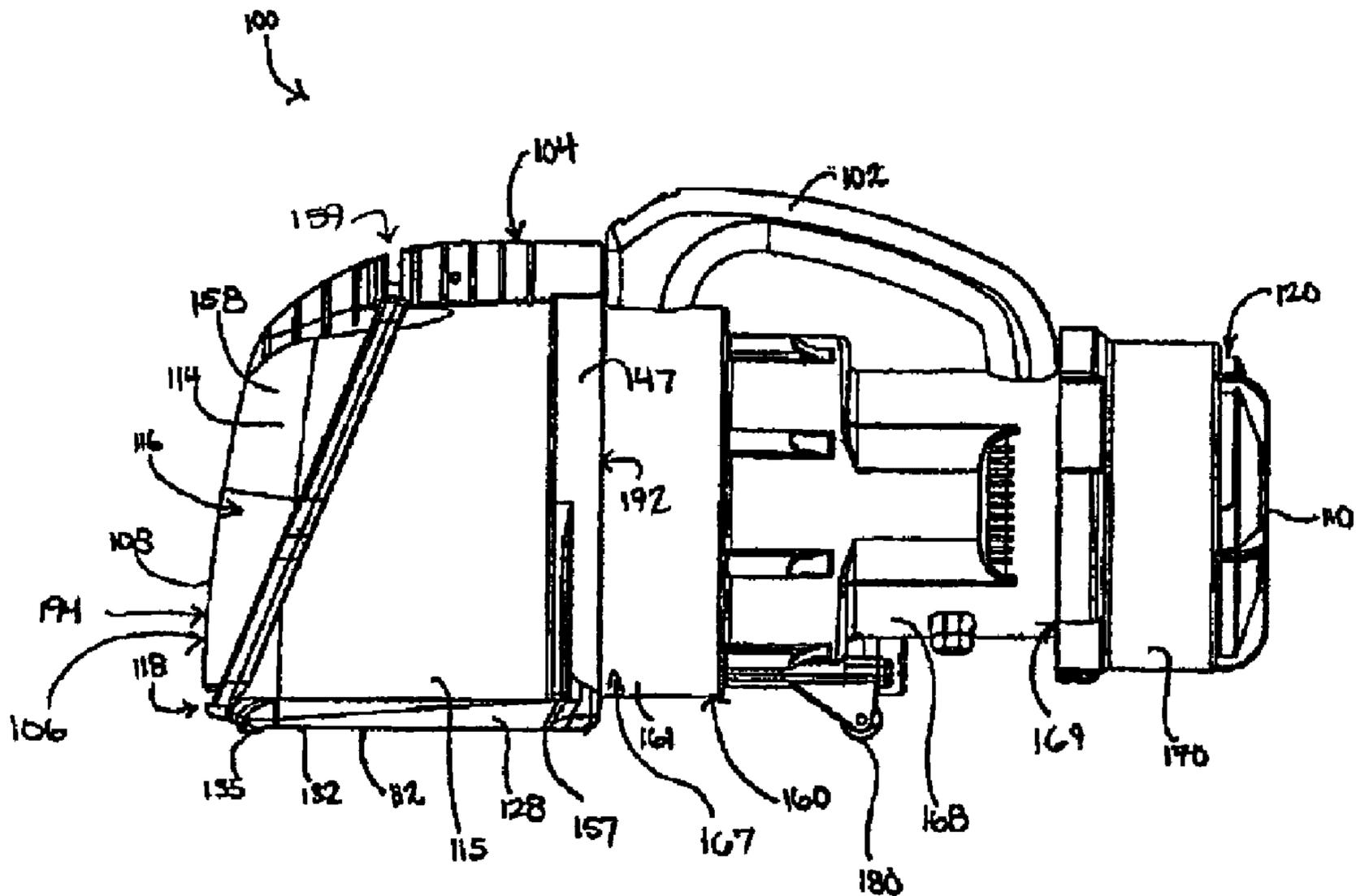




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(54) Titre : APPAREIL DE NETTOYAGE DES SURFACES
(54) Title: SURFACE CLEANING APPARATUS



(57) Abrégé/Abstract:

A surface cleaning apparatus such as a hand vacuum cleaner comprises a first cyclone and at least one additional dirt separation unit. The additional dirt separation comprises a second openable dirt collection chamber. The first and second openable dirt collection chambers are concurrently removably mounted to the surface cleaning apparatus. Each of the first cyclone unit and the additional dirt separation has an openable portion and the openable portions are spaced apart.

ABSTRACT

A surface cleaning apparatus such as a hand vacuum cleaner comprises a first cyclone and at least one additional dirt separation unit. The additional dirt separation comprises a second openable dirt collection chamber. The first and
5 second openable dirt collection chambers are concurrently removably mounted to the surface cleaning apparatus. Each of the first cyclone unit and the additional dirt separation has an openable portion and the openable portions are spaced apart.

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TITLE: SURFACE CLEANING APPARATUS

FIELD

[0001] The specification relates to surface cleaning apparatus and preferably to portable surface cleaning apparatus such as hand or strap carryable surface cleaning apparatus. In a particularly preferred embodiment, the specification relates to a cyclonic vacuum cleaners, and particularly, to cyclonic hand vacuum cleaners having a cyclone unit and an additional dirt separation member.

INTRODUCTION

10 [0002] 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.

[0003] 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.

[0004] Cyclonic vacuum cleaners having two cyclonic cleaning stages are known. Different configurations have been disclosed wherein the two cyclonic stages are emptied concurrently or wherein the two cyclonic stages are emptied separately.

[0005] 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

[0006] 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.

[0007] According to one broad aspect, a surface cleaning apparatus is disclosed which has a cyclonic cleaning stage and an additional dirt separation stage, which may also be a cyclonic separation stage. Each stage has one or more dirt collection chambers. The dirt collection chambers are concurrently removably mounted to the surface cleaning apparatus and have openable portions that are spaced apart. For example, the openable portions may face in opposite directions, e.g., a second cyclonic cleaning stage may be mounted to a wall of a first cyclonic cleaning stage wherein each stage has an openable door. If the cyclones are axially aligned, then the dirt chambers may be at the opposed ends of a module comprising the dirt and second cyclonic cleaning stages. The first stage may be emptied by opening one of the opposed ends and the second stage may be emptied by opening the other opposed end of the module. An advantage of this design is that the stages may be sequentially openable, but the user need not have to change the user's grip on the module. The user may tilt their wrist one way to empty the first stage and then tilt their wrist another way to empty the second stage.

[0008] The design may be used in a portable surface cleaning apparatus such as a hand or strap carriable vacuum cleaner. Alternately, the design may be used in other vacuum cleaner designs, such as an upright or a canister vacuum cleaner wherein the cyclonic cleaning stages are removed for emptying.

[0009] Accordingly, in one embodiment, the surface cleaning apparatus may comprise a front end and a rear end and an air flow passage extends from a dirty air inlet to a clean air outlet. A suction motor is positioned in a suction motor housing. A first cyclone unit is positioned in the air flow passage and comprises a first openable dirt collection chamber and an additional dirt separation unit is positioned in the air flow passage. The additional dirt separation unit comprises

a second openable dirt collection chamber. The first and second openable dirt collection chambers are concurrently removably mounted to the surface cleaning apparatus and each of the first cyclone unit and the additional dirt separation has an openable portion and the openable portions are spaced apart.

5 [0010] In some examples, the first cyclone unit and the additional dirt separation unit are concurrently removably mounted to the surface cleaning apparatus.

[0011] In some examples, the additional dirt separation unit is mounted in a chamber of the surface cleaning apparatus, and the additional dirt separation
10 unit is visible when the chamber is opened.

[0012] In some examples, the first cyclone unit is removably mounted to the surface cleaning apparatus.

[0013] In some examples, the additional dirt separation unit comprises a second cyclone unit.

15 [0014] In some examples, the additional dirt separation unit is mounted to the first cyclone unit. In some examples, the additional dirt separation unit is removably mounted to the first cyclone unit.

[0015] In some examples, each of the first cyclone unit and the additional dirt separation has an openable portion and the openable portions face in a
20 different direction. In some examples, the openable portions are sequentially openable.

[0016] In some examples, the openable portions are spaced apart and opposed.

[0017] In some examples, the first cyclone unit is has an openable end
25 and the additional dirt separation unit is mounted to a portion of the first cyclone unit, preferably external thereof, and preferably spaced from the openable end.

In some examples, the additional dirt separation unit is mounted to a portion of the first cyclone unit opposed to the openable end.

[0018] In some examples, the first cyclone unit has a rear end and the at least one additional dirt separation unit comprises a second cyclone unit provided
5 on the rear end of the first cyclone unit.

[0019] In some examples, the first cyclone unit has a front end that is openable. In some examples, the second cyclone unit has a rear end that is openable.

[0020] In some examples, each of the first and second cyclone unit has a
10 cyclone axis and the cyclone axes are generally parallel.

[0021] In some examples, the first cyclone unit and the additional dirt separation unit are provided in a portable surface cleaning apparatus that is removably mounted to a support structure that is pivotally mounted to a surface cleaning head.

15 [0022] In some examples, the surface cleaning apparatus comprises a hand vacuum cleaner.

[0023] In some examples, the cyclone collection chambers are removable from the surface cleaning apparatus as a sealed unit for emptying.

