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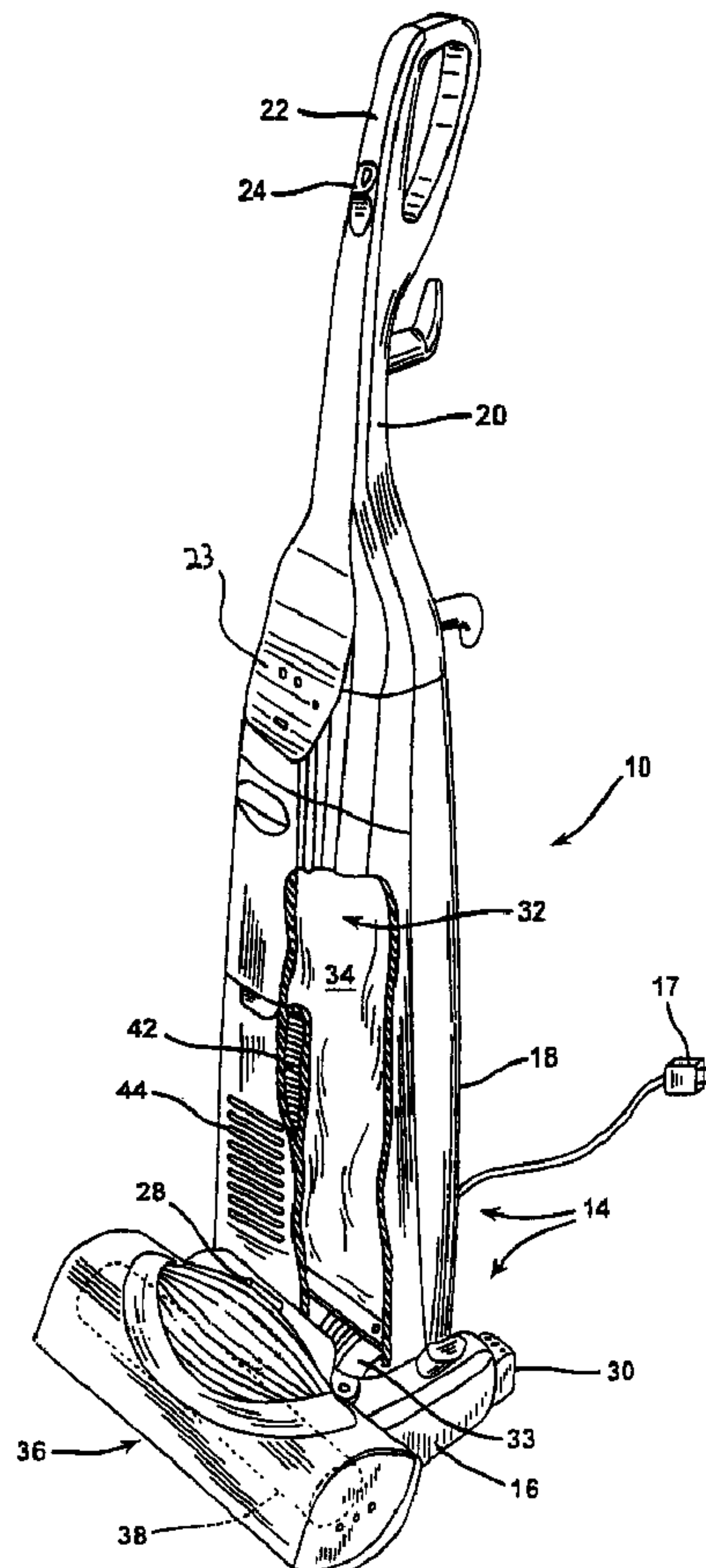
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(54) Titre : ENSEMBLE FILTRE AUTO-NETTOYANT AVEC SIGNAL D'ACTIVATION POUR APPAREIL DE NETTOYAGE
DE PLANCHER

(54) Title: SELF-CLEANING FILTER ARRANGEMENT WITH ACTIVATION SIGNAL FOR FLOOR CARE APPARATUS



(57) Abrégé/Abstract:

A floor care apparatus has a filter with an intake and out take. A first pressure sensor is arranged on the intake while a second pressure sensor is arranged on the out take. A controller connects to the sensors to receive signals indicative of relative pressure.



(57) **Abrégé(suite)/Abstract(continued):**

Whenever a predetermined pressure differential between the signals is achieved, an undesirable load on the filter is deemed occurred and initiation of a self-cleaning of the filter begins. In this manner, filter cleaning only occurs on an as-needed basis and user intervention is avoided, thereby adding convenience. The controller is also able to ascertain a clogged airway condition. Various features contemplate pressure sensor signals arranged to scale suction as positive pressures, meeting the predetermined pressure differential at other than a maximum pressure differential between the first and second pressure sensors, and scaling the predetermined pressure differential relative to the maximum pressure differential.

Abstract of the Disclosure

A floor care apparatus has a filter with an intake and out take. A first pressure sensor is arranged on the intake while a second pressure sensor is arranged on the out take. A controller connects to the sensors to receive signals indicative of relative pressure. Whenever a predetermined pressure differential between the signals is achieved, an undesirable load on the filter is deemed occurred and initiation of a self-cleaning of the filter begins. In this manner, filter cleaning only occurs on an as-needed basis and user intervention is avoided, thereby adding convenience. The controller is also able to ascertain a clogged airway condition. Various features contemplate pressure sensor signals arranged to scale suction as positive pressures, meeting the predetermined pressure differential at other than a maximum pressure differential between the first and second pressure sensors, and scaling the predetermined pressure differential relative to the maximum pressure differential.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE,
A Utility Patent Application

for

**SELF-CLEANING FILTER ARRANGEMENT WITH
ACTIVATION SIGNAL FOR FLOOR CARE APPARATUS**

by

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Technical Field

The present invention relates generally to the floor care field. More particularly, it relates to a floor care apparatus, such as a canister or upright vacuum cleaner, having a self-cleaning filter and arrangement therefor. Particular aspects relate to activation of signals initiating self-cleaning,
5 without user intervention, and doing so only on an as-needed basis.

Background of the Invention

Whether canister or upright, vacuum cleaners in all of their designs and permutations have become increasingly popular over the years. In general,
10 vacuum cleaners incorporate a suction fan motor, attendant dirt cup or dust

bag and a nozzle assembly fluidly and mechanically connected to one another that suck up dirt and dust during operator movement across a dirt-laden floor. Specifically, an agitator within the nozzle assembly rotates to beat the nap of a carpet and dislodge dirt and dust during a time when an operator manipulates the cleaner back and forth. Dirt and dust then enter the cleaner and flow in an airstream toward the motor. Upstream of the motor, the dust and air are separated and particles are trapped in the dirt cup or dust bag. Upon filling, the dirt cup or dust bag can be emptied or discarded and the process repeated.

