



# Brevet canadien / Canadian Patent

Le commissaire aux brevets a reçu une demande de délivrance de brevet visant une invention. Ladite requête satisfait aux exigences de la *Loi sur les brevets*. Le titre et la description de l'invention figurent dans le mémoire descriptif, dont une copie fait partie intégrante du présent document.

Le présent brevet confère à son titulaire et à ses représentants légaux, pour une période expirant vingt ans à compter de la date du dépôt de la demande au Canada, le droit, la faculté et le privilège exclusif de fabriquer, construire, exploiter et vendre à d'autres, pour qu'ils l'exploitent, l'objet de l'invention, sauf jugement en l'espèce rendu par un tribunal compétent, et sous réserve du paiement des taxes périodiques.



The Commissioner of Patents has received a petition for the grant of a patent for an invention. The requirements of the *Patent Act* have been complied with. The title and a description of the invention are contained in the specification, a copy of which forms an integral part of this document.

The present patent grants to its owner and to the legal representatives of its owner, for a term which expires twenty years from the filing date of the application in Canada, the exclusive right, privilege and liberty of making, constructing and using the invention and selling it to others to be used, subject to adjudication before any court of competent jurisdiction, and subject to the payment of maintenance fees.

## BREVET CANADIEN

**2,967,272**

## CANADIAN PATENT

Date à laquelle le brevet a été accordé et délivré

**2018/01/02**

Date on which the patent was granted and issued

Date du dépôt de la demande

**2009/03/13**

Filing date of the application

Date à laquelle la demande est devenue accessible au public pour consultation

**2010/09/13**

Date on which the application was made available for public inspection

Commissaire aux brevets / Commissioner of Patents



(22) Date de dépôt/Filing Date: 2009/03/13

(41) Mise à la disp. pub./Open to Public Insp.: 2010/09/13

(45) Date de délivrance/Issue Date: 2018/01/02

(62) Demande originale/Original Application: 2 917 900

(51) Cl.Int./Int.Cl. *A47L 9/16* (2006.01),  
*A47L 5/22* (2006.01), *A47L 5/24* (2006.01),  
*A47L 5/28* (2006.01)

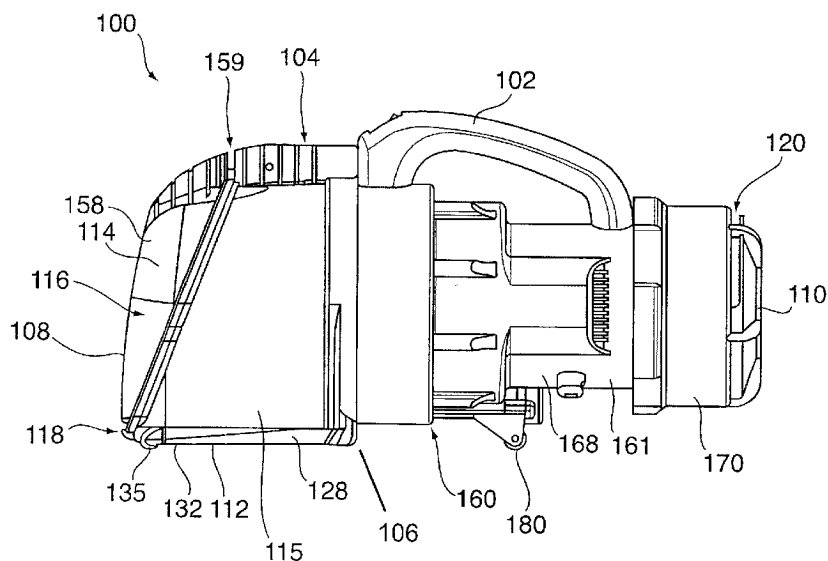
(72) Inventeur/Inventor:  
CONRAD, WAYNE ERNEST, CA

(73) Propriétaire/Owner:  
OMACHRON INTELLECTUAL PROPERTY INC., CA

(74) Agent: BERESKIN & PARR LLP/S.E.N.C.R.L.,S.R.L.

(54) Titre : APPAREIL DE NETTOYAGE DE SURFACE PORTABLE

(54) Title: HAND VACUUM CLEANER



(57) Abrégé/Abstract:

A hand vacuum cleaner has a cleaner body and a post-motor filter is positioned in the air flow passage downstream from and aligned with the suction motor and, the post-motor filter and the cleaner body are separable.

## HAND VACUUM CLEANER

The specification relates to surface cleaning apparatuses. More specifically, the specification relates to cyclonic surface cleaning apparatuses.

### 5 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  
10 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. It is also known to position a dirt collection chamber exterior to a cyclone casing, such as surrounding the cyclone chamber.

### SUMMARY

15 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  
20 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 lie 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 end and defines a dirt outlet of the  
25 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 may be constant or may be variable.

The sidewall is preferably provided on the periphery of the plate.

- 5 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.

- 10 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.

- 15 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.

- 20 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.

- 25 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.

5 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.

10 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  
15 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.

20 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.  
25 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  
5 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  
10 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  
15 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,

20 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  
25 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  
5 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  
10 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  
15 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  
20 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  
25 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.

5 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.

10 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.

15 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  
20 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  
25 114). 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.

5                   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  
10                   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  
15                   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  
20                   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  
25                   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.