[0024] It will be appreciated that a surface cleaning apparatus may
20 incorporate one or more of the features of each of these examples

DRAWINGS

[0025] In the detailed description, reference will be made to the following drawings, in which:

[0026] Figure 1 is a side plan view of an example of a hand vacuum
25 cleaner;

[0027] Figure 2 is a top plan view of the hand vacuum cleaner of Figure 1;

- [0028] Figure 3 is a front plan view of the hand vacuum cleaner of Figure 1;
- [0029] Figure 4 is a partially exploded rear perspective view of the hand vacuum cleaner of Figure 1;
- 5 [0030] Figure 5 is a partially exploded front perspective view of the hand vacuum cleaner of Figure 1;
- [0031] Figure 6 is a cross section taken along line 6-6 in Figure 2;
- [0032] Figure 7A is a bottom perspective view of the hand vacuum cleaner of Figure 1;
- 10 [0033] Figure 7B is a rear perspective view of the hand-vacuum cleaner of Figure 1, showing a suction motor removed from the hand vacuum cleaner;
- [0034] Figure 7C is a front perspective view of the hand-vacuum cleaner of Figure 1, showing a suction motor removed from the hand vacuum cleaner;
- [0035] Figure 7D is a rear perspective view of the hand-vacuum cleaner of Figure 1, showing a post-motor filter housing removed from a suction motor housing;
- 15 [0036] Figure 8 is a cross section showing an alternate example of a hand vacuum cleaner;
- [0037] Figure 9 is an exploded side perspective view of a portion of the hand vacuum cleaner of Figure 8;
- 20 [0038] Figure 10 is an exploded bottom perspective view of a portion of the hand vacuum cleaner of Figure 8;
- [0039] Figure 11 is an exploded bottom perspective view of the hand vacuum cleaner of Figure 8; and
- 25 [0040] Figure 12 is a perspective illustration of the hand vacuum cleaner of Figure 1 mounted to an upright vacuum cleaner.

DESCRIPTION OF VARIOUS EXAMPLES

[0041] 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.

10 [0042] In the drawings attached hereto, the surface cleaning apparatus is exemplified as used in a hand vacuum cleaner that uses a cyclone. It will be appreciated that the vacuum cleaner 100 may be of various types (e.g., an upright vacuum cleaner, a canister vacuum cleaner, an extractor, etc.) and configurations (e.g., different positioning and/or orientation of the cyclonic stages and the suction motor and differing cyclonic stages that may comprise one or more cyclones and one or more filters). The surface cleaning apparatus 100 is preferably any portable surface cleaning apparatus that comprises one or more air treatment members and a suction motor in a self contained unit and may be a pod or hand vacuum cleaner or various designs that may be removably mounted to an upright vacuum cleaner and may be the operating components of the upright vacuum cleaner.

[0043] Referring to Figures 1 to 7D, a first example of a surface cleaning apparatus 100 is shown. Preferably, the surface cleaning apparatus 100 (also referred to herein as vacuum cleaner 100 or cleaner 100) is a vacuum cleaner 100, and more preferably, a portable vacuum cleaner, which is movable along a surface to be cleaned by gripping and maneuvering handle 102. The vacuum cleaner includes an upper portion 104, a lower portion 106, a front end 108, and a rear end 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 end 110, and may be of any design.

[0044] In the example shown, the vacuum cleaner 100 comprises a nozzle 112 and a first cyclone unit 114, which together preferably form a surface cleaning head 116 of the vacuum cleaner 100. As exemplified, the surface cleaning head 116 is preferably provided at the front end 108 of the vacuum cleaner 100.

[0045] 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 end 110 of the cleaner 100.

[0046] Cyclone unit 114 is provided in the airflow passage, downstream of the dirty air inlet 118. Cyclone unit 114 has a front 194, and a rear 192. In the example shown, the cyclone unit 114 is a one piece assembly comprising one cyclone 122, and one dirt collection chamber 124, which are integrally formed. In alternate examples, the cyclone unit 110 may include more than one cyclonic stage, wherein each cyclonic stage comprises one or more cyclones and one or more dirt chambers. Accordingly, the cyclones may be arranged in parallel and/or in sequence. Further, in alternate examples, the cyclone 122 and dirt collection chamber 124 may be separately formed.

[0047] In the example shown, the nozzle 112 is preferably 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. However, it will be appreciated that nozzle 112 may be connected to the cyclone unit or dirt collection chamber at alternate locations.

[0048] Preferably, as exemplified, nozzle 112 may be on lower surface 157 of cyclone unit 114. In a particularly preferred design, the upper wall 126 of the nozzle may be a lower wall 119 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.

[0049] Preferably, as exemplified, 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.

[0050] As shown in Figures 3 and 5, nozzle 112 has a width W_N , and cyclone unit 114 has a width W_C . In the example shown, W_N , and W_C are about the same. An advantage of this design is that the nozzle 112 may have a cleaning path that is essentially as wide as the hand vacuum itself.

[0051] Preferably, nozzle 112 comprises an airflow chamber 136 wherein at least a portion, and preferably a majority, of the lower surface of the chamber 136 is open. Such a design is exemplified in Figure 7A wherein, as mentioned hereinabove, nozzle 112 comprises an upper nozzle wall 126. In the example shown, the upper nozzle wall 126 comprises a lower portion 119 of outer wall 115 of the cyclone unit. Accordingly, nozzle 112 is integral with cyclone unit 114. It will be appreciated that nozzle 112 need not have a common wall with cyclone unit 114. It will also be appreciated that nozzle 112 may be any nozzle known in the art and may comprise an enclosed passage extending from the dirty air inlet.

[0052] If nozzle 112 is open sided, then preferably one or more depending walls 128 extend downwardly from the upper nozzle wall 126. The depending wall 128 is preferably generally U-shaped. In one embodiment, a 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. 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 wall
5 may be continuous to define a single wall as shown, or may be discontinuous. The depending wall is preferably rigid (e.g., integrally molded with cyclone unit 114). However, it may be flexible (e.g., bristles or rubber) or moveably mounted to cyclone unit 114 (e.g., hingedly mounted).

[0053] Preferably, the lower end 132 of depending wall 128 is spaced
10 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 a 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.

15 [0054] 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
20 constant.

[0055] As exemplified, the open end of the U-shape defines an open side
130 of the nozzle 114, 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 114. In use, when optional wheels 135 are in contact with a surface, the open side 130
25 sits above and is adjacent a surface to be cleaned (e.g. floor F). As mentioned hereinabove, preferably, lower end 132 of depending walls 128 is spaced above floor F. Accordingly, some air may enter nozzle 114 by passing underneath depending wall 132. In such a case, the primary air entry to nozzle 114 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.

[0056] In the example shown, the lower end 132 of the depending wall 128 defines an open lower end 134 of the nozzle 114. The open lower end 134 preferably extends to the front end 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.

[0057] 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 preferably spaced from the surface to be cleaned, and the space between the lower end of the depending wall 128 and the surface to be cleaned form the 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 end 108. Optionally, one or more rear wheels 180 may be provided. In an alternate embodiment, no wheels may be provided.

[0058] The upper nozzle wall 126, depending wall 128, and open lower end 134 of the nozzle 112 define the 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 7A).

[0059] An opening 138 may be 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 a cyclone air inlet 140 of cyclone 122.

5 [0060] Cyclone 122 may of any configuration and orientation. Preferably, cyclone 122 comprises a chamber wall 142, which in the example shown, is cylindrical. The cyclone chamber is located inside chamber wall 142. The cyclone 122 extends along an axis 123, which, in the example shown, is preferably parallel to the nozzle axis, and preferably extends generally horizontally when
10 cleaner 100 is in use and wheels 135 are seated on a surface. The cyclone 122 has an air inlet 140 and an air outlet 145, which preferably are at the same end of cyclone 122. Preferably the air inlet and the air outlet are distal to front end 108. 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
15 as is known in the art. Preferably, the dirt outlet is at an opposed end.

[0061] As exemplified, the cyclone air inlet 140 is defined by an aperture in the chamber wall 142. The cyclone inlet 140 is preferably at the rear end 198 of the cyclone 122. As can be seen in Figure 5, the inlet passage 139 is configured such that air enters the cyclone 122 in a tangential flow path, e.g., passage 139
20 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, through outlet 145. Outlet 145 is preferably defined in a rear wall 179 of the cyclone unit 114.

[0062] As exemplified in Figure 6, a plate 174 may be provided adjacent
25 outlet passage 144, spaced from and facing the inlet 176 to outlet passage 144. Plate 174 may be mounted to cyclone 122 via legs 178. In the example shown, plate 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.

[0063] The dirt that is separated from the air exits the cyclone via dirt outlet 146, and enters dirt collection chamber 124. Dirt outlet is preferably at the front 196 of the cyclone 122, and further, is at the front end 108 of the cleaner 100. The dirt collection chamber may be internal or external to the cyclone chamber. Preferably, as exemplified, the dirt collection chamber is external. The dirt collection chamber 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 108.

10 [0064] In the example shown, dirt collection chamber 124 preferably comprises two portions. A first portion 148 is provided immediately adjacent the dirt outlet 146, and is at the front end 108 of the cleaner 100. A second portion 150 is concentric with the cyclone 122. A lower portion 152 of the second portion 150 is below the cyclone. As exemplified, nozzle 112 is positioned below first
15 portion 148, and lower portion 152. Accordingly, dirt chamber 124 may comprise an annular chamber surrounding the cyclone 122.

[0065] A separation plate 154 may be provided in the dirt collection chamber 124, and may be mounted in facing relation to and adjacent the dirt outlet 146. The separation plate 154 aids in preventing dirt in dirt collection
20 chamber 124 from re-entering cyclone 122. Preferably, plate 154 is spaced from dirt outlet 146 and preferably faces dirt outlet 146. Plate 154 may be mounted by any means to any component in cyclone unit 114. As exemplified, the separation plate is preferably mounted on an arm 156, which extends from a front wall 158 at the front end 108 of the cleaner 100.

25 [0066] 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 and/or removable. As exemplified in Figures 4 and 5, front wall 158 is pivotally mounted to the cyclone unit wall 115 and serves as an openable door of the dirt chamber 124, such dirt collection chamber 124 is openable, and dirt collection chamber

124 may be emptied. The dirt collection chamber is preferably openable both when the dirt collection chamber is mounted to the hand vacuum cleaner, or when it is optionally removed. When front wall 158 is pivoted away from the remainder of the cyclone unit 114, separation plate 154, if mounted thereon, also
5 pivots away from the remainder of the cyclone unit. A latch 159 or other securing member or members may be 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 rear wall 179 of the cyclone unit 114 may be openable.