While dirt cups allow users to visually inspect whether the cup is full and requires dumping, filters associated with the cups become saturated with fine particles during filling. Over time, such fine particles restrict airflow and reducing cleaning efficiency of the vacuum cleaner. Eventually the cleaning efficiency of the vacuum cleaner becomes so impaired it is necessary for the operator to either clean or replace the filter in order to achieve the desired level of cleaning. However, filter cleaning and replacement requires manual user intervention, and both can be messy. Filter cleaning performed unnecessarily also acts to prematurely fail the filter material.

Accordingly, the floor care arts have need of simple, yet effective, arrangements for truly self-cleaning filters that minimize or eliminate user involvement. They should also only operate when necessary to extend filter service life and increase cleaning efficiency. Naturally, any improvements

should further contemplate good engineering practices, such as relative inexpensiveness, stability, ease of implementation, low complexity, etc.

Summary of the Invention

5 In accordance with the purposes of the present invention as described herein, an improved floor care apparatus is provided. The apparatus may take the form of a canister or an upright vacuum cleaner or may embody an extraction cleaning device or other hereinafter developed product. In this regard, the present invention relates to a vacuum cleaner, extractor or the like
10 equipped with a more efficient and effective filter cleaning mechanism. Advantageously, the present invention allows for the quick and easy automatic cleaning of dirt and debris from a filter including particularly fine particles from the pores of the filter. As a result each filter has a longer service life and the apparatus may be operated at a higher cleaning efficiency
15 over the entire length of that extended service life.

 In one embodiment, a floor care apparatus has a filter with an intake and out take. A first pressure sensor is arranged on the intake while a second pressure sensor is arranged on the out take. A controller connects to the sensors to receive signals indicative of relative pressure. Whenever a
20 predetermined pressure differential between the signals is achieved, an undesirable load on the filter is deemed having occurred and initiation of a self-cleaning of the filter begins. In this manner, filter cleaning only occurs on an as-needed basis and user intervention is avoided, thereby adding

convenience. The controller is also able to ascertain a clogged airway condition. Various features contemplate pressure sensor signals arranged to scale suction as positive pressures, meeting the predetermined pressure differential at other than a maximum pressure differential between the first
5 and second pressure sensors, and scaling the predetermined pressure differential relative to the maximum pressure differential.

In other embodiments, the controller operates with a visual indicator to indicate a self-cleaning operation or clogged airway condition. Pressure sensors also typify diaphragms, transducers, or the like. Filters are of the type
10 found in dirt cups of bagless vacuum cleaners or other.

In the following description there is shown and described possible embodiments of the invention, simply by way of illustration of one of the modes best suited to carry out the invention. As it will be realized, the invention is capable of other different embodiments, and its several details are
15 capable of modification in various, obvious aspects all without departing from the invention. Accordingly, the drawings and descriptions will be regarded as illustrative in nature and not as restrictive.

Brief Description of the Drawings

20 The accompanying drawings incorporated in and forming a part of the specification, illustrate several aspects of the present invention, and together with the description serves to explain the principles of the invention. In the drawings:

Figure 1 is a perspective view of a floor care apparatus, in this instance an upright vacuum cleaner with dust bag, constructed in accordance with the teachings of the present invention;

5 Figure 2 is a perspective view of a floor care apparatus, in this instance a canister vacuum cleaner, constructed in accordance with the teachings of the present invention;

Figure 3 is a perspective view of a floor care apparatus, in this instance an upright vacuum cleaner with dirt cup, constructed in accordance with the teachings of the present invention;

10 Figure 4 is a cross-sectional view of the dirt cup of Figure 3;

Figure 5 is a diagrammatic view of an arrangement of sensors on a bag mount;

Figure 6 is a detailed top perspective view of a filter assembly;

15 Figure 7 is a graph of suction variation regarding the sensors of Figures 4 and 5; and

Figure 8 is a diagrammatic and circuit view of a representative embodiment of a controller and visual indicator for a self-cleaning filter arrangement.

20 Detailed Description of the Illustrated Embodiments

In the following detailed description of the illustrated embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration, specific embodiments in which the

invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention and like numerals represent like details in the various figures. Also, it is to be understood that other embodiments may be utilized and that process, mechanical, electrical, arrangement, software and/or other changes may be made without departing from the scope of the present invention. In accordance with the present invention, methods and apparatus for self-cleaning floor care apparatus and attendant control, including activation signal, are hereinafter described.

Reference is now made to Figure 1 showing a floor care apparatus of the present invention. The apparatus illustrated exemplifies an upright vacuum cleaner 10 comprised generally of a housing 14 that comprises the nozzle assembly 16 and the canister assembly 18. The canister assembly 18 further includes the handle 20 and the hand grip 22 for maneuvering the cleaner during use. The hand grip 22 carries a control switch 24 for turning the vacuum cleaner 10 on and off while electrical power is supplied from a standard electrical wall outlet through a cord and plug assembly 17. The handle 20, among other things, carries a visual indicator 23 of sorts to indicate a self-clean, replace filter or clogged airway condition as will be described below. At the lower portion of the canister assembly 18, rear wheels (not shown) are provided to support the weight of the vacuum cleaner 10. A second set of wheels (not shown) allow the operator to raise and lower the nozzle assembly 16 through selective manipulation of a height adjustment

switch 28. To allow for convenient storage of the vacuum cleaner 10, a foot latch 30 functions to lock the canister assembly 18 in an upright position, as shown in Figure 1. When the foot latch 30 is released, the canister assembly 18 may be pivoted relative to the nozzle assembly 16 as the vacuum cleaner 10 is manipulated to clean the floor.

Also, the canister assembly 18 carries an internal chamber 32 that houses a suction generator or fan motor 33 (i.e. a state of the art fan and motor combination) and a dust bag 34 for removing dirt or dust entrained in the air stream as it passes in an airflow path from the nozzle assembly 16 to the suction fan motor. During use, the suction fan motor 33 creates the suction airflow in a well known manner.

In the nozzle assembly 16, a nozzle and agitator cavity 36 houses an agitator 38. The rotary scrubbing action of the agitator 38 and the negative air pressure created by the suction fan motor 33 cooperate to brush and beat dirt and dust from the nap of the carpet being cleaned and then draw the dirt and dust laden air from the agitator cavity 36 to the dust bag 34. Specifically, the dirt and dust laden air passes serially through a suction inlet and hose (not shown) and/or an integrally molded conduit in the nozzle assembly 16 and/or canister assembly 18 as is known in the art. Next, it is delivered into the chamber 32 and passes through the porous walls of the dust bag 34. The bag 34 serves to trap the suspended dirt, dust and other particles inside while allowing the now clean air to pass freely through the wall thereof. Clean air

then flows through the suction fan motor 33, final filtration cartridge, including filter 42, and to the environment through the exhaust port 44.