- 5 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  
10 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  
15 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  
20 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  
25 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  
5 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  
10 147, 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  
15 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  
20 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  
25 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  
5 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  
10 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  
15 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  
20 184 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  
25 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  
 5 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  
 10 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.

15 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  
 20 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  
 25 122 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 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,  
5 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  
10 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  
15 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  
20 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  
25 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  
5 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-  
10 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  
15 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  
20 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-  
25 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.

5                   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.

10                  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.

15                  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 hand vacuum cleaner comprising:
  - a) an air flow passage extending from a dirty air inlet to a clear air outlet;
  - b) a cyclone unit positioned in the air flow passage downstream from the dirty air inlet, the cyclone unit is positioned at a front end of the hand vacuum cleaner;
  - c) a main body comprising a suction motor positioned in the air flow passage downstream from the cyclone unit, the suction motor is positioned rearward of the cyclone unit, the suction motor having a front inlet end, an opposed rear end and a suction motor axis; and,
  - d) a post-motor filter housing provided rearward of the suction motor, the post-motor filter housing defining a post-motor filter chamber which contains a post-motor filter, wherein the suction motor axis extends through the post-motor filter chamber and wherein the post-motor filter housing is removably mounted at a rear end of the main body, and wherein the post-motor filter housing has a rear facing surface that is a rearmost surface of a portion of the hand vacuum cleaner that is intersected by the suction motor axis.
2. The hand vacuum cleaner of claim 1, wherein the post-motor filter housing is removably mounted to the rear end of the main body.
3. The hand vacuum cleaner of claim 2, wherein the rear end of the main body has a rear end face and the post-motor filter housing covers the entire rear end face.
4. The hand vacuum cleaner of claim 1, wherein the post-motor filter housing forms a portion of the outer surface of the hand vacuum cleaner.
5. The hand vacuum cleaner of claim 1, wherein the suction motor axis intersects the cyclone unit.
6. The hand vacuum cleaner of claim 1, wherein the cyclone unit is movably mounted with respect to the main body.

7. The hand vacuum cleaner of claim 6, wherein the cyclone unit is removably mounted to the front end of the main body.
8. The hand vacuum cleaner of claim 1, wherein the clean air outlet is provided in the post-motor filter housing.
9. The hand vacuum cleaner of claim 7, wherein air exiting the clean air outlet travels in a direction transverse to the suction motor axis.
10. The hand vacuum cleaner of claim 1, wherein air exiting a header downstream of a pre-motor filter and air entering the post-motor filter housing travels in a flow direction that is parallel to the suction motor axis.
11. The hand vacuum cleaner of claim 1, further comprising a pre-motor filter in the air flow passage downstream from the cyclone unit and upstream from the suction motor, wherein the pre-motor filter is disposed forward of the suction motor and the suction motor axis intersects the pre-motor filter.
12. The hand vacuum cleaner of claim 1, wherein the suction motor includes a fan, the fan has a diameter in a direction transverse to the suction motor axis and the diameter of the fan is proximate a diameter of the post-motor filter in a direction transverse to the suction motor axis.
13. The hand vacuum cleaner of claim 1, wherein a portion of the main body houses a fan of the suction motor, the portion has a diameter in a direction transverse to the suction motor axis and the diameter of the portion is proximate a diameter of the post-motor filter housing in a direction transverse to the suction motor axis.

