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(12) **United States Patent**
Conrad

(10) **Patent No.: US 10,076,217 B2**
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(54) **UPRIGHT VACUUM CLEANER**

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(73) Assignee: **Omachron Intellectual Property Inc.**, Hampton, Ontario (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 399 days.

This patent is subject to a terminal disclaimer.

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Related U.S. Application Data

(63) Continuation of application No. 14/036,818, filed on Sep. 25, 2013, now Pat. No. 9,301,662, which is a continuation of application No. 13/396,918, filed on Feb. 15, 2012, now Pat. No. 8,567,006, which is a continuation of application No. 11/954,310, filed on Dec. 12, 2007, now Pat. No. 8,166,607.

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(51) **Int. Cl.**

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A47L 5/36	(2006.01)
A47L 5/28	(2006.01)
A47L 9/16	(2006.01)

(52) **U.S. Cl.**

CPC ***A47L 5/225*** (2013.01); ***A47L 5/32*** (2013.01); ***A47L 5/365*** (2013.01); *A47L 5/28* (2013.01); *A47L 9/165* (2013.01); *A47L 9/1608* (2013.01)

(58) **Field of Classification Search**

CPC A47L 5/225; A47L 5/28; A47L 5/32

USPC 15/328, 329, 331, 335, 334, 353

See application file for complete search history.

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Primary Examiner — Bryan R Muller

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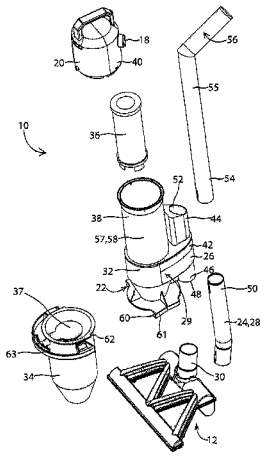
(57) **ABSTRACT**

Several embodiments of an upright surface cleaning apparatus are disclosed. The surface cleaning apparatus has a first cyclonic cleaning stage and comprises a surface cleaning head having a dirty fluid inlet. A fluid flow path extends from the dirty fluid inlet to a clean air outlet of the upright surface cleaning apparatus. A support member is mounted to the surface cleaning head. A portable cleaning unit is removably mounted to the surface cleaning apparatus.

20 Claims, 24 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 60/869,586, filed on Dec. 12, 2006.

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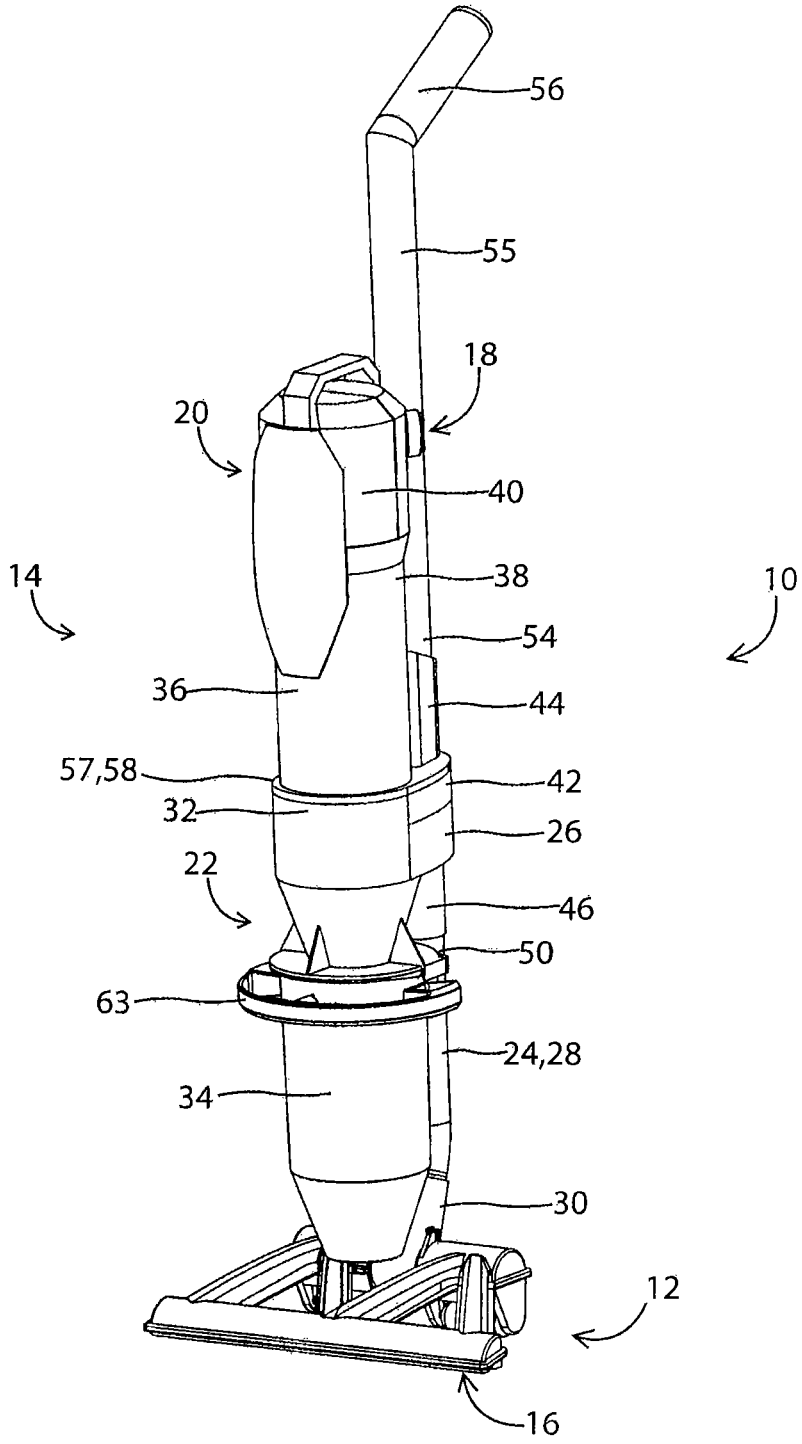
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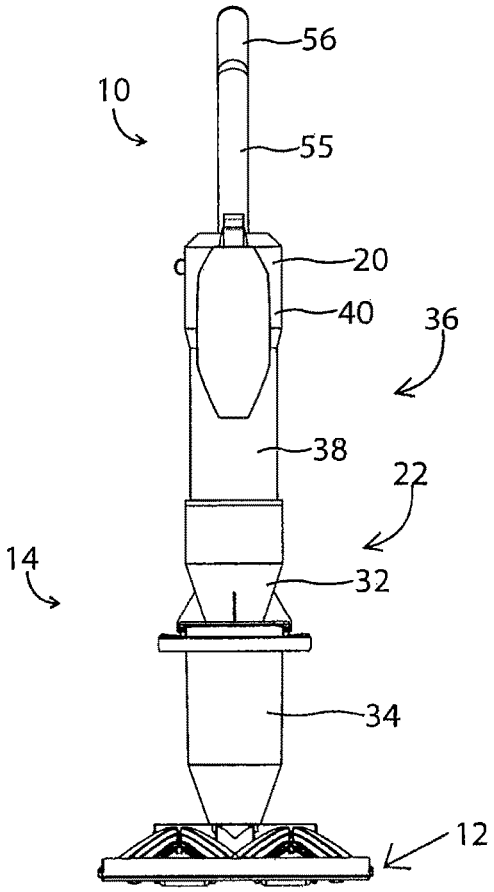

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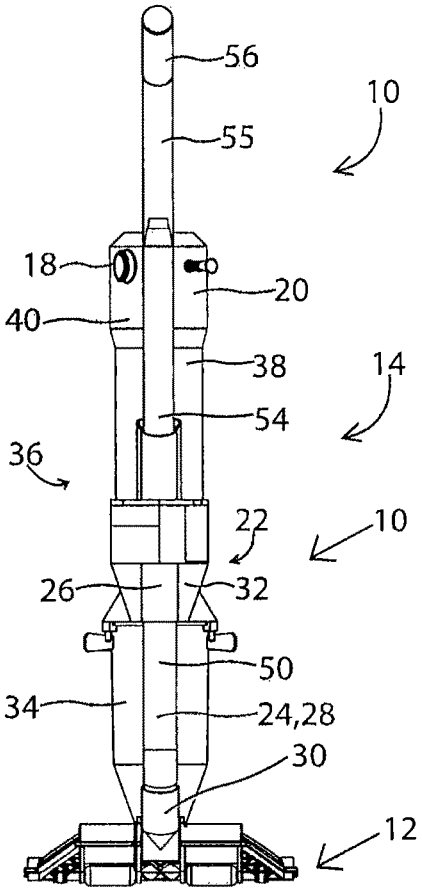

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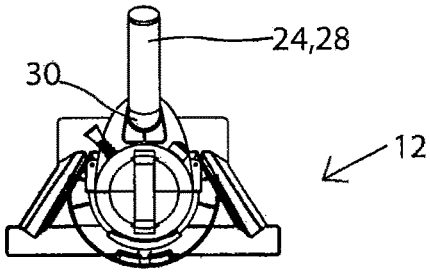

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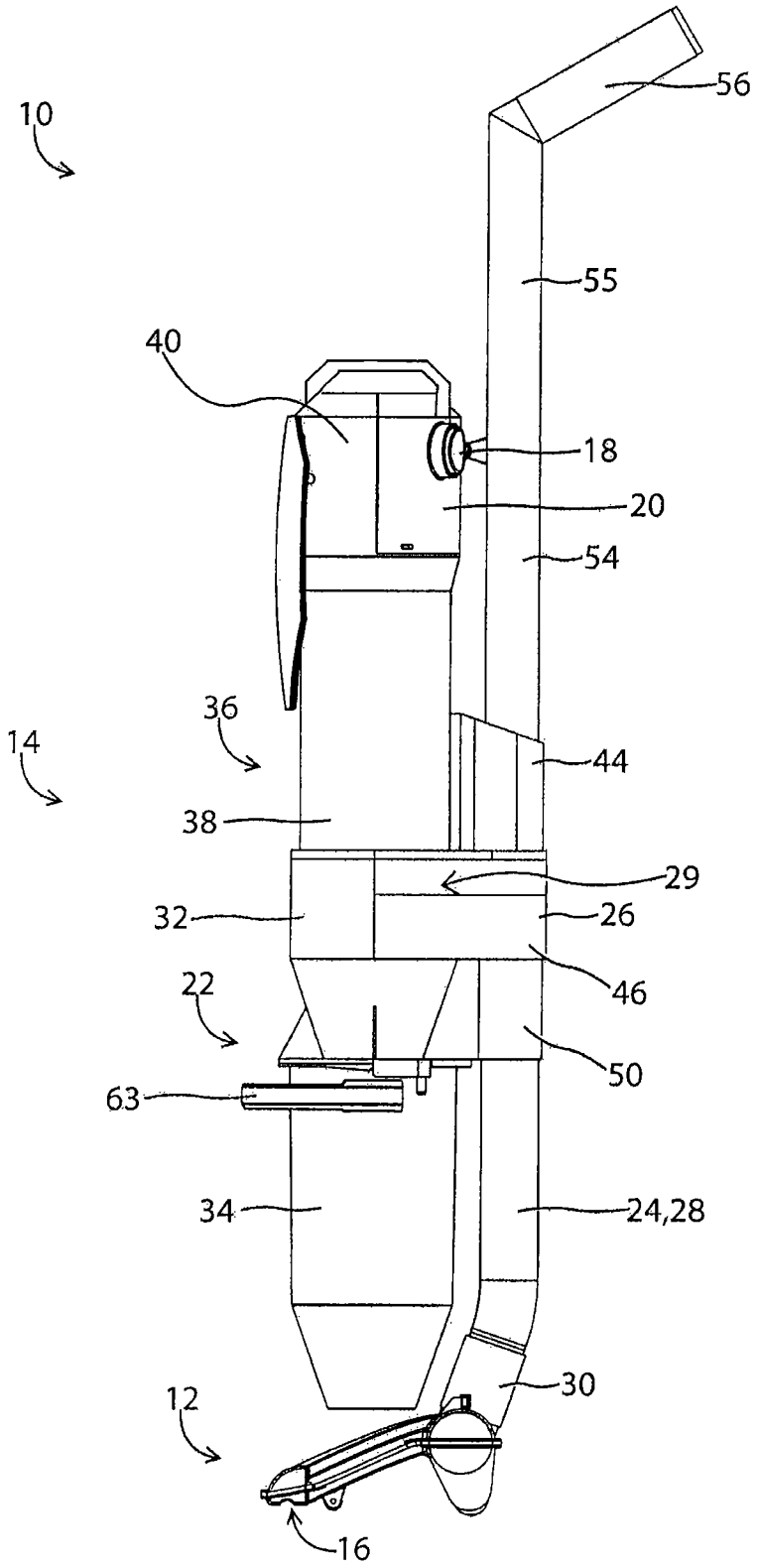

