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

(57) **Abrégé/Abstract:**

A hand vacuum cleaner has an air flow passage extending from a dirty air inlet to a clean air outlet. A cyclone unit comprises a cyclone stage and is positioned in the air flow passage upstream from a suction motor. The suction motor is housed in a cleaner body. A handle is provided on the cleaner body. The cyclonic stage comprises a cyclone and an openable front wall provided at a front end of the cyclonic stage. The cyclonic stage is provided forward of the suction motor. A pre-motor filter is positioned in the air flow passage downstream from an air outlet of the cyclone and rearward of a sidewall of the cyclone. The cyclonic stage is removable from the cleaner body with the openable front wall in a closed position. When the cyclonic stage is removed, the pre-motor filter is accessible for removal.

## ABSTRACT

A hand vacuum cleaner has an air flow passage extending from a dirty air inlet to a clean air outlet. A cyclone unit comprises a cyclone stage and is positioned in the air flow passage upstream from a suction motor. The suction motor is housed  
5 in a cleaner body. A handle is provided on the cleaner body. The cyclonic stage comprises a cyclone and an openable front wall provided at a front end of the cyclonic stage. The cyclonic stage is provided forward of the suction motor. A pre-motor filter is positioned in the air flow passage downstream from an air outlet of the cyclone and rearward of a sidewall of the cyclone. The cyclonic  
10 stage is removable from the cleaner body with the openable front wall in a closed position. When the cyclonic stage is removed, the pre-motor filter is accessible for removal.

## 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  
5 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  
10 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  
15 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;  
20 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  
25 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.

5 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  
10 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.

15 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.

20 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.

25 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.

5 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.

10 In some examples, the pre-motor filters comprise an upstream filter and a downstream filter, the downstream filter having smaller pores than the upstream filter.

It will be appreciated that an embodiment may contain one or more of features set out in the examples.

## 15 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;

20 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;

25 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  
5 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  
10 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  
20 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;

5 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;

10 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.

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#### 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.

25 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  
5 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  
10 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  
15 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  
20 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  
25 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.

5 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  
10 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  
15 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  
20 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  
25 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.

5                   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  
10 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  
15 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  
20 480 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.

25                   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.

5 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  
10 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.

15 The absence of mechanical fasteners 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  
20 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.

25 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.

5                   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.

10                   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.

15                   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  
20 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  
25 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.

5 Alternately, it will be appreciated that hand vacuum 400 may be partially nest between, or be received between, the ribs 256.

As exemplified, to supportively 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

10 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

15 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

20 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

25 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.

5                    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  
10 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  
15 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  
20 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  
25 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  
5 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  
10 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  
15 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  
20 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  
25 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  
5 200 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  
10 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  
15 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  
20 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.

25 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.

5                    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  
10 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  
15 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.  
20 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  
25 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  
5 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  
10 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  
15 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  
20 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  
25 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.

5 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  
10 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  
15 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  
20 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  
25 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.

5                    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  
10 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  
15 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.

20                    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  
25 446 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.

5                   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  
10 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  
15 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  
20 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  
25 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 than 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.

5 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  
10 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.

15 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  
20 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  
25 8, nozzle 412 has a width  $W_N$  and, as shown in Figure 11, coupling plate 123 has a width  $W_p$  that is generally the same as width  $W_N$ .

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 wall 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.

5 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  
10 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  
15 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  
20 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  
25 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.

5 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.

10 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  $W_o$  and a length  $L_o$  that are preferably the same as the width  $W_o$  and a length  $L_o$  of the opening 438. A sealing gasket 123 may provided at the juncture of the openings.

15 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.

20 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  
25 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.

5                    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  
10 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  
15 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  
20 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.  
25 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  
5 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  
10 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  
15 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  
20 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.  
25 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.

5 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  
10 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  
15 departing from the scope of the invention as defined in the claims appended hereto.

## Claims:

1. A hand vacuum cleaner comprising:
  - (a) a front end and a rear end;
  - (b) an air flow passage extending from a dirty air inlet of the hand vacuum cleaner to a clean air outlet of the hand vacuum cleaner;
  - (c) a cyclone unit positioned in the air flow passage upstream from a suction motor and comprising a first cyclonic stage;
  - (d) the first cyclonic stage comprising a front end, a rear end and a cyclone, the cyclone comprising a cyclone sidewall, a cyclone air inlet, a first stage cyclone air outlet comprising a screen and a cyclone axis extending in an axial direction between the front end and the rear end of the hand vacuum cleaner, the first stage cyclone air outlet having a direction of flow, the first cyclonic stage comprising an openable front wall provided at the front end of the first cyclonic stage;
  - (e) a pre-motor filter positioned in the air flow passage downstream from the first stage cyclone air outlet and rearward of the cyclone sidewall, the pre-motor filter having a diameter in a direction transverse to the cyclone axis that is larger than a diameter of the cyclone air outlet in the direction transverse to the cyclone axis;
  - (f) a cleaner body including the suction motor, the suction motor is positioned in the air flow passage downstream from the pre-motor filter, the suction motor having a motor axis and a downstream end, the first cyclonic stage is provided forward of the suction motor; and,
  - (g) a handle provided on the cleaner body,wherein the pre-motor filter has an outer perimeter defining a volume and the cyclone axis and the motor axis each extend through a centre of the volume, and  
wherein the cyclone axis is generally parallel to the motor axis, and

wherein when the openable front wall is opened, the front end of the first cyclonic stage is opened and has an opening, the opening has a diameter in the direction transverse to the cyclone axis, and the rear end of the first cyclonic stage has a diameter that is generally equal to the diameter of the opening, and

wherein the first cyclonic stage is removable from the cleaner body with the openable front wall in a closed position, and

wherein, when the first cyclonic stage is removed, the pre-motor filter is accessible for removal.

2. The hand vacuum cleaner of claim 1, wherein the openable front wall has a radial centre and the cyclone axis and the motor axis extend through the radial centre.
3. The hand vacuum cleaner of claim 1, wherein the motor axis and the cyclone axis are co-axial.
4. The hand vacuum cleaner of claim 1, further comprising a second cyclonic stage downstream of the first cyclonic stage, the second cyclonic stage comprising a plurality of cyclones, wherein the cyclone axis extends through a centre of the second cyclonic stage.
5. The hand vacuum cleaner of claim 1, wherein the dirty air inlet is provided at the front end of the hand vacuum cleaner.
6. The hand vacuum cleaner of claim 5, wherein air travels rearwardly from the dirty air inlet to the cyclone air inlet of the first cyclonic stage.

7. The hand vacuum cleaner of claim 6, wherein the cyclone air inlet of the first cyclonic stage is located at a rear end of the first cyclonic stage.
8. The hand vacuum cleaner of claim 5, wherein air travels in the axial direction from the dirty air inlet to the cyclone air inlet of the first cyclonic stage.
9. The hand vacuum cleaner of claim 1, further comprising a post-motor filter positioned in the air flow passage downstream from the suction motor, the post-motor filter has an outer perimeter defining a volume and the cyclone axis and the motor axis each extend through a centre of the volume of the post-motor filter.
10. The hand vacuum cleaner of claim 1, wherein the opening extends in a plane that is at a non-zero angle to the cyclone axis and the direction transverse to the cyclone axis.
11. A hand vacuum cleaner comprising:
  - (a) a front end and a rear end;
  - (b) an air flow passage extending from a dirty air inlet of the hand vacuum cleaner to a clean air outlet of the hand vacuum cleaner, wherein the dirty air inlet is provided at the front end of the hand vacuum cleaner;
  - (c) a cyclone unit positioned in the air flow passage upstream from a suction motor and comprising a first cyclonic stage;
  - (d) the first cyclonic stage provided at the front end of the hand vacuum cleaner, the first cyclonic stage comprising a front end, a rear end and a cyclone, the cyclone comprising a cyclone sidewall, a cyclone air inlet, a first stage cyclone air outlet and a cyclone axis extending in an axial direction between the front end and the rear end of the hand vacuum cleaner, the first stage cyclone air outlet having a direction of flow, the first

cyclonic stage comprising an openable front wall provided at the front end of the first cyclonic stage;

- (e) a cleaner body including a pre-motor filter, the pre-motor filter having a diameter in a direction transverse to the cyclone axis that is larger than a diameter of the cyclone air outlet in the direction transverse to the cyclone axis;
- (f) the cleaner body including the suction motor, the suction motor is positioned in the air flow passage downstream from the pre-motor filter, the suction motor having a motor axis and a downstream end; and,
- (g) a second cyclonic stage downstream of the first cyclonic stage, the second cyclonic stage comprising a plurality of cyclones, wherein the cyclone axis extends through a centre of the second cyclonic stage, wherein the pre-motor filter is positioned in the air flow passage downstream from the second cyclonic stage and rearward of the second cyclonic stage, wherein the pre-motor filter has an outer perimeter defining a volume and the cyclone axis and the motor axis each extend through a centre of the volume, and wherein the motor axis extends in the axial direction, and wherein air travels rearwardly from the dirty air inlet to the cyclone air inlet of the first cyclonic stage, and, wherein the first cyclonic stage is removable from the cleaner body with the openable front wall in a closed position.

12. The hand vacuum cleaner of claim 11, wherein, when the front wall is in an open position, the front wall opens a cyclone chamber and a dirt collection chamber.

13. The hand vacuum cleaner of claim 11, wherein the motor axis and the cyclone axis are co-axial.

14. The hand vacuum cleaner of claim 11, further comprising a post-motor filter positioned in the air flow passage downstream from the suction motor, the post-motor filter has an outer perimeter defining a volume and the cyclone axis and the motor axis each extend through a centre of the volume of the post-motor filter.
15. The hand vacuum cleaner of claim 14, wherein the post-motor filter has a diameter that is different to the pre-motor filter diameter.
16. The hand vacuum cleaner of claim 15, wherein the diameter of the post-motor filter is smaller than a diameter of the rear end of the first cyclonic stage.
17. The hand vacuum cleaner of claim 11, wherein the suction motor has a diameter that is smaller than the diameter of the pre-motor filter.
18. The hand vacuum cleaner of claim 11, further comprising a post-motor filter positioned in the air flow passage downstream from the suction motor, the post-motor filter has a diameter that is smaller than a diameter of the rear end of the first cyclonic stage.
19. The hand vacuum cleaner of claim 18, wherein the diameter of the pre-motor filter is different to the diameter of the post motor filter.
20. The hand vacuum cleaner of claim 11, wherein the front wall has a radial centre and the cyclone axis and the motor axis extend through the radial centre.
21. The hand vacuum cleaner of claim 20, wherein the motor axis and the cyclone axis are co-axial.

22. The hand vacuum cleaner of claim 11, wherein when the openable front wall is opened, the front end of the first cyclonic stage is opened and has an opening, the opening has a diameter in the direction transverse to the cyclone axis, and the rear end of the first cyclonic stage has a diameter that is generally equal to the diameter of the opening.
23. The hand vacuum cleaner of claim 11, wherein air travels in the axial direction from the dirty air inlet to the cyclone air inlet of the first cyclonic stage.
24. The hand vacuum cleaner of claim 11, wherein the cyclone air inlet of the first cyclonic stage is located at a rear end of the first cyclonic stage.
25. A hand vacuum cleaner comprising:
- (a) a front end and a rear end;
  - (b) an air flow passage extending from a dirty air inlet of the hand vacuum cleaner to a clean air outlet of the hand vacuum cleaner, wherein the dirty air inlet is provided at the front end of the hand vacuum cleaner;
  - (c) a cyclone unit positioned in the air flow passage upstream from a suction motor and comprising a cyclonic stage comprising an openable end;
  - (d) the cyclonic stage comprising an upper end, a lower end, a front end, a rear end, and a cyclone, the cyclone comprising a cyclone sidewall, a cyclone air inlet, a cyclone air outlet and a cyclone axis extending in an axial direction between the front end and the rear end of the hand vacuum cleaner, the cyclone air outlet having a direction of flow;
  - (e) a pre-motor filter positioned in the air flow passage downstream from the cyclone air outlet and rearward of the cyclone sidewall, the pre-motor filter having a length between the upper end of the cyclonic stage and the lower

end of the cyclonic stage in a direction transverse to the cyclone axis that is larger than a length of the cyclone air outlet in the direction transverse to the cyclone axis; and,

(f) a cleaner body including the suction motor, the suction motor is positioned in the air flow passage downstream from the pre-motor filter, the suction motor having a motor axis and a downstream end, the cyclonic stage is provided forward of the suction motor,

wherein the pre-motor filter has an outer perimeter defining a volume and the cyclone axis and the motor axis each extend through the volume, and

wherein the cyclone axis is generally parallel to the motor axis, and

wherein when the openable end is opened, the openable end has an opening, the opening has a length between the upper end of the cyclonic stage and the lower end of the cyclonic stage in the direction transverse to the cyclone axis, and the length of the pre-motor filter is generally equal to the length of the opening, and

wherein the cyclonic stage is removable from the cleaner body with the openable end in a closed position, and

wherein, when the cyclonic stage is removed, the pre-motor filter is visible.