With reference to Figure 2, a floor care apparatus of the present invention in this embodiment exemplifies a canister vacuum cleaner 210
5 comprised generally of a base assembly 212 and a nozzle assembly 214. Although not shown, the base assembly contains a suction fan motor that cooperates with an agitator 216 in the nozzle assembly for sucking up dirt and dust in the manner previously described for the upright cleaner. A wand 218 mechanically and fluidly connects to the nozzle assembly and facilitates the
10 sucking up of dirt and dust. In various embodiments, it comprises a unitary, telescopic or connecting section of pipe. Near the base assembly, a hose 220, flexible for user manipulation, connects thereto and likewise facilitates cleaning. Finally, a handle 230 having ends 217, 219 connects mechanically and fluidly to both the wand 218 and the hose 220 and enables an airflow path
15 between the nozzle assembly and the suction fan motor of the base assembly.

In either floor care apparatus embodiment, the cleaners have a dust bag and filter within a housing configured to enable the indication to users of a replace filter, cleaning of filter required, or clogged airway condition during use.

20 With reference to Figure 3, a floor care apparatus of the present invention in this embodiment exemplifies another upright vacuum cleaner 10 including a housing 14 with both a nozzle assembly 16 and a canister assembly 18, as before. In addition, the canister assembly 18 includes a cavity

or receiver 64 for receiving and holding a dirt cup or collection vessel 50. The dirt cup is removable in the cavity and when full, upon visual inspection, users pull the dirt cup from the cavity and empty its contents.

5 The operation of the airflow through the dirt cup 50 will now be described in greater detail with reference to Figure 4. During normal vacuum cleaner operation, the suction generator draws air from the suction inlet through the dirt cup 50 where dirt and debris is trapped and then exhausts clean air from the exhaust port. As the vacuum cleaner continues to operate, fine dirt particles not removed from the airstream by the cyclonic action in the
10 annular space S is stripped from the airstream and trapped by filter media 62 of a filter 52. The filter 52 may include a sidewall 54, a hub 56 and multiple partitions 58 extending between the hub and the sidewall (see Figure 6). The partitions serve to divide the filter 52 into multiple sections 60. Over time, these fine dirt particles begin to close off the pores in the filter media 62
15 thereby restricting airflow. This not only causes the motor of the suction generator to run hotter and at a lower efficiency, it also reduces airflow thereby adversely affecting the cleaning efficiency of the vacuum cleaner. Consequently, the airflow may become so restricted as to prevent the vacuum cleaner from cleaning properly. It is then necessary to either clean or replace
20 the filter 52.

The present invention, in one aspect, allows the filter 52 to be self-cleaned *in situ* in a very convenient and efficient manner. Specifically, with reference to Figure 4, a stepper motor may be activated to rotate an air guide

86 through various arcs by means of attendant meshing drive gears 80, 82. This functions then to rotate the air guide 86 so that the outlet 90 thereof is exactly aligned over or in registration with one of the sections 60 of the filter 52. In this manner, the suction generator draws clean air through the inlet 88
5 of the air guide 86 and then directed by the outlet 90 thereof through the single individual section 60 of the filter 52 with which the outlet is aligned. Since the clean air is moving through the selected section 60 of the filter 52 in a direction opposite that of normal operation, dirt (and particularly fine dirt from the pores of the filter), is forced from or blown out of the filter media 62.
10 For a further description of this technology, reference is taken to U.S. Patent Application Serial No. 11/633,902, incorporated herein, in its entirety, by reference. Alternatively, however, other self-cleaning filters contemplate various mechanical shaking, flicking, beating, etc., of filter material to shake loose entrenched dirt and debris. In either, the cleaning cycle may last, for
15 example, from about 1 to about 30 seconds and more typically from about 3 to about 15 seconds. Section-by-section cleaning of the filter can also be filter wide cleaning and still be embraced within the invention.

With reference to Figure 4, the dirt cup 50 includes sensors P_A , P_B to determine undesirable loads on the filter, thereby indicating a dirty filter
20 requiring cleaning, especially self-cleaning, or a clogged airway somewhere else in the cleaner. Figure 4 shows the sensors P_A , P_B arranged about the filter

62. In this configuration, the sensor P_A is positioned in a pre-filter location, directly upstream of the filter, while the sensor P_B is positioned in a post-filter location, directly downstream of the filter. The sensors P_A , P_B may be attached to the dirt cup 50 (e.g., to walls of the dirt cup), to the filter 52, or otherwise positioned in the dirt cup 50. The sensors may take the form of diaphragms, pressure transducers, or the like, having electrical output signals indicative of a measured or observed pressure. They may also embody a type to sense strain/force of air pressure (differential, absolute and/or combinations). The sensors P_A , P_B may also be used in a vacuum cleaner including a dust bag, such as the cleaners of Figures 1 and 2. Figure 5 shows the sensors P_A , P_B positioned on a bag mount 506. As shown, sensor P_A is positioned upstream of a dust bag (not shown), while sensor P_B is positioned downstream of the bag. These sensors may take the form of pressure ports having small, flexible vacuum tubes that connect the ports to a transducer. Of course, the sensors P_A , P_B may take any form and location, other sensors and other locations are also contemplated.

In Figure 8, each of the pressure sensors P_A , P_B are connected to a processor 81. Examples of preferred processors include, but are not limited to, microprocessor(s), application specific integrated circuit(s) (ASIC), software or other programming, or the like. Regardless of type, the processor is configured to sort a relative difference between each of the signals of the sensors and appropriately provide signals to initiate self-cleaning 83 and to power a visual indicator or display 23 to show the filter self-cleaning or a

clogged airway condition. In this regard, the processor is configured with varieties of external power supplies (V_{cc}), clock signals (Clock), resistors R , transistors (not shown), etc. to drive a visual indicator 23. In one instance, the visual indicator is a segmented display having two segments, one each for
 5 self-clean and clog that light to show various status of the cleaner.

Also, the sorting of relative differences between signals of the pressure sensors may be further enhanced via comparison to a reference pressure P_R stored, for example, as a single or table of values in an attendant memory M . In this regard, reference pressures include, but are not limited to, an ambient
 10 pressure external to the floor care apparatus, a minimum pressure that must be overcome before providing any visual indications to users, or boundary conditions that must be satisfied. The memory also contemplates resetting functionality that occurs when users empty dirt cups, replace full dust bags with new, empty ones, or clean or replace filters.

