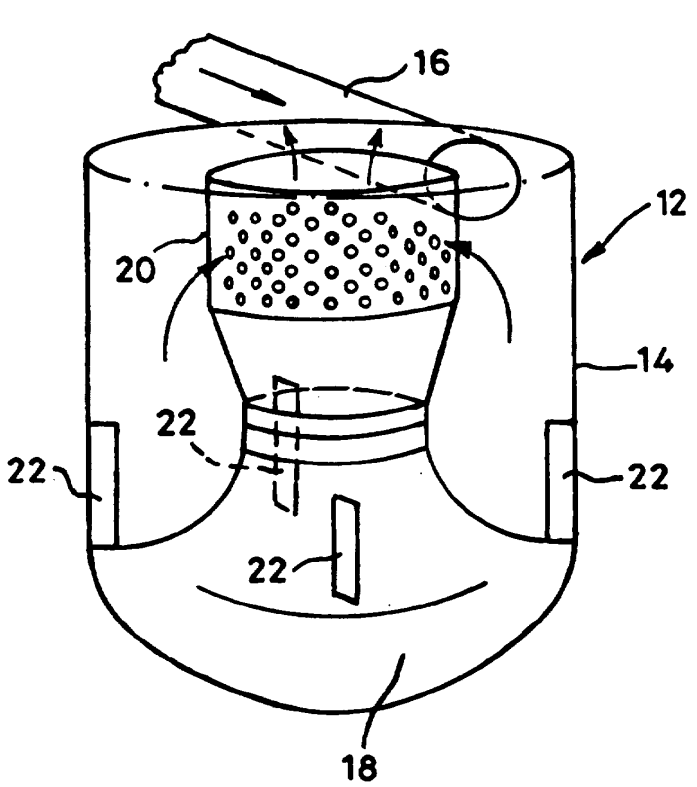
(54) Title: IMPROVED DUST SEPARATION APPARATUS

(57) Abstract

Apparatus for separating dirt and dust entrained in an airflow therefrom, comprising a bin (12) having an outer wall (14) with a circular cross section, a tangential airflow inlet (16) for introducing the airflow to the bin (12) substantially tangentially to the outer wall (14), and an airflow outlet, wherein settling means (22), for encouraging dirt and dust collected in the bin (12) to settle, are provided inside the bin (12). Preferably, the settling means comprise inwardly extending projections, advantageously in the form of fins or baffles (22). This arrangement encourages dirt and dust separated from the airflow to remain in the bin (12) and discourages re-entrainment with the airflow.



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IMPROVED DUST SEPARATION APPARATUS

The invention relates to apparatus for separating dirt or dust particles from an airflow by cyclonic means. The invention relates particularly, but not exclusively, to cyclonic dust separation apparatus for use in a vacuum cleaner.

Cyclonic dust separation apparatus typically comprises an outer bin or container having a cylindrical or frusto-conical outer wall. A tangential air inlet supplies a dirty airflow to the interior of the bin or container such that the airflow is set into a swirling motion within the bin or container. By this swirling motion, dirt and dust particles are separated from the airflow and the particles collect in the lower portion of the bin or container whilst the airflow exits via an outlet located radially inwardly of the outer wall. Sometimes, the airflow is then passed to a second cyclone designed to separate from the airflow fine dust particles which are not separated in the first cyclone.

Vacuum cleaners incorporating such dust separation apparatus are known. However, it has been found that, when the height of the bin or container is reduced or when the bin or container becomes full of collected dirt and dust, then some of the separated dirt and dust can

become re-entrained in the airflow so that it passes out of the container again. When no second cyclone is provided the airflow exhausted from the bin or container carries with it more dirt and dust particles than is desirable. In cases where a second cyclone is provided, the re-entrained dirt and dust particles are separated from the airflow downstream of the bin or container but this then fills the collecting chamber of the second cyclone unacceptably quickly.

It is an object of the present invention to provide cyclonic dust separating apparatus wherein the risk of re-entrainment of separated dirt and dust into the airflow is reduced.

The invention provides apparatus for separating dirt or dust entrained in an airflow therefrom as set out in claim 1. Preferable and advantageous features of the invention are set out in the subsidiary claims. The invention also provides a vacuum cleaner comprising apparatus as set out in claims 1 to 18.

The provision of settling means inside the bin in the form of inwardly extending projections, particularly fins or baffles, encourages the separated dirt and dust to settle at the bottom of the bin. It is thought that pockets of relative stillness are created in the area of these projections which allow the separated dirt and dust to settle rather than becoming re-entrained into the airflow. Furthermore, experimentation has shown

that the provision of this type of settling means does not adversely affect the separation efficiency of the apparatus as a whole. However, the percentage of dirt and dust particles exiting from the bin or cylinder has been found to reduce in the presence of these settling means.

Embodiments of the invention will now be described with reference to the accompanying drawings wherein:

Figure 1a is a schematic perspective view of a bin or container forming part of dust separation apparatus according to the present invention;

Figure 1b is a schematic plan view of the bin or container shown in Figure 1a and illustrating the likely airflow pattern when the apparatus is in use;

Figure 2 is a sectional side view through a bin or container forming part of apparatus according to the invention;

Figures 3a and 3b are sectional side and plan views respectively of the bin or container shown in Figure 2 in use;

Figures 4a and 4b are vertical and horizontal partial sections through a first alternative fin; and

Figures 5a and 5b are horizontal sectional views through second and third alternative fins.

Figures 1a and 1b illustrate schematically the principle behind the present invention. Dust separating apparatus incorporates a bin or container 12 having an

outer wall 14 which has a circular cross-section. The bin or container 12 is normally generally cyclindrical in shape although conical or frusto-conical bins are not excluded. The bin 12 has an air inlet 16 which admits an airflow carrying dirt and dust particles into the bin or cylinder 12. The airflow enters the bin 12 tangentially so that the airflow adopts a swirling motion around the interior of the outer wall 14. By virtue of this swirling motion, the dirt and dust particles entrained within and carried by the airflow are separated out from the airflow and collect in the lower region 18 of the bin 12. The airflow moves towards the centre of the bin 12 and exits from the bin 12 by passing through small holes or perforations in a central shroud 20. The airflow then passes from the illustrated separation apparatus either direct to an exhaust port or to a second, high-efficiency cyclone for cyclonic separation of very fine dust particles which may remain in the airflow.

In order to prevent dirt and dust particles collected in the lower portion 18 of the bin 12 from becoming re-entrained into the airflow, fins or baffles 22 are arranged to project inwardly from the outer wall 14 into the interior of the bin 12. Four fins 22 are provided in the lower region 18 of the bin 12 and the fins 22 are equispaced about the circumference of the outer wall 14. As illustrated in Figure 1b it is

believed that the provision of these fins 22 creates pockets immediately on the upstream side of each fin 22 wherein the airflow is relatively still compared to the remainder of the interior of the bin 12. Small eddies may occur in these regions. Any dirt and dust particles which collect in these regions appear to remain separate from the main airflow and the dirt and dust particles are encouraged to settle and discouraged from becoming re-entrained in the main airflow.

Figure 2 shows in more detail a bin 12 which forms part of the separation apparatus according to the invention. The bin 12 has an outer wall 14 which is cylindrical in shape and has a handle 24 formed integrally therewith or attached thereto. The lower portion 18 of the bin 12 is frusto-conical in shape and forms a collector for a high-efficiency cyclone positioned upstream of the bin 12. An upstanding wall 26 mates with a frusto-conical fine dust collector (not shown) to form part of the high-efficiency cyclone.

Webs or fins 22 are positioned at the lower end of the outer wall 14 and project into the interior of the bin 12 from the outer wall 14. Each fin 22 has a generally horizontally extending upper edge 28 and a generally vertical inner edge 30. The fins 22 can be moulded integrally with the bin 12 or manufactured separately and fixedly attached thereto during the manufacturing process.

In the embodiment illustrated in Figure 2, four equispaced fins 22 are provided. Different numbers of fins 22 can be provided as desired. A plan view of the bin illustrated in Figure 2 is shown in Figure 3b. Figure 3a illustrates the bin 12 in use, and in particular in combination with high-efficiency cyclone apparatus located centrally inside the outer wall 14.

Tests have shown that the effect of the dust settling apparatus varies according to the dimensions of the fins 22. The effect has been found to be particularly advantageous if the fins 22 project into the bin 12 to a depth d of between 10mm and 40mm, particularly 20mm. Also, it has been found that the height h of the fins 22 is advantageously between 50mm and 100mm, particularly 66mm.

The shape of the fins 22 has also been found to affect the amount of dust which successfully settles in the lower region 18 of the bin 12. Figure 4 illustrates one embodiment of a fin 22. Both the upper edge 28 and the inner edge 30 are chamfered such that the sharp or acutely-angled edge lies on the upstream side of the fin 22.

Alternative embodiments are of course possible. Figure 5a is a horizontal cross-section through a web having a tongue 32 extending from the inner edge 30 of the fin 22 in the downstream direction. However, the preferred embodiment is illustrated in Figure 5b. In

this embodiment, the upper edge 28 is radiussed and the thickness of the fin 22 increases with distance from the upper edge 28. This is illustrated in Figure 2. Also, the inner edge 30 is partially chamfered and partially radiussed. In the lower region of the fin 22, the inner edge 30 has a chamfered portion 30′ and a radiussed portion 30′′. As the thickness of the fin 22 decreases in the vicinity of the upper edge 28, the size of the chamfered portion 30′ decreases and, at or near the junction with the upper edge 28, the inner edge 30 becomes completely radiussed.

It will be appreciated by a skilled reader that adaptations and variations will achieve the same effect.

CLAIMS

1. Apparatus for separating dirt or dust entrained in an airflow therefrom, comprising a bin having an outer wall with a circular cross-section and a lower dirt-collecting area, a tangential airflow inlet for introducing the airflow to the bin substantially tangentially to the outer wall, and an airflow outlet, wherein settling means, in the form of a plurality of substantially planar projections extending radially inwardly from the outer wall, are provided inside the lower dirt-collecting area of the bin for encouraging dirt and dust collected in the bin to settle.

2. Apparatus as claimed in claim 1, wherein the projections are equispaced about the outer wall.

3. Apparatus as claimed in claim 1 or 2, wherein four projections are provided.

4. Apparatus as claimed in any one of the preceding claims, wherein the or each projection takes the form of a fin or baffle.

5. Apparatus as claimed in any one of the preceding claims, wherein the or each projection has an upper edge

which extends substantially perpendicular to the longitudinal axis of the bin.

6. Apparatus as claimed in claim 5, wherein the upper edge is radiussed.

7. Apparatus as claimed in claim 5, wherein the upper edge is chamfered.

8. Apparatus as claimed in any one of the preceding claims, wherein the or each projection has an inner edge which extends substantially parallel to the longitudinal axis of the bin.

9. Apparatus as claimed in claim 8, wherein the inner edge is at least partially chamfered.

10. Apparatus as claimed in claim 8 or 9, wherein the inner edge is at least partially radiussed.

11. Apparatus as claimed in any one of claims 8 to 10, wherein the inner edge has a tongue protruding from the downstream side thereof.

12. Apparatus as claimed in any one of the preceding claims, wherein the or each projection extends inwardly from the outer wall for between 10mm and 40mm.

13. Apparatus as claimed in claim 12, wherein the or each projection extends inwardly from the outer wall by substantially 20mm.

14. Apparatus as claimed in any one of the preceding claims, wherein the or each projection has a height of between 50mm and 100mm.

15 Apparatus as claimed in claim 14, wherein the or each projection has a height of between 60mm and 80mm.

16. Apparatus as claimed in claim 15, wherein the or each projection has a height of substantially 66mm.

17. Apparatus as claimed in any one of the preceding claims, wherein the outer wall of the bin is substantially cylindrical.

18. Apparatus substantially as hereinbefore described with reference to any one of the embodiments shown in the accompanying drawings.

19. A vacuum cleaner comprising apparatus as claimed in any one of the preceding claims.

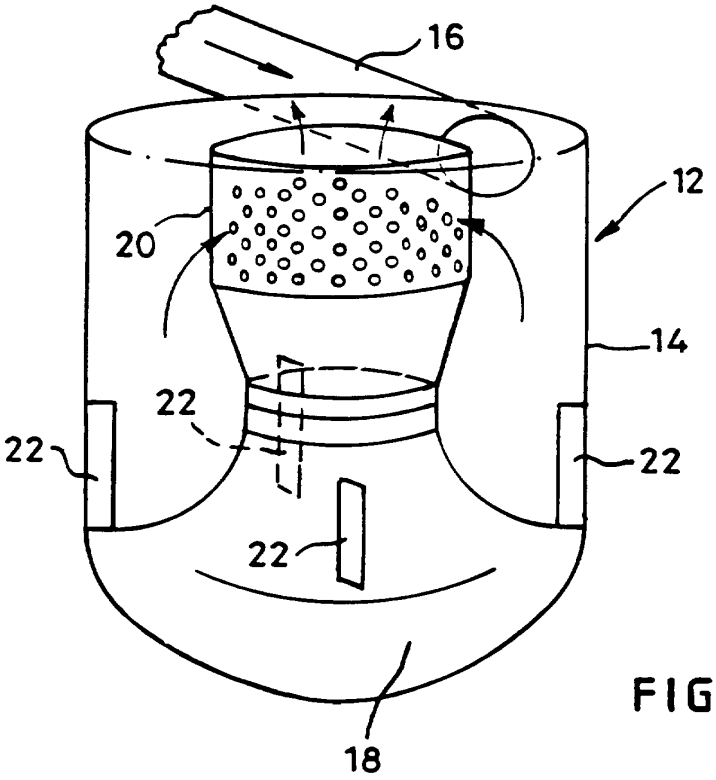


FIG.1a

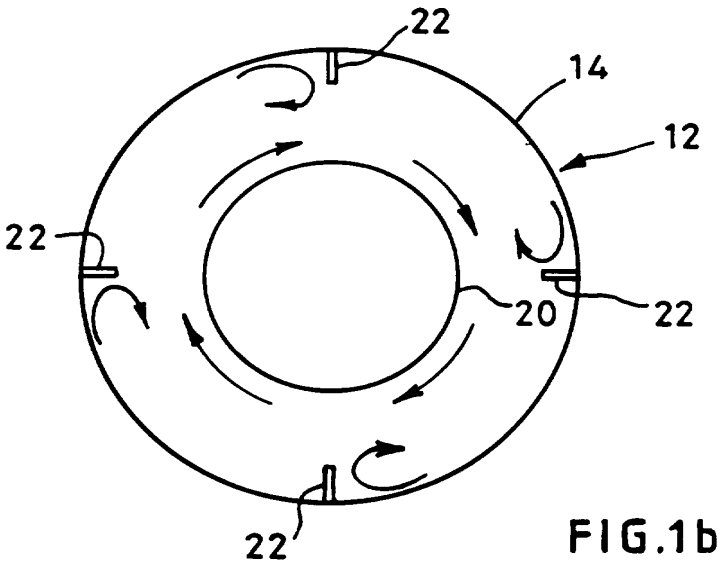


FIG.1b

FIG.2

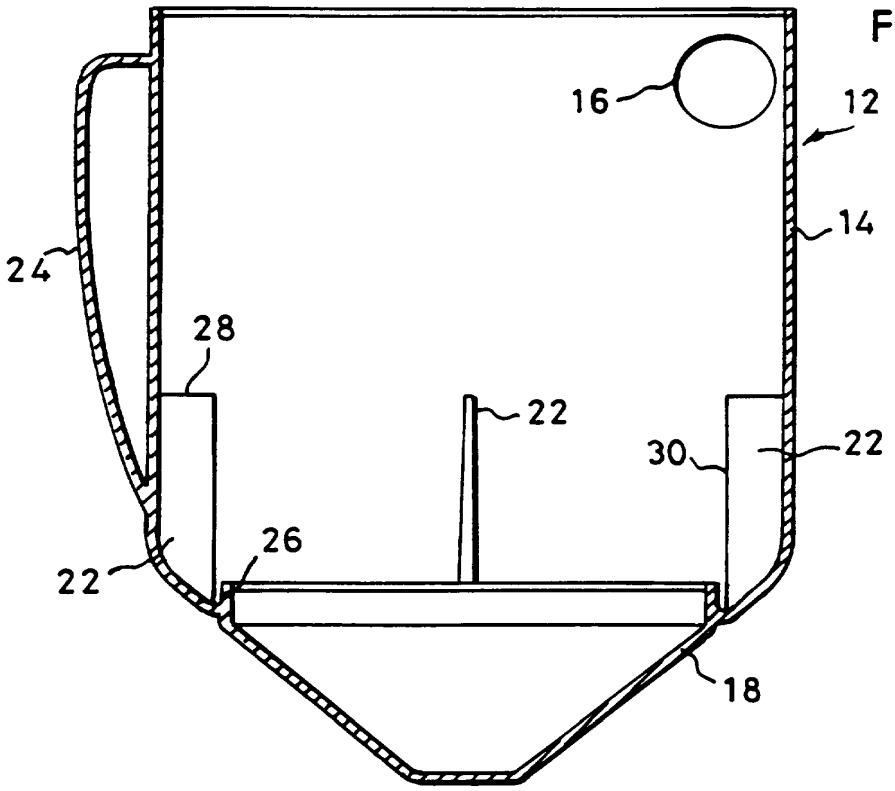


FIG.3

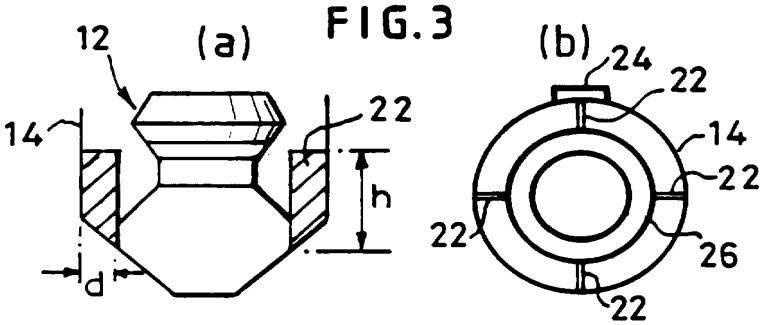
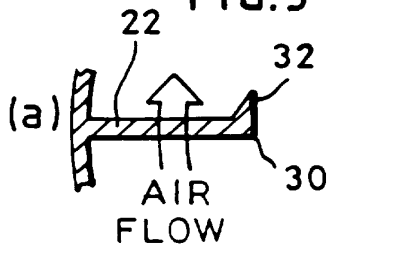


FIG.5



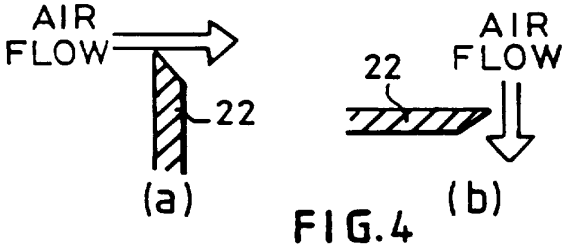


FIG.4

INTERNATIONAL SEARCH REPORT

Intern. ial Application No
PCT/GB 96/00336

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B04C5/081 B04C5/14 A47L9/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B04C A47L

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,2 171 248 (VAN BERKEL) 29 August 1939 see page 2, left-hand column, line 29 - line 61 see page 2, right-hand column, line 16 - page 3, left-hand column, line 11; figures ---	1-5, 7-10, 12-17,19
X	DE,C,754 339 (FREEMAN) 25 October 1951 see page 7, line 52 - line 65; figures -----	1,2,4-8, 17

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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"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

1

Date of the actual completion of the international search	Date of mailing of the international search report
8 May 1996	17.05.1996

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	Van der Zee, W

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

ernational application No.
PCT/GB96/00336

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 18
because they relate to subject matter not required to be searched by this Authority, namely:
see PCT-Rule 6.2(a)

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter ial Application No
PCT/GB 96/00336

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-2171248	29-08-39	NONE	
DE-C-754339		BE-A- 420877	
		BE-A- 426877	
		GB-A- 507412	
		US-A- 2102525	14-12-37

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Search result: 1 of 1

(WO/1980/002561) PROCESS FOR PREPARING IMMUNE YPSILON-GLOBULIN DERIVATIVE

Biblio. Data | Full Text | National Phase | Notices | Documents

Latest bibliographic data on file with the International Bureau

Pub. No.: WO/1980/002561 **International Application No.:** PCT/JP1979/000131
Publication Date: 27.11.1980 **International Filing Date:** 23.05.1979

IPC: ***C07K 16/00*** (2006.01), ***C07K 16/06*** (2006.01), *A61K 38/00* (2006.01)

Priority Data: JP79/00131 23.05.1979 WO

Title: PROCESS FOR PREPARING IMMUNE YPSILON-GLOBULIN DERIVATIVE

Abstract: A process for preparing immune (Alpha)-globulin derivative having a reduced anti-complement value and permitting intravenous injection, which comprises reacting, in water, immune (Alpha)-globulin with a compound capable of forming trithionate ion in water and a compound capable of forming sulphite ion in water to thereby split the chain-to-chain disulphide bond of the (Alpha)-globulin, and S-sulphonate the thus split sulphur atom.

Publication Language: Japanese (JA)

Filing Language: Japanese (JA)

PCT

世界知的所有権機関
国際事務局

特許協力条約に基づいて公開された国際出願

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C 07 G 7/00; A 61 K 37/06	A1	(43) 国際公開日	1980年11月27日 (27. 11. 80)

(21) 国際出願番号 PCT／JP79／00131
(22) 国際出願日 1979年5月23日 (23. 05. 79)

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(81) 指定国 CH, DE, DK, SE, SU, US.
添付公開書類 国際調査報告書

(54) Title: PROCESS FOR PREPARING IMMUNE γ-GLOBULIN DERIVATIVE

(54) 発明の名称 免疫Ｙ－グロブリン誘導体の製造法

(57) Abstract

A process for preparing immune γ-globulin derivative having a reduced anti-complement value and permitting intravenous injection, which comprises reacting, in water, immune γ-globulin with a compound capable of forming trithionate ion in water and a compound capable of forming sulphite ion in water to thereby split the chain-to-chain disulphide bond of the γ-globulin, and S-sulphonate the thus split sulphur atom.

(57) 要約

ヒト免疫Ｙ－グロブリンを水中でトリチオン酸イオンを形成し得る化合物および亜硫酸イオンを形成し得る化合物と水中において反応せしめて、この免疫Ｙ－グロブリンの鎖間ジスルフイド結合を切断すると共に、その切断された硫黄原子をＳ－スルホン化することからなる、抗補体価の低下した静脈注射が可能な免疫Ｙ－グロブリン誘導体の製造法。

情報としての用途のみ

PCTに基づいて公開される国際出願のパンフレット第1頁にPCT加盟国を同定するために使用されるコード。

AT	オーストリア	MC	モナコ
BR	ブラジル	MG	マダガスカル
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明　細　書

発明の名称

免疫γ－グロブリン誘導体の製造法

技術分野

本発明は免疫γ－グロブリン誘導体の製造法に関する。更に詳しくは、本発明はS－スルホン化免疫γ－グロブリンの製造の改良に関する。

背景技術

免疫グロブリンは各種疾病に対する抗体を有しているため各種疾病の予防及び治療に使用されているが、通常、免疫グロブリン製剤は、その用法として筋肉注射に限定されている。すなわち、かかる製剤を静脈注射すると投与された免疫グロブリンと補体との結合により血清補体濃度が低下し、いわゆる抗補体性と呼ばれる副作用が起り血圧降下，体温上昇，循環器系の障害などが観察される。

このため、免疫グロブリンを静脈内投与に対して安全なものにする目的で種々の研究が行われている。

第1の方法としては、ヒト免疫グロブリンを酵素により補体結合部と考えられる部分を切断除去する方法がある。例えば、酵素としてペプシンを

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用いるニソノフ（Nisonoff, A.）の方法〔サイエンス（Sience）132, 1770（1970）参照〕や、酵素として血漿中のプラスミノーゲンやカテプシン等を用いる特公昭47－37529号公報に記載の方法がある。しかしながら、これらの酵素処理免疫グロブリンでは、その半減期が短かく、従つて治療効果の持続時間の短かい欠点のあることはマーラー（Merler, E.）〔ボックスサング（Vox Sang）13, 102（1967）参照〕及びジャガー（Jager, B）〔アーク・イントラ・メディシン（Arch. Intora. Med.）119, 60（1967）参照〕が述べている通りである。

第2の方法としては、ヒト免疫グロブリンを蛋白質アシル化剤で処理する方法が知られている。例えば、特開昭49－6119号公報によればアシル化処理により一応抗補体価の低減した変性免疫グロブリンが得られている。しかしながら、この方法によるアシル化免疫グロブリンは人体内で抗原性を生じる恐れがあるので、大量投与は難しいとみられる。

第3の方法として、ヒト免疫グロブリンのジスルフイド結合を還元した後、アルキル化する方法が知られている。例えば、特開昭48－103723号公報によれば、免疫グロブリンと同一の見掛け

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分子量を有し、しかも抗補体価が減少した変性免疫グロブリンが得られている。しかしながら、この方法は2段階の反応であり、又操作もかなり煩雑であつて優れた方法とはいい難く工業的に不利な欠点を有している。

第4の方法として、ヒト免疫グロブリンの鎖間ジスルフイド結合をテトラチオン酸イオンと亜硫酸イオンとでS－スルホン化せしめる静脈注射用として適する免疫グロブリン誘導体の製造に関する報告がある（特開昭50－121421号公報，同51－1630号公報，同51－76418号公報および同51－112512号公報参照）。この方法は公知の方法のなかでは最も優れた方法である。しかしながら、この方法は酸化剤として不安定なテトラチオン酸塩を用いているため、反応を完全に進行するのに大量のテトラチオン酸塩を必要とし、その為副反応を惹起しやすく、又、場合により蛋白変性を起しやすく、従つて抗補体価が充分下がり難いという改良すべき点もみられる。更にテトラチオン酸イオンは酸化力が比較的強く、鎖間ジスルフイド結合のみでなく、一緒に鎖内ジスルフイド結合を切断する可能性もあり、そのため反応の制御に十分な注意が必要であるという不便な点もある。

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発明の開示

本発明者は、かかる欠点を改良すべく鋭意研究した結果、ヒト免疫グロブリンの鎖間ジスルフイド結合を切断すると共に、その切断された硫黄原子をS－スルホン化（$-S-SO_3^-$）するのに酸化剤として安定で反応性が適度の大きさを持つトリチオン酸イオンと亜硫酸イオンを用いることにより、上記欠点のない、静脈注射用に適した免疫グロブリン誘導体を製造できることを見出し、本発明に到達した。

すなわち、本発明はヒト免疫グロブリンを水中でトリチオン酸イオンを形成し得る化合物および水中で亜硫酸イオンを形成し得る化合物と水中において反応せしめて、該免疫グロブリンの鎖間ジスルフイド結合を切断すると共に、その切断された硫黄原子をS－スルホン化（$-S-SO_3^-$）することを特徴とする免疫グロブリン誘導体の製造方法である。

図面の簡単な説明

第1図の(イ)は免疫γ－グロブリン（IG），(ロ)は実施例1で得られたスルホン化γ－グロブリン（GGS），(ハ)は比較例で得られたスルホン化γ－グロブリン（GGS）のそれぞれドデシル硫酸ナトリウムデイスク電気泳動の結果を示すパターンである。

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第１図の(ニ)は上記パターンの各バンドと分子量との関係を示す図である。

第２図の(イ)は実施例１で得られたスルホン化γ－グロブリン（GGS），(ロ)は比較例で得られたスルホン化γ－グロブリン（GGS）のそれぞれセファデックスG２００によるゲル濾過パターンを示す図である。

発明を実施するための最良の形態

本発明で用いられる酸化剤であるトリチオン酸イオン源としては水中でトリチオン酸イオンを形成し得るものであれば如何なる化合物でも使用し得るが、好適に用いられるものとしては、例えばトリチオン酸ナトリウム，トリチオン酸カリウムの如きトリチオン酸のアルカリ金属塩がある。

亜硫酸イオン源としては水中で亜硫酸イオンを形成し得るものであれば如何なる化合物でも使用しうるが、好適に用いられるものとしては、亜硫酸，亜硫酸ナトリウム，亜硫酸水素ナトリウム，亜硫酸カリウム，ピロ重亜硫酸ナトリウムがあげられる。

亜硫酸イオンを形成し得る化合物の量は免疫グロブリンの切断すべき鎖間ジスルフイド結合に対して２モル倍以上、好ましくは１０モル倍以上が用いられる。またトリチオン酸イオンを形成し得

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る化合物の量は免疫グロブリンの切断すべき鎖間ジスルフイド結合に対して1モル倍以上、好ましくは2モル倍以上が用いられる。反応は水中で行なわれるが、反応時のpH は6.0～10.0の範囲が好ましい。

反応温度は50℃以下、好ましくは10～45℃の範囲で選ばれる。50℃以上の温度では免疫グロブリン分子が蛋白変性を受け易く好ましくない。10℃以下の温度では反応の進行は極めて遅く工業的ではない。

反応時間は免疫グロブリンの鎖間ジスルフイド結合がほとんど切断されてS－スルホン化される迄であるが、それは試薬量，反応温度等により異なる。一般に0.5～24時間の間で選ばれる。

本発明により免疫グロブリンの鎖間ジスルフイド結合が切断され、ジスルフイド結合がS－スルホネート基（$-S-SO_3^-$）に変換したH鎖，L鎖が得られる。反応後生成物の分離は一般的に透析，塩析，カラムクロマト等の精製方法を用いて行なわれる。例えば反応後生理食塩液によつて透析することにより目的物質の生理食塩液溶液が得られる。

以下実施例により本発明方法を詳述するが、本発明はこれに限定されるものではない。

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Dyson Ex1020
Page 661

参考例

1. トリチオン酸ナトリウムの製造

チオ硫酸ナトリウムと30%過酸化水素水とから、トリチオン酸ナトリウムを文献記載の方法（新実験化学講座8巻無機化合物の合成〔Ⅱ〕P482，丸善）により合成した。

このものは室温に数ケ月放置したがほとんど変化が見られなかつた。また、このものの水溶液を45℃で4.5時間加熱したが、ほとんど変化しなかつた。

2. テトラチオン酸ナトリウムの製造

チオ硫酸ナトリウムとヨウ素とから、テトラチオン酸ナトリウムを文献記載の方法（Handduch der Praparatinen Anorganischen Chemie, Vol. 1, P362, Ferdinand Enke Verlag Stuttgart 1960）により合成した。

このものは室温に1週間放置することにより純度が85%に低下し、亜硫酸ガスのにおいを発生させた。

また、このものの水溶液を45℃，4.5時間加熱した結果、純度が50%以下に低下した。

実施例1

ヒト免疫グロブリンの16% pH 7.5のリン

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酸緩衝化生理食塩液溶液5 mlに、亜硫酸ナトリウム0.1616 g（免疫グロブリンの鎖間ジスルフイド結合に対して64倍モル）とトリチオン酸ナトリウム0.0766 g（鎖間ジスルフイド結合に対して16倍モル）を含むpH 7.5のリン酸緩衝化生理食塩液5 mlを加え、45℃の温度で4.5時間反応した。反応終了後生理食塩液で反応試薬が0.1 mMol／l以下の濃度になる迄透析し、スルホン化γ-グロブリンの生理食塩液の7%溶液11 mlを得た。

この5%溶液についての抗補体価〔Kabat and Mayer「Experimental Immunochemistry」P225（61）記載の測定法による〕CH_{50}は14.9%であつた。

原料であるヒト免疫グロブリンの5%溶液の抗補体価CH_{50}は90%であつた。

また、このもののジフテリア抗体価は0.8 units/mlであり原料であるヒト免疫グロブリンのそれと一致した。

また、このもののドデシル硫酸ナトリウムデイスク電気泳動をウエーバーとオズボーンの方法〔J. Biol. Chem. 244, 4406（1969）〕で行つた。結果を第1図の(ロ)に示した。図から明らかなようにほとんどH鎖，L鎖であり鎖間ジスル

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フイド結合がスルホン化されていることが確認された。

一方、^{35}S の Na_2SO_3 を用いて同様に反応を行つた結果、免疫グロブリン1モル当り7～8.5モルの $-S-SO_3^-$ 基が導入されていることが確認された。

免疫電気泳動パターンはテトラチオン酸ナトリウムを用いて得られたもの（第1図の(ハ)）と全く一致した。

比較のために第1図の(イ)にはヒト免疫γ－グロブリンのパターンを示した。

更にセファデックスG－200を用いたゲル沪過パターンを第2図の(イ)に示した。5％溶液の OD_{450} は0.950であつた。

実施例2

トリチオン酸ナトリウム0.0155g（鎖間ジスルフイド結合に対して3.2倍モル）を用いる以外は実施例1と同様に行い、抗補体価 CH_{50} 15.2％のスルホン化γ－グロブリンを得た。

比較例

ヒト免疫グロブリンの16％リン酸緩衝化生理食塩液溶液5mlに亜硫酸ナトリウム0.1616

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g（免疫グロブリンの鎖間ジスルフイド結合に対して64倍モル）とテトラチオン酸ナトリウム・2水和物0.0988g（鎖間ジスルフイド結合に対して16倍モル）とを含むpH 7.5リン酸緩衝生理食塩液5mlを加え、45℃の温度で4.5時間反応した。反応終了後反応試薬が0.1mMol/l以下の濃度になる迄生理食塩液で透析し、スルホン化γ-グロブリンの生理食塩液の7%溶液11mlを得た。

この5%溶液の抗補体価CH_{50}は20.2%であり、OD_{450}は0.112であつた。

このもののドデシル硫酸ナトリウムデイスク電気泳動のパターンは第1図の(ハ)に示した通りであつた。またセフアデツクスG-200を用いたゲル濾過パターンは第2図の(ロ)に示した通りであつた。

産業上の利用可能性

本発明においては、スルホン化剤として比較的安定なトリチオン酸イオンと亜硫酸イオンとを用いているため、反応中反応試剤の分解がなく、その為試薬量が少量でよいので副反応が少なく、その結果抗補体価及び濁度が低く、反応後の精製が極めて簡単な静脈注射用に適した免疫γ-グロブリン誘導体が得られるという利点がある。

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本発明によつて得られるS－スルホン化免疫γ－グロブリンは人体内で元の免疫グロブリンに復元する性質を有し、抗原性を生ずる恐れもなく、血流中で分解もされ難いものである。そして各種抗体活性を保持したまま抗補体価のみが低下しているので静脈注射が可能であり、人体内での効果の持続時間も非常に長いという特徴を有している。

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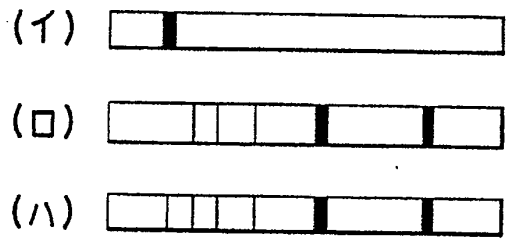
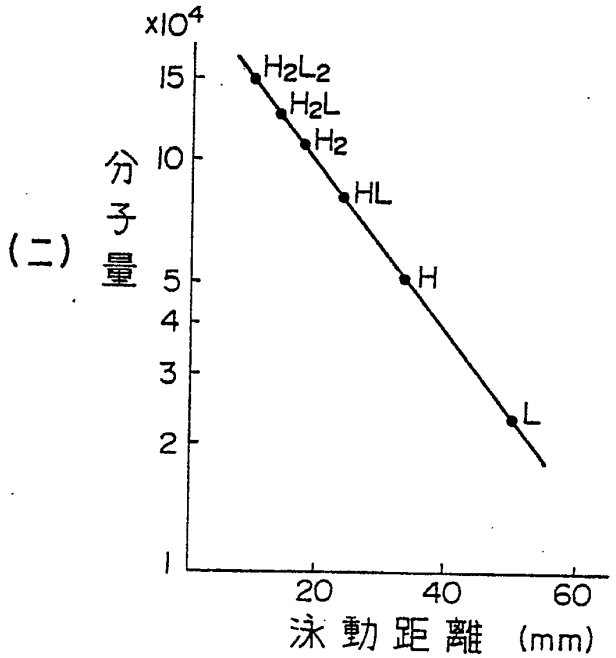
請求の範囲

1. ヒト免疫γ－グロブリンを水中でトリチオン酸イオンを形成し得る化合物および亜硫酸イオンを形成し得る化合物と水中において反応せしめて、該免疫γ－グロブリンの鎖間ジスルフィド結合を切断すると共に、その切断された硫黄原子をS－スルホン化（$-S-SO_3^-$）することを特徴とする免疫γ－グロブリン誘導体の製造法。

2. 水中でトリチオン酸イオンを形成し得る化合物が、トリチオン酸ナトリウム又はトリチオン酸カリウム又はこれらの混合物のうちのいずれかである請求の範囲第1項記載の免疫γ－グロブリン誘導体の製造法。

第 1 図





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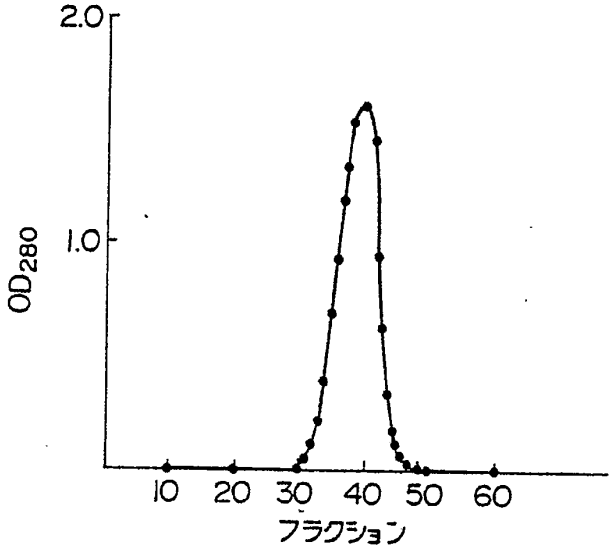
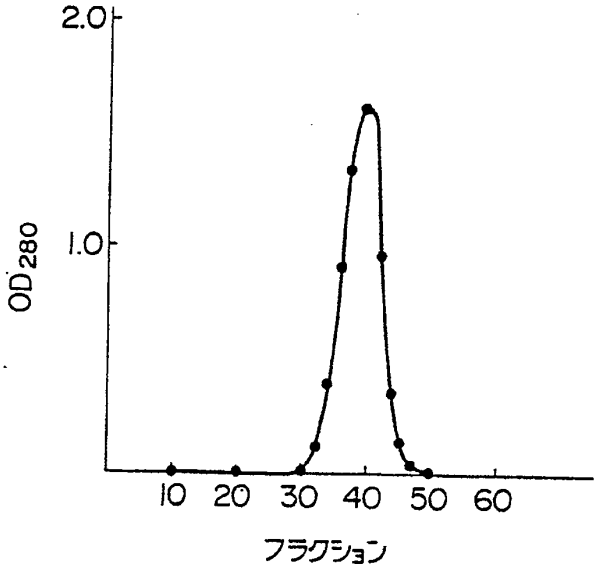
第 2 図

(イ)



(ロ)



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国際調査報告

国際出願番号PCT/JP79/00131

Ⅰ. 発明の属する分野の分類

国際特許分類(IPC)

C07G 7/00, A61K 37/06

Ⅱ. 国際調査を行った分野

調査を行った最小限資料

分類体系	分類記号
IPC	C07G 7/00, A61K 37/06

最小限資料以外の資料で調査を行ったもの

Ⅲ. 関連する技術に関する文献

引用文献のカテゴリー*	引用文献名 及び一部の箇所が関連するときは、その関連する箇所の表示	請求の範囲の番号
A	JP, A, 51-112512, 1976-10-05	1, 2

*引用文献のカテゴリー
「A」一般的技術水準を示す文献
「E」先行文献ではあるが国際出願日以後に公表されたもの
「L」他のカテゴリーに該当しない文献
「O」口頭による開示、使用、展示等に言及する文献
「P」国際出願日前でかつ優先権の主張の基礎となる出願の日以後に公表された文献
「T」国際出願日又は優先日以後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「X」特に関連のある文献

Ⅳ. 認証

国際調査を完了した日	国際調査報告の発送日
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国際調査機関	権限のある職員
日本国特許庁 (ISA/JP)	4,C 6617 特許庁審査官 柏田 操

様式PCT/ISA/210(第2ページ) (1977年10月)

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP79/00131

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

C07G 7/00, A61K 37/06

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
I.P.C	C07G 7/00, A61K 37/06

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	JP, A, 51-112512, 1976-10-05	1, 2

* Special categories of cited documents: [15]

"A" document defining the general state of the art

"E" earlier document but published on or after the international filing date

"L" document cited for special reason other than those referred to in the other categories

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but on or after the priority date claimed

"T" later document published on or 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

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
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International Searching Authority [1]	**Signature of Authorized Officer [20]**
Japanese Patent Office	

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(56) Für die Beurteilung der Patentfähigkeit in Betracht gezogene Druckschriften:

DE	36 24 086 C2
DE	30 09 253 A1
GB	22 13 405 A
US	25 66 662

(54) Vorrichtung zur Staubabscheidung

(57) Eine Vorrichtung zur Staubabscheidung, insbesondere zur Rückgewinnung durch Abscheidung von pulverförmigen Lacken bei Lackierungsanlagen, besteht aus einem Zyklon und einem nachgeschalteten Sammelbehälter zur Sammlung der im Zyklon abgeschiedenen Partikel sowie aus einer Wirbelstütze im Übergangsbereich zwischen Zyklon und Sammelbehälter. Zur Halterung der Wirbelstütze in diesem Übergangsbereich ist ein randseitig im Bereich der Austragöffnung gehaltenes Maschengewebe vorgesehen, dessen Maschenweite über der maximalen Korngröße der abgeschiedenen Partikel liegt.