26. The hand vacuum cleaner of claim 25, wherein the front end of the cyclone unit comprises a wall that is at a non-zero angle to the cyclone axis and the direction transverse to the cyclone axis.

27. The hand vacuum cleaner of claim 25, further comprising a post-motor filter positioned in the air flow passage downstream from the suction motor, the post-motor filter having a radial outer perimeter which is positioned radially outwardly of a motor of the suction motor.

28. The hand vacuum cleaner of claim 25, wherein, when the openable end is in an open position, the openable end opens a cyclone chamber and a dirt collection chamber.
29. The hand vacuum cleaner of claim 25, wherein the motor axis and the cyclone axis are co-axial.
30. The hand vacuum cleaner of claim 25, further comprising a post-motor filter positioned in the air flow passage downstream from the suction motor, the post-motor filter has a curved outer perimeter that defines a volume, the volume has a radially inner centre and the cyclone axis and the motor axis each extend through the centre of the volume.
31. The hand vacuum cleaner of claim 25, wherein the suction motor has a length in the direction transverse to the cyclone axis that is smaller than the length of the pre-motor filter.
32. The hand vacuum cleaner of claim 25, wherein air travels in the axial direction from the dirty air inlet to the cyclone air inlet of the cyclonic stage.

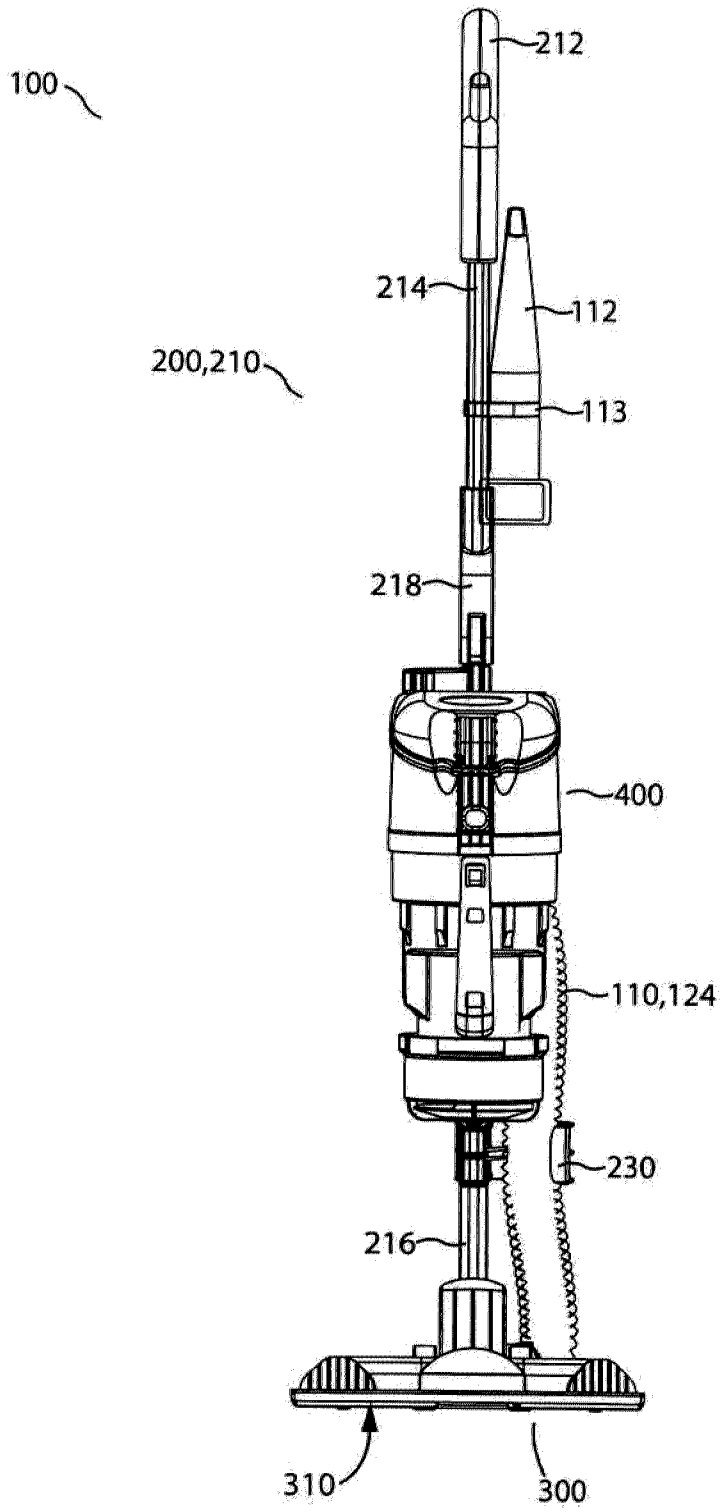


Fig. 1