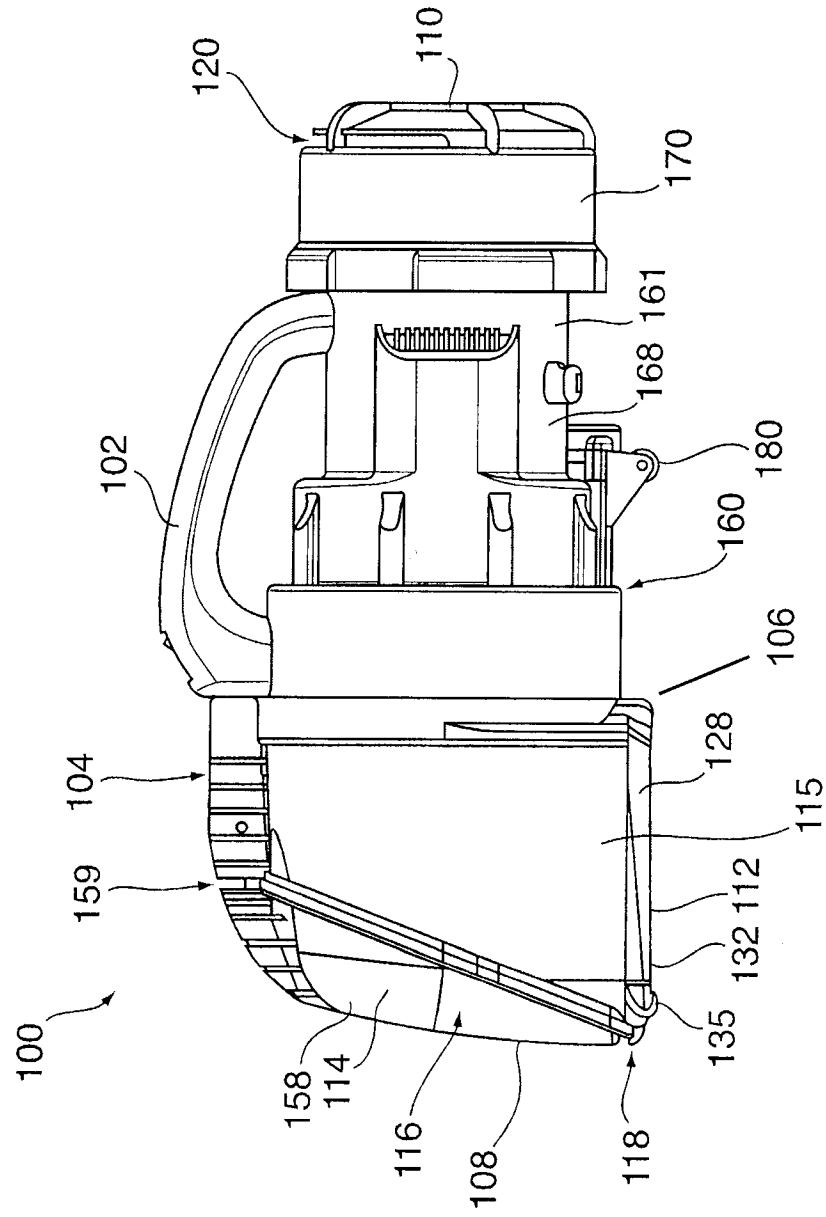
14. The hand vacuum cleaner of claim 1, wherein the post-motor filter housing is cylindrical in shape and has a sidewall extending forwardly from the rearmost surface, and wherein the sidewall is an exterior surface of the hand vacuum cleaner.
15. The hand vacuum cleaner of claim 14, wherein the post-motor filter comprises a porous filter media and the suction motor axis intersects the porous filter media.
16. The hand vacuum cleaner of claim 1, wherein the post-motor filter housing is located at a rear end of the hand vacuum cleaner, the post motor filter has an outer wall that extends around the suction motor axis and defines an exterior surface of the rear end of the hand vacuum cleaner which extends around the suction motor axis.
17. The hand vacuum cleaner of claim 1, further comprising a handle with a first end extending from the main body at a location forward of the post-motor filter chamber.
18. The hand vacuum cleaner of claim 17, further comprising a finger gap defined in part by the handle wherein the finger gap is forward of the post-motor filter and rearward of the cyclone unit.
19. The hand vacuum cleaner of claim 1, wherein the post-motor filter is positioned above the dirty air inlet when the hand vacuum cleaner is positioned on a horizontal surface.
20. A hand vacuum cleaner comprising:
- a) an air flow passage extending from a dirty air inlet to a clear air outlet;
  - b) a cyclone unit positioned in the air flow passage downstream from the dirty air inlet, the cyclone unit is positioned at a front end of the hand vacuum cleaner;
  - c) a main body comprising a suction motor positioned in the air flow passage downstream from the cyclone unit, the suction motor is positioned rearward of the cyclone unit, the suction motor having a front inlet end, an opposed rear end and a suction motor axis; and,

- d) a post-motor filter housing provided at a rearward end of the hand vacuum cleaner, the post-motor filter housing defining a post-motor filter chamber which contains a post-motor filter, wherein the suction motor axis extends through the post-motor filter chamber and wherein the post-motor filter housing is removably mounted at a rear end of the main body, and wherein air exiting the clean air outlet travels in a direction transverse to the suction motor axis.
21. The hand vacuum cleaner of claim 20, wherein the post-motor filter housing is removably mounted to the rear end of the main body.
22. The hand vacuum cleaner of claim 21, wherein the rear end of the main body has a rear end face and the post-motor filter housing covers the entire rear end face.
23. The hand vacuum cleaner of claim 20, wherein the post-motor filter housing forms a portion of the outer surface of the hand vacuum cleaner.
24. The hand vacuum cleaner of claim 20, wherein the suction motor axis intersects the cyclone unit.
25. The hand vacuum cleaner of claim 20, wherein the cyclone unit is movably mounted with respect to the main body.
26. The hand vacuum cleaner of claim 25, wherein the cyclone unit is removably mounted to the front end of the main body.
27. The hand vacuum cleaner of claim 20, wherein the clean air outlet is provided in the post-motor filter housing.
28. The hand vacuum cleaner of claim 20, wherein air exiting a header downstream of a pre-motor filter and air entering the post-motor filter housing travels in a flow direction that is parallel to the suction motor axis.