Der Vorteil der Verwendung eines Maschengewebes als Halterungselement besteht im wesentlichen darin, daß bei ausreichender mechanischer Stabilität einerseits eine vollständige Durchlässigkeit für die abzuscheidenden Partikel erreicht wird, so daß die bei bekannten Lösungen (stegförmige Verbindungselemente) zwischen Wirbelstütze und Außenwandung auftretenden Grenzschichtbrücken und die damit eintretende Verringerung des Zyklon-Wirkungsgrades vermieden werden.

Vorteilhafterweise kann die gesamte Baueinheit Maschengewebe/Wirbelstütze schwenkbar angeordnet sein, so daß auch Reinigungsarbeiten einfach durchzuführen sind.

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Beschreibung

Die Erfindung betrifft eine Vorrichtung zur Staubabscheidung mit Umkehr der Hauptströmungsrichtung, insbesondere zur Rückgewinnung durch Abscheidung von pulverförmigen Lacken bei Lackierungsanlagen, bestehend aus mindestens einem Zyklon und einem darunter angeordneten Sammelbehälter zur Sammlung der im Zyklon abgeschiedenen Partikel, sowie mit jeweils einer Wirbelstütze im Übergangsbereich zwischen Zyklon und Sammelbehälter zur Stabilisierung der Strömungsverhältnisse, insbesondere Zentrierung des Zentralwirbels.

Derartige Zyklone sind allgemein bekannt, beispielsweise aus der DE-PS 36 24 086.

Als Wirbelstütze ist dort ein Kegel unterhalb der Austragsöffnung des Zyklons vorgesehen, dessen Spitze in das Innere des Zyklons hin zeigt und der dazu dient, die Bewegungsrichtung des einströmenden Feststoff-Gas-Gemisches nach der Abscheidung der Feststoffpartikel an den Wandungen des Zyklons in Richtung eines Austrittsstutzens hin umzukehren.

Andere bekannte Vorrichtungen verwenden statt einer kegelförmigen Wirbelstütze ein plattenförmiges Bauteil, meist eine Blechscheibe, die den gleichen Zweck erfüllen soll.

Ein Problem bei beiden Bauteilen ist deren Befestigung an den umgebenden Komponenten der Staubabscheidungsvorrichtung im Bereich der Austragsöffnung des Zyklons.

Bei der bekannten Befestigungsweise mittels stegförmiger Verbindungselemente zwischen Kegel und Außenwandung bzw. zwischen Blechscheibe (Sternblech) und Außenwandung bilden sich unerwünschte Grenzschichtbrücken, über die an den Wandungen des Zyklons abgeschiedene Feststoffpartikel wieder aufgewirbelt werden und in den von der Wirbelstütze nach oben umgelenkten und zentrierten Zentralwirbel gelangen und somit mit dem Gas wieder ausgeschieden werden, was eine Verringerung des Zyklon-Wirkungsgrades bedeutet.

Es ist auch bekannt, diese sogenannten Sternbleche in die Trennstelle zwischen Zyklon und Sammelbehälter einfach einzulegen, was bei Reinigungsarbeiten aber oft zu dem Nachteil führt, daß die Wirbelstütze nicht wieder eingebaut wird und sich somit ebenfalls die Leistungsfähigkeit des Zyklons verringert.

Es ist daher Aufgabe der Erfindung, die bekannte Vorrichtung zur Staubabscheidung soweit zu verbessern, daß der Austragsbereich des Zyklons so ausgebildet wird, daß einerseits eine einwandfreie Zentrierung des Zentralwirbels erreicht wird, andererseits Ablagerungen im Austragsbereich des Zyklons zuverlässig vermieden werden.

Erfindungsgemäß wird diese Aufgabe dadurch gelöst, daß zur Halterung der Wirbelstütze ein randseitig im Bereich der Austragöffnung gehaltenes Maschengewebe dient, dessen Maschenweite über der maximalen Korngröße der abgeschiedenen Partikel liegt.

Diese überraschend einfache Lösung wird allen praktischen Anforderungen gerecht und ist konstruktiv einfach und in vielfältiger Ausführungsart zu bewerkstelligen.

Der Grundgedanke der Erfindung besteht hierbei darin, anstelle der bekannten stegartigen Verbindungselemente zwischen Wirbelstütze und Außenwandung mit dem Maschengewebe ein materialmäßig "homogenes" Bauteil einzusetzen, dessen mechanische Stabilität

ausreicht, um eine bauübliche Wirbelstütze zu tragen, das andererseits bei geeigneter Maschenwahl vollständig durchlässig für die abzuscheidenden Partikel ist. Dabei kann die Maschenweite so gewählt werden, daß grobe Verunreinigungen aufgefangen werden, was bei einer Wiederverwendung der abgeschiedenen Partikel von Bedeutung ist. Insofern wirkt das Maschengewebe als Grobfilter.

Die Verwendung von Maschengewebe als Sieb ist allgemein bekannt beispielsweise als Bauelement zur Abtrennung von Partikeln aus einem durchströmenden Medium; die US-2 566 662 widmet sich diesem "klassischen" Verwendungsbereich eines Siebes, nämlich der Abspaltung von Feststoffpartikeln. Hierzu wird unter anderem ein perforiertes Blech eingesetzt, dessen Öffnungen so dimensioniert sind, daß die abzuspaltenden Partikel (hier Sand) passieren können.

Die GB-A-2 213 405 zeigt darüber hinaus eine Vorrichtung mit zwei konisch geformten Sieben, deren Aufgabe in einer Aufspaltung einer Mischung aus Öl, Wasser und Gas zu Meßzwecken besteht, wobei eventuell in diesem Gemisch enthaltene Feststoffpartikel passieren können.

Die oben erwähnten, dort verwendeten Bauteile (Maschengewebe, perforiertes Blech) erfüllen lediglich die geschilderte Siebfunktion, dienen aber nicht zusätzlichen Zwecken, insbesondere nicht zur Halterung anderer Bauteile, wie dies die erfindungsgemäße Lösung vorsieht.

Vorteilhafte Ausgestaltungen der erfindungsgemäßen Lösung sind den Unteransprüchen zu entnehmen, wobei insbesondere auf die schwenkbare Anordnung der Baueinheit Rahmen-Maschengewebe-Wirbelstütze hingewiesen werden soll.

Ein Ausführungsbeispiel der Erfindung wird anhand der Zeichnung noch kurz erläutert: In den Figuren ist ein Zyklon **10** dargestellt, dessen Gehäuse im oberen Teil zylindrisch, in seinem unteren Teil kegelstumpfförmig ausgeführt ist. Am unteren Ende des kegelstumpfförmigen Teils befindet sich die Austragsöffnung für die abgeschiedenen Feststoffpartikel.

Diese Feststoffpartikel gelangen als Feststoff-Gas-Gemisch A beispielsweise tangential in den oberen zylindrischen Teil des Zyklons **10** und werden dann auf einer spiralförmigen Bahn A' nach unten zur Austragsöffnung hin geführt, wobei infolge der hierbei auftretenden Zentrifugalkräfte die Feststoffpartikel sich an den Innenwandungen des konischen Teils des Zyklons **10** abscheiden und durch die Austragsöffnung in einen Sammelbehälter **11** fallen. Das derart von dem weit überwiegenden Teil (95 bis 97%) der Feststoffpartikel gereinigte Gas (beispielsweise Luft) gelangt dann über eine aufwärts gerichtete Strömung B' (Wirbelkern) nach oben in einen gestrichelt dargestellten Gasaustrittsstutzen **8** und wird von diesem als Gasstrom B wieder an die Umgebung abgegeben.

Zur einwandfreien Stabilisierung der diese Festpartikelabscheidung bewirkenden Strömungsverhältnisse (spiralförmiger Abscheideweg A'/Wirbelkern B') ist es bekannt, im Bereich der Austragsöffnung, also dem Bereich geringsten Querschnittes des kegelstumpfförmigen Teils des Zyklons **10**, eine plattenförmige Wirbelstütze **12** anzubringen, die den spiralförmig abwärts gerichteten Gasstrom A' in die nach oben gerichtete Wirbelkernströmung B' umkehrt.

Gemäß der Erfindung ist diese plattenförmige Wirbelstütze **12** mittels eines Maschengewebes **12A** in einem Rahmen **12B** eingespannt, der seinerseits in einem unte-

ren, sich kegelstumpfartig erweiternden Endteil **10A** des Zyklons **10** angeordnet ist, der auch als separates Zwischenteil zwischen Zyklon **10** und Sammelbehälter **11** ausgebildet sein kann.

Zur schwenkbaren Verbindung des Rahmens **12B** mit dem Endteil **10A** dient eine vertikale Achse S.

In **Fig.** 1 ist der Zyklon **10** und die Wirbelstütze **12** in ihrer einen Endposition, der Arbeitsposition, dargestellt, wo der Rahmen **12B** im wesentlichen horizontal liegt und die Wirbelstütze **12** in der zur Funktion des Zyklons optimalen Position im Bereich der Austragsöffnung hält. Diese Position dient vorteilhafterweise bei entferntem Sammelbehälter **11** auch zur Reinigung des Maschengewebes beispielsweise durch Ausblasen infolge der sich einstellenden Druckverhältnisse, da bei Funktion des Zyklons die entfernten Schmutzpartikel abgesaugt werden können.

In **Fig.** 2 ist die zweite Endposition der Wirbelstütze **12** dargestellt, nämlich im seitlich abgeklappten Zustand (Wartungsposition), wo der Zyklon **10** sich außer Betrieb befindet und er für Reinigungszwecke von unten her zugänglich sein muß.

Die beschriebene Art der Befestigung der Wirbelstütze **12** mittels Maschengewebe **12A** ist nur eine Variante von vielen denkbaren Möglichkeiten, um den Erfindungsgedanken zu realisieren, nämlich eine feste Positionierung der Wirbelstütze **12** im Hinblick auf eine Optimierung der Funktion ohne Ausbildung von Grenzschichtbrücken (Abscheidungsgrad) des Zyklons.

Patentansprüche

1. Vorrichtung zur Staubabscheidung mit Umkehr der Hauptströmungsrichtung, insbesondere zur Rückgewinnung durch Abscheidung von pulverförmigen Lacken bei Lackierungsanlagen, bestehend aus einem Zyklon und einem nachgeschalteten Sammelbehälter zur Sammlung der im Zyklon abgeschiedenen Partikel sowie mit einer Wirbelstütze im Übergangsbereich zwischen Zyklon und Sammelbehälter (Austragöffnung des Zyklons) zur Stabilisierung der Strömungsverhältnisse, insbesondere Zentrierung des Zentralwirbels, **dadurch gekennzeichnet,** daß zur Halterung der Wirbelstütze (12) ein randseitig im Bereich der Austragöffnung gehaltenes Maschengewebe (12A) dient, dessen Maschenweite über der maximalen Korngröße der abgeschiedenen Partikel liegt.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß das Maschengewebe (12A) randseitig in einem Rahmen (12B) eingespannt ist und in seinem mittleren Bereich die Wirbelstütze (12) befestigt ist.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Wirbelstütze (12) als Abschirmkegel ausgebildet ist, dessen Spitze zum Zyklon (10) hin gerichtet ist.

4. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Wirbelstütze (12) ein flaches Blechteil ist.

5. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß die Wirbelstütze (12) als zwei Platten ausgeführt ist, die beidseitig des Siebgewebes (12A) liegen und dieses zwischen sich einspannen.

6. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß der Rahmen (12B) um eine Schwenkachse (S) aus der Austragöffnung horizontal verschwenkbar ist.

7. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß das Maschengewebe (12A) aus zwei Lagen besteht, die eine plattenförmige Wirbelstütze zwischen sich einschließen.

Hierzu 2 Seite(n) Zeichnungen

– Leerseite –

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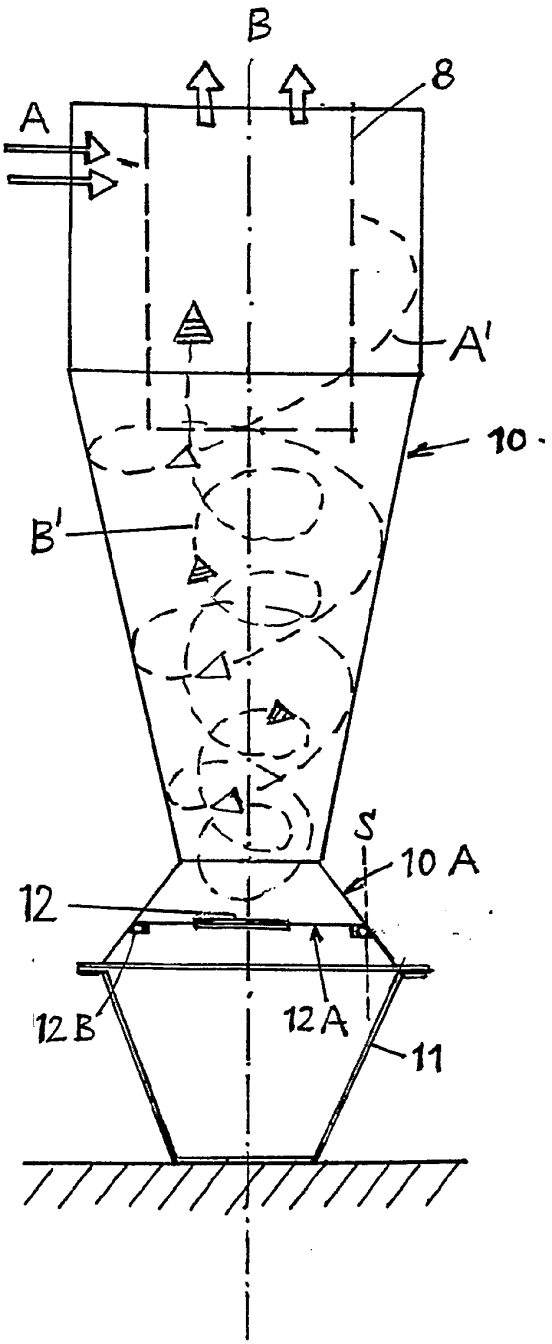

FIG.1

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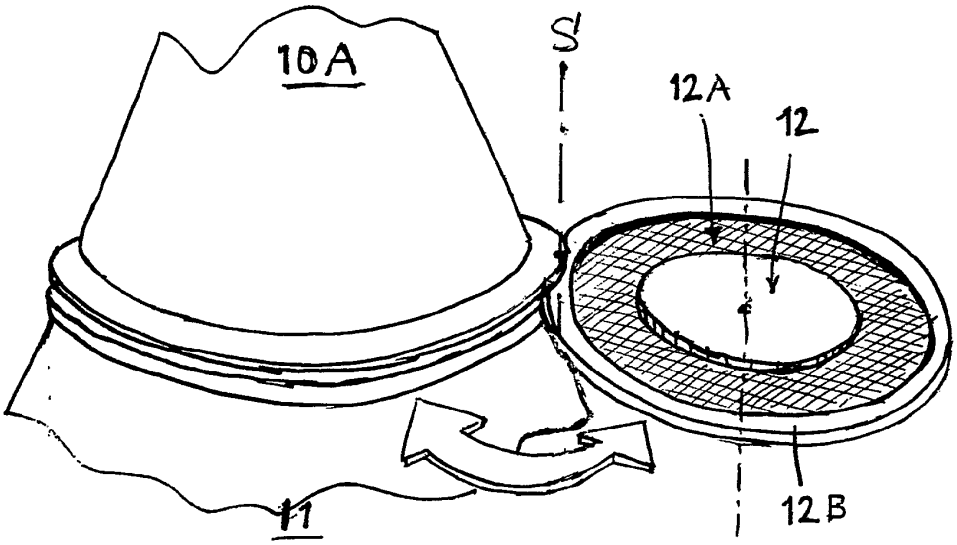

FIG.2

Dyson Ex1020
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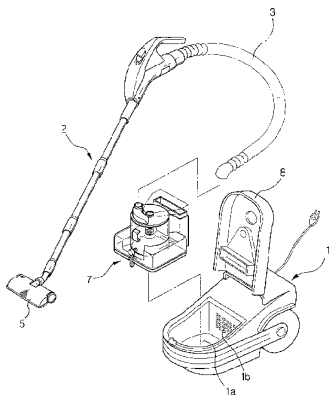
(74) **Mandataire(s) :** CABINET BALLOT.

(54) ASPIRATEUR COMPORTANT UN DISPOSITIF COLLECTEUR DE POUSSIERE DE TYPE CYCLONE.

(57) L'aspirateur comprend un corps d'aspirateur (1), une brosse d'aspiration (5) et un dispositif collecteur de poussière de type cyclone (7) monté dans une chambre collectrice de poussière (la) communiquant avec une chambre de motorisation (1b). Le dispositif (7) comprend un corps de cyclone cylindrique, un réceptacle à impuretés sous le corps de cyclone dont le fond est fermé par un élément de base pivotant, et un couvercle pour fermer le sommet du corps de cyclone, le couvercle comportant un conduit d'entrée d'air, un conduit de sortie d'air, et une grille de séparation d'impuretés.



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ASPIRATEUR COMPORTANT UN DISPOSITIF COLLECTEUR DE POUSSIERE DE TYPE CYCLONE

La présente invention concerne un aspirateur comportant un dispositif collecteur de poussière de type cyclone qui sépare par force centrifuge les impuretés de l'air qui est aspiré dans l'aspirateur.

En général, les aspirateurs tels que de type balai, de type à cuve ou similaires, comportent une brosse d'aspiration qui est connectée au corps de l'aspirateur et se déplace le long de la surface à nettoyer. Le corps de l'aspirateur comprend une chambre collectrice de poussière, dans laquelle est montée de façon amovible un filtre à poussière, et une chambre de motorisation, dans laquelle est monté un moteur pour générer la force d'aspiration. La force d'aspiration attire de l'air ainsi que toute poussière ou saleté présente sur la surface à nettoyer dans le corps d'aspirateur. L'air est évacué de l'aspirateur après passage à travers le filtre à poussière qui est disposé dans la chambre collectrice de poussière du corps d'aspirateur. Les diverses impuretés dans l'air sont retenues par le filtre à poussière, et l'air propre est rejeté dans l'environnement.

L'aspirateur classique décrit ci-dessus a toutefois une structure dans laquelle des impuretés sont retenues et recueillies par un filtre à poussière expansible. Lorsque le filtre à poussière est plein d'impuretés, il doit être remplacé, et un utilisateur doit retirer manuellement le filtre sale utilisé et

insérer un nouveau filtre, ce qui est à la fois malcommode et non hygiénique.

La présente invention a été réalisée pour surmonter les problèmes mentionnés ci-dessus de l'art antérieur. Ainsi, un but de la présente invention est de prévoir un aspirateur comportant un dispositif collecteur de poussière de type cyclone qui soit capable de séparer par force centrifuge et de recueillir de la poussière ou des impuretés à partir de l'air qui est aspiré par la brosse d'aspiration.

Selon la présente invention, le but ci-dessus est atteint avec un aspirateur comprenant un corps d'aspirateur, une brosse d'aspiration par laquelle de l'air et des impuretés sont aspirées, et un dispositif collecteur de poussière de type cyclone. Le corps d'aspirateur comporte une chambre de motorisation et une chambre collectrice de poussière en communication avec la chambre de motorisation. Le dispositif collecteur de poussière de type cyclone est monté dans la chambre collectrice de poussière et sépare les impuretés de l'air par force centrifuge. Le dispositif collecteur de poussière de type cyclone comprend un corps de cyclone cylindrique creux ayant son sommet ouvert, sa base fermée et une sortie pour les impuretés. Le sommet ouvert admet de l'air et des impuretés dans le corps de cyclone, les impuretés étant séparées de l'air par force centrifuge. Les impuretés sont ensuite évacuées du corps de cyclone par la sortie pour impuretés. Le dispositif collecteur de poussière de type cyclone comprend également un réceptacle à impuretés pour recueillir les impuretés qui ont été

évacuées par la sortie pour impuretés, un élément de base articulé au réceptacle à impuretés, et un couvercle pour fermer le haut du corps de cyclone. Le couvercle comporte un conduit d'entrée d'air par lequel l'air et les impuretés aspirées par la brosse d'aspiration entrent dans le corps de cyclone, un conduit de sortie d'air par lequel l'air est évacué du corps de cyclone, et une grille de séparation d'impuretés. La grille s'étend vers le bas à partir du conduit de sortie d'air et dans le corps de cyclone, et elle comporte une pluralité de trous fins.

Les buts ci-dessus et d'autres caractéristiques et avantages de la présente invention apparaîtront plus clairement à la lecture de la description détaillée suivante faite en relation avec les dessins joints, dans lesquels :

la figure 1 est une vue en perspective illustrant un aspirateur comportant un dispositif collecteur de poussière de type cyclone selon la présente invention ;

la figure 2 est une vue éclatée en perspective illustrant le dispositif collecteur de poussière de la figure 1 ;

la figure 3 est une vue en coupe illustrant le dispositif collecteur de poussière de la Fig. 2 à l'état assemblé ; et

la figure 4 est une vue en section prise sensiblement selon la ligne I-I de la figure 2.

La présente invention d'un aspirateur comportant un dispositif collecteur de poussière de type cyclone va être décrite plus en détail ci-dessous, en se référant aux dessins joints.

La figure 1 est une vue en perspective représentant schématiquement un aspirateur comportant le dispositif collecteur de poussière de type cyclone selon la présente invention.

Considérant la figure 1, l'aspirateur comprend un corps 1, une brosse d'aspiration 5 qui est connectée au corps 1 par l'intermédiaire d'un tube de connexion 2 et d'un tuyau de connexion 3, et un dispositif collecteur de poussière de type cyclone 7.

Le corps d'aspirateur 1 comprend une chambre collectrice de poussière 1a, dans laquelle est logé le dispositif collecteur de poussière de type cyclone 7, et une chambre de motorisation (non montrée), dans laquelle est logé un moteur (non montré). La chambre de motorisation et la chambre collectrice de poussière 1a communiquent l'une avec l'autre. Le moteur génère une importante force d'aspiration, laquelle permet à la brosse d'aspiration 5 d'aspirer les impuretés sur la surface à nettoyer. La brosse d'aspiration 5 est connectée par l'intermédiaire du tube de connexion 2 et du tuyau de connexion 3 au dispositif collecteur de poussière qui se trouve dans la chambre collectrice de poussière 1a. Ici, un couvercle 8 est fixé au corps d'aspirateur 1 pour recouvrir le dispositif collecteur de poussière de type cyclone 7 lorsque celui-ci est dans la chambre collectrice de poussière 1a. Le couvercle 8 s'ouvre et se ferme.

Le dispositif collecteur de poussière de type cyclone 7 recueille les impuretés après les avoir séparées par force centrifuge de l'air qui est aspiré dans l'aspirateur par la brosse d'aspiration 5. Le

dispositif collecteur de poussière de type cyclone 7 est logé de façon amovible dans la chambre collectrice de poussière 1a. Comme représenté aux figures 2, 3 et 4, le dispositif collecteur de poussière de type cyclone 7 comprend un corps de cyclone 11, un réceptacle à impuretés 13, un élément de base 15, et un couvercle 17.

Le corps de cyclone 11 a une forme creuse sensiblement cylindrique avec un diamètre interne prédéterminé. Le corps de cyclone 11 comporte un sommet 11a ouvert et un fond fermé 11b. Une poignée 12 est formée sur la surface externe du corps de cyclone 11, et une sortie pour impuretés 11c d'une taille prédéterminée est formée dans la partie inférieure du corps de cyclone 11. Ainsi, les impuretés dans l'air qui est aspiré dans la partie supérieure du corps de cyclone 11 sont séparées de l'air par centrifugation et évacuées dans le réceptacle à impuretés 13 par la sortie pour impuretés 11c.

Le réceptacle à impuretés 13 fait fonction de lieu de récupération pour les impuretés qui ont été évacuées par la sortie pour impuretés 11c. Ce réceptacle à impuretés 13 couvre la base 11b du corps de cyclone 11, et il entoure partiellement le pourtour externe du corps de cyclone 11. Le réceptacle à impuretés 13, qui communique avec le corps de cyclone 11 uniquement par la sortie pour impuretés 11c, a un fond ouvert 13a.

L'élément de base 15 est monté sur l'extrémité inférieure du réceptacle à impuretés 13 pour ouvrir et fermer le fond 13a de celui-ci, et vider les impuretés

qui y ont été recueillies. L'élément de base 15 est écarté du fond 11b du corps de cyclone 11 d'une distance prédéterminée. Il est ainsi défini un espace prédéterminé entre l'élément de base 15 et le corps de cyclone 11. Une extrémité de l'élément de base 15 est montée de façon pivotante sur la partie inférieure du réceptacle à impuretés 13, par l'intermédiaire d'un axe d'articulation 14. Par conséquent, pour retirer les impuretés recueillies dans le réceptacle à impuretés 13, on fait pivoter l'élément de base 15 autour de l'axe de pivotement 14 afin d'ouvrir le fond 13a du réceptacle à impuretés 13 pour vider celui-ci. A cet effet, un moyen de verrouillage 18 est également prévu pour verrouiller et libérer l'extrémité non articulée de l'élément de base 15 afin de permettre à l'élément de base 15 de recouvrir ou découvrir sélectivement le fond 13a du réceptacle à impuretés 13.

Le moyen de verrouillage 18 comprend un élément pivotant 21 pourvu d'un crochet 21a pour prendre et retenir l'extrémité non articulée de l'élément de base 15, et un ressort 23. L'élément pivotant 21 est monté de façon pivotante sur la paroi externe du réceptacle à impuretés 13, et il est rappelé élastiquement par le ressort 23, d'une manière telle que le crochet 21a de l'élément de pivot 21 soit positionné au niveau du fond 13a du réceptacle à impuretés 13. De plus, le ressort 23 est disposé entre le réceptacle à impuretés 13 et l'élément pivotant 21 pour solliciter l'autre extrémité de celui-ci. Ainsi, comme indiqué par les deux lignes en traits interrompus à la Fig. 3, l'élément de base 15 est verrouillé dans le crochet 21a de manière à

recouvrir le fond 13a du réceptacle à impuretés 13. Autrement dit, l'élément de base 15 est verrouillé avec le crochet 21a et, par conséquent, il ferme le fond 13a du réceptacle à impuretés 13.

Le couvercle 17 est connecté au sommet 11a du corps de cyclone 11 et le recouvre. Le couvercle 17 comprend un conduit d'entrée d'air 17a, un conduit de sortie d'air 17b, et une grille de séparation d'impuretés 17c, tous trois communiquant avec le corps de cyclone 11. Le conduit d'entrée d'air 17a guide l'air qui est amené par la brosse d'aspiration 5, le tube de connexion 2 et le tuyau de connexion 3 dans le corps de cyclone 11. Le conduit d'entrée d'air 17a s'étend vers l'intérieur du corps de cyclone 11 pour générer un vortex à partir de l'air qui a été amené dans le corps de cyclone 11. Après que l'air et les impuretés ont été aspirés dans le conduit d'entrée d'air 17a, et que les impuretés ont été séparées de l'air par centrifugation, l'air propre est évacué par le conduit de sortie d'air 17b. Le conduit de sortie d'air 17b est formé dans la partie centrale du couvercle 17. La grille de séparation d'impuretés 17c s'étend vers le bas à partir du conduit de sortie d'air 17b jusqu'à une profondeur prédéterminée dans le corps de cyclone 11. La grille de séparation d'impuretés 17c présente une pluralité de trous fins pour empêcher le passage de poussière ou d'impuretés.

D'autre part, il est préférable qu'une unité filtrante 19 soit également prévue pour filtrer l'air qui sort par le conduit de sortie d'air 17b en direction de la chambre de motorisation 1b. L'unité

filtrante 19 comprend un filtre à air 31, un boîtier de filtre 33, et un conduit d'air 35. Le boîtier de filtre 33, qui loge le filtre à air 31, comporte une entrée d'air 33a et une sortie d'air 33b. L'air issu du conduit de sortie d'air 17b du corps de cyclone 11 passe dans l'entrée d'air 33a qui est formée dans la partie supérieure du boîtier de filtre 33. Le filtre à air 31 est inséré de façon amovible dans le boîtier de filtre 33, par le passage d'entrée d'air 33a. Le passage de sortie d'air 33b est formé sur le côté du boîtier de filtre 33 qui fait face à la chambre de motorisation 1b lorsque le boîtier de filtre 33 est monté dans la chambre collectrice de poussière 1a. Le conduit d'air 35 connecte le conduit de sortie d'air 17b avec l'entrée d'air 33a du boîtier de filtre 33. Comme représenté à la Fig. 1, le conduit d'air 35 est formé sur la porte 8. Par conséquent, en fermant ou en ouvrant la porte 8, le conduit d'air 35 peut respectivement être connecté au conduit de sortie d'air 17b et à l'entrée d'air 33a, ou en être déconnecté.

Le fonctionnement du dispositif collecteur de poussière de type cyclone selon la présente invention va maintenant être décrit.

D'abord, lorsque l'aspirateur est en marche, le moteur génère une importante force d'aspiration au niveau de la brosse d'aspiration 5. Cette force d'aspiration attire de l'air et les impuretés présentes sur la surface à nettoyer dans la brosse d'aspiration 5, le tube de connexion 2 et le tuyau de connexion 3, et dans le corps de cyclone 11. L'air est amené obliquement dans le corps de cyclone 11 par le conduit

d'entrée d'air 17a, et il descend dans le corps de cyclone 11 tout en créant un vortex. En conséquence, les impuretés sont séparées de l'air par la force centrifuge du vortex, elles descendent le long de l'intérieur du corps de cyclone 11, et elles sont évacuées dans le réceptacle à impuretés 13 par la sortie pour impuretés 11c. Dès lors, comme les impuretés évacuées dans le réceptacle à impuretés 13 s'accumulent sous la partie inférieure du corps de cyclone 11, le reflux des impuretés dans le corps de cyclone 11 par la sortie pour impuretés 11c qui est formée dans la partie supérieure du réceptacle à impuretés est empêché.

Dans le même temps, après que les impuretés ont été séparées de l'air, l'air propre est évacué par les trous fins de la grille 17c et le conduit de sortie d'air 17b, et il est amené dans le boîtier de filtre 33 par le conduit d'air 35. L'air est alors filtré au passage à travers le filtre à air 31. Par conséquent, même les impuretés de petite taille, qui n'ont pu être séparées par centrifugation, sont retenues par le filtre à air 31. L'air filtré est ensuite rejeté dans l'environnement après passage dans la chambre de motorisation 1b.

Lorsque le réceptacle à impuretés 13 est plein d'impuretés, l'utilisateur ouvre la porte 8 sur le corps d'aspirateur 1. Le conduit d'air 35, qui est formé dans la porte 8, se sépare d'avec le conduit de sortie d'air 17b du couvercle 17 et le boîtier de filtre 33. Dans cette situation de déconnexion, l'utilisateur accède au dispositif de type cyclone 7

dans la chambre collectrice de poussière 1a. En appuyant sur l'extrémité du levier du pivot 21, il libère le crochet 21a de l'extrémité de l'élément de base 15 et, comme montré à la Fig. 3, l'élément de base 15 est alors libre de s'ouvrir, en découvrant le fond 13a du réceptacle à impuretés 13. Le fond 13a du réceptacle à impuretés 13 étant ouvert, les impuretés qui ont été accumulées dans le réceptacle à impuretés 13 peuvent être retirées. Après vidage des impuretés, le réceptacle à impuretés 13 peut être fermé en repoussant contre son fond 13a l'élément de base 15. L'élément de base 15 est maintenu en place en verrouillant à nouveau le crochet 21a.

Le filtre à air 31 peut également être remplacé en retirant le vieux filtre à air et en insérant un nouveau filtre par l'entrée d'air 33a ouverte du boîtier de filtre 33.

Bien que l'exemple de réalisation préféré de la présente invention soit représenté sous la forme d'un aspirateur de type cuve (voir la figure 1), on comprendra aisément que le dispositif collecteur de poussière de type cyclone selon la présente invention peut être employé dans d'autres types d'aspirateurs, tels des aspirateurs de type balai ou similaires.

Comme décrit ci-dessus, dans le dispositif collecteur de poussière de type cyclone selon la présente invention, du fait que le réceptacle à impuretés se trouve sous la partie inférieure du corps de cyclone 11, les impuretés qui ont été recueillies dans le réceptacle à impuretés 13 ne peuvent retourner dans le corps de cyclone 11.

De plus, la présente invention améliore l'efficacité de nettoyage de l'aspirateur de par un processus de séparation des impuretés en deux étapes. Les impuretés sont d'abord séparées de l'air par centrifugation dans le corps de cyclone 11. Après cela, les impuretés les plus petites, qui n'ont pas été séparées lors du processus de centrifugation, sont retenues par l'unité filtrante 19.

REVENDICATIONS

1. Aspirateur, caractérisé en ce qu'il comprend :

un corps d'aspirateur (1) comportant une chambre de motorisation (1b) et une chambre collectrice de poussière (1a) en communication avec la chambre de motorisation (1b) ;

une brosse d'aspiration (5) par laquelle de l'air et des impuretés sont aspirées ; et

un dispositif collecteur de poussière de type cyclone (7) monté dans la chambre collectrice de poussière (1a) pour séparer les impuretés de l'air par centrifugation, le dispositif collecteur de poussière de type cyclone (7) comprenant :

un corps de cyclone cylindrique creux (11) ayant son sommet (11a) ouvert, sa base (11b) fermée et une sortie (11c) pour les impuretés, le sommet ouvert (11a) admettant de l'air et des impuretés dans le corps de cyclone (11), le corps de cyclone (11) séparant les impuretés de l'air par centrifugation, la sortie pour impuretés (11c) permettant le passage des impuretés qui ont été séparées de l'air par centrifugation ;

un réceptacle à impuretés (13) couvrant la base et une partie de la surface externe du corps de cyclone (11), le réceptacle à impuretés (13) recueillant les impuretés qui ont été évacuées par la sortie pour impuretés (11c) ;

un élément de base (15) connecté de façon pivotante au fond (13a) du réceptacle à impuretés (13) ; et

un couvercle (17) pour recouvrir le sommet (11a) du corps de cyclone (11), le couvercle (17) comportant un conduit d'entrée d'air (17a) par lequel l'air et les impuretés aspirées par la brosse d'aspiration (5) entrent dans le corps de cyclone (11), un conduit de sortie d'air (17b) par lequel l'air est évacué du corps de cyclone (11), et une grille de séparation d'impuretés (17c), la grille (17c) s'étendant vers le bas à partir du conduit de sortie d'air (17b) et comportant une pluralité de trous fins.

2. Aspirateur selon la revendication 1, caractérisé en ce qu'il comprend des moyens filtrants (19) pour filtrer l'air qui est évacué par la sortie d'air (17b).

3. Aspirateur selon la revendication 2, caractérisé en ce que les moyens filtrants (19) comprennent :

un filtre à air (31) ;

un boîtier de filtre (33), le boîtier de filtre (33) comportant une entrée d'air (33a) et une sortie d'air (33b), la sortie d'air (33b) communiquant avec la chambre de motorisation (1b), le boîtier de filtre (33) étant monté dans la chambre collectrice de poussière (1a) ; et

un conduit d'air (35) pour connecter le conduit de sortie d'air (17b) à l'entrée d'air (33a) du boîtier de filtre (33).

4. Aspirateur selon la revendication 3, caractérisé en ce que le conduit d'air (35) est formé dans une porte (8) de l'aspirateur, la porte (8) étant articulée sur le corps d'aspirateur (1) pour ouvrir et

fermer la chambre collectrice de poussière (1a), le conduit d'air (35) étant déconnecté d'avec le conduit de sortie d'air (17b) et l'entrée d'air (33a), ou connecté avec eux, selon que la porte (8) est ouverte ou fermée, respectivement.

5. Aspirateur selon l'une des revendications 1 à 4, caractérisé en ce qu'une extrémité de l'élément de base (15) est articulée sur une extrémité inférieure du réceptacle à impuretés (13), tandis que l'autre extrémité de l'élément de base (15) est connectée au réceptacle à impuretés (13) par un moyen de verrouillage (18), de telle sorte que le fond du réceptacle à impuretés (13) soit fermé ou ouvert en verrouillant ou déverrouillant l'élément de base (15), respectivement.

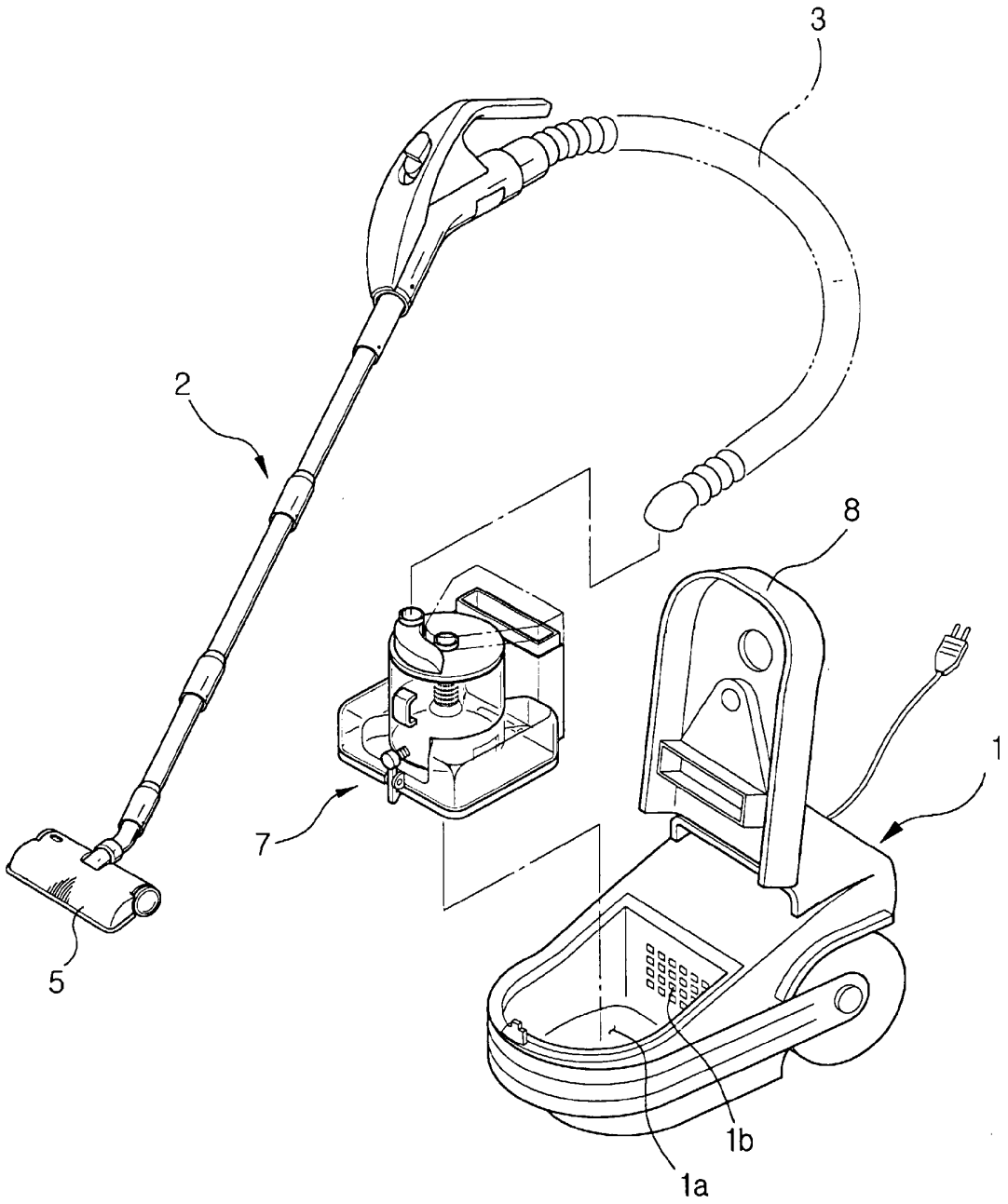
6. Aspirateur selon la revendication 5, caractérisé en ce que le moyen de verrouillage (18) comprend :

un élément pivotant (21) monté pivotant sur une paroi externe du réceptacle à impuretés (13), l'élément pivotant (21) comportant un crochet (21a) formé en une de ses extrémités pour empêcher que tombe librement l'extrémité de l'élément de base (15) ; et

un ressort (23) pour rappeler l'élément pivotant (21) d'une manière telle que le crochet (21a) retienne l'élément de base (15).