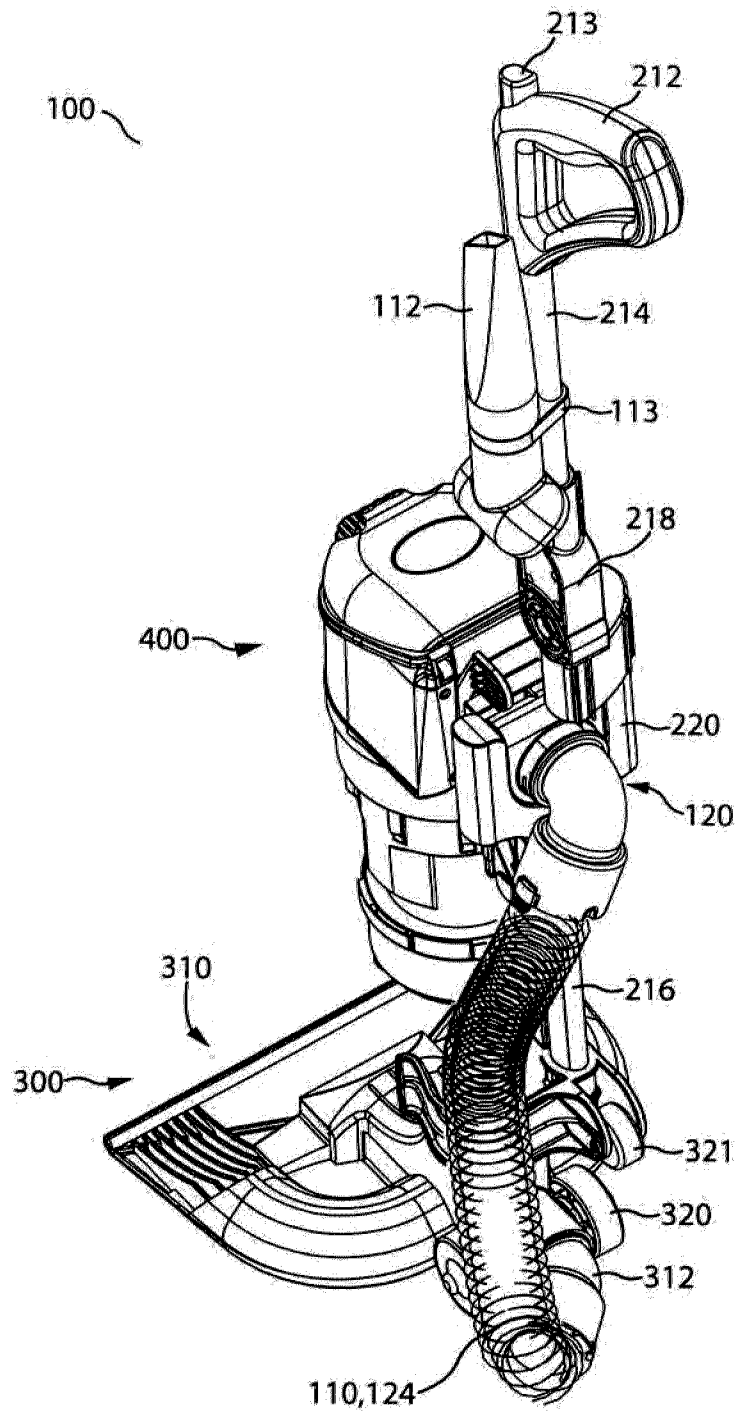


Fig. 2

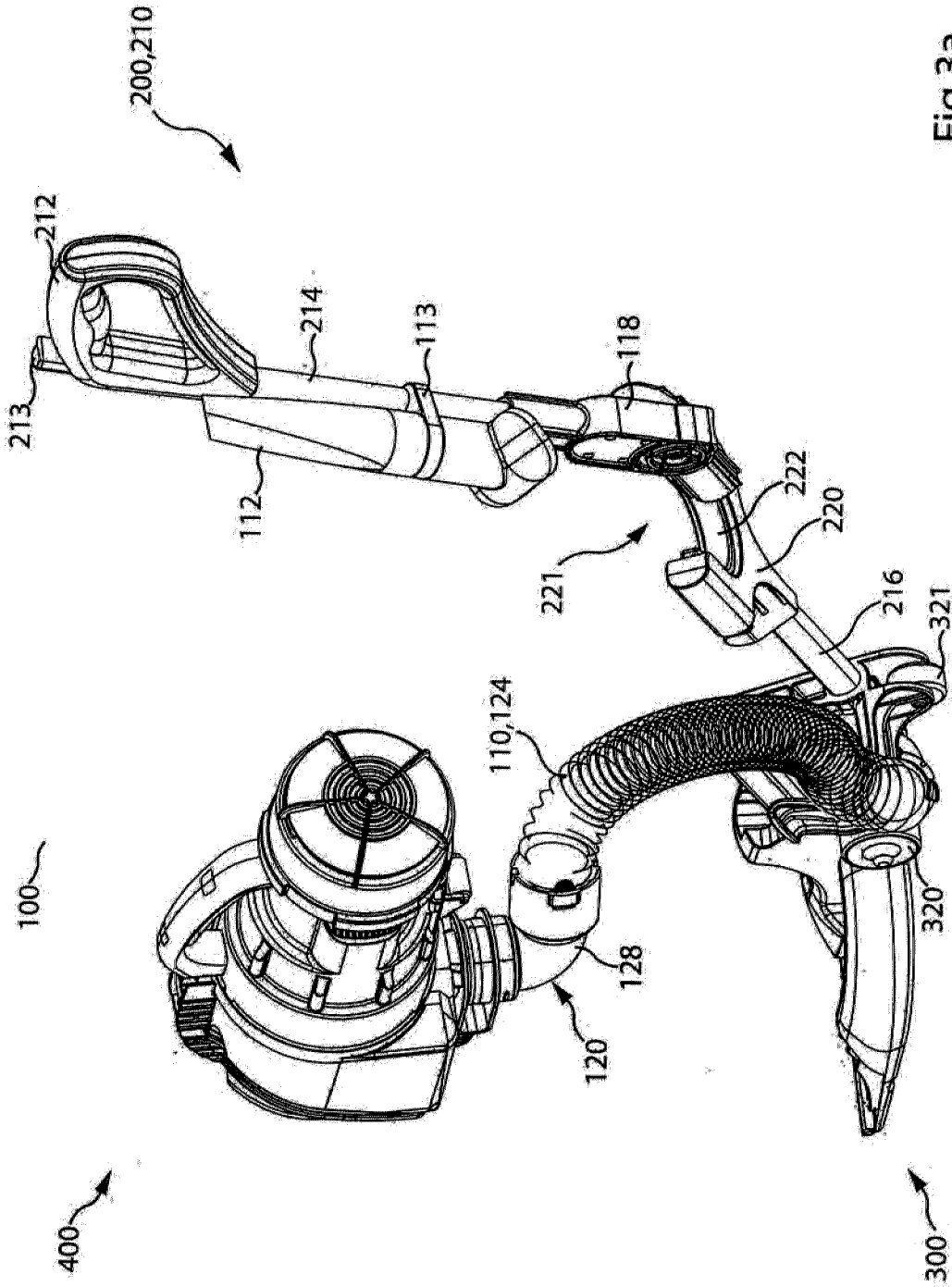


Fig.3a

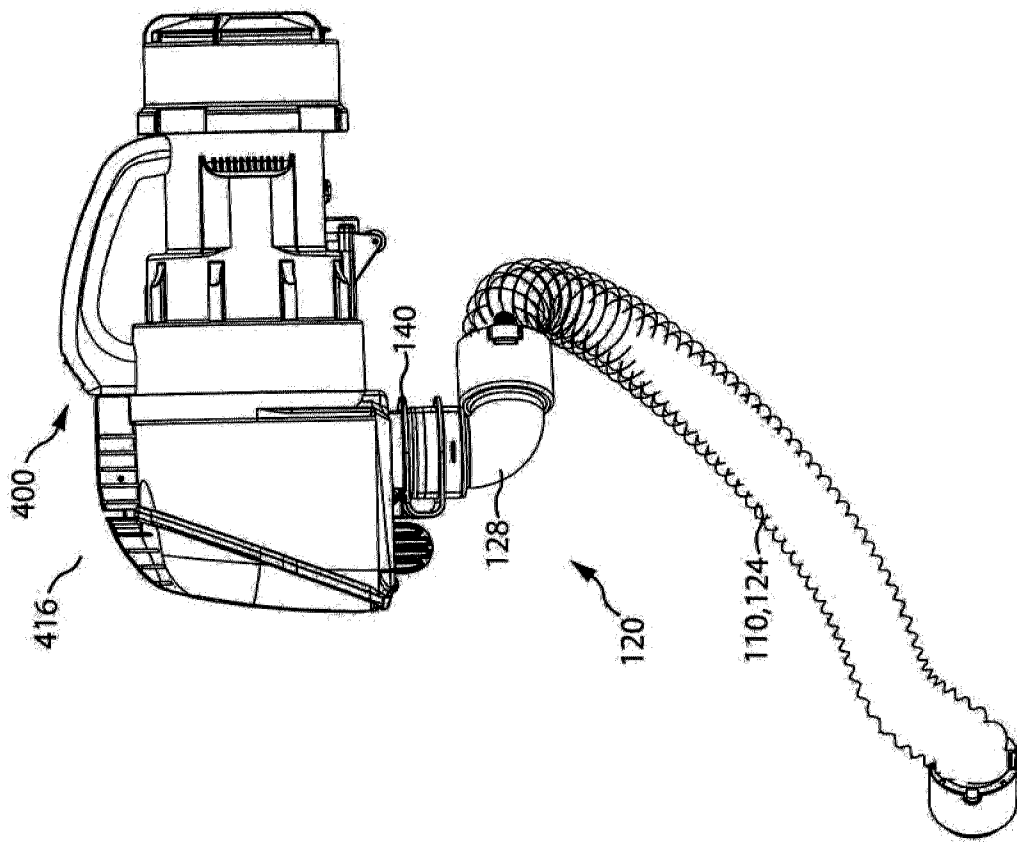


Fig.3b

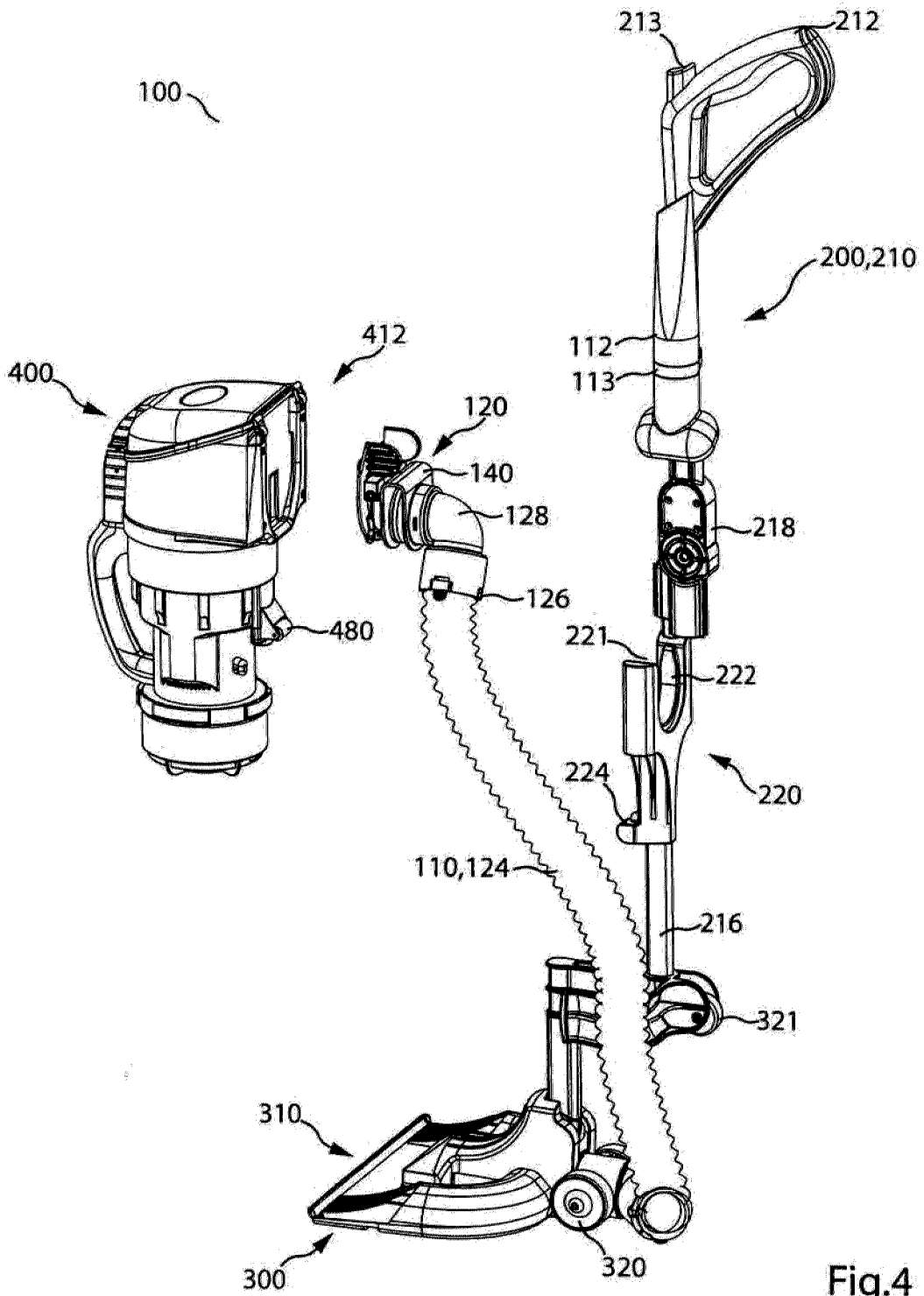


Fig.4

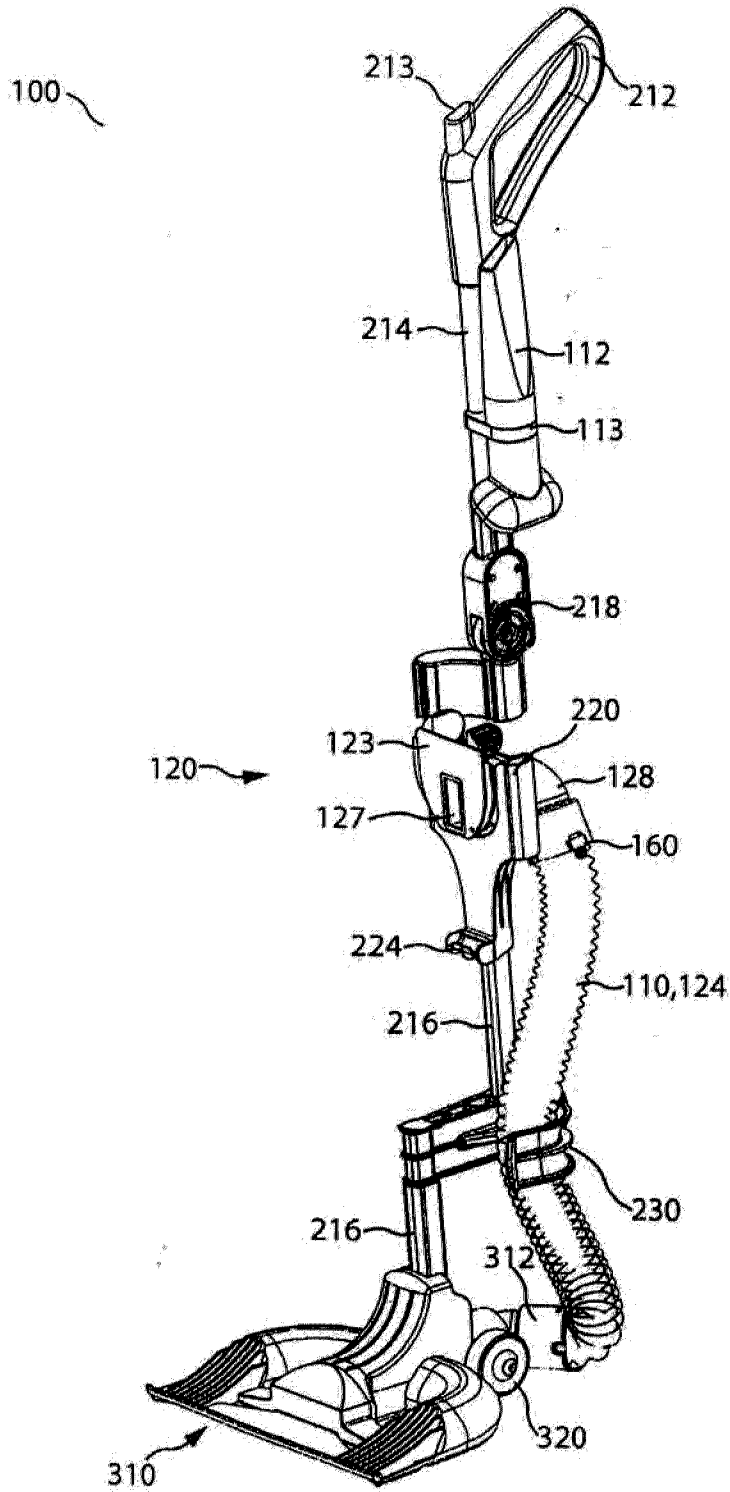


Fig.5

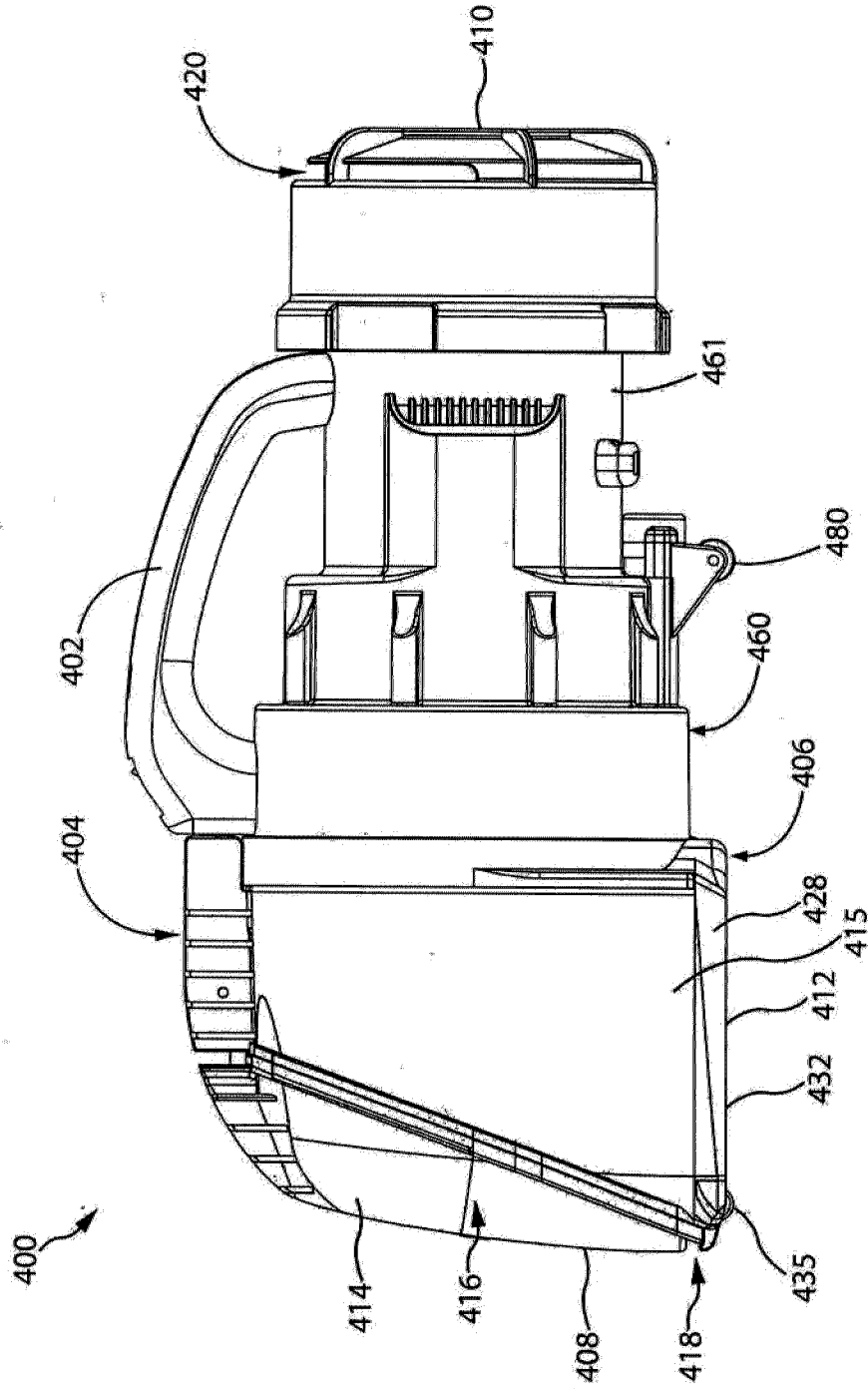


Fig.6

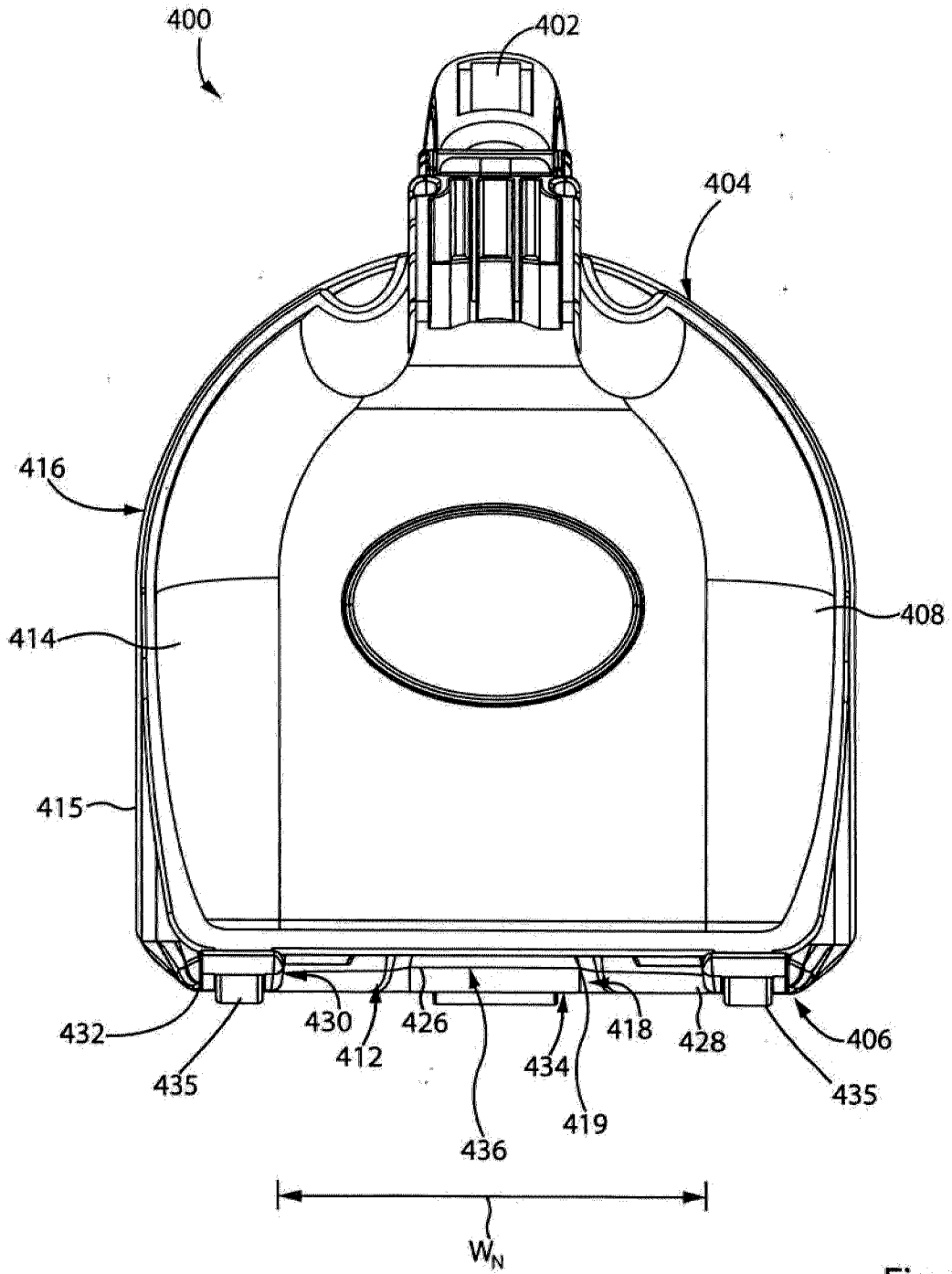


Fig. 7

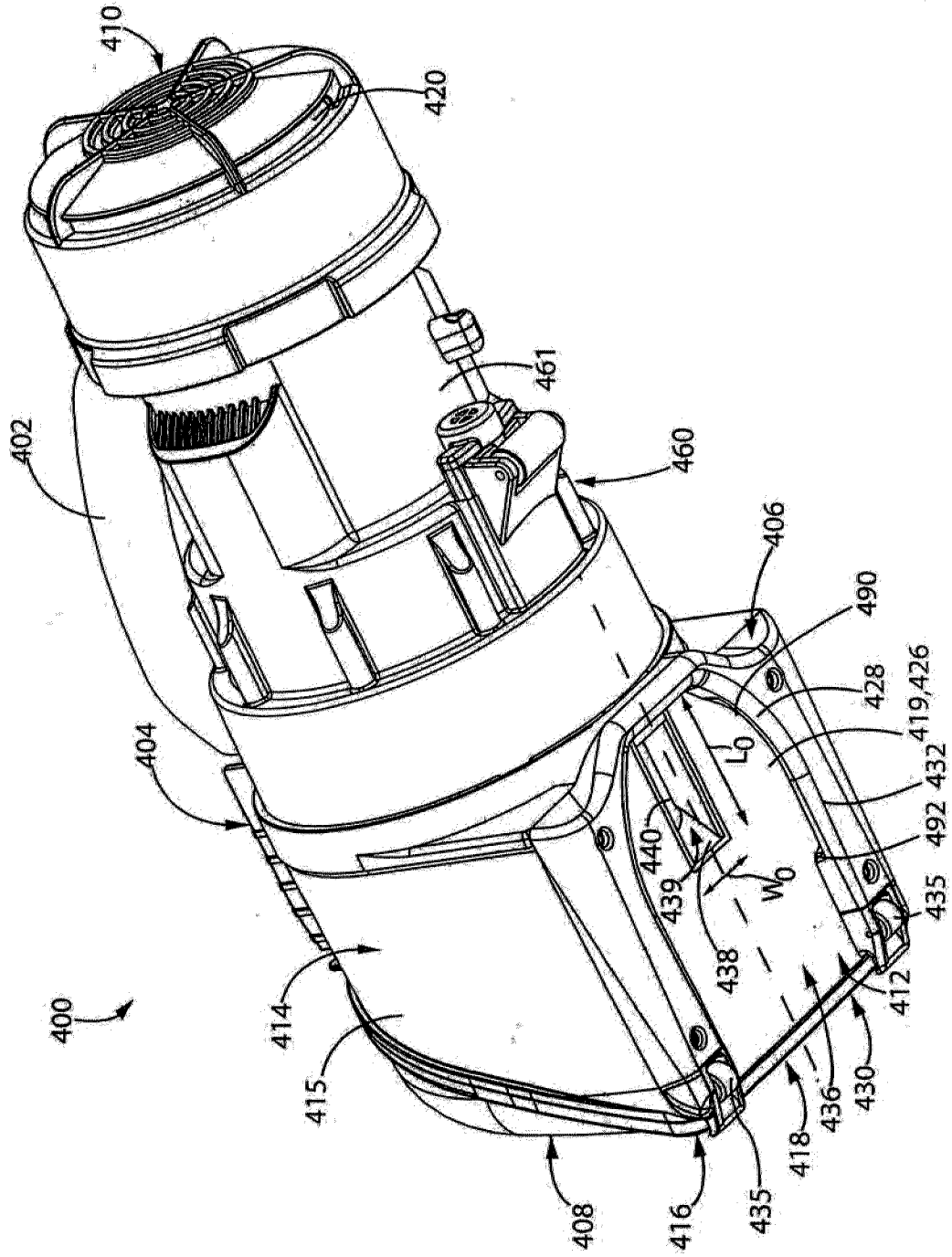