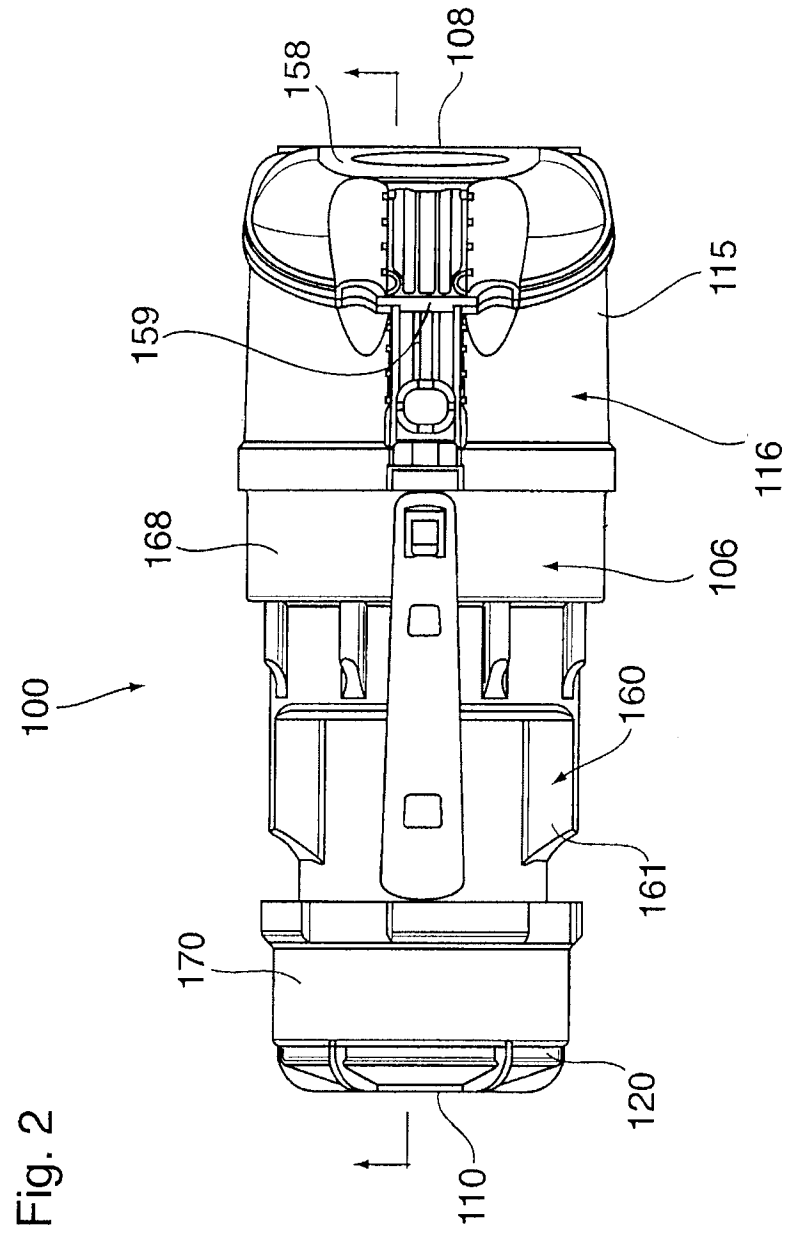
29. The hand vacuum cleaner of claim 20, further comprising a pre-motor filter in the air flow passage downstream from the cyclone unit and upstream from the suction motor, wherein the pre-motor filter is disposed forward of the suction motor and the suction motor axis intersects the pre-motor filter.
30. The hand vacuum cleaner of claim 20, wherein the suction motor includes a fan, the fan has a diameter in a direction transverse to the suction motor axis and the diameter of the fan is proximate a diameter of the post-motor filter in a direction transverse to the suction motor axis.
31. The hand vacuum cleaner of claim 20, wherein a portion of the main body houses a fan of the suction motor, the portion has a diameter in a direction transverse to the suction motor axis and the diameter of the portion is proximate a diameter of the post-motor filter housing in a direction transverse to the suction motor axis.
32. The hand vacuum cleaner of claim 20, wherein the post-motor filter housing is cylindrical in shape and has a sidewall extending forwardly from a rearmost surface of the hand vacuum cleaner, and wherein the sidewall is an exterior surface of the hand vacuum cleaner.
33. The hand vacuum cleaner of claim 32, wherein the post-motor filter comprises a porous filter media and the suction motor axis intersects the porous filter media.
34. The hand vacuum cleaner of claim 20, wherein the post-motor filter housing is located at a rear end of the hand vacuum cleaner, the post motor filter has an outer wall that extends around the suction motor axis and defines an exterior surface of the rear end of the hand vacuum cleaner which extends around the suction motor axis.

35. The hand vacuum cleaner of claim 20, further comprising a handle with a first end extending from the main body at a location forward of the post-motor filter chamber.
36. The hand vacuum cleaner of claim 35, further comprising a finger gap defined in part by the handle wherein the finger gap is forward of the post-motor filter and rearward of the cyclone unit.
37. The hand vacuum cleaner of claim 20, wherein the post-motor filter is positioned above the dirty air inlet when the hand vacuum cleaner is positioned on horizontal surface.