2812531

FIG. 1



2812531

FIG.2

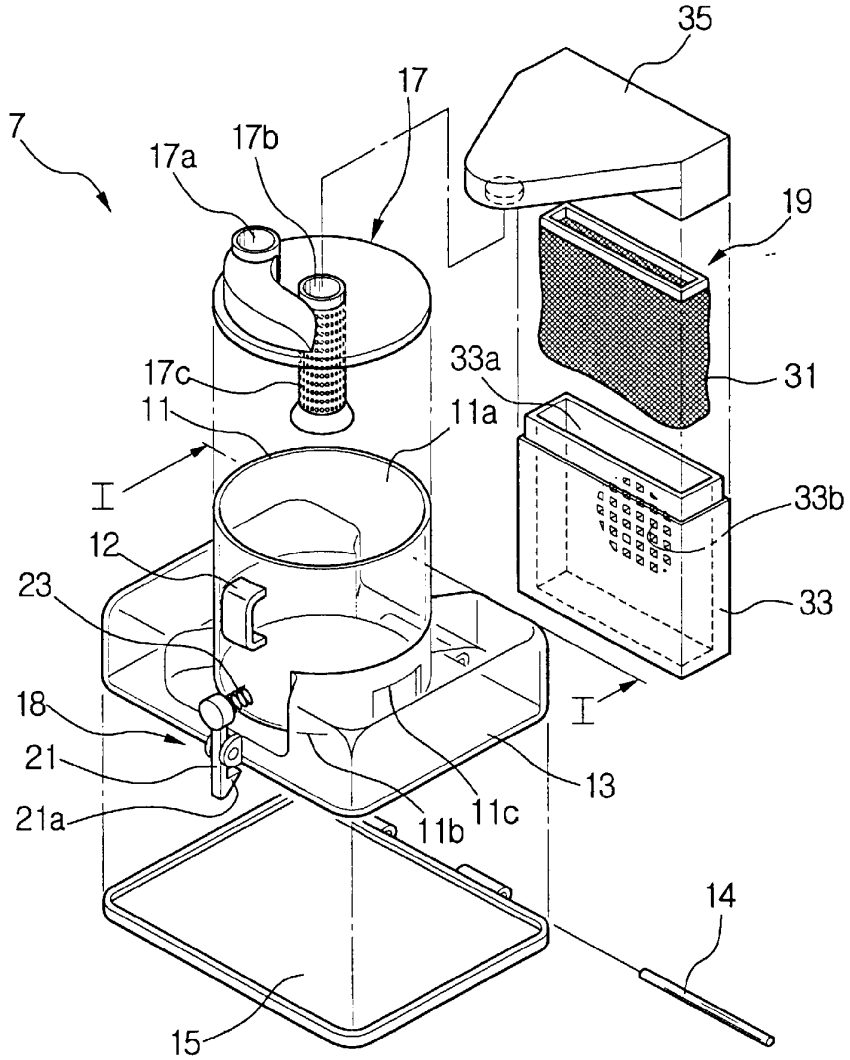


FIG.3

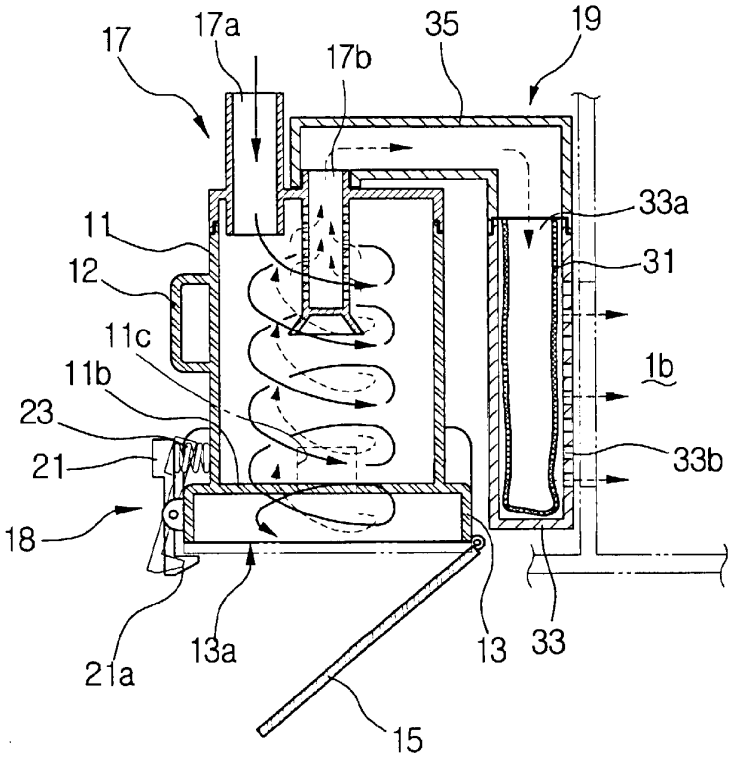
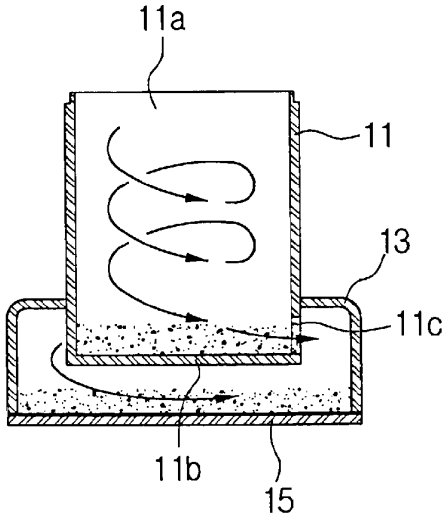

17
17a
17b
35
19
33a
31
1b
33b
11
12
11c
11b
23
21
18
21a
13a
13
33
15

FIG.4


11a
11
13
11c
11b
15

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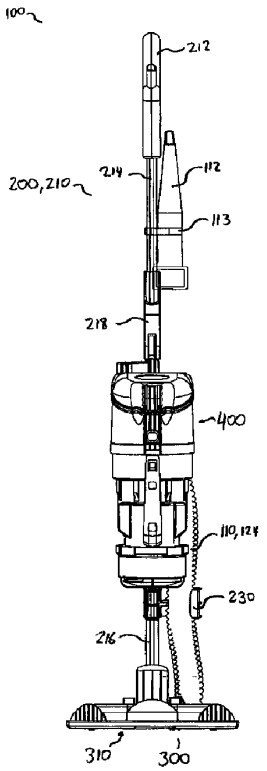
(54) Titre : APPAREIL DE NETTOYAGE DES SURFACES
(54) Title: SURFACE CLEANING APPARATUS



(57) Abrégé/Abstract:
A surface cleaning apparatus comprises a floor cleaning unit and an upright section comprising a handle drivingly connected to the surface cleaning head. The surface cleaning apparatus also comprises a cyclone mounted on the upright section and positioned in the air flow passage. The cyclone is inverted and/or has an external dirt collection chamber.

ABSTRACT

A surface cleaning apparatus comprises a floor cleaning unit and an upright section comprising a handle drivingly connected to the surface cleaning head. The surface cleaning apparatus also comprises a cyclone mounted on the upright section and positioned in the air flow passage. The cyclone is inverted and/or has an external dirt collection chamber.

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TITLE: SURFACE CLEANING APPARATUS

FIELD

The specification relates to the constructions of a surface cleaning apparatus. In a preferred embodiment, the specification relates to a cyclone unit that comprises a cyclone and a dirt chamber that is external the cyclone. In another embodiment, the specification relates to a first stage cyclone for an upright or stick vacuum cleaner wherein the first stage cyclone is inverted.

INTRODUCTION

The following is not an admission that anything discussed below is prior art or part of the common general knowledge of persons skilled in the art.

Cyclonic separators, including those used in vacuum cleaners are known in the art. Typically, a cyclonic separator has an inlet for fluid (air, liquid or and air and liquid mix) to be treated and an outlet for treated fluid. Dirt may be collected either in the cyclone chamber itself (e.g. in the bottom) or in a collection chamber in fluid communication with the cyclone separator. Various such constructions are known in the art.

Cyclonic hand vacuum cleaners have also been developed. These vacuum cleaners have typically used similar operating principles as full size cyclonic vacuum cleaners. See for example PCT publication WO 2008/009890; PCT publication WO 2008/009888; PCT publication WO 2008/009883; and United States patent 7,370,387.

SUMMARY

The following introduction is provided to introduce the reader to the more detailed discussion to follow. The introduction is not intended to limit or define the claims.

According to one broad aspect, a surface cleaning apparatus is provided that comprising an inverted first stage cyclone mounted to an upright

section of an upright surface cleaning apparatus, and preferably of a stick vacuum cleaner. When the surface cleaning apparatus is in use, dirt is entrained in an air stream that is drawn into the cyclone, separated by the cyclonic action of the cyclone and then deposited in a dirt chamber. Preferably the dirt chamber is external cyclone so that the accumulation of dirt within the dirt collection chamber may not affect the performance of the cyclone. In a preferred embodiment, the cyclone may have a cylindrical housing or perimeter wall with an upward facing dirt outlet that is surrounded by, e.g., a generally annular shaped dirt collection chamber. In this embodiment, dirt that is separated from the air stream may be ejected from the dirt outlet of the cyclone and fall into, and collect within, the surrounding dirt collection chamber.

According to another broad aspect, a surface cleaning apparatus is provided that comprising a cyclonic unit mounted to an upright section of an upright surface cleaning apparatus, and preferably of a stick vacuum cleaner. When the surface cleaning apparatus is in use, dirt is entrained in an air stream that is drawn into the cyclone, separated by the cyclonic action of the cyclone and then deposited in a dirt chamber. The cyclonic unit comprises a cyclone and a dirt chamber that is external cyclone. In a preferred embodiment, the cyclone may have a cylindrical housing or perimeter wall with a dirt outlet that is surrounded by, e.g., a generally annular shaped dirt collection chamber. In this embodiment, dirt that is separated from the air stream may be ejected from the dirt outlet of the cyclone and pass into, and collect within, the surrounding dirt collection chamber.

In one embodiment, a surface cleaning apparatus may comprise a floor cleaning unit comprising a surface cleaning head. The surface cleaning head may have a dirty air inlet, a cleaning head air outlet and an upright section comprising a handle drivingly connected to the surface cleaning head. The surface cleaning apparatus may also comprise a cyclone unit mounted on the upright section and positioned in the air flow passage. The cyclone unit may

comprise a cyclone having an air inlet and an air outlet, and a dirt collection chamber exterior to the cyclone. The surface cleaning apparatus may also comprise a suction motor positioned in the air flow path.

In one embodiment, a surface cleaning apparatus may comprise a floor cleaning unit comprising a surface cleaning head having a dirty air inlet, a cleaning head air outlet and an upright section comprising a handle drivingly connected to the surface cleaning head; A first stage cyclone unit may be mounted on the upright section and positioned in the air flow passage. The cyclone unit may comprise an inverted cyclone having an air inlet and an air outlet, and a dirt outlet at an upper end with a suction motor positioned in the air flow path.

In some examples, the surface cleaning apparatus may comprise a surface cleaning unit removably mounted to the handle wherein the surface cleaning unit comprises the cyclone unit and the suction motor.

In some examples, the cyclone comprises a dirt outlet provided at an upper end of the cyclone.

In some examples, the cyclone and the dirt collection chamber are concurrently openable.

In some examples, the cyclone is positioned interior of the dirt collection chamber.

In some examples, the upright section has an absence of a housing defining a recess for receiving the portable surface cleaning apparatus.

In some examples, the upright section may comprise at least one support rod.

In some examples, the dirt outlet may comprise an open end of the cyclone and the apparatus further comprises a plate facing the dirt outlet.

In some examples, the plate has a diameter about the same as a diameter of the dirt outlet.

In some examples, the plate is mounted to an upper end of the cyclone unit.

In some examples, the air outlet of the cyclone comprises a vortex finder and a shroud is provided in the air flow path from a cyclone chamber in the cyclone to the air outlet of the cyclone.

In some examples, the surface cleaning may comprise a plurality of pre-motor filters.

In some examples, the pre-motor filters comprise an upstream filter and a downstream filter, the downstream filter having smaller pores then the upstream filter.

It will be appreciated that an embodiment may contain one or more of features set out in the examples.

DRAWINGS

In the detailed description, reference will be made to the following drawings, in which:

Figure 1 is a front elevation view of an example of a vacuum cleaner;

Figure 2 is a back perspective view of the vacuum cleaner of Figure 1 with a portable surface cleaning apparatus mounted to a support structure;

Figure 3a is a back perspective view of the vacuum cleaner of Figure 1 with the portable surface cleaning apparatus removed from the support structure and in a position in which it may be carried by hand;

Figure 3b is a side elevation view of the portable surface cleaning apparatus of Figure 3a wherein the portable surface cleaning apparatus has

been removed from the support structure and is in a position in which it may be carried by hand with flexible hose detached from the surface cleaning head;

Figure 4 is a partially exploded side perspective view of the vacuum cleaner of Figure 1 with the portable surface cleaning apparatus removed from air flow communication with the floor cleaning unit;

Figure 5 is a front isometric view of the vacuum cleaner of Figure 1 with the portable surface cleaning apparatus removed;

Figure 6 is side elevation view of a hand vacuum cleaner;

Figure 7 is a front elevation view of the hand vacuum cleaner of Figure 6;

Figure 8 is a bottom isometric view the hand vacuum cleaner of Figure 6;

Figure 9 is a bottom isometric view of the hand vacuum cleaner and an attachment member;

Figure 10 is a partially exploded bottom isometric view of the hand vacuum cleaner and an attachment member of Figure 9;

Figure 11 is a side isometric view of the attachment member of Figure 9;

Figure 12 is a front elevation view of the attachment member of Figure 11;

Figure 13 is a side isometric view of the attachment member of Figure 11;

Figure 14 is a partially exploded isometric view of the attachment member of Figure 11;

Figure 15 is a front isometric view of an alternate example of a vacuum cleaner with a portable surface cleaning apparatus mounted thereto;

Figure 16 is a partial rear isometric view of the vacuum cleaner of Figure 15;

Figure 17 is a rear isometric view of an alternate example of a vacuum cleaner with a portable surface cleaning apparatus mounted thereto;

Figure 18 is a partial front isometric view of the vacuum cleaner of Figure 17 with the portable surface cleaning apparatus removed;

Figure 19 is a partial top view of the surface cleaning head of the vacuum cleaner of Figure 17;

Figure 20 is a side elevation view of a portable surface cleaning apparatus having a partially transparent dirt chamber;

Figure 21 is an isometric view of the portable surface cleaning apparatus of Figure 20 with the dirt chamber door removed; and,

Figure 22 is a section view of the portable surface cleaning apparatus of Figure 20.

DESCRIPTION OF VARIOUS EXAMPLES

Various apparatuses or methods will be described below to provide an example of each claimed invention. No example described below limits any claimed invention and any claimed invention may cover processes or apparatuses that are not described below. The claimed inventions are not limited to apparatuses or processes having all of the features of any one apparatus or process described below or to features common to multiple or all of the apparatuses described below. It is possible that an apparatus or process described below is not an embodiment of any claimed invention.

Figures 1-5 exemplify an upright vacuum cleaner optionally having a removably mounted portable surface cleaning apparatus, optionally a hand vacuum cleaner, wherein the portable surface cleaning apparatus preferably has

a nozzle having an open sided air flow chamber. It will be appreciated that the portable surface cleaning apparatus may be of any construction (e.g., a hand vacuum cleaner) and may use any particular air treatment member (e.g., one or more cyclones comprising one or more cyclonic cleaning stages and one or more filters). It will also be appreciated that the upright structure to which the portable surface cleaning apparatus is removably attached may be of any particular design. Further, the floor cleaning unit may alternately, or in addition, use an open sided nozzle and may selectively receive an auxiliary cleaning tool.

Referring to Figures 1 to 5, a first example of a surface cleaning apparatus 100 is shown. The surface cleaning apparatus 100 is a vacuum cleaner that comprises a floor cleaning unit 200 comprising a surface cleaning head 300 having a support structure 210 pivotally mounted thereto and a portable surface cleaning apparatus 400 that is removably mounted to support structure 210. Support structure 210 may also be referred to as a handle, a backbone or an upright section.

In the example shown, the handle 210 has an upper portion 214 and a lower portion 216 that are optionally pivotally connected by a hinge 218. The handle 210 is attached to the surface cleaning head 300 and a user can move the surface cleaning head 300 along a surface to be cleaned by gripping and maneuvering the handle 210. Optionally, the lower portion 216 of the handle 210 can be hingedly or pivotally attached to the surface cleaning head 300, so that the lower portion 216 of the handle 210 can move relative to the surface cleaning head 300 during use. This may enable the user to move the surface cleaning head 300 beneath cabinets, furniture or other obstacles.

The upper portion 214 of the handle optionally includes a grip 212 that is shaped to be gripped by a user. In the example shown, the grip 212 is at the top, or upper end of the upper portion 214 of the handle 210 and is formed in a closed loop-type shape having surfaces that are rounded to increase user

comfort. In other examples, the grip 212 may be of a different configuration or may be located at a different position on the upper portion 214 of the handle 210.

In addition to the grip 212, the upper portion 214 of the handle 210 optionally includes a bracket 113 that supports an auxiliary, or accessory or supplemental cleaning tool 112. In the example shown, the bracket 113 is configured to hold a single auxiliary cleaning tool 112, but in other examples the bracket 113 may be configured to hold more than one auxiliary cleaning tool 112. Also, while shown attached to the upper portion 214, it is understood that the bracket 113 may be attached to other locations on the surface cleaning apparatus, including the lower portion 216, the surface cleaning head 300 and/or the hand vacuum 400.

In the example shown, the upper and lower portions 214, 216 have a generally cylindrical or tube-like shape. However, in other examples, the upper and lower portions 214, 216 may any other type of thin support members having suitable cross-sectional shape including square, rectangular or polygonal. In addition, the upper and lower portions 214, 216 may be solid or hollow and may be formed from any suitable material, including plastic and metal. In other embodiments, it will be appreciated that handle may be a single unit, e.g., a support rod such that upper and lower portions 214, 216 are part of the same element. Alternately, upright section 210 may comprise a frame for removably receiving a portable surface cleaning apparatus.

The upper and lower portions 214, 216 of the handle 210 are optionally pivotally joined by hinge 218. When the hinge 218 is in a first position, as shown in Figures 1, 2, 4 and 5 the upper and lower portions 214, 216 of the handle 210 are generally aligned with each other. The hinge 218 is retained in this first position by a biasing or locking means so that first portion 214 of the handle 210 remains in a generally vertical aligned with lower portion 216 when not in use and so that movements of the first portion 214 of the handle 210 can be translated to the second portion 216. In use, the hinge 218 can be unlocked,

or released from the first position and can move into a second position, wherein the grip 212 is preferably rotated forwardly.

In the example shown, the grip 212 comprises a hinge release 213 that can be activated by a user during use of vacuum cleaner 100 to unlock the hinge 218. When a user activates the hinge release 213, the retaining or locking means used to secure the hinge 218 in the first position is disengaged, allowing the hinge 218 to rotate or pivot, as shown in Figure 3a. As the hinge 218 rotates, the first portion 214 of the handle 210 can be moved into a plurality of angular positions relative to the second portion 216 handle 210. Optionally, the hinge 218 may rotate between, and lock into, a given number of set or indexed angular positions. Alternatively, the rotation of the hinge 218 may be continuously variable, after being initially unlocked, allowing for the first portion 214 to be moved into an indefinite number of angular positions relative to the second portion 216 (e.g., freely rotatable).

In the example of the vacuum cleaner 100 shown, the lower portion 214 of the handle 210 extends from the hinge 218 to the surface cleaning head 300 and optionally comprises the portable surface cleaning apparatus mount 220 for receiving and supporting the hand vacuum 400. The lower portion 216 also optionally comprises a hose guide 230 for keeping the flexible hose 124 in close proximity to the backbone 200. When the portable surface cleaning apparatus 400 is detached or removed from the backbone 200 the flexible hose 124 may be removed from the hose guide 230, as shown in Figure 3a.

The surface cleaning head 300 serves as a base portion of the vacuum cleaner 100 and is preferably in rolling contact with the surface to be cleaned. When the vacuum cleaner is 100 in an upright position (as exemplified in Figures 1, 2, 4 and 5) the surface cleaning head 300 is supported by optional main or rear wheels 320 and/or optional front wheels (not shown). However, when the vacuum cleaner 100 is moved into an angled position during use (as exemplified in Figure 3a) additional optional support wheel 321 that is provided

on upright section 210 may also roll across the surface to be cleaned. In other examples of the vacuum cleaner 100 the surface cleaning head 300 may include a greater or fewer number of wheels.

The surface cleaning head 300 also comprises a dirty air inlet 310 that is connected in fluid communication with a dirty air outlet 312 by one or more dirty air conduits (not shown). Preferably, the dirty air conduit is an air flow chamber wherein at least a portion of the lower side is open.

If the upright section includes a suction motor and/or an air treatment unit, then the dirty air outlet 312 may, in turn, be coupled, optionally removably coupled, to the upstream end of the conduit, preferably a flexible hose 124, that extends from the dirty air outlet 312 of the surface cleaning head 300 to the upright section, such as the attachment member air inlet 126. The fluid pathway may continue through the attachment member passageway 128, which terminates in attachment portion air outlet 127, and through attachment portion air outlet 127 which mates with the opening 438 of the portable cleaning apparatus 400. The connection between the attachment portion 120 and the portable cleaning apparatus 400 is discussed in greater detail below.

Mount 220 is preferably configured to removably receive a portion of the portable surface cleaning apparatus and/or an attachment member removably mounted to the portable surface cleaning apparatus. The mount is preferably configured to retain portable surface cleaning apparatus therein under the influence of gravity. Accordingly, a mechanical lock need not be used. In particular, a user may lift the portable surface cleaning apparatus off of upright section 210 without having to press a button or otherwise release a mechanical lock.

As exemplified in Figures 1-5 the mount 220 may be generally U-shaped and may be sized to receive collar 140 or other mounting portion of the attachment member 120. The inner surface of the mount 220 comprises a

protrusion 222 that extends outward from the inner surface of the mount 220 and removably seats within the generally U-shaped channel 144 of the collar 140. It will be appreciated that mount 220 may comprise more than one member, as exemplified in Figures 14-15.

The mount 220 may be located in a variety of locations along the length of the second portion 216. Preferably, the mount 220 is positioned at approximately the waist height of the intended user (e.g., 2.5 – 3.5 feet above the floor) so that the user can attached or detach the hand vacuum 400 from the backbone 200 without bending over. This may decrease the stress and strain experienced by the user when the user removes the hand vacuum 400 from the backbone 200.

When attached to the portable surface cleaning apparatus 400 and seated in the mount 220 (as shown in Figures 1 and 2), the attachment member 120 transfers all or a portion of the load (i.e. the weight) of the hand vacuum 400 to the mount 220. Another portion of the load of the hand vacuum 400 may be supported by an additional mounting bracket, such as mount bracket 224, which receives and supports optional rear wheel 480 of the portable surface cleaning apparatus 400. The surface of the mount bracket 224 may be complimentary to the curved shape of the optional rear wheel 480 so that the optional rear wheel 480 can at least partially nest within mount bracket 224. In addition to supporting the weight of the portable surface cleaning apparatus 400, the attachment portion 120 also preferably serves as a fluid conduit establishing a fluid flow connection between the hand vacuum 400 and the airflow conduit 110, which is preferably a flexible hose 124.

Loads placed on the mount 220 (via both the U-shaped opening and/or the mount bracket 224) are in turn transferred via the lower portion 216 of the handle 210 to the surface cleaning head 300 and ultimately to the floor or other type of surface being cleaned. The mount 220 may be made from any

material that can support the weight of the hand vacuum 400, including plastic and metal.

In the example of the vacuum cleaner 100 shown, the optional rear wheel 480 of hand vacuum 400 and the attachment member 120 are each preferably freely received by the mount 220 and held in place by gravity. The protrusion 222 that seats within the channel 144 of the attachment member 120 also provides a degree of lateral support, restraining the movement of the attachment member 120 (and therefore the hand vacuum 400) when the handle 210 is moved from a vertical position to an angled position when in use. Further protrusion 222 may comprise a cam surface to assist in guiding protrusion 222 into channel 144 as the portable surface cleaning apparatus is lowered onto mount 220. Accordingly, the attachment member 120 and the optional rear wheel 480 are preferably not held in place by clips, straps or any other type of mechanical fastening means.

The absence of mechanical fasters allows for simple, one-handed removal of the attachment member 120 and the hand vacuum 400 from the mount 220, without the need to unlock or undo any fasteners. One-handed detachment of the hand vacuum 400 may be advantageous as it allows a user to control and maneuver the backbone 200 with one hand while simultaneously removing the hand vacuum 400 from the mount 220 with the other hand. In use, this may allow a user to frequently attach and detach the portable surface cleaning apparatus 400 from the mount 220 in response to the user's needs, for example navigating around furniture, stairs or other obstacles on the surface to be cleaned.

While in the preferred example described above the mount 220 is free of fasteners, in another example the mount 220 may be outfitted with fastening devices for retaining the attachment member 120 and the additional wheel 480. Examples of possible fasteners include clips, snaps, and straps. Magnets may alternately or in addition be used. An advantage of using magnets

may assist in holding the portable surface cleaning apparatus on the backbone but still permit one handed removal as no lock need be released.

Optionally, instead of removing the attachment portion 120 from the mount 220, the hand vacuum 400 may be decoupled from the attachment portion while the attachment portion is positioned in mount 220, as shown in Figure 5. In an embodiment, it will be appreciated that attachment member 120 may not be removable from mount 220.

Referring to Figures 15-19, other examples of the vacuum cleaner 100 are shown. These figures exemplify features of a surface cleaning apparatus that may be used with any embodiment disclosed in herein, either individually or in any particular combination or sub-combination. The features exemplified in these figures include a surface cleaning head, a support structure for an upright or stick vacuum cleaner, and a handle mount for a surface cleaning apparatus.

In this description, an alternate structure for supporting an air treatment unit and/or a suction motor is provided. As exemplified, the second portion 216 may include a generally upside down U-shaped wishbone portion 250. The wishbone 250 is optionally provided with a hinge 218 at the centre of an upper portion of the wishbone 252, and each prong 254 of the wishbone extends downward, and connects to a rib 256. The ribs 256 are preferably substantially parallel and cooperate to define an optional mount for receiving a removable surface cleaning unit, such as the split saddle configuration that is exemplified. Optionally, the ribs 256 may be integrally formed with the prongs 254 of the wishbone portion 250, or they may be separate tubes or rods fastened to the prongs 254 of the wishbone 250, as shown.

A preferred mount comprises a pair of generally opposing saddle flanges 280 (one on each rib) that cooperate to provide a mount or a mounting location for the attachment member 120 that is connected to the hand vacuum

400. Due to the spacing of the ribs 256 and the general curvature of the hand vacuum 400, the hand vacuum 400 is preferably positioned in front of ribs 256. The attachment member 120 extends rearward of hand vacuum 400 and may be received on split saddle flanges 280 in a similar manner to mount 220. Alternately, it will be appreciated that hand vacuum 400 may be partially nest between, or be received between, the ribs 256.

As exemplified, to supportingly engage the attachment member 120, each saddle flange 280 preferably includes a projection or protrusion (not shown) that is received within the channel 142 of the collar 140 (as described in more detail with reference to Figures 11-14 below). The generally curved profile of the collar 140 and channel 142 may enable the attachment member 120 (and the associated hand vacuum 400) to generally self-level or self-register between the ribs 256 when the user initially places the attachment member 120 on the saddle flanges 280. Like the mount 220 described above, the saddle flanges 280 may include magnets or other fastening devices to secure or retain the attachment member 120. Optionally, the mount 220 or any other suitable type of mounting hardware may replace the saddle flanges 280 in this example.

The lower ends of the ribs 256 may be attached to a bracket 260 having a generally opposite configuration than the wishbone. That is, the bracket may include two, upward facing projections 262, for attaching to the ribs 256, that are connected by a cross-member 264 to provide a single downward facing coupling point 266. The spaced apart ribs provide two mounting points. Various of such structure may be used.

Preferably, lower portion 216 is rotatably mounted to the cleaning head. Accordingly, a user may rotate grip 212 clockwise or counterclockwise to assist in steering the cleaning head. Accordingly an advantage of providing a single, downward facing coupling point may be the fact that a single coupling point can be pivotally and rotationally connected to the surface cleaning head

300. Another advantage is that a narrower rear end may be utilized for the floor cleaning unit.

Accordingly, as exemplified, the bracket 260 preferably also includes a housing 268, which is preferably hollow, having a lower opening 270 that connects to the surface cleaning head 300. As exemplified, housing 268 may be pivotally mounted to surface cleaning head, preferably at about the location of rear wheels 320, such as by having a portion pivotally mounted to the axle of rear wheels 320. Optionally, the connection between the lower opening 270 and the surface cleaning head 300 can be a rotatable and pivotal connection. The hollow housing 268 may extend from the lower opening 270, through the cross-member 264 to define an upper collar 272.

Optionally, as in this example, the surface cleaning head 300 includes a hollow conduit member 330 and a second air conduit 334. As exemplified in Figures 17-19, one example of the second air conduit 334 is a second flexible hose 335. In the preferred arrangement shown, the dirty air outlet 312 of the surface cleaning head 300 is connected to the second or upstream flexible hose 335 and the second flexible hose 335 extends from the dirty air outlet 312, through the hollow conduit member 330, through the hollow housing 268 to the upper collar 272. The downstream end of the second flexible hose 335 may be fixedly connected to the upper collar 272, or it may have a fitting that seats upon a surface of the upper collar 272 preventing the second flexible hose 335 from retracting within the hollow housing 268 while leaving the downstream end of the second flexible hose 335 free to extend upward, away from the upper collar 272.

The second flexible hose 335 forms part of the continuous airflow passageway that connects the dirty air outlet 312 of the surface cleaning head 300 to the opening 438 on the hand vacuum 400. To establish the continuous airflow passageway, the downstream end of the second upstream flexible hose 335 may be connected to the upstream end of the downstream flexible hose 124.

The connection between the flexible hose 124 and the downstream end of the second flexible hose 335 is preferably a detachable connection so that the flexible hose 124 can be detached from the surface cleaning head 300 as described above.

Optionally, the second flexible hose 335 is also an extensible, or stretchable, hose that can extend when pulled on by the user. In some examples, the second flexible hose 335 is a stretch hose and may have a stretched length to non-stretched length ratio of between 2:1 – 6:1. In examples where the second flexible hose 335 is not stretchable, when a user removes the hand vacuum 400 from its mount during use, the maximum distance that the hand vacuum 400 can be separated from the backbone 200 and the surface cleaning head 300 is determined by the length of the flexible hose 124. However, in some instances, a user may wish to move the hand vacuum 400 a greater distance from the backbone 200, for example to pass the surface cleaning head 300 under a bed or other large piece of furniture. When a stretchable second flexible hose 335 is used, the downstream end of the second flexible hose 335 can unseat from the upper collar 272 and extend away from the bracket 260, whereby some of hose 335 may pass through housing 268 thereby lengthening the airflow conduit connecting the hand vacuum 400 to the surface cleaning head 300 and allowing the hand vacuum 400 to be moved further from the backbone 200 in use. Accordingly, it will be appreciated that some or all of the conduit that may be extended to provide additional length for an air flow passage may be stored on the surface cleaning head 300.

It will be appreciated that lower section 216 may be rotatably mounted on cleaning head 300 without hose 335 extending through a housing 268. Further, a housing 268 may be used even if lower section 216 is not rotatably mounted to cleaning head 300. Such a housing need not be pivotally mounted to surface cleaning head.

Preferably, the second flexible hose 335 is also resilient so that it will return to its original, un-stretched length when it is released by the user. The resilience of the second flexible hose 335 may tend to retract the second flexible hose 335 through the hollow housing 268 and the hollow conduit member 330 and may serve to re-seat the downstream end of the second flexible hose 335 on the upper collar 272. In this example, the second flexible hose 335 functions as a variable length air conduit and may reduce the need for a user to add extra hoses or conduit members to the vacuum 100 during use.

To allow for easy and repeated extension of the second flexible hose 335, the second flexible hose 335 may be sized to freely pass through both the hollow conduit member 330 of the surface cleaning head 300 and the hollow housing 268 of the bracket 260.

In the example shown in Figure 15-19, the hollow housing 268 is integral the bracket 260 and also serves as the coupling means that connects the lower portion 216 to the surface cleaning head 300. As shown, the coupling between the lower portion 216 and the surface cleaning head 300 may be the telescoping or overlapping engagement of the lower opening 270 over the surface cleaning head 300 hollow conduit member 330. In other examples, the coupling or attachment between the lower portion 216 and the surface cleaning head 300 may be any type of connection including a threaded connection, clamps or tabs. The connection between the lower portion 216 and the surface cleaning head 300 may be fixed or selectively releasable. An advantage of providing a single, downward facing coupling point 266 may be the fact that a single coupling point 266 can be pivotally and rotationally connected to the surface cleaning head 300. Further, the hollow conduit member 330 may be pivotally connected to the surface cleaning head 300, as exemplified in Figures 15-19, and in other examples, the hollow conduit member 330 may be fixedly connected to the surface cleaning head 300, or integrally formed therewith.

As shown, the hollow housing 268 may be integral with the bracket 260 and provide both a hollow passageway and an attachment point. However, in other examples, the hollow housing 268 may be external the bracket 260 and may be formed from a separate conduit. Similarly, the air flow conduit 110 connecting the attachment member 120 to the second flexible hose 335 may be the flexible hose 124 or any other suitable conduit, including flexible conduits, rigid conduits, conduits integral with the handle and conduits external the handle.

Optionally, the ribs 256 (or another portion of the second portion 216) may be surrounded by a housing or shell. The housing may provide structural strength to the second portion 216 or it may merely provide an improved aesthetic appearance of the vacuum 100, or both. If a housing is formed around a section of the second portion 216 (or any other section of the handle 210 or backbone 200) the mount for supporting the hand vacuum (for example the mount 220 or the saddle flanges 260) may be within a recess in the housing. Providing a recess in the housing for receiving the hand vacuum may create a more integrated or seamless visual appearance when the hand vacuum is mounted to the backbone 200; it may also improve the rigidity of the backbone 200.

As exemplified, wishbone portion 250 preferably extends forwardly and provides a mount for upper portion 214 (i.e. the handle) at a forward point of the backbone. Further, passageway 268 extends rearwardly. Accordingly, when hand vacuum 400 is mounted to the backbone, the centre of gravity of the backbone and hand vacuum 400 combined is below a plane P extending from the axle of rear wheel 320 to the upper end of upper portion 214 (as exemplified in Figure 17), thereby improving maneuverability of surface cleaning head 300. It will be appreciated that other constructions, such as that exemplified in Figures 1-5, may be used to position the centre of gravity behind the plane. In the example shown (best exemplified in Figure 5), the lower portion 216 includes an upper end, that is connected to the hinge 218 such that the upper portion 214 is

drivingly connected to the surface cleaning head 300. In this construction the lower end includes a step-back or kinked-back portion 215. The step-back portion 215 enables the mount 220 to be positioned sufficiently behind the rear wheels 320 such that the centre of gravity of the combination of the backbone 200 and the hand vacuum 400 is below the plane P. As a result of this configuration, the vacuum 100 may be more stable when rotated and maneuvered by the user, especially when upper portion 214 is rotated about hinge 218. Specifically, locating the centre of gravity of the combination of the hand vacuum 400 and the backbone 200 below the plane P may tend to reduce the over rotation of the backbone 200 or over-steer of the vacuum 100 in use, and may reduce the strain on a user's arm and wrist.

It will be appreciated that the dual hose construction (i.e. the flexible hose 124 and the second flexible hose 335 of Figure 15-19) may be used in combination with any example disclosed herein or by itself in a surface cleaning apparatus. Similarly, the positioning of a removably mounted portable surface cleaning apparatus with a low centre of gravity may be used in combination with any example disclosed herein or by itself in a surface cleaning apparatus.

Referring now to Figures 6-14, examples of the portable cleaning apparatus 400 and the attachment member 120 of the vacuum 100 are shown in more detail. It will be appreciated that any portable surface cleaning apparatus may be used. Preferably, the portable surface cleaning apparatus uses cyclonic separation. More preferably, the portable surface cleaning apparatus is a hand vacuum cleaner.

The hand vacuum 400 can be operated as the vacuum suction supply for the vacuum 100 and it can be operated as a stand alone hand vacuum cleaner, that is movable along a surface to be cleaned by gripping and maneuvering handle 402, when it is removed from, or detached from the backbone 200. The hand vacuum 400 includes an upper portion 404, a lower

portion 406, a front 408, and a rear 410. In the example shown, maneuvering handle 402 is provided at the upper portion 404. In alternate examples, maneuvering handle 402 may be provided elsewhere on the vacuum cleaner 400, for example at the rear 410.

In the example shown, the hand vacuum 400 comprises a nozzle 412 and a cyclone unit 414, which together preferably form a cleaning head portion 416 of the hand vacuum 400. In the example shown, the cleaning head portion 416 is provided at the front 408 of the hand vacuum 400.

Nozzle 412 comprises a dirty air inlet 418, through which dirty air is drawn into the portable cleaning apparatus 400, and when used as a hand vacuum cleaner the nozzle 412 directly engages a surface to be cleaned. An airflow passage extends from the dirty air inlet 418 to a clean air outlet 420 of the hand vacuum 400. In the example shown, clean air outlet 420 is at the rear 410 of the hand vacuum 400. It will be appreciated that clean air outlet may optionally be connected to a fluid conduit provided in the floor cleaning unit.

Cyclone unit 414 is provided in the airflow passage, downstream of the dirty air inlet 418. In the example shown, the cyclone unit 414 comprises one cyclone 422, and one dirt chamber 424. In alternate examples, the cyclone unit 410 may include more than one cyclone, and more than one dirt chamber. Further, the cyclones chambers may be arranged in stages, and may be provided in parallel or in sequence. Alternately, or in addition, one or more filters or other dirt separation members may be used.

In a preferred embodiment, cyclone unit 414 is the first cyclonic cleaning stage of an upright vacuum cleaner and one or more additional cyclonic stages may optionally be provided. Cyclone unit 414 preferably comprises an inverted cyclone and/or a dirt collection chamber that partially or completely surrounds a cyclone chamber.

Referring to Figures 20 and 21, an example of a cyclone unit 414 is shown in more detail. Within the cyclone unit 414, the cyclone 422 may be of any configuration and orientation. Preferably, cyclone 422 comprises a chamber wall 442, which in the example shown, is cylindrical. The cyclone chamber is located inside chamber wall 442. The cyclone 422 has an air inlet and an air outlet, which, preferably are at the same end of cyclone 422. Preferably the air inlet and the air outlet are distal to front end of the hand vacuum 400. The cyclone air inlet and cyclone air outlet may be of any configuration known in the art and the cyclone air outlet may be covered by a screen or shroud or filter as is known in the art.

The air travels in a cyclonic path in the cyclone, and dirt in the air is separated from the air. The air exits the cyclone via an outlet passage 444. As exemplified in Figure 21, a plate 474 may be provided adjacent outlet passage 444, spaced from and facing the outlet passage 444. As exemplified in Figure 22, the cyclone outlet passage 444 may comprise a vortex finder 482, upstream from and in communication with the dirt outlet 446. As exemplified, the vortex finder is a cylindrical conduit, having an inlet facing the dirt outlet 446.

In the example shown, plate 474, legs 478 and a wire mesh surrounding legs 478 form a shroud 484 that is optionally removably mounted in cyclone 422.

Preferably, the shroud 484 is positioned such that air must pass through the openings in the shroud prior to traveling to a downstream component (e.g., a further cyclonic stage or a suction motor). As exemplified, the shroud surrounds the cyclone air outlet, or outlet passage 444. The shroud 484 may serve to prevent elongate material and larger, lighter dirt from passing through dirt outlet 446. As exemplified, the shroud 484 surrounds the vortex finder 482. Legs 478 extend from plate 474, along vortex finder 482. As exemplified, the shroud 484 also comprises a ring 485 that is integral with legs 478 and surrounds vortex finder 482. The ring and legs provide a mount for plate 474. Optionally, a

screen extends from plate 474, around legs 478, to ring 485. Accordingly, the screen is positioned in the air flow path of air exiting the cyclone chamber and entering the vortex finder 482. It will be appreciated that in alternate embodiments, the shroud may be any other suitable configuration. For example, a plate need not be provided. In another example, the plate may be provided as part of the vortex finder. The shroud screen may be made of a wire mesh. Alternately, shroud 484 may be a molded plastic covering vortex finder 482 and may have a plurality of apertures therein.

Optionally, the dirt chamber may be internal or external to the cyclone chamber. Preferably, as exemplified in Figures 20-22, the dirt chamber 424 is external the outer cyclone housing 442, and the dirt that is separated from the air exits the outer cyclone housing 442 via dirt outlet 446, and enters dirt chamber 424. In the example shown, the dirt chamber 424 has an outer wall 415 that comprises a first portion 425 and a second portion 427. The second portion 427 may also be referred to as a door or outlet end wall. Together, the first and second portions 425, 427 cooperate to define a sealed dirt chamber 424. As exemplified, the first and second portions 425, 427 of the dirt chamber outer wall 415 may also form the outer housing, casing or unit wall of the cyclone unit 414, and more generally of the cleaning head portion 416 of the hand vacuum 400. In other examples, the first and second portions 425, 427 of the dirt chamber outer wall, or portions thereof, may be surrounded by a separate housing, casing or wall structure that defines the outer surface of the cyclone unit 414 and the cleaning head portion 416 of the hand vacuum 400. Also, the dirt chamber 424 may be in communication with the cyclone chamber by any means known in the art. Accordingly, one or more dirt outlets may be provided. Preferably, the dirt outlet is at the end opposed to the air inlet and, preferably, the dirt outlet is at the front end of the hand vacuum 400.