Fig. 8

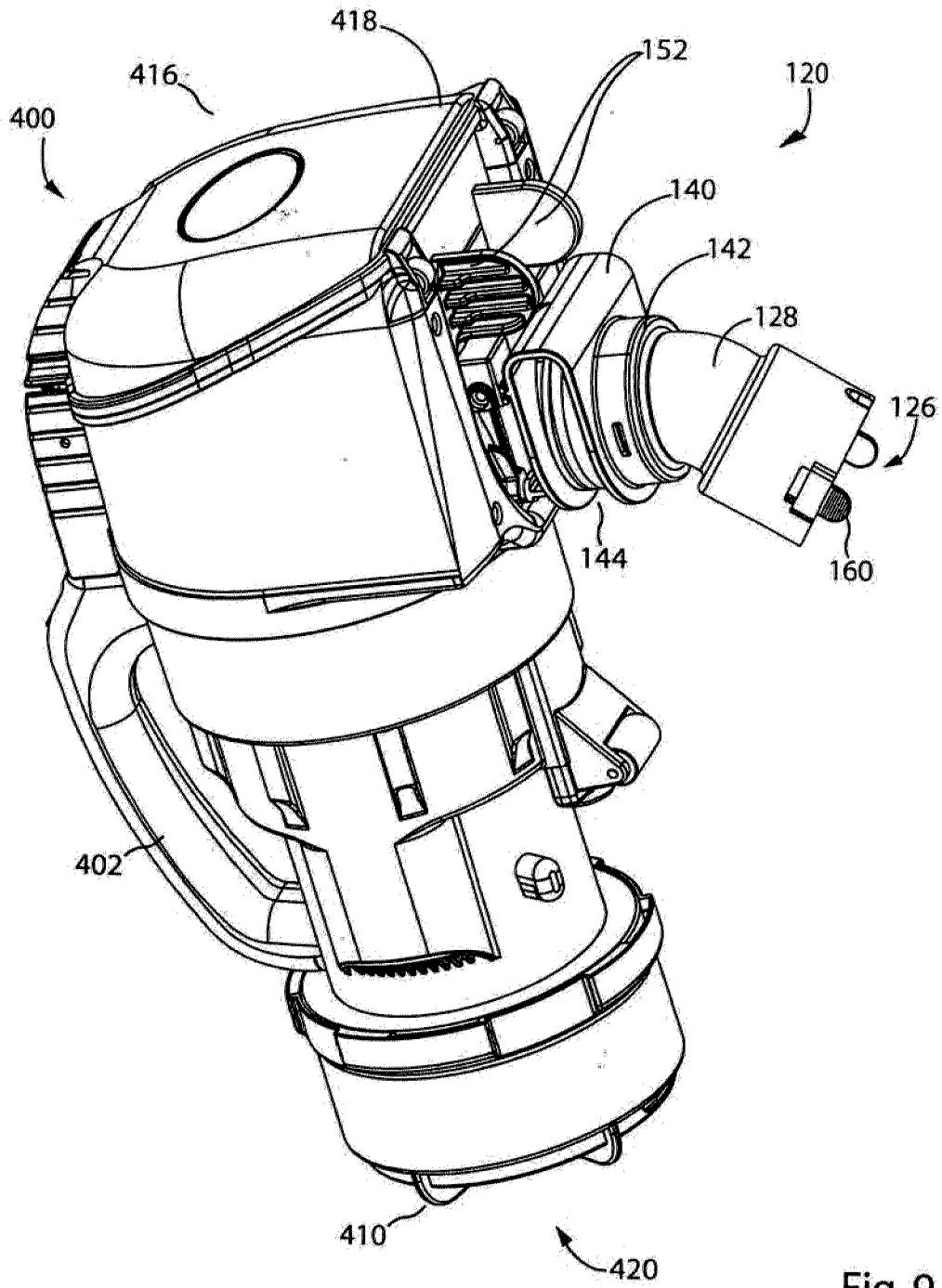


Fig. 9

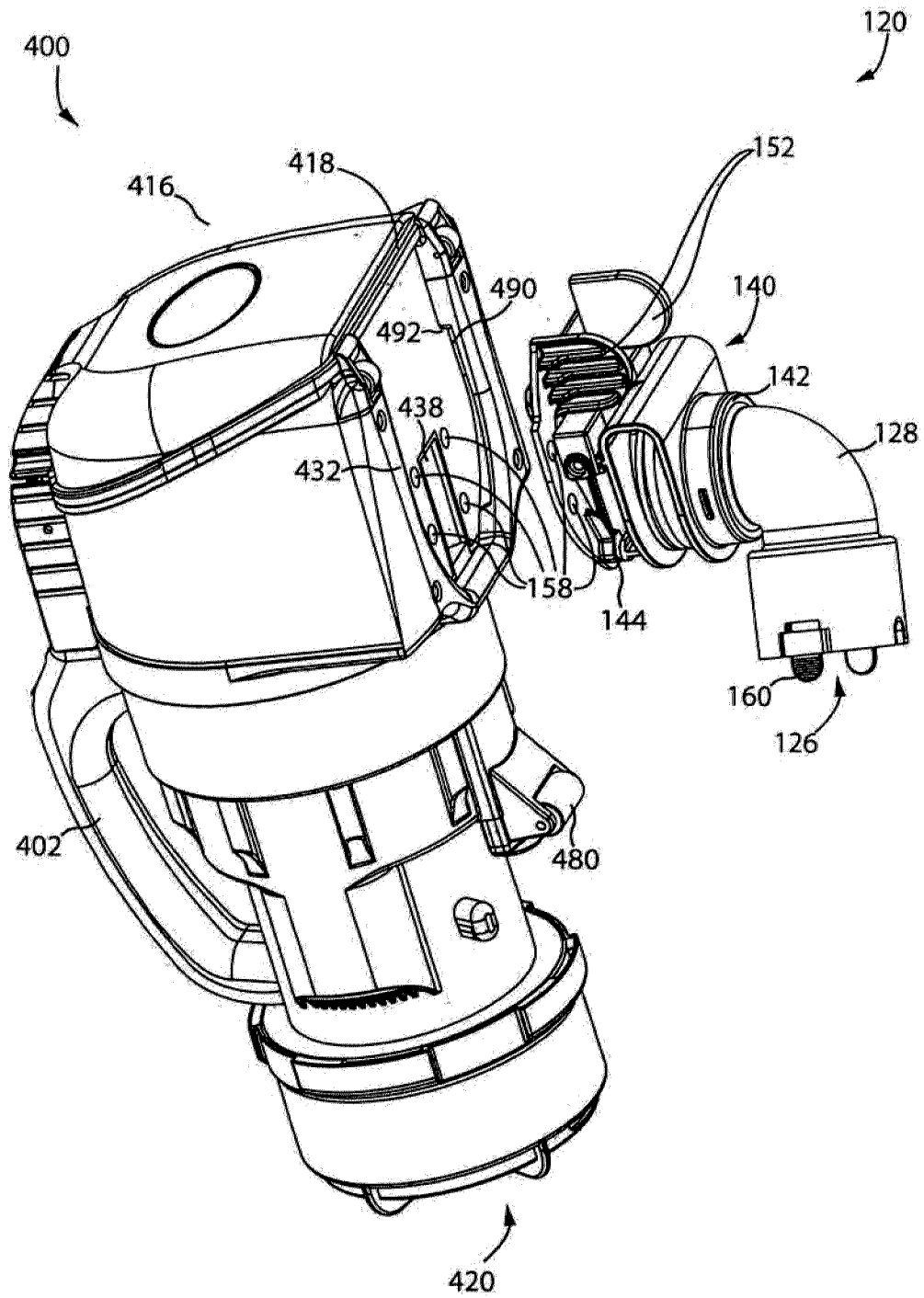


Fig. 10

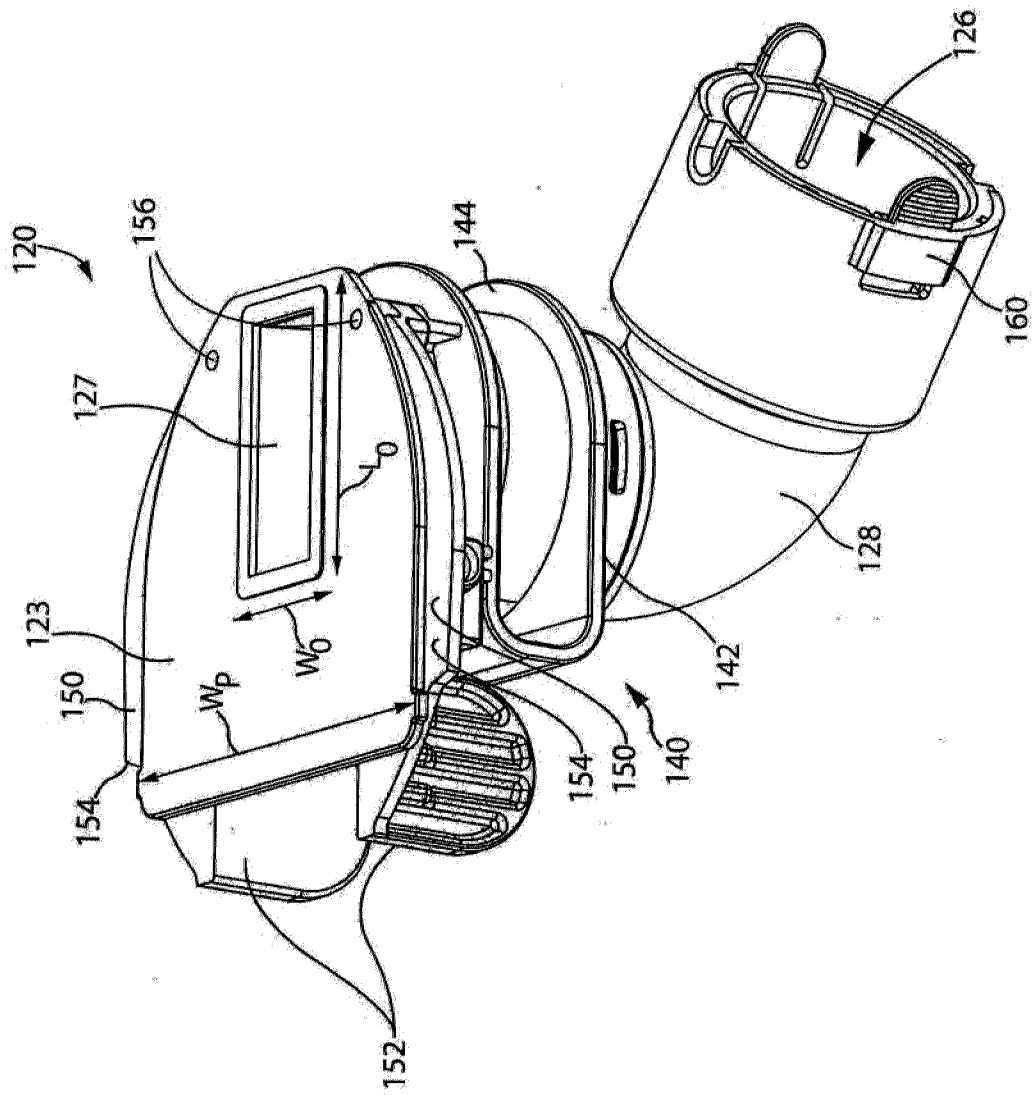


Fig. 11

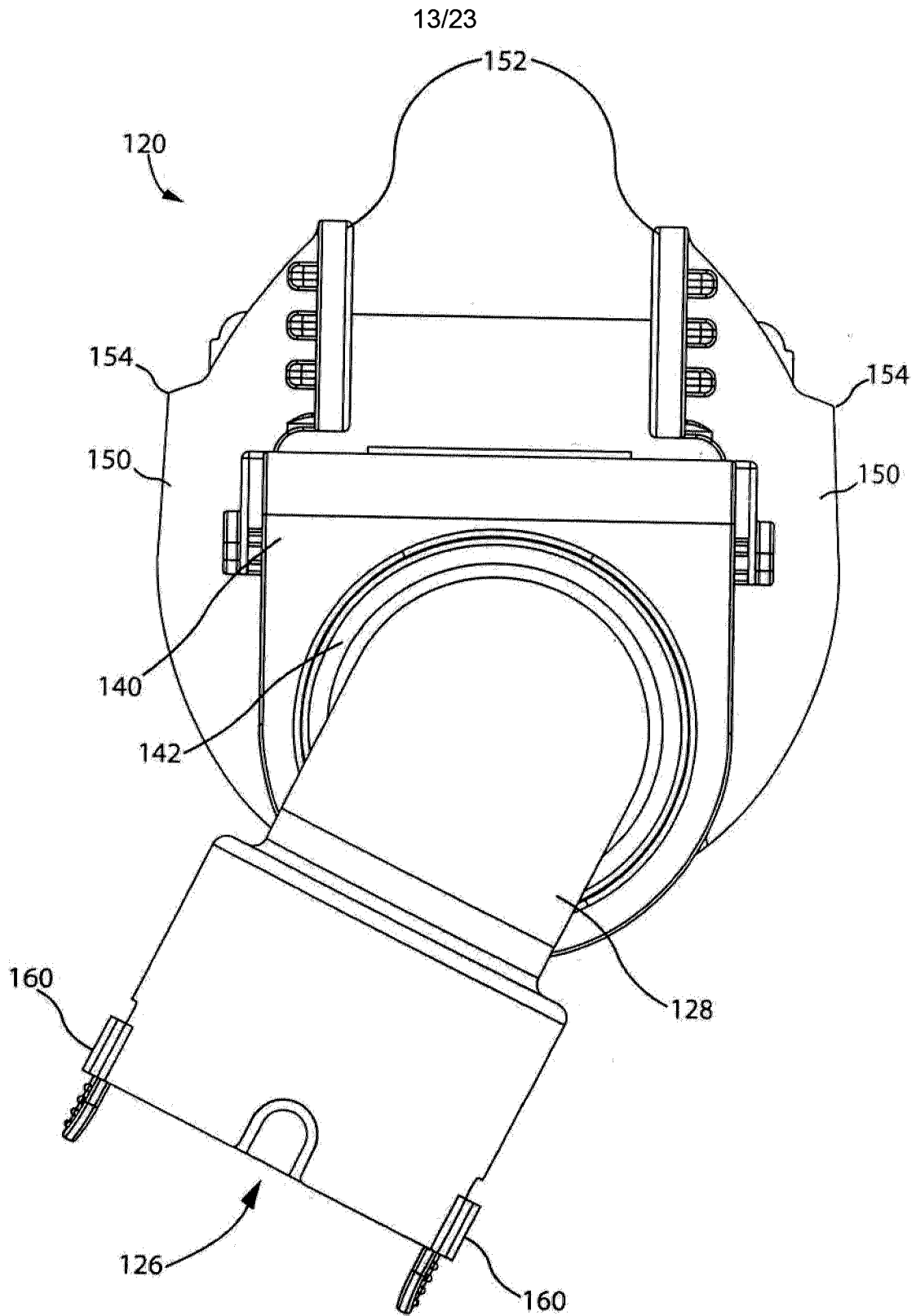


Fig. 12

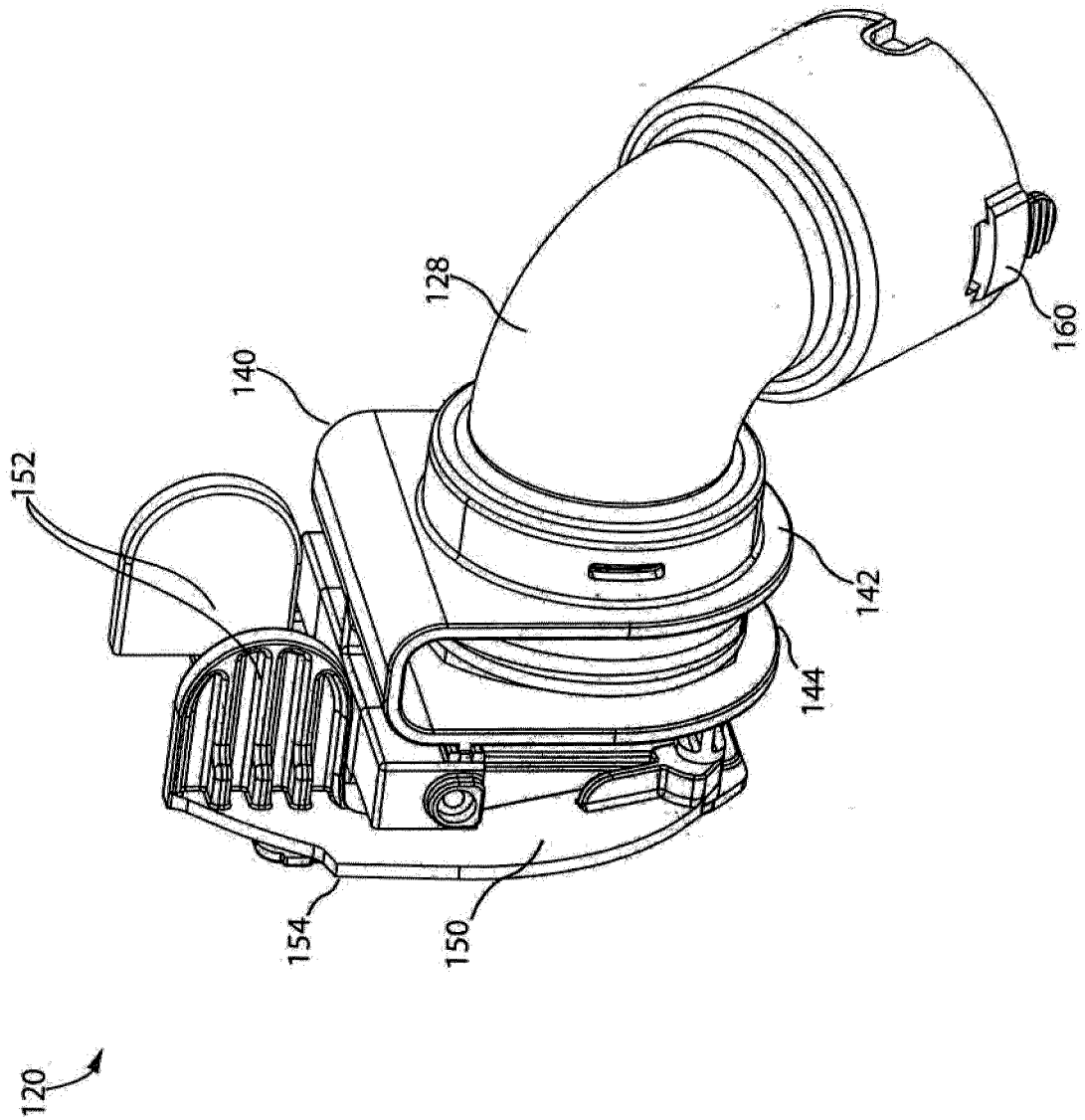


Fig. 13

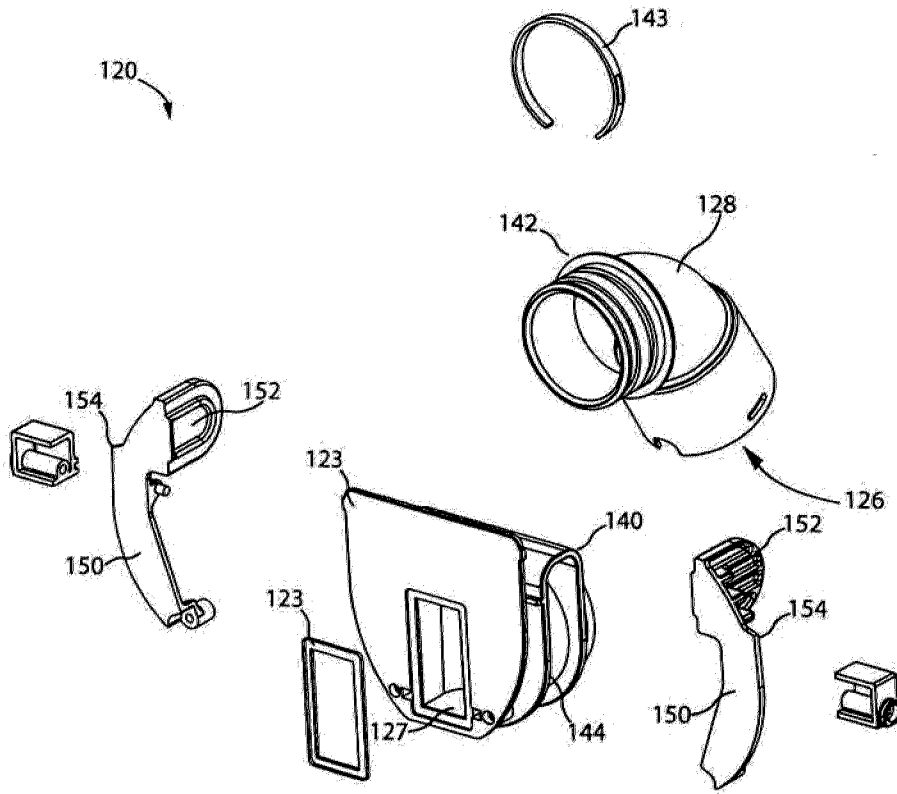


Fig.14

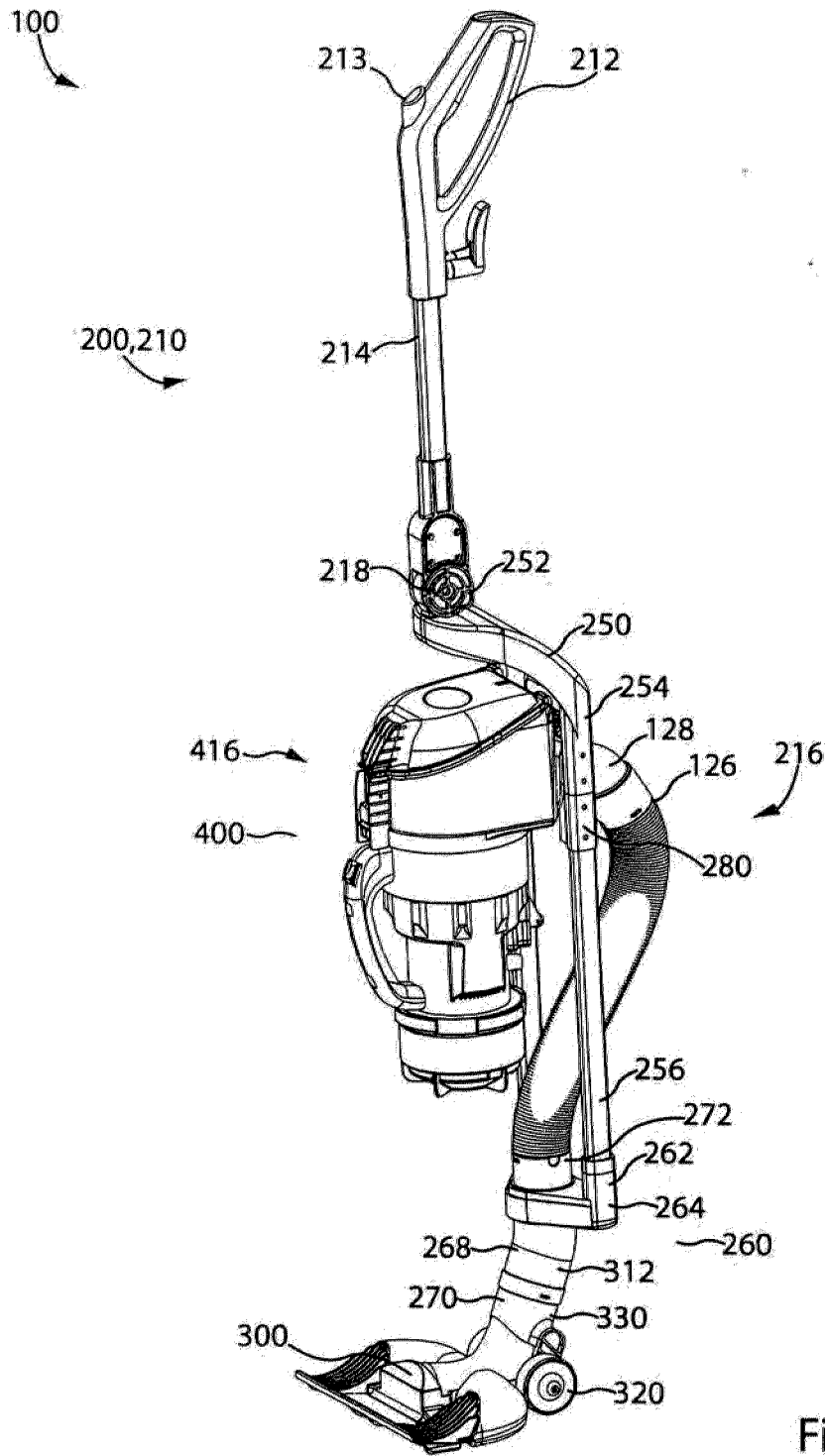