[0067] The rear portion of the dirt collection chamber 124 may be closed
10 by wall 179.

[0068] The clean air exiting cyclone 122 passes through outlet 145 of outlet passage 144, exits surface cleaning head 116, and passes into the cleaner body 160. In the example shown, the cleaner body 160 is positioned rearward of the surface cleaning head 116. Further, as exemplified in Figures 8-11, the air
15 mat pass through a second cyclonic stage prior to entering motor 164.

[0069] The cleaner body comprises a suction motor housing 168, which has a front end 167, and a rear end 169. The suction motor housing 168 houses a suction motor 164. The suction motor 164 may be any type of suction motor. The suction motor draws air into the dirty air inlet 118 of the cleaner 100, through
20 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 123 preferably extend in the same direction and are preferably generally parallel.

[0070] In the example shown, the vacuum cleaner 100 further comprises
25 an additional dirt separation unit 121. As exemplified in Figures 1-7B, the additional dirt separation unit 121 is provided in a chamber of the cleaner body, and more particularly, mounted in the suction motor housing.

[0071] In the example shown in Figures 1-7B, the additional dirt separation unit is a pre-motor filter 162. Pre-motor filter 162 is provided in the airflow path preferably adjacent and downstream of the outlet passage 144, and preferably facing the outlet 145. More particularly, pre-motor filter 162 is provided in a chamber 161 of the motor housing 168 between the motor and the first cyclone unit 114. In the exemplified embodiment, cyclone unit 114, pre-motor filter 162, and the suction motor 164 are preferably linearly aligned. That is, they all extend along a common axis 125 of the cleaner 100. If the vacuum cleaner is of a non-linear configuration, then pre-motor filter 162 need not be located adjacent outlet passage 144.

[0072] Pre-motor filter 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.

[0073] The cleaner body 160 further comprises an optional post-motor filter housing 170. A post motor filter 166 is provided in the post-motor filter housing 170. The post motor filter 166 is provided in the airflow path downstream of, and preferably adjacent, the suction motor 164. In the example shown, the post motor filter 166 is linearly aligned with the cyclone unit 114, pre-motor filter 162, and motor 164, along axis 125. Post motor filter 166 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.

[0074] Clean air outlet 120 is provided downstream of post-motor filter 166. Clean air outlet 120 may comprise a plurality of apertures formed in housing 170.

[0075] Referring to Figure 7B, the suction motor housing 168 is preferably removably mounted to the hand vacuum cleaner 100. In the example shown, the suction motor housing 168 is removably mounted to the first cyclone unit 114 of the vacuum cleaner 100, and more particularly, the front end 167 of the suction

motor housing 168 is removably mounted to the first cyclone unit 114. When the suction motor housing 168 is removed from the hand vacuum cleaner 100, the additional dirt separation unit 121 is visible. That is, as shown in Figure 7B, the pre-motor filter 162 is visible when suction motor housing 168 is removed from the vacuum cleaner 100. Accordingly, the pre-motor filter 162 may be removed, serviced, changed, or cleaned. Accordingly, suction motor housing 168 is openable by removing it from the vacuum cleaner 100.

[0076] In the example shown, the cyclone unit 114 comprises the dirt collection chamber 124. Accordingly, when the cyclone unit 114 is removed from the suction motor housing 168, the dirt collection chamber 124 is removed from the suction motor housing. Further, as shown in Figure 7C, the cyclone unit 114, and the dirt collection chamber 124, are preferably removed as a sealed unit for emptying. That is, cyclone unit 114 is sealed, except for the fluid flow passages leading to and from the first cyclone unit 114 (i.e. opening 138 and outlet 145). In order to empty the dirt collection chamber 124, the front wall 158 may be opened, and the dirt may be emptied from dirt chamber 124. Cyclone unit 114 may be emptied by any other means known in the vacuum cleaner arts.

[0077] The motor housing 168 may be removably mounted to the surface cleaning apparatus 100 in any manner. For example, it may be mounted thereto by a screw mount, a bayonet mount and/or hand operable mechanical fasteners such as latches.

[0078] Preferably, the cyclone unit 114 and the motor housing 168 are configured such that one component defines a platform that may be used to stand the vacuum cleaner upright on a horizontal surface. Preferably, one component is rotated on the other unit to align the mounting or engagement members. Preferably, the rear end of the suction motor housing is configured as a platform such that the rear end may be placed on a horizontal surface (e.g., a floor or a table top) and stood upright (i.e., with the end of motor housing adjacent cyclone unit 114 facing up). In such an orientation, the cyclone unit may

be placed on top of motor housing 168 and rotated until the cyclone unit is locked into place on the motor housing.

[0079] Accordingly, in order to removably mount the motor housing 168 to the surface cleaning apparatus, one of the cyclone unit 114 and the motor housing 168 may have a ring wall 147 that is positioned exterior to an outer surface of the other of the first cyclone unit and the suction motor housing when the hand vacuum cleaner 100 is assembled. In the example shown, the cyclone unit 114 has the ring wall 147 at the rear end 192 thereof, and the front 167 of the motor is insertable into the ring wall. In the example shown, the ring wall 147 is a continuous wall. In alternate example, the ring wall 147 may be discontinuous.

[0080] Further, the cyclone unit 114 and the motor housing 168 are preferably rotationally mounted together. For example, as shown, the motor housing 168 has a first mounting member 175, and the cyclone unit 114 has a second mounting member 173. The first 173 and second 175 mounting members are releasably engageable with each other when the front 167 of the motor housing 168 is inserted into the ring wall 147, and the motor housing 168 is, e.g., rotated with respect to the cyclone unit 114. Preferably, as in the example shown, the first 173 and second 175 mounting members comprise a bayonet mount. In alternate examples, the first and second mounting members may be another type of mounting member, such as mating screw threads.

[0081] Referring to Figure 7D, the suction motor housing 168 is preferably removably mounted to the post-motor filter housing 170. More particularly, the rear end 169 of the suction motor housing 168 is preferably removably mounted to the post-motor filter housing. The suction motor housing 168 and the post-motor filter housing may be removably mounted together by any means including those referred to for removably securing motor housing 168 to cyclone unit 114.

[0082] One or more additional rear wheels 180 may be mounted to motor housing 168, preferably at lower portion 106, and may be used in conjunction with or instead of front 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.

[0083] Referring now to Figures 8 to 11, in which like numerals refer to like features, with the first digit incremented to 8 to refer to the figure number, an alternate example of a hand vacuum cleaner 800 is shown. This embodiment shows various alternate constructions, one or more of which may be used in addition to or in replacement of, those of the embodiment of Figures 1-7.

[0084] For example, nozzle 812 is an enclosed air flow passage as opposed to an open sided air flow chamber. Nozzle 812 comprises a lower wall 837, which closes lower end 834.

[0085] In this example, front wall 858 may be pivotally mounted to wall 815, as shown in Figures 9 to 11, or may not be pivotally mounted to wall 815.

[0086] Further, in this example, the vacuum cleaner 800 comprises two additional dirt separation units 821, including a second cyclone unit 851 in the airflow passage downstream of the first cyclone unit 114, as well as a pre-motor filter 862 in the airflow passage downstream of the second cyclone unit 851. However, in alternate embodiments, only the second cyclone unit may be provided

[0087] In the example shown, the second cyclone unit 851 comprises a plurality of second stage cyclones 897 arranged in parallel. The second cyclone unit 851 has an inlet 853 in communication with each second stage cyclone 897, and each second stage cyclone 897 has an outlet 855, which is at the same end as inlet 853. In alternate examples, the second cyclone unit 851 may comprise only a single cyclone, or multiple cyclones arranged in series. As exemplified,

the second cyclone unit extends along an axis 893, which is preferably parallel to the axis 823 of the first cyclone unit.

[0088] Preferably, the second cyclone unit 851 has a second dirt collection chamber. As exemplified, each of the cyclones 897 of the second cyclone unit
5 has an internal dirt collection chamber (i.e. the dirt collection chamber is within the cyclone).

[0089] As exemplified, both the pre-motor filter 862 and the second cyclone unit 851 are provided in a common chamber of the surface cleaning apparatus. Preferably, each of the pre-motor filter 862 and the second cyclone
10 unit 851 are visible when the chamber is opened. For example, one unit may be mounted to the motor housing and another to the cyclone unit 114.

[0090] As exemplified, both the pre-motor filter 862 and the second cyclone unit 851 are provided in the motor housing 868. Further, suction motor housing 868 is removably mounted to vacuum cleaner 800 to open the suction
15 motor housing 168. Preferably, as shown, second cyclone unit 851 is mounted to first cyclone unit 814. For example, as shown, the second cyclone unit 851 may be provided on the rear 892 of the first cyclone unit 814. Further, the pre-motor filter 862 is mounted to or in the suction motor housing 868. Accordingly, when suction motor housing 868 is removed from the hand vacuum cleaner 800, as
20 shown in Figure 11, both pre-motor filter 862 and second cyclone unit 851 are visible.

[0091] In alternate embodiments, only one of the additional dirt separation units may be visible when the chamber is opened. For example, both the pre-motor filter 862 and the second cyclone unit 851 may be mounted to the suction
25 motor housing 868, and only the second cyclone unit 851 may be visible when the suction motor housing is opened.

[0092] The second cyclone unit 851 may be removably mounted to the cyclone unit 814 and is preferably mounted and more preferably, removably

mounted to, e.g., rear wall 892 of the first cyclone unit 814. The second cyclone unit 851 may be removable mounted by any means known in the art such as a bayonet mount, a screw mount or hand operable mechanical fasteners. Preferably, when the second cyclone unit 851 is removed from the cyclone unit
5 814, the dirt chambers of the second stage cyclones 897 are sealed. For example, as shown, the dirt chambers of the second stage cyclones 897 are sealed by a front wall 891, and a rear wall 899.