In the example shown, the dirt chamber 424 comprises two volumes. A first volume 448 is provided immediately adjacent the dirt outlet 446,

and above the top of the outer cyclone housing 442, when the hand vacuum 400 is mounted on the backbone 200. A second volume 450 is the generally annular space formed between the outer cyclone housing 442 and the first portion 425 of the dirt chamber outer wall 415.

A separation plate 454 may be provided in the dirt chamber 424, adjacent the dirt outlet 446. The separation plate 454 aids in preventing dirt in dirt chamber 424 from re-entering cyclone 422. Preferably, plate 454 is spaced from dirt outlet 446 and faces dirt outlet 446. Plate 454 may be mounted by any means to any component in cyclone unit 414. As exemplified, the separation plate is mounted on an arm, which extends from an inner surface of the front wall 458 of the hand vacuum 400.

When the vacuum 100 is used to clean a surface the dirt separated from the dirty air is collected in and retained in the dirt chamber 424. When the hand vacuum 400 is mounted on the backbone 200, gravity will urge the dirt toward the bottom the dirt chamber 424 as exemplified in Figure 20 (that is, toward the air outlet 420 and away from the second portion 427 of the dirt chamber outer wall 415). As a result of ongoing or extended use of the vacuum 100, the amount of dirt collected within dirt chamber 424 will increase. As the amount of dirt contained within the dirt chamber 424 increases, the level of dirt within the dirt chamber 424 will rise, relative to the bottom of the dirt chamber 424 as exemplified in Figure 20. Over time, the level of dirt within the dirt chamber 424 will approach an optional designated fill line F indicated on at least one side of the first portion 425 of the dirt chamber outer wall 415.

The position of the fill line F may be based on the performance characteristics of the cyclone 422 including the height of the cyclone outer surface 442 or other suitable factors. As exemplified in Figure 20, the location of the fill line F may be below the top of the cyclone outer housing 442 and the dirt outlet 446 (when the hand vacuum 400 is vertically mounted on the backbone 200). Locating the fill line F below the dirt outlet 446 may reduce the likelihood of

dirt re-entering the outer cyclone housing 442 and fouling the cyclone 422 or otherwise interfering with the operation of the hand vacuum 400. Optionally, the fill line F may be defined by the edge of the second portion 427 of the dirt chamber wall 415, instead of a line on the first portion 425.

In the example shown in Figures 20 and 21, the first portion 425 of the dirt chamber outer wall 415 is transparent (or at least substantially transparent) to allow a user to see the amount of dirt contained within the dirt chamber 424 without having to open or otherwise access the dirt chamber 424. When the hand vacuum is mounted on the backbone 200, a user looking into the dirt chamber 424 may be able to compare the height of the dirt in the dirt chamber 424 to the position of the fill line F to determine if the dirt chamber 424 is "full". Being able to see the amount of dirt in the dirt chamber 424 may enable a user to determine how much capacity remains within the dirt chamber 424, and accordingly anticipate how much additional cleaning can be completed before the dirt chamber 424 needs to be emptied. While the first portion 425 of the dirt chamber outer wall 415 is preferably transparent to allow a user to see inside the dirt chamber 424, the outer cyclone housing 442 is preferably opaque to conceal the cyclone 422 and to provide a contrasting background to allow the user to accurately determine the height of the dirt within the dirt chamber 424.

Due to the operation of the cyclone 422 and configuration of the dirt outlet 446, it may impede the operation of the vacuum 100 (and the hand vacuum 400) if the dirt outlet 446 is substantially blocked or occluded by the accumulated dirt in the dirt chamber 424. To reduce the chances of the dirt outlet 446 being blocked by dirt the fill line F may be located below the dirt outlet 446 as exemplified. The position of the fill line F may also be based on a maximum volume of the dirt chamber below the fill line F so that when the hand vacuum 400 is operated on its side, as a hand vacuum, the dirt in the dirt chamber 424 will not completely submerge the cyclone outer housing 442 and the dirt outlet 446. Optionally, the first portion 425 of the dirt chamber outer wall

415 may include a second fill line that is oriented to be read when the hand vacuum 400 is in a sideways orientation. The dirt chamber 424 may also include a plurality of additional indicator lines, such as a half-full line and a quarter-full line.

Despite the presence of the fill line F indicating the maximum intended capacity of the dirt chamber 424, a user may be tempted to continue to operate the vacuum 100 to collect additional dirt, particularly if it appears that there is additional dirt storage capacity within the dirt chamber 424 above the fill line F, for example dirt chamber volume 448. As described above, filling the dirt chamber 424 above the fill line F can impede the operation of the vacuum 100. Therefore, to deter users from over-filling the dirt chamber 424 (i.e. filling above the fill line F), the second portion 427 of the cyclone unit wall 415 is preferably opaque (or at least substantially opaque) to visually obscure portions of the dirt chamber 424 from the user, as exemplified in Figure 20. Optionally, the first portion 425 may be partially translucent and partially opaque to further conceal the interior of the dirt chamber 424.

The second portion 427 of the dirt chamber outer wall 415 abuts the first portion 425 at a joint or juncture. The position of the juncture may be such that the lowest portion of the juncture (when the hand vacuum 400 is vertically mounted on the backbone 200) is proximate the fill line F. Configuring the dirt chamber 424 in this manner may further deter the user from over-filling the dirt chamber 424 because the opaque second portion 427 may create the illusion that the dirt chamber 424 does not extend much above the fill line F.

This embodiment is particularly preferred. When a user approaches the vacuum cleaner, they may approach it from the front, as seen in Figure 1. In this orientation, the shortest portion of first portion 425 is visible. Accordingly, if second portion is an openable lip, and is made from a plastic that is less translucent then first portion 415, a user may determine to empty the dirt collection chamber prior to using the vacuum cleaner if the dirt collection appears

to be full due to dirt extending all the way up to the lowest portion of lid 427. It will be appreciated that a fill line need not be marked on the dirt collection chamber itself.

Cyclone unit 414 may be emptied by any means known in the art. For example, one of the ends of the cyclone unit 414 may be openable. The second portion 427 may be a pivotally mounted door to the first portion 425 of the cyclone unit wall 415, such that cyclone unit 414 may be opened, and dirt chamber 424 may be emptied. When second portion 427 is pivoted away from the remainder of the cyclone unit 414, separation plate 454 also preferably pivots away from the remainder of the cyclone unit 414. A securing member such as a latch 459, a screw mount or the like may be provided, which secures second portion 427 to the first portion 425 of the wall 415. In alternate examples, second portion 427 may be removable from cyclone unit wall 415 (As exemplified in Figure 21) or the opposed end of the cyclone unit 414 may be openable.

In the example shown, the nozzle 412 is positioned at the lower portion 406 of the portable cleaning apparatus 400. More preferably, as in the example shown, nozzle 412 is positioned at the bottom of the portable cleaning apparatus 400, and is preferably beneath the cyclone unit 414 when used as a hand vacuum cleaner and is between the cyclone unit 414 and the mount 220 when attached to the backbone 200. Further, as in the example shown, the nozzle 412 is preferably fixedly positioned at the lower portion 406 of the portable cleaning apparatus 400. That is, the nozzle 412 is not movable with respect to the remainder of the portable cleaning apparatus 400, and is fixed at the lower portion 106 of the portable cleaning apparatus 400. As shown in Figures 7 and 8, nozzle 412 has a width WN and, as shown in Figure 11, coupling plate 123 has a width Wp that is generally the same as width WN.

Nozzle 112 exemplifies a particular design for an open sided nozzle. Open sided nozzle 112 has an open side that faces the surface to be cleaned when the nozzle is placed against a surface to be cleaned. Accordingly,

nozzle 112 defines an air flow chamber that has an open lower side. In operation, air will flow longitudinally through the air flow chamber to an air exit. It will be appreciated that only part of the nozzle may have an open lower side. Alternately, all of the nozzle, from an air inlet end to the air outlet, may have an open lower side. It will be appreciated that various other design may be used.

Referring now to Figures 8-14, nozzle 412 comprises an upper nozzle wall 426. In the example shown, the upper nozzle wall 426 comprises a portion 419 of a wall 415 of the cyclone unit. Nozzle 412 further preferably comprises a depending wall 428 extending downwardly from the upper nozzle wall 426. The depending wall 428 is generally U-shaped. The height of the depending wall may vary. The open end of the U-shape defines an open side wall 430 of the nozzle 414, and forms the dirty air inlet 418 of the portable cleaning apparatus 400. In the example shown, the open side wall 430 is provided at the front of the nozzle 414 and forms a portion of a flow passage that is in communication with the opening 438. When in use as a hand vacuum, optional wheels 435 are in contact with a surface and the open side wall 430 sits above and is adjacent a hard surface to be cleaned. It will be appreciated that depending wall 428 may be positioned only rearward of opening 438. Alternately, or in addition, depending wall 428 may be provided adjacent the lateral sides of opening 438. The depending walls may be discrete walls or they may be joined together as exemplified. The walls may be continuous or discontinuous.

In the example shown, the lower end 432 of the depending wall 428 defines an open lower end 434 of the nozzle 414. The open lower end 434 extends to the front 408 of the hand vacuum 400, and merges with the open side 430. In use, the open lower end 434 faces a surface to be cleaned. In the example shown, a plurality of wheels 435 are mounted to the depending wall 428, and extend below the lower end 432 of the depending wall 428. Accordingly, when in use as a hand vacuum, when wheels 435 are in contact with a surface, the lower end 432 of the depending wall 428 is spaced from a

surface to be cleaned, and the space between the lower end of the depending wall 428 and the surface to be cleaned form a secondary dirty air inlet to the portable cleaning apparatus 400 when used as a hand vacuum.

The upper nozzle wall 426, depending wall 428, and open lower end 434 of the nozzle 412 define an airflow chamber 436 of the nozzle. An opening 438 is preferably provided in the upper nozzle wall 426, and is in communication with the airflow chamber 436. When in use as a hand vacuum, the wheels 435 are in contact with a surface, the opening 438 faces a surface to be cleaned, air enters the dirty air inlet 418, passes horizontally through the airflow chamber 436, and passes into the opening 438. Opening 438 is in communication with a cyclone inlet passage 439, which is in communication with a cyclone air inlet 440 of cyclone 422. In some embodiments, opening 438 need not be in upper wall 426.

Nozzle 412 and attachment member 120 are configured such that attachment member 120 may form part of the air flow conduit to opening 438 when attachment member 120 is mounted to hand vacuum 400. For example, when the portable cleaning apparatus 400 is used in combination with the backbone 200 and the surface cleaning head 300, the opening 438 in the nozzle 412 is in sealed, fluid communication with the air outlet 127 of the attachment member 120. By way of this connection, a continuous fluid pathway is established between the dirty air input 310 of the surface cleaning head 300 and the opening 438.

It will be appreciated that attachment member 120 may be removably mounted to nozzle 412 by any engagement means known in the connecting arts. Further, attachment member may be of any configuration. Attachment member may be part of, or may be connected to, an accessory cleaning tool by any means, such as a flexible hose. The flexible hose may be hose 110 if hose 110 is removably mounted to the floor cleaning unit.

As exemplified, attachment member 120 is removably engaged with nozzle 412 by the engagement of pivoting arms in slots provided on nozzle 412. Accordingly, for example, nozzle 412 may also include a slot 490 defining a recess in the depending wall 428 that is adjacent the upper nozzle wall 426. The slot 490 preferably extends continuously along the U-shaped portion of the nozzle depending wall 428 and may be bounded at each end by corners 492. The attachment member 120 includes two arms 150 each having a shoulder 154 and being pivotally connected to the coupling plate 123 using pins 156 (alternatively, the arms 150 could be resilient). Figure 14 is a partially exploded view of the attachment member 120, illustrating one example of the rotational connection between the coupling 142 and the collar 140. In the example shown, the coupling 142 comprises a cylindrical body wall that passes through an opening in the collar 140. Once the coupling 142 had been inserted into the collar 140 it is retained using fastening clip 143. The combination of the coupling plate 123 and the arms 150 may also be described as connecting portion, mounting portion or nozzle mounting portion of the attachment member 120.

In order to assemble the mount on nozzle 412, coupling plate 123 may be slid into the open end of airflow chamber 436. Accordingly, when the coupling plate 123 of the attachment portion 120 is slid into the airflow chamber 436, the arms 150 are pressed together by the nozzle 412 walls until the point when arms 150 are aligned with slot 190 (i.e. when the shoulders 154 are advanced past the corners 192). When the arms 150 are aligned with the slot 190, the attachment member 120 is "clicked-in" or locked in place when the arms 150 spread apart and the shoulders 154 of the arms 150 become lodged behind the corners 192 of slot 190. The arms 150 may be manually separated or the attachment member may include a biasing means (not shown) that biases the arms 150 apart. With the arms 150 in the spread configuration the attachment member 120 cannot be slidingly removed from the nozzle 412. When a user wishes to detach the attachment means 120 from the nozzle 412 the user may

squeeze upstanding tabs 152 together thereby allowing the shoulders 154 to slide past the corners 192. The mount may alternately be inserted by squeezing upstanding tabs 152 together so that plate 123 may be inserted in chamber 436.

When the hand vacuum 400 is coupled to the attachment member 120 the airflow chamber 436 may receive, and be partially filled with the coupling plate 123 of the attachment portion 120. The coupling plate 123 is preferably shaped to be slidingly received within the airflow chamber 436.

Insertion of the coupling plate 123 into the airflow chamber 436 serves to register the air outlet 127 with the nozzle opening 438. As shown, the air outlet 127 has a width Wo and a length Lo that are preferably the same as the width Wo and a length Lo of the opening 438. A sealing gasket 123 may provided at the juncture of the openings.

The attachment member 120 and the nozzle 412 may also include a plurality of magnets 158 that magnetically couple the attachment member 120 to the nozzle 412 to improve the connection between them and ensure that air outlet 127 is properly registered with opening 438. It will be appreciated that, in an alternate embodiment, only magnets maybe used. Other mounting means may be used. For example, a plurality of latches may be used or air outlet 127 may extend into opening 438.

Optionally, when the attachment member 120 is coupled to the portable cleaning apparatus 400, the upstream end of the air conduit 110 (for example hose 124) can be detached from the surface cleaning head 300 and the combination of the attachment member 120 and the flexible hose 124 (decoupled from the surface cleaning head 300) can serve as an auxiliary or accessory cleaning tool. The free end of the hose 124 may be maneuvered by the user to clean objects and surfaces that cannot be cleaned using the surface cleaning head 300. In some examples, the upstream end of the flexible hose 124 may be connected to the auxiliary cleaning tool 112. Alternatively, the flexible hose 124

may be removed from the attachment member 120 and the auxiliary cleaning tool 112 may be mounted directly to the air inlet 126 of the attachment member 120. It will be appreciated that tool 112 may have a plate 123 and arms 150 provided at the coupling end thereof.

Optionally, the attachment member 120 may be removed from the nozzle 412 and the auxiliary cleaning tool 112 may be fitted directly to the nozzle 412, without the use of a flexible hose 124 or other type intermediate air conduit. In addition to the auxiliary or accessory cleaning tool 112, the nozzle 412 may be directly connected to any one of a number of cleaning tools that have been provided with the an appropriate attachment member, including wands, brushes, crevasse tools and other hoses.

Clean air outlet 420 is provided downstream of the cyclone unit 414, suction motor and optional post-motor filter contained optionally within the cleaner body 460. Clean air outlet 420 may comprise a plurality of apertures formed in housing 461. The cleaner body 460 may also contain one or more of a separation plate, a dirt chamber a pre-motor filter and a plurality of connecting fluid conduits or passageways.

In the example shown, cleaner body 460 is removably mounted to head portion 416. For example, cleaner body 460 may be entirely removable from head portion 416, or pivotably mounted to head portion 416. Accordingly, cleaner body 460 and head portion 416 may be separated in order to provide access to the interior of cleaner body 460 or head portion 416. This may allow a pre-motor filter to be cleaned, changed, or serviced, or the motor to be cleaned, changed or serviced. Alternately, head portion 416 may be cleaned or serviced. For example, any dirt stuck in the enclosed passages portable cleaning apparatus 400 may be removed. Alternately, a replacement cleaner body 460 or head portion 416 may be provided, and may be mounted to an existing head portion 416 or cleaner body 460, respectively.

One or more additional rear wheels 480 may be mounted to housing 461 at lower portion 406, and may be used in conjunction with wheels 435 when the portable cleaning apparatus 400 is used as a hand vacuum. When the portable cleaning apparatus 400 is attached to the backbone 200 the additional wheel 480 preferably engages with the mount bracket 224 and partially supports the portable cleaning apparatus 400 on the handle 210 as described above.

Preferably, as exemplified, the portion of the attachment member 120 that is used to mount the attachment member to the backbone may also comprise part of the air flow path from surface cleaning head 300 to hand vacuum cleaner 400. For example, the attachment member 120 may include a mounting portion or collar 140 that includes a coupling 142 and defines a channel 144. The collar 140 is connected to the airflow passageway 128, or alternatively may be connected directly to the air conduit 110. Optionally, the coupling 142 is a rotatable coupling that allows the airflow passageway 128 to rotate relative to the collar 140. The upstream end of the airflow passageway 128 defines the air inlet 126. In operation, the air inlet 126 is preferably coupled to the airflow conduit 110 that extends to the surface cleaning head 300 (the flexible air hose 124 in the example shown). The air inlet 126 is releasably coupled to the flexible air hose by clips 160. Downstream of the coupling 142 an enclosed airflow passage connects the airflow passage 128 to the air outlet 127. It will be appreciated that the attachment member 120 need not comprise part of the air flow passage. For example, coupling 142 may be located out of the flow path defined by passageway 128. Alternately, plate 123 need not have opening 127. Accordingly, attachment member may have a first part that is secured to hand vacuum 400 and a second distinct part that completes that air flow passage from surface cleaning head 300 to opening 438.

The airflow passageway 128 may be flexible or rigid and may be generally straight or may have a curved shape, as shown. Preferably, the curved airflow passageway 128 subtends fewer than 45 degrees.

It will be appreciated that a construction that uses a dirt collection chamber that partially or completely surrounds a cyclone in an upright surface cleaning apparatus may be used by itself or with any other feature disclosed herein. It will be appreciated that an inverted first stage cyclone in an upright surface cleaning apparatus may be used by itself or with any other feature disclosed herein. In addition, any of the features disclosed herein may be used by themselves, or with any other feature, and may include the construction of the dirt collection chamber to denote a fill line.

What has been described above has been intended to be illustrative of the invention and non-limiting and it will be understood by persons skilled in the art that other variants and modifications may be made without departing from the scope of the invention as defined in the claims appended hereto.

CLAIMS:

1. A surface cleaning apparatus comprising:
   (a) a floor cleaning unit comprising a surface cleaning head having a dirty air inlet, a cleaning head air outlet and an upright section comprising a handle drivingly connected to the surface cleaning head;
   (b) a cyclone unit mounted on the upright section and positioned in the air flow passage, the cyclone unit comprising a cyclone having an air inlet and an air outlet, and a dirt collection chamber exterior to the cyclone; and,
   (c) a suction motor positioned in the air flow path.

2. The surface cleaning apparatus of claim 1 further comprising a surface cleaning unit removably mounted to the handle wherein the surface cleaning unit comprises the cyclone unit and the suction motor.

3. The surface cleaning apparatus of any of claims 1-2 wherein the cyclone comprises a dirt outlet provided at an upper end of the cyclone.

4. The surface cleaning apparatus of any of claims 1-3 wherein the cyclone and the dirt collection chamber are concurrently openable.

5. The surface cleaning apparatus of any of claims 1-4 wherein the cyclone is positioned interior of the dirt collection chamber.

6. The surface cleaning apparatus of any of claims 1-5 wherein the upright section has an absence of a housing defining a recess for receiving the portable surface cleaning apparatus.

7. The surface cleaning apparatus of any of claims 1-6 wherein the upright section comprises at least one support rod.

8. The surface cleaning apparatus of any of claims 1-7 wherein the dirt outlet comprises an open end of the cyclone and the apparatus further comprises a plate facing the dirt outlet.

9. The surface cleaning apparatus of claim 8 wherein the plate has a diameter about the same as a diameter of the dirt outlet.

10. The surface cleaning apparatus of any of claims 8-9 wherein the plate is mounted to an upper end of the cyclone unit.

11. The surface cleaning apparatus of any of claims 1-10 which in the air outlet of the cyclone comprises a vortex finder and a shroud is provided in the air flow path from a cyclone chamber in the cyclone to the air outlet of the cyclone.

12. The surface cleaning apparatus of any of claims 1-11 further comprising a plurality of pre-motor filters.

13. The surface cleaning apparatus of claim 12 wherein the pre-motor filters comprise an upstream filter and a downstream filter, the downstream filter having smaller pores then the upstream filter.

14. A surface cleaning apparatus comprising:

(a) a floor cleaning unit comprising a surface cleaning head having a dirty air inlet, a cleaning head air outlet and an upright section comprising a handle drivingly connected to the surface cleaning head;

(b) a first stage cyclone unit mounted on the upright section and positioned in the air flow passage, the cyclone unit comprising an inverted cyclone having an air inlet and an air outlet, and a dirt outlet at an upper end; and,

(c) a suction motor positioned in the air flow path.

15. The surface cleaning apparatus of claim 14 further comprising a surface cleaning unit removably mounted to the handle wherein the surface cleaning unit comprises the cyclone unit and the suction motor.

16. The surface cleaning apparatus of any of claims 14-15 wherein the dirt collection chamber is external to the cyclone

17. The surface cleaning apparatus of any of claims 14-16 wherein the cyclone and the dirt collection chamber are concurrently openable.

18. The surface cleaning apparatus of any of claims 14-17 wherein the cyclone is positioned interior of the dirt collection chamber.

19. The surface cleaning apparatus of any of claims 14-19 wherein the upright section has an absence of a housing defining a recess for receiving the portable surface cleaning apparatus.

20. The surface cleaning apparatus of any of claims 14-19 wherein the upright section comprises at least one support rod.

21. The surface cleaning apparatus of any of claims 14-20 wherein the dirt outlet comprises an open end of the cyclone and the apparatus further comprises a plate facing the dirt outlet.

22. The surface cleaning apparatus of claim 21 wherein the plate has a diameter about the same as a diameter of the dirt outlet.

23. The surface cleaning apparatus of any of claims 21-22 wherein the plate is mounted to an upper end of the cyclone unit.

24. The surface cleaning apparatus of any of claims 14-23 which in the air outlet of the cyclone comprises a vortex finder and a shroud is provided in the air flow path from a cyclone chamber in the cyclone to the air outlet of the cyclone.

25. The surface cleaning apparatus of any of claims 14-24 further comprising a plurality of pre-motor filters.

26. The surface cleaning apparatus of claim 25 wherein the pre-motor filters comprise an upstream filter and a downstream filter, the downstream filter having smaller pores then the upstream filter.

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Figures: 15-16-17-18-19-20

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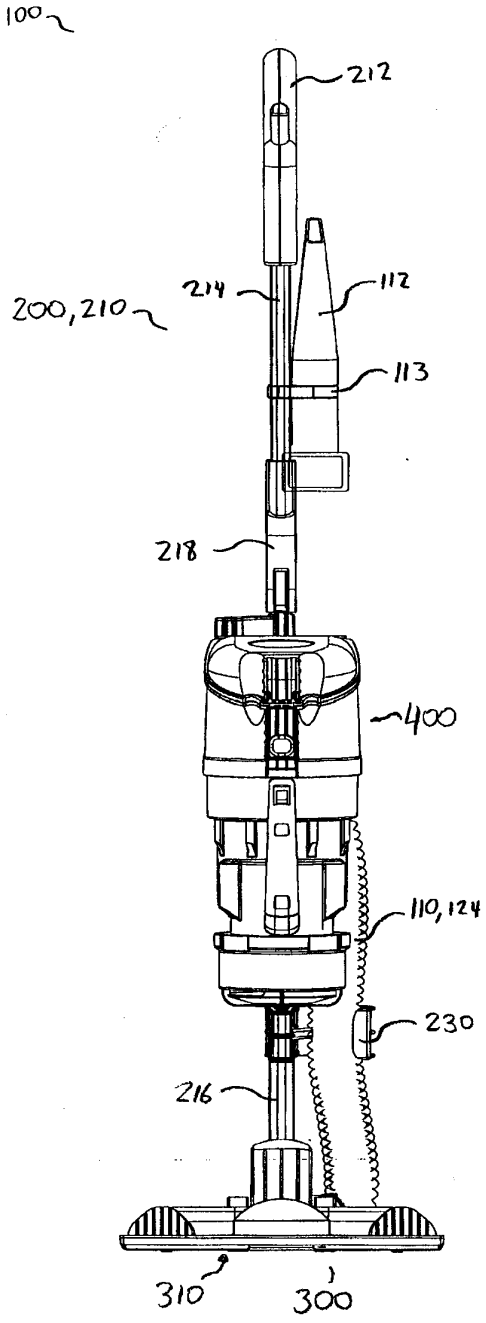
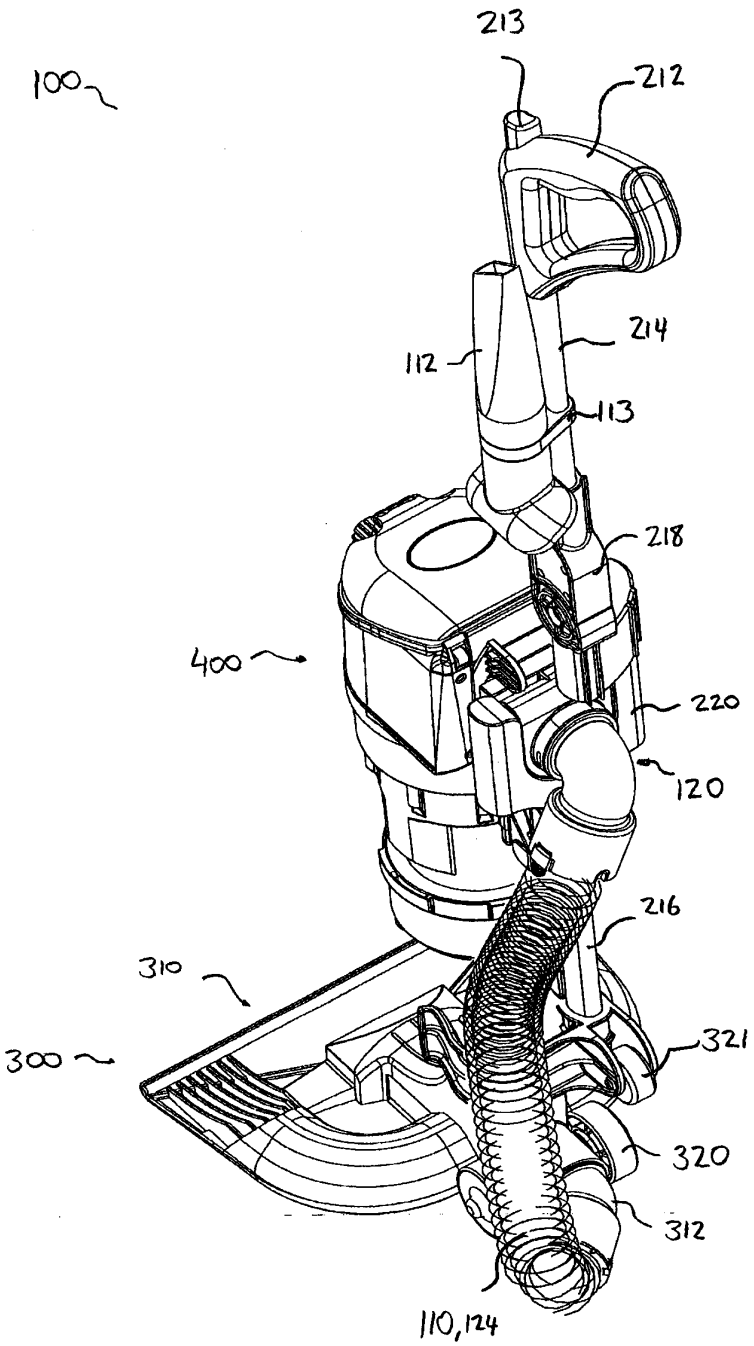


FIG. 1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300
320
312
110,124

FIG. 2

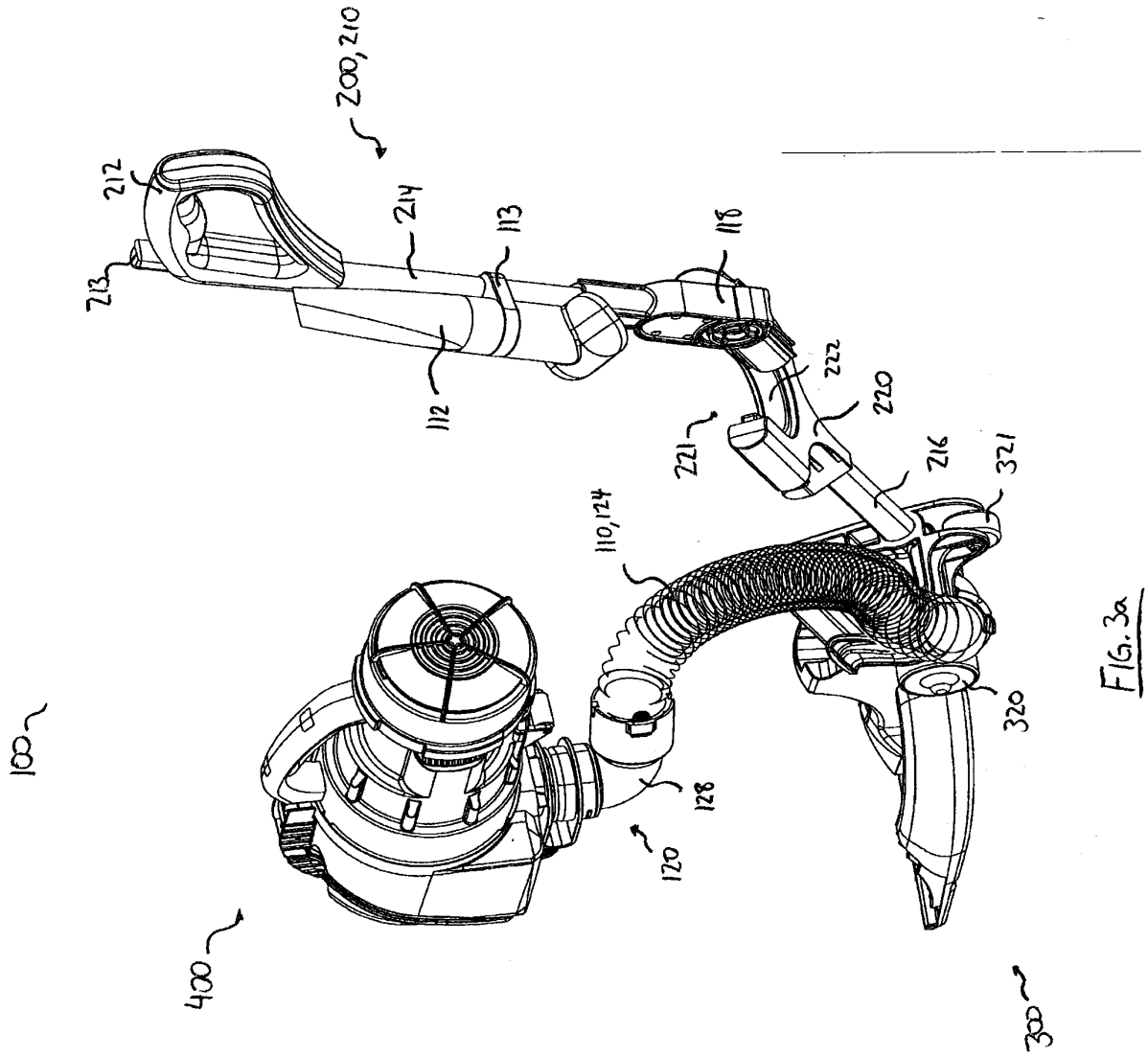
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FIG. 3a

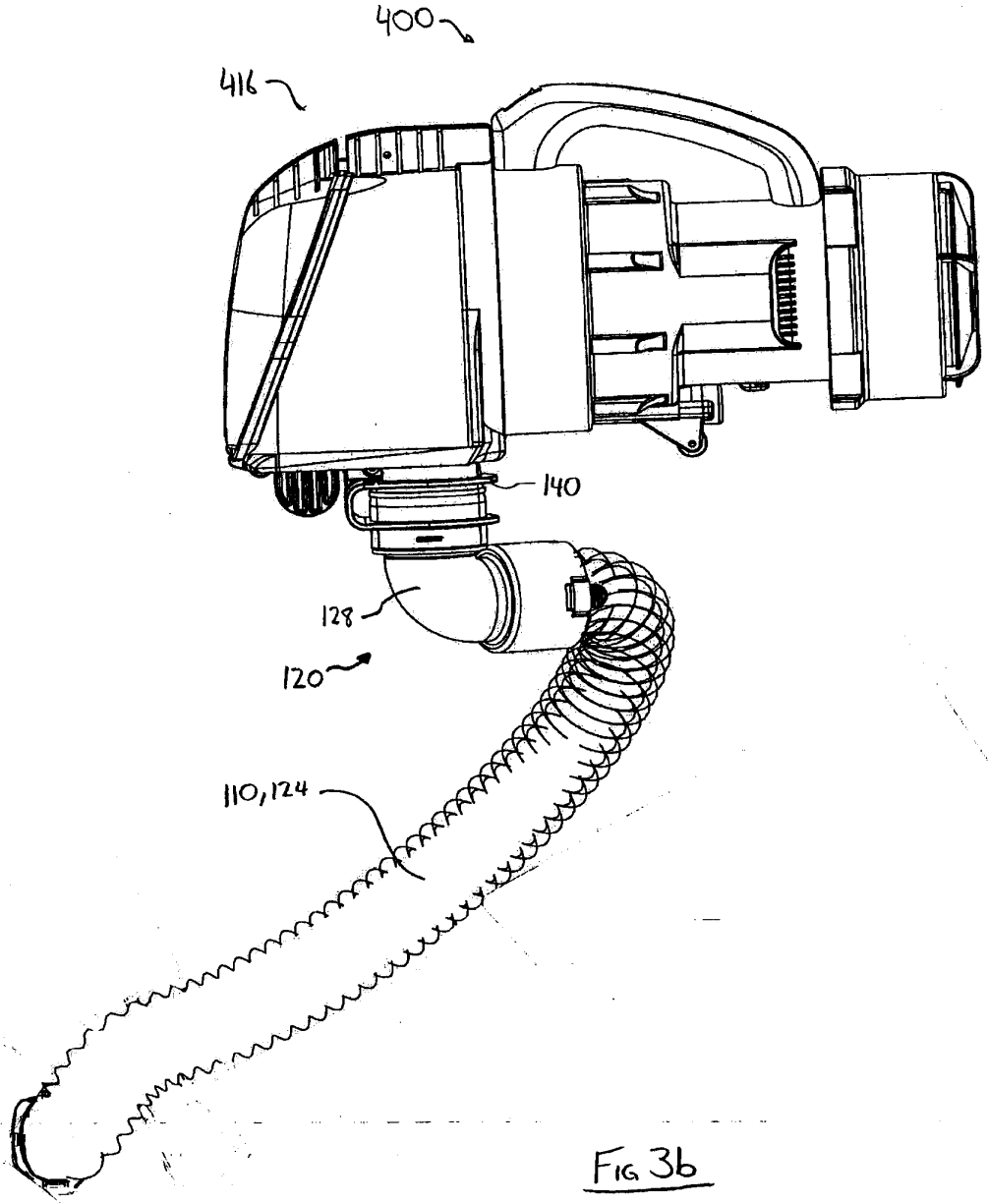
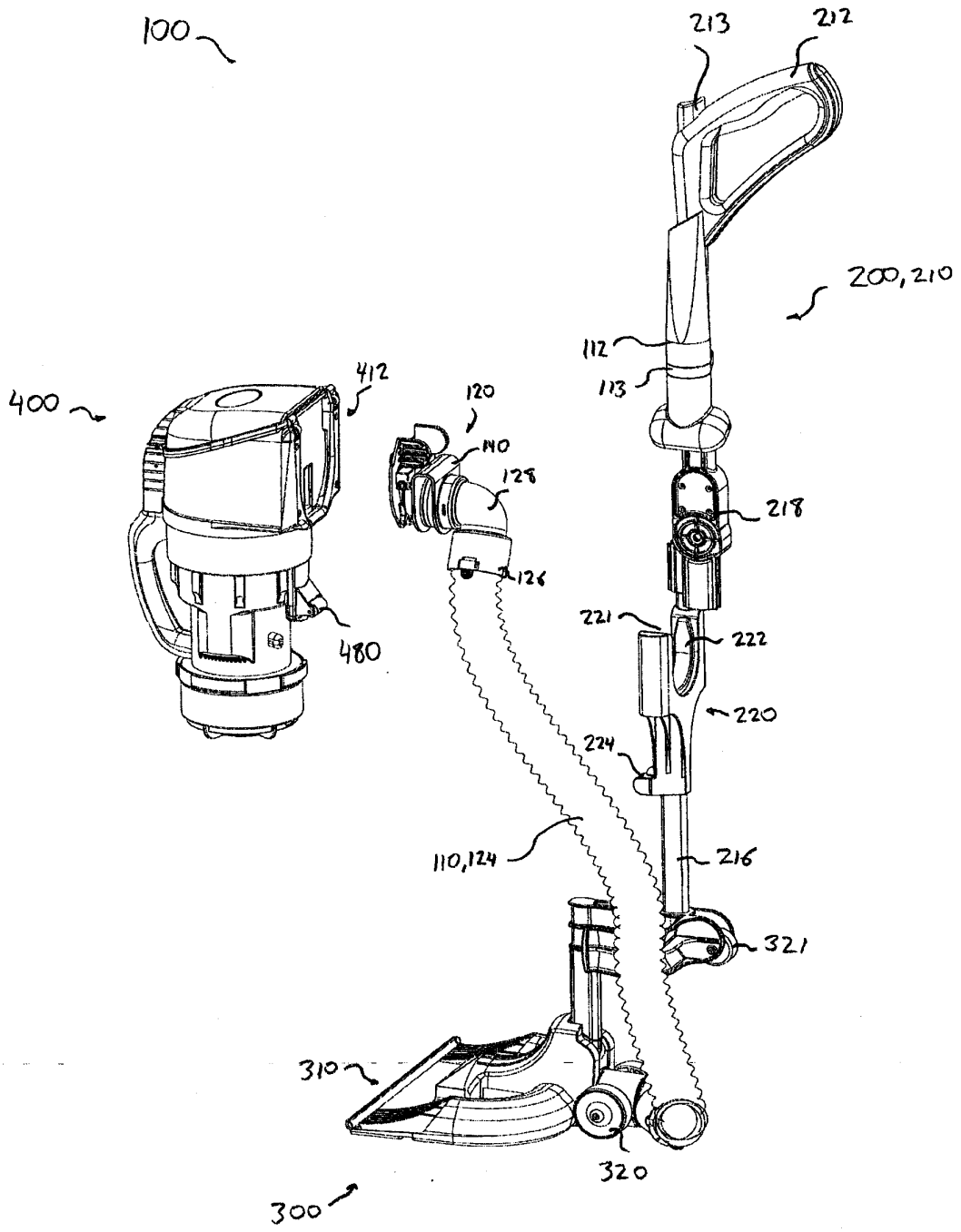


Fig 3b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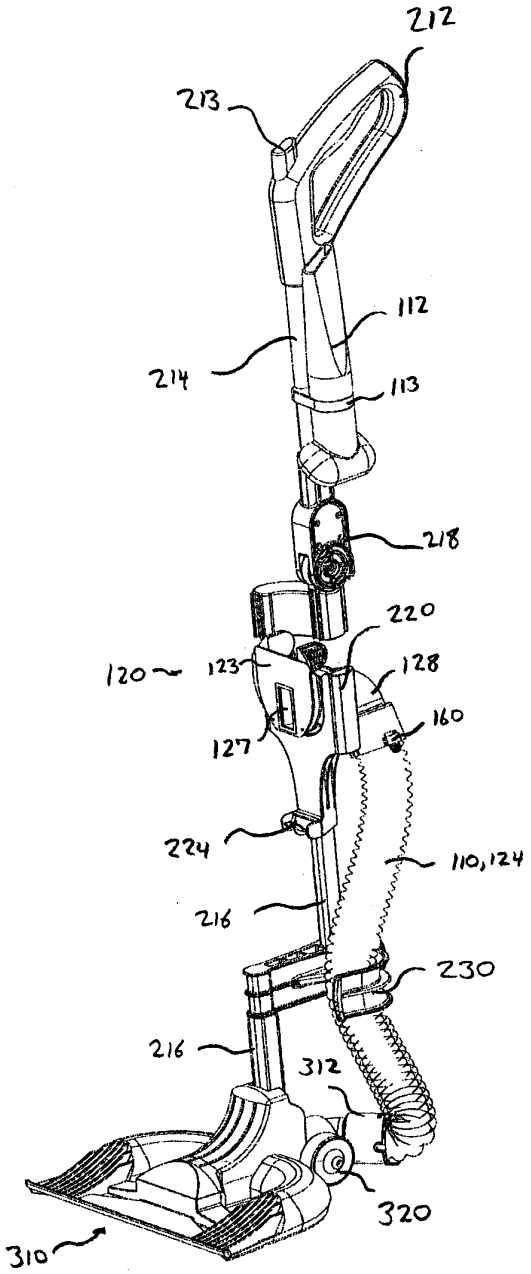
300