Fig. 15

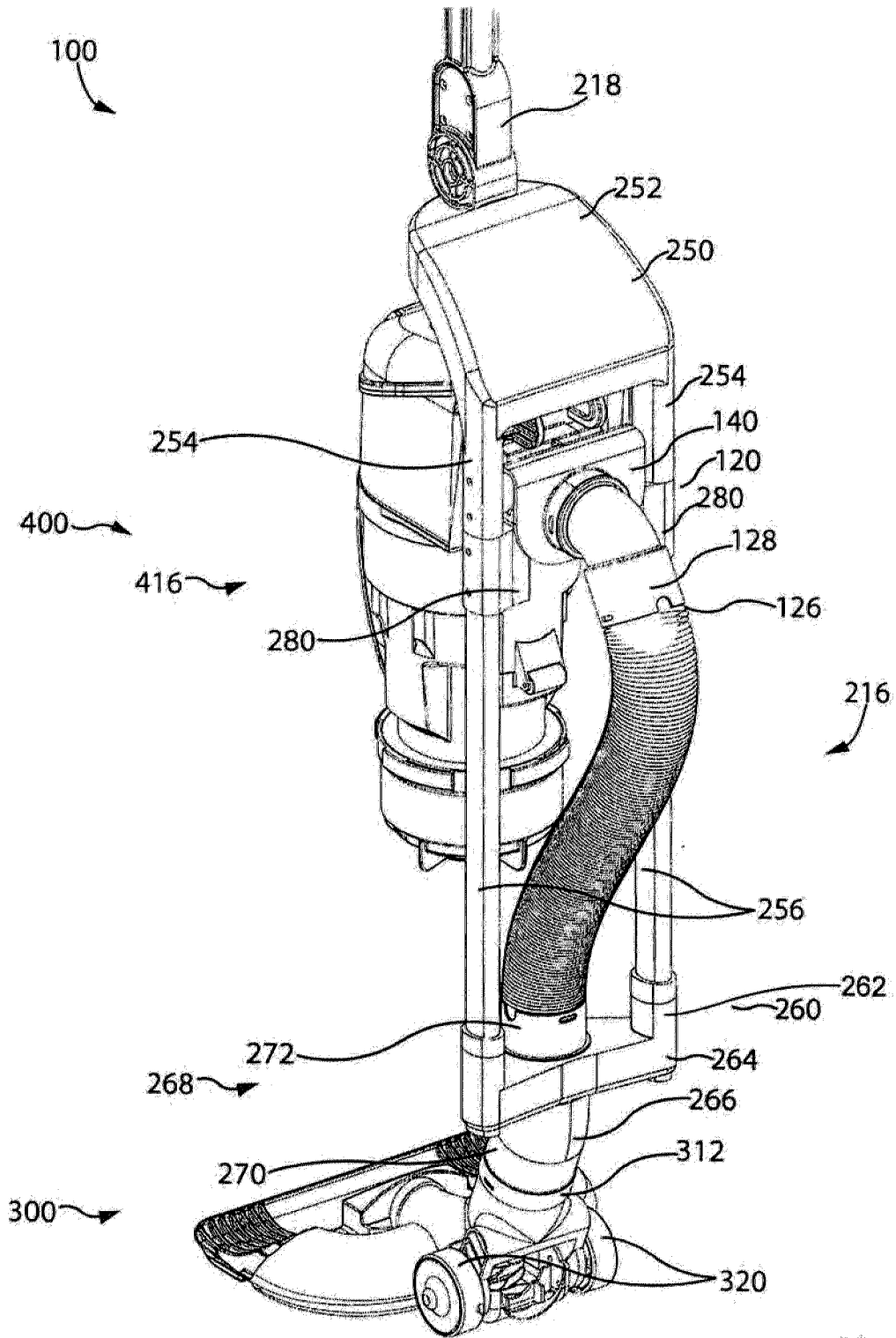


Fig. 16

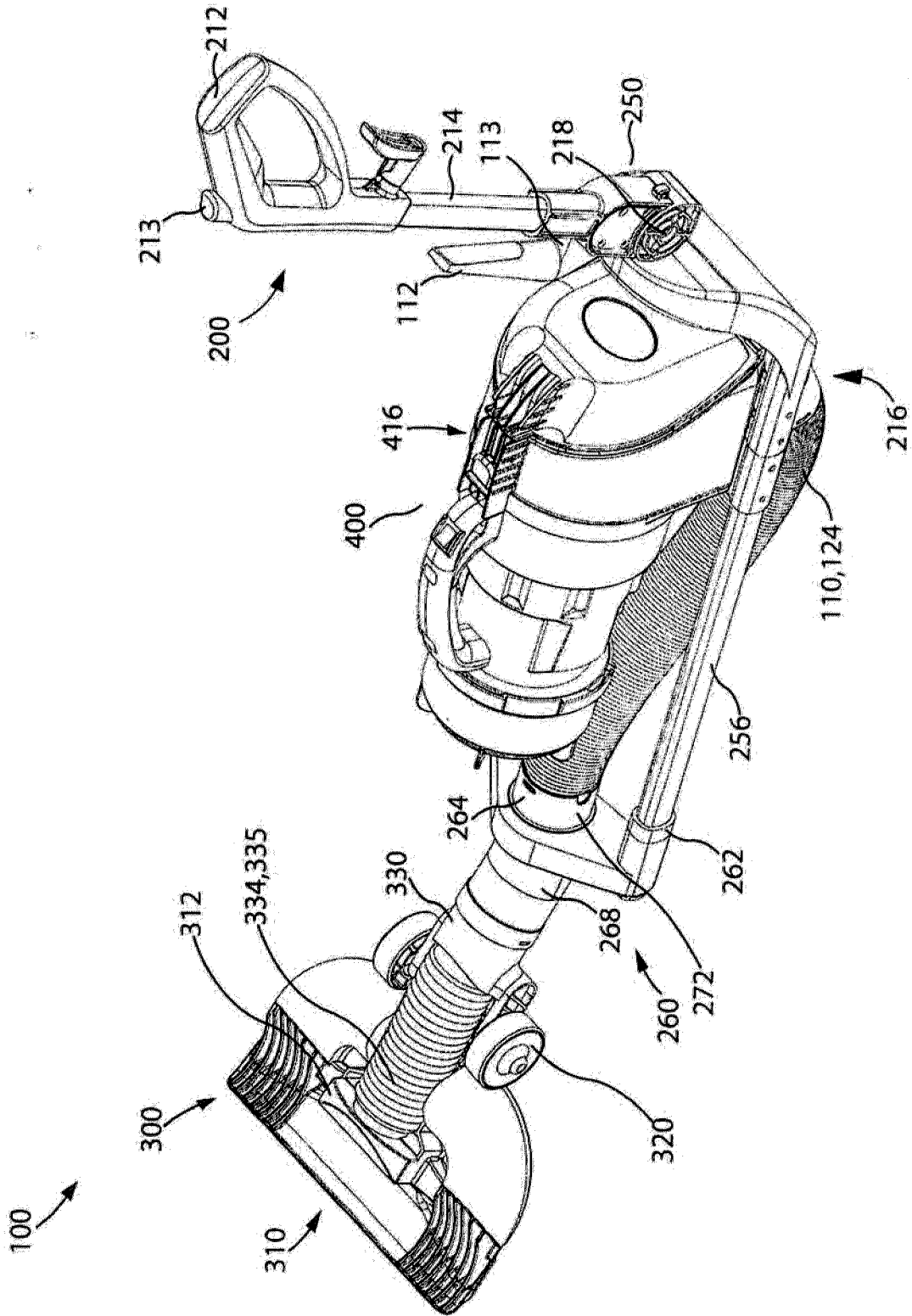


Fig. 17

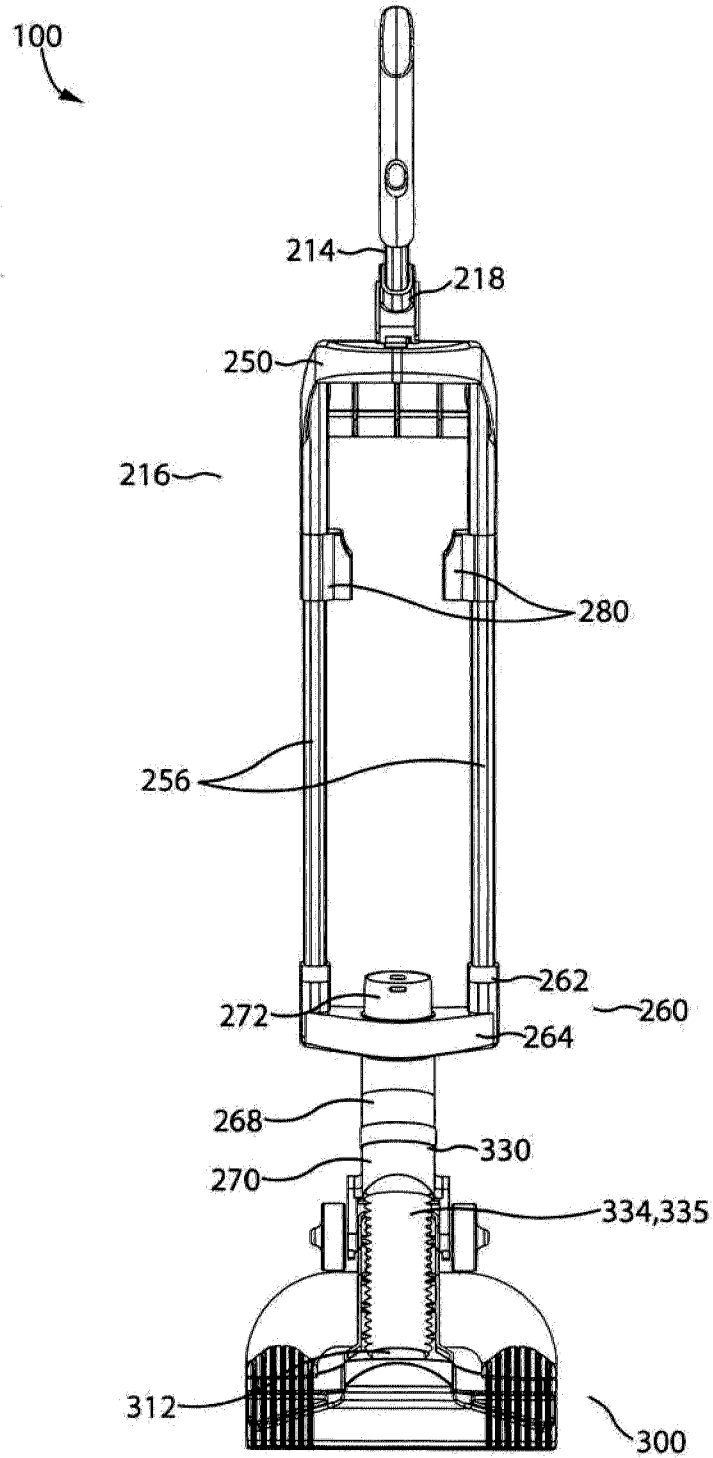


Fig. 18

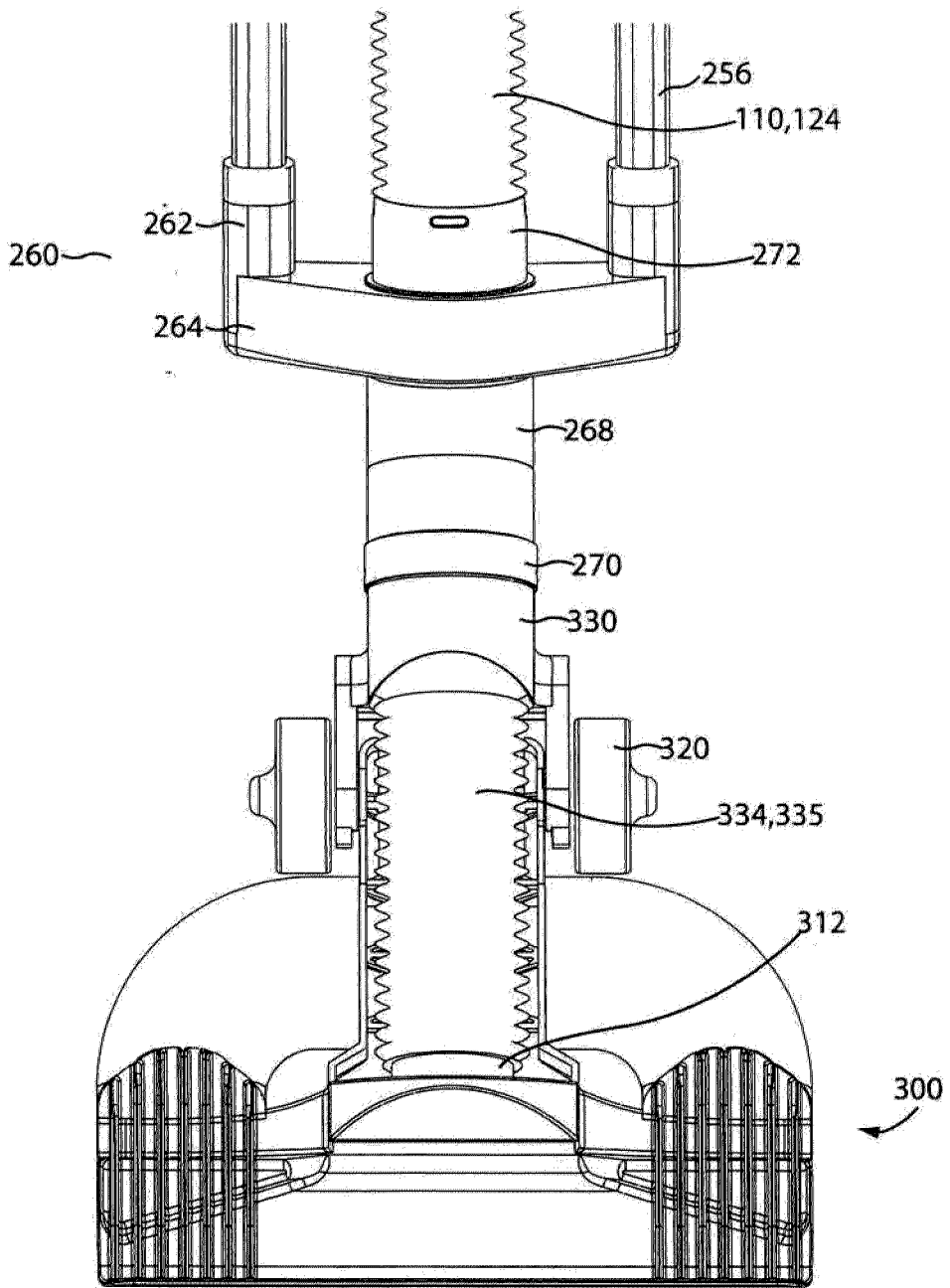


Fig. 19

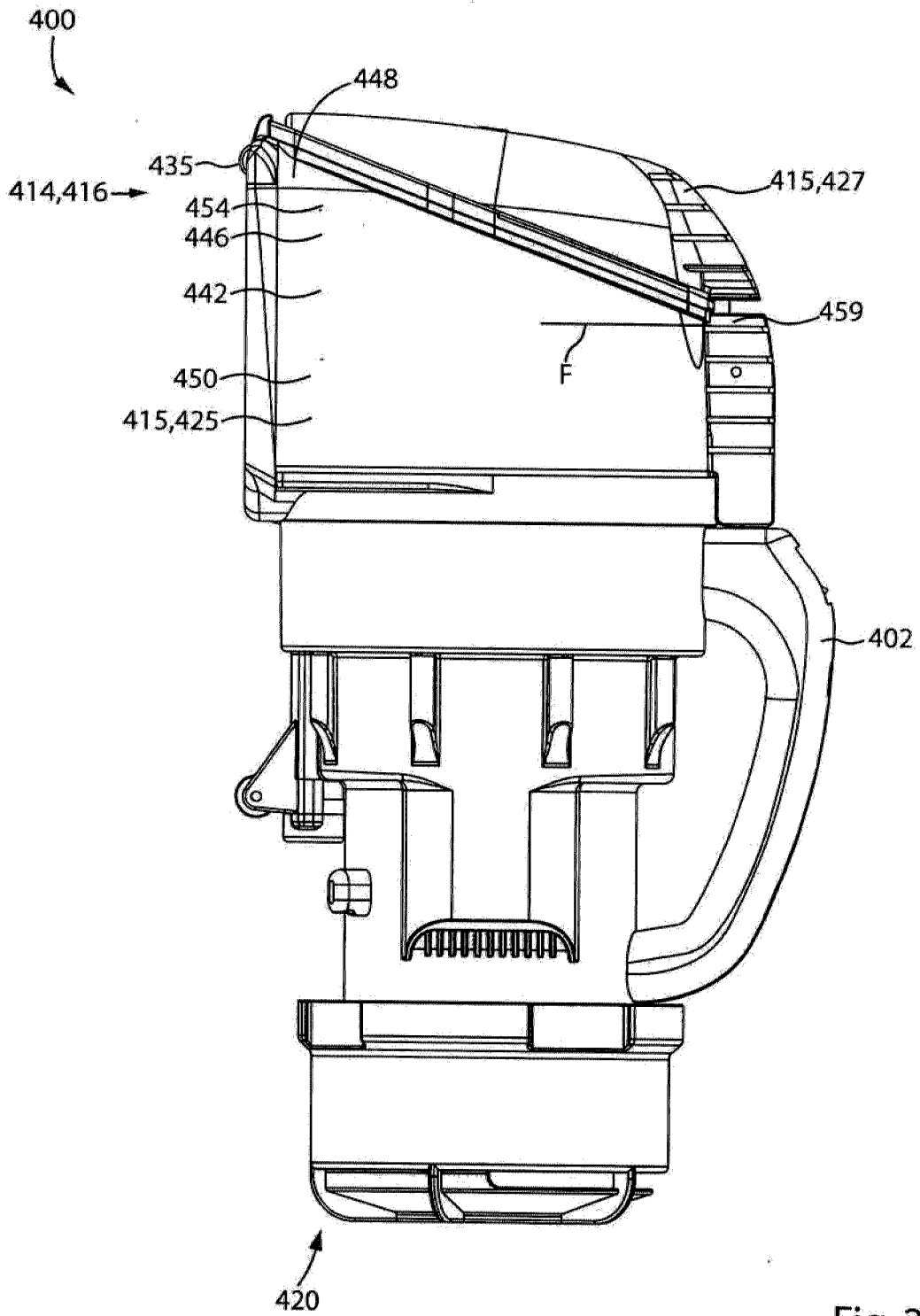


Fig. 20

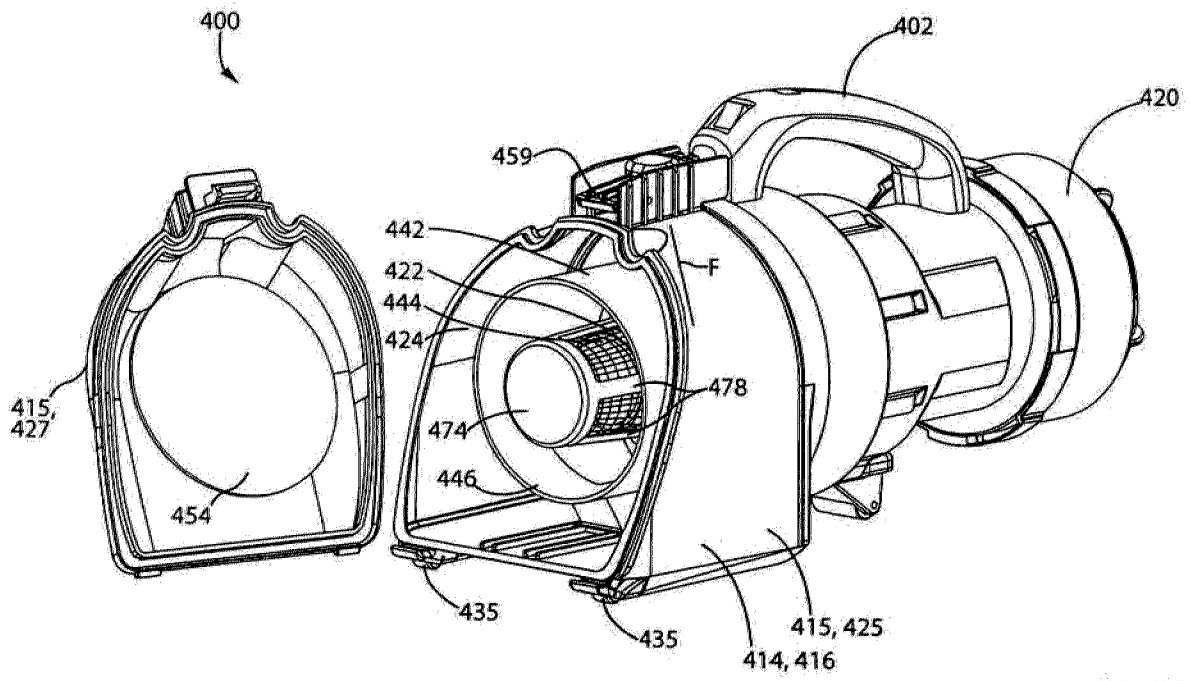


Fig. 21

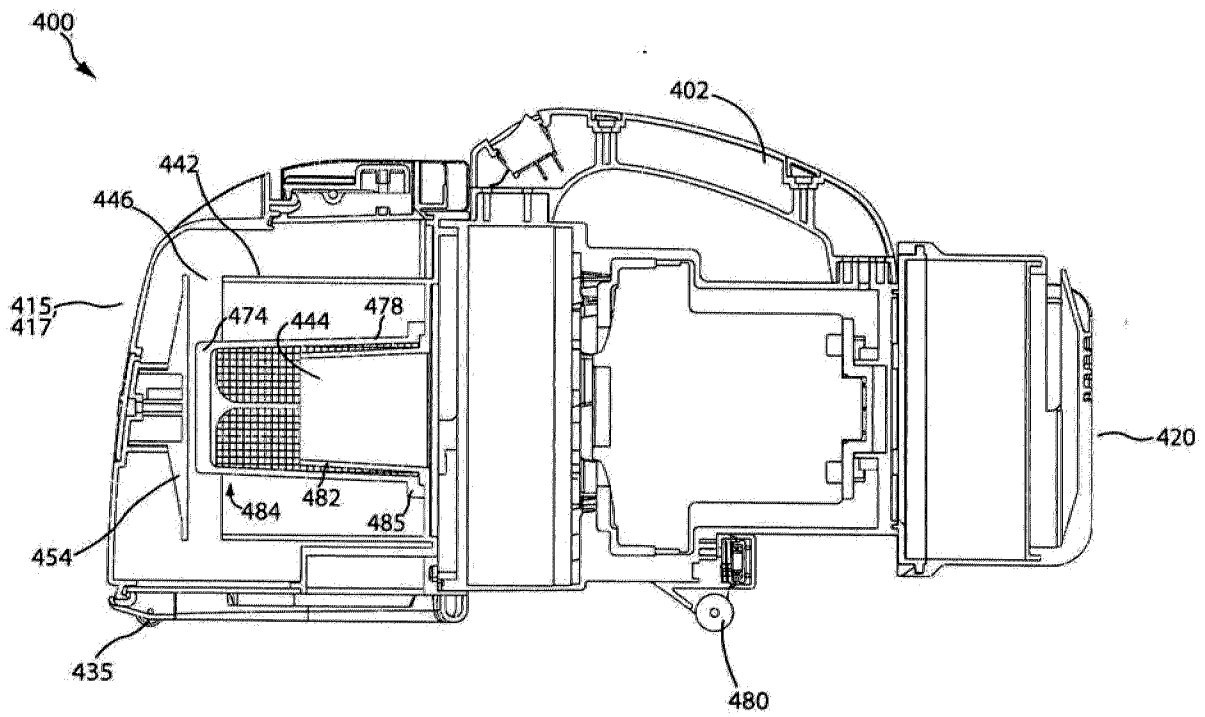


Fig.22