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(71) Applicant: LG Electronics Inc.

Seoul City (KR)

(72) Inventors:

- Yang, Byeong-Sun
Changwon City
Gyeongsangnam-do, 641-774 (KR)
- Jung, Jae-Duck
Changwon City,
Gyeongsangnam-do 641-778 (KR)
- Sung, Ha-Jong
Changwon City,
Gyeongsangnam-do, 641-315 (KR)

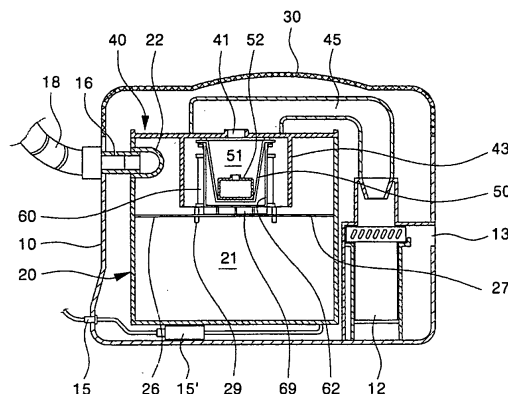
(74) Representative: Henkel, Feiler & Hänzel

Möhlstrasse 37
81675 München (DE)

(54) Dust-collecting device and vacuum cleaner for both wet and dry cleaning using the same

(57) The present invention relates to a dust-collecting device and a vacuum cleaner for both wet and dry cleaning using the dust-collecting device. The dust-collecting device of the present invention comprises a dust-collecting tank (20) for collecting water and foreign substances in a cyclone manner, the dust-collecting tank (20) having a suction port (22) formed such that air flows along an inner peripheral surface of a dust-collecting space (21) defined therein; a tank cover portion for selectively shielding the dust-collecting space, the tank cover portion (40) having a first discharge port (41); a floater guide (50) including an inner space (51) communicating with the first discharge portion (41), a floater (52) for opening or closing the first discharge port (41), and a plurality of communication holes (53) formed along an outer peripheral surface of the floater guide (50); a dust-collecting filter (60) provided to surround the outer peripheral surface of the floater guide (50) in order to filter out foreign substances; and a waterblocking wall (43) for surrounding at least a portion corresponding to the suction port (22) with a gap with respect to an outer peripheral surface of the dust-collecting filter (60). According to the vacuum cleaner using the dust-collecting device according to the present invention constructed as such, there are advantages in that water is prevented from being transferred to parts within a main body (10) of the vacuum cleaner, and the structures of the dust-collecting filter (60) and the like provided within the dust-collecting tank (20) can be more firmly maintained.

Fig. 3



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a vacuum cleaner capable of performing wet cleaning, and more particularly, to a vacuum cleaner for both wet and dry cleaning, wherein water and a detergent are sprayed and then sucked back together with foreign substances that in turn are separated by a dust-collecting device provided in the vacuum cleaner.

2. Description of the Prior Art

[0002] A vacuum cleaner is one of household electric appliances, which can perform cleaning by generating a strong suction force in a main body or a nozzle of the vacuum cleaner, sucking contaminants existing on an area to be cleaned into the main body and collecting them therein. Recently, there has been developed a vacuum cleaner that can perform wet cleaning with a wet duster mounted thereon, or perform wet cleaning by exchanging a simple accessory tool such as a nozzle assembly and repeatedly spraying water and a detergent from the vacuum cleaner itself and sucking the water and detergent, even while performing the basic function of collecting dry dust and the like.

[0003] Fig. 1 shows the configuration of a conventional vacuum cleaner for both wet and dry cleaning. Referring to this figure, a fan/motor assembly 2 for generating a suction force is provided within a main body 1 of the vacuum cleaner. A dust-collecting canister 3 is installed within the main body 1 to collect water and foreign substances except air among sucked matters. An upper portion of the dust-collecting canister 3 is shielded by a cover 4 that is formed with a first discharge port 5 for allowing only air passing through the dust-collecting canister 3 to be discharged therethrough.

[0004] External water, foreign substances and air are sucked through a nozzle assembly (not shown) connected through a suction hose 6 to the main body 1 and then introduced into the dust-collecting tank 3. The water and foreign substances are separated from the air in a cyclone manner within the dust-collecting canister 3. Within the dust-collecting canister 3, a floater guide 7 is formed at a position corresponding to the first discharge port 5 of the cover 4. A floater 8 for selectively opening or closing the first discharge port 5 is installed in the floater guide 7. The floater guide 7 is perforated to have a plurality of inlet holes 7a.

[0005] One side of the main body 1 is provided with a second discharge port 9 through which air with the water and the detergent removed therefrom among the matters sucked through the nozzle assembly is discharged back to the outside. The second discharge port 9 is a portion through which air that has passed through the

first discharge port and the fan/motor assembly 2 is discharged.

[0006] However, there are the following problems in the prior art described above.

[0007] In the conventional vacuum cleaner, the water and the foreign substances are rotated at high speed within the dust-collecting canister 3 by means of the strong cyclonic suction force. During such rotation of the water and the foreign substances, there is a problem in that a part of the water is splashed on an inner wall surface of the dust-collecting canister 3 and then transferred directly to the floater guide 7.

[0008] The water transferred to the floater guide 7 at high speed and with large impulse is introduced together with the air into the floater guide 7 through the inlet holes 7a of the floater guide 7. Further, the water has adverse effects on the fan/motor assembly 2 or other parts within the main body 1 while passing through the first discharge port 5 by the suction force from the fan/motor assembly 2.

SUMMARY OF THE INVENTION

[0009] Accordingly, the present invention is conceived to solve the aforementioned problems in the prior art. An object of the present invention is to prevent water from being transferred to the exterior of a dust-collecting canister in a vacuum cleaner for both wet and dry cleaning.

[0010] Another object of the present invention is to ensure securer collection of water and foreign substances in a vacuum cleaner for both wet and dry cleaning.

[0011] A further object of the present invention is to ensure securer installation of parts provided in a water tank in a vacuum cleaner for both wet and dry cleaning.