FIG. 4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310

FIG. 5

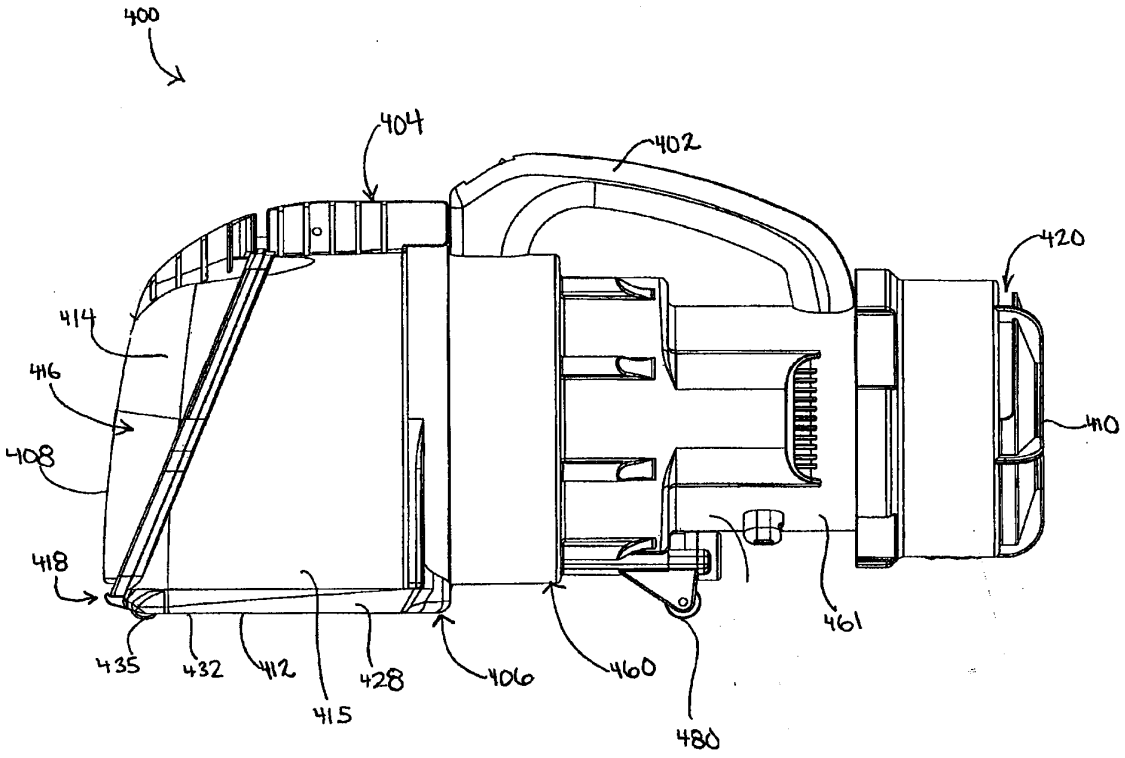
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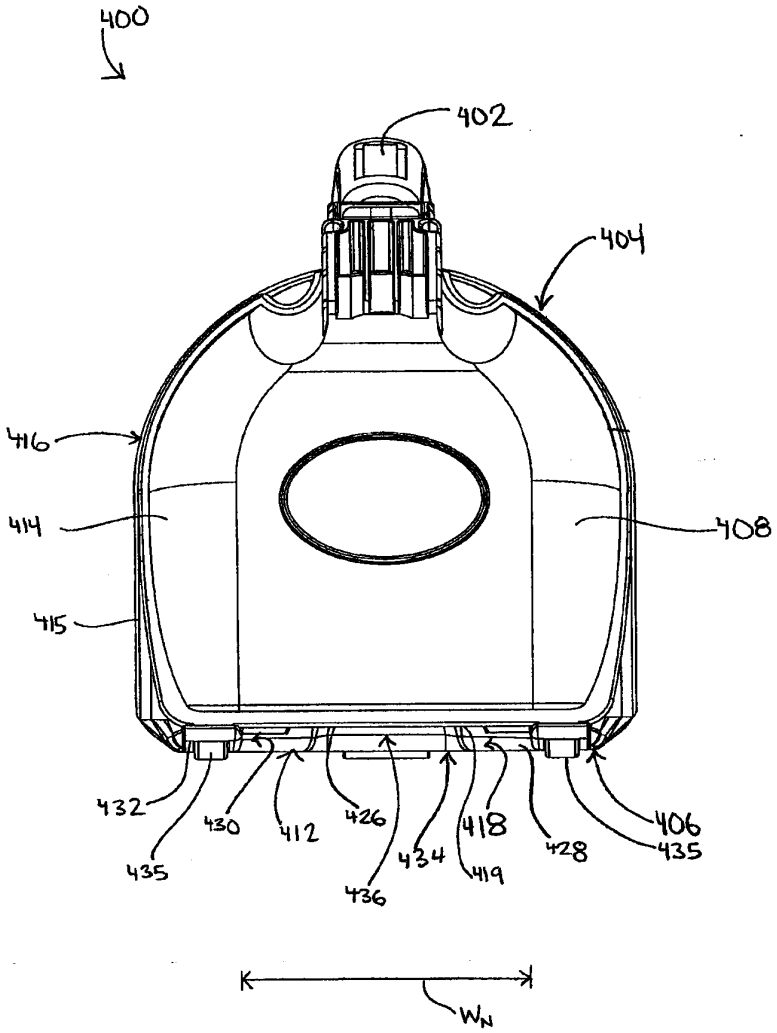
FIG. 6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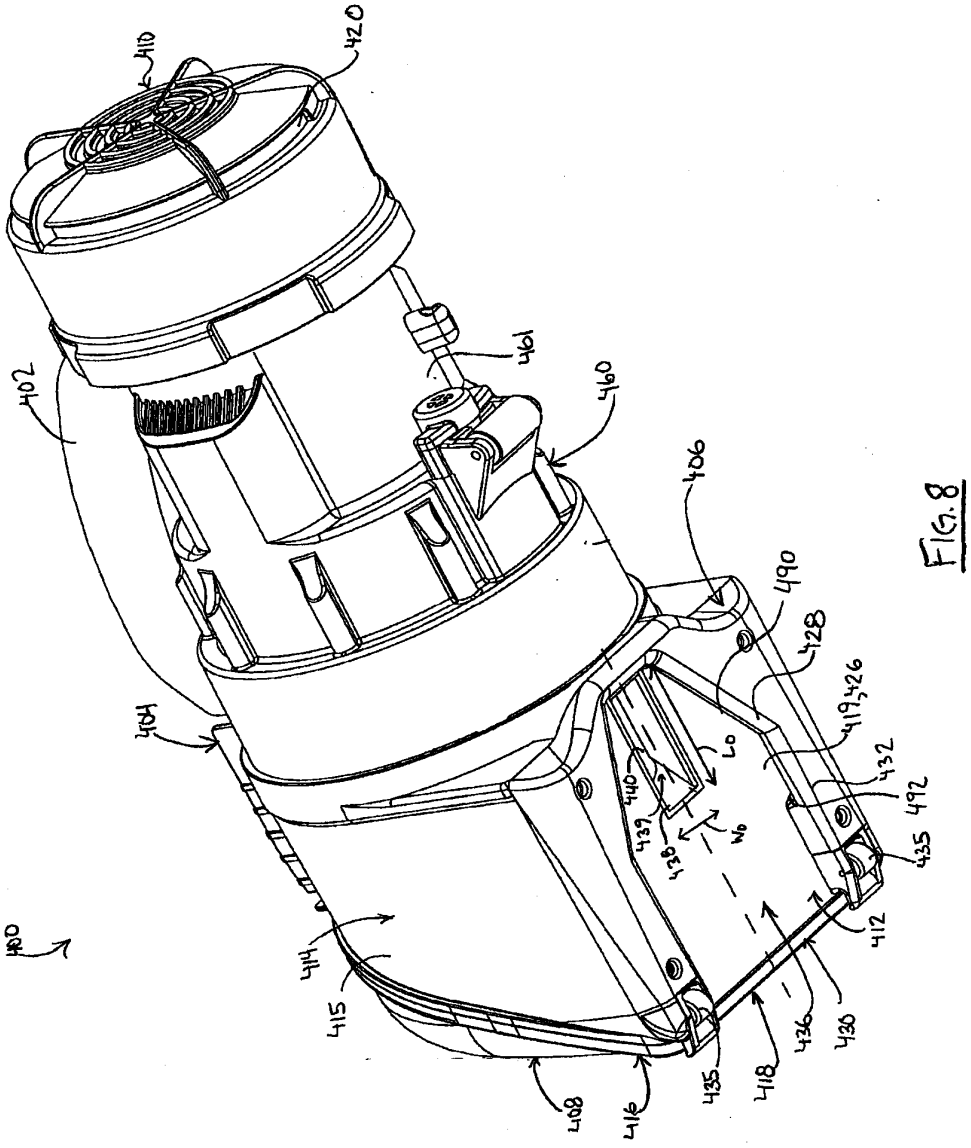
W_N

FIG. 7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461
490
492
Lo
Wo

FIG. 8

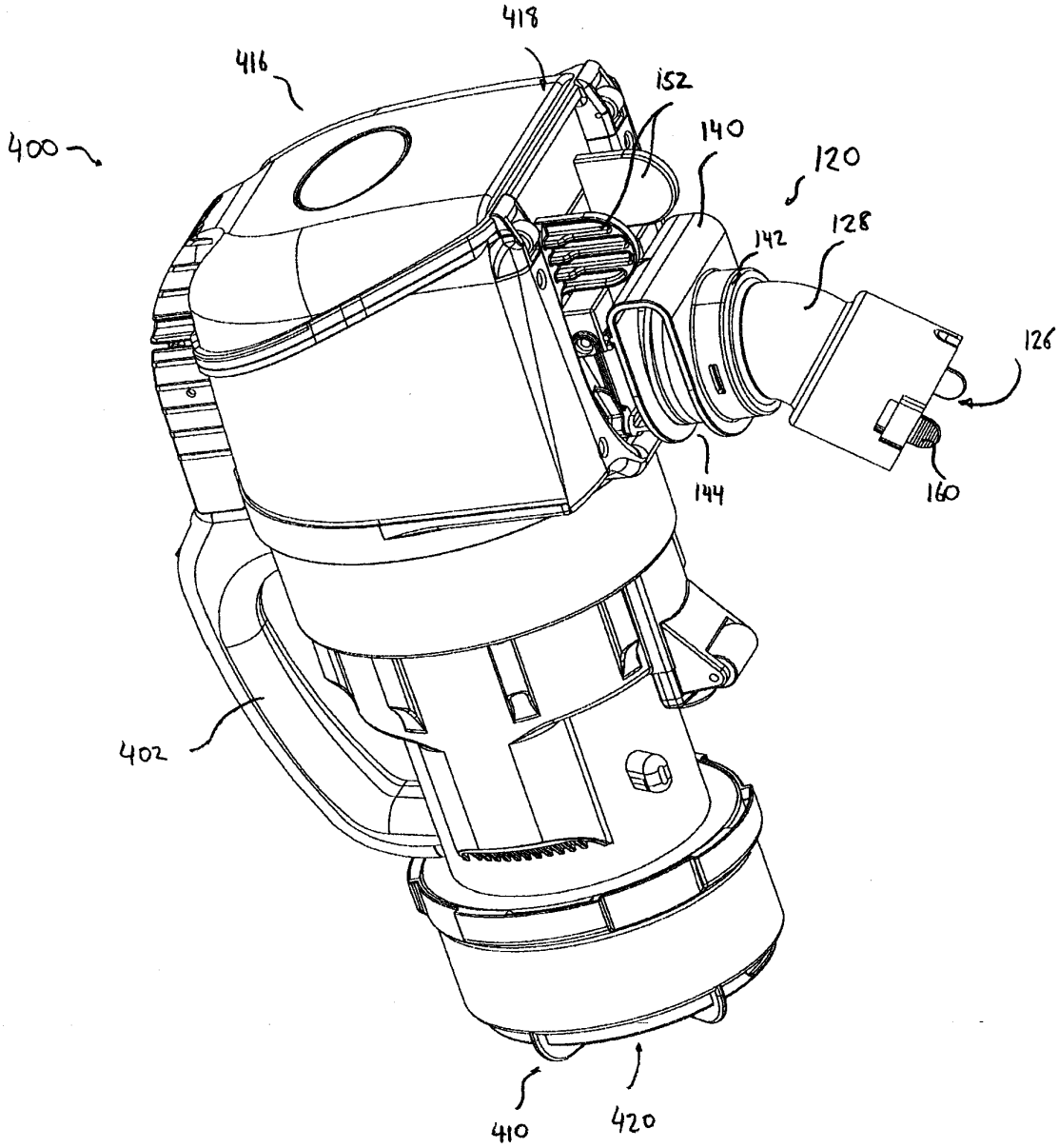
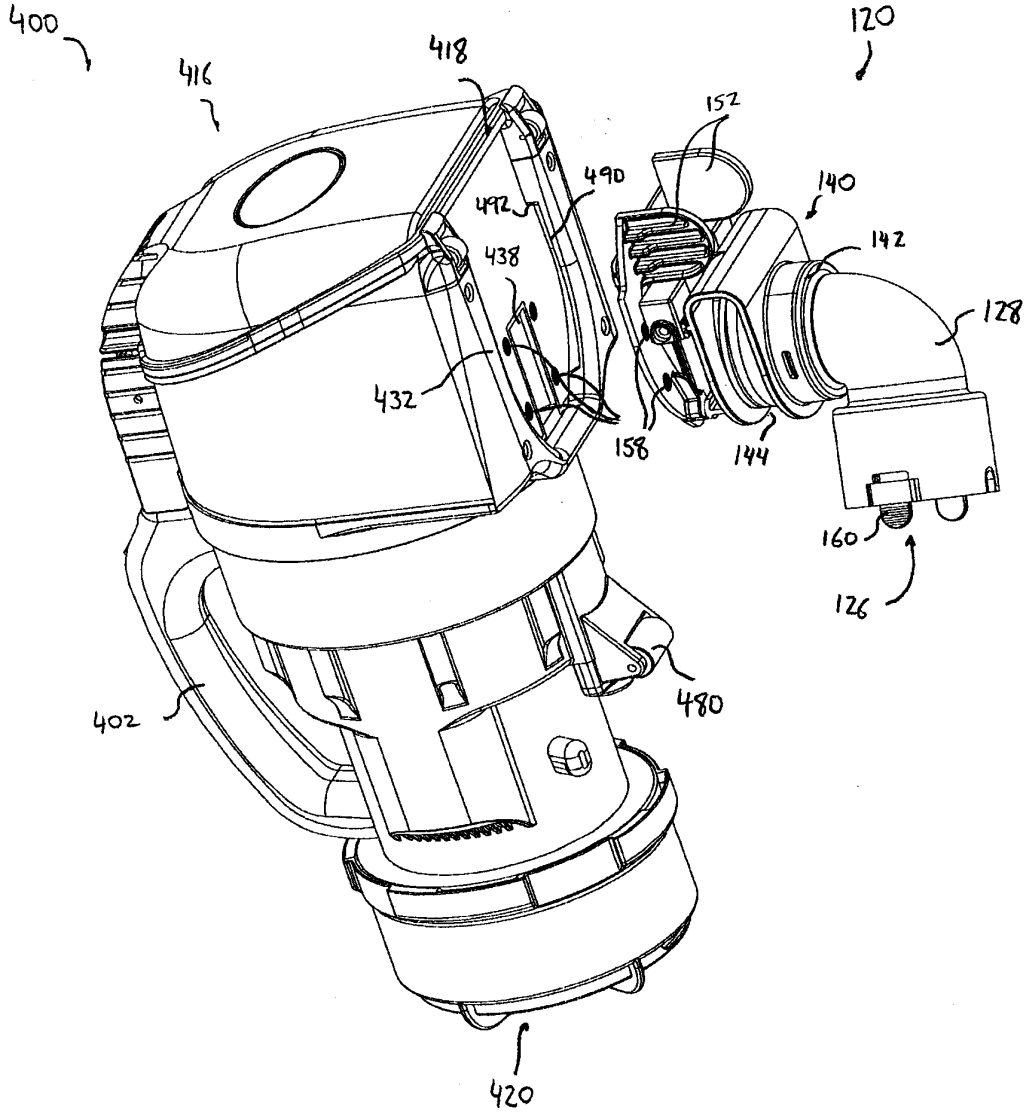


FIG.9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418
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142
438
128
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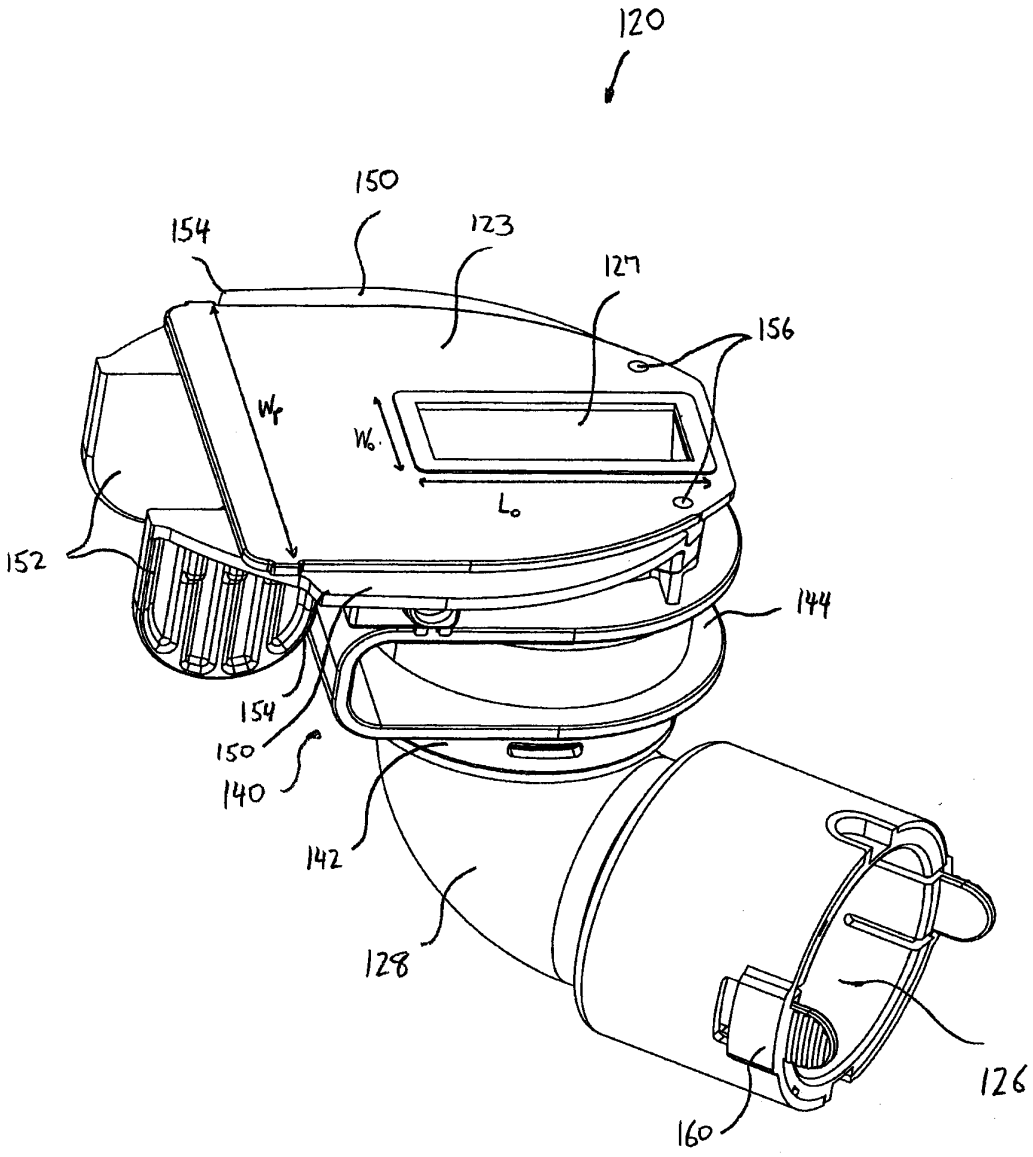
144
160
126
480
402
420

FIG. 10


120
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123
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156
W_f
W_o
L_o
152
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150
140
142
128
126
160

FIG. 11

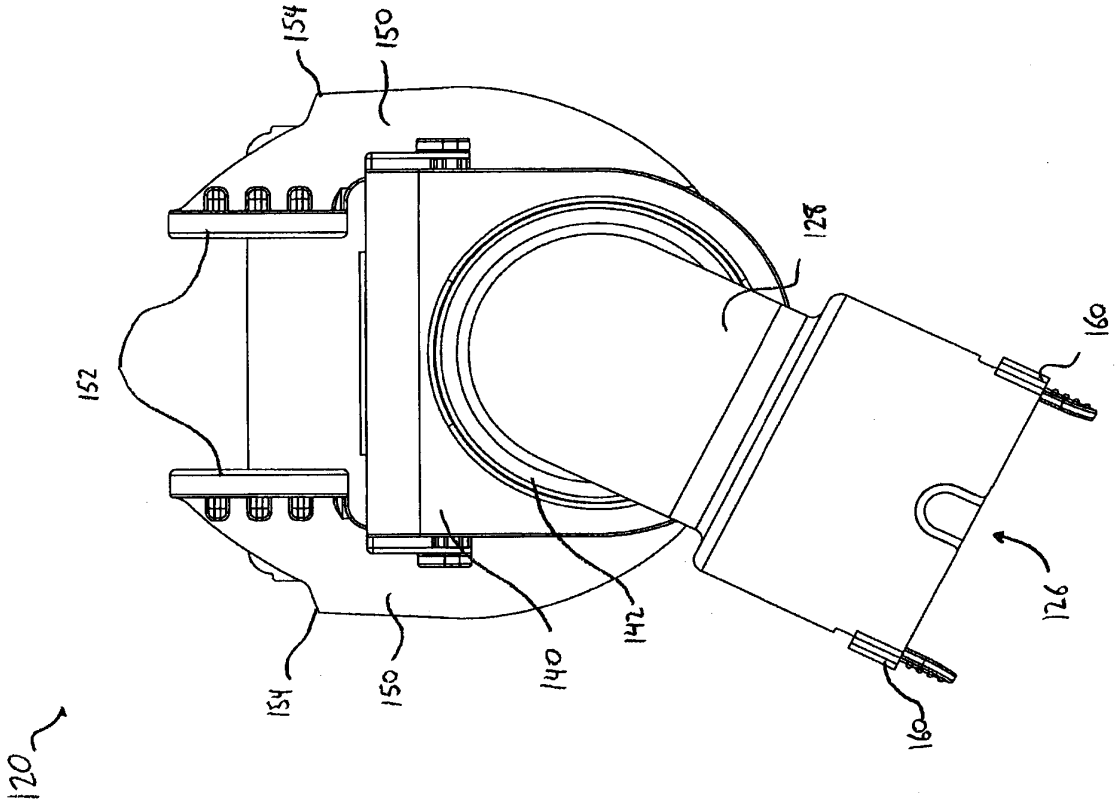


FIG. 12

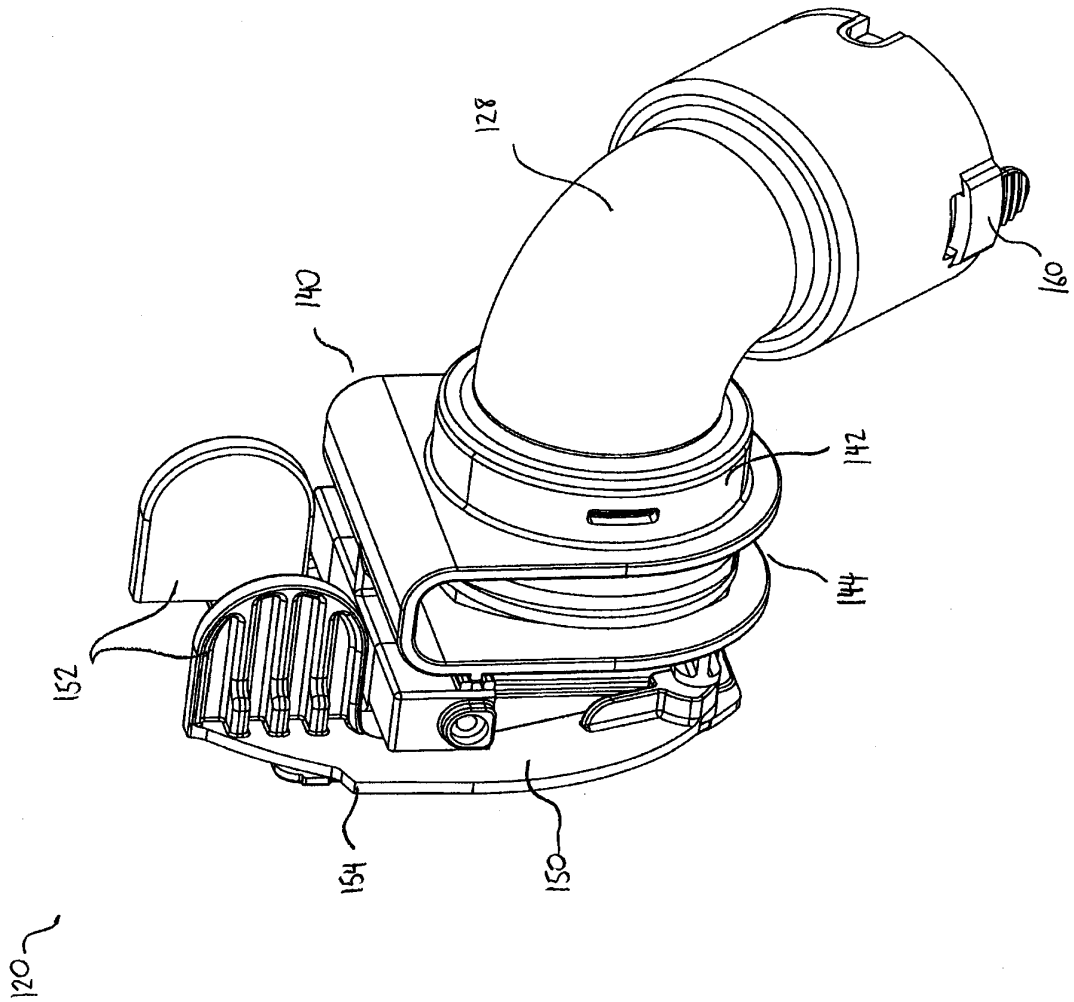


FIG. 13

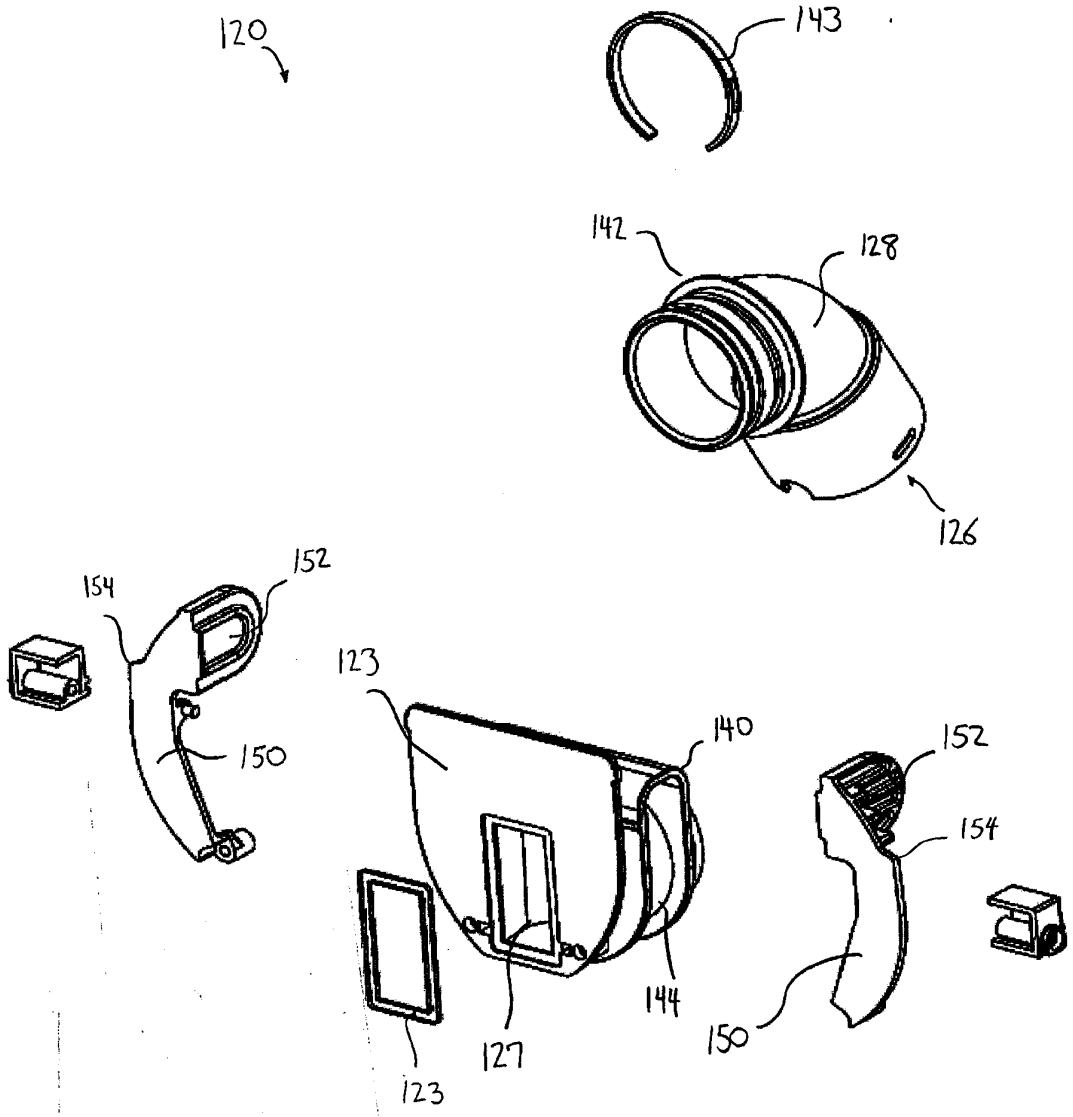
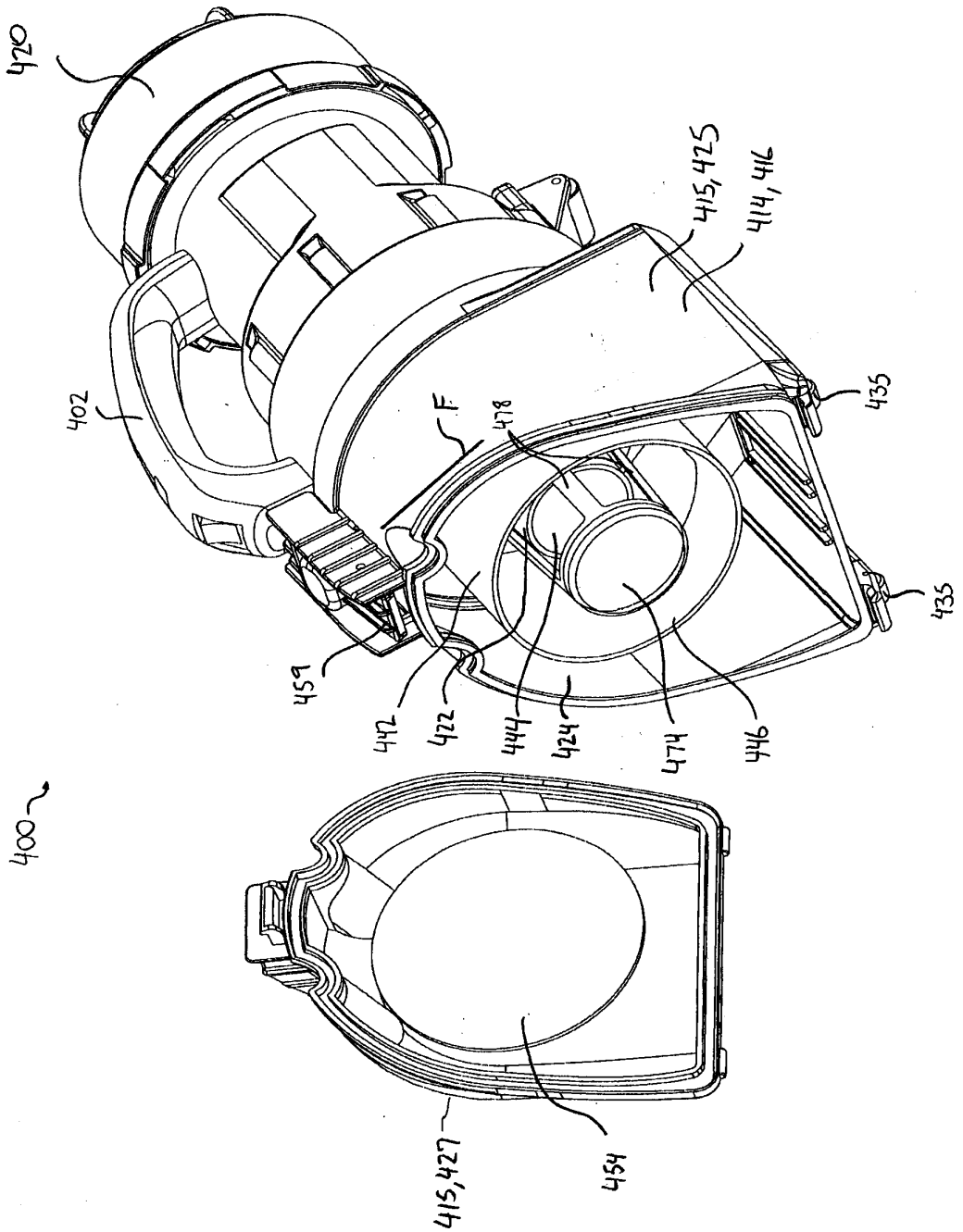


FIG. 14


420
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415, 427
454

FIG. 21

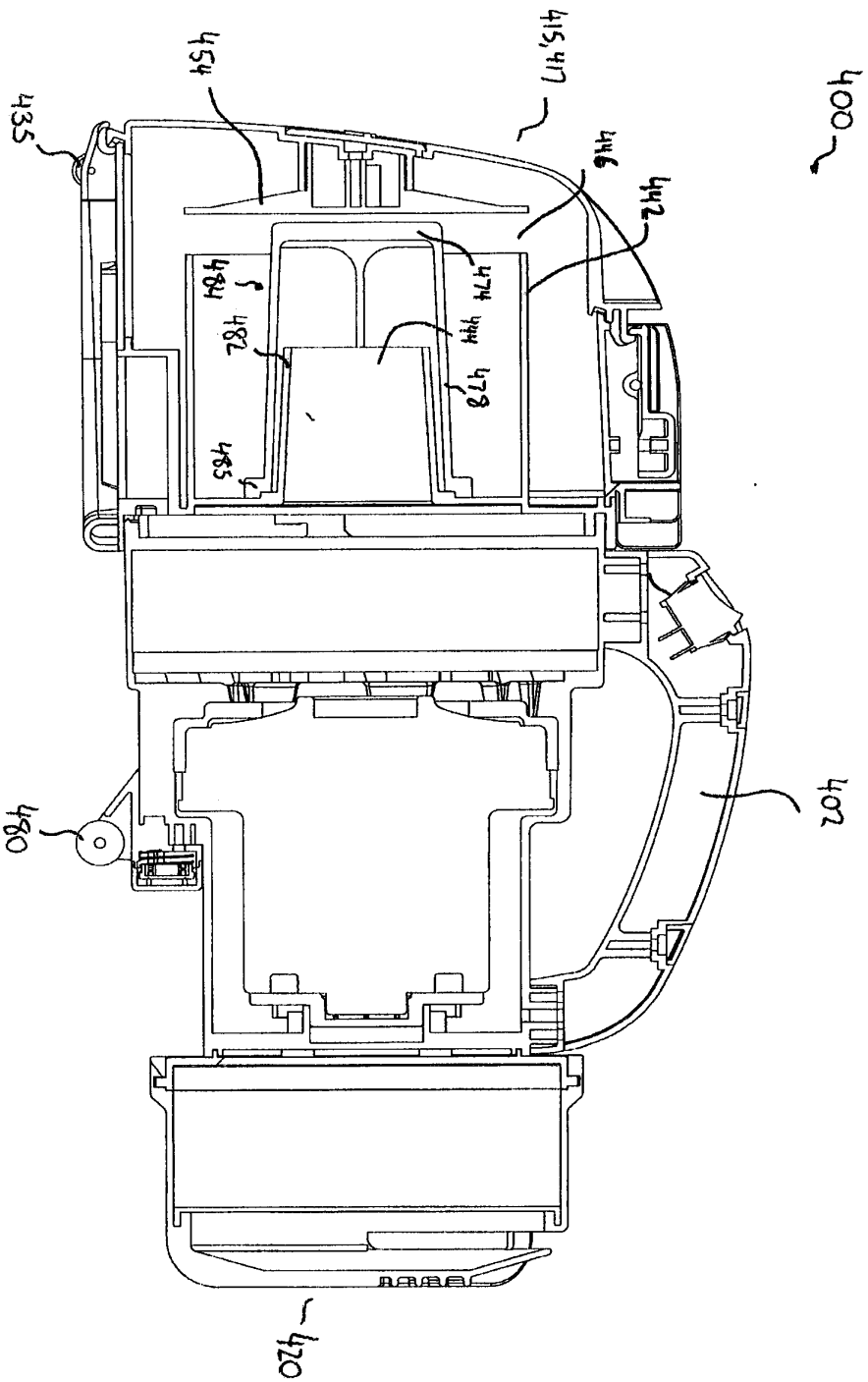

FIG. 22

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(54) Title of the Invention: **Floor tool for a cleaning appliance**
Abstract Title: **Floor Tool for a Cleaning Applicance**

(57) A floor tool (1) for a cleaning appliance comprising a cleaner head (2) rotatably attached to a conduit (14) carried by a pair of wheels (15, 16) that converge beneath the conduit (14).