15 In other embodiments, Figure 7 shows the relationship between the sensors and how this is used to initiate a self-cleaning of the filter, such as by the signal labeled self-clean emanating from the controller 81 in Figure 8. Namely, the controller is programmed to recognize a prescribed magnitude $\Delta P'$ as the signal representing a "filter undesirably loaded" or a "filter needs
 20 cleaning" condition. Upon recognizing this condition, the controller initiates the self-cleaning function, previously described. The $\Delta P'$, however, need not be a true maximum ΔP_{max} between P_{Amax} and P_{Bmin} , as shown. That is, $\Delta P'$ can be a value of about half to three-fourths, or so, or any percentage of the ΔP_{max}

proven optimal to maintain an adequate average airflow (e.g., suction). In other words, waiting until the filter is fully dirty or the dust bag is completely full/saturated may lead to prolonged reduction in suction and/or suction motor damage.

5 It should also be understood that due to pressure sensor P_A , Figures 4 and 5, being installed immediately prior to (upstream from) the filter or bag, a clog occurring anywhere in an airway (especially in airway hoses or housing conduits) therefore upstream from both sensors P_A and P_B , causes a spike in the pressure at P_A and P_B , minimizing the pressure differential, given as $\Delta P_{\min}$.
 10 In this way, two contrasting signals, $\Delta P'$ and $\Delta P_{\min}$, distinguish between self-cleaning of the filter and a clogged airway condition, respectively. Upon recognition of the latter, the controller would activate the visual display 23 indicating a clog and that such must or should be cleared. However, boundary conditions must be further established to differentiate $\Delta P_{\min}$ and $\Delta P_{\min}$ where
 15 pressure differential at the beginning of filter loading may actually be less. One way to accomplish this is to define a pressure level P_C which both P_A and P_B must simultaneously exceed during a clogged airway condition or sealed suction. P_R in Figure 7 can also set this P_C value. A lower limit on electrical current would also distinguish between $\Delta P_{\min}$ and $\Delta P_{\min}$ as motor amp draw
 20 at the clog condition would be a minimum. In the graph, it will be noticed that it is preferred to scale suction of the floor care apparatus as positive pressures and do so in a relative range, such as between 0 to about 3 psi.

Grams woodflour represents the other axis and preferably ranges from 0 to about 1800. Of course, other scales and arrangements are possible.

The foregoing was chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby
5 enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally and equitably
10 entitled. Relatively apparent modifications, of course, include combining the various features of one or more figures with the features of one or more of other figures.

In the Claims

1. A floor care apparatus, comprising:
a filter with an intake and out take; and
a first pressure sensor arranged on the intake and a second pressure sensor arranged on the out take, wherein a predetermined pressure differential between the first and second pressure sensors indicates an undesirable load on the filter and causes activation of a signal to initiate a self-cleaning of the filter.
5
2. The floor care apparatus of claim 1, wherein a controller responds to the predetermined pressure differential between the first and second sensors and causes the activation of the signal.
3. The floor care apparatus of claim 2, wherein the controller distinguishes between the signal to initiate the self-cleaning of the filter and a clogged airway.
4. The floor care apparatus of claim 1, further including a visual display identifying the self-cleaning of the filter.

5. The floor care apparatus of claim 3, further including a visual display identifying the clogged airway.

6. The floor care apparatus of claim 3, wherein the controller distinguishes between the signal to initiate the self-cleaning of the filter and the clogged airway by comparison to a predetermined threshold.

7. The floor care apparatus of claim 1, wherein the filter is disposed in a dirt cup.

8. The floor care apparatus of claim 1, wherein the first and second pressure sensors are both arranged to sense suction of the floor care apparatus as positive pressures.

9. The floor care apparatus of claim 1, wherein the predetermined pressure differential is a pressure differential other than a maximum pressure differential between the first and second pressure sensors.

10. The floor care apparatus of claim 9, wherein the pressure differential other than the maximum pressure differential is in a range from about one-half to about three-quarters percent of the maximum pressure differential.

11. The floor care apparatus of claim 1, wherein the filter is not a dust bag.

12. A floor care apparatus, comprising:

a filter with an intake and out take;

5 a first pressure sensor arranged on the intake and a second pressure sensor arranged on the out take, both the sensors providing a signal indicative of pressure; and

a controller in receipt of the signals from the sensors, wherein a predetermined pressure differential between the signals indicates an undesirable load on the filter and causes activation of another signal to initiate a self-cleaning of the filter, the controller able to distinguish between the signals from the sensors to either initiate the self-cleaning of the filter or to
10 indicate a clogged airway condition.

13. The floor care apparatus of claim 12, wherein the first and second pressure sensors are both arranged to scale suction of the floor care apparatus as positive pressures in a range between 0 and about 3 psi.

14. The floor care apparatus of claim 12, wherein the predetermined pressure differential is a pressure differential other than a maximum pressure differential between the first and second pressure sensors.

15. The floor care apparatus of claim 14, wherein the pressure differential other than the maximum pressure differential is in a range from about one-half to about three-quarters percent of the maximum pressure differential.

16. The floor care apparatus of claim 12, further comprising a visual indicator to indicate a self clean, replace filter, or clogged airway condition.

17. A method of using a floor care apparatus, comprising:
providing a filter with an intake and an out take;
arranging a first pressure sensor on the intake and a second pressure sensor on the out take;
5 determining a pressure differential between the first and second pressure sensors; and
initiating a self-cleaning of the filter based on the determining.

18. The method of claim 17, wherein the initiating the self-cleaning occurs when the pressure differential reaches a predetermined value.