[0093] Preferably, the first cyclone unit 814 has an openable end, and the additional cyclone unit 851 is mounted to a portion of the first cyclone unit 814
10 spaced from an openable end of the first cyclone unit 814 and, more preferably, opposed to the openable end of the first cyclone unit 814. For example, as shown, front end 894 of cyclone unit 814 is openable via openable door 858, and the second cyclone unit 851 is mounted to the rear end 892, which is spaced from and opposed to the front end 894.

15 [0094] As exemplified, it is preferred that one of the ends of the second cyclone unit 851 that is transverse to the direction of air flow from the first cyclone unit 814 to the second cyclone unit 851 is openable. For example, the rear end of the second cyclone unit 851 may be openable. Preferably, as exemplified, rear wall 899 is pivotally mounted to the second cyclone unit 851,
20 and is secured to second cyclone unit 851 by, e.g., a latch 895. Second cyclone unit 851 may be opened and therefore emptyable when mounted to cyclone unit 114 and/or when removed therefrom. It will be appreciated that alternately, or in addition, the front end of the second cyclone unit 851 may be openable, either while second cyclone unit 851 is mounted to first cyclone unit 814 and/or when
25 removed therefrom.

[0095] In a preferred embodiment, the portions that are openable preferably extend in generally the same direction. Accordingly, as exemplified, door 858 and rear wall 899 are generally parallel. However, it will be appreciated that an alternate portion of second cyclone unit 851 may be openable. For

example, the bottom of the second cyclone unit 851 may be openable. Such a design may be used if the axis of the second cyclone unit 815 is transverse to the axis of the first cyclone unit 814.

[0096] Preferably, the first and second openable dirt collection chambers
5 are concurrently removably mounted to the surface cleaning apparatus. For example, as shown in Figure 10, when the first cyclone unit 814, including the first dirt collection chamber 824, is removed from the surface cleaning apparatus 800, the second cyclone unit 851, including the second dirt collection chamber, is concurrently removed from the surface cleaning apparatus 800.

10 [0097] Preferably, the openable portions of each cyclone unit face in a different direction (e.g., one may face forwards and the other may face rearwards). More preferably, the openable portions of each cyclone unit are spaced apart. For example, as shown, openable door 858 of the first cyclone unit 814 is at the front 808 of the vacuum cleaner 800, and faces the front 808 of
15 the vacuum cleaner 800. The rear wall 899 of the second cyclone unit 851 is spaced rearwardly from the front 808, and faces the rear 810 of the vacuum cleaner 800. Accordingly, the openable portions are spaced apart from each other, and are also opposed to each other.

[0098] Preferably, the openable portions the first 814 and second 851
20 cyclone units are sequentially openable. For example, as shown, the openable door 858 of the first cyclone unit 814 is openable by latch 859, and the openable door of the second cyclone unit 851 is openable by latch 895. Latches 859 and 895 are separately controlled. Accordingly, the first 814 and second 851 cyclone units may be opened sequentially.

25 [0099] In operation, a user may remove a module comprising the first and second cyclone units from the vacuum cleaner, one of cyclone units may be opened and emptied and then the other cyclone unit may be opened and emptied. As exemplified, front door 858 may be opened and the dirt chamber

emptied by tilting the front end 808 of the vacuum cleaner downwardly. The user may then close door 858 and open the second cyclone unit (e.g., wall 899). The user may then tilt the front end 808 upwardly so as to empty the second cyclone unit. This operation may be achieved without the user having to change their grip
5 on the module that is removed from the vacuum cleaner. It will be appreciated that the front end of the second cyclone unit 851 may alternately or in addition be opened.

[00100] In an alternate embodiment, the pre-motor filter may be mounted on wall 892 and may have a sealed chamber. In such an embodiment, the pre-
10 motor filter may be concurrently removed from the vacuum cleaner with the first cyclone unit 814 and then emptied.

[00101] It will be appreciated that in alternate examples, the additional dirt separation unit may comprise only a second cyclone unit, without a pre-motor filter.

15 [00102] As shown in Figure 12, in addition to being usable as a portable vacuum cleaner, surface cleaning apparatus 100 may be mountable in another type of vacuum cleaner, such as an upright vacuum cleaner 1200, as a removable pod. For example, as shown, surface cleaning apparatus 100 is mounted to a support structure 1202 of vacuum cleaner 1200, which pivotally
20 mounted to and in fluid communication with a surface cleaning head 1204 of vacuum cleaner 1200. It will be appreciated that a module comprising the first and second cyclone units from the upright vacuum cleaner 1200 leaving housing 860 mounted to support structure 1202.

25

CLAIMS:

1. A surface cleaning apparatus comprising:
 - (a) a front end and a rear end;
 - 5 (b) an air flow passage extending from a dirty air inlet to a clean air outlet;
 - (c) a suction motor positioned in a suction motor housing;
 - (d) a first cyclone unit positioned in the air flow passage, the first cyclone unit comprising a first openable dirt collection chamber; and,
 - 10 (e) an additional dirt separation unit positioned in the air flow passage, the additional dirt separation unit comprising a second openable dirt collection chamber, the first and second openable dirt collection chambers are concurrently removably mounted to the surface cleaning apparatus, each of the first cyclone unit and the additional dirt separation has an openable portion and the openable portions are spaced apart.
- 15 2. The surface cleaning apparatus of claim 1 wherein the first cyclone unit and the additional dirt separation unit are concurrently removably mounted to the surface cleaning apparatus.
- 20 3. The surface cleaning apparatus of any of claims 1-2 wherein the at least one additional dirt separation unit is mounted in a chamber of the surface cleaning apparatus and the at least one additional dirt separation unit is visible when the chamber is opened.
- 25 4. The surface cleaning apparatus of any of claims 1-3 wherein the first cyclone unit is removeably mounted to the surface cleaning apparatus.
5. The surface cleaning apparatus of any of claims 1-4 wherein the at least one additional dirt separation unit comprises a second cyclone unit.

6. The surface cleaning apparatus of any of claims 1-5 wherein the additional dirt separation unit is mounted to the first cyclone unit.
- 5 7. The surface cleaning apparatus of claim 6 wherein the additional dirt separation unit is removably mounted to the first cyclone unit
8. The surface cleaning apparatus of any of claims 6-7 wherein each of the first cyclone unit and the additional dirt separation has an openable portion and
10 the openable portions face in a different direction.
9. The surface cleaning apparatus of claim 8 wherein the openable portions are sequentially openable.
- 15 10. The surface cleaning apparatus of any of claims 8-9 wherein the openable portions are spaced apart and opposed.
11. The surface cleaning apparatus of any of claims 1-10 wherein the first cyclone unit is has an openable end and the additional dirt separation unit is
20 mounted to a portion of the first cyclone unit spaced from the openable end.
12. The surface cleaning apparatus of any of claims 1-12 wherein the additional dirt separation unit is external to the first cyclone unit.
- 25 13. The surface cleaning apparatus of any of claims 1-12 wherein the first cyclone unit is has an openable end and the additional dirt separation unit is mounted to a portion of the first cyclone unit opposed to the openable end.

14. The surface cleaning apparatus of any of claims 1-13 wherein the first cyclone unit has a rear end and the at least one additional dirt separation unit comprises a second cyclone unit provided on the rear end of the first cyclone unit.
- 5
15. The surface cleaning apparatus of claim 14 wherein the first cyclone unit has a front end that is openable.
- 10
16. The surface cleaning apparatus of any of claims 14-15 wherein the second cyclone unit has a rear end that is openable.
- 15
17. The surface cleaning apparatus of any of claims 14-16 wherein the each of the first and second cyclone unit has a cyclone axis and the cyclone axis are generally parallel.
- 20
18. The surface cleaning apparatus of any of claims 1-17 wherein the first cyclone unit and the additional dirt separation unit are provided in a portable surface cleaning apparatus that is removably mounted to a support structure that is pivotally mounted to a surface cleaning head.
19. The surface cleaning apparatus of any of claims 1-18 wherein the surface cleaning apparatus comprises a hand vacuum cleaner.
- 25
20. The surface cleaning apparatus of any of claims 1-19 wherein the cyclone collection chambers are removable from the surface cleaning apparatus as a sealed unit for emptying.