[0012] According to an aspect of the present invention for achieving the objects, there is provided a dust-collecting device, comprising a dust-collecting tank for collecting water and foreign substances in a cyclone manner, the dust-collecting tank having a suction port formed such that air flows along an inner peripheral surface of a dust-collecting space defined therein; a tank cover portion for selectively shielding the dust-collecting space, the tank cover portion having a first discharge port; a floater guide including an inner space communicating with the first discharge portion, a floater for opening or closing the first discharge port, and a plurality of communication holes formed along an outer peripheral surface of the floater guide; a dust-collecting filter provided to surround the outer peripheral surface of the floater guide in order to filter out foreign substances from air flowing from the dust-collecting space to the interior of the floater guide; and a water-blocking wall for surrounding at least a portion corresponding to the suction port with a gap with respect to an outer peripheral surface of the dust-collecting filter.

[0013] Preferably, the dust-collecting space is divided into upper and lower space sections by partition plate.

[0014] The partition plates are at least two, each of the partition plates is constructed such that an extension of the center of rotation thereof passes closely by the center of the dust-collecting space, and an upper surface of each of the partition plates is formed with ribs for supporting the dust-collecting filter.

[0015] The ribs are formed to protrude by a predetermined height from both upper and lower surfaces of each of the partition plates.

[0016] Further, the dust-collecting filter is fitted around an outer peripheral surface of a filter guide mounted on the tank cover portion to shield the floater guide, and the filter guide is formed with a plurality of communication holes.

[0017] Preferably, intermediate communication holes are formed along an entire intermediate portion of the outer peripheral surface of the filter guide, and peripheral communication holes are formed at positions corresponding to the intermediate communication holes along an entire intermediate portion of the outer peripheral surface of the floater guide.

[0018] More preferably, lower communication holes are formed along a lower end of the outer peripheral surface of the filter guide, and four-directional communication holes are formed along a lower end of the outer peripheral surface of the floater guide to communicate with some of the lower communication holes.

[0019] A plurality of upper communication holes are formed at upper portions of the outer peripheral surface of the filter guide above the intermediate communication holes.

[0020] Furthermore, the water-blocking wall is formed as an arcuate wall having a predetermined length between the dust-collecting filter and the suction port.

[0021] Preferably, the water-blocking wall is constructed in the form of a cylinder to surround the outer peripheral surface of the dust-collecting filter.

[0022] Further, a protection portion made of a sound-absorbing material is provided on an outer surface of the water-blocking wall.

[0023] Furthermore, the water-blocking wall is provided on the tank cover portion.

[0024] Preferably, the water-blocking wall is formed integrally with the floater guide and then mounted on the tank cover portion.

[0025] More preferably, the water-blocking wall is detachably mounted on the floater guide.

[0026] A plurality of lifting guide ribs are formed vertically on an inner wall surface of the floater guide.

[0027] The lifting guide ribs protrude radially inward by a predetermined width from the inner wall surface of the floater guide such that a distance between tips of the lifting guide ribs are constant.

According to a still further aspect of the present invention for achieving the objects, there is provided a vacuum cleaner for both wet and dry cleaning, comprising a main body having an inner space containing a motor assembly for generating a suction force and a detergent

supply portion for supplying a detergent; a dust-collecting tank installed within the main body to separate water and foreign substances from air sucked through a nozzle assembly and collect the separated water and foreign substances; a floater provided within the dust-collecting tank to selectively shut off communication between the dust-collecting tank and the motor assembly; a filtering means for filtering out the foreign substances and passing only air therethrough within the dust-collecting tank; and a water-blocking wall surrounding at least one side of the filtering means to prevent the water from being transferred directly to the filtering means.

[0028] Preferably, further comprising a main body cover installed at one side of the main body to selectively shield the inner space of the main body.

[0029] More preferably, the main body cover is provided with a tank cover portion for selectively shielding a dust-collecting space of the dust-collecting tank, and a connection flow passage for causing the dust-collecting space of the dust-collecting tank to communicate with the motor assembly.

[0030] Further, the water-blocking wall is formed integrally with the main body cover.

[0031] Furthermore, a supporting structure is further formed on at least one of the dust-collecting tank and the filtering means to firmly support the filtering means within the dust-collecting tank.

[0032] The supporting structure includes ribs formed integrally with a partition plate for dividing the interior of the dust-collecting tank into upper and lower spaces and with the filtering means, respectively.

[0033] With the present invention constructed as above, there are advantages in that water is prevented from being transferred to parts within the main body in the vacuum cleaner for both wet and dry cleaning, and the structure of the dust-collecting filter and the like provided in the dust-collecting tank can be maintained more securely.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a sectional view showing the structure of a conventional vacuum cleaner;

Fig. 2 is an exploded perspective view showing a vacuum cleaner in which a dust-collecting device according to an embodiment of the present invention is employed;

Fig. 3 is a sectional view schematically showing the inner structure of vacuum cleaner according to the embodiment of the present invention;

Fig. 4 is an exploded perspective view showing the structure of a dust tank of vacuum cleaner according to the embodiment of the present invention;

Fig. 5 is an exploded perspective view showing the structures of a floater guide, a dust-collecting filter and a filter guide of vacuum cleaner according to the embodiment of the present invention;

Fig. 6 is a sectional view showing the structures of a floater guide, a dust-collecting filter and a filter guide of vacuum cleaner according to the other embodiment of the present invention;

Fig. 7 is a sectional view schematically showing the inner structure of vacuum cleaner according to the other embodiment of the present invention;

Fig. 8 is a sectional view showing the structures of a tank cover portion of vacuum cleaner according to the other embodiment of the present invention;

Fig. 9a is a sectional view showing the structure of a water-blocking wall of vacuum cleaner according to the other embodiment of the present invention;

Fig. 9b is a sectional view showing the structure of a water-blocking wall of vacuum cleaner according to the other embodiment of the present invention

Fig. 10 is an sectional view showing the structure of vacuum cleaner according to the another embodiment of the present invention;

Fig. 11 is an exploded perspective view showing the structures of a tank cover portion and a dust-collecting of vacuum cleaner according to the another embodiment of the present invention;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] Fig. 2 is an exploded perspective view showing a vacuum cleaner according to a preferred embodiment of the present invention, Fig. 3 is a sectional view schematically showing the inner structure of a vacuum cleaner according to the embodiment of the present invention; Fig. 4 is an exploded perspective view showing the structure of a dust tank of a vacuum cleaner according to the embodiment of the present invention; and Fig. 5 is an exploded perspective view showing the structures of a dust-collecting filter and a filter guide of a vacuum cleaner according to the embodiment of the present invention.