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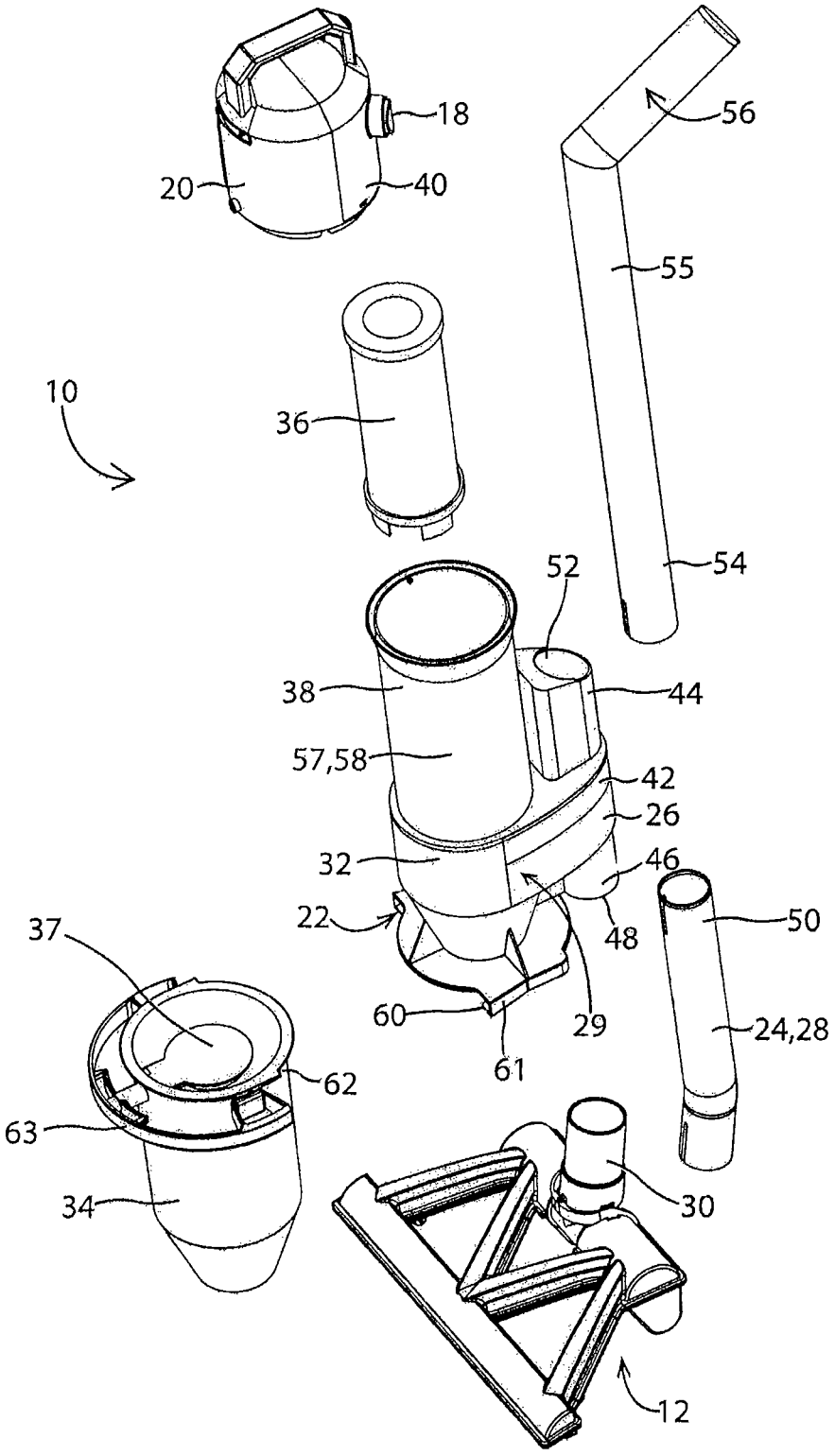
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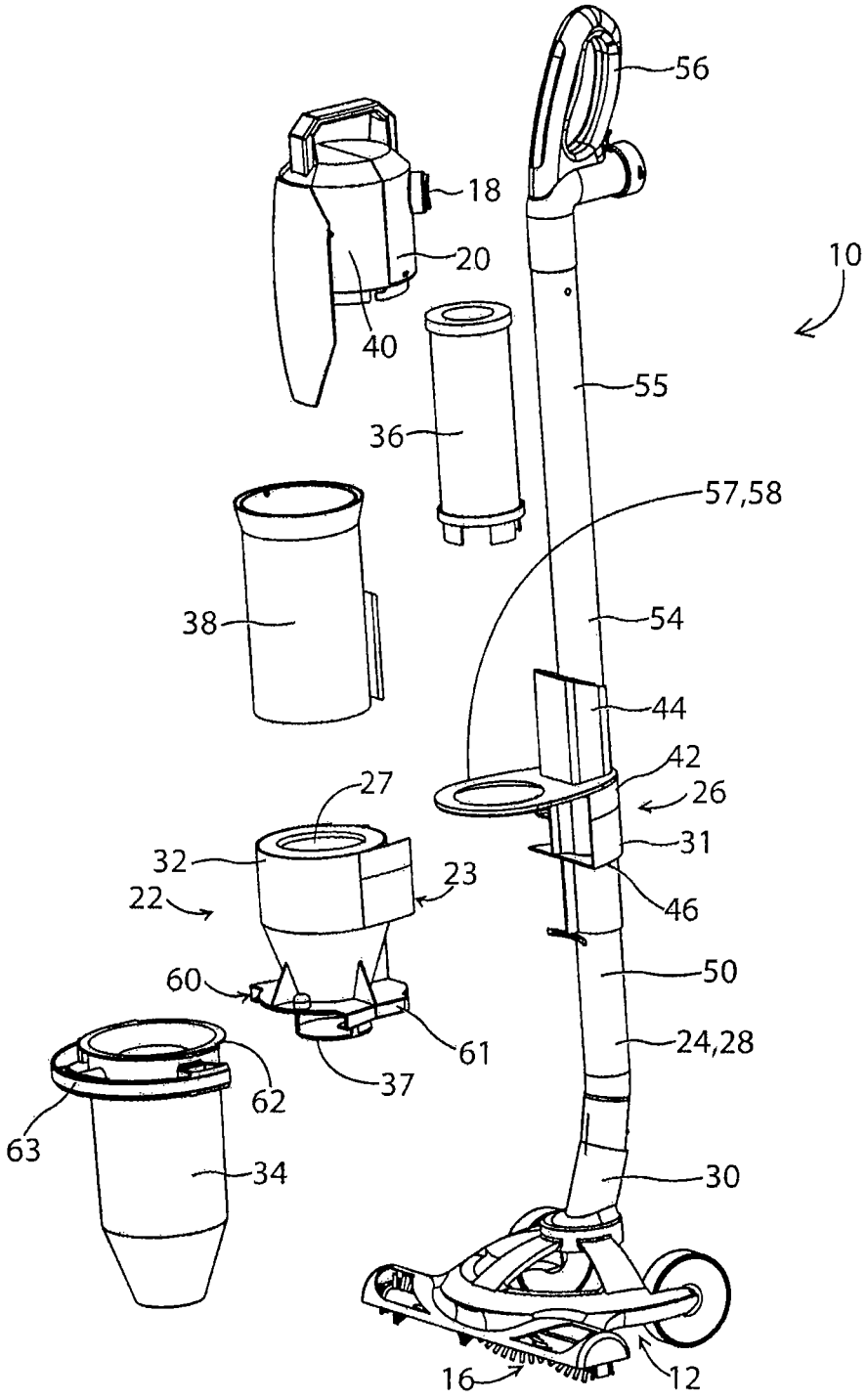
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Fig. 7

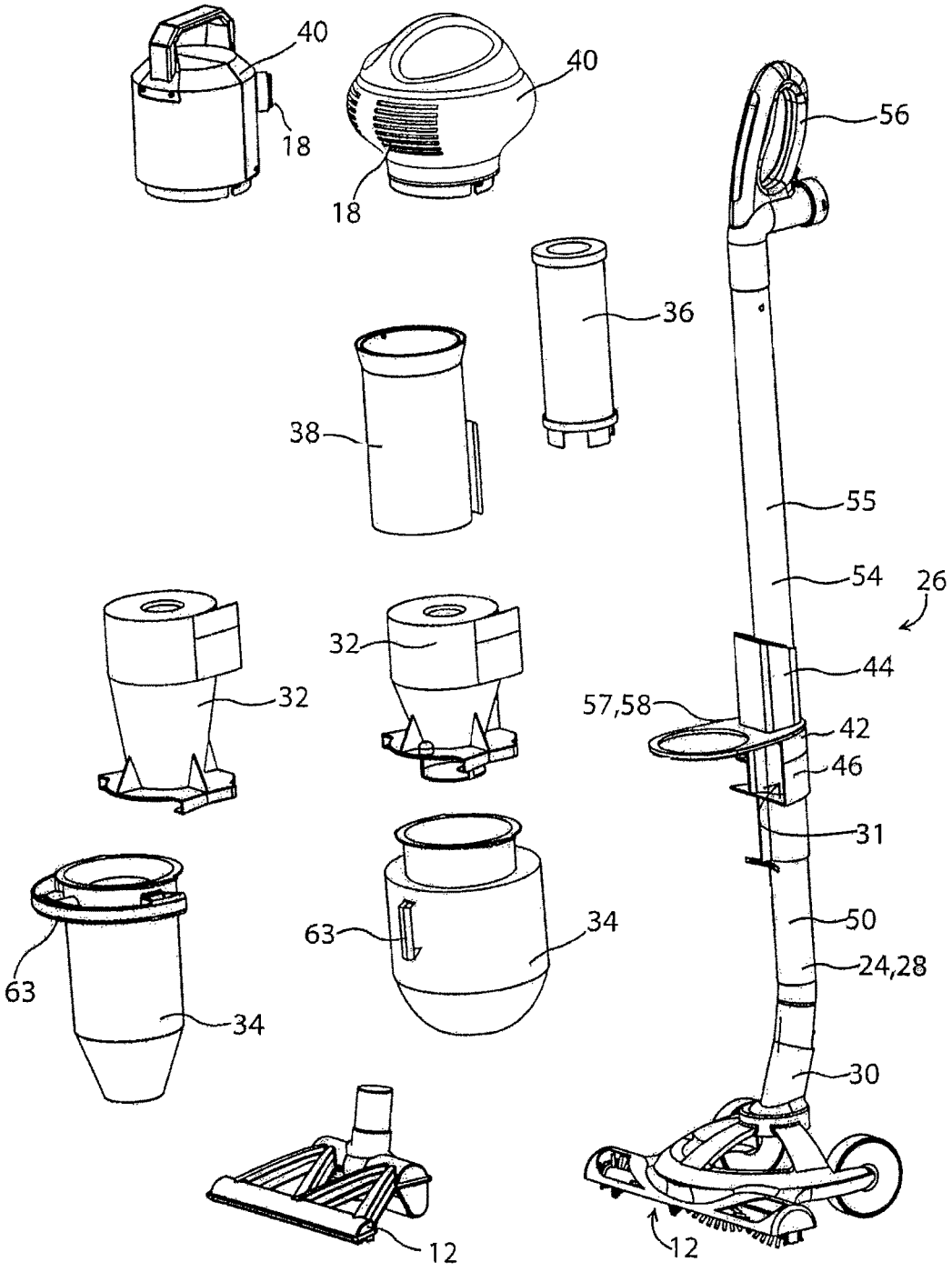
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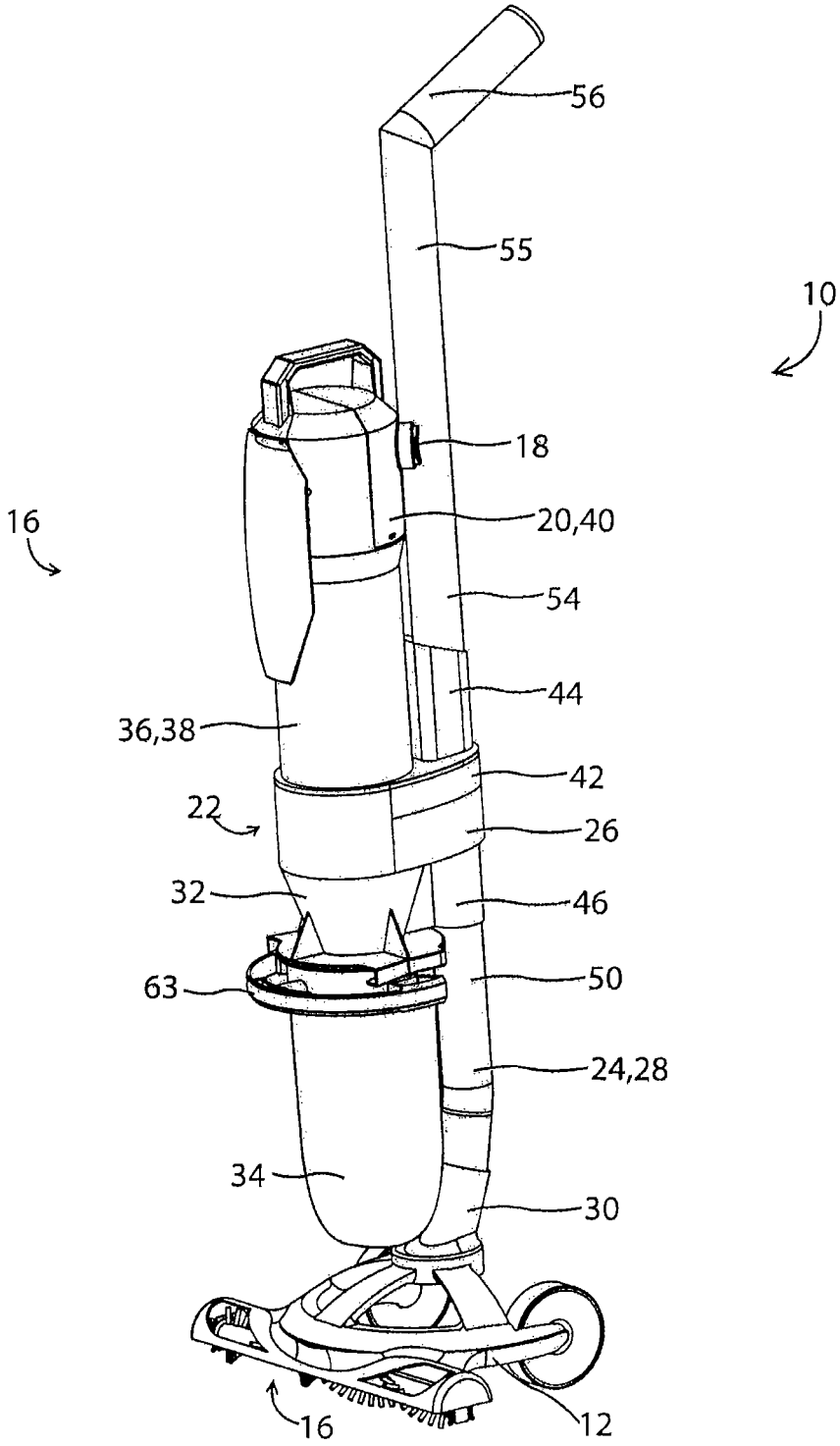
Fig. 08



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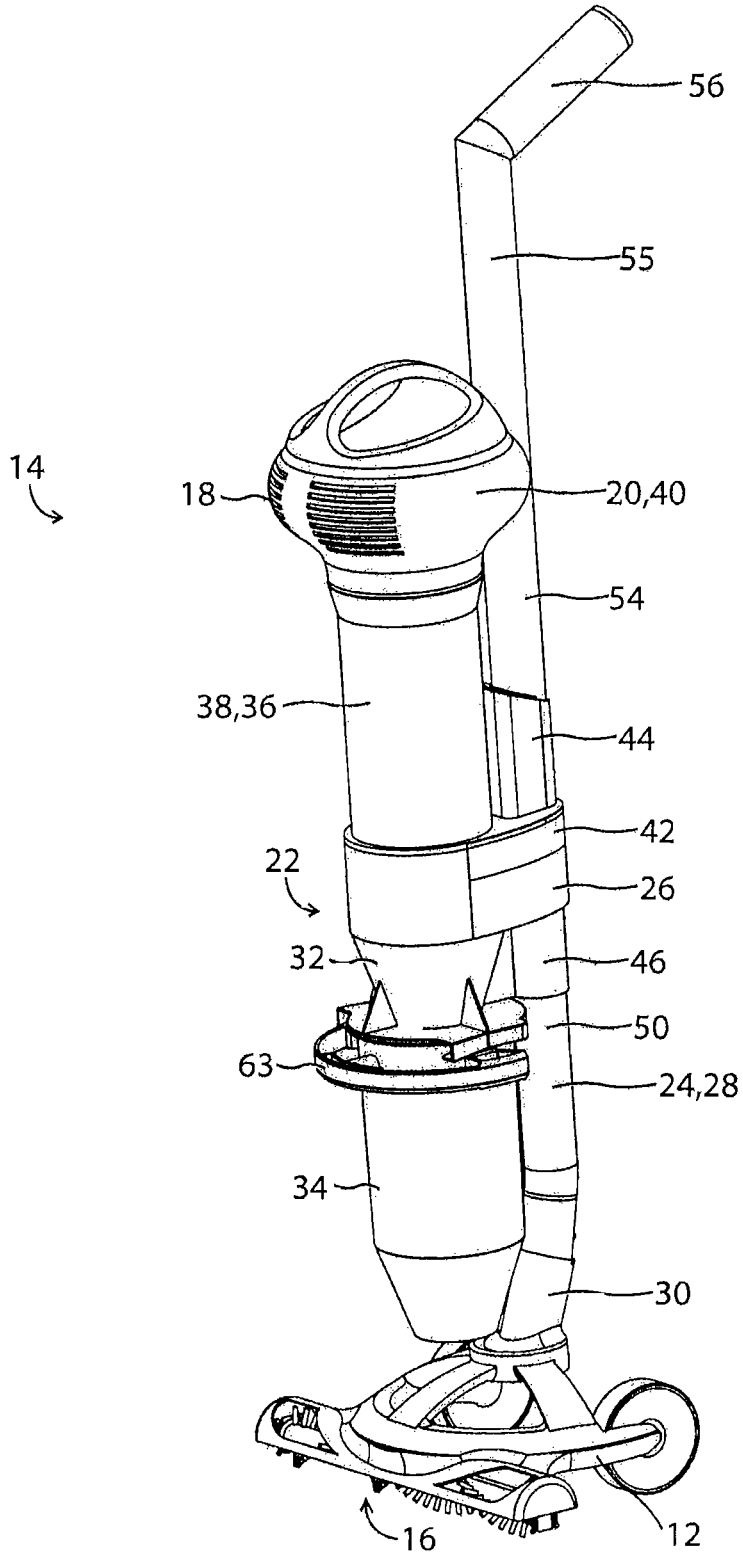