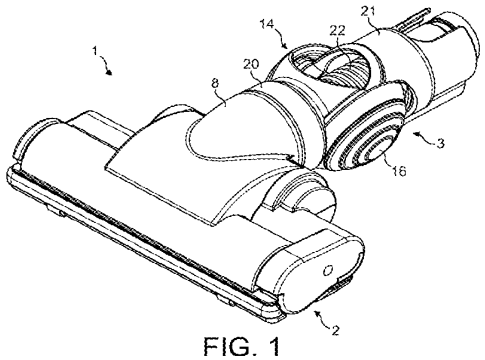

FIG. 1

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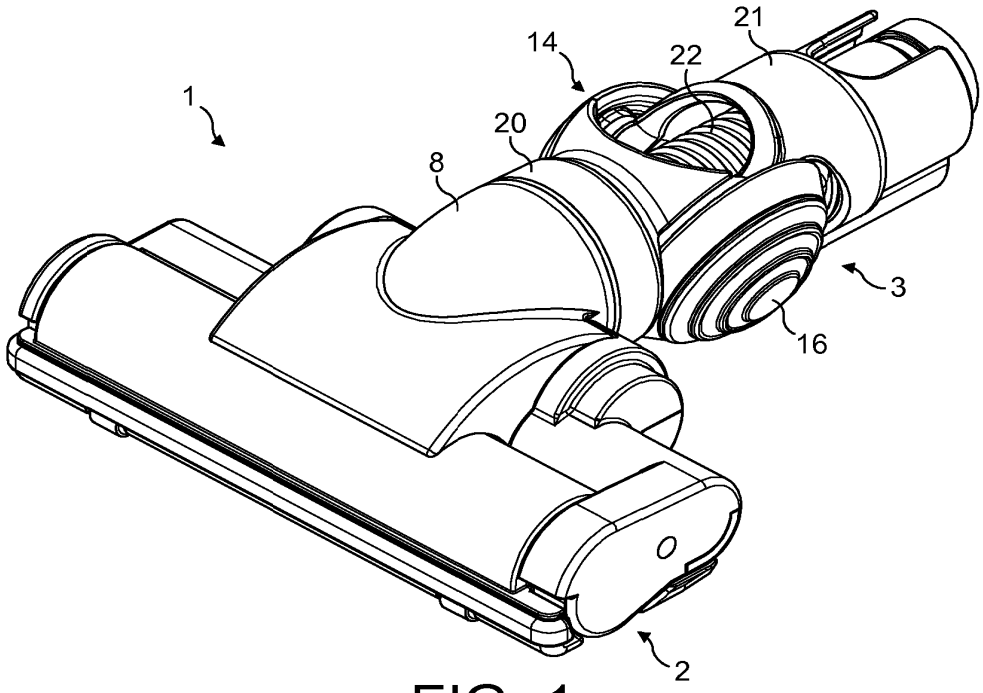

FIG. 1

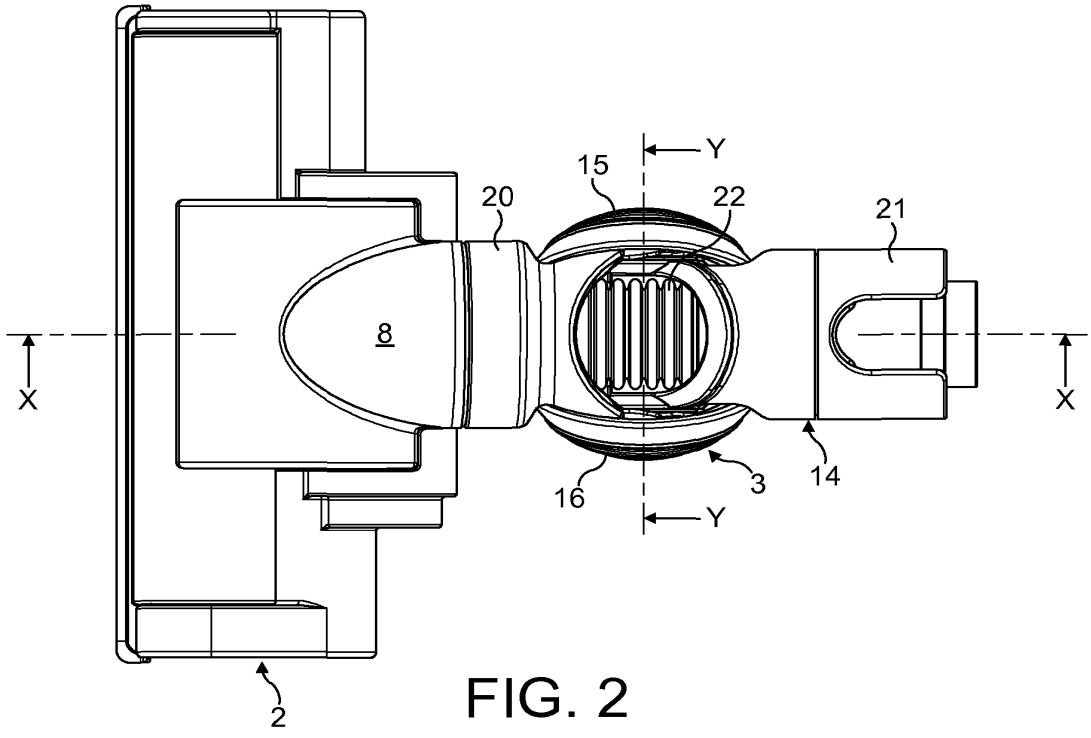

FIG. 2

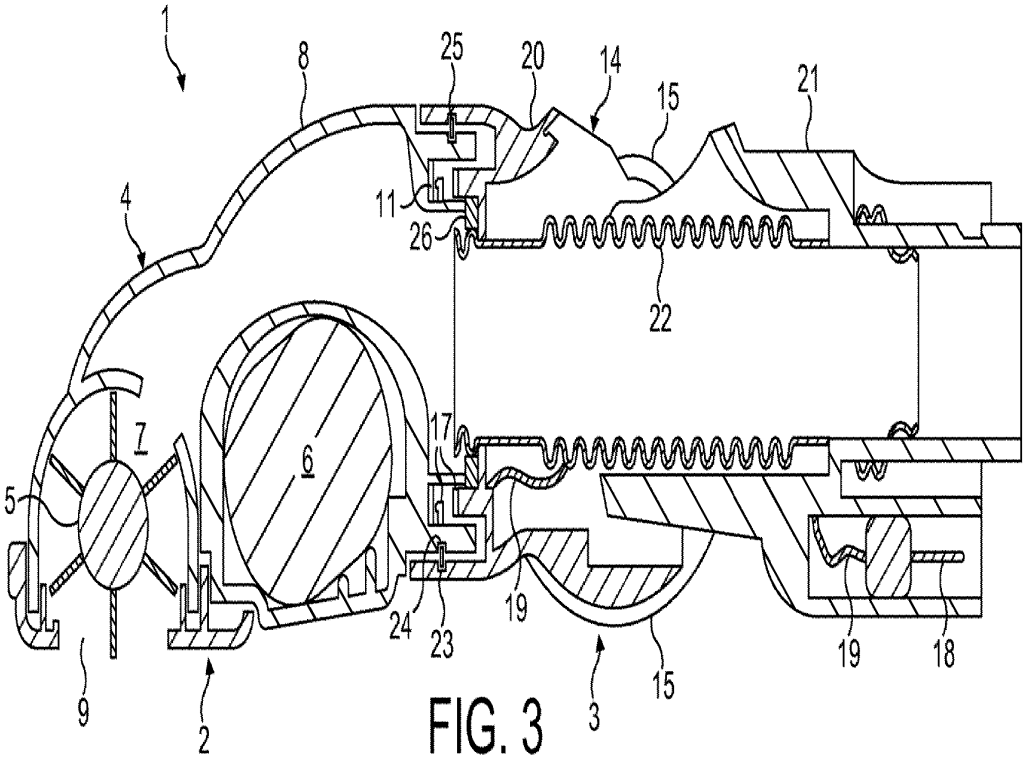

FIG. 3

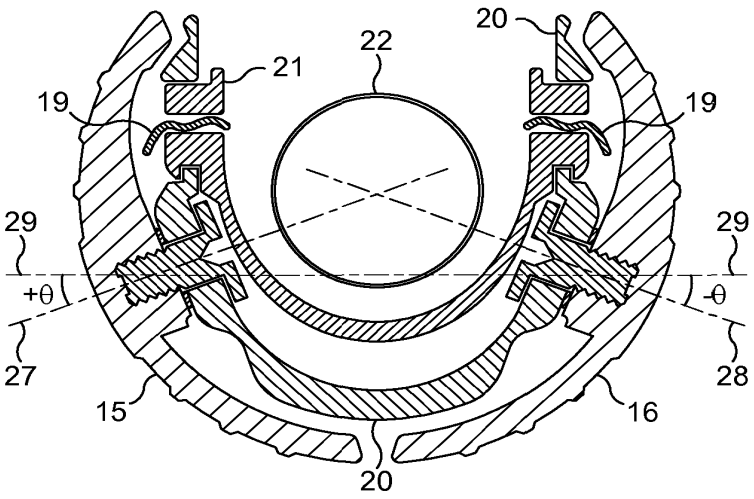

FIG. 4

09 02 10

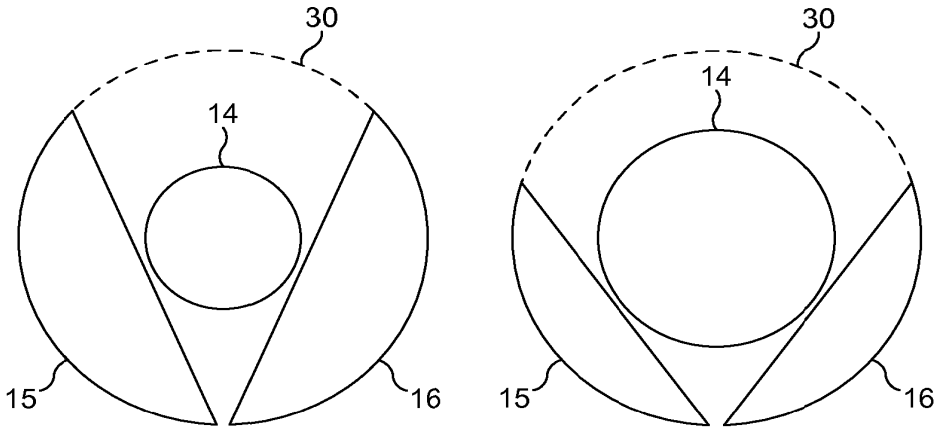

FIG. 5

Floor Tool for a Cleaning Appliance

The present invention relates to a floor tool for a cleaning appliance.

Cleaning appliances, such as vacuum cleaners, floor polishers and shampoo machines, may include a hose-and-wand assembly to which different accessories may be attached. One such accessory is a floor tool which a user manoeuvres back and forth over a surface to be cleaned. The floor tool may include wheels which aid the user in manoeuvring the floor tool. However, there is often difficultly in manoeuvring the floor tool in directions beyond that of a straight line.

In a first aspect, the present invention provides a floor tool for a cleaning appliance comprising a cleaner head rotatably attached to a conduit carried by a pair of wheels that converge beneath the conduit.

The conduit fluidly couples the cleaner head to the cleaning appliance such that fluid may be carried between the cleaning appliance and a surface to be cleaned. The free end of the conduit may be adapted for releasable attachment to a wand, hose or like duct of the cleaning appliance. Alternatively, the conduit may form an integral part of the cleaning appliance.

In converging beneath the conduit, the wheels rotate about axes of rotation that are oriented such that the separation between the wheels is smallest beneath the conduit. In providing convergent wheels, a space is defined between the two wheels through which the conduit can pass. Accordingly, the floor tool is supported by wheels that do not unduly increase the size, and in particular the height, of the floor tool.

By including a bend in the conduit, movement of the floor tool beyond that of a straight line is made possible by rotating the free end of the conduit. To facilitate steering of the floor tool, the conduit preferably comprises a forward portion that is pivotally attached to a rearward portion. The wheels are then rotatably attached to the forward portion,

which is in turn rotatably attached to the cleaner head. This arrangement additionally helps to prevent the cleaner head being inadvertently lifted as the floor tool is manoeuvred over the cleaning surface. Advantageously, the rearward portion is attached to the forward portion at points above those at which the wheels are attached to the forward portion. Consequently, the length of the conduit may be kept to a minimum, resulting in a more compact floor tool.

The wheels are preferably dome-shaped. Accordingly, as the conduit rotates relative to the cleaner head, the wheels continue to provide a rolling support. Moreover, the wheels advantageously provide a substantially continuous arcuate support in the plane normal to the longitudinal axis of the conduit. Consequently, as the floor tool is steered in different directions, a smooth transition occurs as support moves from one wheel to the next. Indeed, in order that, from the point of the user, the transition between wheels feels continuous, the gap between the wheels preferably subtends an angle at the centre of the conduit of no more than 20 degrees. That is to say that, in the plane normal to the longitudinal axis of the conduit, the gap subtends an angle of no more than 20 degrees at the longitudinal axis of the conduit.

The surfaces of the wheels are preferably coincident with a common sphere. Moreover, the centre of the common sphere is ideally coincident with the longitudinal axis of the conduit. Consequently, as the conduit rotates relative to the cleaner head, the conduit maintains the same height above the cleaning surface. This then helps prevent lifting of the cleaner head as the floor tool is steered in different directions.

In a further aspect, the present invention provides a floor tool for a cleaning appliance comprising a cleaner head rotatably attached to a conduit carried by a pair of dome-shaped wheels, the wheels having axes of rotation that are oriented such that the wheels converge beneath the conduit.

In a still further aspect, the present invention provides a coupling comprising a conduit carried by a pair of wheels, wherein the conduit has a first end for rotatable attachment

to a cleaner head and a second end for attachment to a duct of a cleaning appliance, and the wheels converge beneath the conduit.

In order that the present invention may be more readily understood, embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates a floor tool in accordance with the present invention;

Figure 2 is a plan view of the floor tool;

Figure 3 is a sectional view of the floor tool taken along the line X-X as illustrated in Figure 2;

Figure 4 is a sectional view of the floor taken along the line Y-Y as illustrated in Figure 2; and

Figure 5 illustrates simplified sectional views of floor tools having (a) a small diameter conduit, and (b) a large diameter conduit.

The floor tool 1 of Figures 1 to 4 comprises a cleaner head 2 rotatably attached to a coupling 3. The free end of the coupling 3 is attachable to a wand, hose or other such duct of a cleaning appliance (not shown).

The cleaner head 2 comprises a housing 4, a brushbar 5 and a motor 6. The housing 4 defines a chamber 7 within which the brushbar 5 is rotatably mounted, and an outlet duct 8 that extends from the chamber 7 to the rear of the cleaner head 2. An opening 9 formed on the underside of the housing 2 provides an inlet to the chamber 7. The brushbar 5 is driven by the motor 6, which is located to the rear of the cleaner head 2 beneath the outlet duct 8. The motor 6 is coupled to an electrical terminal 11 provided

at an end of the outlet duct 8, through which electrical power may be delivered to the motor 6.

The coupling 3 comprises a conduit 14 carried by a pair of wheels 15,16, an electrical terminal 17,18 provided at each end of the conduit 14, and an electrical cable 19 that extends between the electrical terminals 17,18.

The conduit 14 comprises a forward portion 20, a rearward portion 21, and a flexible hose 22.

The forward portion 20 is pivotally attached at one end to the rearward portion 21. The other end of the forward portion 20 is shaped as a cylindrical collar that receives the end of the outlet duct 8. An annular groove 23,24 is formed around each of the forward portion 20 and the outlet duct 8 into which a snap ring 25 is seated. The snap ring 25 extends between the two grooves 23,24 such that relative rotation of the forward portion 20 and outlet duct 8 is possible whilst relative separation is not. A gasket 26 made of resilient material (e.g. rubber or foam) is provided within the forward portion 20. The outlet duct 8, when received within the forward portion 20, abuts and compresses the gasket 26 to form a seal between the cleaner head 2 and the coupling 3. The surface of the gasket 26 is coated with a low friction material (e.g. PTFE or HDPE) such that relative rotation of the outlet duct 8 and forward portion 20 does not result in adverse wearing of the gasket 26.

One end of the rearward portion 21 is pivotally attached to the forward portion 20, whilst the other end is shaped for attachment to a wand, hose or other such duct of a cleaning appliance.

The hose 22 is held within and extends between the forward and the rearward portions 20,21. The hose 22 is ribbed such that the length of the hose 22 can be made to expand and contract. Consequently, as the rearward portion 21 pivots relative to the forward portion 20, the length of the hose 20 varies to accommodate the change.

Each wheel 15,16 is domed-shaped and is rotatably attached to the forward portion 20. One wheel 15 rotates about a first axis of rotation 27 and the other wheel 16 rotates about a second axis of rotation 28. The axes of rotation 27,28 are non-parallel and lie in a common plane normal to the longitudinal axis of the forward portion 20. More specifically, the first axis 27 is tiled by $+\theta$ and the second axis is tilted by $-\theta$ relative to a line 29 passing through the wheel centres, the tilt occurring in the common plane. Consequently, the two axes of rotation 27,28 intersect one another at a point that is spaced above the line 29 passing through the wheel centres. Owing to the tilt in the axes of rotation 27,28, the wheels 15,16 converge beneath the conduit 14, i.e. the separation between the wheels 15,16 is smallest beneath the conduit 14.

The curvature of each dome-shaped wheel 15,16 is spherical. Furthermore, the two wheels 15,16 are arranged (i.e. spaced from one another and tilted) such that the surfaces of the wheels 15,16 are coincident with a common sphere 30. The surfaces of the two wheels 15,16 may thus be regarded as defined by an imaginary sphere 30 from which a v-shaped wedge has been removed (this is perhaps best visualised in Figure 5). The centre of this common sphere 30 is coincident with the longitudinal axis of the forward portion 20, the advantage of which is outlined below.

The electrical terminals 17,18 of the coupling 3 are located at the ends of the forward and rearward portions 20,21. The terminals 11,17 of the outlet duct 8 and the forward portion 20 forms a slip ring arrangement so as to permit relative rotation. The electrical cable 19 extends between and connects the terminals 17,18 of the forward and rearward portions 20,21. From the terminal 17 provided on the forward portion 20, the cable 19 extends between the forward portion 20 and the hose 22, divides in two with each half passing through a pivot formed between the forward and rearward portions 20,21, and extends between rearward portion 21 and the hose 22.

The floor tool 1 is intended to be used with a cleaning appliance that carries fluid to and/or from a surface, e.g. wet/dry vacuum cleaners, polishing/waxing machines and

carpet shampoo machines. The floor tool 1 is manoeuvred over the surface to be cleaned by means of a duct of the cleaning appliance. The duct includes an electrical terminal that mates with the electrical terminal 18 provided on the rearward portion 21. Electrical power is thus delivered by the cleaning appliance to the motor 6 of the cleaner head 2, which in turn drives the brushbar 5 to agitate the cleaning surface and/or massage a fluid into the surface.

As the floor tool 1 is manoeuvred forwards and backwards, the forward portion 20 of the coupling 3 pivots relative to the rearward portion 21 such that the cleaner head 2 maintains a flat profile with the cleaning surface. Steering of the floor tool 1 is achieved by rotating the duct of the cleaning appliance, which in turn causes the rearward portion 21 of the coupling 3 to rotate about its longitudinal axis. When manoeuvring the floor tool 1, the rearward portion 21 is normally angled relative to the forward portion 20. Consequently, as the rearward portion 21 rotates about its longitudinal axis, the forward portion 20 is caused to precess about the longitudinal axis of the rearward portion 21. Owing to the weight of the cleaner head 2, as well as the pivot formed between the forward and rearward portions 20,21, rather than precessing in a cone-like manner, the forward portion 20 precesses in a plane parallel to the cleaning surface. The net result is that the cleaner head 2 moves to the right or left in response to clockwise or anticlockwise rotation of the duct of the cleaning appliance. As the cleaner head 2 moves to the right or left, the outlet duct 8 rotates relative to the forward portion 20 such that the cleaner head 2 maintains a flat profile with the cleaning surface.

As the floor tool 1 is manoeuvred forwards and backwards, the wheels 15,16 of the coupling 3 rotate to provide a rolling support for the conduit 14. In response to steering the floor tool 1, the forward portion 20 rotates about its longitudinal axis. As the forward portion 20 rotates, one of the two wheels 15,16 maintains contact with the cleaning surface and thus continues to provide rolling support for the conduit 14. The surfaces of the wheels 15,16 are coincident with a common sphere 30, the centre of which is coincident with the longitudinal axis of the forward portion 20. Consequently,

as the forward portion 20 rotates about its longitudinal axis, the wheels 15,16 continue to support the forward portion 20 at the same height above the cleaning surface. No lifting of the cleaner head 2 therefore occurs and a flat profile with the cleaning surface is maintained.

The rolling support provided by the wheels 15,16 describes an arc in the plane normal to the longitudinal axis of the forward portion 20. This arcuate rolling support includes a small discontinuity at the gap between the two wheels 15,16. The discontinuity, however, is sufficiently small that, from the point of view of a user, the rolling support feels continuous.

Since the floor tool 1 is moved predominantly in a forward and backward direction, ease of movement would be greatest if both wheels 15,16 were to rotate about a single horizontal axis. However, if the wheels 15,16 were to rotate about a single horizontal axis, hemispherical wheels would be required in order to provide a continuous rolling support. Such an arrangement would leave no space for the conduit 14 to pass between the wheels 15,16. The angle by which the rotational axes 27,28 are tilted is therefore ideally as small as possible whilst permitting sufficient space for the conduit 14 to pass between the wheels 15,16. The angle of tilt will thus depend upon the diameter of the conduit 14 as well as the diameter of the common sphere 30 coincident with the wheel surfaces. By way of example, Figure 7 illustrates two arrangements in which (a) a small diameter conduit 14 and (b) a large diameter conduit 14 are employed; in both arrangements, the diameter of the common sphere 30 of the wheels 15,16 is the same.

As can be seen in Figure 4, the rearward portion 21 is pivotally attached to the forward portion 20 at points directly above those points at which the wheels 15,16 are attached to the forward portion 20. Consequently, the overall length of the conduit 14 may be kept to a minimum, resulting in a more compact floor tool 1. Nevertheless, the points at which the rearward portion 21 attaches to the forward portion 20 may be located elsewhere.

In the embodiment described above, the cleaner head 2 includes a brushbar 5 that is driven by a motor 6. However, the cleaner head 2 may include alternative means for agitating or otherwise working a surface to be cleaned. By way of example, the brushbar 5 may be driven by an air turbine rather than a motor. Alternatively, the brushbar 5 and motor 6 may be omitted altogether from the cleaner head 2. There are therefore applications for which the electrical terminals 17,18 and cable 19 may be omitted from the coupling 3.

Wheels 15,16 having surfaces that are coincident with a common sphere 30 have the advantage that the forward portion 20 maintains the same height above the cleaning surface as the forward portion 20 rotates. Nevertheless, there may be applications for which it is advantageous to have a forward portion 20 that increases or decreases in height with rotation. Accordingly, it is not essential that the surfaces of the wheels 15,16 have spherical curvature or that the surfaces are coincident with a common sphere. Moreover, the dome-shaped wheels need not be continuously curved but may include a flat section at the wheel axes.

In the embodiment described above, the conduit 14 comprises a forward portion 20 pivotally attached to a rearward portion 21. The provision of a pivot has the advantage of ensuring that the cleaner head 2 maintains a flat profile with the cleaning surface as the floor tool 1 is manoeuvred back and forth. Nevertheless, there may be applications for which a pivot within the conduit 14 may not be necessary. By way of example, the outlet duct 8 of the cleaner head 2 may be pivotally attached to the remainder of the cleaner head 2. In this instance, the conduit 14 may be formed as a unitary element having an elbow or bend such that rotation of the conduit 14 continues to bring about steering of the cleaner head 2.

Whilst the cleaner head 2 and the coupling 3 are attached in a manner that is intended to prevent their separation, the two may be adapted for separable attachment. The coupling 3 may then be used with different cleaner heads to form a floor tool 1. Moreover, whilst the coupling 3 is intended to be releasably attached to a duct of a

cleaning appliance, the coupling 3 may alternatively form an integral part of the cleaning appliance. The cleaning appliance may then be used with different, interchangeable cleaner heads.

Conventional floor tools often include wheels that aid in manoeuvring the floor tool. However, movement of the floor tool is typically constrained to that along a straight line. In contrast, the floor tool 1 of the present invention can be manoeuvred in directions beyond that of a straight line.

Floor tools capable of movement beyond a straight line are known. In one example, a pair of wheels is arranged on opposite sides of a conduit attached to a cleaner head. The wheels rotate about a common horizontal axis such that, when steering the floor tool, one of the wheels lifts off the cleaning surface. Additionally, the conduit rocks to one side causing the height of the conduit above the cleaning surface to increase. This in turn causes the rear of the cleaner head to lift off the cleaning surface resulting in loss of performance. Furthermore, the lifting of the cleaner head places a strain on the arm of the user and thus repeated steering of the floor tool can become tiring. In a further example, a cleaner head is attached to a conduit carried by three wheels. A barrel-shaped wheel sits below the conduit and two larger wheels are located on opposite sides of the conduit. This arrangement has the advantage that, as the floor tool is steered left or right, the height of the conduit above the cleaning surface is unchanged and thus the cleaner head maintains a flat profile with the surface. Nevertheless, the floor tool is relatively bulky owing to the presence of three wheels. In particular, since the conduit sits on top of the barrel-shaped wheel, the height of the floor tool is relatively high. Additionally, the provision of three wheels increases the weight and cost of the floor tool.

With the floor tool of the present invention, a substantially continuous rolling support is provided by two wheels only. Accordingly, the floor tool is both lighter and cheaper than the aforementioned floor tool having three wheels. Moreover, the conduit of the floor tool passes between, rather than over, the wheels and thus the floor tool is more

compact. In particular, the floor tool is of lower height, making it well-suited at cleaning beneath structures of particularly low profile. As the floor tool is steered to the left or right, the conduit (or at least that portion of the conduit attached to the cleaner head) maintains the same height above the cleaning surface. Consequently, the cleaner head maintains a flat profile with the cleaning surface and no loss of performance occurs. Additionally, in comparison to the aforementioned floor tool having two wheels, less effort is required on the part of the user to steer the floor tool. Furthermore, the floor tool is capable of tighter turns.

CLAIMS

1. A floor tool for a cleaning appliance comprising a cleaner head rotatably attached to a conduit carried by a pair of wheels that converge beneath the conduit.

2. A floor tool as claimed in claim 1, wherein the wheels have non-parallel axes of rotation that intersect above a line passing through the wheel centres.

3. A floor tool as claimed in claim 1 or 2, wherein the wheels are dome-shaped.

4. A floor tool as claimed in any one of the preceding claims, wherein the wheels provide a substantially continuous arcuate support in a plane normal to a longitudinal axis of the conduit.

5. A floor tool as claimed in any one of the preceding claims, wherein the wheels are separated beneath the conduit by a gap that subtends an angle at a centre of the conduit by no more than 20 degrees.

6. A floor tool as claimed in any one of the preceding claims, wherein the wheels have surfaces of spherical curvature.

7. A floor tool as claimed in any one of the preceding claims, wherein the wheels have surfaces coincident with a common sphere.

8. A floor tool as claimed in claim 7, wherein the conduit has a longitudinal axis that is coincident with the centre of the common sphere.

9. A floor tool as claimed in any one of the preceding claims, wherein the conduit comprises a forward portion pivotally attached to a rearward portion, and the wheels are rotatably attached to the forward portion.

10. A floor tool as claimed in claim 9, wherein the conduit comprises a flexible hose that extends between the forward portion and the rearward portion.

11. A floor tool as claimed in claim 9 or 10, wherein the wheels are attached to the forward portion at a first set of points, and the rearward portion is attached to the forward portion at a second set of points located above the first set of points.

12. A floor tool for a cleaning appliance comprising a cleaner head rotatably attached to a conduit carried by a pair of dome-shaped wheels, the wheels having axes of rotation that are oriented such that the wheels converge beneath the conduit.

13. A coupling comprising a conduit carried by a pair of wheels that converge beneath the conduit, the conduit having a first end for rotatable attachment to a cleaner head and a second end for attachment to a duct of a cleaning appliance.

14. A floor tool substantially as hereinbefore described with reference to and illustrated in the accompanying drawings.

15. A coupling substantially as hereinbefore described with reference to and illustrated in the accompanying drawings.

Application No: GB0823191.2 **Examiner:** Mr Henrik Mensing

Claims searched: 1-15 **Date of search:** 19 March 2009

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 12, 13	GB 2441301 A (DYSON TECHNOLOGY LTD), see for instance page 2, lines 8-19; page 9, line 7 to page 10, line 19; page 11, lines 13-30 and figure 9-12.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A47L; B60B

The following online and other databases have been used in the preparation of this search report

EPODOC, WPI, TXTE

International Classification:

Subclass	Subgroup	Valid From
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(56) Documents Cited:
EP 0100438 A **US 4573234 A**

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UK CL (Edition X) **A4B, A4F**
INT CL **A47G, A47L, H02J**
Other: **WPI, EPODOC**
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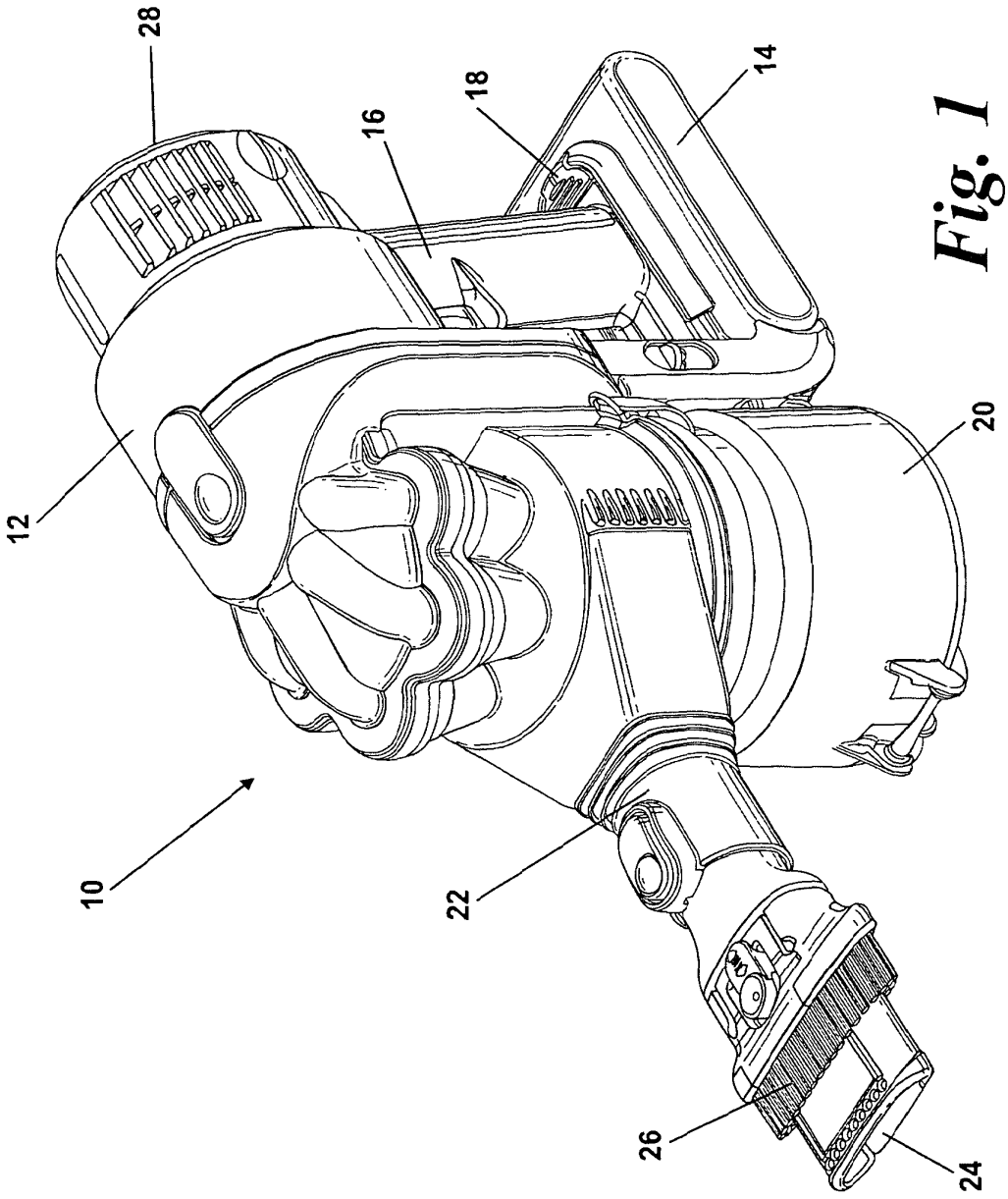
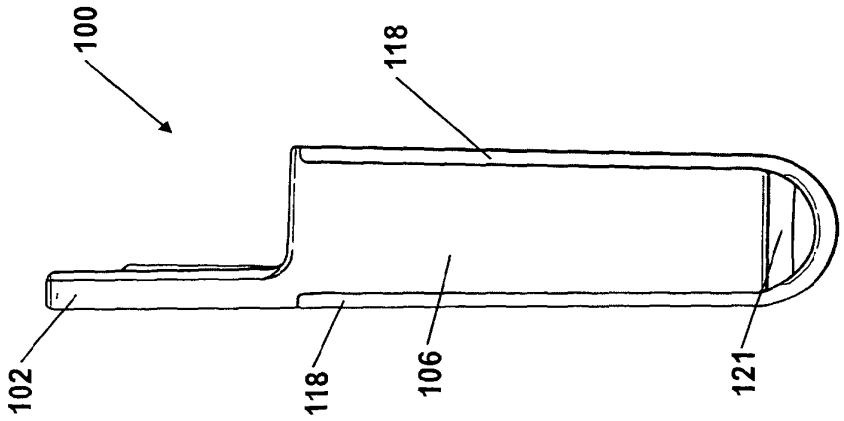


Fig. 1

Dyson Ex1020
Page 771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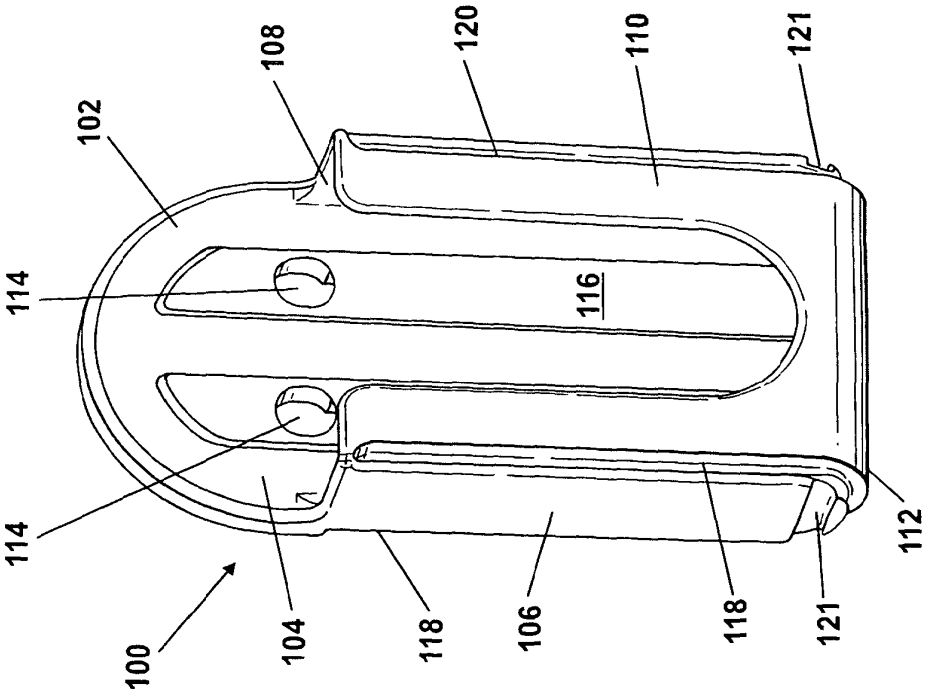
106
121

Fig. 3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118
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Fig. 2

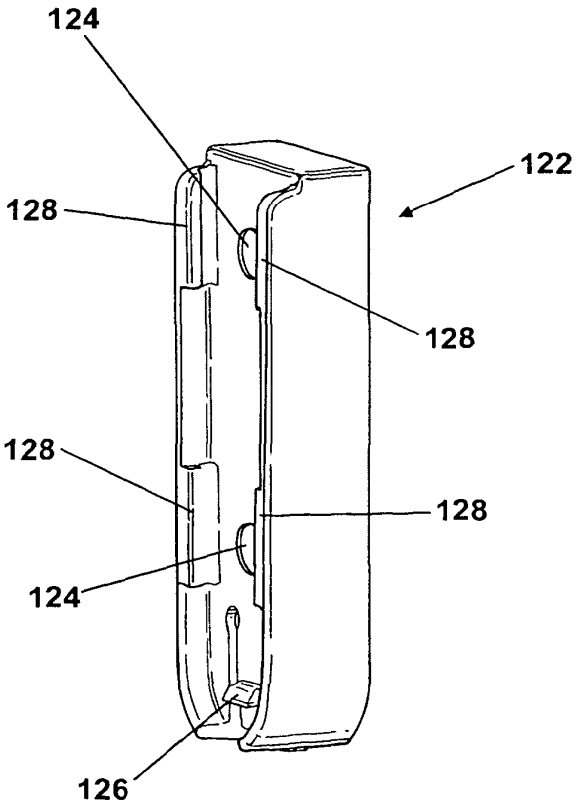

Fig. 4

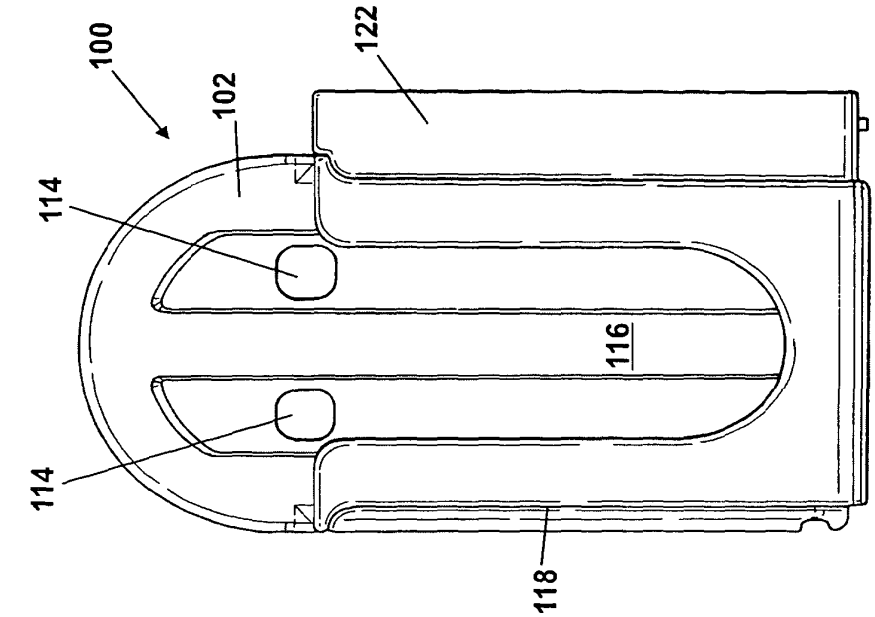

Fig. 6

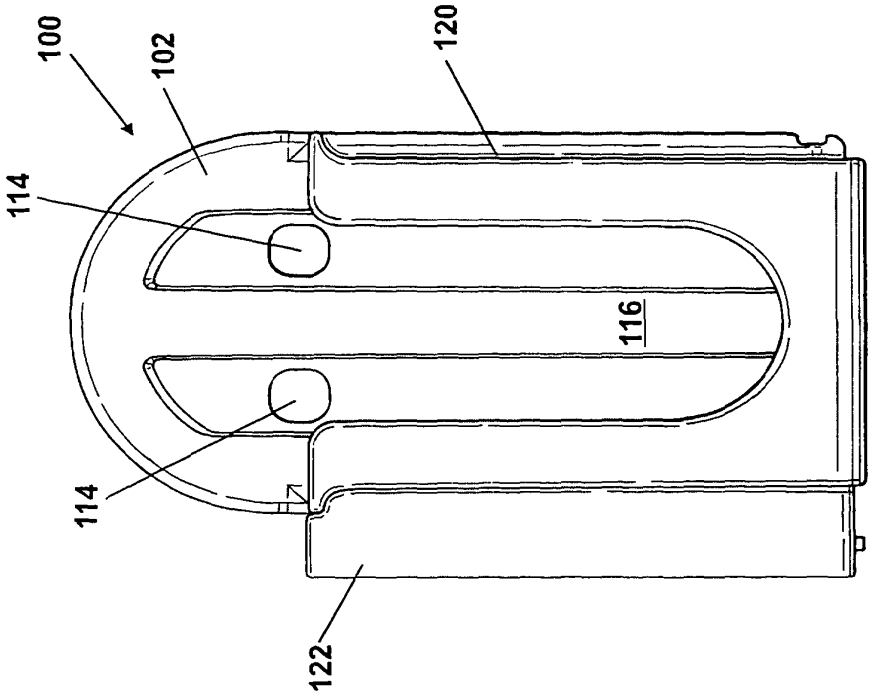

Fig. 5

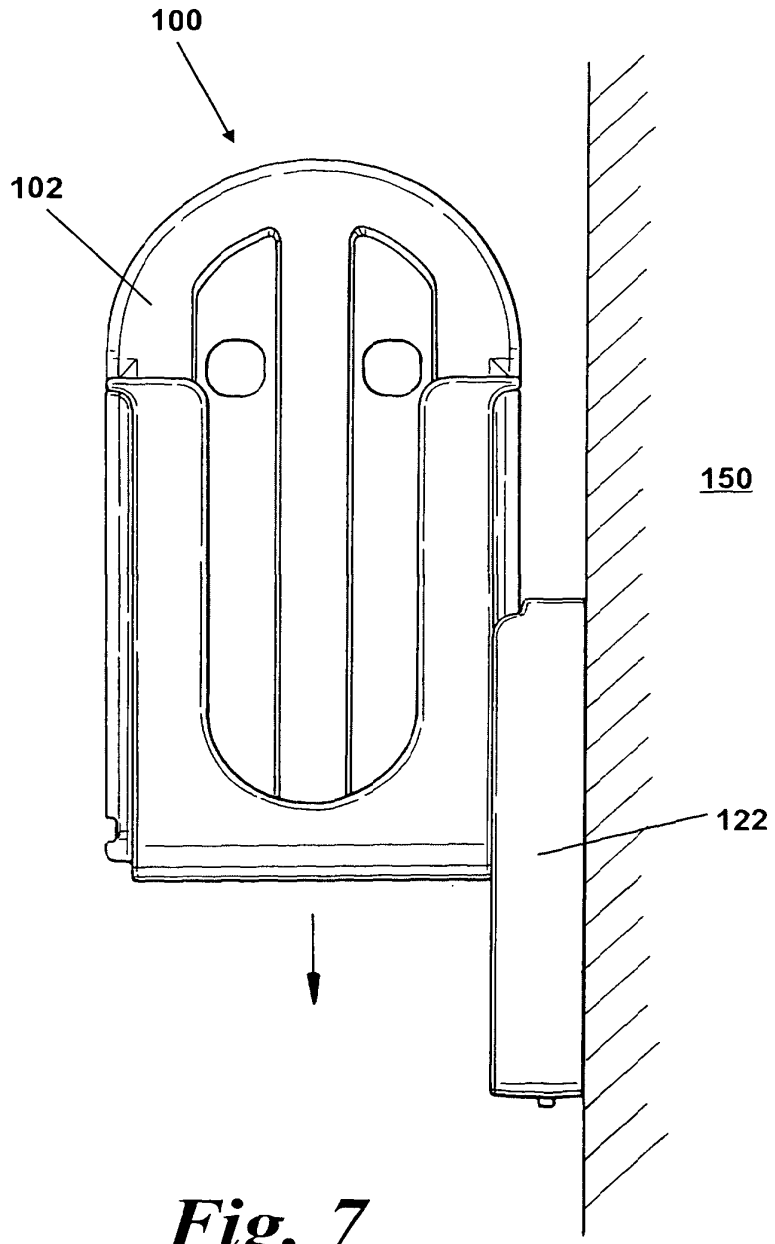

Fig. 7

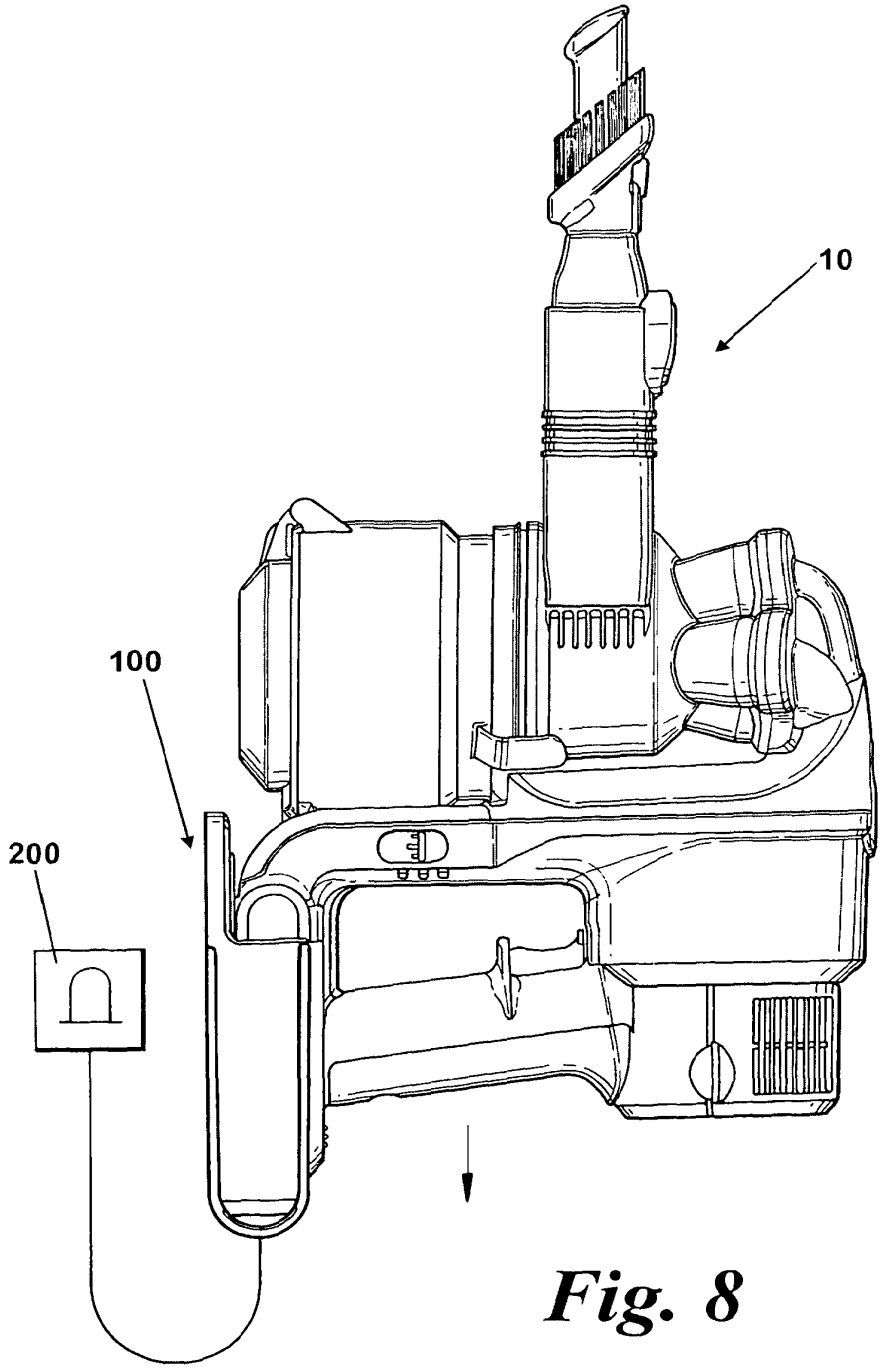

Fig. 8

A Support Device

The invention relates to a support device for a handheld cleaning appliance. Particularly, but not exclusively, the invention relates to a support device for a handheld vacuum cleaner.