Fig. 1







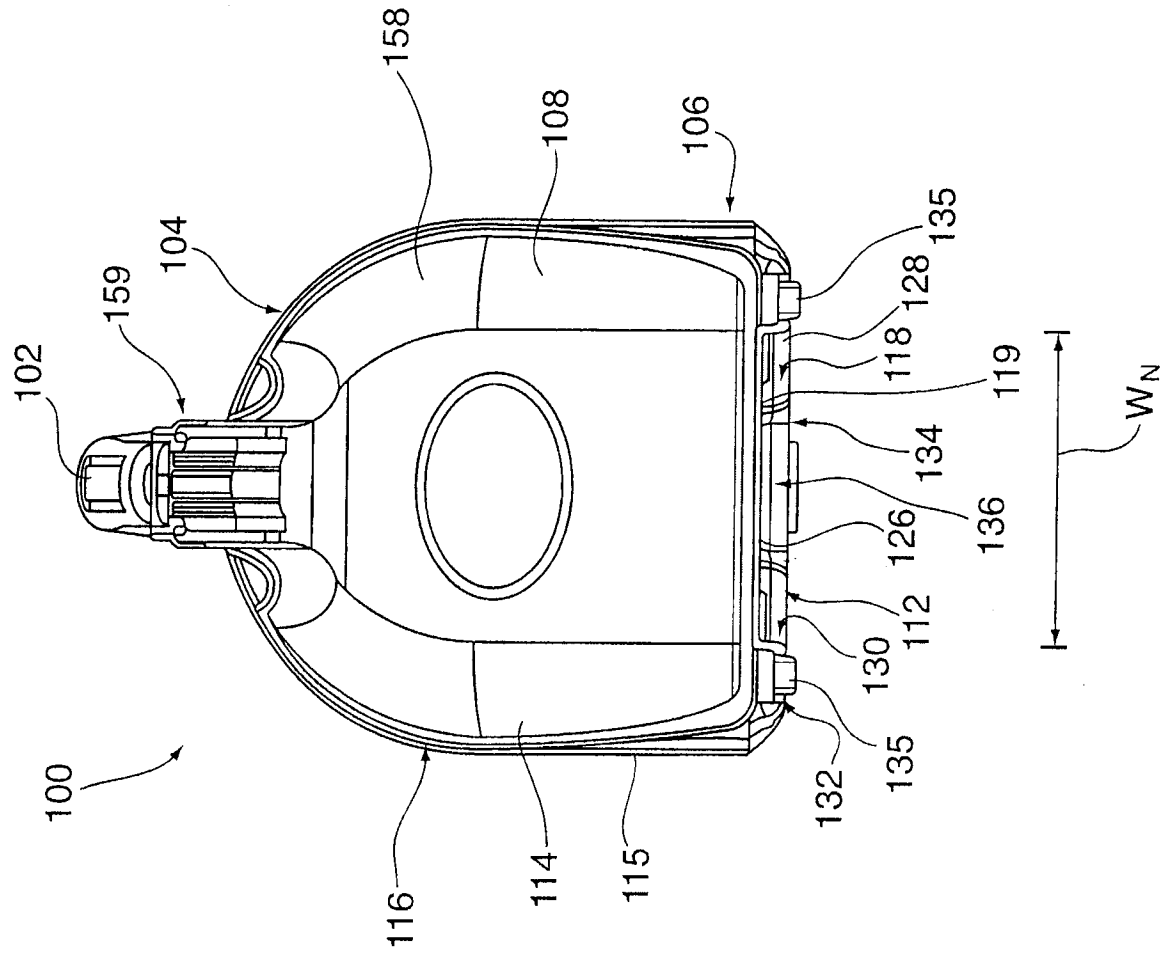
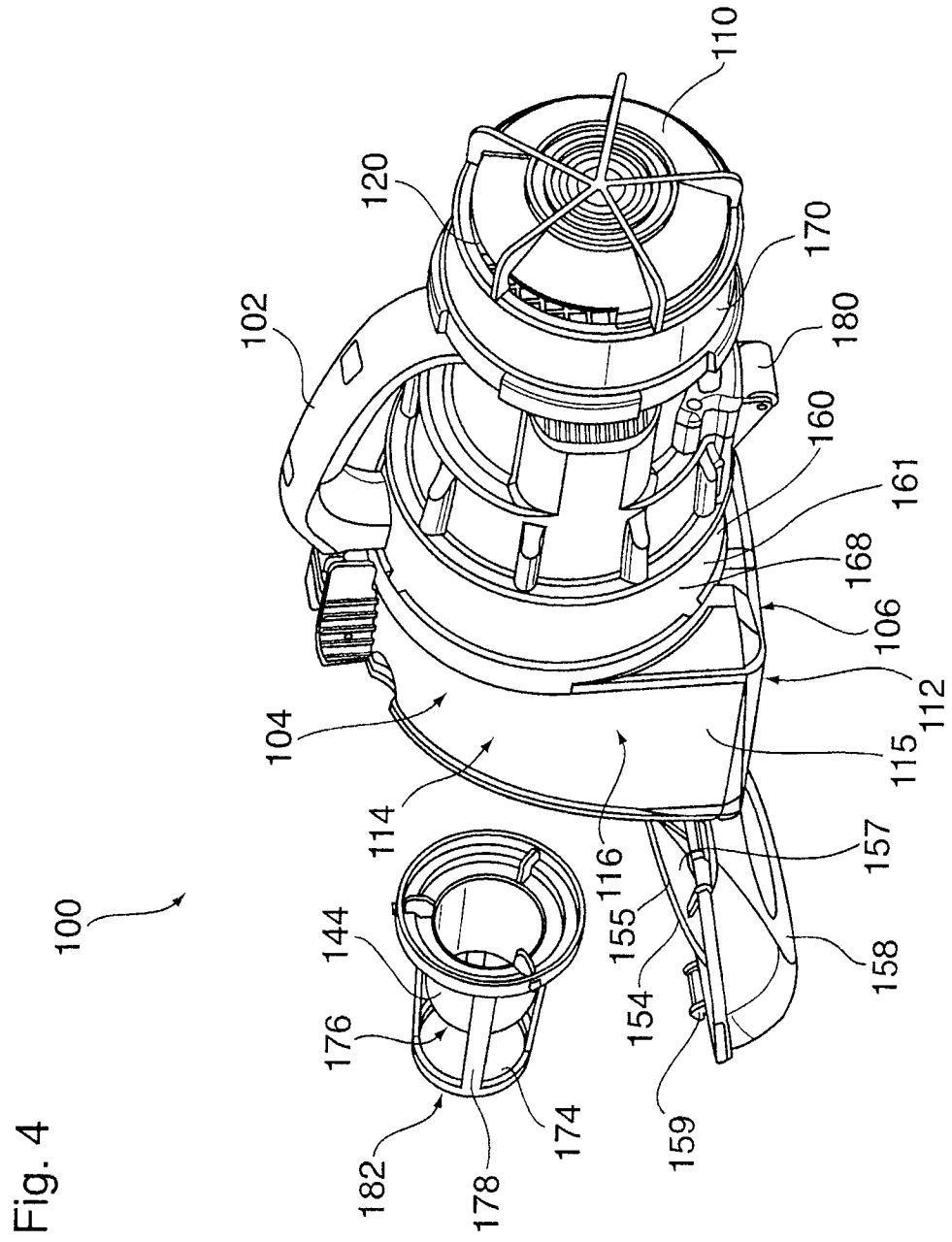