[0036] Referring to these figures, a predetermined inner space 11 is formed in a main body 10 of the vacuum cleaner. A variety of parts for constructing the vacuum cleaner are installed in the inner space 11 of the main body 10. The main body 10 defines an external appearance of the main body 10. A motor assembly 12 is provided in the main body 10. The motor assembly 12 is a portion that generates a suction force for use in operations of the vacuum cleaner. One side of the main body 10 where the motor assembly 12 is provided is formed with a second discharge port 13 through which air that has passed through the motor assembly 12 is discharged to the exterior of the main body 10.

[0037] A detergent tank 14 is provided in the main body 10. A detergent diluted with water at a predeter-

mined ratio is contained in the detergent tank 14. A pump 15' is provided to supply the detergent and water contained in the detergent tank 14, and a detergent supply port 15 is provided at an outer surface of the main body 10. A detergent hose 19 is connected to the detergent supply port 15 so that the detergent and water pressurized by the pump 15' can be delivered to a nozzle assembly.

[0038] A hose connection portion 16 is formed at another side of the main body 10. The hose connection portion 16 serves to cause the exterior of the main body 10 to communicate with the inner space 11, and more specifically, connects a suction port 22 of a dust-collecting tank 20 to a suction hose 18 to be described later. The suction hose 18 serves to transfer a detergent, water and the like sucked through the nozzle assembly into the main body 10.

[0039] The substantially cylindrical dust-collecting tank 20 is installed at one side of the inner space 11 of the main body 10. The dust-collecting tank 20 is a portion for separating water and foreign substances from water, air and foreign substances sucked by means of the suction force from the motor assembly 12 and collecting the water and foreign substances. The dust-collecting tank 20 defines a dust-collecting space 21 therein. The dust-collecting space 21 has an open top and may be constructed in various configurations according to the shape of the inner space 11 of the main body 10.

[0040] The structure of the dust-collecting tank 20 will be described with reference to Fig. 4. The suction port 22 for causing the dust-collecting space 21 to communicate with the suction hose 18 is formed to penetrate through a portion of an upper end of the dust-collecting tank 20. A wall for defining the suction port 22 extends into the dust-collecting space 21, and a portion of the wall on the side of an outlet of the suction port (a portion facing the interior of the dust-collecting space 21) is open so that it can perform a circular motion within the dust-collecting space 21.

[0041] A seating guide 23 is provided along a periphery of the upper end of the dust-collecting tank 20. The seating guide 23 may be intermittently formed along the periphery of the upper end of the dust-collecting tank 20. The seating guide 23 is formed to radially extend by a predetermined width at a position slightly below the upper end of the dust-collecting tank 20. Reference numeral 24 designates a handle for lifting the dust-collecting tank 20.

[0042] First and second partition plates 26 and 27 are provided within the dust-collecting tank 20 to partition the dust-collecting space 21 into upper and lower space sections. Each of the first and second partition plates 26 and 27 is formed in the form of a semi-circular plate. The first and second partition plates 26 and 27 are formed with hinge shafts 26' and 27' at positions corresponding to both ends of a diameter of the semi-circle of each of the first and second partition plates 26 and 27. The hinge shafts 26' and 27' are supported by structures formed

on an inner surface of the dust-collecting tank 20 so as to function as the centers of rotation. The first and second partition plates 26 and 27 divide the dust-collecting space 21 into the upper and lower space sections, so that water and foreign substances collected in the lower space section cannot be affected by the suction force generated from the motor assembly 12.

[0043] A communicating portion 28 is formed at one side of the first partition plate 26. When the first partition plate 26 is opened or closed, the communicating portion 28 prevents the first partition plate 26 from interfering with the suction port 22 and simultaneously serves to transfer the water and foreign substances into the lower space section of the dust-collecting space 21 divided by the partition plates 26 and 27.

[0044] Supporting ribs 29 are provided on upper surfaces of the first and second partition plates 26 and 27. Although each of the supporting ribs 29 takes the shape of a cylindrical protrusion, it is not necessarily to be shaped as such. The supporting ribs 29 serve to support a dust-collecting filter 60 to be described later. Therefore, the supporting ribs 29 are provided at positions corresponding to the dust-collecting filter 60 in a region corresponding to the center of the dust-collecting space 21. The supporting ribs 29 may also be provided on lower surfaces of the partition plates 26 and 27. In this case, it is not necessary to consider orientations of the partition plates 26 and 27 upon installation thereof.

[0045] A portion of each of the partition plates 26 and 27 inside the supporting ribs 29 is provided with a semi-circular rib 29'. The semi-circular ribs 29' support spacer ribs 69 of the filter guide 62 to be described later.

[0046] The partition plates 26 and 27 are installed horizontally within the dust-collecting tank 20. To this end, a structure for supporting necessary portions of the partition plates 26 and 27 is provided. For example, the partition plates 26 and 27 can be horizontally supported due to the shape of the dust-collecting tank 20 itself or may be supported by additional supporting ribs protruding from a bottom surface of the dust-collecting tank 20.

[0047] Returning again to Fig. 2, a main body cover 30 is mounted on the top of the main body 10. The main body cover 30 is seated on the main body 10 to shield the inner space 11 from the outside. The main body cover 30 defines an external appearance of the vacuum cleaner in cooperation with the main body 10. Reference numeral 32 designates a handle.

[0048] As well shown in Fig. 3, a lower surface of the main body cover 30 is provided with a tank cover portion 40. The tank cover portion 40 serves to shield the dust-collecting space 21 of the dust-collecting tank 20 from the outside. That is, the tank cover portion functions to define a partition between the inner space 11 and the dust-collecting space 21.

[0049] The tank cover portion 40 is formed with a first discharge port 41 therethrough at a portion corresponding to the center of the dust-collecting tank 20. The first discharge port 41 is a portion through which air is dis-

charged from the dust-collecting tank 20.