Handheld vacuum cleaners are well known and have been manufactured and sold for several years. Typically, a handheld vacuum cleaner comprises a body which houses a motor and a fan unit for generating an airflow. The airflow enters the vacuum cleaner via an inlet. A separator such as a filter, bag or cyclonic separator is located downstream of the inlet to separate dirt and dust from the airflow. Further, it is common for a handheld vacuum cleaner to be battery powered. In many cases, a rechargable battery is provided. An example of this type of vacuum cleaner is shown in GB 1 207 278.

Handheld vacuum cleaners are often of a relatively small size when compared to upright or cylinder vacuum cleaners. Further, they are often required to be easily accessible for spot cleaning or other such cleaning tasks. Therefore, it is useful and practical to store a handheld vacuum cleaner on a support surface such as an internal wall where it can easily be reached. It is known to provide a support device for a handheld vacuum cleaner in order to achieve this. Further, it is known to provide a charger for a rechargeable battery within the support device. An example of such a support device is shown in US 4,225,814. The support device is used for storage and recharging of the handheld vacuum cleaner. The support device has a plurality of screw holes so that the support device can be secured to a support surface such as a wall.

However, a disadvantage of the type of support device disclosed in US 4,225,814 is that only one wall of the support device can be secured to a support surface. This is due in part to the shape of the support device which is elongate and flat, and in part to the provision of screw holes in only one wall of the support device. Therefore, this arrangement provides a limited number of orientations in which the support device can

be secured to a support surface and may not allow the handheld vacuum cleaner to be stored in the most convenient orientation in a home.

It is therefore an object of the invention to provide a support device for a handheld vacuum cleaner which allows the support device to be mounted on a support surface in at least two different orientations. It is a further object of the invention to provide a support surface having at least two walls which are capable of connection to a support surface so that the support device can be retained in at least two different orientations with respect to the support surface. This gives a user improved flexibility regarding storage of the handheld vacuum cleaner on a support surface.

The invention provides a support device for a handheld cleaning appliance comprising a body having a plurality of walls, a portion of the body defining a receiving portion for receiving at least a part of the handheld cleaning appliance, wherein at least two of the walls are capable of connection to a support surface so that the support device can be retained in at least two different orientations with respect to the support surface. By providing such an arrangement, a user can choose from at least two orientations of the support device (and therefore the handheld cleaning appliance when it is located in the support device) with respect to a support surface. This allows a user to select an orientation which fits most conveniently into a room or space.

The invention further provides a connector capable of being fixedly secured to the support surface. Preferably, the connector is arranged removably to receive one of the at least two walls in order to retain the support device on the support surface. By providing such an arrangement, a connector can be fixed to a support surface and the remainder of the support device can be attached thereto. This allows different orientations of the support device to be selected without the need to remove securing components such as screws or nails from the support surface.

Preferably, the connector is arranged slidably to receive one of the at least two walls. By providing a slidable engagement between the connector and the remainder of the

support device, the remainder of the support device can easily and quickly be removed from the connector without undue burden.

Preferably, the receiving portion is arranged such that, when the support device is retained on the support surface and a handheld cleaning appliance is located in the receiving portion, the handheld cleaning appliance lies alongside the support surface. By providing such an arrangement, the largest dimensions of a handheld cleaning appliance can be held parallel to the support surface. This minimises the intrusion of the handheld cleaning appliance into a room or area in which the support surface is located.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is an isometric view showing a handheld vacuum cleaner;

Figure 2 is an isometric view showing a body forming part of a support device according to the invention;

Figure 3 is a side view showing the body of Figure 2;

Figure 4 is an isometric view showing a connector forming part of the support device according to the invention;

Figure 5 is a front view showing the connector of Figure 4 attached to the body of Figure 2 in a first configuration;

Figure 6 is a front view showing the connector of Figure 4 attached to the body of Figure 2 in a second configuration;

Figure 7 is a front view showing the body of Figure 2 during attachment to the connector of Figure 4 in the second configuration; and

Figure 8 is a side view showing a support device according to the invention when supporting the handheld vacuum cleaner of Figure 1.

Figure 1 shows a handheld vacuum cleaner 10. The hand-held vacuum cleaner 10 has a main body 12 which houses a motor and fan unit (not shown). The main body 12 also includes a battery pack 14. A handle 16 is provided on the main body 12 for manipulating the hand-held vacuum cleaner 10 in use. At the base of the handle 16 is located a mounting portion 18. The mounting portion 18 is arranged to connect the battery pack 14 to the remainder of the handheld cleaning appliance 10. Cyclonic separating apparatus 20 is attached to the main body 12. An inlet pipe 22 extends from a portion of the cyclonic separating apparatus 20 remote from the main body 12. A dirty air inlet 24 is formed at the distal end of the inlet pipe 22. A brush tool 26 is slidably mounted on the distal end of the inlet pipe 22. A set of exhaust vents 28 are provided on the main body 12 for exhausting air from the hand-held vacuum cleaner 10.

In use, the motor and fan unit draws a flow of dirt- and dust-laden air into the dirty air inlet 24, through the inlet pipe 22 and into the cyclonic separating apparatus 20. The cyclonic separating apparatus 20 separates dirt and dust from the airflow. The cleaned airflow then passes through the motor and fan unit and out of the exhaust vents 28.

Figures 2 and 3 show a part of the support device 100 according to the invention. The support device 100 is suitable for use with the handheld vacuum cleaner 10 of Figure 1. The support device 100 comprises a body 102 having a rear wall 104, two side walls 106, 108, a front wall 110 and a base wall 112. A pair of holes 114 is formed in the rear wall 104. The holes 114 are arranged to include metallic contacts (not shown) arranged to supply power to the battery pack 14 when the handheld cleaning appliance 10 is located in the support device 100.

A part of the body 102 defines a receiving portion 116. The receiving portion 116 takes the form of a cavity defined by the front, rear, side and base walls 104, 106, 108, 110,

112. The receiving portion 116 is dimensioned to receive the battery pack 14 and mounting portion 18 of the handheld vacuum cleaner 10. The front wall 110 is shaped to abut the mounting portion 18 of the handheld vacuum cleaner 10 when the handheld vacuum cleaner 10 is inserted into the receiving portion 116.

Two channels 118 are formed on the side wall 106. One channel 118 is formed adjacent the rear wall 104 and the other channel 118 is formed adjacent the front wall 110. Two further channels 120 are formed on the opposing side wall 108. One channel 120 is formed adjacent the rear wall 104 and the other channel 120 is formed adjacent the front wall 110. Only one of the channels 120 can be seen in Figure 2. Each channel 118, 120 extends parallel to the respective side wall 106, 108. Additionally, the lower ends of each side wall 106, 108 include a notch 121.The purpose of the channels 118, 120 and the notches 121 will be described later.

It is desirable to connect the body 102 of the support device 10 shown in Figures 2 and 3 to a support surface such as a wall or cabinet. In order to connect the support device 10 to a support surface, the support device 10 further comprises a connector 122. The connector 122 is shown in Figure 4. The connector 122 includes two through-holes 124. The through-holes 124 are dimensioned to receive attachment devices such as screws or nails (not shown) so that the connector 122 can be retained on a support surface (not shown) such as a wall. The connector 122 also includes a catch 126. The catch 126 is arranged to engage with the notch 121 formed on each of the side walls 106, 108 of the support device 100.

The connector 122 further includes four lugs 128. The lugs 128 are dimensioned and arranged slidably to engage with either the two channels 116 located on the side wall 106 or the two channels 118 located on the opposing side wall 108. This is in order to attach the connector 122 to the body 102 of the support device 100 in one of two possible positions. The connector 122 is held in position on the body 102 of the support device 100 by engagement of the catch 126 with one of the notches 121.

The two possible locations of the connector 122 on the body 102 of the support device 100 are shown in Figures 5 and 6. In Figure 5, the connector 122 is shown attached to the side wall 106 in a first configuration of the support device 100. In Figure 6, the connector 122 is shown attached to the opposing side wall 108 in a second configuration of the support device 100.

In use, a user attaches the connector 122 to the support surface 150 using suitable attachment means such as screws or nails. The screws or nails are inserted through the through-holes 124 formed in the connector 122. The connector 122 is shown attached to a support surface 150 in Figure 7.

A user can choose from two configurations of the body 102 with respect to the connector 122. The choice of the configuration will determine the orientation of the support device 100 with respect to the support surface 150. Figure 7 shows the process necessary to select the second configuration of the support device 100. In use, the user slides the lugs 128 into the channels 120. The lugs 128 cooperatively engage with the channels 120 so that the body 102 of the support device 100 can be pushed down onto the connector 122 until the connector 122 and body 102 are in the relationship shown in Figure 6. At this point, the catch 126 engages with the notch 121 and the body 102 and connector 122 of the support device 100 are held in a fixed relationship. The support device 100 is now in the second configuration.

In this configuration, the support device 100 extends away from the support surface 150 into a room or area (not shown) in which the support surface 150 is located. The support device 100 is now securely attached to the support surface 150 and is ready to receive the handheld vacuum cleaner 10.

Figure 8 shows the handheld vacuum cleaner 10 of Figure 1 located in the support device 100 and being supported thereby. In order to locate the handheld vacuum cleaner 10 in the support device 100, the user holds the handheld vacuum cleaner 10 so that the

dirty air inlet 22 is pointing upwards. The user then inserts the handheld vacuum cleaner 10 into the receiving portion 116 so that the battery pack 14 is partly surrounded by the walls 104, 106, 108, 110, 112 of the body 102 of the support device 100. When correctly located, the battery pack 14 abuts the base wall 112 of the body 102 and the mounting portion 18 abuts the front wall 110 of the body 102.

When located in the support device 100, the handheld vacuum cleaner 10 lies alongside the support surface 150 (not shown in Figure 8). This is because the body 102 of the support device 100 extends perpendicularly away from the support surface 150 (Figure 7). This arrangement allows the handheld vacuum cleaner 10 to be supported by the support device 100 with minimal intrusion into the room or area in which the support surface 150 is located. Additionally, the battery pack 14 may be charged by a power source 200 which is connected to the support device 100. Arrangements for charging a battery pack are known in the art and will not be described further here.

The invention is not limited to the precise details of the embodiment described above. For example, the support device need not include a connector. Through-holes for the introduction of screws, nails or other attachment devices may be provided in at least two of the walls of the body of the support device. This allows the support device to be directly connected to the support surface.

Additionally, more than two alternative configurations of the support device may be possible. Any number of configurations may be used, for example, the rear wall of the body of the support device could be capable of connection to the support surface.

Alternatively, more than one connector may be provided. This may be necessary if, for example, the handheld vacuum cleaner is very heavy or the weight of the handheld vacuum cleaner needs to be spread out over a greater area. This may occur when attempting to fix the support device to an internal partition wall or other relatively weak structure.

The invention is applicable to all types of handheld cleaning appliance, for example, floor polishers, floor sweepers and wet/dry machines. What is important is that the support device has at least two walls which are capable of connection to a support surface so that the support device can be retained in at least two different orientations with respect to the support surface.

CLAIMS

1. A support device for a handheld cleaning appliance comprising a body having a plurality of walls, a portion of the body defining a receiving portion for receiving at least a part of the handheld cleaning appliance, wherein at least two of the walls are capable of connection to a support surface so that the support device can be retained in at least two different orientations with respect to the support surface.

2. A support device as claimed in claim 1, wherein the at least two walls can each be fixedly secured to the support surface.

3. A support device as claimed in claim 1, further comprising a connector capable of being fixedly secured to the support surface, wherein the connector is arranged removably to receive one of the at least two walls in order to retain the support device on the support surface.

4. A support device as claimed in claim 3, wherein the connector is arranged slidably to receive one of the at least two walls.

5. A support device as claimed in any one of the preceding claims, wherein the receiving portion is arranged such that, when the support device is retained on the support surface and a handheld cleaning appliance is located in the receiving portion, the handheld cleaning appliance lies alongside the support surface.

6. A support device as claimed in any one of the preceding claims, wherein the receiving portion is arranged such that, when the support device is retained on the support surface, the support device extends away from the support surface.

7. A support device as claimed in any one of the preceding claims, wherein the receiving portion takes the form of a cavity arranged to surround at least a part of the handheld cleaning appliance.

8. A support device as claimed in any one of the preceding claims, further comprising a power source for supplying power to charge a battery forming part of the handheld cleaning appliance.

9. A support device as claimed in any one of the preceding claims, wherein the handheld cleaning appliance is a handheld vacuum cleaner.

10. A support device substantially as hereinbefore described with reference to the accompanying drawings.

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(21) Application No: **0025497.9**

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ONLINE: WPI EPODOC JAPIO
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FIG.1

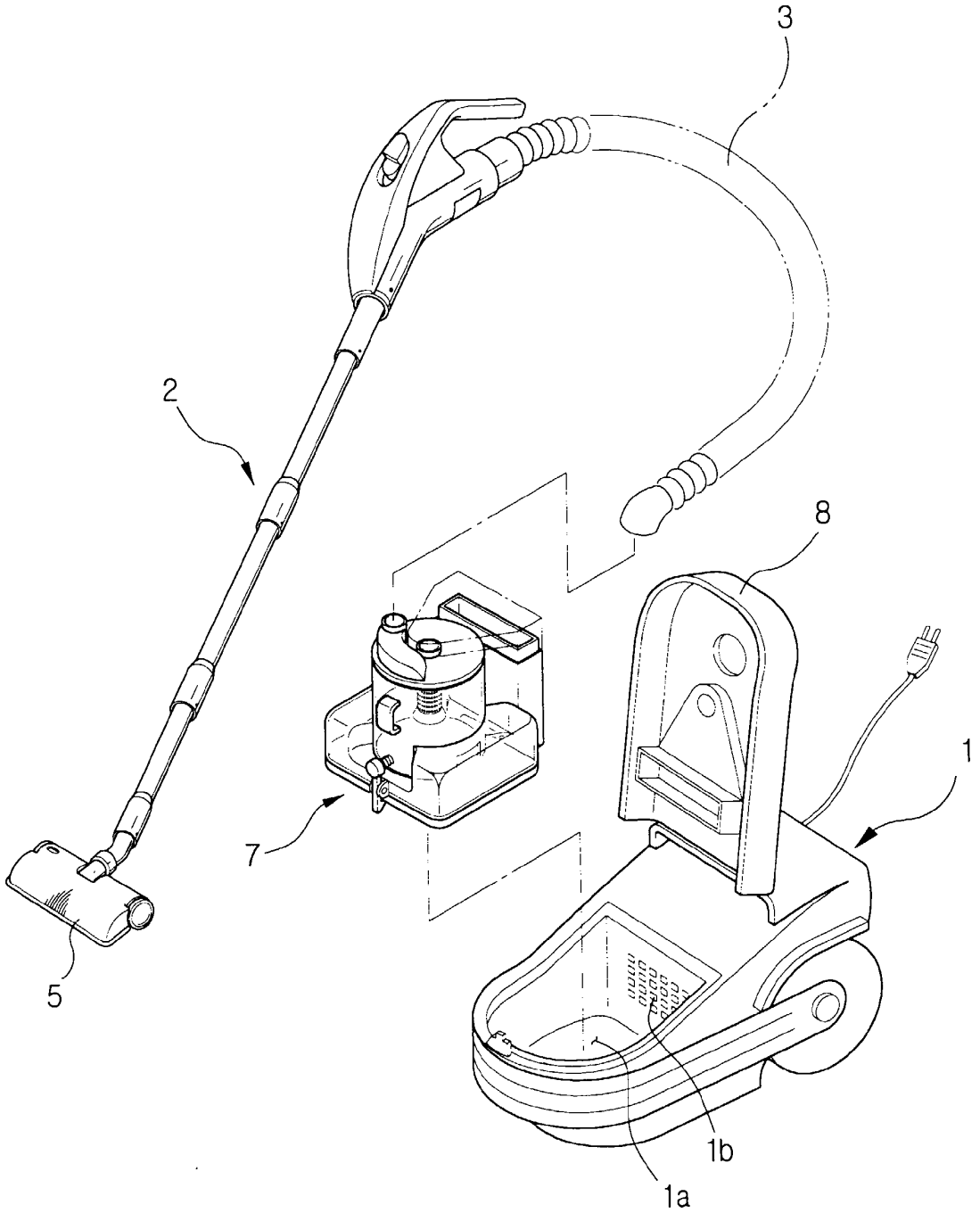

FIG.2

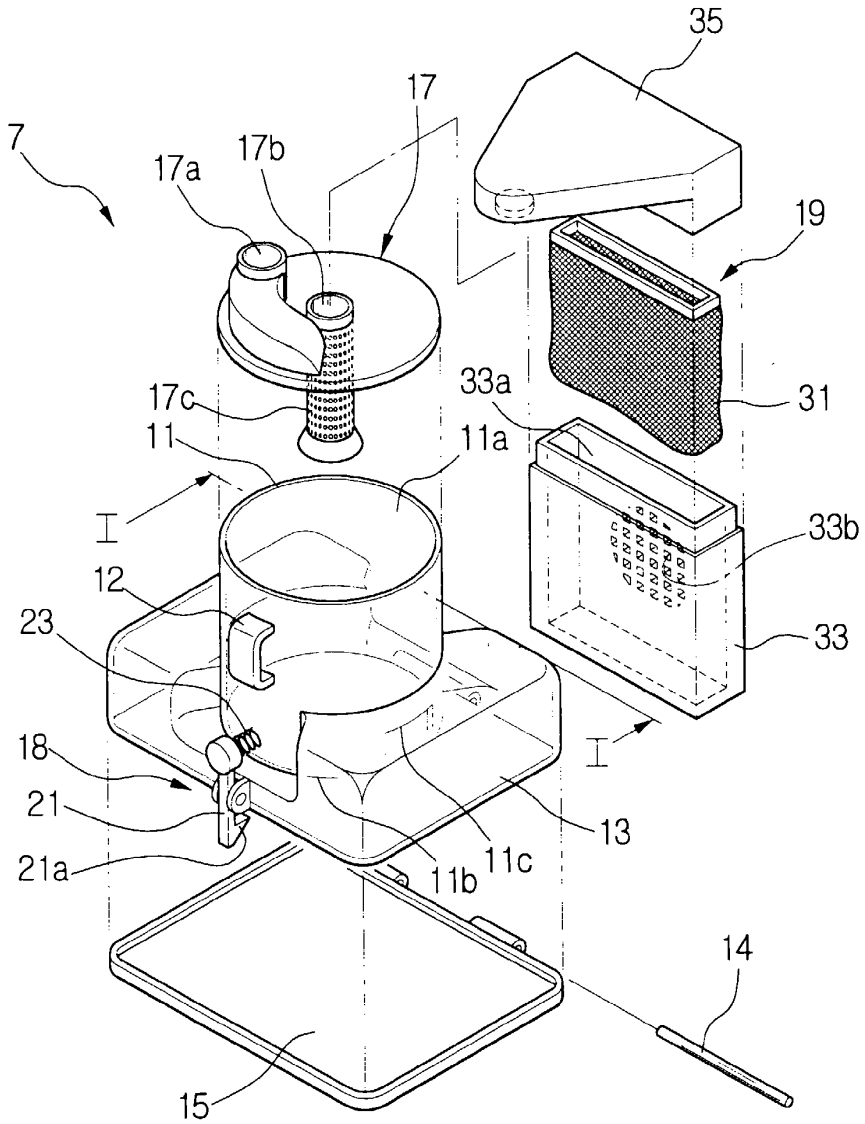
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FIG.3

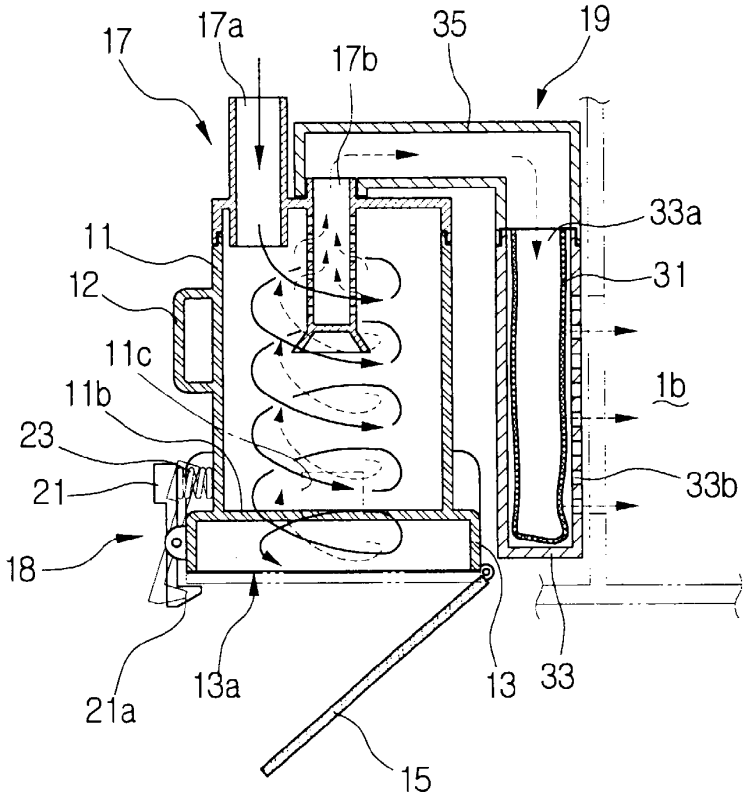
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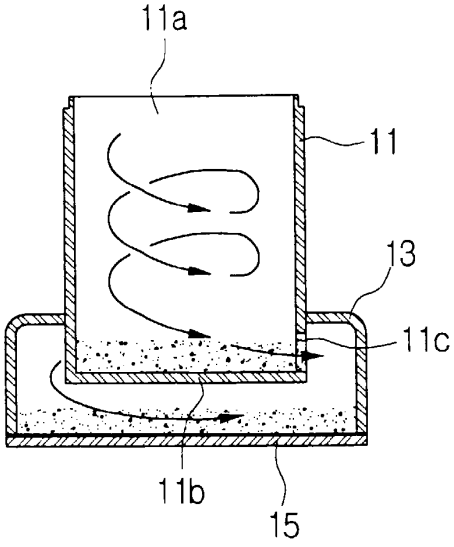
FIG.4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2365324

VACUUM CLEANER HAVING CYCLONE TYPE DUST COLLECTING APPARATUS

The present invention relates to a vacuum cleaner having cyclone type dust collecting apparatus that separates by centrifugal force contaminants from the air drawn into the vacuum cleaner.

Generally, vacuum cleaners such as upright type, canister type cleaners or the like, have a suction head or brush that is connected to the body of the vacuum cleaner and moves along on the cleaning surface. The body of the cleaner includes a dust collecting chamber, in which a dust filter is detachably mounted, and a motor chamber, in which a motor for generating the suction force is mounted. The suction force draws air and any dust or dirt on the cleaning surface into the cleaner body. The air is discharged from the cleaner after passing through the dust filter. The various contaminants in the air are filtered out by the dust filter, while the clean air is discharged to the environment.

A disadvantage of a structure in which contaminants are filtered and collected by an expendable dust filter is that when the dust filter is clogged with contaminants, the filter has to be replaced and the user must manually remove the used, dirty filter and insert a new one, which is both inconvenient and unhygienic.

According to a first aspect of the invention, a vacuum cleaner comprises a cleaner body having a motor driving chamber and a dust collecting chamber in communication with the motor driving chamber; a suction brush through which contaminants and air are drawn in; and cyclone type dust collecting means mounted in the dust collecting chamber for separating the contaminants from the air by a centrifugation, the cyclone type dust collecting means comprising: a hollow cylindrical cyclone body having a cylindrical outer surface, an open top, a closed bottom, and a contaminant outlet, the open top allowing air and contaminants into the cyclone body, the cyclone body separating contaminants from the air by centrifugation, the contaminant outlet allowing the contaminants that have been separated from the air by centrifugation to pass through; a contaminant receptacle covering the bottom and a portion of the cylindrical outer surface of the cyclone body, the contaminant receptacle collecting the contaminants discharged through the contaminant outlet; a base member pivotally coupled to the bottom of the contaminant receptacle; and a cover for covering the top of the cyclone body, the cover having an air inlet passage through which air and contaminants drawn in through the suction brush enter into the cyclone body, an air outlet passage through which the air is discharged from the cyclone body, and a contaminant

separating grille, the grille extending downwardly from the air outlet passage and having a plurality of fine holes.

The invention will now be described by way of example with reference to the drawings in which:

Figure 1 is a perspective view of a vacuum cleaner in accordance with the invention, having cyclone type dust collecting apparatus;

Figure 2 is an exploded, perspective view of the dust collecting apparatus of Figure 1;

Figure 3 is a sectional view of the dust collecting apparatus of Figure 2 in an assembled state; and

Figure 4 is a cross-sectional view taken generally along the line I-I of Figure 2.

Referring to Figure 1, a vacuum cleaner includes a body 1, a suction head or brush 5 connected to the body 1 through a connecting tube 2 and a connecting hose 3, and a cyclone dust collecting device 7.

The cleaner body 1 includes a dust collecting chamber 1a, in which the cyclone dust collecting device 7 is nested, and a motor chamber (not shown) in which a motor (not shown) is nested. The motor driving chamber and the dust collecting chamber 1a communicate with each other. The motor generates a strong suction force, which enables the suction head 5 to draw in contaminants on the cleaning surface. The suction head 5 is connected via the connecting tube 2 and the connecting hose 3 to the dust collecting device 7, which is located in the dust collecting chamber 1a. Here, a cover 8 is attached to the cleaner body 1 to cover the cyclone dust collecting device 7, when the dust collecting device 7 is in the dust collecting chamber 1a. The cover 8 can be opened and closed.

The dust collecting device 7 separates by centrifugal force and collects contaminants from the air that is drawn into the vacuum cleaner through the suction head 5 and is detachably nested in the dust collecting chamber 1a. As shown in Figures 2, 3, and 4, the cyclone dust collecting device 7 includes a cyclone body 11, a contaminant receptacle 13, a base member 15, and a cover 17.

The cyclone body 11 is hollow and substantially cylindrical, with a predetermined inner diameter. It has an open top 11a, a closed bottom 11b, a handle 12 formed on the outer surface of the body 11, and a contaminant outlet 11c of a predetermined size formed on the lower portion of the cyclone body 11. Accordingly, contaminants in the air, drawn

into the upper portion of the cyclone body 11 are separated from the air by centrifugation and discharged into the contaminant receptacle 13 through the contaminant outlet 11c.

References herein to "top", "bottom", "upper" "lower" and so on are to be construed as relating to the orientation or position of components of the cleaner when the cleaner is in its normal operating orientation.

The contaminant receptacle 13, which serves as a collection place for the contaminants that have been discharged through the contaminant outlet 11c, covers the bottom 11b of the cyclone body 11 and partly surrounds the outer circumference of the cyclone body 11. The receptacle 13 communicates with the cyclone body 11 exclusively through the contaminant outlet 11c, and has an open bottom 13a which can be opened and closed by a base member 15 mounted on the lower end of the receptacle 13 so that collected contaminants can be removed from the receptacle 13. The base member 15 is spaced apart from the bottom 11b of the cyclone body 11 by a predetermined distance. Accordingly, a predetermined space is defined between the base member 15 and the cyclone body 11. One end of the base member 15 is pivotally mounted on the lower portion of the contaminant receptacle 13 by a hinge shaft 14 to allow contaminant removal. For this purpose, a locking device 18 is also provided to lock or unlock the unhinged edge of the base member 15 to permit the base member 15 to selectively cover or uncover the bottom 13a of the contaminant receptacle 13.

The locking device 18 includes a pivot member 21 having a hook 21a for contacting and supporting the unhinged edge of the base member 15, and a spring 23. The pivot member 21 is pivotally mounted on an outer side of the contaminant receptacle 13 and resiliently biased by the spring 23 in a manner such that the hook 21a of the pivot member 21 is positioned at the bottom 13a of the contaminant receptacle 13. Further, the spring 23 is disposed between the contaminant receptacle 13 and the pivot member 21 to bias the other end of the pivot member 21. Accordingly, as indicated by the phantom lines in Figure 3, the base member 15 is locked in the hook 21a so as to cover the bottom 13a of the contaminant receptacle 13.

The cover 17 is connected to and covers the top 11a of the cyclone body 11 and includes an air inlet passage 17a, an air outlet passage 17b, and a contaminant separating grille 17c, all of which communicate with the cyclone body 11. The air inlet passage 17a guides air, drawn in through the suction head 5, the connecting tube 2 and the connecting hose 3, into the cyclone body 11. The air inlet passage 17a extends tangentially towards the

interior of the cyclone body 11 to generate a vortex with the air drawn into the cyclone body 11. After the air and the contaminants are drawn through the air inlet passage 17a, and the contaminants are separated from the air by centrifugation, and clean air is discharged through the air outlet passage 17b. The air outlet passage 17b is formed in the middle portion of the cover 17. The contaminant separating grille 17c extends downwardly from the air outlet passage 17b a predetermined depth into the cyclone body 11, and has a plurality of fine holes for preventing the discharge of dust or contaminants.

As a preferred feature, a filtering section 19 is provided to filter the air which blows through the air outlet passage 17b toward the motor chamber 1b. The filtering section 19 includes an air filter 31, a filter case 33, and an air duct 35. The filter case 33, which houses the air filter 31, includes an air inlet 33a and an air outlet 33b. The air discharged from the air outlet passage 17b of the cyclone body 11 flows through the air inlet 33a, which is formed in the upper portion of the filter case 33. The air filter 31 is removably inserted into the filter case 33 through the air inlet passage 33a. The air outlet passage 33b is formed on the side of the filter case 33 that faces the motor driving chamber 1b, when the filter case 33 is mounted in the dust collecting chamber 1a. The air duct 35 connects the air outlet passage 17b with the air inlet 33a of the filter case 33. As shown in Figure 1, the air duct 35 is formed in the cover 8 for the dust collecting chamber 1a. Accordingly, by closing or opening the cover 8, the air duct 35 can be respectively connected to or disconnected from the air outlet passage 17b and the air inlet 33a.

The operation of the dust collecting apparatus will now be described.

Firstly, when the vacuum cleaner is on, the motor generates a strong suction force at the suction head 5. This suction force draws in air and contaminants on the cleaning surface through the suction head 5, connecting tube 2 and connecting hose 3, and into the cyclone body 11. Air is drawn obliquely into the cyclone body 11 by the rotationally directing air inlet passage 17a and descends into the cyclone body 11 while creating a vortex. Accordingly, the contaminants are separated from the air by the centrifugal force of the vortex, descend along the interior of the cyclone body 11, and are discharged to the contaminant receptacle 13 through the contaminant outlet 11c. Here, since the contaminants discharged into the contaminant receptacle 13 accumulate below the lower portion of the cyclone body 11, the reverse flow of contaminants into the cyclone body 11 through the contaminant outlet 11c, formed in the upper portion of the contaminant receptacle 13 is prevented.

Meanwhile, after the contaminants have been separated from the air, the clean air is discharged through the fine holes of the grille 17c and the air outlet passage 17b, and is drawn into the filter case 33 through the air duct 35. The air is then filtered as it passes through the air filter 31. Accordingly, even minute contaminants, which cannot be separated by the centrifugation, are captured by the air filter 31. The filtered air is then discharged to the environment after passing through the motor driving chamber 1b.

When the contaminant receptacle 13 is filled with contaminants, the user opens the cover 8 on the cleaner body 1. The air duct 35, which is formed in the cover 8, separates from the air outlet passage 17b of the cover 17 and the filter case 33. In this detached state, the user can access the cyclone device 7 in the dust collecting chamber 1a. By pressing the end of the pivot lever 21, the hook 21a disengages from the end of the base member 15 and, as shown in Figure 3, the base member 15 is free to open, exposing the bottom 13a of the contaminant receptacle 13. With the bottom 13a of the contaminant receptacle 13 open, the contaminants that have accumulated in the contaminant receptacle 13 can be removed. After dumping out the contaminants, the contaminant receptacle 13 can be closed by pushing the base member 15 up to the bottom of the 13a of the contaminant receptacle 13. The base member 15 is held in place by re-locking the hook 21a.

The air filter 31 can also be replaced by removing the old air filter and inserting a new one through the open air inlet 33a of the filter case 33.

Although the preferred embodiment of the present invention depicts a canister type vacuum cleaner (see Figure 1), it will be clearly understood that the cyclone type dust collecting apparatus of the invention also can be employed in other types of vacuum cleaners, such as the upright type vacuum cleaners or the like.

As explained above, since, in the described cyclone type dust collecting apparatus the contaminant receptacle is located below the lower portion of the cyclone body 11, the contaminants that have been discharged into the contaminant receptacle 13 cannot flow back into the cyclone body 11.

In addition, the apparatus improves the cleaning efficiency of the vacuum cleaner by providing a two-step contaminant separation process. The contaminants are first separated from the air by centrifugation in the cyclone body 11. After that, minute contaminants, which were not separated during the centrifugation process, are captured by the filtering section 19.

CLAIMS

1. A vacuum cleaner comprising:

a cleaner body having a motor driving chamber and a dust collecting chamber in communication with the motor driving chamber;

a suction brush through which contaminants and air are drawn in; and

cyclone type dust collecting means mounted in the dust collecting chamber for separating the contaminants from the air by a centrifugation, the cyclone type dust collecting means comprising:

a hollow cylindrical cyclone body having a cylindrical outer surface, an open top, a closed bottom, and a contaminant outlet, the open top allowing air and contaminants into the cyclone body, the cyclone body separating contaminants from the air by centrifugation, the contaminant outlet allowing the contaminants that have been separated from the air by centrifugation to pass through;

a contaminant receptacle covering the bottom and a portion of the cylindrical outer surface of the cyclone body, the contaminant receptacle collecting the contaminants discharged through the contaminant outlet;

a base member pivotally coupled to the bottom of the contaminant receptacle; and

a cover for covering the top of the cyclone body, the cover having an air inlet passage through which air and contaminants drawn in through the suction brush enter into the cyclone body, an air outlet passage through which the air is discharged from the cyclone body, and a contaminant separating grille, the grille extending downward from the air outlet passage and having a plurality of fine holes.

2. A vacuum cleaner according to claim 1, further comprising filtering means for filtering the air which is discharged through the air outlet.

3. A vacuum cleaner according to claim 2, wherein the filtering means comprises:

an air filter;

a filter case housing the air filter, the filter case having an air inlet and an air outlet, the air outlet communicating with the motor driving chamber, the filter case being mounted in the dust collecting chamber; and

an air duct for connecting the air outlet passage to the air inlet of the filter case.

4. A vacuum cleaner according to claim 3, wherein the air duct is formed in a door of the vacuum cleaner, the door being hingedly connected to the cleaner body to open or close the dust collecting chamber, wherein the air duct is disconnected from or connected to the air outlet passage and air inlet when the door is opened or closed, respectively.

5. A vacuum cleaner according to any preceding claim, wherein one end of the base member is hingedly connected on a lower end of the contaminant receptacle, and the other end of the base member is connected to the contaminant receptacle by a locking means, whereby the bottom of the contaminant receptacle is closed or opened by respectively locking or unlocking the base member.

6. A vacuum cleaner according to claim 5, wherein the locking means comprises:

a pivot member pivotally formed on an outer side of the contaminant receptacle, the pivot member having a hook formed on one end for preventing free fall of the end of the base member; and

a spring for biasing the pivot member in a manner such that the hook supports the base member.

7. A vacuum cleaner constructed and arranged substantially as herein described and shown in the drawings.

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(54) Particle collection systems

(57) A particle collection system comprises a series of parallel troughs 11, 12 in a blast room floor for receiving particles therein. Collection ducts 15, 16 receive particles from the troughs 11, 12, and air flow inducers 19, 20 connected to the collection ducts 15, 16 induce relatively large volume carrier air flows at relatively low pressure in the collection ducts 15, 16 in response to relatively small volume control air flows at relatively high pressure to draw particles along the collection ducts into common recovery conduit 31 along which the particles are conducted towards a particle collection zone. The air requirement of such a system is relatively low, and thus the capacity of associated air components, such as a fan or cyclone, may be lower than would otherwise be required, so that the system as a whole is economical both to install and to run.