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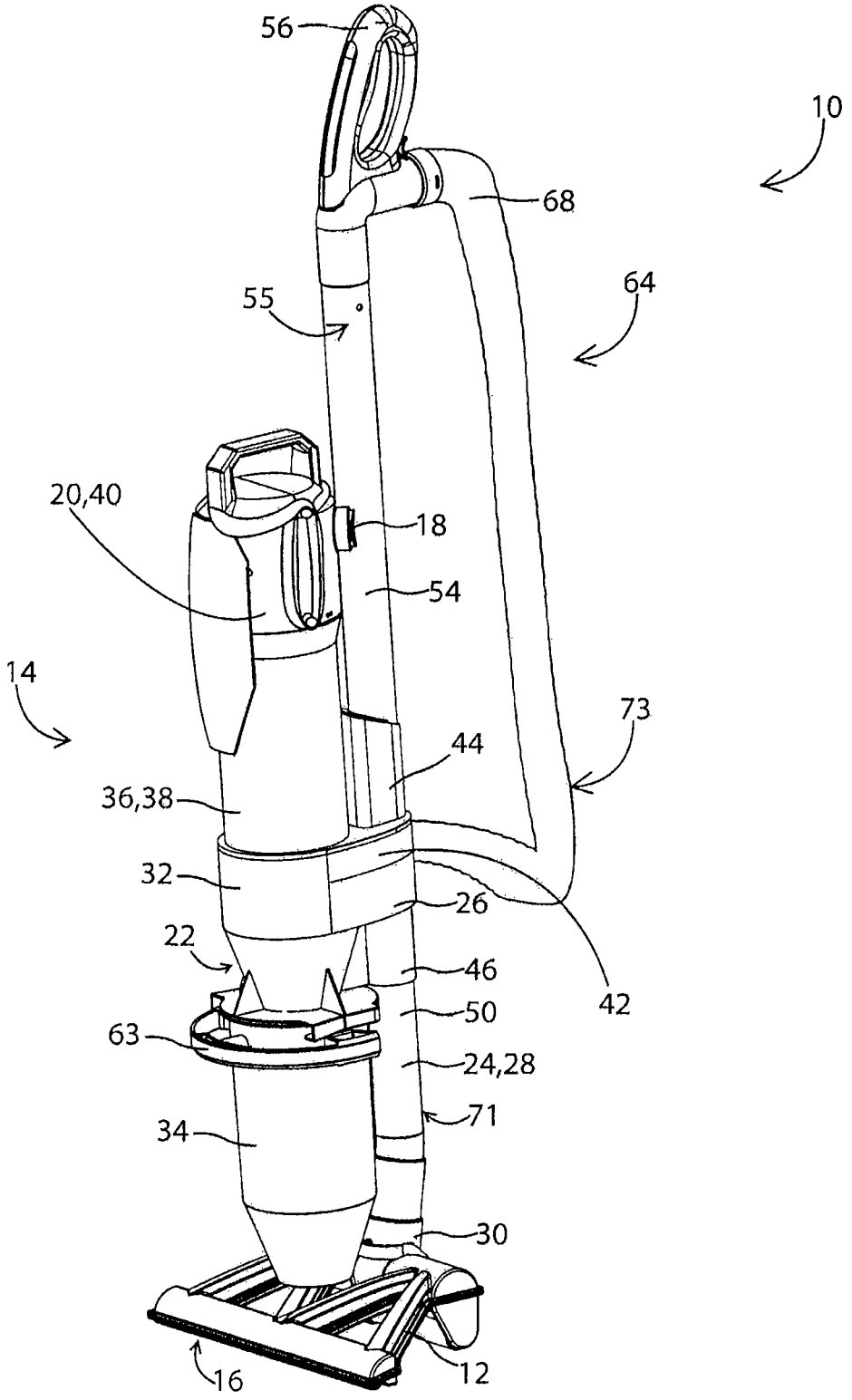
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Fig. 11

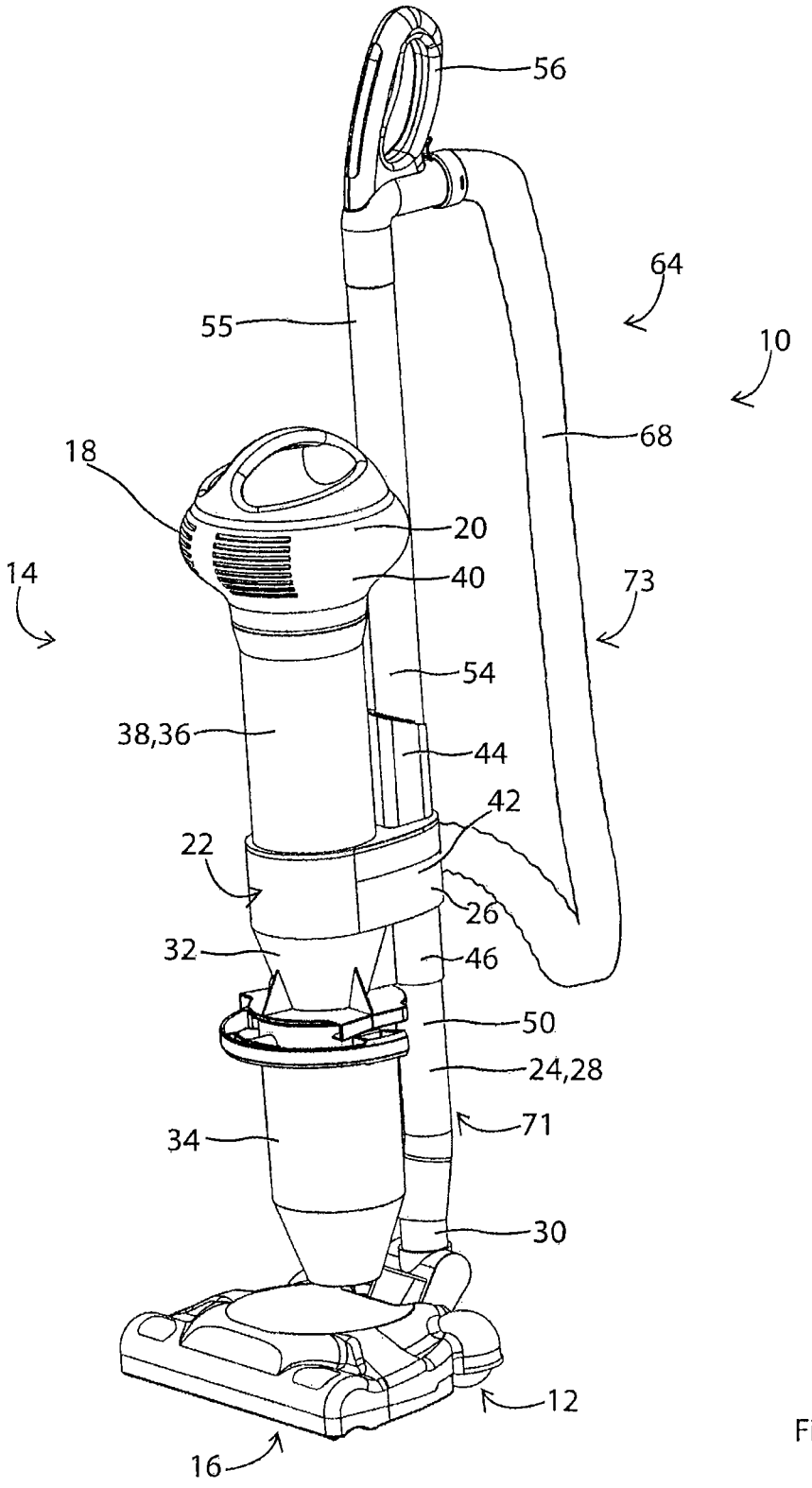
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Fig. 12

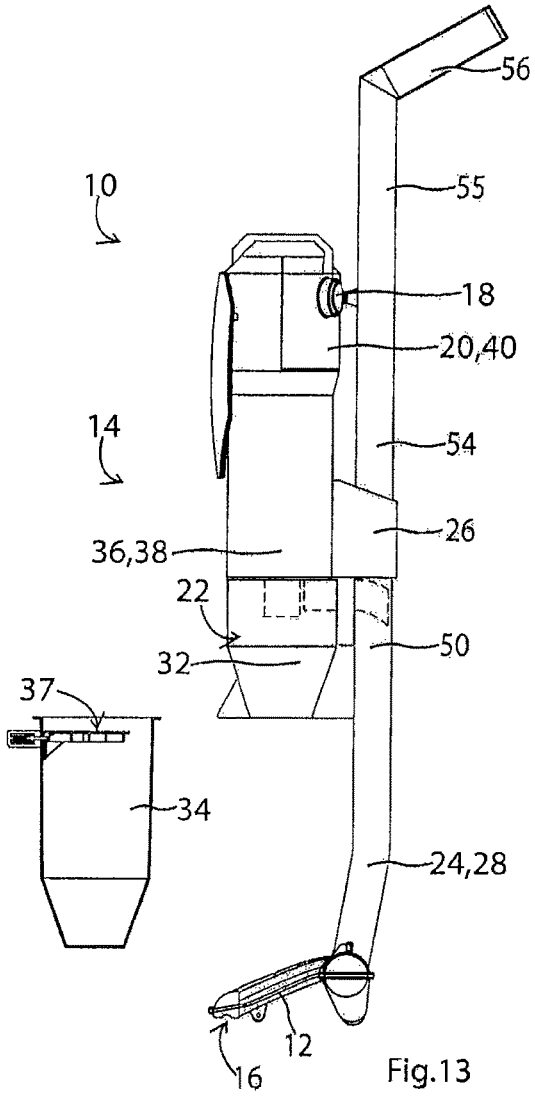
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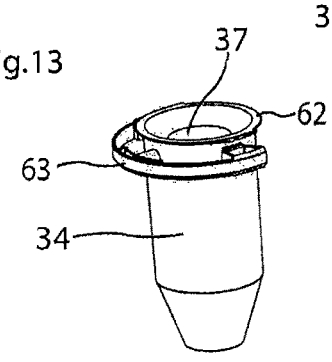
Fig.13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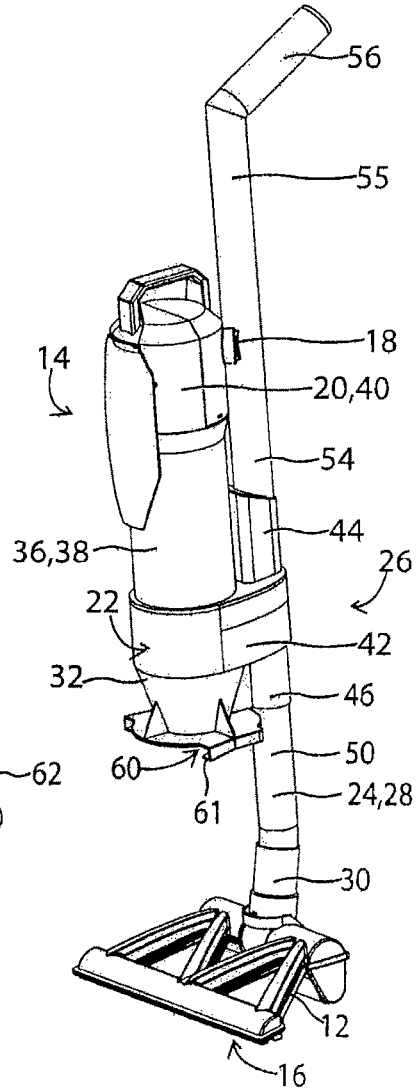
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Fig. 14