[0050] A water-blocking wall 43 is provided to surround the first discharge port 41 of the tank cover portion 40. The water-blocking wall 43 prevents water introduced into the dust-collecting tank 20 from exiting through the first discharge port 41. The water-blocking wall 43 generally takes the shape of a cylinder and thus has a substantially circular cross section. It will be apparent that the water-blocking wall 43 is not necessarily cylindrical but may have a semi-circular shape in cross section. This is to effectively shield at least a portion facing the suction port 22.

[0051] A connection flow passage 45 for causing the motor assembly 12 to communicate with the first discharge port 41 is provided in the main body cover 30. The connection flow passage 45 provided in the main body cover 30 causes the motor assembly 12 to communicate with the first discharge port 41 when the main body cover 30 is mounted on the main body 10.

[0052] A floater guide 50 is installed on the tank cover portion 40. As well shown in Fig. 5, the floater guide 50 generally takes the shape of a cylinder of which the diameter of an upper portion is relatively larger than that of a lower portion thereof. An inner space 51 of the floater guide 50 is formed to communicate with the first discharge port 41. A plurality of lifting guide ribs 51' are formed to extend vertically within the inner space 51 of the floater guide 50. The plurality of lifting guide ribs 51' are arranged at a predetermined interval.

[0053] The lifting guide ribs 51' are constructed such that the diameter of a circle defined by tips of the lifting guide ribs is constant throughout the entire lengths thereof. This is achieved because the diameter of the upper portion of the inner space 51 is relatively larger than that of the lower portion thereof but the radially inward protruding widths of the lifting guide ribs 51' increase toward the upper portion of the inner space. The lifting guide ribs 51' allow a predetermined gap to be maintained between an outer peripheral surface of a floater 52 to be described below and an inner peripheral surface of the inner space 51.

[0054] The floater 52 is provided within the floater guide 50. The floater 52 serves to selectively open and close the first discharge port 41. That is, if the dust-collecting space 21 is filled with water and foreign substances up to a predetermined level, the floater 52 clogs the first discharge port 41 by means of pressure generated by the motor assembly 12.

[0055] Peripheral communication holes 53 are formed along the outer peripheral surface of the floater guide 50. The peripheral communication holes 53 are formed in a line along the outer peripheral surface of the floater guide 50 at an approximately intermediate position of the entire height of the floater guide. The peripheral communication holes 53 are separated from one another by the lifting guide ribs 51'. Four-directional communication holes 54 are formed at predetermined positions at a lower end of the outer peripheral surface

of the floater guide 50. Four four-directional communication holes 54 are formed in total at an angular interval of about 90 degrees. The peripheral communication holes 53 and the four-directional communication holes 54 serve to cause the inner space 51 to communicate with the outside.

[0056] A mounting flange 55 is formed along the upper end of the floater guide 50. The mounting flange 55 protrudes radially outward to have a predetermined width. The mounting flange 55 is used to mount the floater guide 50 on the tank cover portion 40.

[0057] It will be apparent that the mounting flange 55 may be formed integrally with the tank cover portion 40. In this case, the floater guide 50 should be properly designed in shape. Further, the water-blocking wall 43 may be formed integrally with the floater guide 50. That is, the water-blocking wall 43 may be formed integrally with and along a tip of the mounting flange 55 of the floater guide 50.

[0058] A sealing member 56 is provided along an inner periphery on a lower surface of the mounting flange 55. The sealing member 56 ensures sealing by coming into close contact with a relevant portion of a filter guide 62 to be described later. Meanwhile, it is also preferred that a sealing member (not shown) be provided at a periphery of an entrance of the inner space 51 corresponding to an upper surface of the mounting flange 55.

[0059] Wing-mounting members 57 are formed to protrude from the lower surface of the mounting flange 55. The wing-mounting members 57 are used to mount the filter guide 62 to the mounting flange 55. A reinforcement rib 57' is formed to protrude from a lower surface of each of the wing-mounting members 57.

[0060] A tip guide 58 is provided at one end of each of the wing-mounting members 57. The tip guide 58 is formed approximately perpendicularly to a direction of the formation of the wing-mounting member 57. The tip guide 58 is connected through a connection neck 58' to the wing-mounting member 57. The connection neck 58' is constructed to be elastically deformed to a certain extent due to connection of only a portion of the neck to the wing-mounting member 57.

[0061] A guide catching protrusion 59 is formed at an upper end of the tip guide 58, i.e. a portion thereof extending from the connection neck 58'. The guide catching protrusion 59 is formed to be upwardly inclined in a direction toward the connection neck 58' and in a direction opposite thereto, such that it is formed to protrude in the form of a triangle when viewed from a side. The guide catching protrusion 59 prevents a mounting wing 68, which has been mounted to the wing-mounting member 57, from being arbitrarily demounted therefrom.

[0062] The dust-collecting filter 60 is provided to surround the floater guide 50. The dust-collecting filter 60 primarily serves to filter out fine dust. The dust-collecting filter 60 is formed to take the shape of a cylinder and has annular frames 61 at upper and lower ends. A dust-

collecting portion 61' that is pleated and takes the shape of a cylinder is provided between the frames 61.

[0063] The dust-collecting filter 60 is fixedly mounted to the filter guide 62. The dust-collecting filter 60 is installed to be fitted around an outer peripheral surface of the filter guide 62. The filter guide 62 generally takes the shape of a cylinder, and an inner space 63 thereof is open only upwardly, i.e. in a direction toward the first discharge port 41 in the same manner as the floater guide 50.

[0064] Intermediate communication holes 64 are formed along the outer peripheral surface of the filter guide 62. As shown in Fig. 6b, the intermediate communication holes 64 are formed at positions conforming to the peripheral communication holes 53 of the floater guide 50. Therefore, the inner space 51 of the floater guide 50 can be viewed through the intermediate communication holes 64 and the peripheral communication holes 53 from the exterior of the filter guide 62.

[0065] Lower communication holes 65 are formed at a lower end of the filter guide 62 below the intermediate communication holes 64. Three lower communication holes 65 constitute one set, and two sets of lower communication holes are provided at an angular interval of 180 degrees, i.e. at opposite sides of the outer peripheral surface of the filter guide 62. As shown in Fig. 6c, one of the lower communication holes in each set communicates with the four-directional communication hole 54.