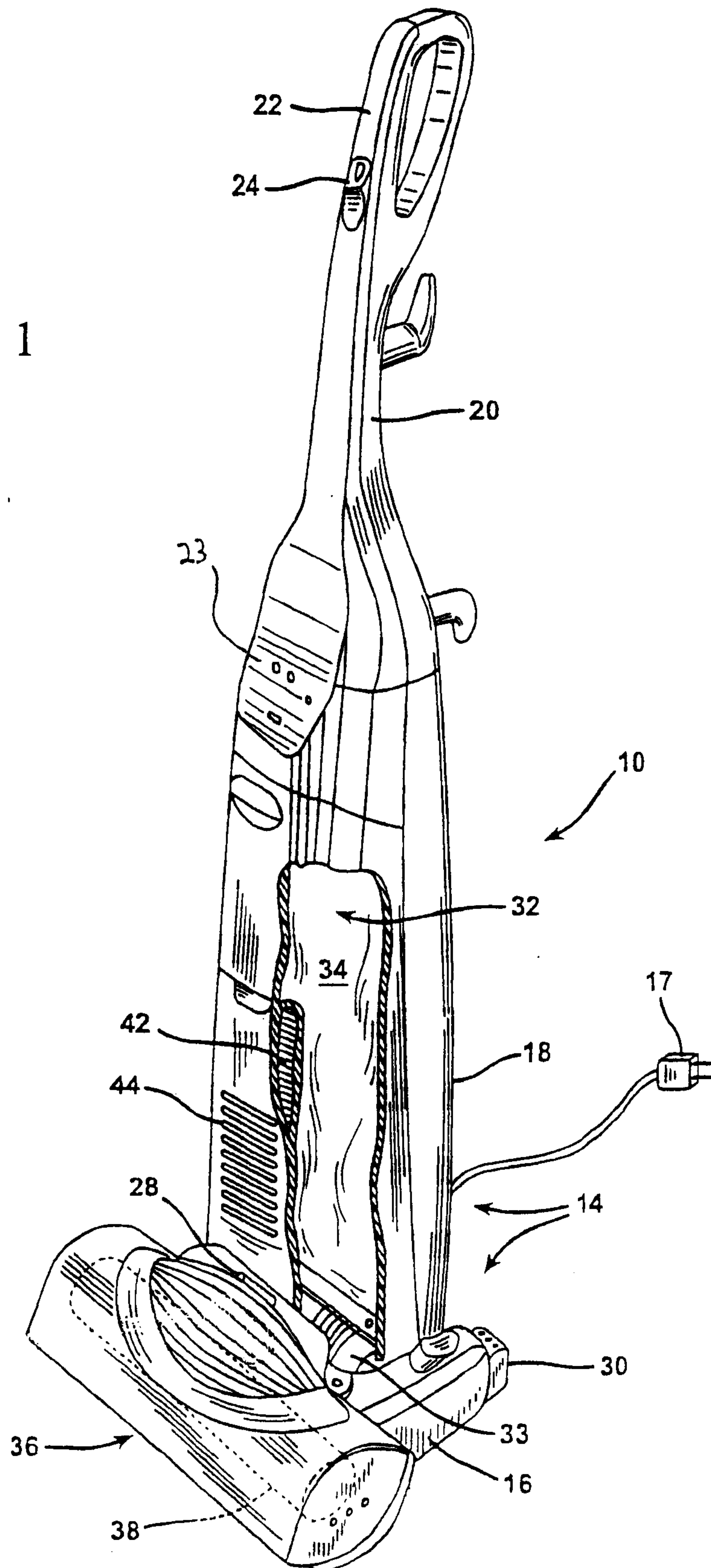
19. The method of claim 18, further including connecting a controller to the first and second pressure sensors for ascertaining whether the pressure differential reaches the predetermined value.

20. The method of claim 17, wherein the determining further includes calculating a maximum pressure differential.

21. The method of claim 17, further including ascertaining a clogged airway condition.

22. The method of claim 17, further including providing a visual indicator to indicate a self clean, replace filter, or clogged airway condition.