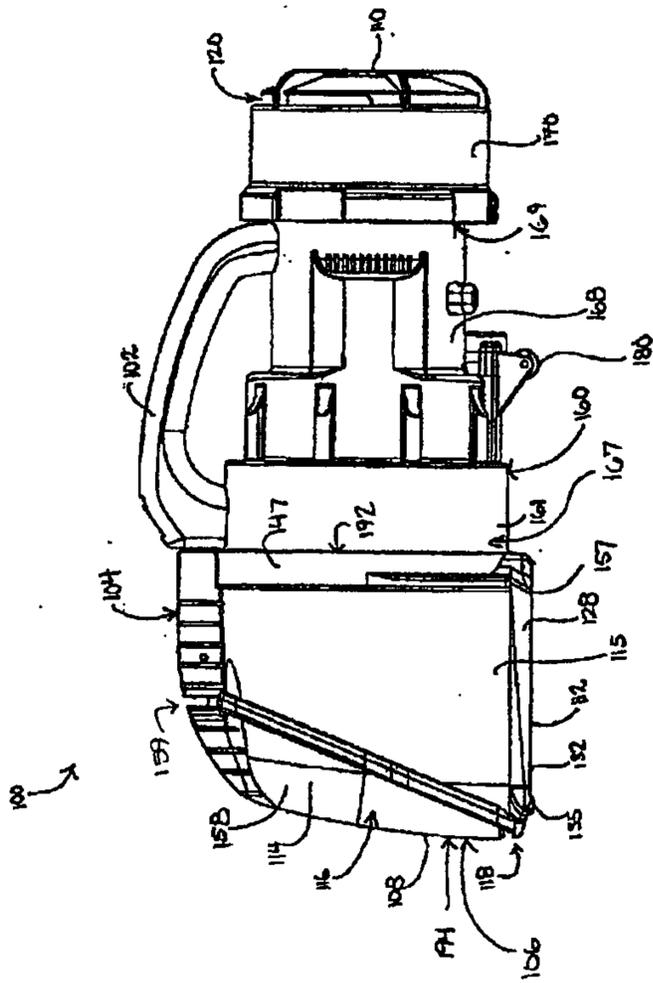


FIG. 1

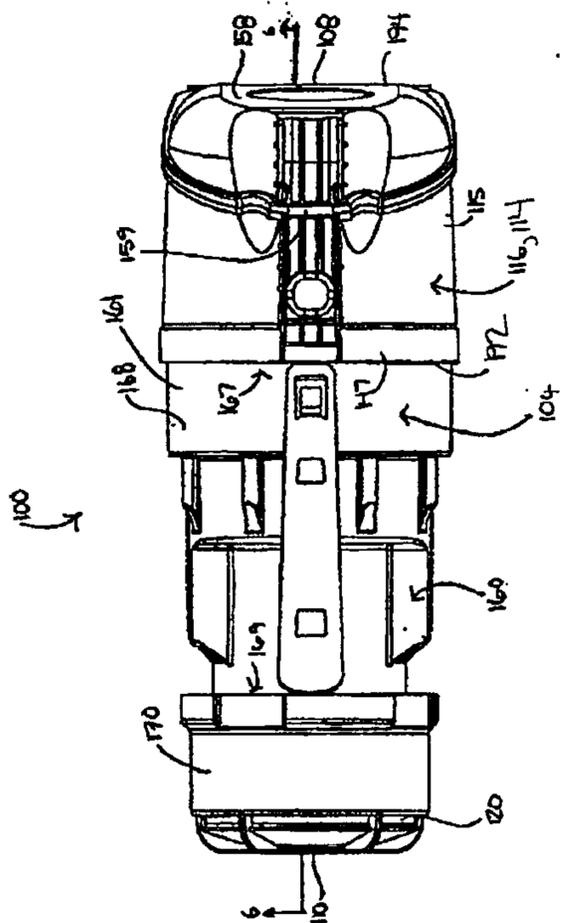
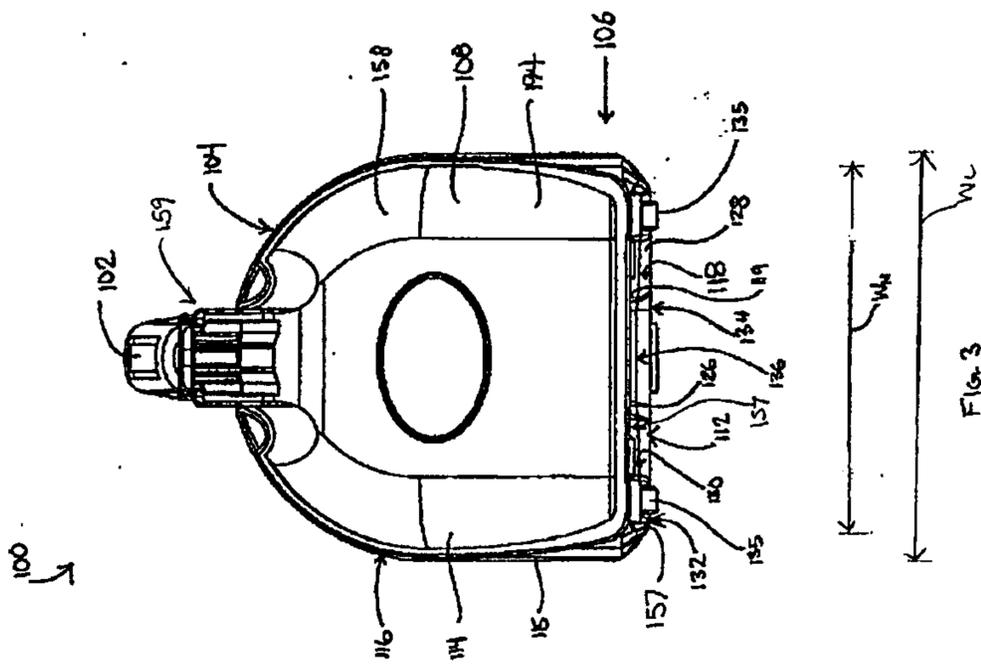