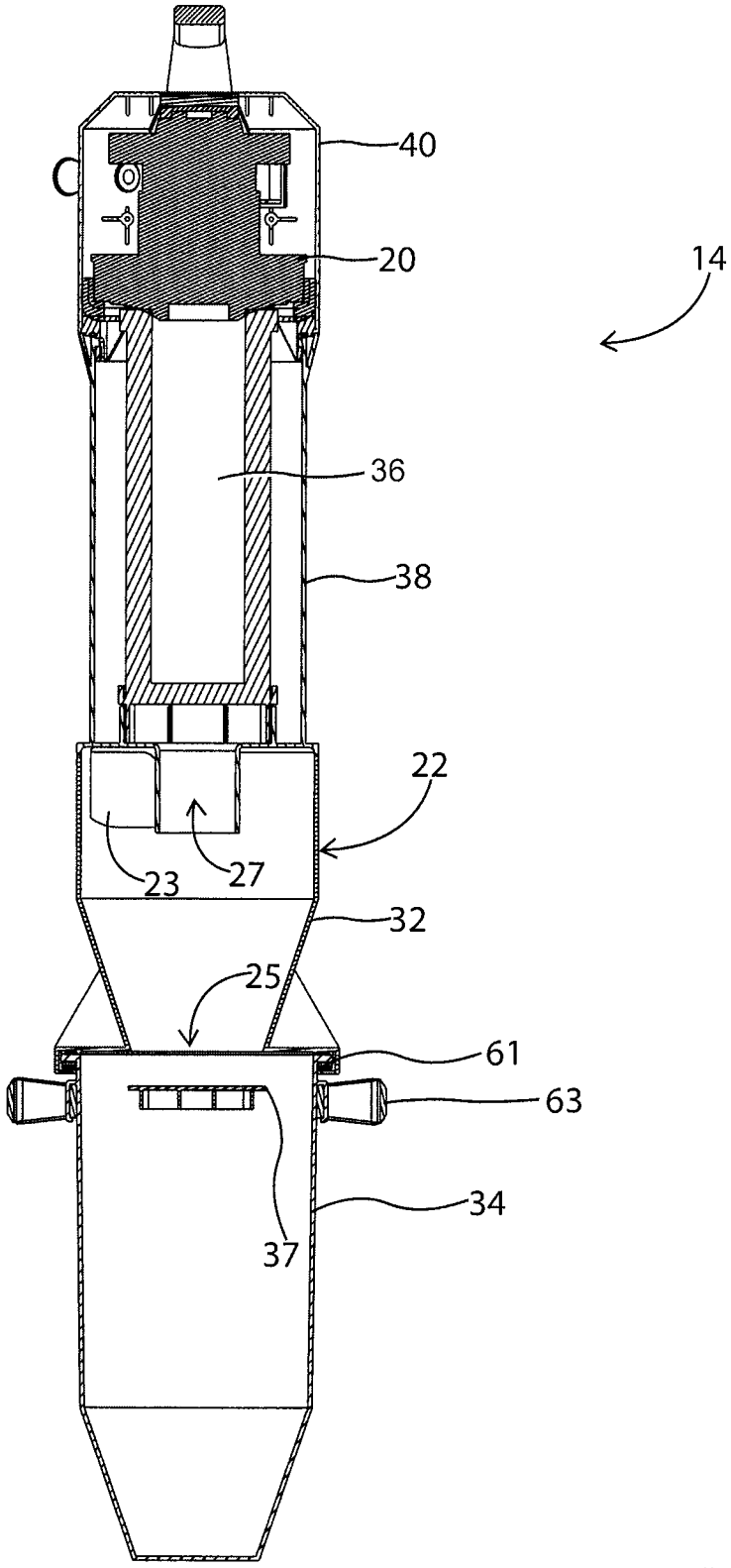

Fig. 15

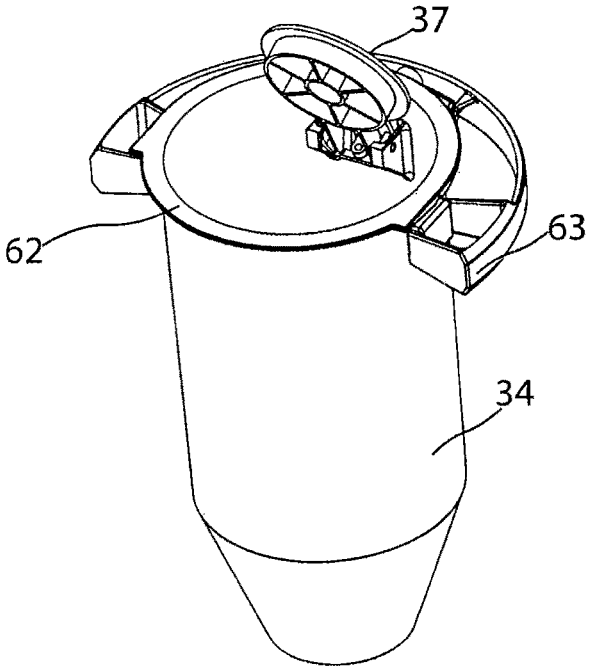

Fig. 17

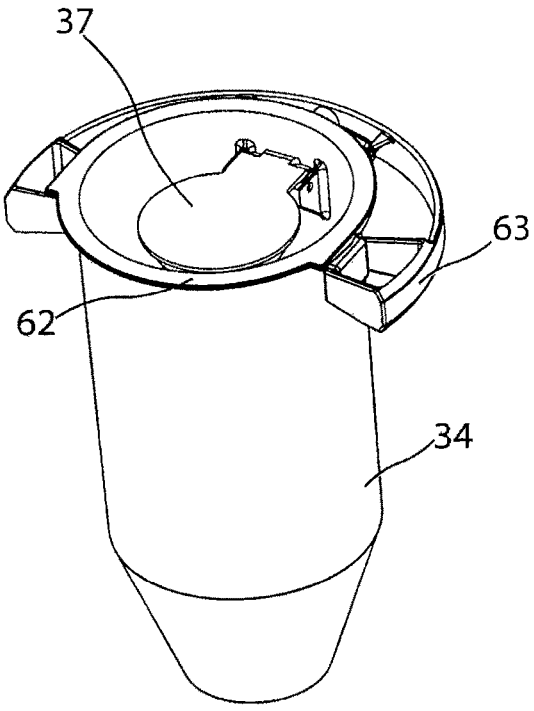

Fig. 16

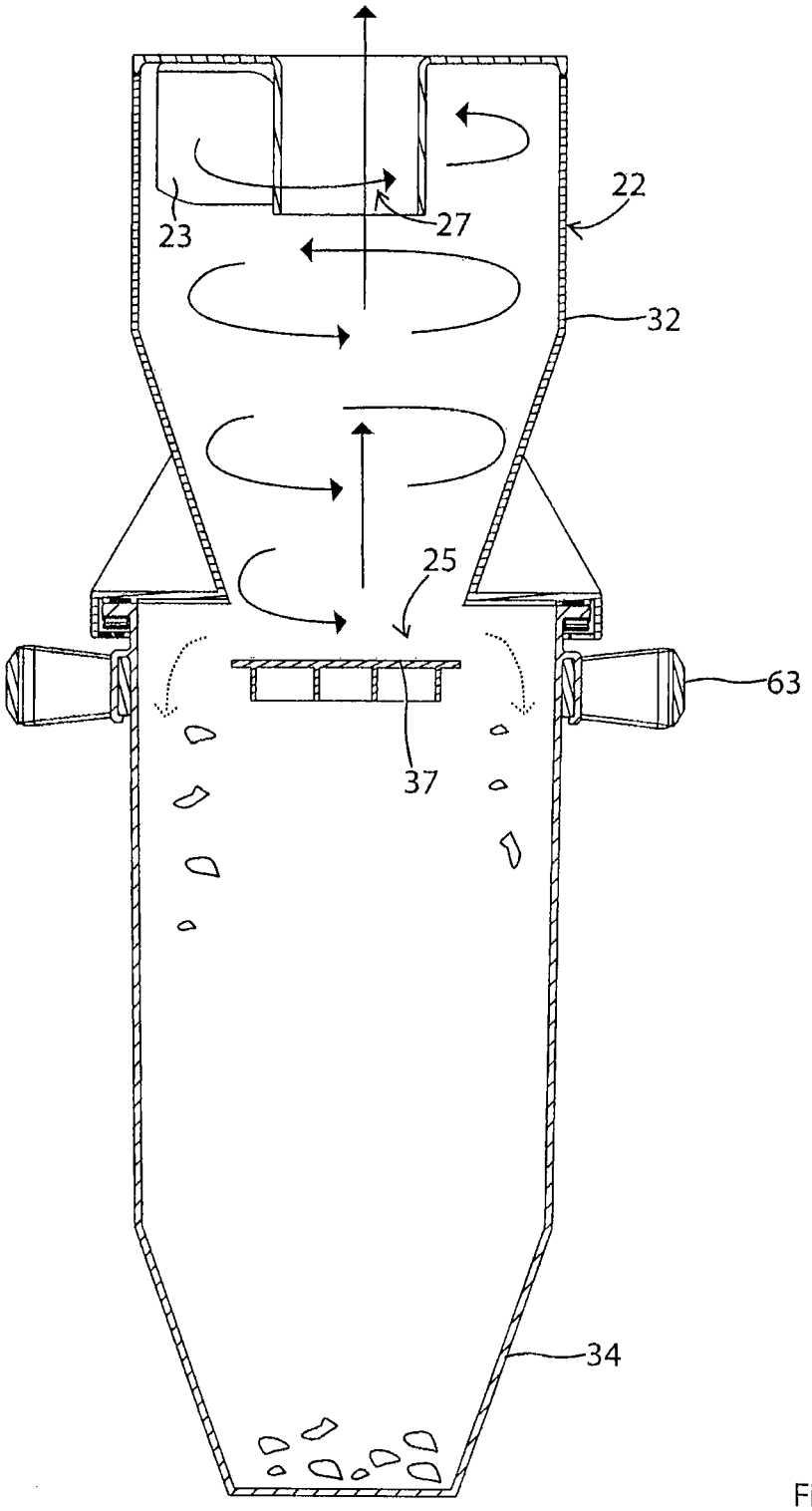

Fig. 18

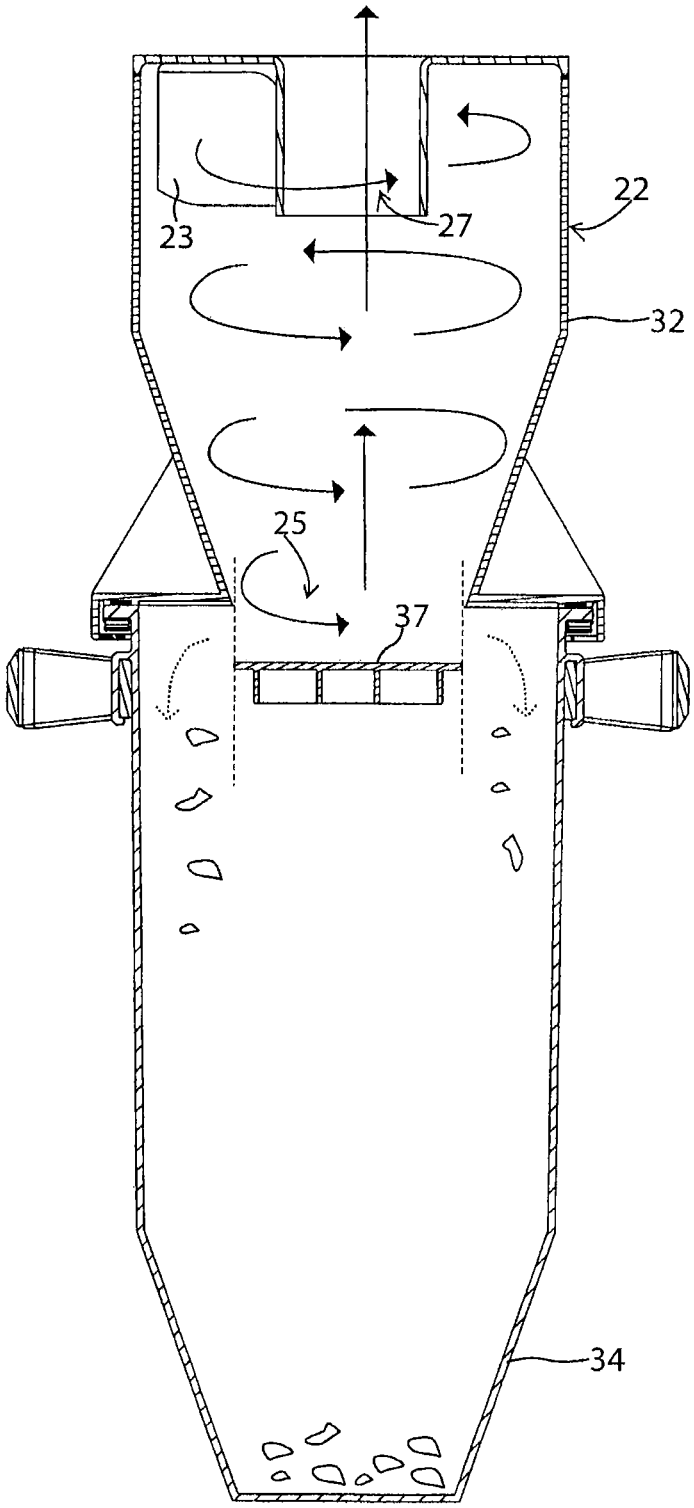

Fig. 19

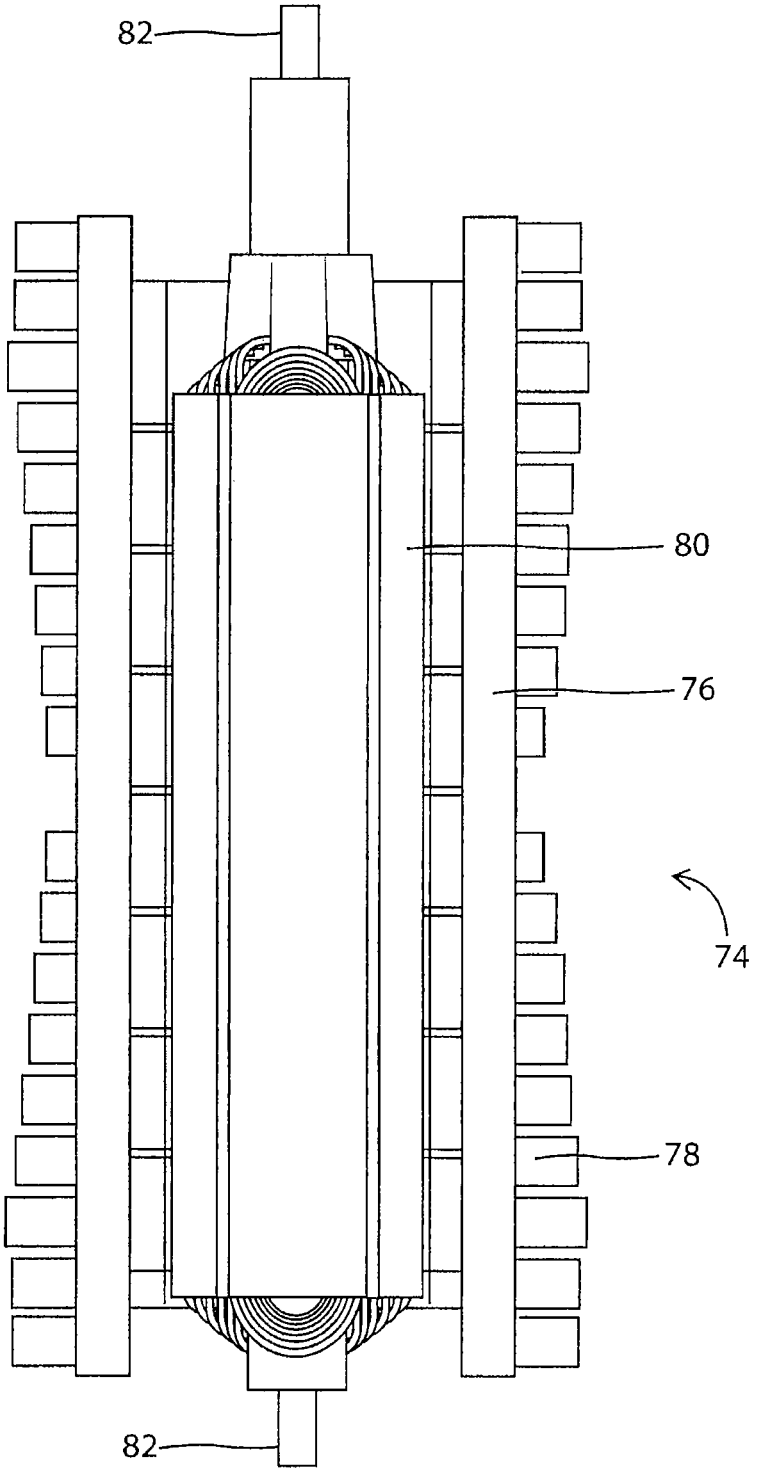

Fig. 20

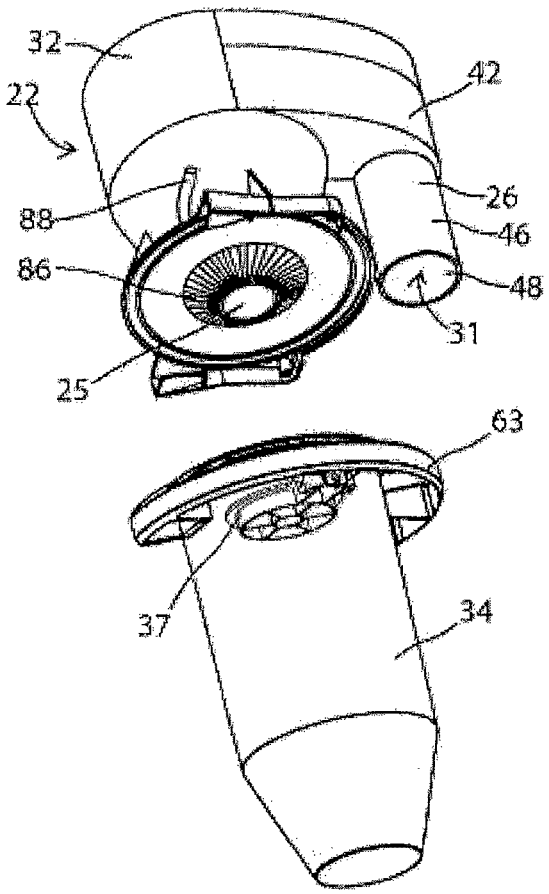

Fig. 21a

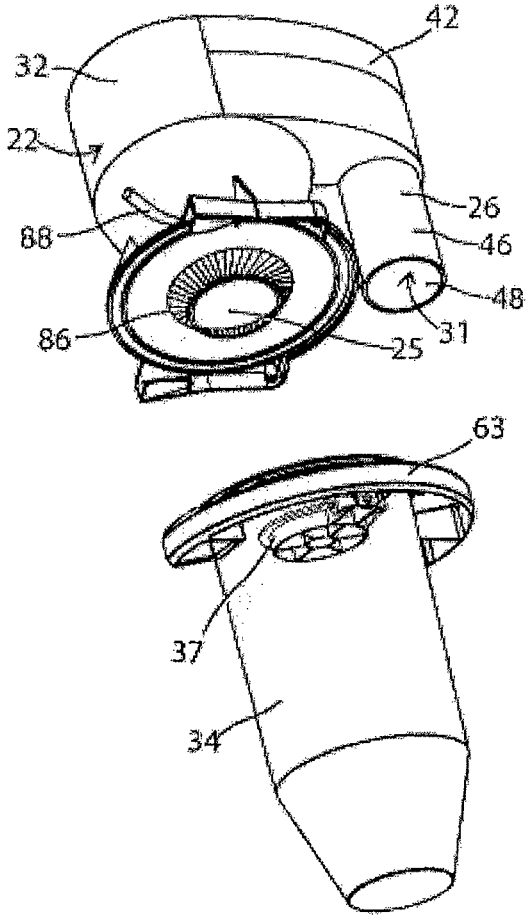

Fig. 21b

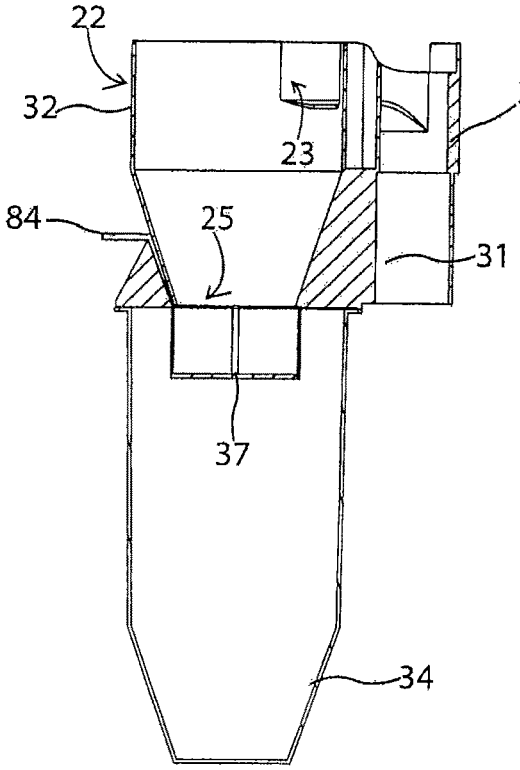

Fig. 22a

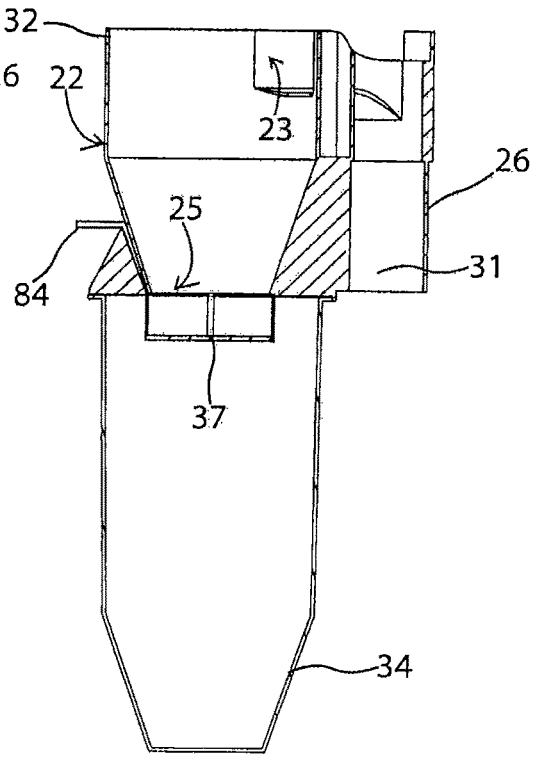

Fig. 22b