FIG. 1



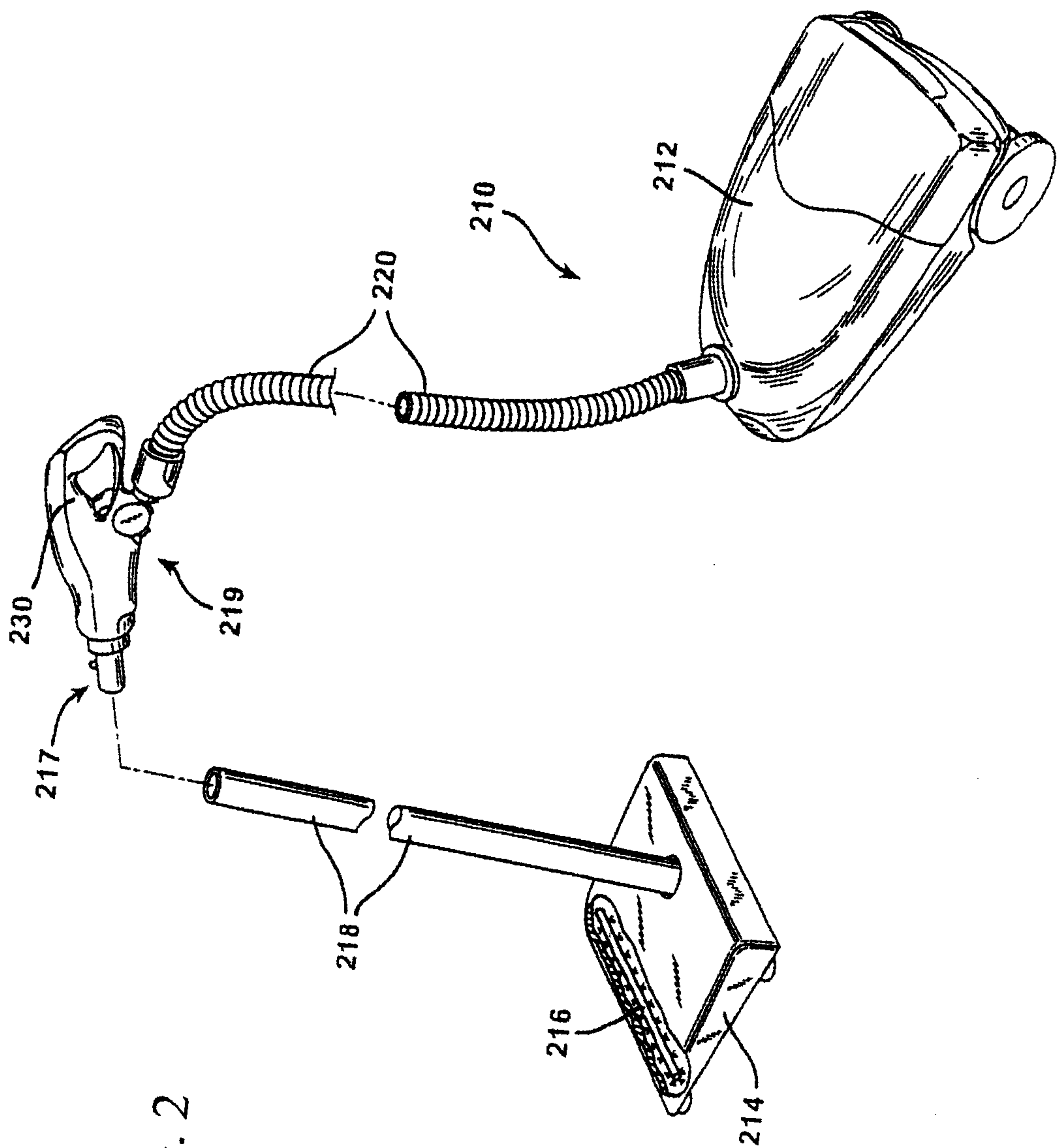
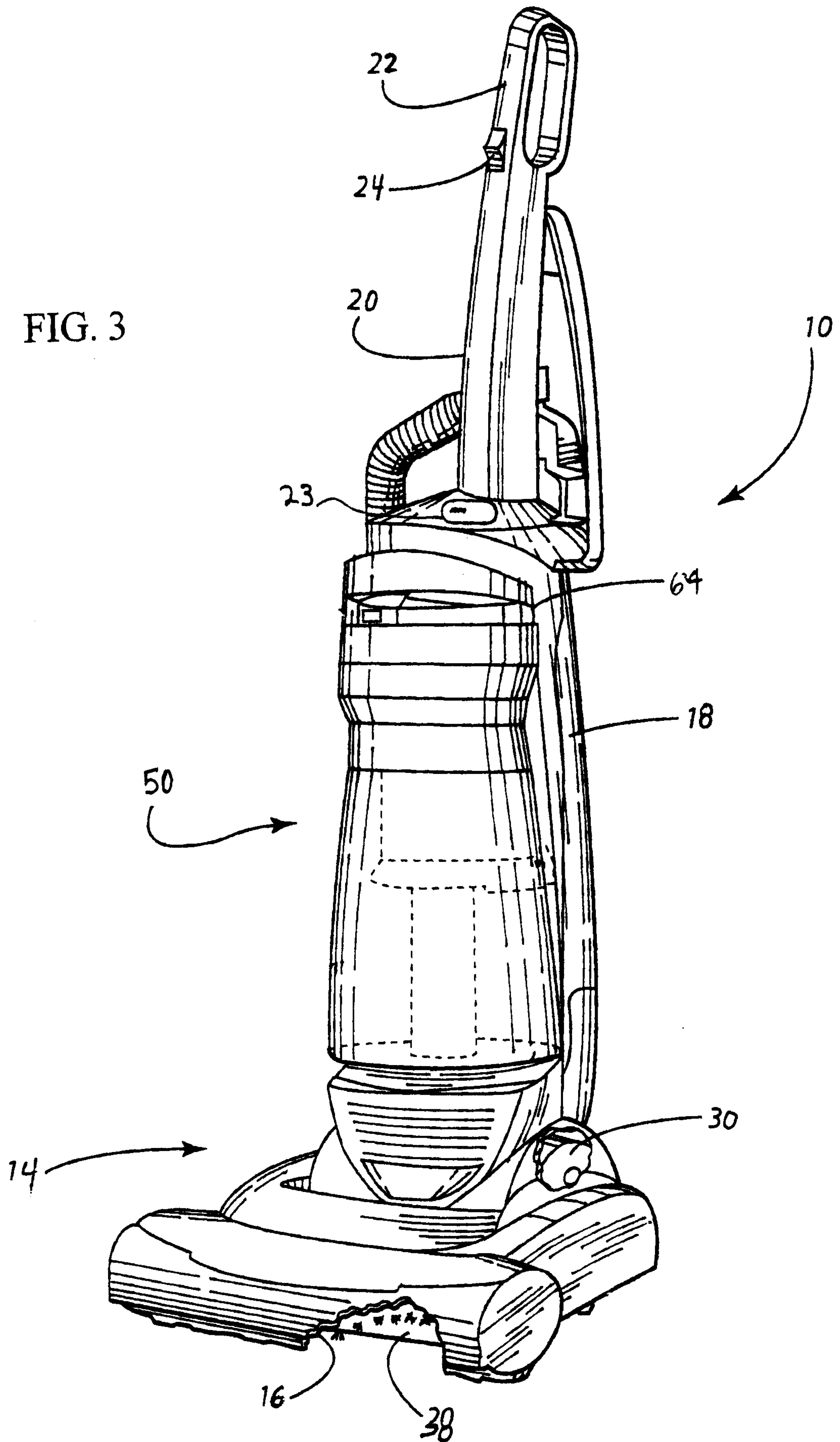