Fig. 3



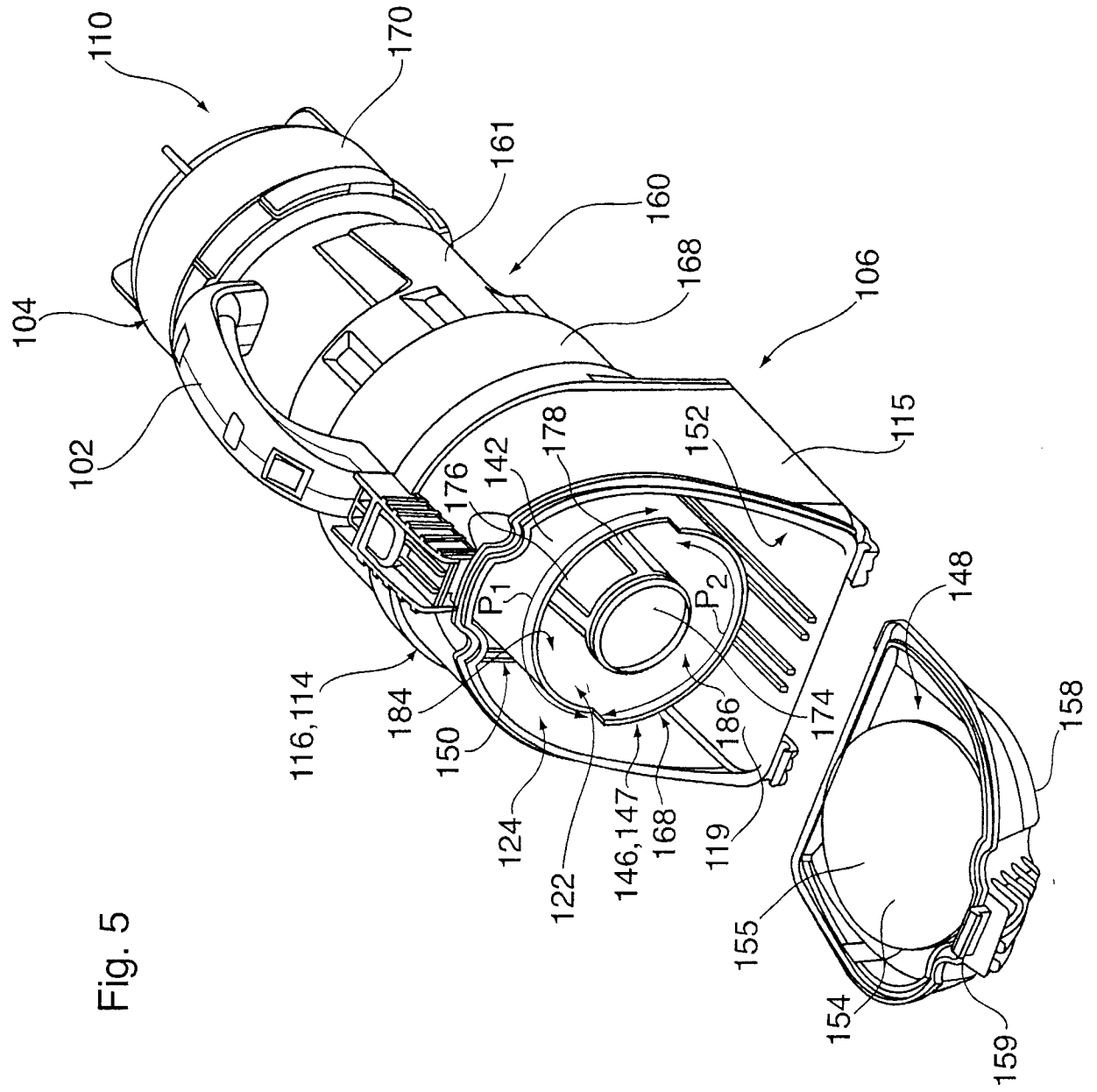


Fig. 6