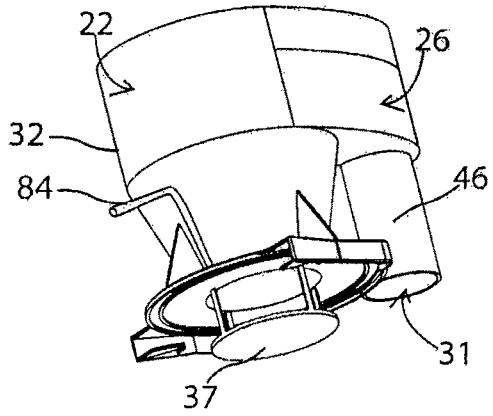

Fig. 22c

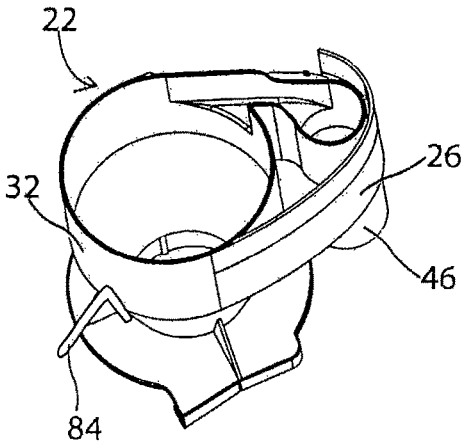

Fig. 22d

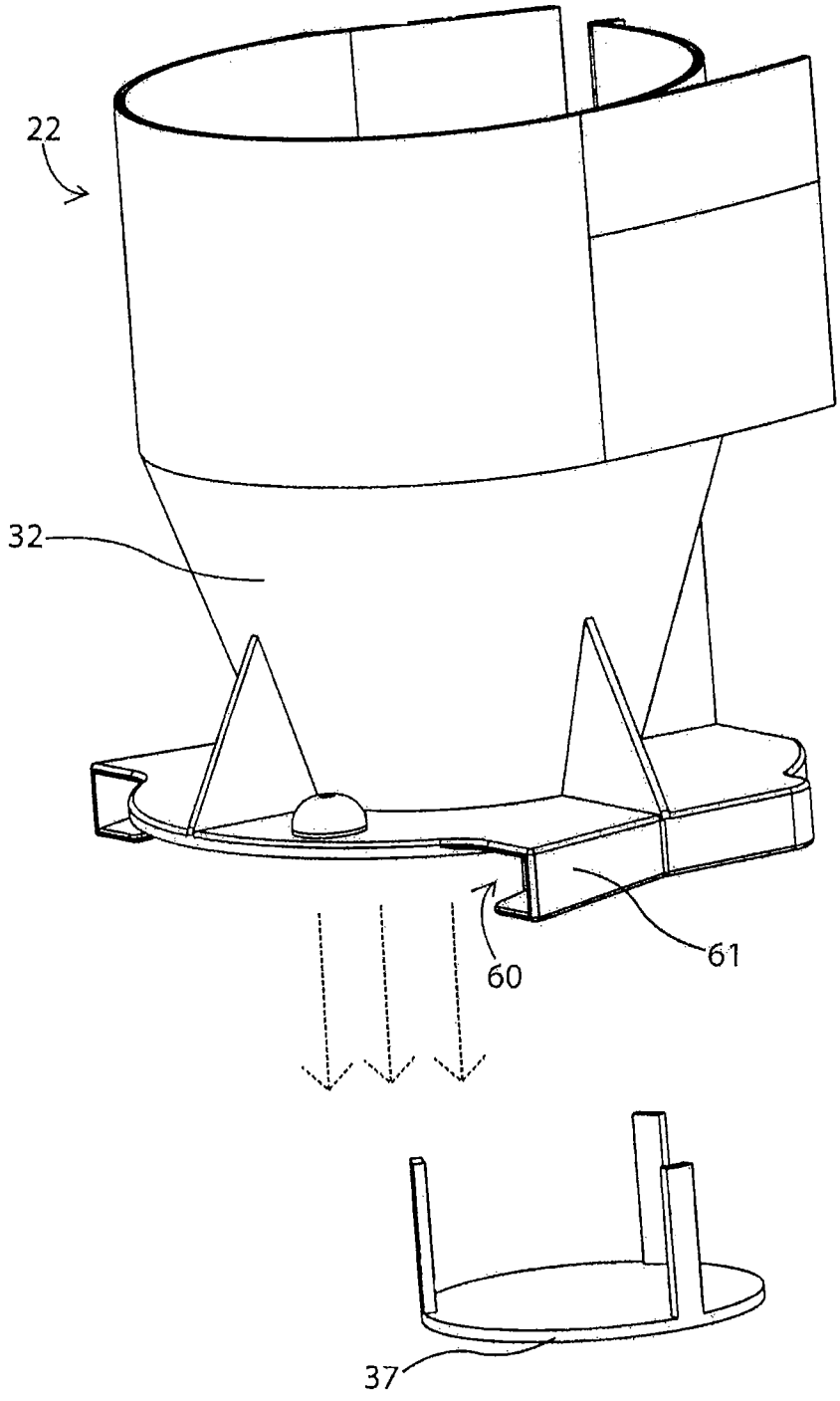

Fig. 22e

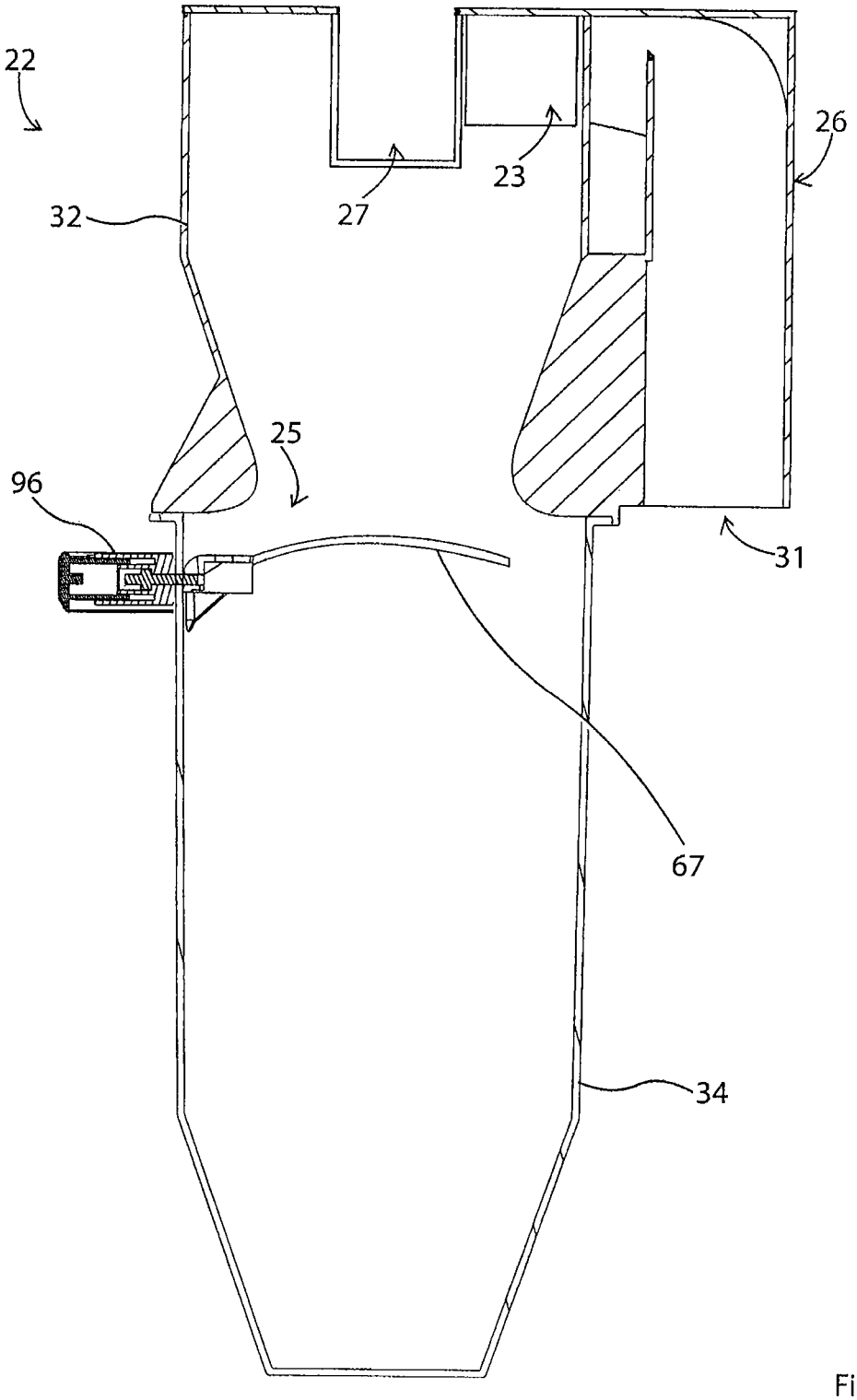

Fig. 23

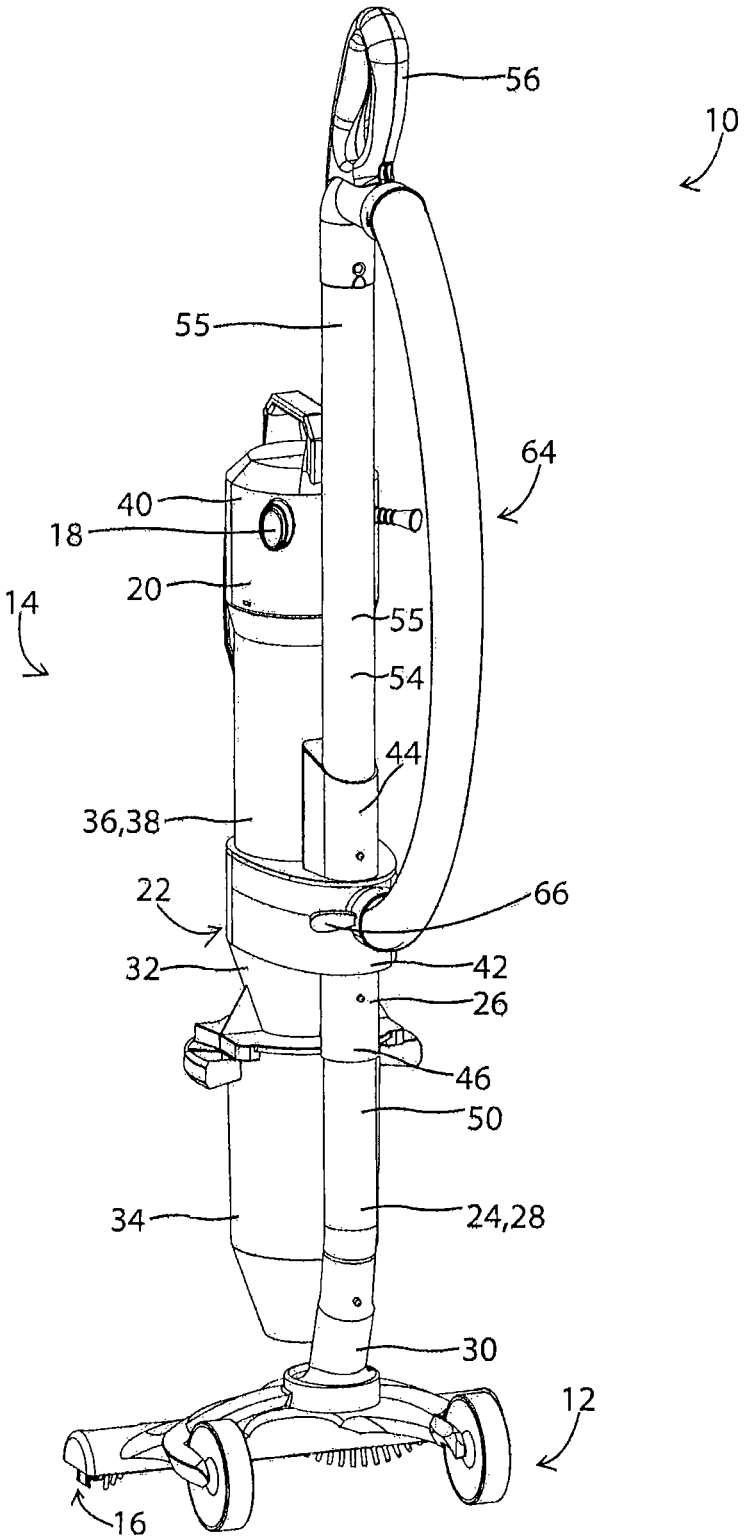
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Fig. 24

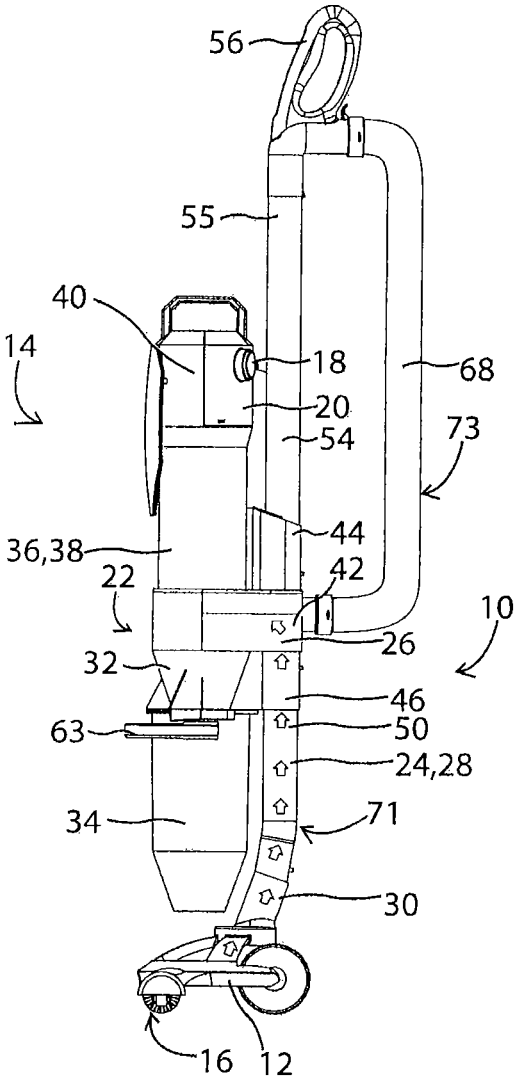
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Fig. 26

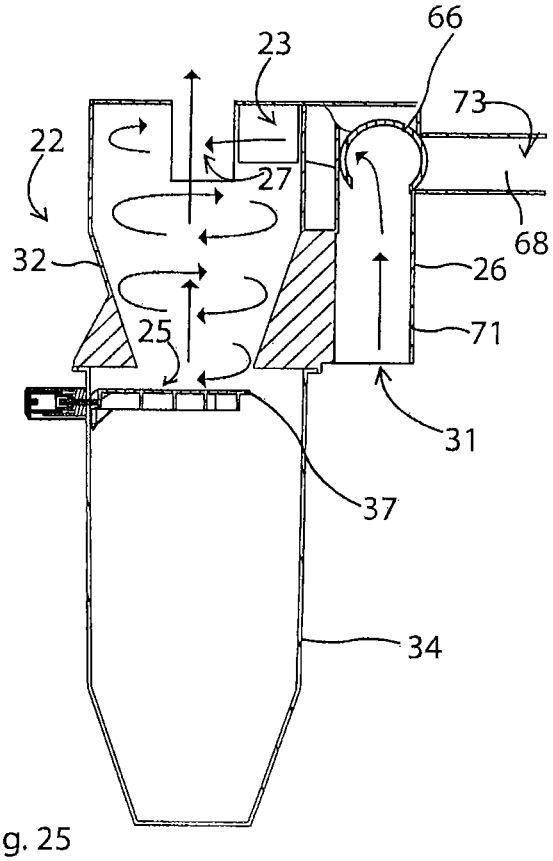
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Fig. 25