FIG. 2

FIG. 3



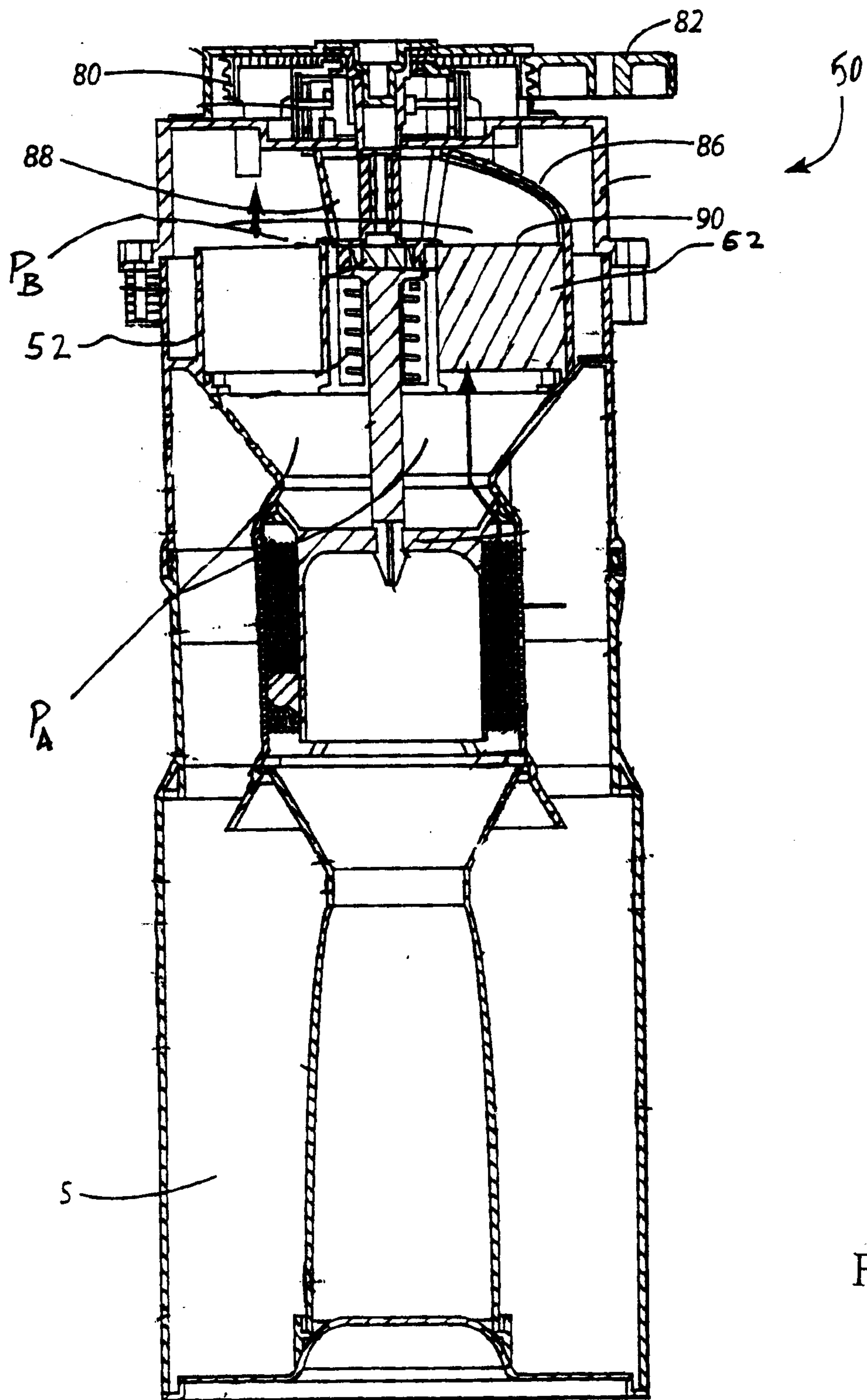


FIG. 4

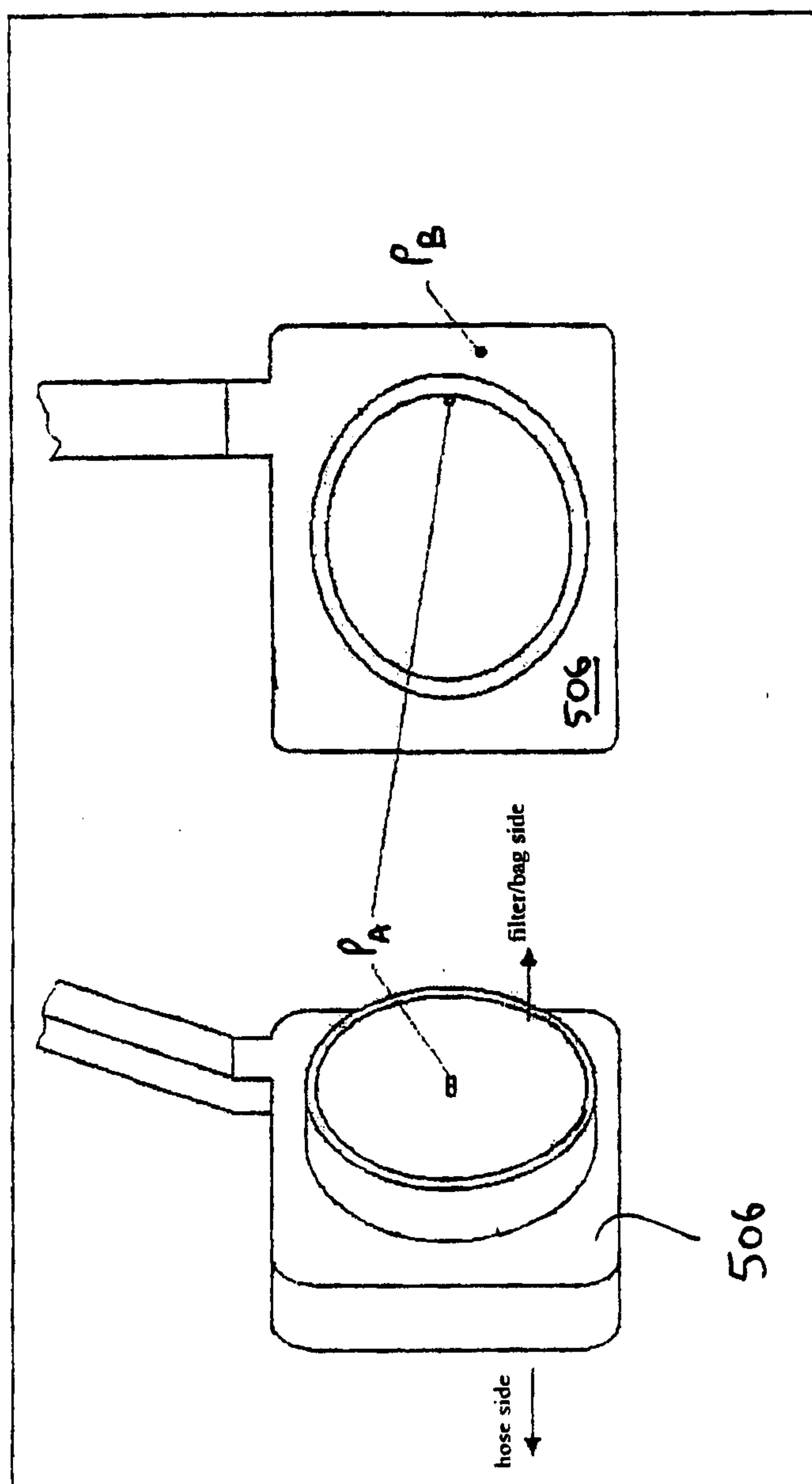