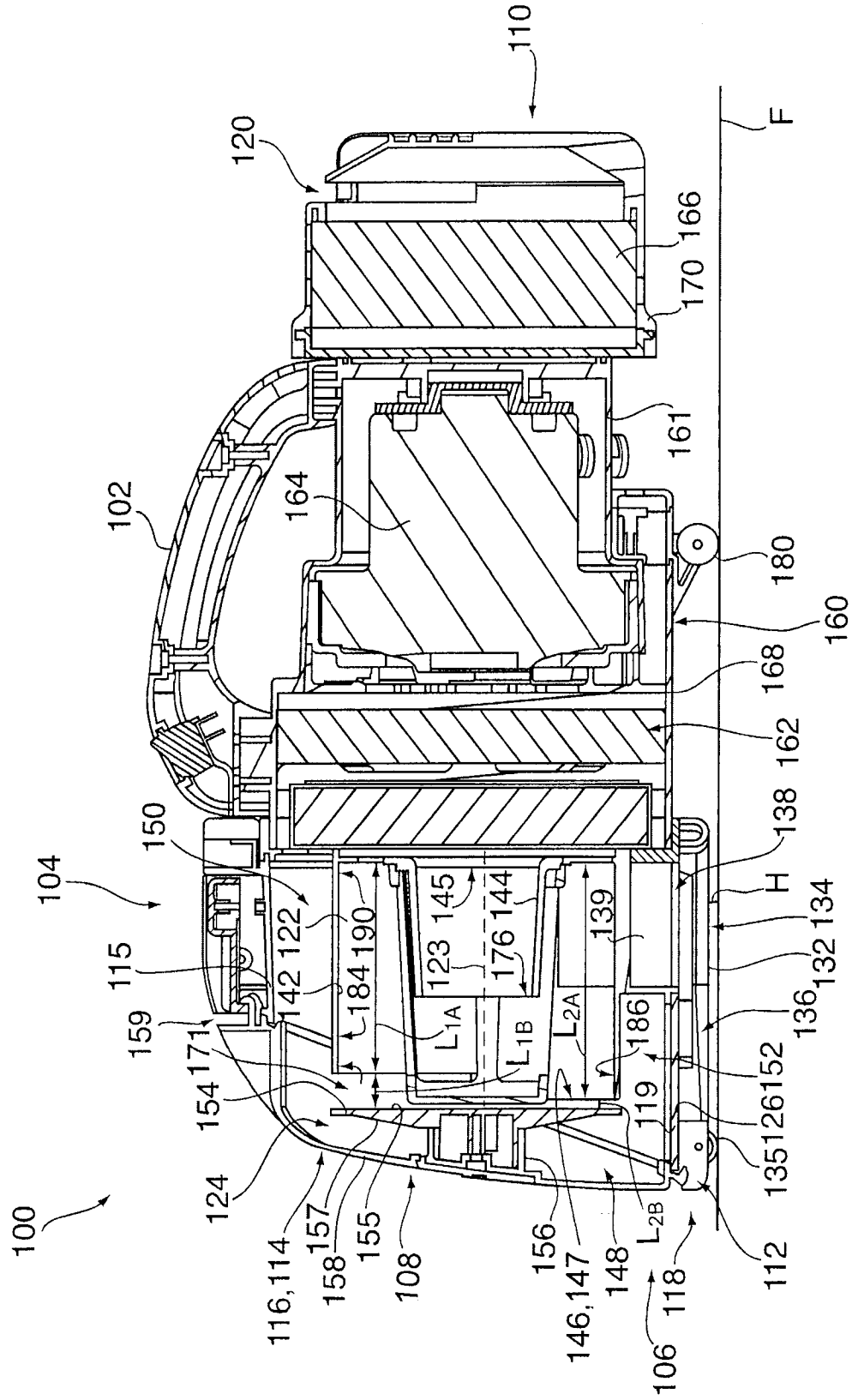


Fig. 7

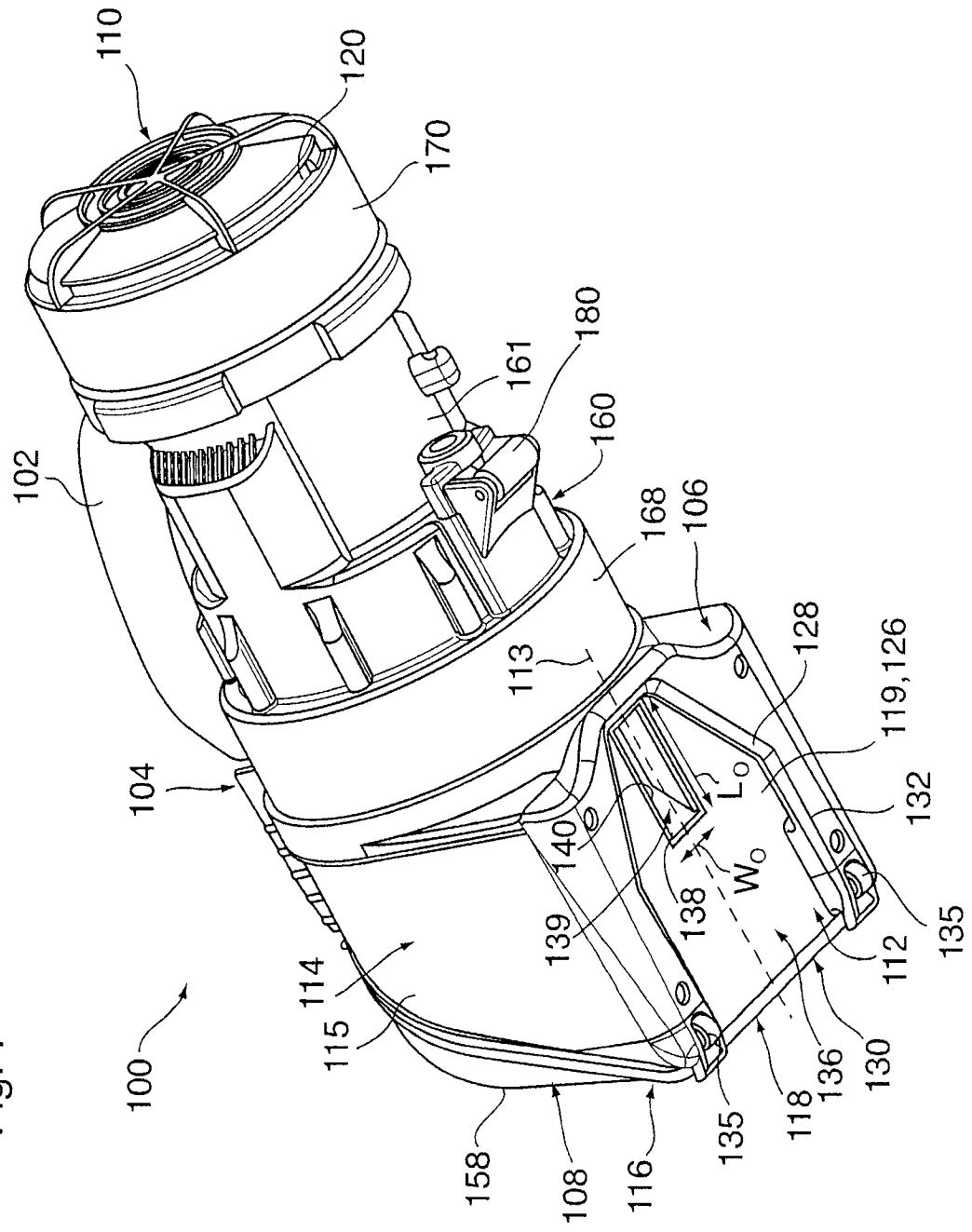