[0066] Upper communication holes 66 are formed just above the intermediate communication holes 64. Likewise, three upper communication holes 66 are also formed at an angular interval of 180 degrees. However, as shown in Fig. 6a, the upper communication holes 66 do not communicate directly with the inner space 51 of the floater guide 50. The positions where the upper and communication holes 66 and 65 are formed respectively at the upper and lower ends of the outer peripheral surface of the filter guide 62 partially overlap with each other.

[0067] There is the predetermined gap between the outer peripheral surface of the floater guide 50 and the inner peripheral surface of the filter guide 62. Particularly, the gap is widened toward the lower end of the floater guide 50. Therefore, even though the lower or upper communication holes 65 or 66 do not communicate directly with the interior of the floater guide 50, they can communicate with the interior of the floater guide 50 through the gap.

[0068] A filter stopper 67 is provided along the upper end of the filter guide 62. The filter stopper 67 serves to guide the insertion of the dust-collecting filter 60 in place. That is, the frame 61 provided at the upper end of the dust-collecting filter 60 is caught by the filter stopper 67 and thus cannot be further inserted.

[0069] The mounting wings 68 are provided at the upper end of the filter guide 62 to be mounted to the wing-mounting members 57 of the mounting flange 55. Each

of the mounting wings 68 is formed to protrude with a predetermined width and length from the upper end of the filter guide 62. Although the mounting wings 68 are formed at an angular interval of 120 degrees in this embodiment, they are not necessarily formed in such a manner.

[0070] Finally, the spacer ribs 69 are formed to protrude from a lower surface of the filter guide 62. The spacer ribs 69 are supported by the semi-circular rib 29'. The spacer ribs 69 protrude by a predetermined length corresponding to a gap between the lower surface of the filter guide 62 and the partition plates 26 and 27.

[0071] Next, another embodiment of the present invention will be described with reference to Fig. 7. In this embodiment, a motor assembly 112 is provided in a main body 110 of a vacuum cleaner. The motor assembly 112 is a portion that generates a suction force for use in operations of the vacuum cleaner. One side of the main body 110 where the motor assembly 112 is provided is formed with a second discharge port 113 through which air that has passed through the motor assembly 112 is discharged to the exterior of the main body 110. A detergent tank is provided in the main body 110 and contains a diluted detergent. The detergent contained in the detergent tank is delivered to the outside by a pump.

[0072] A hose connection portion 116 is formed at another side of the main body 110. The hose connection portion 116 serves to cause the exterior of the main body 110 to communicate with a dust-collecting space 121 of a dust-collecting tank 120 to be described later. A suction hose 118 is connected to the hose connection portion 116. The suction hose 118 serves to transfer a detergent, water and the like sucked through a nozzle assembly into the dust-collecting tank 120.

[0073] The substantially cylindrical dust-collecting tank 120 is installed at one side of the interior of the main body 110. The dust-collecting tank 120 is a portion for separating water and foreign substances from water, air and foreign substances sucked by means of the suction force from the motor assembly 112 and collecting the water and foreign substances. The dust-collecting tank 120 defines the dust-collecting space 121 therein. The dust-collecting space 121 has an open top.

[0074] A suction port 122 for causing the dust-collecting space 121 to communicate with the suction hose 118 is formed to penetrate through a portion of an upper end of the dust-collecting tank 120. A wall for defining the suction port 122 extends into the dust-collecting space 121, and a portion of the wall on the side of an outlet of the suction port (a portion facing the interior of the dust-collecting space 121) is open so that it can perform a circular motion within the dust-collecting space 121. Other structures of the dust-collecting tank 120 may be similar to those of the previous embodiment.

[0075] Meanwhile, an additional main body cover may be provided on the main body 110. The main body cover serves to selectively shield the interior of the main body

110. Therefore, the main body cover may be provided in various forms at any positions so far as the main body cover can selectively shield the interior of the main body 110.

[0076] The dust-collecting space 121 of the dust-collecting tank 120 has an open top. The open top of the dust-collecting tank 120 is shielded by a tank cover portion 140. The tank cover portion 140 can be formed integrally with the main body cover in the same manner as the previous embodiment or separately therefrom.

[0077] The tank cover portion 140 is formed with a first discharge port 141 therethrough at a portion corresponding to the center of the dust-collecting tank 120. The first discharge port 141 is a portion through which air is discharged from the dust-collecting tank 120.

[0078] A water-blocking wall 143 is provided to surround the first discharge port 141 of the tank cover portion 140. The water-blocking wall 143 prevents water introduced into the dust-collecting tank 120 from exiting through the first discharge port 141. The water-blocking wall 143 generally takes the shape of a cylinder and thus has a substantially circular cross section. It will be apparent that the water-blocking wall 143 is not necessarily cylindrical but may have a semi-circular shape in cross section. This is to effectively shield at least a portion facing the suction port 122.

[0079] A floater guide 150 is installed on the tank cover portion 140. The floater guide 150 generally takes the shape of a cylinder of which the diameter of an upper portion is relatively larger than that of a lower portion thereof. An inner space 151 of the floater guide 150 is formed to communicate with the first discharge port 141. A floater 152 is provided within the inner space 151 of the floater guide 150. The floater 152 serves to selectively open and close the first discharge port 141. That is, if the dust-collecting space 121 is filled with water and foreign substances up to a predetermined level, the floater 152 clogs the first discharge port 141 by means of pressure generated by the motor assembly 112.

[0080] Peripheral communication holes 153 are formed along an outer peripheral surface of the floater guide 150. The peripheral communication holes 153 may be formed at various positions throughout the outer peripheral surface of the floater guide 150.

[0081] Meanwhile, the floater guide 150 may be formed integrally with the tank cover portion 140, or may be formed separately from and then installed on the tank cover portion. Fig. 8 shows a structure in which that the floater guide 150 and the water-blocking wall 143 are formed separately from and then installed on the tank cover portion 140. The floater guide 150 may be bonded to the tank cover portion 140 using an adhesive or fastened thereto using screws or the like. It will be apparent that the floater guide may be mounted on the tank cover portion 140 in the same manner as the previous embodiment. Fig. 8 shows that a flange 155 is formed along a periphery of an upper end of the floater guide 150 and the water-blocking wall 143 is formed to extend down-

ward from the upper end of the flange 155.