Fig. 2



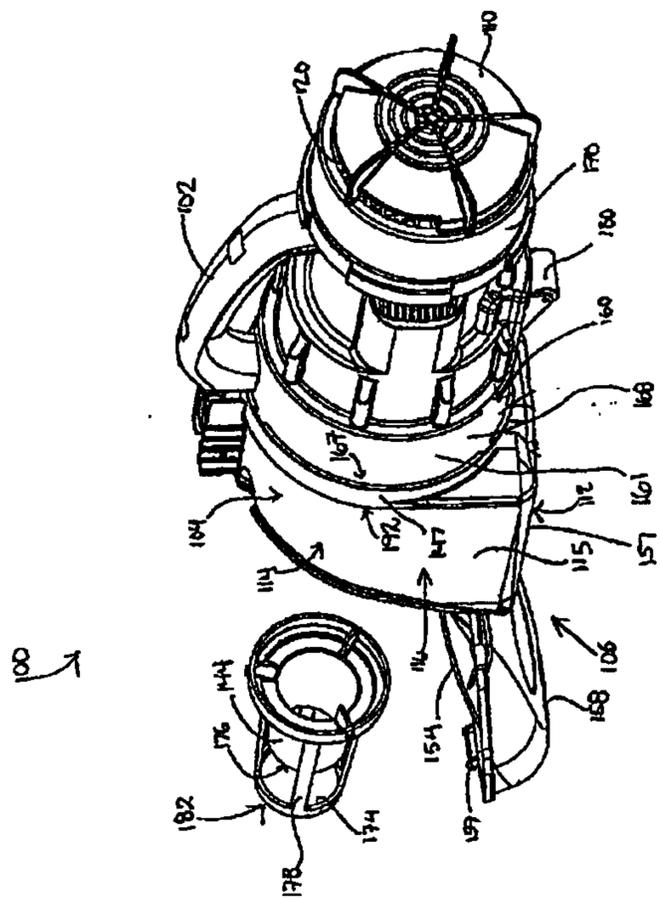


FIG. 4

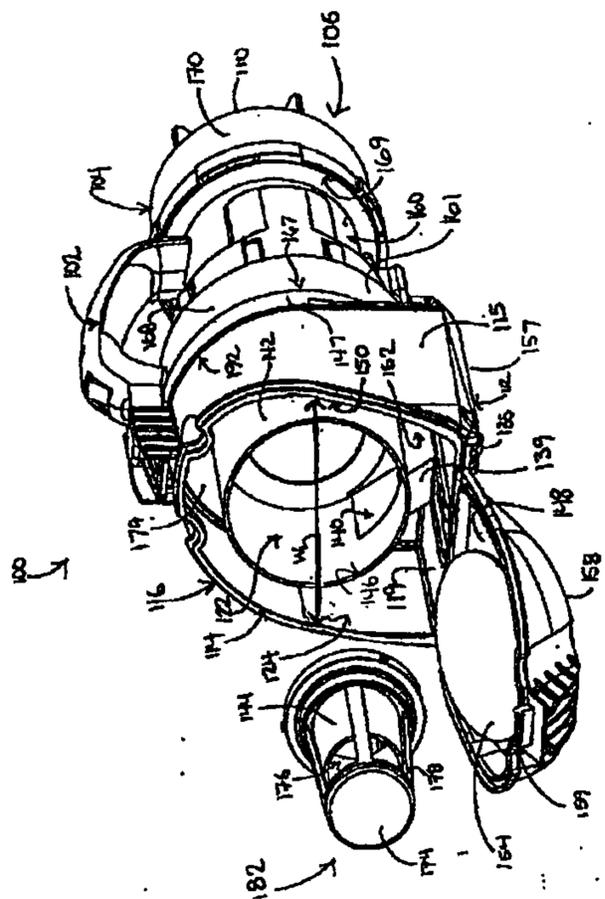


FIG. 5

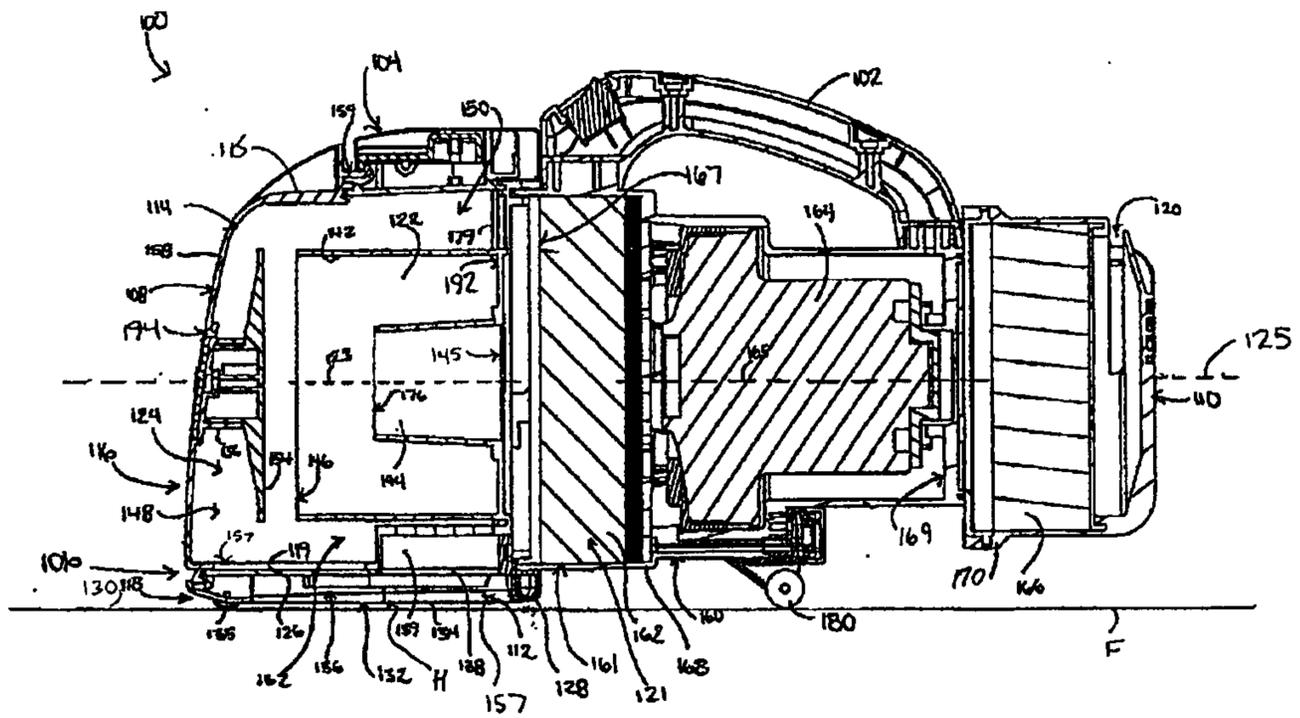


FIG. 6

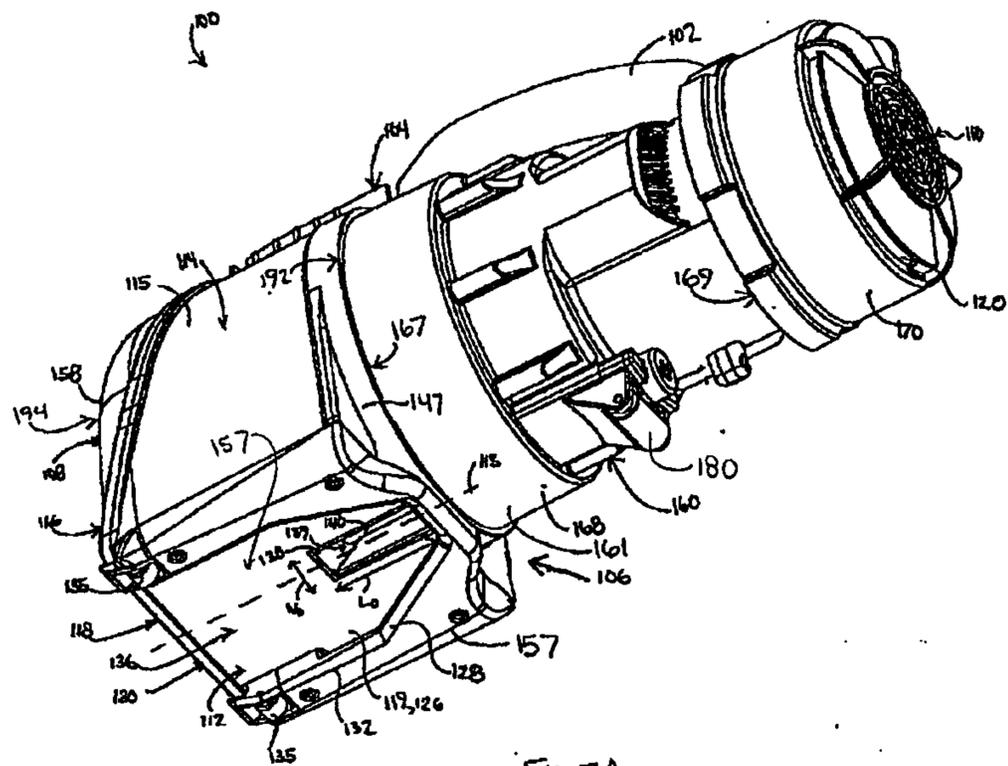