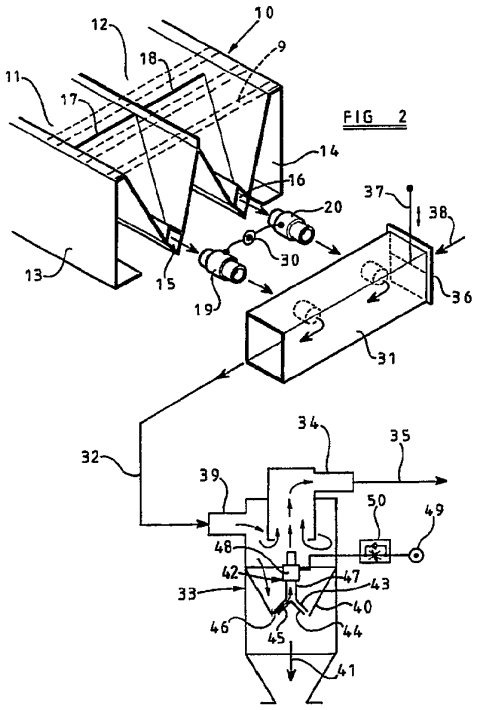

FIG 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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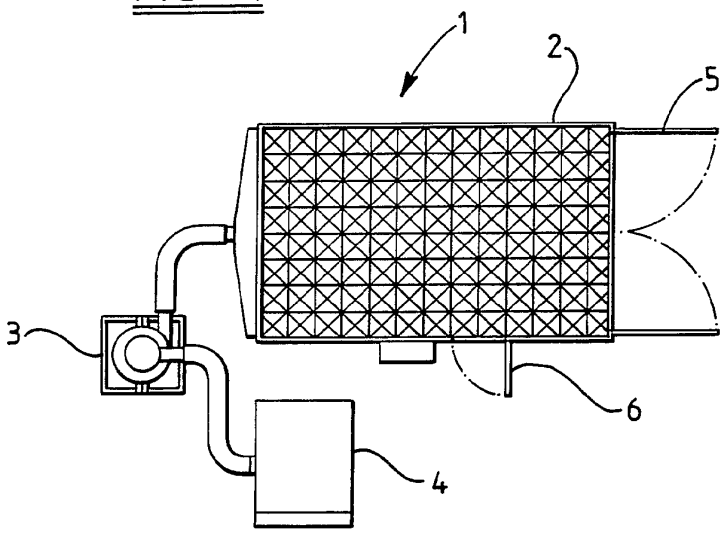
FIG 1



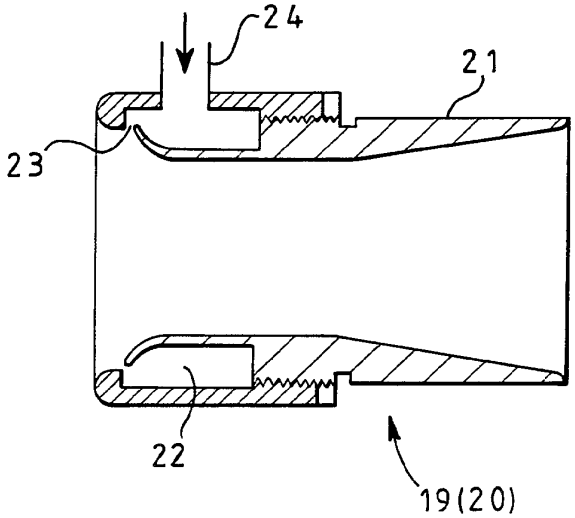


FIG 3

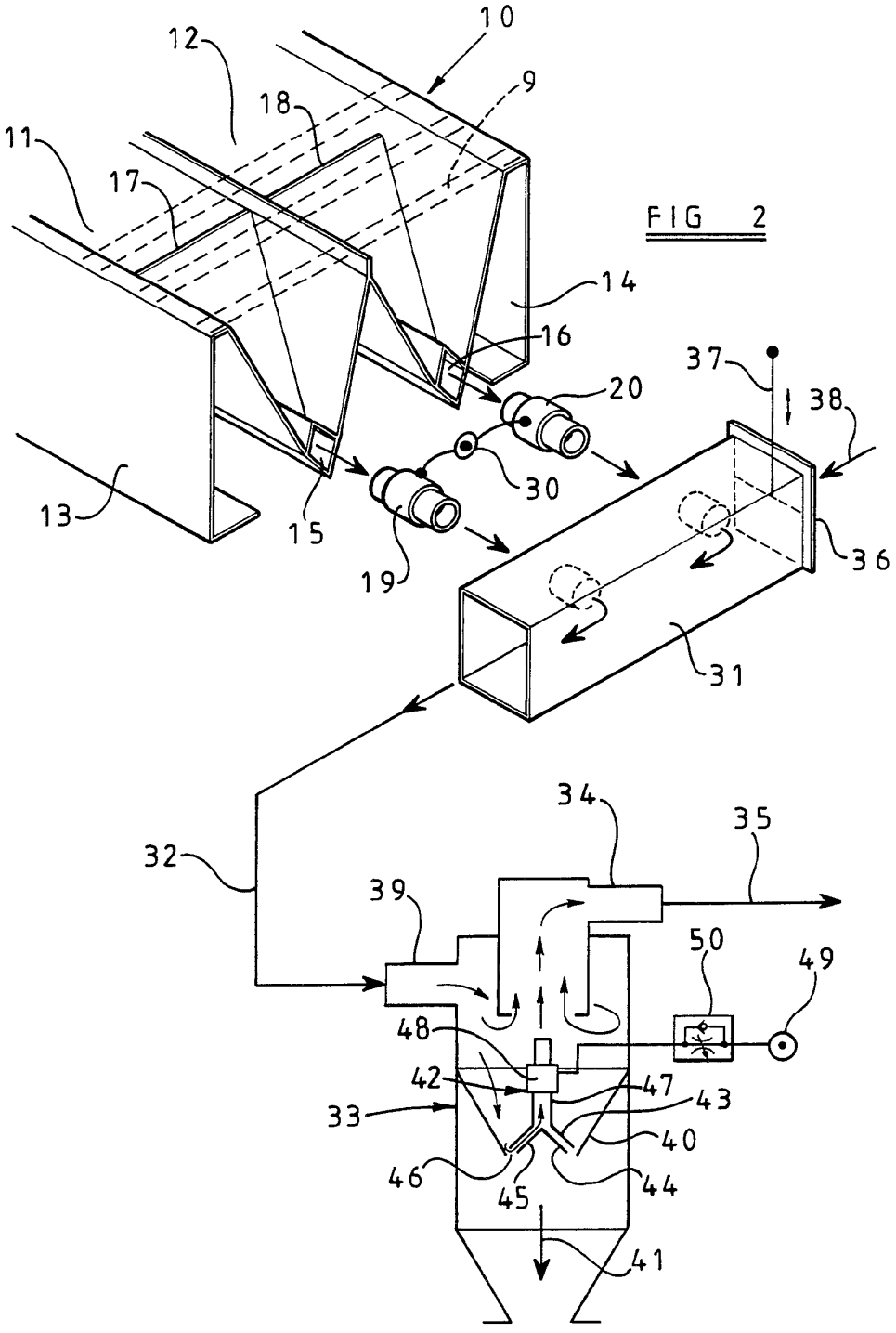

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FIG 2

FIG 4

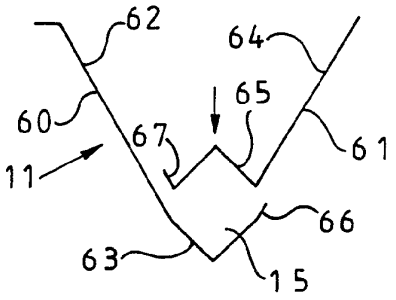


FIG 7

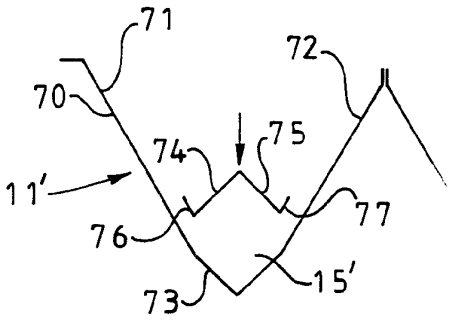
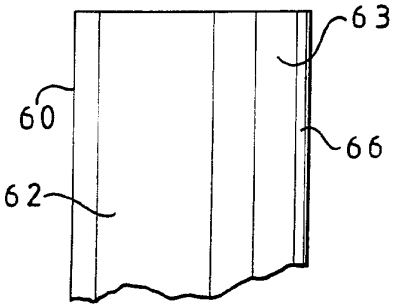


FIG 5



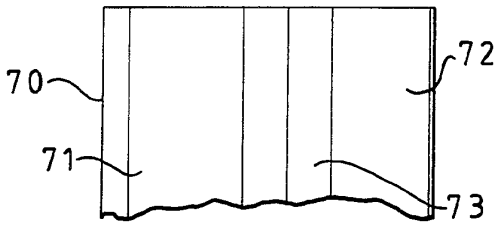
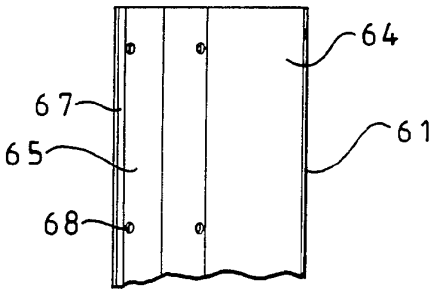


FIG 8

FIG 6



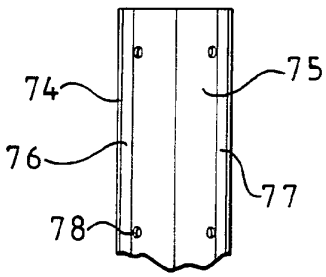


FIG 9

"Particle Collection Systems"

This invention relates to particle collection systems, and is concerned more particularly, but not exclusively, with such systems for the collection and recycling of the particles used in a peening or coating removal process in which a surface to be treated is impacted by such particles.

It is known to remove a coating, such as a layer of paint, from a surface to be treated by blasting the surface with a stream of metal or plastics particles fired from a particle gun. Paint removal by use of such a surface blasting process is particularly advantageous in certain fields as it eliminates the need to use hazardous paint-removing solvents and is capable of removing paint layers with particular accuracy so that, for example, it is often possible to use such a process to remove an outer paint layer whilst leaving an inner paint layer intact. A similar surface blasting process can be used to counteract the effects of the stress induced in a machined surface by the machining of such a surface. Such a process, which is commonly referred to as peening, is highly effective in increasing the service life of machined parts which are subjected to high stress in use, such as certain aircraft parts.

In order to contain both the particles used in such a surface blasting treatment process and the material removed from the surface, it is usual to provide a specially adapted blast room within which the object to be treated is accommodated. Such a blast room will generally include a

floor incorporating particle collection ducts into which pass the particles which have been used in, and the material which has been removed by, the blasting process and along which the particles and entrained material are conducted by an air flow towards a cyclone which separates the particles from the air flow and also from the entrained material and returns the particles to a particle collection zone to permit them to be used again in the surface blasting process. The air flow which is used to conduct the particles through the particle collection system is induced by a fan, and the size of the fan, as well as the size of the cyclone used to subsequently separate the particles from the air flow, is dependent on the size of the particle collection area provided in the floor of the blast room. Thus, where a blast room having a large particle collection area is required for the treatment of large objects, a large fan and a large cyclone are required, and these significantly increase both the installation costs and the running costs of the blast room.

It is an object of the invention to provide a particle collection system which has a lower air requirement than prior systems of comparable capacity, and which can accordingly be used with a smaller fan and/or smaller cyclone than such prior systems.

According to the present invention there is provided a particle collection system comprising trough means for receiving particles therein, collection duct means associated with the trough means for receiving particles from the trough means, air flow induction means for inducing a relatively

large volume carrier air flow at relatively low pressure in the collection duct means in response to a relatively small volume control air flow at relatively high pressure in order to draw particles along the collection duct means in the carrier air flow, and air conduit means into which the particles are drawn in the carrier air flow from the collection duct means and along which the particles are conducted towards a particle collection zone.

Such a particle collection system is particularly advantageous when used for recycling of particles used in a surface blasting process as referred to above, in which case the trough means will generally be incorporated in the floor of a specially adapted blast room. In this case the particles which are received by the trough means will include both the particles used for blasting and also entrained material which has been removed by the blasting process. Because only a relatively small volume control air flow is required to induce the carrier air flow for conducting the particles along the collection duct means, the air requirement of such a system is relatively low, and thus the capacity of associated air components, such as a fan or cyclone, may be lower than would otherwise be required, so that the system as a whole is economical both to install and to run. Furthermore the control air flow may be adjustable to suite the particular requirements in use of the system.

However it should be appreciated that the particle collection system is not limited to use in a surface blasting process. In fact the system may be used in any application

in which the collection and transport of particulate material is desired.

In a preferred embodiment the trough means comprises a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles towards the bottoms of the troughs, and the collection duct means comprises a series of collection ducts each of which is provided at the bottom of a respective one of the troughs. The troughs preferably include transverse dividers spaced at intervals along their lengths.

Preferably the air flow induction means comprises a respective air flow inducer coupled to each collection duct so as to draw particles along the collection duct towards the air conduit means in a carrier air flow induced by a control air flow applied to the air flow inducer.

Furthermore it is preferred that an air controller is coupled to the air flow induction means so as to apply pulsed control air flows to the air flow inducers in a predetermined sequence so as to induce pulsed carrier air flows in the collection ducts.

In one embodiment of the invention the air flow induction means comprises a plurality of pairs of air flow inducers, and the air controller is arranged to apply a respective pulsed control air flow to each pair of air flow inducers separately from each of the other pairs of air flow inducers and to apply such control air flows to the pairs of air flow inducers consecutively.

Conveniently the air conduit means comprises a

common air conduit along which a continuous flow of air is conducted and into which the particles are drawn from the collection duct means by a series of carrier air flows.

The air conduit means may be coupled to cyclone means for separating the particles from the continuous flow of air and for supplying the separated particles to the particle collection zone.

Furthermore the air conduit means may be coupled to a fan for drawing said continuous flow of air therethrough and may be provided with a damper for controlling the input of air drawn into the air conduit means by the fan.

The invention also provides a particle cleaning system comprising cyclone means for receiving an air flow containing particles and entrained material and incorporating outlet means through which particles and entrained material separated from the air flow by the cyclone means pass towards a particle collector, extraction means defining a gap through which the separated particles and entrained material are conducted as they pass through the outlet means and incorporating an extraction duct opening into the gap, and air flow induction means for inducing a relatively large volume carrier air flow at a relatively low pressure in the extraction duct in response to a relatively small volume control air flow at a relatively high pressure in order to draw entrained material away from the particles conducted through the gap and carry the entrained material in the induced carrier air flow along the extraction duct towards an entrained material extraction zone.

Such a particle cleaning system can be made to be adjustable by variation of the air control flow in order to permit the carrier air flow to be finely set to ensure that the entrained material is removed from the particles in an efficient manner without drawing the particles themselves along the extraction duct.

The invention further provides a particle collection system comprising a floor incorporating a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles which land on the floor towards the bottoms of the troughs, and a series of collection ducts each of which is provided at the bottom of a respective one of the troughs and has a lower wall which is integrally formed with at least one of the side walls of the trough and an upper wall which is joined to the lower wall along its longitudinal edges, holes being provided at intervals along the length of the upper wall for passage of particles into the duct.

In order that the invention may be more fully understood, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a schematic plan view of a blast room;

Figure 2 is a schematic diagram showing parts of a particle collection system in accordance with the invention, partly in perspective view and partly in axial section;

Figure 3 is an explanatory diagram showing an air flow inducer in axial section;

Figures 4 to 6 show various views of part of a

particle collection floor in accordance with the invention; and

Figures 7, 8 and 9 show various views of part of an alternative particle collection floor in accordance with the invention.

Figure 1 shows a blast room 1 which is adapted to contain an object to be treated by subjecting it to impact by a stream of particles fired from a particle gun held by an operator within the room. The room 1 has a floor 2 of waffle construction which is specially adapted for collection of particles fired from the gun after they have rebounded from the object and, in many cases, also from the walls of the room, and which is connected to a cyclone 3 and a dust collector 4. The blast room 1 is also provided with end doors 5 for introduction of the object to be treated, and a further door 6 for operator access. As will be described in more detail below, the room is provided with a particle collection system which collects the particles and the material removed by the particles, separates the particles from the other material and returns the particles to a particle collection zone so that the particles can be reused in the blasting process.

Figure 2 shows a portion 10 of the blast room floor which comprises a pair of parallel troughs 11 and 12 supported by two channel-section support members 13 and 14, which also support an overlying floor grid 9 (shown in broken lines), and having at their bottoms two collection ducts 15 and 16. Each trough 11 or 12 also has spaced along its length a series of

transverse dividers 17 or 18 each of which has two oppositely inclined walls which, together with the oppositely inclined walls of the associated trough 11 or 12, serve to channel the particles towards apertures (not shown in Figure 2) in the upper wall of the collection duct 15 or 16 so that the particles pass into the interior of the duct. In a typical blast room floor a series of such portions 10 will be arranged side-by-side so as to impart to the floor the waffle construction already referred to.

Furthermore, as shown schematically in Figure 2, respective air flow inducers 19 and 20 are connected to the outlets of the connection ducts 15 and 16. As may be appreciated more particularly by referring to Figure 3, each air flow inducer 19 or 20, which is of per se known type, comprises a main air flow conduit 21 surrounded by an annular chamber 22 which opens into the duct 21 by way of a narrow annular gap 23 so that the application of a control flow of compressed air of relatively small volume but having a relatively high pressure by way of a control duct 24 provides a flow of air through the gap 23 which induces a relatively large volume carrier air flow at a relatively low pressure in the duct 21. In this way a small volume compressed air flow may be used to induce air flows, drawn into the collection ducts 15 and 16 through their opposite, open ends, for transporting the particles without it being necessary to provide high volume air flows along the ducts produced by a fan for this purpose.

In the particular embodiment of Figure 2, the air

flow inducers 19 and 20 are supplied with a pulse of compressed air by way of a common control duct 30 so as to produce pulsed carrier air flows in the collection ducts 15 and 16 for carrying the particles and entrained material along the ducts 15 and 16 and through the air flow inducers 19 and 20 into a common recovery conduit 31 to which the outlets of the air flow inducers 19 and 20 are connected. The pulsed control air flow is supplied from a source of compressed air by way of a process sequencer (not shown) which supplies a pulse of air to each pair of air flow inducers 19, 20 in turn. Various modes of sequencing the pairs of air flow inducers are possible, and it may be desirable to apply a greater number of control air pulses, or control air pulses of greater length, to those pairs of air flow inducers which are associated with the parts of the floor which will tend to receive the greater number of particles, that is the parts of the floor closest to the side walls of the blast room.

As shown schematically by the arrow 32 in Figure 2, the recovery conduit 31 is coupled by a flexible hose to a cyclone 33 which in turn has an air outlet 34 coupled to a centrifugal fan, as indicated schematically by the arrow 35. Furthermore the recovery conduit 31 has an inlet 36 provided with a damper 37 which may be adjusted to vary the quantity of air drawn through the inlet 36 in the direction of the arrow 38. It will be appreciated that the fan will produce a continuous flow of air drawn through the inlet 36 into the recovery conduit 31, and that this flow of air will conduct the particles and entrained material injected into the

recovery conduit 31 by way of the air flow inducers 19, 20 so as to carry the particles and entrained material into the inlet 39 of the cyclone 33 for the purpose of separating the particles from the entrained material and the air flow. The fact the particles are transported into the recovery conduit 31 by pulsed carrier air flows, rather than continuous carrier air flows, is advantageous not only because it decreases the total quantity of air required for the control air flows which induce the carrier air flows, but also because it minimises the total quantity of air which is conducted along the recovery conduit 31 and thus enables the size of the cyclone 33 to be kept to a minimum.

As is well known, the cyclone 33 imparts a vortex motion to the incoming air flow in order to cause the entrained particles to be forced outwardly by centrifugal action and to enter an outlet funnel 40 through which the particles fall under gravity in the direction of the arrow 41 towards a particle collector (not shown). The air flow from which the particles have been separated rises in a vortex towards the outlet 34.

Furthermore, in order to separate the entrained material from the particles prior to the particles being supplied to the particle collector, an extractor 42 is positioned within the funnel 40 and includes upper and lower conical members 43 and 44 which define therebetween a narrow inlet 45 of an extraction duct 47, the inlet 45 opening radially outwardly into an annular gap 46 between the outer peripheries of the conical members 43 and 44 and the inside

wall of the funnel 40. The extraction duct 47 is provided with an air flow inducer 48 which is supplied with compressed air from a compressed air duct 49 in order to induce a relatively large volume carrier air flow at relatively low pressure in the extraction duct 47. This creates a flow of air into the inlet 45 in the vicinity of the annular gap 46 which draws entrained material from the particles passing through the gap 46 and carries such material in the induced carrier air flow along the extraction duct 47 towards the air outlet 34 and eventually to an extractor (not shown) upstream of the fan. A needle valve 50 permits adjustment of the control air flow applied to the air flow inducer 48 so as to finely adjust the carrier air flow along the extraction duct 47 so as to ensure optimum cleaning of the particles by removal of the entrained material without drawing the particles themselves along the extraction duct 47.

Figure 4 is a cross sectional view of the trough 11 showing how this may be formed by welding two appropriately profiled metal sheets 60 and 61. Figure 5 shows a plan view of one end of the sheet 60, and Figure 6 shows a plan view of one end of the sheet 61. The sheet 60 forms both an inclined side wall 62 of the trough 11 and a lower wall 63 of the associated collection duct 15, whereas the sheet 61 forms both the other inclined side wall 64 of the trough 11 and an upper wall 65 of the collection duct 15. Furthermore the sheets 60 and 61 are formed with flanges 66 and 67 by means of which the lower and upper walls 63 and 65 are joined along their longitudinal edges by means of adhesive tape or by some other

suitable bonding means, such as a weld. As may be seen in Figure 6, holes 68 are formed in the upper wall 65 by drilling for the passage of particles into the duct 15.

Figure 7 shows an alternative form of trough 11' incorporating a collection duct 15' at its bottom. In this case a single profiled sheet 70 forms both of the inclined side walls 71 and 72 of the trough, as well as the lower wall 73 of the collection duct. A separate profiled sheet 74 forms the upper wall 75 of the collection duct and is provided with flanges 76 and 77 for joining together the longitudinal edges of the lower and upper walls 73 and 75 by means of adhesive tape. Figures 8 and 9 show plan views of the sheets 70 and 74, and in addition Figure 9 shows holes 78 drilled in the upper surface 75 for the passage of particles into the collection duct.

CLAIMS

1. A particle collection system comprising trough means for receiving particles therein, collection duct means associated with the trough means for receiving particles from the trough means, air flow induction means for inducing a relatively large volume carrier air flow at relatively low pressure in the collection duct means in response to a relatively small volume control air flow at relatively high pressure in order to draw particles along the collection duct means in the carrier air flow, and air conduit means into which the particles are drawn in the carrier air flow from the collection duct means and along which the particles are conducted towards a particle collection zone.

2. A system according to claim 1, wherein the trough means comprises a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles towards the bottoms of the troughs, and the collection duct means comprises a series of collection ducts each of which is provided at the bottom of a respective one of the troughs.

3. A system according to claim 2, wherein the troughs include transverse dividers spaced at intervals along their lengths.

4. A system according to claim 1, 2 or 3, wherein the air flow induction means comprises a respective air flow inducer coupled to each collection duct so as to draw particles along the collection duct towards the air conduit means in a carrier

air flow induced by a control air flow applied to the air flow inducer.

5. A system according to claim 4, wherein an air controller is coupled to the air flow induction means so as to apply pulsed control air flows to the air flow inducers in a predetermined sequence so as to induce pulsed carrier air flows in the collection ducts.

6. A system according to claim 5, wherein the air flow induction means comprises a plurality of pairs of air flow inducers, and the air controller is arranged to apply a respective pulsed control air flow to each pair of air flow inducers separately from each of the other pairs of air flow inducers and to apply such control air flows to the pairs of air flow inducers consecutively.

7. A system according to any preceding claim, wherein the air conduit means comprises a common air conduit along which a continuous flow of air is conducted and into which the particles are drawn from the collection duct means by a series of carrier air flows.

8. A system according to any preceding claim, wherein the air conduit means is coupled to cyclone means for separating the particles from the continuous flow of air and for supplying the separated particles to the particle collection zone.

9. A system according to any preceding claim, wherein the air conduit means is coupled to a fan for drawing said continuous flow of air therethrough and may be

provided with a damper for controlling the input of air drawn into the air conduit means by the fan.

10. A particle cleaning system comprising cyclone means for receiving an air flow containing particles and entrained material and incorporating outlet means through which particles and entrained material separated from the air flow by the cyclone means pass towards a particle collector, extraction means defining a gap through which the separated particles and entrained material are conducted as they pass through the outlet means and incorporating an extraction duct opening into the gap, and air flow induction means for inducing a relatively large volume carrier air flow at a relatively low pressure in the extraction duct in response to a relatively small volume control air flow at a relatively high pressure in order to draw entrained material away from the particles conducted through the gap and carry the entrained material in the induced carrier air flow along the extraction duct towards an entrained material extraction zone.

11. A particle collection system comprising a floor incorporating a series of parallel troughs having downwardly inclined side walls extending longitudinally of the troughs for conducting particles which land on the floor towards the bottoms of the troughs, and a series of collection ducts each of which is provided at the bottom of a respective one of the troughs and has a lower wall which is integrally formed with at least one of the side walls of the trough and an upper wall which is joined to the lower wall along its longitudinal edges, holes being provided at intervals along the length of the upper wall for passage of particles into the duct.

12. A particle collection system substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) - 17 -	Application number GB 9321782.6
Relevant Technical Fields (i) UK Cl (Ed.M) BIT (TPFB, TPFK, TPPA) (ii) Int Cl (Ed.5) B04C 5/00; B04C 9/00; B0D 50/00; B0D 51/06	Search Examiner A J RUDGE Date of completion of Search 17 JANUARY 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI, CLAIMS, EDOC, WPIL	Documents considered relevant following a search in respect of Claims :- 1-10

Categories of documents

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Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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07944875 14.09.1992

(51) INT CL[5]
A47L 5/24

(52) UK CL (Edition M)
A4F FD11 FEBA FEB11 FEB19 FEF11 FFB203 FHA FHC13

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UK CL (Edition L) A4F
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ONLINE DATABASE : WPI

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(54) Vacuum cleaner

(57) A vacuum cleaner, which is convertible between a hand-held vacuum and a stick-type vacuum, includes a housing (12) having a rondure first end (22) and narrowing to a generally oblate, low profile nozzle (166) at a second end, includes a dirt cup (14) mounted telescopically within the opening in the second end and adapted to move between a retracted position within the housing and an extended position. The free end of the dirt cup (14) may receive a cleaning tool (16) having a pivoting head (222), while the inner end is adapted to receive a filter assembly (146, Figures 8A-8D). The housing (12) contains a suction fan (24). The dirt cup is cleaned by withdrawing it from the end of the nozzle and removing the spun-bonded filter assembly (146).

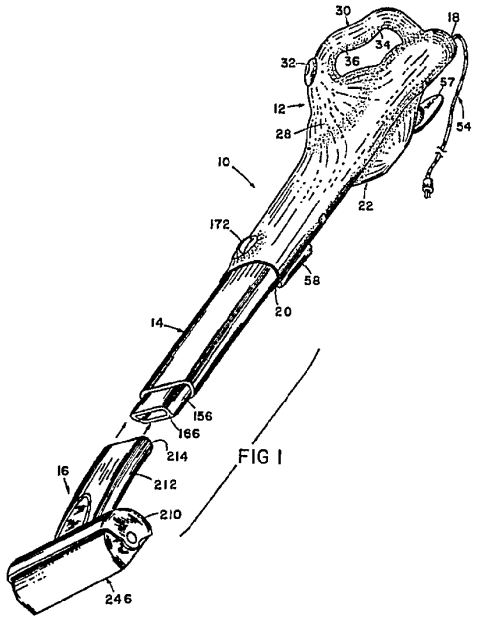

FIG 1

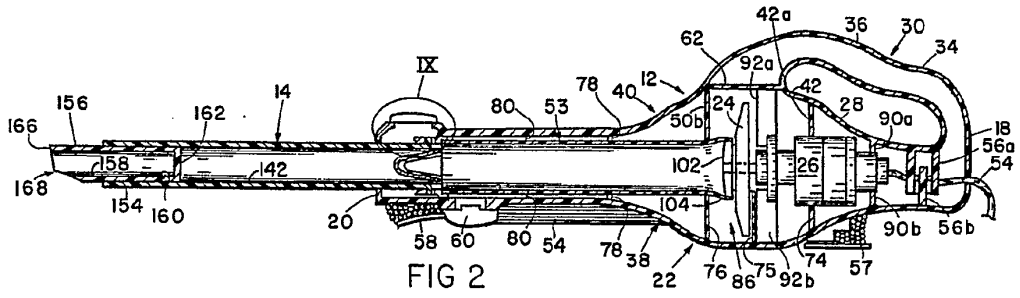

FIG 2

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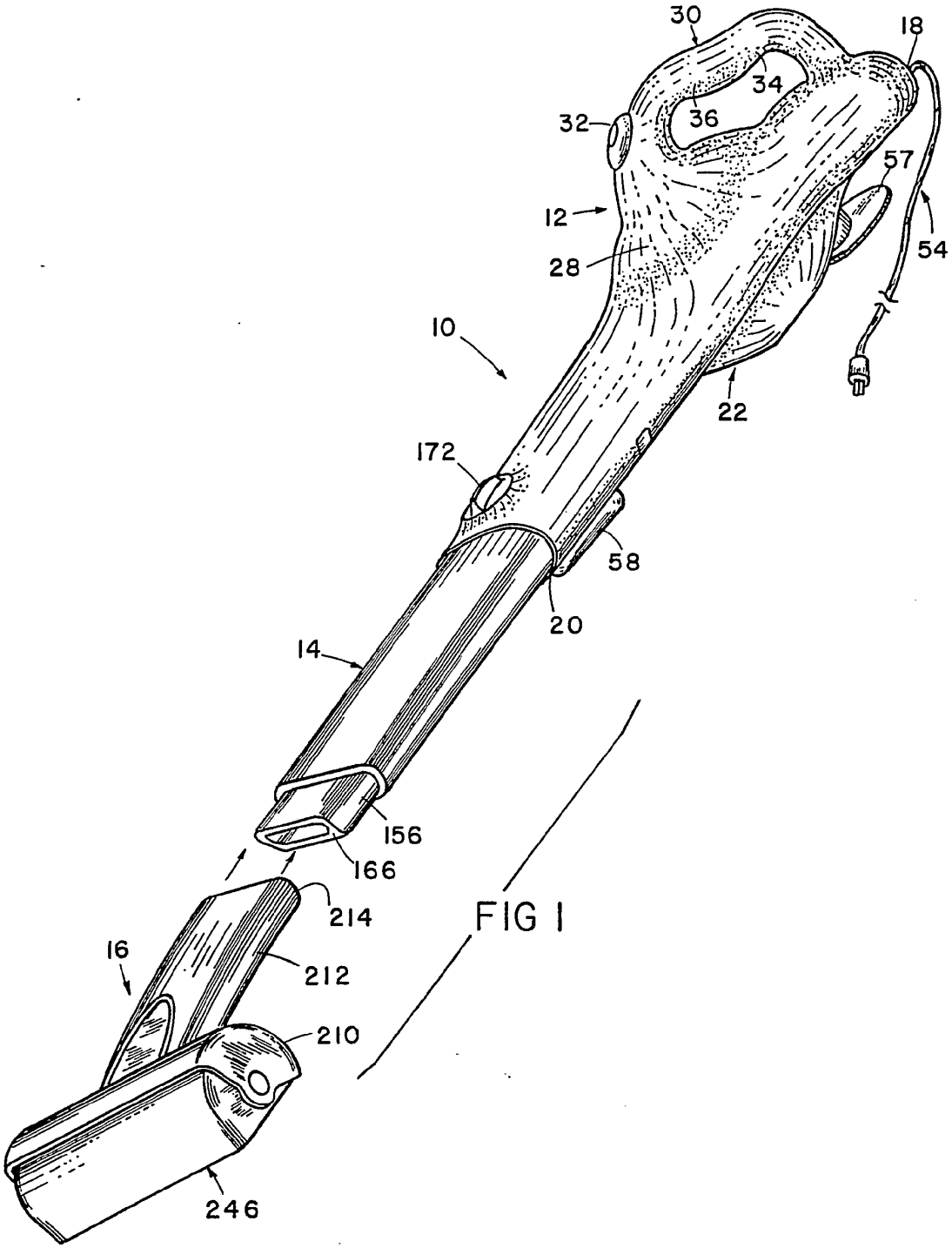
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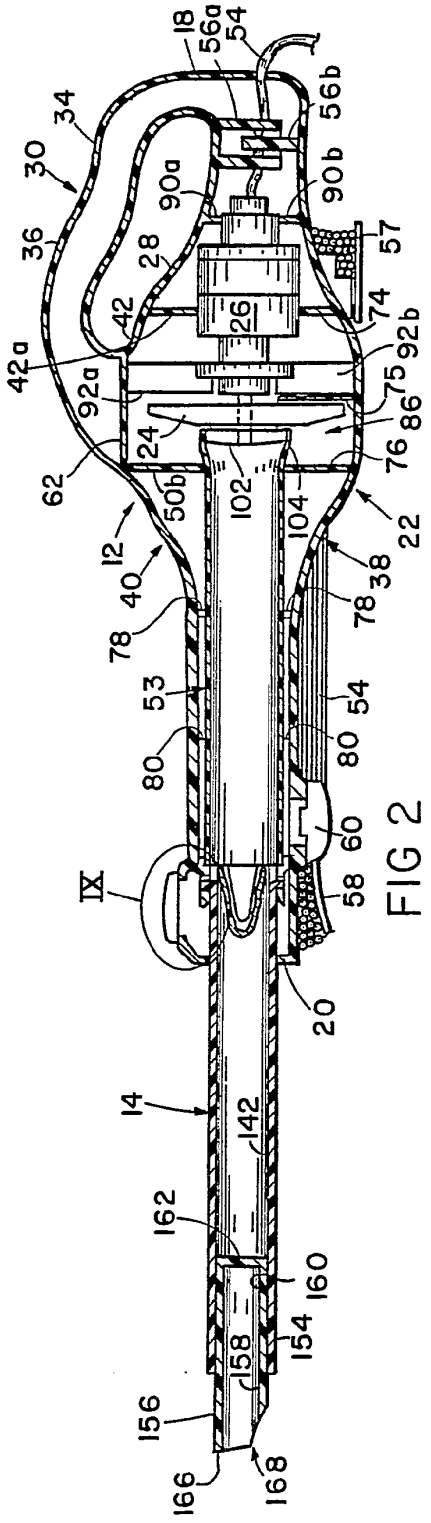
FIG 1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56b
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90b
90a
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57
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74
26
92b
42a
92a
75
86
24
76
62
50b
102
104
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FIG 2

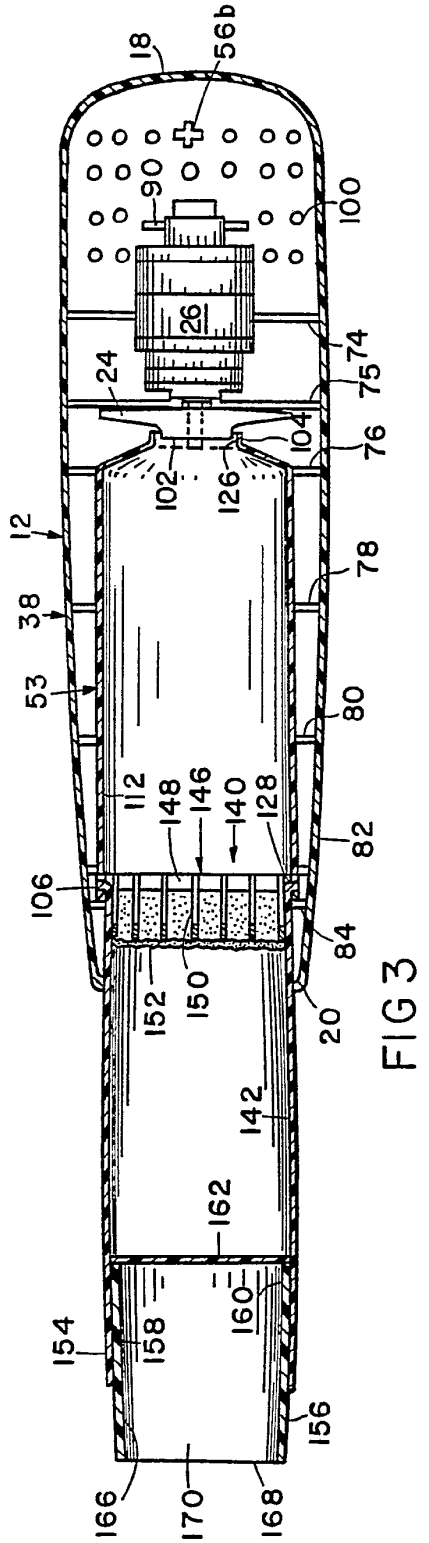
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FIG 3

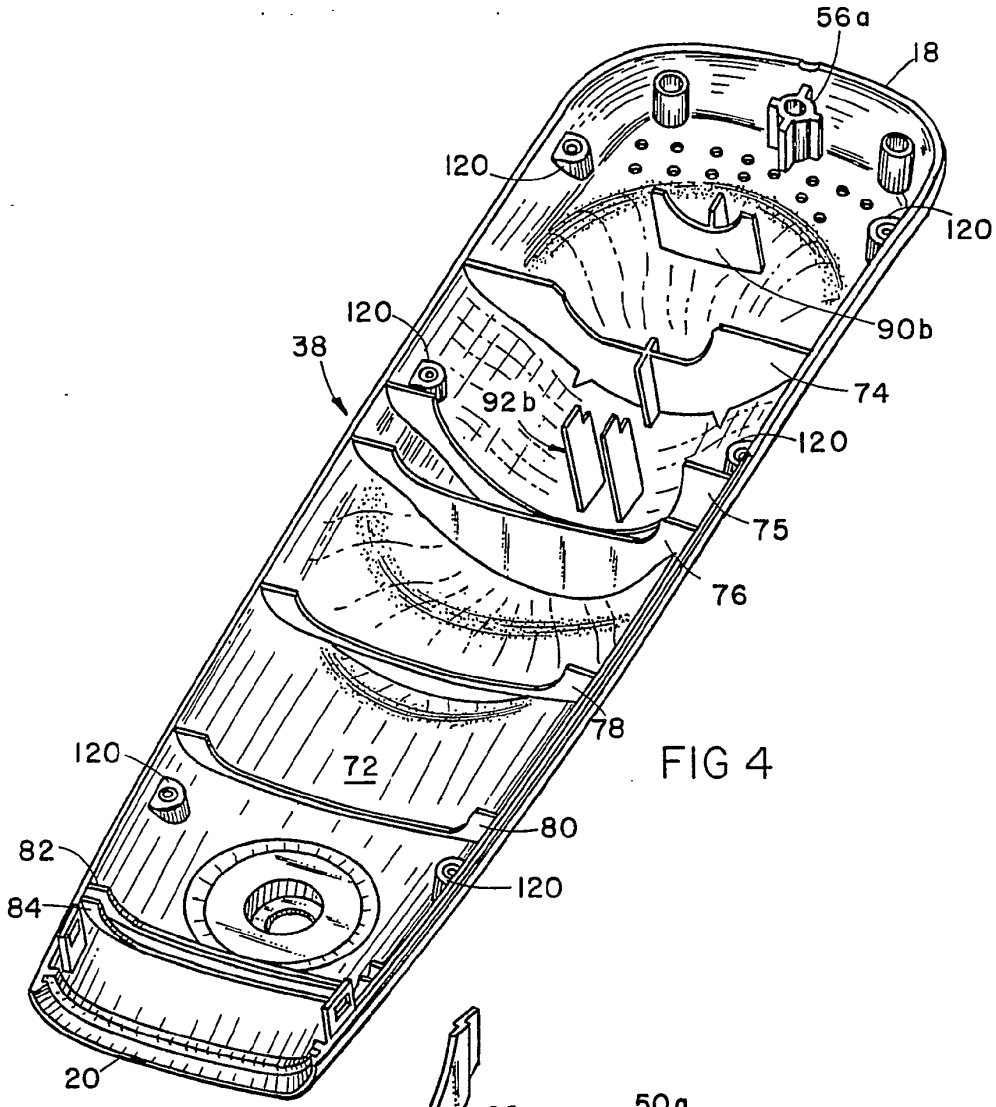
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FIG 4

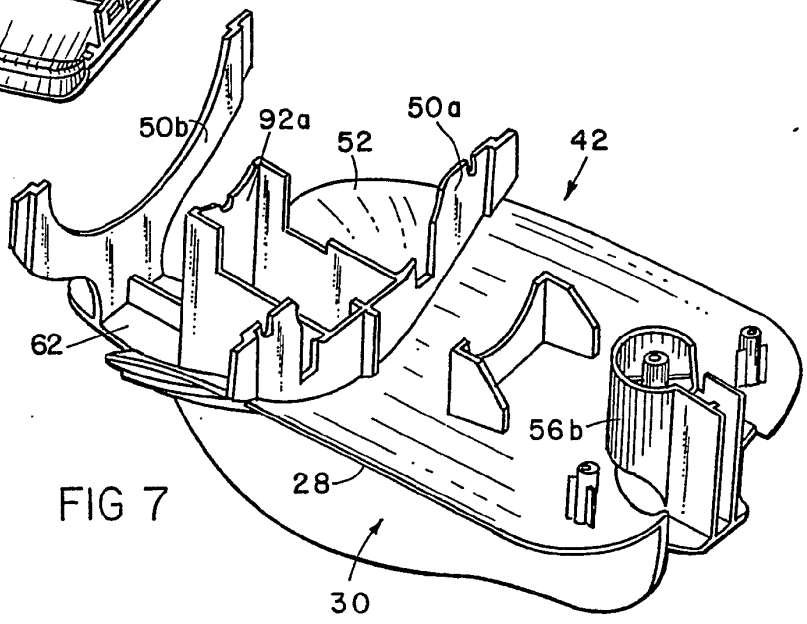
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FIG 7