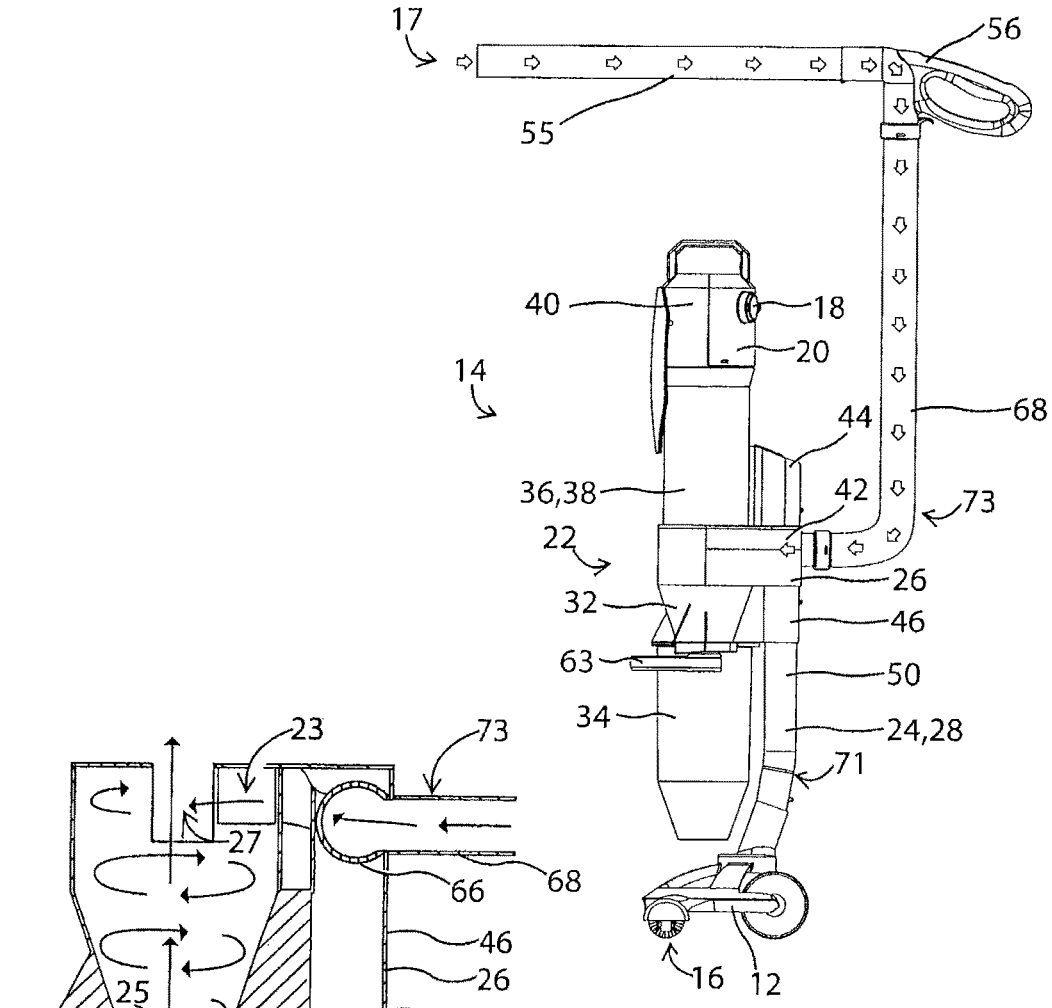
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Fig. 28

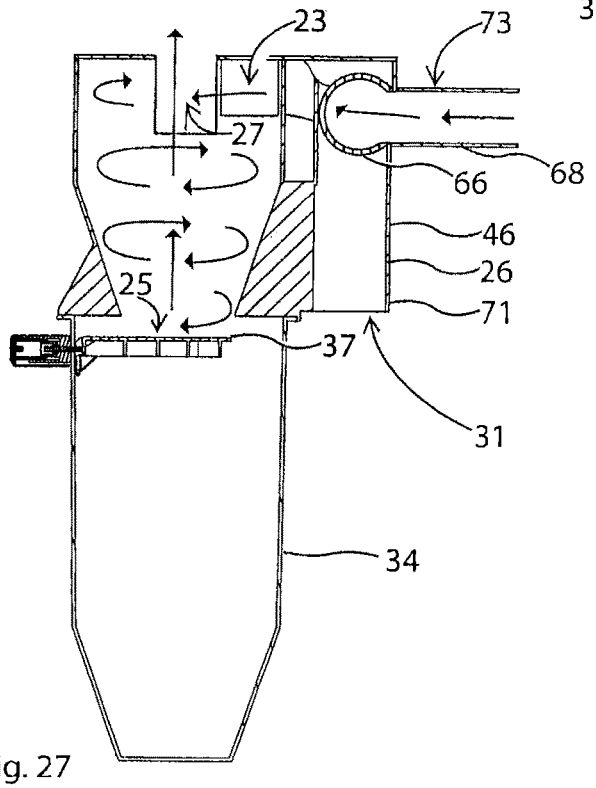
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Fig. 27

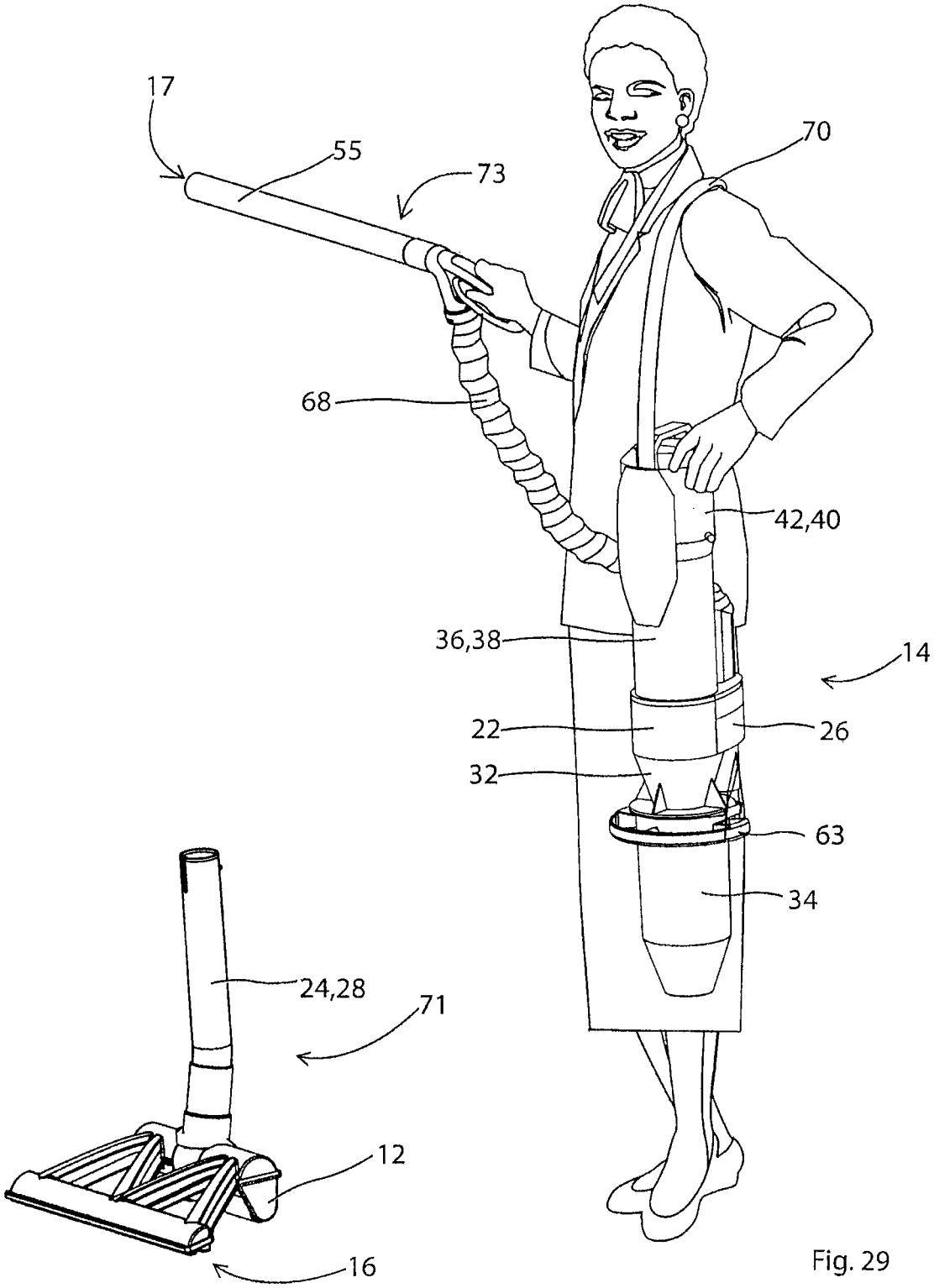

Fig. 29

UPRIGHT VACUUM CLEANER

CROSS REFERENCE TO RELATED APPLICATIONS

This invention is a continuation of U.S. patent application Ser. No. 14/036,818, which was allowed on Feb. 10, 2016, and which is a continuation of Ser. No. 13/396,918 filed on Feb. 15, 2012, now U.S. Pat. No. 8,567,006, which is a continuation of U.S. patent application Ser. No. 11/954,310 filed on Dec. 12, 2007, now U.S. Pat. No. 8,166,607, which claims priority from U.S. Provisional patent application 60/869,586, filed on Dec. 12, 2006, each of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The invention relates to a surface cleaning apparatus. More specifically, the invention relates to an upright surface cleaning apparatus that includes a mounting member to which one or more components of an upper section are mounted.

BACKGROUND OF THE INVENTION

Upright cyclonic vacuum cleaners are known in the art. Typical upright cyclonic vacuum cleaners include an upper section, including the cyclone assembly, mounted to a surface cleaning head. An upflow conduit is typically provided between the surface cleaning head and the upper section. In some such vacuum cleaners, a spine or backbone extends between the surface cleaning head and the upper section for supporting the upper section. In other vacuum cleaners, a spine or backbone is not provided, and the upflow conduit supports the upper section. For example, U.S. Pat. No. 1,759,947 to Lee describes an upright cyclonic vacuum cleaner wherein the upper section includes a single cyclone. A conduit extends from the surface cleaning head into the bottom of the cyclone and upwards towards the top of the cyclone. Air exits the conduit at the top portion of the cyclone. Another upright cyclonic vacuum cleaner is disclosed in U.S. Pat. No. 6,334,234 to Conrad. In the cleaner, the upper section includes a first cyclonic cleaning stage comprising a single cyclone, and a second cyclonic cleaning stage comprising a plurality of cyclones mounted above the first cyclonic cleaning stage. A conduit extends from the surface cleaning head through the bottom of the first cyclone and upwards toward the top of the first cyclone.

SUMMARY OF THE INVENTION

In accordance with one broad aspect, an upright surface cleaning apparatus is provided. The upright surface cleaning apparatus has a first cyclonic cleaning stage and comprises a surface cleaning head having a dirty fluid inlet. A fluid flow path extends from the dirty fluid inlet to a clean air outlet of the upright surface cleaning apparatus. A support member is mounted to the surface cleaning head, and a mounting member mounted to the support member. At least two operating components of the upright surface cleaning apparatus, including a cleaning stage, are mounted directly or indirectly to the mounting member. A suction motor is provided in the fluid flow path downstream of the cleaning stage. According to this aspect, the mounting member, which preferably has an air flow conduit therethrough, may

be used as a hub to which operating components, e.g., one or more of a cyclone casing, a filter casing and a motor casings, are attached.

Embodiments in accordance with this broad aspect may be advantageous because various components, such as the suction motor and/or the cleaning stage may be relatively easily removed from the surface cleaning apparatus, and therefore may be easily repaired or cleaned.

In some embodiments, the support member comprises an airflow duct forming part of the fluid flow path. In some other embodiments, the airflow duct is an up flow duct and the mounting member has an airflow passage therethrough in air flow communication with the first cyclonic cleaning stage.

In some embodiments, the cleaning stage comprises a cyclonic cleaning stage and another of the operating components comprises the suction motor.

In some embodiments, the cleaning stage comprises a cyclonic cleaning stage, another of the operating components comprises the suction motor, and the suction motor is mounted above the cyclonic cleaning stage. In some further embodiments, the cyclonic cleaning stage comprises a cyclone housing that is mounted directly or indirectly to the mounting member, a filter is positioned downstream to the cyclonic cleaning stage and the suction motor is mounted to a housing in which the filter is located. In some such embodiments, the filter is provided in the cyclone housing and the suction motor is mounted to the cyclone housing. In other such embodiments, the filter is provided in a filter housing that is mounted to the cyclone housing and the suction motor is mounted to the filter member.

In some embodiments, at least one of the operating components is removably mounted to the mounting member.

In some embodiments, the mounting member includes an air flow valve.

In some embodiments, the apparatus further comprises an above floor cleaning wand mounted to the mounting member or an operating component mounted to thereto.

In some embodiments, the upright surface cleaning apparatus comprises an upper portion comprising the suction motor and the cleaning stage and the upper portion is removably mounted to the surface cleaning head and useable as a portable surface cleaning apparatus.

In some embodiments, the cleaning stage comprises a first cyclonic cleaning stage and additional operating components comprise a second cyclonic cleaning stage and the suction motor. In some further embodiments, at least two of the first cyclonic cleaning stage, the second cyclonic cleaning stage and the suction motor are mounted directly to the mounting member. In yet further embodiments, the first cyclonic cleaning stage has a longitudinally extending outer surface and the outer surface is visible except for a portion facing the support member.

In some embodiments, the support member comprises an air flow duct forming part of the fluid flow path.

In accordance with another broad alternate aspect, an upright surface cleaning apparatus is provided. The upright surface cleaning apparatus comprises a surface cleaning head having a first dirty fluid inlet. The upright surface cleaning apparatus further comprises an above floor cleaning wand having a second dirty fluid inlet. An upright section is pivotally mounted to the surface cleaning head and comprises a support member and a first cyclonic cleaning stage selectively connectable in fluid flow communication with the first dirty fluid inlet and the second dirty fluid inlet. The first cyclonic cleaning stage has a longitudinally extending outer surface and the outer surface is visible except for a

portion facing the support member. Air flow passages from each of the first and second dirty fluid inlets merge at a position proximate the inlet of the first cyclonic cleaning stage. A suction motor is positioned downstream from the first cyclonic cleaning stage. Such a design may be optionally used with a mounting member.

In some embodiments, the suction motor is mounted on the upright section. In some embodiments, the suction motor is mounted above the first cyclonic cleaning stage.

In some embodiments, the support member is an up flow duct in a fluid flow path from the first dirty fluid inlet to the first cyclonic cleaning stage.

In some embodiments, the first cyclonic cleaning stage is removably mounted to the upper section.

In some embodiments, the first cyclonic cleaning stage comprises at least one collection chamber and the collection chamber is removably mounted to the first cyclonic cleaning stage.

In some embodiments, the support member comprises an up flow duct in a fluid flow path from the first dirty fluid inlet to the first cyclonic cleaning stage and the first cyclonic cleaning stage is mounted directly or indirectly to the upflow duct. In some such embodiments, the suction motor is mounted directly or indirectly to the upflow duct.

In some embodiments, the support member comprises an up flow duct in a fluid flow path from the first dirty fluid inlet to the first cyclonic cleaning stage and the first cyclonic cleaning stage, a second cyclonic cleaning stage and the suction motor are mounted directly to the upflow duct or a component mounted to the upflow duct.

In some embodiments, the apparatus further comprises a cleaning and suction unit removably mounted to the surface cleaning apparatus and useable as a portable surface cleaning apparatus, the cleaning and suction unit comprising the suction motor, the first cyclonic cleaning stage and the above floor cleaning wand.

In some embodiments, the support member is an up flow duct in a fluid flow path from the first dirty fluid inlet to the first cyclonic cleaning stage and the cleaning and suction unit removably mounted to the upflow duct.

In accordance with another alternate broad aspect, an upright surface cleaning apparatus is provided. The upright surface cleaning apparatus comprises a surface cleaning head having a first dirty fluid inlet. The upright surface cleaning apparatus further comprises an above floor cleaning wand having a second dirty fluid inlet. An upright section is pivotally mounted to the surface cleaning head and comprises a cleaning and suction unit removably mounted to the surface cleaning apparatus and useable as a portable surface cleaning apparatus. The cleaning and suction unit comprises a suction motor, a first cyclonic cleaning stage, and the above floor cleaning wand. The first cyclonic cleaning stage is selectively connectable in fluid flow communication with the first dirty fluid inlet and the second dirty fluid inlet. The first cyclonic cleaning stage has a longitudinally extending outer surface and the outer surface is visible except for a portion facing the support member. Such a design may be optionally used with by itself or with one or both of either of the forgoing aspects.

In some embodiments, the upright section is pivotally mounted to the surface cleaning head by a support member that is an up flow duct in a fluid flow path from the first dirty fluid inlet to the first cyclonic cleaning stage.

In some embodiments, the first cyclonic cleaning stage is removably mounted to the cleaning and suction unit.

In some embodiments, the first cyclonic cleaning stage comprises at least one collection chamber and the collection chamber is removably mounted to the first cyclonic cleaning stage.