FIG. 7A

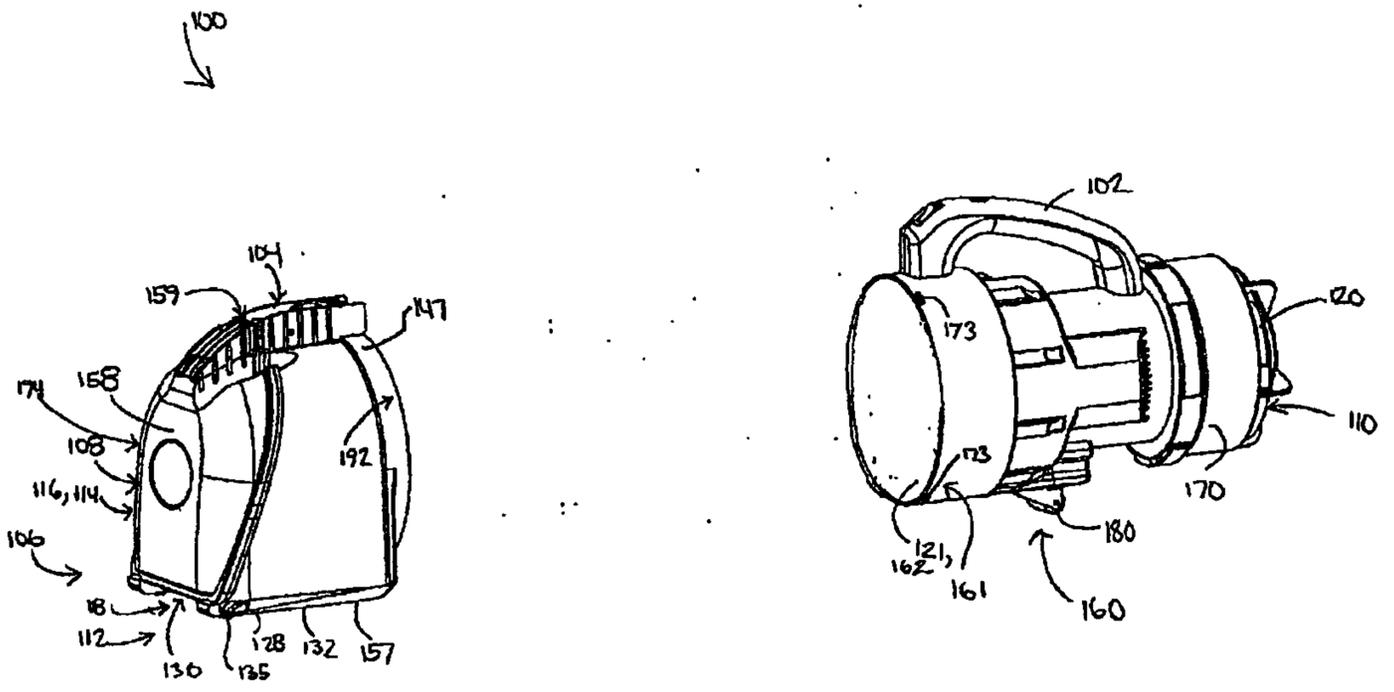


FIG 7B

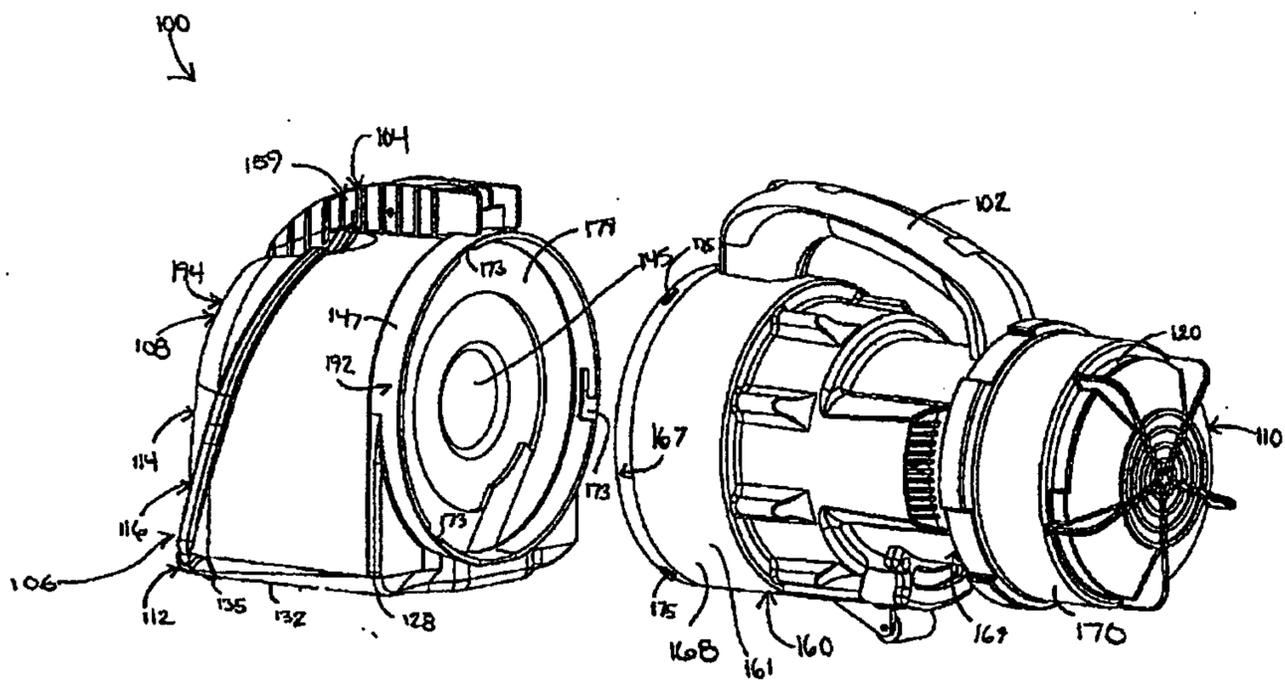


FIG 7C

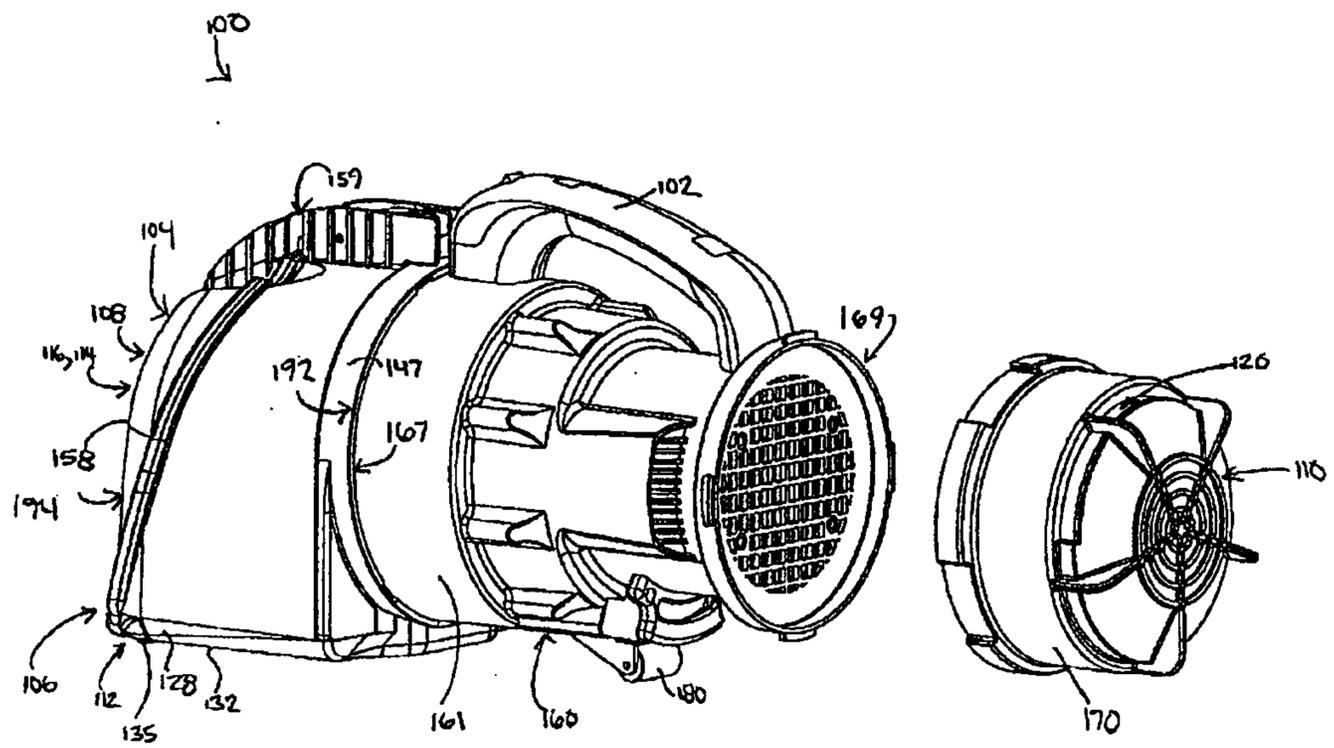


FIG 7D

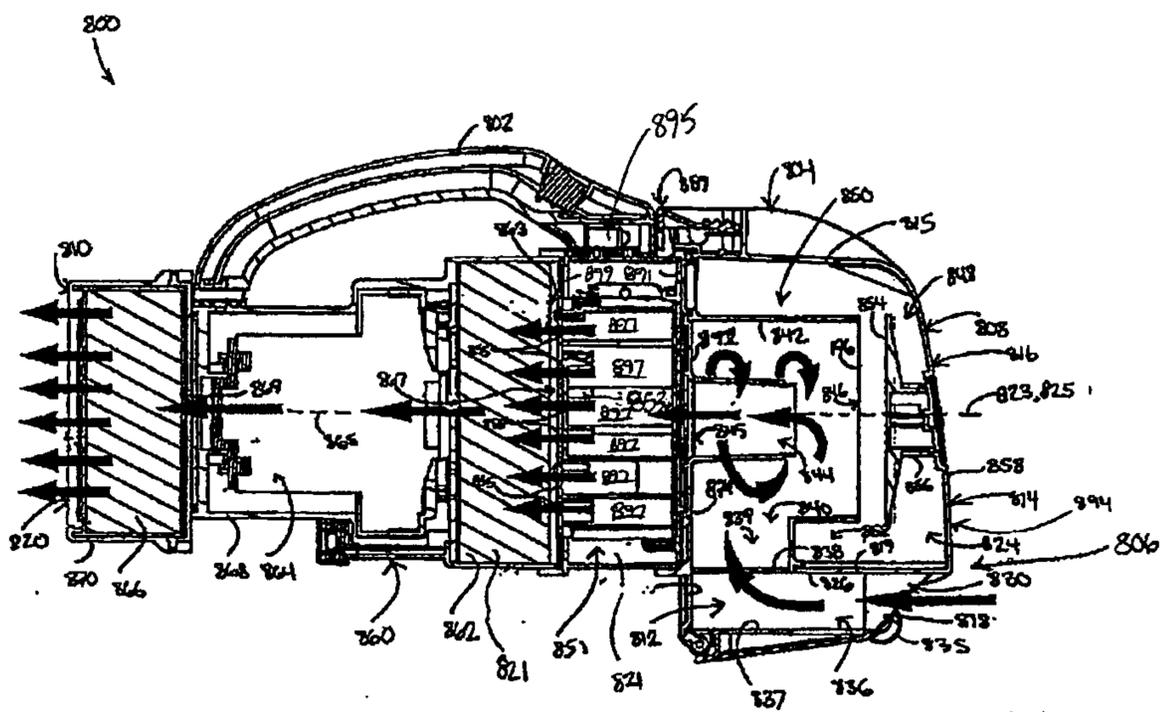


FIG. 8