[0082] The shape of a cross section of the water-blocking wall 143 is shown in Fig. 9. That is, Fig. 9a shows a water-blocking wall 143 with a circular cross section. At this time, the water-blocking wall 143 is placed to surround the floater guide 150. Fig. 9b shows a water-blocking wall 143' with a semi-circular cross section. The water-blocking wall 143' is placed between the suction port 122 and the floater guide 150.

[0083] Next, Figs. 10 and 11 show a further embodiment of the present invention. Referring to these figures, a motor assembly 212 is provided in a main body 210 of a vacuum cleaner. The motor assembly 212 is a portion that generates a suction force for use in operations of the vacuum cleaner. One side of the main body 210 where the motor assembly 212 is provided is formed with a second discharge port 213 through which air that has passed through the motor assembly 212 is discharged to the exterior of the main body 210.

[0084] A detergent tank (not shown) is provided in the main body 210. A detergent diluted with water at a predetermined ratio is contained in the detergent tank. A pump 215' is provided to supply the detergent and water contained in the detergent tank to the outside, and a detergent supply port 215 is provided at an outer surface of the main body 210. A detergent hose (not shown) is connected to the detergent supply port 215 so that the detergent and water pressurized by the pump 215' can be delivered to a nozzle assembly.

[0085] A hose connection portion 216 is formed at another side of the main body 210. The hose connection portion 216 connects a suction port 222 of a dust-collecting tank 220 to a suction hose 218 to be described later. The suction hose 218 serves to transfer a detergent, air and the like sucked through the nozzle assembly into the main body 210.

[0086] The substantially cylindrical dust-collecting tank 220 is installed at one side of the interior of the main body 210. The dust-collecting tank 220 is a portion for separating water and foreign substances from water, air and foreign substances sucked by means of the suction force from the motor assembly 212 and collecting the water and foreign substances. The dust-collecting tank 220 defines a dust-collecting space 221 therein. The dust-collecting space 221 has an open top and may be constructed in various configurations according to the shape of the interior of the main body 210.

[0087] A suction port 222 for causing the dust-collecting space 221 to communicate with the suction hose 218 is formed to penetrate through a portion of an upper end of the dust-collecting tank 220. A wall for defining the suction port 222 extends into the dust-collecting space 221, and a portion of the wall on the side of an outlet of the suction port (a portion facing the interior of the dust-collecting space 221) is open so that it can perform a circular motion within the dust-collecting space 221.

[0088] It is preferred that a main body cover for selectively opening and closing the interior of the main body

210 be provided on one side of the main body 210. Although the main body cover may be installed at any positions on the main body 210, it is preferably installed at the top of the main body 210.

[0089] The dust-collecting space 221 of the dust-collecting tank 220 is opened or closed by a tank cover portion 240. The tank cover portion 240 serves to shield the dust-collecting space 221 of the dust-collecting tank 220 from the outside, and may be provided on the main body cover or separately therefrom.

[0090] The tank cover portion 240 is formed with a first discharge port 241 therethrough at a portion corresponding to the center of the dust-collecting tank 220. The first discharge port 241 is a portion through which air is discharged from the dust-collecting tank 220.

[0091] A water-blocking wall 243 is provided to surround the first discharge port 241 of the tank cover portion 240. The water-blocking wall 243 prevents water introduced into the dust-collecting tank 220 from exiting through the first discharge port 241. The water-blocking wall 243 generally takes the shape of a cylinder and thus has a substantially circular cross section. It will be apparent that the water-blocking wall 243 is not necessarily cylindrical but may have a semi-circular shape in cross section. This is to effectively shield at least a portion facing the suction port 222.

[0092] A protection portion 244 is provided to surround an outer peripheral surface of the water-blocking wall 243. The protection portion 244 absorbs impact generated when foreign substances collide against the wall-blocking wall 243. Therefore, it is possible to eliminate noises generated upon collision of the foreign substances against the water-blocking wall 243. To this end, it is preferred that the protection portion 244 be made of a shock-absorbing and absorbent material.

[0093] A connection flow passage 245 causes the motor assembly 212 to communicate with the first discharge port 241. The connection flow passage 245 is preferably provided in the main body cover. It will be apparent that the connection flow passage 245 may be formed separately from the main body cover or integrally with the tank cover portion 240.

[0094] A floater guide 250 is installed on the tank cover portion 240. As well shown in Fig. 11, the floater guide 250 generally takes the shape of a cylinder of which the diameter of an upper portion is relatively larger than that of a lower portion thereof. An inner space 251 of the floater guide 250 is formed to communicate with the first discharge port 241.

[0095] A floater 252 is provided within the interior of the floater guide 250. The floater 252 serves to selectively open and close the first discharge port 241. That is, if the dust-collecting space 221 is filled with water and foreign substances up to a predetermined level, the floater 252 clogs the first discharge port 241 by means of pressure generated by the motor assembly 212.

[0096] Peripheral communication holes 253 are formed along an outer peripheral surface of the floater

guide 250. The plurality of peripheral communication holes 253 are formed to be elongated vertically along the outer peripheral surface of the floater guide 250.

[0097] A mounting flange 255 is formed along an upper end of the floater guide 250. The mounting flange 255 protrudes radially outward to have a predetermined width. The mounting flange 255 is used to mount the floater guide 250 on the tank cover portion 240. Wing-mounting members 257 are formed in the mounting flange 55. The plurality of wing-mounting members 257 are formed at a predetermined interval.

[0098] It will be apparent that the mounting flange 255 may be formed integrally with the tank cover portion 240. In this case, the floater guide 250 should be properly designed in shape. Further, the water-blocking wall 243 may be formed integrally with the floater guide 250. That is, the water-blocking wall 243 may be formed integrally with and along a tip of the mounting flange 255 of the floater guide 250.

[0099] A dust-collecting filter 260 is provided to surround the floater guide 250. The dust-collecting filter 260 primarily serves to filter out fine dust. The dust-collecting filter 260 is constructed as follows.

[0100] The dust-collecting filter 260 is provided with a filter guide 262 for use in mounting the dust-collecting filter to the floater guide 250. A dust-collecting portion 261' is provided at an outer peripheral surface of the filter guide 262 to filter out fine dust. The filter guide 262 generally takes the shape of a cylinder, and an inner space thereof is open only upwardly, i.e. in a direction toward the first discharge port 241 in the same manner as the floater guide 250.