In some embodiments, the upright section is pivotally mounted to the surface cleaning head by a support member that comprises an up flow duct in a fluid flow path from the first dirty fluid inlet to the first cyclonic cleaning stage, and the first cyclonic cleaning stage, a second cyclonic cleaning stage and the suction motor are mounted directly to the upflow duct or a component mounted to the upflow duct.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the instant invention will be more fully and completely understood in accordance with the following drawings of the preferred embodiments of the vacuum cleaner in which:

FIG. **1** is a perspective view of an upright vacuum cleaner according to a first embodiment of the instant invention;

FIG. **2** is a front elevational view of the vacuum cleaner of FIG. **1**;

FIG. **3** is a rear elevational view of the upright vacuum cleaner of FIG. **1**;

FIG. **4** is a top plan view of the upright vacuum cleaner of FIG. **1**;

FIG. **5** is a side elevational view of the upright vacuum cleaner of FIG. **1**;

FIG. **6** is an exploded view of the upright vacuum cleaner of FIG. **1**;

FIG. **7** is an exploded view of an alternate embodiment of the vacuum cleaner of FIG. **1**;

FIG. **8** is an exploded view showing a plurality of different components which are interchangeable and may be utilized to custom design different vacuum cleaners using common components;

FIG. **9** is a perspective view of an alternate embodiment of a vacuum cleaner which may be constructed using the components of FIG. **8**;

FIG. **10** is a further alternate embodiment of a vacuum cleaner which may be constructed using the components of FIG. **8**;

FIG. **11** is a further alternate embodiment of a vacuum cleaner which may be constructed using the components of FIG. **8**;

FIG. **12** is a further alternate embodiment of a vacuum cleaner which may be constructed using the components of FIG. **8**;

FIG. **13** is a side elevational view of the vacuum cleaner of FIG. **1** wherein the dirt chamber is slidably mountable on the cyclone housing and separately removable from the vacuum cleaner;

FIG. **14** is a perspective view of FIG. **13**;

FIG. **15** is a longitudinal section through the upper casing of the vacuum cleaner of FIG. **13**;

FIG. **16** is a top plan view of the dirt chamber of FIG. **13** with the separation plate shown in the horizontal position;

FIG. **17** is a top plan view of the dirt chamber of FIG. **13** with the separation plate shown in a raised position;

FIG. **18** is a cross section through the cyclone housing and dirt chamber shown in FIG. **15** with the air flow pattern shown therein;

FIG. **19** is a cross section through an alternate cyclone housing and dirt chamber showing the air flow pattern therein;

FIG. **20** is a partial longitudinal sectional view through a rotatably mounted brush for a surface cleaning head wherein the brush drive motor is mounted internally inside the rotatably mounted brush;

FIG. **21***a* is an exploded view of a cyclone housing showing an iris for the outlet of the cyclone chamber in a first position;

FIG. **21***b* is an exploded view of the cyclone housing and dirt chamber of FIG. **24***a* showing the iris in a second position;

FIG. **22***a* is a cross section through an alternate cyclone housing and dirt chamber showing an adjustable height plate at a first position;

FIG. **22***b* is a cross section through the same cyclone housing and dirt chamber as in FIG. **22***a* wherein the plate has been adjusted to be closer to the dirt outlet of the cyclone;

FIG. **22***c* is a perspective view of the cyclone housing of FIG. **25***a* with the cyclone chamber removed;

FIG. **22***d* is a perspective view from above of the cyclone housing of FIG. **22***c;*

FIG. **22***e* is a perspective view of the cyclone housing of FIG. **25** with the separation plate removed;

FIG. **23** is a cross section through an alternate cyclone housing and dirt chamber wherein the configuration of the plate is adjustable;

FIG. **24** is a perspective view of an upright vacuum cleaner in accordance with a further alternate embodiment of the instant invention wherein a valve is provided for adjusting the vacuum cleaner from a floor cleaning mode to above floor cleaning mode;

FIG. **25** is a cross section through the cyclone housing and dirt chamber of the vacuum cleaner of FIG. **24** wherein the vacuum cleaner is in the floor cleaning mode;

FIG. **26** is a side elevational view of the vacuum cleaner of FIG. **25** in partial section showing the air flow from the surface cleaning head to the cyclone inlet;

FIG. **27** is a cross section through the cyclone housing and dirt chamber of the vacuum cleaner of FIG. **26** wherein the vacuum cleaner is in the above floor cleaning mode;

FIG. **28** is a side elevational view of the vacuum cleaner of FIG. **29** showing the air flow from the inlet of the cleaning wand to the cyclone inlet;

FIG. **29** is a perspective view of a vacuum cleaner in accordance with another embodiment of the instant invention having a shoulder strap and wherein the upper section has been removed from the cleaning head and handle extension and is used in the above floor-cleaning mode.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. **1-5** an embodiment of a surface cleaning apparatus **10** of the present invention is shown. Surface cleaning apparatus **10** is an upright vacuum cleaner, and comprises a surface cleaning head **12** and an upper section **14**. A dirty fluid inlet **16** is provided in the surface cleaning head **12**, and a fluid flow path extends from the dirty fluid inlet **16** to a clean air outlet **18** of the surface cleaning apparatus **10**. The fluid flow path includes a suction motor **20** and at least one cleaning stage **22**. In the embodiments shown, a support member or spine **24** is mounted to the surface cleaning head **12**, and a mounting member **26** is mounted to the support member. At least two operating components of the surface cleaning apparatus **10** are mounted directly or indirectly to the mounting member. Accordingly, the support member supports the upper section **14** on the surface cleaning head **12**.

In the embodiments shown, fluid enters surface cleaning head via dirty fluid inlet **16** in surface cleaning head **12**, and is directed upwards into the at least one cleaning stage via an upflow duct **28**. In some embodiments, as shown, support member **24** comprises upflow duct **28**. That is, support member **24** provides fluid communication between surface cleaning head **12** and upper section **14**. In other embodiments, upflow duct **28** may be a separate member. For example, upflow duct **28** may be a conduit that is affixed to support member **24**. In the embodiments shown, support member **24** is pivotally mounted to surface cleaning head **12** via a pivoting connector **30**. Accordingly, upper section **14** is pivotally mounted to surface cleaning head **12**.

In the embodiments shown, support member **24** extends upwardly towards mounting member **26**. Mounting member **26** serves as a support to which at least two operating components of the upright surface cleaning apparatus **10** are mounted. In the preferred embodiment, cleaning stage **22** is directly or indirectly mounted to mounting member **26**, as will be described further hereinbelow. In a further preferred embodiment, cleaning stage **22** and suction motor **20** are directly or indirectly mounted to mounting member **26**. In other embodiments, other operating components, such as a filter assembly or another cleaning stage, may be mounted to mounting member **26**. In some embodiments, mounting member **26** may be integrally formed with support member **24**. In other embodiments, as shown in FIGS. **21-22**, mounting member **26** may be integrally formed a component of upper section **14**, for example cyclonic cleaning stage **22**. In other embodiments, mounting member **26** may be a separate member. As exemplified, mounting member may have a fluid flow path therethrough (see for example FIG. **7**) or it may not include a fluid flow path therethrough.

In embodiments wherein support **24** comprises upflow duct **28**, mounting member **26** may further serve to connect support **24** in fluid communication with cyclonic cleaning stage **22**. That is, mounting member **26** may comprise an airflow passage **31** (shown in FIGS. **7**, **8**, **21-22**, and **23-28**). In alternate embodiments (not shown), a mounting member may not be provided, and support **24** may be mounted directly to cyclonic cleaning stage **22**. In further alternate embodiments, wherein upflow duct **28** is a separate member, a mounting member may not be provided, and upflow duct **28** and support **24** may be mounted directly to cyclonic cleaning stage **22**.

In the embodiments shown, air passes from support **24**, into mounting member **26**, and from mounting member **26** into cleaning stage **22**. In the embodiments shown, cleaning stage **22** is a single cyclonic cleaning stage **22**, which is provided in cyclone housing **32** having a longitudinally extending outer surface. In some embodiments, housing **32** is transparent or translucent, such that a user may view the interior thereof. Air enters cyclonic cleaning stage **22** via inlet **23**, which, in the embodiments shown is provided in an upper part of cyclonic cleaning stage **22**. In some embodiments, prior to entering inlet **23**, the air may be directed along the exterior of cyclonic cleaning stage **22**, such that air enters cyclonic cleaning stage **22** in a tangential direction. For example, as can be seen in FIG. **5**, mounting member **26** comprises a portion **29** extending along cyclonic cleaning stage **22**. In alternate embodiments, wherein a mounting member is not provided, a portion of upflow duct **28** may extend externally along cyclonic cleaning stage **22** towards inlet **23**. In cyclonic cleaning stage **22**, dirt is separated from

air, and passes through outlet **35** into dirt chamber **34**, which is provided below cyclonic cleaning stage **18**.

In some embodiments, a plate **37** may be positioned adjacent outlet **25**. It will be appreciated that plate **37** may be positioned at any height in dirt chamber **34**. Preferably, plate **37** is positioned proximate the top of dirt chamber **34** and proximate dirt outlet **25** from cyclone housing **32**. Accordingly, as shown in FIG. **15**, essentially the entire volume of dirt chamber **34** is available to function as dirt collection chamber **34**. Preferably, plate **37** is positioned inwards from an inner wall of dirt collection chamber **34**, except for the portion of the inner wall to which plate **37** may be attached, so as to define an annular gap between the outer wall of plate **37** and the inner wall of dirt chamber **34**. Preferably, the minimum distance between plate **37** and cyclone housing **32** or dirt chamber **34**, is at least as large as the largest dimension of the cyclone inlet **23**. For example, if the cyclone inlet **23** has a 1 inch diameter, then the minimum distance between plate **37** and cyclone housing **32** or dirt chamber **34** is preferably is 1 inch or larger. An advantage of such a design is that any dirt particle that enters the cyclone housing **32** will be able to pass through the gap into dirt collection chamber **34**. The distance between the top of plate **37** and the bottom of the cyclone housing may be 0.01-2.5 inches and is preferably at least the largest diameter of the cyclone inlet.

In some embodiments, the plate **37** may be removable with dirt chamber **34** from surface cleaning apparatus **10**, as will be described further hereinbelow (see for example the embodiment of FIG. **6**). An advantage of this design is that plate **37** defines a partial cover for the dirt collection chamber **34**. Alternately, as shown in the embodiment of FIG. **7**, plate **37** may remain in position when dirt chamber **34** is removed. In such an embodiment, plate **34** is preferably attached to the bottom of cyclone housing **32**.

In a particularly preferred embodiment, as exemplified in FIGS. **16** and **17**, plate **37** is pivotally mounted to the inner wall of cyclone chamber **34**. Accordingly, plate **37** may be in the horizontal or closed position shown in FIG. **16** when surface cleaning apparatus **10** is in use and when dirt chamber **34** is removed from the vacuum cleaner. When dirt collection chamber **34** is inverted for emptying, plate **37** may pivot to an open position (as exemplified in FIG. **17**) due to gravity. If plate **37** is pivotally mounted to the inner wall of chamber **34**, then the annular gap is preferably at least one inch. Such a configuration permits plate **37** to pivot open to permit dirt to be emptied out of chamber **34** when chamber **34** is inverted.

In some embodiments, plate **37** may have the same diameter as the cyclone dirt outlet **25**. Accordingly, if the cyclone housing **32** is cylindrical, then the diameter of plate **37** may be the same as the diameter of the cyclone. Alternately, a shown in FIG. **19**, if the cyclone is conical, plate **37** may have the same diameter as the outlet **25** of cyclone housing **34**. Alternately, plate **37** may have a larger diameter, as shown in FIG. **18**. It will be appreciated that if the cyclone is conical, then plate **37** may have a diameter that is equal to the projected diameter of a end of the cone that is projected to the top of plate **37**.

Referring back to FIGS. **1-5**, surface cleaning apparatus **10** further comprises a filter assembly **36** provided downstream from cleaning stage **22**. In the embodiments shown, filter assembly **36** is housed in filter housing **38**. In alternate embodiments (not shown), filter assembly may be provided in the cyclone housing **32**. From cyclonic cleaning stage **22**, air passes out of outlet **27** upwardly and through filter assembly **36**. The air exits filter assembly **36** and is directed to motor **20**, which is housed in housing **40**. In the embodiments shown, motor **20** is provided on upper section **14**, adjacent and above filter assembly **36**. In alternate embodiments, motor **20** may be provided in cleaning head **12**. In either embodiment, motor **20** is provided downstream from the cleaning stage **22**. Accordingly, a downflow duct may be provided between upper section **14** and surface cleaning head **12**. In some embodiments, support member **24** may comprise the downflow duct. In other embodiments, the downflow duct may be a separate member.

In alternate embodiments, cleaning unit may be otherwise configured. For example, upper section **14** may comprise a second cleaning stage (not shown) positioned above cleaning stage **22** and including a plurality of cyclones in parallel. furthermore, in some embodiments, cleaning unit may comprise no filter assemblies, or more than one filter assembly.

As previously mentioned, in one optional aspect a mounting member **26** serves to provide a support to which operating components, preferably at least two operating components, of the upright surface cleaning apparatus are directly or indirectly mounted. In the preferred embodiment, one of the operating components comprises cleaning stage **22**. In a further preferred embodiment, the other of the operating components comprises suction motor **20**. Preferably, suction motor **20** and/or cleaning stage **22** are removably mounted to mounting member **26**. In some embodiments, mounting member **26** further serves to connect upflow duct **28** in fluid communication with cyclonic cleaning stage **22**. It will be appreciated that, in accordance with this aspect, any construction may be used for the operating components. For example, any cyclonic cleaning stage or stages and/or any filtration member known in the surface cleaning art may be used.

Referring to FIGS. **6** and **7**, in the embodiments shown, mounting member **26** comprises a body **42** having an upper portion **44** and a lower portion **46**. Lower portion **46** defines an opening **48** for receiving an upper end **50** of support member **24**. Upper end **50** of support member **24** may be securely mounted in opening **48** by any means, such as by an adhesive, a friction fit, a set screw or the like. In embodiments wherein support member **24** comprises upflow duct **28**, opening **48** may be in fluid communication with a cyclone chamber inlet **23**. In the embodiment shown, the upper portion **44** of mounting member **24** comprises a second opening **52**. Second opening **52** receives a lower end **54** of a handle extension **55**, which supports handle **56**. Lower end **54** may be secured in second opening **52** by any means known in the art.

Mounting member **26** further comprises a portion **57** for receiving one or more operating components of surface cleaning apparatus **10**. For example, as shown in FIG. **7**, mounting member **26** is provided with a securing ring **58**. Securing ring **58** provides a member to which one or more operating components may be mounted, preferably removably mounted. For example, in the embodiments shown in FIGS. **1-14**, upper section **14** may be assembled by positioning filter housing **38** above securing ring **58**, and positioning cleaning stage housing **32** below ring **58**. Filter housing **38** and cleaning stage housing **32** may then be secured together, preferably removably secured together, for example by using screws, a bayonet mount, or a screw thread. In alternate embodiments, filter housing **38** and cleaning stage **32** may be permanently secured together, for example by using an adhesive or welding.

Motor housing **40** may then be mounted to filter housing **38**, for example by using by using screws, a bayonet mount, a screw thread, or an adhesive or welding. Preferably motor

housing **40** is removably mounted to filter housing **38**. Additionally, dirt chamber **34** may be mounted, preferably removably mounted, to cleaning stage **22**. Accordingly, in this embodiment, the first cleaning stage **22** is directly mounted to mounting member **26**, and motor **20** is indirectly mounted to mounting member **26**.

In other embodiments, operating components of surface cleaning apparatus **10** may be mounted to mounting member **26** in another manner. For example, in one embodiment (not shown), mounting member **26** may comprise a bracket to which filter housing **38** may be mounted, for example by using screws. Cleaning stage housing **32** may then be mounted to filter housing, without contacting mounting member **26**. Dirt chamber **34** may then be mounted to cleaning stage housing **32**, and motor housing **40** may be mounted above filter housing **38**. Accordingly, in this embodiment, both of first cleaning stage **22** and motor **20** are indirectly mounted to mounting member **26**.

In another embodiment (not shown), motor housing **40** may be positioned above securing ring **58**, and filter housing **38** may be positioned below securing ring **58**, and motor housing **40** and filter housing **38** may be secured together, for example using screws. Cleaning stage housing **32** may then be mounted below filter housing **38**, for example using screws, and dirt chamber **34** may be mounted below dirt chamber **34**. Accordingly, in this embodiment, motor **20** is directly mounted to mounting member **26**, and cleaning stage housing **22** is indirectly mounted to mounting member **26**. In other embodiments, as previously mentioned, motor **20** may be provided on surface cleaning head **12**. Accordingly, in such embodiments, motor **20** may not be mounted to mounting member **26** at all.

In yet another embodiment, a second cleaning stage (not shown) may be provided, and may be positioned above securing ring **58**. First cleaning stage **22** may be positioned below securing ring **58**, and may be secured to the second cleaning stage.

It will be appreciated that, in alternate embodiments, upper section **14** may have the units arranged in a different order. For example, motor housing **40** need not be provided on top of filtration housing **38**. Instead, motor housing **40** could be provided beneath dirt chamber **34**.