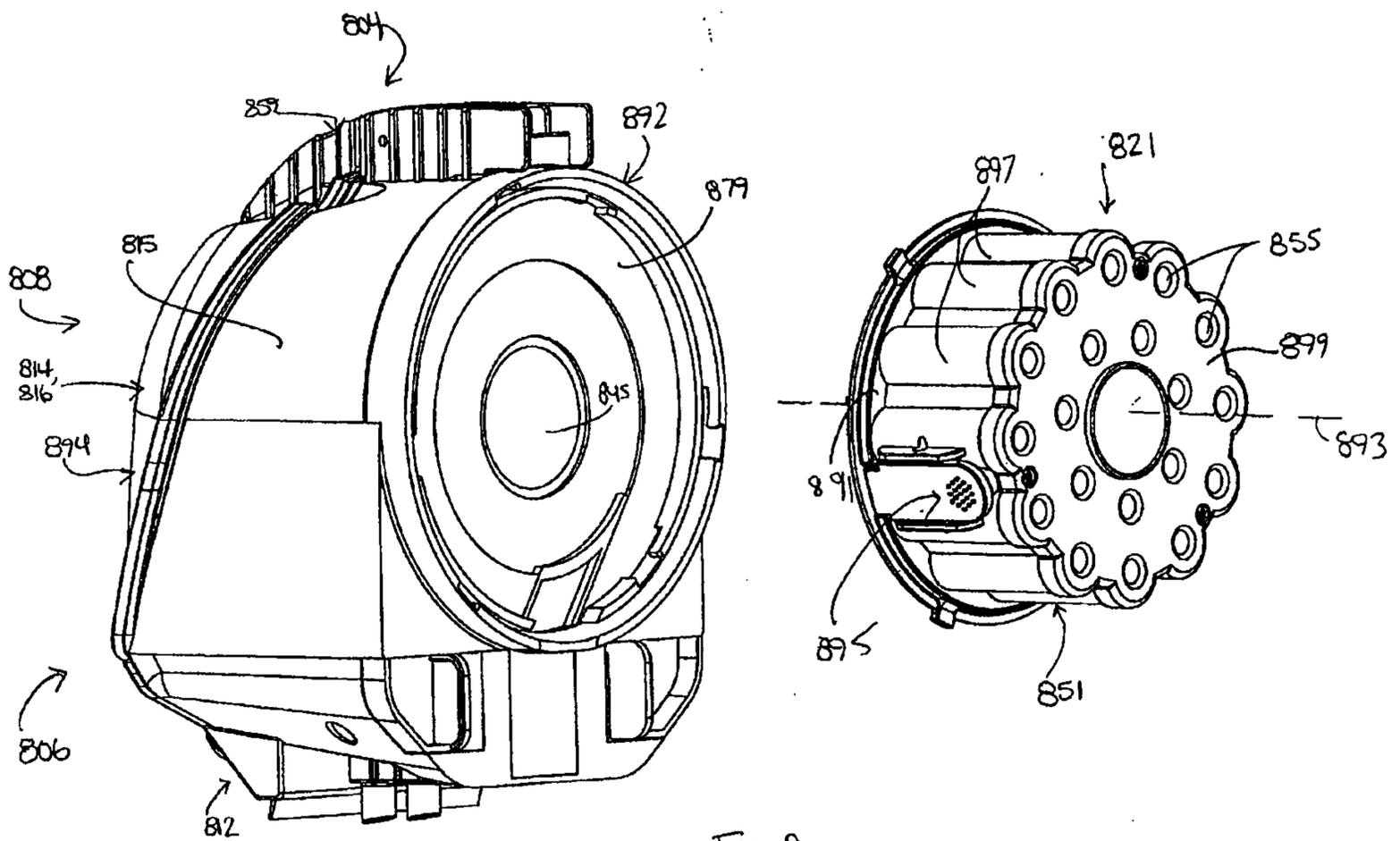


FIG. 9

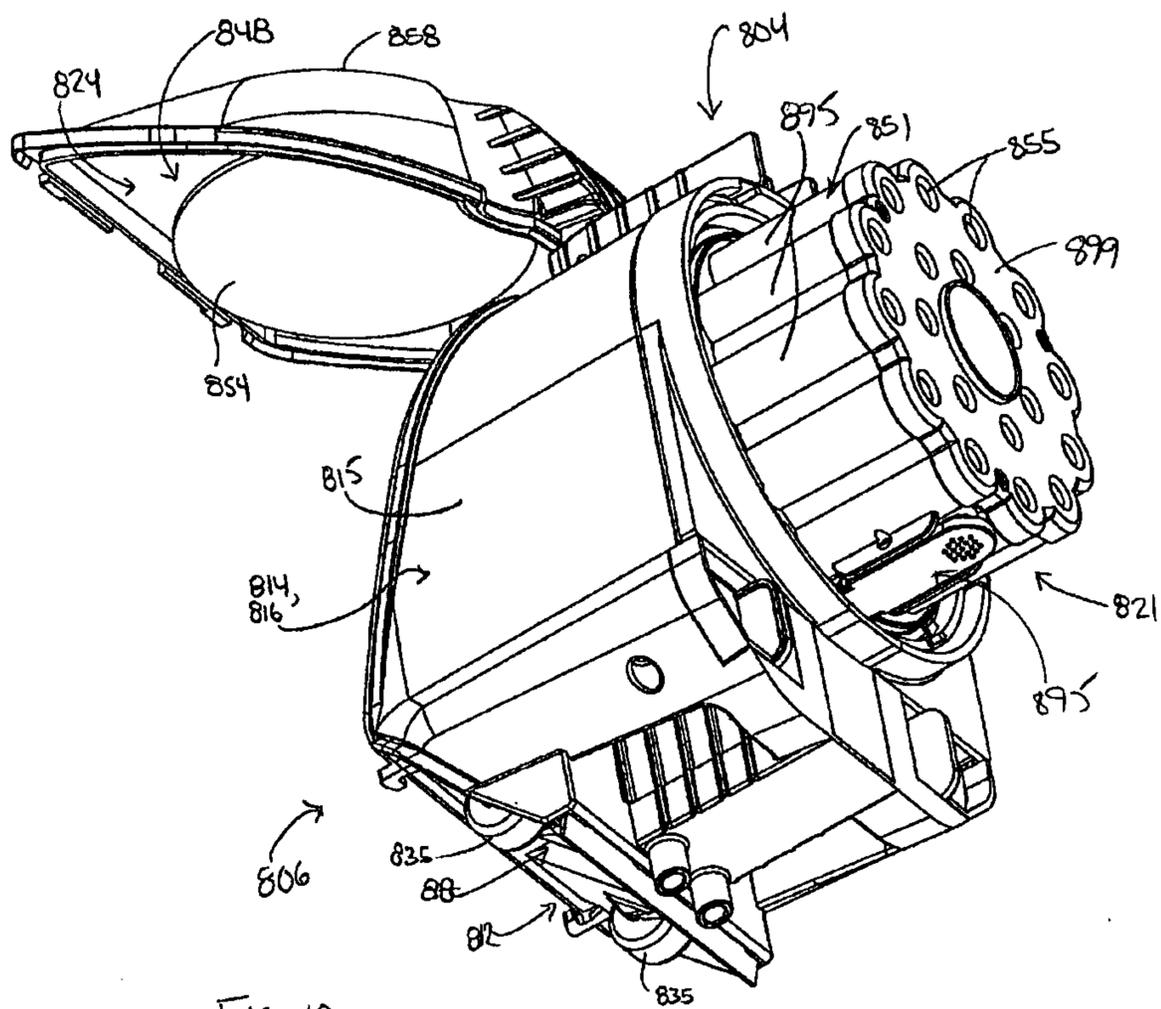


FIG. 10

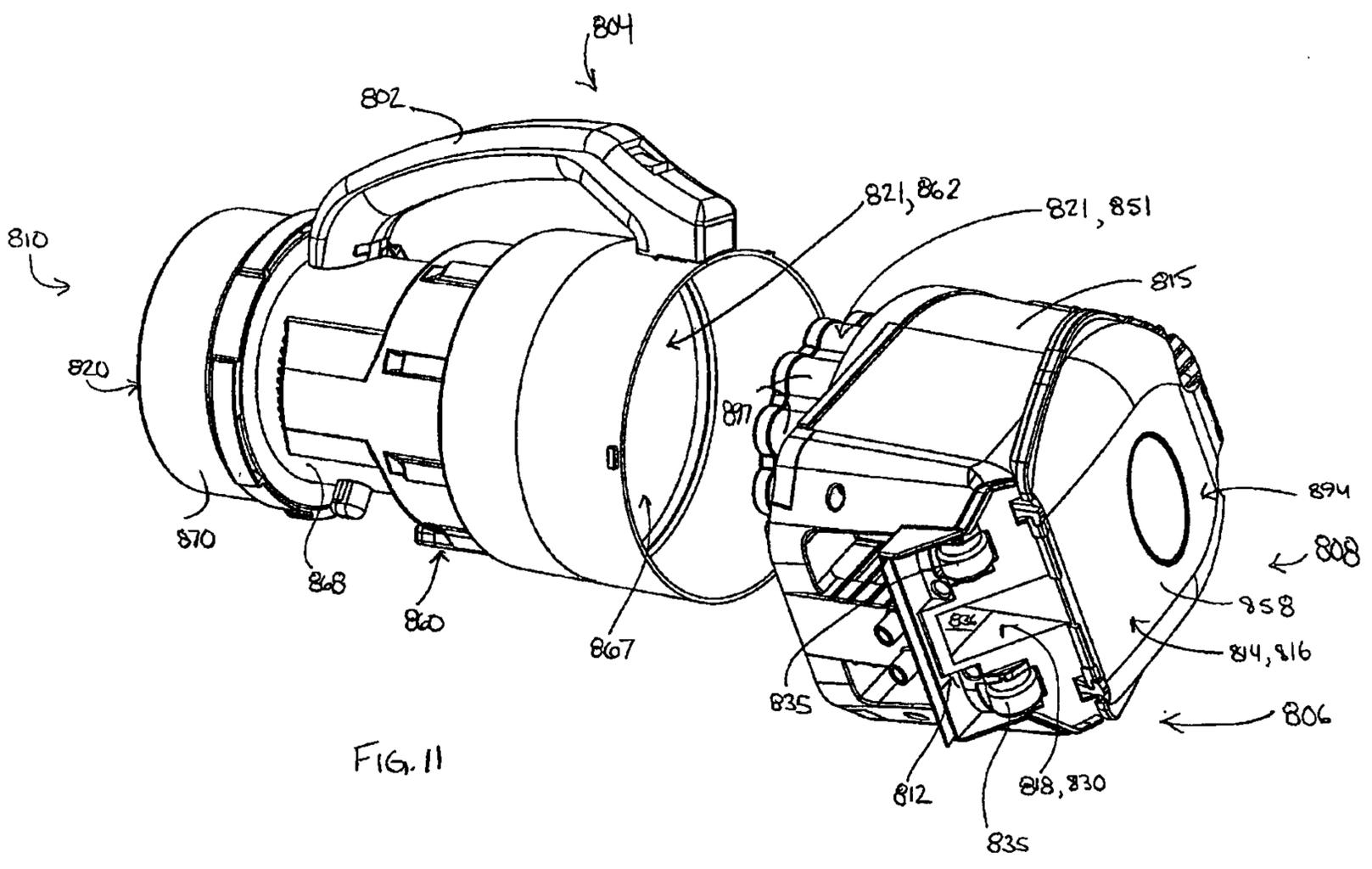


FIG. 11

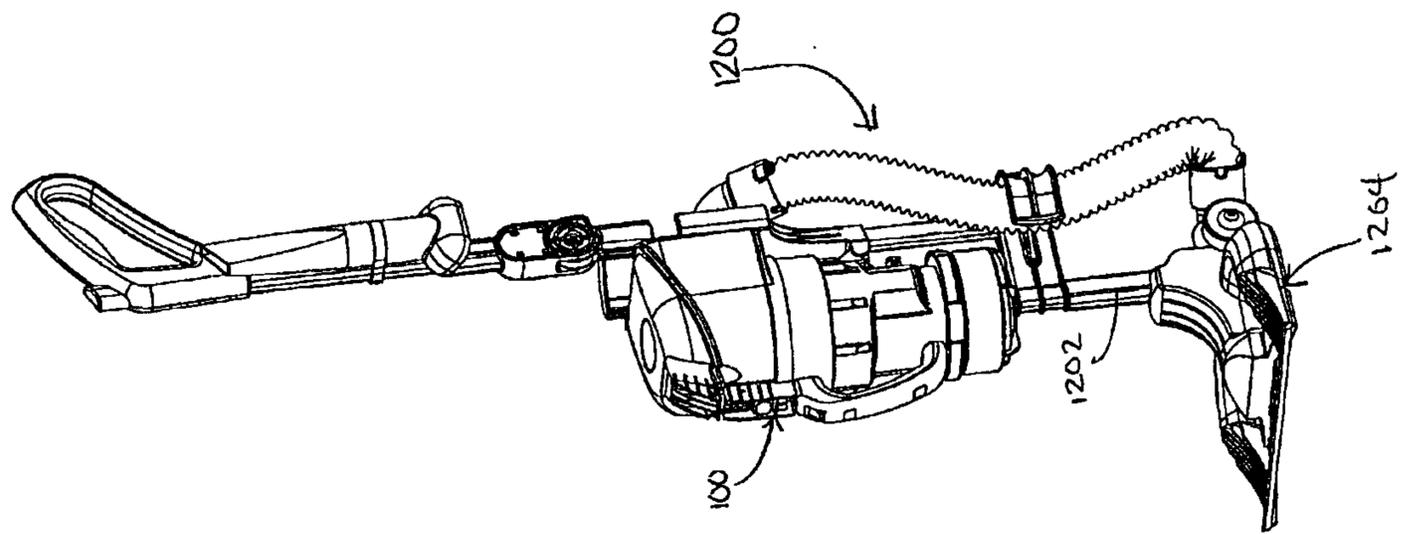


FIG 12