[0101] A plurality of communication holes 264 are formed along the outer peripheral surface of the filter guide 262. The communication holes 264 are formed over various regions on the outer peripheral surface of the filter guide 262. Mounting wings 268 are provided at an upper end of the filter guide 262 to be mounted to the wing-mounting members 257 of the mounting flange 255. Each of the mounting wings 268 is formed to protrude with a predetermined width and length from the upper end of the filter guide 262.

[0102] The operations of the dust-collecting device according to the present invention constructed as above and the vacuum cleaner for both wet and dry cleaning using the dust-collecting device will be described in detail below.

[0103] First, assembly of structures for allowing water and foreign substances to be separated from air within the dust-collecting tank 20 will be explained. The dust-collecting tank 20 can be detachably mounted within the main body 10 in a state where the dust-collecting tank is separated from the main body cover 30.

[0104] The floater guide 50 is mounted on the tank cover portion 40 provided in the main body cover 30. The inner space 51 of the floater guide 50 is caused to communicate with the connection flow passage 45 through the first discharge port 41. In this embodiment,

the floater guide 50 is fastened using screws.

[0105] The filter guide 62 is mounted on the mounting flange 55 of the floater guide 50, particularly, by inserting the mounting wings 68 of the filter guide 62 into the wing-mounting members 57. This is performed by rotating the filter guide 62 with respect to the floater guide 50 in a state where upper surfaces of the mounting wings 68 are in close contact with the lower surface of the mounting flange 55. In this state, the mounting wings 68 move along the mounting flange 55, ride over the guide catching protrusions 59 and are then inserted into the wing-mounting members 57.

[0106] At this time, the tip guides 58 including the guide catching protrusions 59 are pushed out and then restored due to elastic deformation of the connection necks 58' so that the mounting wings 68 can be caught by the wing-mounting members 57. It will be apparent that the plurality of mounting wings 68 are simultaneously caught by the wing-mounting members 57. Since one end of each of the mounting wings 68 is caught by the relevant guide catching protrusion 59, it cannot be arbitrarily demounted from the relevant wing-mounting member.

[0107] When the filter guide 62 is mounted to the floater guide 50, the peripheral communication holes 53 are caused to match the intermediate communication holes 64. Some of the four-directional communication holes 54 communicate with the lower communication holes 65. Each of opposite ones of the four-directional communication holes 54 spaced apart at an angular interval of 180 degrees communicates with one of the relevant set of three lower communication holes 65. The upper communication holes 66 communicate not directly but indirectly through the peripheral communication holes 53 or the four-directional communication holes 54 with the inner space 51 of the floater guide 50.

[0108] When the floater guide 50 is mounted on the tank cover portion 40, sealing is achieved therebetween by means of the sealing member. Sealing between the floater guide 50 and the filter guide 61 is also achieved by means of the sealing member 56, thereby preventing a suction force or water from leaking out.

[0109] Meanwhile, the dust-collecting filter 60 is inserted into the filter guide 62. As the dust-collecting filter 60 is inserted into the filter guide 62, the outer peripheral surface of the filter guide 62 is surrounded by the dust-collecting portion 61'. Therefore, air containing foreign substances passes through the dust-collecting portion 61' by means of the suction force transmitted through the communication holes 64, 65 and 66 formed in the filter guide 62.

[0110] As described above, the floater guide 50, the filter guide 62 and the dust-collecting filter 60 are mounted on the tank cover portion 40 of the main body cover 30. Particularly, the structures are constructed to be placed within the water-blocking wall 43. Therefore, as the main body cover 30 is mounted on the main body 10, the tank cover portion 40 shields the dust-collecting

tank 20, and the dust-collecting filter 60 and the like are placed in the inner space 21 of the dust-collecting tank 20.

[0111] At this time, the frame 61 provided at the lower end of the dust-collecting filter 60 is supported by or placed with a certain gap with respect to the supporting ribs 29 formed at the partition plates 26 and 27. The spacer ribs 69 of the filter guide 62 are placed on the semi-circular ribs 29' of the partition plates 26 and 27. Once the bottoms of the dust-collecting filter 60 and the filter guide 62 are supported by the partition plates 26 and 27, the dust-collecting filter 60, the filter guide 62, the partition plates 26 and 27 and the like are prevented from being damaged or changed in their installation states even though impact is exerted on the vacuum cleaner.

[0112] Next, the operation of the vacuum cleaner for both wet and dry cleaning having such dust-collecting structures will be explained. When an operating signal is provided to the vacuum cleaner, the motor assembly 12 is driven and generates a suction force. The suction force generated by the motor assembly 12 is transmitted to the nozzle assembly provided at a leading end of the suction hose 18 through the connection flow passage 45 and the dust-collecting tank 20.

[0113] Meanwhile, with the driving of the pump 15', the detergent contained in the detergent tank 14 is delivered through a detergent supply port 15 and a detergent hose 19 to the nozzle assembly from which the detergent is sprayed to an area to be cleaned.

[0114] Then, the nozzle assembly sucks foreign substances and the detergent-mixed water together with air. The air is transferred to the suction port 22 through the suction hose 18, and performs circular motion along an inner peripheral surface of the dust-collecting space 21 of the dust-collecting tank 20 while exiting through the suction port 22.

[0115] During such a process, the water and large foreign substances remain in the dust-collecting space 21, whereas the air and fine foreign substances pass through the dust-collecting filter 60. The fine foreign substances entrained by the air are filtered out while passing through the dust-collecting portion 61' of the dust-collecting filter 60. The air that has passed through the dust-collecting portion 61' is transferred to the inner space 51 of the floater guide 50 through the communication holes 64, 65 and 66 of the filter guide 61 and the communication holes 53 and 54 of the floater guide 50.

[0116] The air passes through the inner space 51, the first discharge port 41 and the connection flow passage 45 to the second discharge port 13 through which the air is discharged to the exterior of the main body 10.

[0117] Meanwhile, in the embodiment shown in Fig. 7, the water, foreign substances and air sucked by means of the suction force from the motor assembly 112 rotate along an inner wall of the dust-collecting tank 120. The water and foreign substances among them fall to a lower portion of the dust-collecting space 121, while the

air flows into the floater guide 150. The air transferred to the interior of the floater guide 150 is sucked to the motor assembly 112 through the first discharged port 141. The air that has passed through the motor assembly 112 is discharged to the exterior of the vacuum cleaner through the second discharge port 113.