In the above embodiments, dirt chamber **34** is preferably removably mounted to cleaning stage **22**, such that a user may empty dirt chamber **34**. For example, referring to FIGS. **13** and **14**, cleaning stage housing **32** comprises flanges **61** at a lower end thereof which provide slots **60**. Dirt chamber **34** comprises a rim **62**, which may be slidably received in slots **60**. Dirt chamber **34** further comprises a handle **63**, for gripping dirt chamber **34**. In some embodiments, plate **37** may be removable with dirt chamber **34** from surface cleaning apparatus **10** (see for example the embodiment of FIG. **6**). An advantage of this design is that plate **37** defines a partial cover for the dirt collection chamber. Alternately, as shown in the embodiment of FIG. **7**, plate **37** may remain in position when dirt chamber **34** is removed.

One advantage of the embodiments described above is that the volume of the upright vacuum cleaner may be reduced. In particular, in the embodiments shown, a housing is not provided for receiving upper section **14**. That is, the outer surfaces of one or more of cleaning stage **22**, motor housing **40**, filter housing **38**, and dirt chamber **34** may be visible when surface cleaning apparatus is in use (except for the portions facing support member **24**, handle extension **55**, and/or the upflow duct). Accordingly, the overall volume of the vacuum cleaner is reduced. In addition, the weight of the vacuum cleaner is also substantially reduced. In particular, the amount of plastic that is typically used to construct an upper casing of a cyclonic vacuum cleaner that receives a removable cyclone chamber or dirt chamber substantially increases the weight of the vacuum cleaner. In the embodiments shown, surface cleaning apparatus **10** may weigh 10 lbs. or less (without the cord) and, preferably less than 8 lbs.

A further advantage of the embodiments shown is that, if the elements of upper section **14** are removably mounted to each other and to mounting member **26**, the upper section **14** may be easily disassembled for cleaning. In addition, if a component needs to be replaced, the user may merely acquire the required component (e.g. by purchasing it at a store or on line) and replace the faulty component. For example, if motor **20** fails, pursuant to a warranty plan, the manufacturer may merely ship the required motor housing **40** and motor **20** to the customer who may remove (e.g., unscrew) the motor housing **40** having the faulty suction motor **20** and replace it with the new replacement part.

A further advantage of this design is that filter assembly **36** may be accessed for removal (for cleaning or replacement) by disassembling a portion of upper section **14**. For example, in the embodiments of FIGS. **6** and **7**, filter assembly **36** may be accessed by removing motor housing **40** from upper section **14**. Accordingly, a door or the like is not required in filter housing **38**, thereby simplifying the construction of filter housing **38**.

A further advantage of this modular construction is that alternate vacuum cleaners may be created by selecting alternate components for upper section **14** and/or alternate surface cleaning heads **12**. For example, referring to FIG. **8**, a plurality of upright vacuum cleaners may be designed by utilizing alternate motor housings **40**, **40'**, cleaning stage housings **32**, **32'**, dirt chambers **34**, **34'**, and surface cleaning heads **12**, **12'**.

In some embodiments, a plurality of different motor casings **40**, cleaning stage housings **32**, dirt chambers **34**, and cleaning heads **12** are provided. In addition, a plurality of handles **56** may be provided. Accordingly, a plurality of vacuum cleaners having a different appearance may be prepared by selecting particular components. For example, as shown in FIG. **9**, surface cleaning apparatus **10** utilizes the same components as the vacuum cleaner of FIG. **1** except that a different dirt chamber **34** and a different surface cleaning head **12** are utilized. Accordingly, surface cleaning apparatus **10** has a different appearance. Similarly, with respect to FIG. **10**, a different motor housing **40** and surface cleaning head **12** are utilized to create a vacuum cleaner of a different appearance to that of FIG. **1**.

In accordance with another aspect of this invention, which may be use by itself or with any other aspect, an above floor cleaning assembly **64** is provided (see for example FIG. **11**). In this embodiment, surface cleaning apparatus **10** comprises first **16** and second **17** (shown in FIG. **28**) dirty fluid inlets, which are selectively connectable in fluid flow communication with cleaning stage **22**. Surface cleaning apparatus **10** may be converted from a floor cleaning mode (FIGS. **25** and **26**) to an above floor cleaning mode (FIGS. **27**, and **28**) by rotating an airflow valve **66** provided in mounting member **26**. In the floor cleaning mode, valve **66** connects upflow duct **28** to cyclone inlet **23** such that air travels from first dirty fluid inlet **16** in surface cleaning head **12** to cyclone inlet **23**. When valve **66** is rotated to the other position, and handle extension **55** is removed from mounting member **26**, air travels from second dirty fluid inlet **17** through handle extension **55**, to flexible hose **68**, and past valve **66** to cyclone inlet **23**. Accordingly, in this embodiment, the first **16** and second **17** dirty fluid inlets are

respectively in flow communication with first **71** and second **73** airflow passages, which merge at a position proximate the inlet of the first cyclonic cleaning stage **22**. One advantage of this design is that a simplified structure for converting a surface cleaning apparatus **10** to an above cleaning mode is provided. In addition, as valve **66** is provided in mounting member **26**, and therefore a few feet above the floor, then a user need not bend down to rotate valve **66** between the floor cleaning position and the above floor cleaning position. In other embodiments, valve **66** may be affixed to the handle **56** or support member **24**.

In accordance with another aspect of this invention, which may be used by itself or with any other aspect or aspects, surface cleaning apparatus **10** is convertible to a portable surface cleaning apparatus. That is upper section **14** is convertible to a portable cleaning and suction unit. Referring to FIG. **29**, surface cleaning apparatus **10** is provided with a shoulder strap **70**. In order to convert the surface cleaning apparatus **10** to a portable surface cleaning apparatus, the user may unwind shoulder strap **70** and extend it across their shoulder. Upper section **14**, including mounting member **26**, may be removed from support member **24** by, for example, actuating a release catch which secures handle **56** in opening **52**, and lifting upper section **12** off of support member **24** using a handle on top of motor housing **40**. Accordingly, upper section **14** is converted to a portable cleaning and suction unit **14**.

In any of the above embodiments, as exemplified in FIG. **20**, surface-cleaning head **12** includes a rotatably mounted brush **74**. Rotatably mounted brush **74** includes a central hub **76** with a plurality of bristles **78** extending outwardly therefrom. In accordance with this aspect, it is preferred that central hub **76** is at least sufficiently hollow to receive brush drive motor **80** therein. Accordingly, if brush drive motor is non-rotatably mounted in central hub **76**, and if axles **82** are rotatably mounted in bearings in surface cleaning head **12**, then when brush drive motor **80** is engaged, the rotation of brush drive motor **80** will cause brush **74** to rotate. Brush drive motor may be non-rotatably mounted in hub **76** by, e.g., a friction fit, a set screw or an adhesive.

In some embodiments, the vacuum cleaner may be reconfigurable to adapt the vacuum cleaner to collect a different types of particulate matter. For example, it may be desirable to utilize the vacuum cleaner to collect dry wall dust. Accordingly, the vacuum cleaner may be reconfigurable in one of several ways. Referring to FIGS. **22***a*-**22***d*, according to one option, lever **84** is drivingly connected to plate **37** so as to adjust the position of plate **37** with respect to outlet **25**. Accordingly, if the vacuum cleaner is to be utilized to collect standard household dust including dog hair, then the lever **84** may be moved to a first position, which is better suited for collecting such material. However, if the vacuum cleaner is then going to be used to collect, for example, dry wall dust, the lever **84** may be used to a second position wherein plate **37** is at a distance from outlet **25** that is more suited for the collection of dry wall dust. In a particularly preferred embodiment, a scale or labeled positions may be provided on the outer surface of housing **32** to indicate the preferred position of lever **84** for different types of dust. Accordingly, in order to reconfigure surface cleaning apparatus **10** for a particular type of dirt, a user may merely move lever **84** to a pre-marked position. It will be appreciated that lever **84** may operate in a variety of ways, each of which is within the scope of this description. For example, lever **84** may be slidably mounted in a vertical direction so that as lever **84** is moved upwardly or downwardly, plate **37** is also moved upwardly or downwardly. Alternately, a gear or crank mechanism may be utilized such that as lever **84** is moved sideways or rotated, the height of plate **37** is adjusted.

Alternately, it will be appreciated that plate **37** may be removably mounted, either to dirt chamber **34** or cyclone housing **32** (as exemplified in FIG. **22***e*). Accordingly, a plate having a different configuration, e.g., convex as exemplified in FIG. **23**, may re selectively inserted. Alternately, as exemplified in FIG. **23**, a control **90** may be provided which, when actuated, will cause plate **37** to change its configuration. For example, a plurality of cables may extend underneath plate **37** and be connected to a take up reel, which is driven by rotation of control **90**. Accordingly, when control **90** is turned and draws the cable onto the reel, plate **37** will deform to a position shown in FIG. **26**. When control **90** is rotated in the opposite direction, the elasticity of plate **37** will cause it to revert to its original shape (e.g. flat).

In some embodiments, the size of dirt outlet **25** may be variable. For example, as shown in FIGS. **21***a* and **21***b*, an iris **86** may be provided. The size of the opening **25** defined by iris **86** may be controlled by adjustable lever **88**. The outer surface of cyclone housing **32** may have a scale provided thereon, or labeled positions defining the preferred position for lever **88** (and accordingly the size of opening of iris **86**) for different types of dirt.

While the above description provides examples of the embodiments, it will be appreciated that some features and/or functions of the described embodiments are susceptible to modification without departing from the spirit and principles of operation of the described embodiments. Accordingly, what has been described above has been intended to be illustrative of the invention and non-limiting and it will be understood by persons skilled in the art that other variants and modifications may be made without departing from the scope of the invention as defined in the claims appended hereto.

What is claimed is:

1. An upright surface cleaning apparatus operable in an upright configuration, an above floor cleaning configuration and a portable configuration, the upright surface cleaning apparatus comprising:

(a) a surface cleaning head having a first dirty fluid inlet;

(b) a support member moveably mounted to the surface cleaning head;

(c) a cleaning and suction unit removably mounted to the support member and useable when removed from the support member, the cleaning and suction unit comprising a suction motor, a cleaning stage, a flexible hose having an air inlet end and an air outlet end and a hub having an upper section having an opening and a lower section having an opening for removably receiving an end of the support member;

(d) a rigid conduit having an upright section handle, wherein in the floor cleaning configuration, the upright section handle is at an upper end of the rigid conduit and is drivingly connected to the surface cleaning head; and,

(e) a first fluid flow path extending from the first dirty fluid inlet to the hub and a second fluid flow path extending from the hub to a clean air outlet,

wherein, in the upright configuration, an upright assembly is provided that comprises the surface cleaning head, the support member, the rigid conduit and the cleaning and suction unit, and an inlet end of the second fluid flow path is engaged with the opening of the upper section and the support member is received in the opening of the lower section with the opening

of the upper section and the opening of the lower section being substantially aligned with one another,

and, in the above floor cleaning configuration, the second air flow path comprises the rigid conduit positioned upstream from the flexible hose,

and, in the portable configuration, a portable assembly is provided that comprises the cleaning and suction unit.

2. The surface cleaning apparatus of claim **1** wherein the hub is provided on a rear side of the cleaning and suction unit.

3. The surface cleaning apparatus of claim **1** wherein, in the upright configuration, the rigid conduit is received in the opening of the upper section of the hub.

4. The surface cleaning apparatus of claim **1** wherein the support member comprises a rigid up flow duct.

5. The surface cleaning apparatus of claim **1** wherein the cleaning and suction unit is vertically removeable from the support member.

6. The surface cleaning apparatus of claim **1** wherein the support member comprises a rigid up flow duct and the cleaning and suction unit is vertically removeable from the up flow duct.

7. The surface cleaning apparatus of claim **1** wherein the cleaning stage has an air inlet in a side wall thereof.

8. The surface cleaning apparatus of claim **1** wherein, in the floor cleaning configuration, the cleaning and suction unit is spaced from an upper surface of the surface cleaning head.

9. An upright surface cleaning apparatus operable in an upright configuration, an above floor cleaning configuration and a portable configuration, the upright surface cleaning apparatus comprising:

(a) a surface cleaning head having a first dirty fluid inlet and a support member moveably mounted to the surface cleaning head between an upright storage position and a reclined in use position;

(b) a cleaning and suction unit removably mounted to the surface cleaning head and useable when removed from the surface cleaning head, the cleaning and suction unit comprising a hub, a suction motor and a cleaning stage, the cleaning stage being removable from the cleaning and suction unit for emptying when the cleaning and suction unit is mounted to the support member, wherein the support member terminates below an upper end of the cleaning and suction unit when the support member is in the upright storage position and the cleaning and suction unit is mounted to the support member;

(c) a rigid conduit having an upright section handle, wherein in the floor cleaning configuration, the upright section handle is at an upper end of the rigid conduit and is drivingly connected to the surface cleaning head; and,

(d) a first fluid flow path extending from the first dirty fluid inlet to the hub and a second fluid flow path extending from the hub to a clean air outlet,

wherein the hub provides an interface for the rigid conduit and the support member, the support member is removably receivable in a lower end of the hub and a lowermost end of the rigid conduit is removably receivable in the hub and, when the rigid wand and the support member are received in the hub, the support member is longitudinally aligned with the rigid conduit, and

wherein, in the upright configuration, the cleaning and suction unit is mounted to the surface cleaning head with the cleaning and suction unit spaced from an upper surface of the surface cleaning head, the upright section handle is drivingly connected to the surface cleaning head, an inlet end of the rigid conduit is received in the hub and the support member is received in the hub and the rigid conduit is spaced from the support member,

and, in the above floor cleaning configuration, the second air flow path comprises the rigid conduit positioned upstream from the flexible hose,

and, in the portable configuration, a portable assembly is provided that comprises the cleaning and suction unit.

10. The surface cleaning apparatus of claim **9** wherein the hub is provided on a rear side of the cleaning and suction unit.

11. The surface cleaning apparatus of claim **9** wherein, in the upright configuration, the rigid conduit is received in an upper opening of the hub.

12. The surface cleaning apparatus of claim **9** wherein the support member comprises a rigid up flow duct.

13. The surface cleaning apparatus of claim **9** wherein the cleaning and suction unit is vertically removeable from the support member.

14. The surface cleaning apparatus of claim **9** wherein the support member comprises a rigid up flow duct and the cleaning and suction unit is vertically removeable from the up flow duct.

15. The surface cleaning apparatus of claim **9** wherein the cleaning stage has an air inlet in a side wall thereof.

16. A surface cleaning apparatus comprising:

(a) a surface cleaning head having a first dirty fluid inlet and an up flow duct extending along a duct axis and fluidly connected downstream from the first dirty air inlet;

(b) a cleaning and suction unit comprising a cleaning stage, a suction motor fluidly connected downstream from the cleaning stage, a clean air outlet fluidly connected downstream from the suction motor and a hub having a lower opening and an upper opening, the cleaning and suction unit being removably mounted to the surface cleaning head and usable when removed from the surface cleaning head, the up flow duct is received in the lower opening of the hub when the cleaning and suction unit is mounted to the surface cleaning head; and,

(c) a rigid above floor cleaning wand extending along a wand axis and having an upstream end that is removably mounted to the cleaning and suction unit and a downstream end that is axially spaced apart from the upstream end and includes a handle;

wherein the surface cleaning apparatus is operable in:

(i) a floor cleaning mode in which the cleaning and suction unit is supported by the up flow duct being received in the lower opening of the hub, the cleaning stage is in fluid communication with the first dirty fluid inlet and the above floor cleaning wand is mounted to the cleaning and suction unit so that the wand axis is coaxial with the up flow duct axis and the handle is drivingly connected to the surface cleaning head;

(ii) an above floor cleaning mode in which the cleaning and suction unit is mounted on the surface cleaning head, the up flow duct is received in the lower opening, the upstream end of the wand is removed from the cleaning and suction unit and functions as a second dirty fluid inlet that is in fluid communication with the cleaning stage via a flexible hose; and,

(iii) a portable mode in which the cleaning and suction unit is removed from the surface cleaning head.

17. The surface cleaning apparatus of claim **16** wherein, the upstream end of the rigid conduit is removably receivable in the upper opening of the hub.

18. The surface cleaning apparatus of claim **17** wherein, in the floor cleaning configuration, the cleaning and suction unit is spaced from an upper surface of the surface cleaning head.

19. The surface cleaning apparatus of claim **16** wherein the hub is provided on a rear side of the cleaning and suction unit.

20. The surface cleaning apparatus of claim **16** wherein the cleaning and suction unit is vertically removeable from the support member.

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