FIG. 5

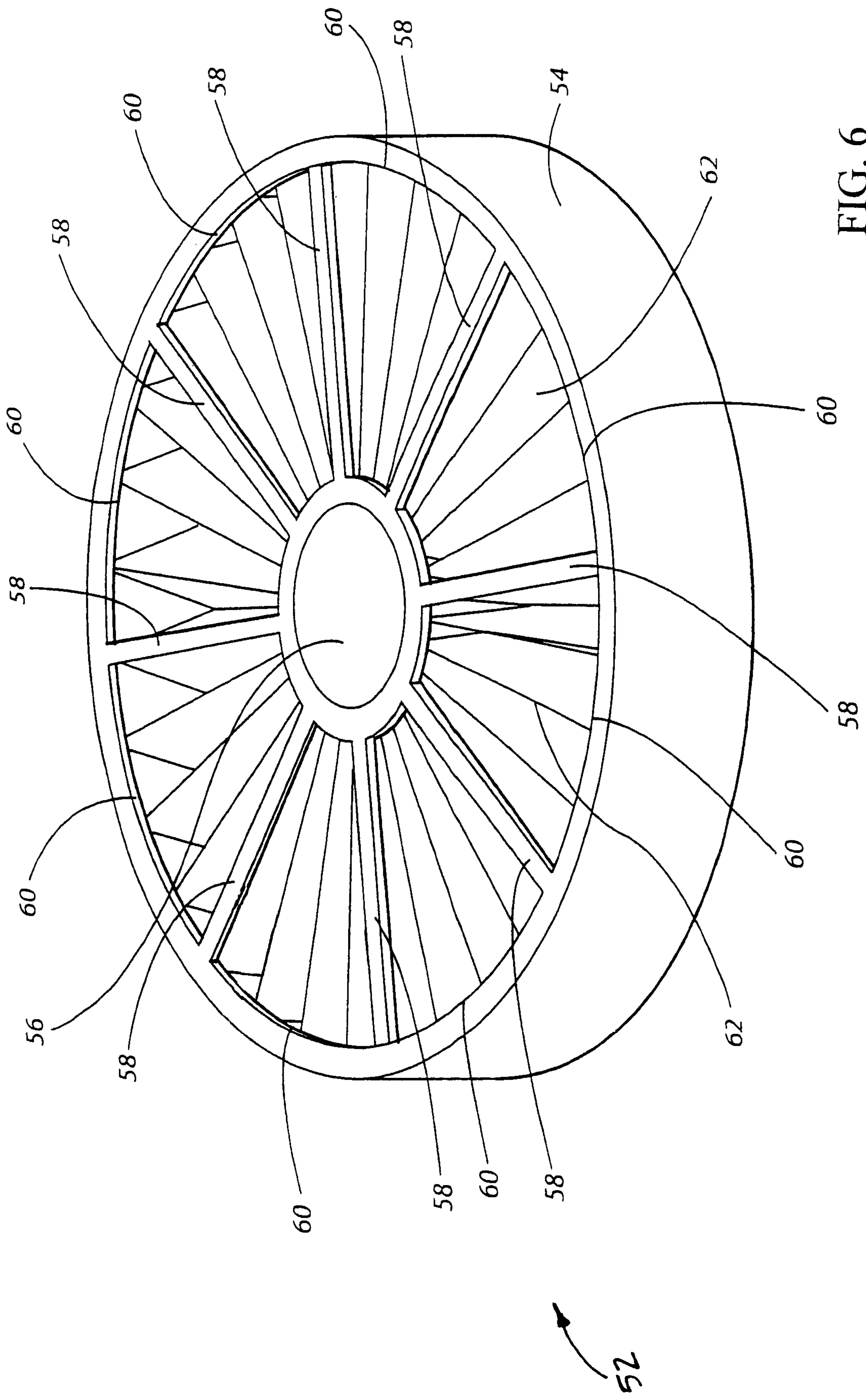


FIG. 6

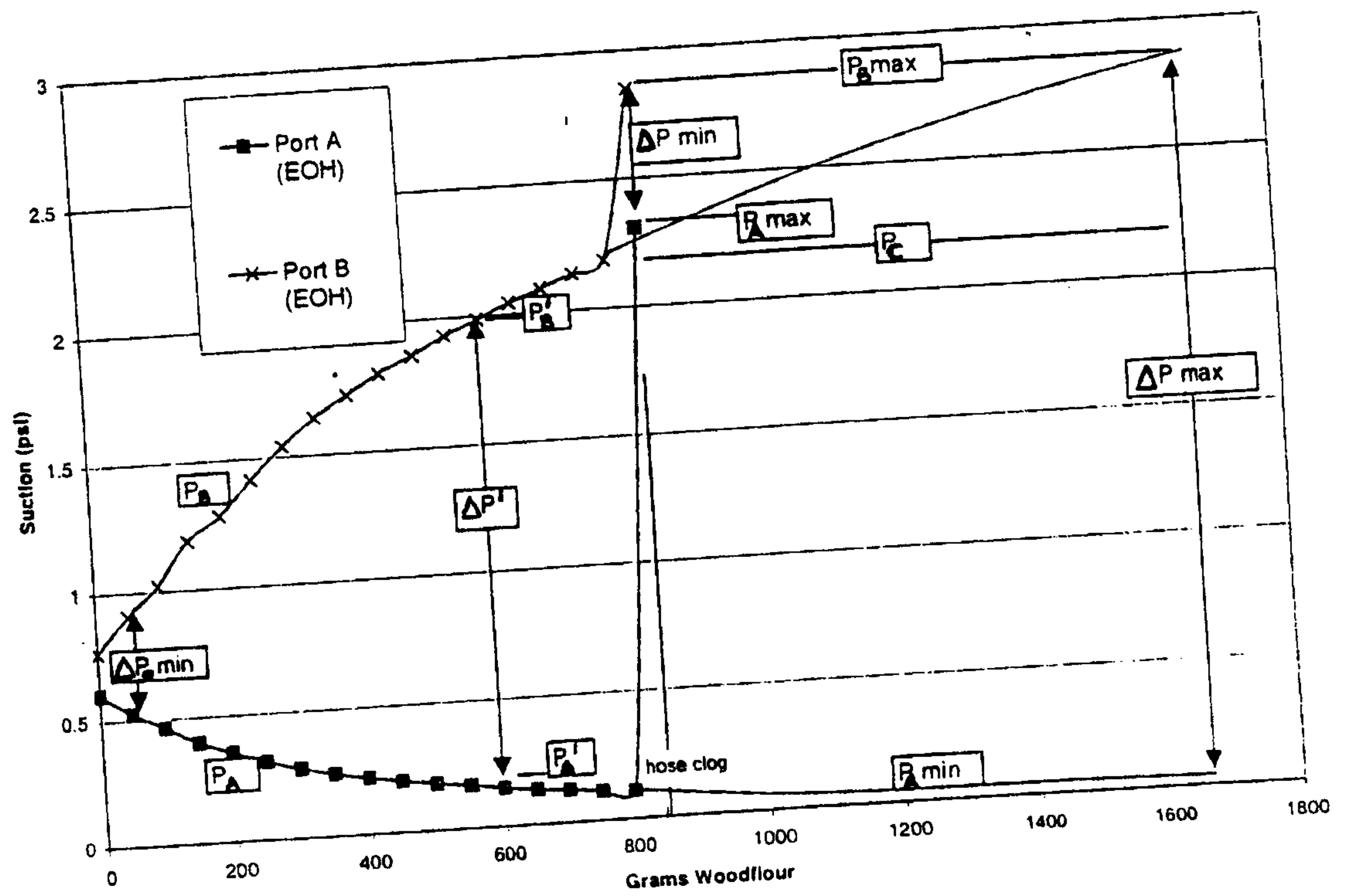


FIG. 7

FIG. 8