Fig.8

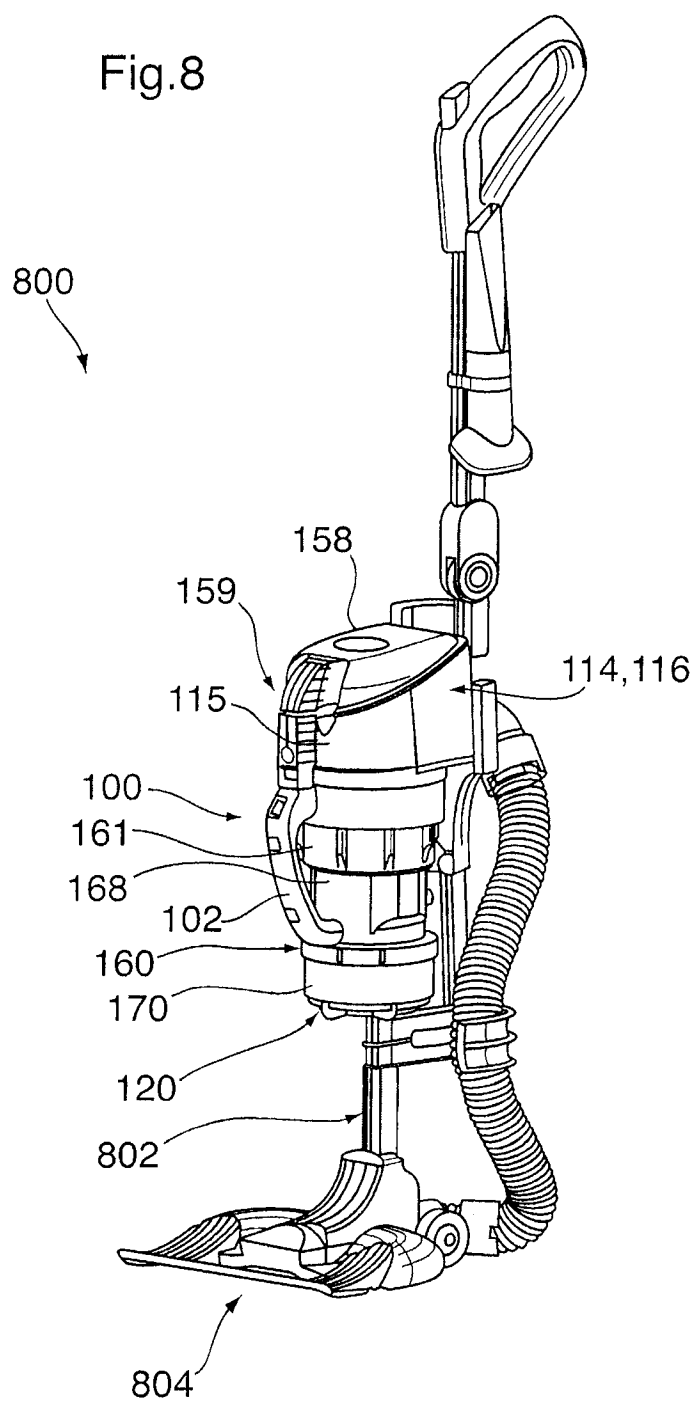




Fig. 9.