[0118] At this time, the water-blocking wall 143 serves to prevent water or foreign substances from being transferred directly to the interior of the floater guide 150. Particularly, the water-blocking wall 143 prevents water from being transferred to the interior of the floater guide 150 between the suction port 122 and the floater guide 150.

[0119] In the embodiment shown in Fig. 10, the collection of water and foreign substances sucked by means of the suction force generated by the motor assembly 212 in the dust-collecting tank 221 and the flow of air are the same as the other embodiments.

[0120] However, since the filter 260 is provided in this embodiment, fine dust can be filtered out in the same manner as the embodiment shown in Fig. 2. Further, since the connection flow passage 245 is provided within the main body 210 in this embodiment, more secure communication between the dust-collecting tank 220 and the motor assembly 212 can be achieved.

[0121] The scope of the present invention is not limited to the aforementioned embodiments but is defined by the appended claims. It will be apparent that those skilled in the art can make various modifications and adaptations within the scope of the invention defined by the claims.

[0122] For example, the dust-collecting tank may take various shapes rather than a cylindrical shape. The partition plates will be formed to conform to the shape of the dust-collecting tank.

[0123] The water-blocking wall may also take various shapes. The water-blocking wall may take any shapes capable of preventing at least water introduced through the suction port of the dust-collecting tank from being splashed to the dust-collecting filter.

[0124] Further, with the installation of the protection portion around the outer peripheral surface of the water-blocking wall in all the aforementioned embodiments, it is possible to eliminate noises produced when foreign substances collide against the water-blocking wall.

[0125] As described above, with the dust-collecting device and the vacuum cleaner for both wet and dry cleaning using the dust-collecting device according to the present invention, it can be expected to obtain the following advantages.

[0126] First, in the vacuum cleaner for both wet and dry cleaning, water is effectively prevented from being transferred to the interior of the floater guide, thereby avoiding the water from damaging parts within the main body of the vacuum cleaner.

[0127] Further, since the dust-collecting filter, the filter guide and the like that have been formed separately from the dust-collecting tank and provided to the tank

cover portion are supported by the partition plates within the dust-collecting tank in the present invention, they are prevented from being broken or changed in their installation states. Thus, there is an advantage in that product reliability of the vacuum cleaner is improved.

[0128] Moreover, since the filter guide and the floater guide are constructed properly even with the presence of the dust-collecting filter in the present invention, there is an advantage in that water and foreign substances can be more effectively separated from air.

Claims

1. A dust-collecting device, comprising:

a dust-collecting tank for collecting water and foreign substances in a cyclone manner, the dust-collecting tank having a suction port formed such that air flows along an inner peripheral surface of a dust-collecting space defined therein;

a tank cover portion for selectively shielding the dust-collecting space, the tank cover portion having a first discharge port;

a floater guide including an inner space communicating with the first discharge portion, a floater for opening or closing the first discharge port, and a plurality of communication holes formed along an outer peripheral surface of the floater guide;

a dust-collecting filter provided to surround the outer peripheral surface of the floater guide in order to filter out foreign substances from air flowing from the dust-collecting space to the interior of the floater guide; and

a water-blocking wall for surrounding at least a portion corresponding to the suction port with a gap with respect to an outer peripheral surface of the dust-collecting filter.

2. The device as claimed in claim 1, wherein the dust-collecting space is divided into upper and lower space sections by partition plate.

3. The device as claimed in claim 2, wherein the partition plates are at least two, each of the partition plates is constructed such that an extension of the center of rotation thereof passes closely by the center of the dust-collecting space, and an upper surface of each of the partition plates is formed with ribs for supporting the dust-collecting filter.

4. The device as claimed in claim 3, wherein the ribs are formed to protrude by a predetermined height from both upper and lower surfaces of each of the partition plates.

5. The device as claimed in one of claims 1 through 4, wherein the dust-collecting filter is fitted around an outer peripheral surface of a filter guide mounted on the tank cover portion to shield the floater guide, and the filter guide is formed with a plurality of communication holes.

6. The device as claimed in claim 5, wherein intermediate communication holes are formed along an entire intermediate portion of the outer peripheral surface of the filter guide, and peripheral communication holes are formed at positions corresponding to the intermediate communication holes along an entire intermediate portion of the outer peripheral surface of the floater guide

7. The device as claimed in claims 5 or 6, wherein lower communication holes are formed along a lower end of the outer peripheral surface of the filter guide, and four-directional communication holes are formed along a lower end of the outer peripheral surface of the floater guide to communicate with some of the lower communication holes.

8. The device as claimed in one of claims 5 through 7, wherein a plurality of upper communication holes are formed at upper portions of the outer peripheral surface of the filter guide above the intermediate communication holes.

9. The device as claimed in one of claims 1 through 8, wherein the water-blocking wall is formed as an arcuate wall having a predetermined length between the dust-collecting filter and the suction port.

10. The device as claimed in one of claims 1 through 8, wherein the water-blocking wall is constructed in the form of a cylinder to surround the outer peripheral surface of the dust-collecting filter.

11. The device as claimed in one of claims 1 through 10, wherein a protection portion made of a sound-absorbing material is provided on an outer surface of the water-blocking wall.

12. The device as claimed in one of claims 1 through 11, wherein the water-blocking wall is provided on the tank cover portion.

13. The device as claimed in one of claims 1 through 12, wherein the water-blocking wall is formed integrally with the floater guide and then mounted on the tank cover portion.

14. The device as claimed in one of claims 1 through 11, wherein the water-blocking wall is detachably mounted on the floater guide.

15. The device as claimed in one of claims 1 through 14, wherein a plurality of lifting guide ribs are formed vertically on an inner wall surface of the floater guide. 5
16. The device as claimed in claim 15, wherein the lifting guide ribs protrude radially inward by a predetermined width from the inner wall surface of the floater guide such that a distance between tips of the lifting guide ribs are constant. 10
17. A vacuum cleaner for both wet and dry cleaning, comprising:
- a main body having an inner space containing a motor assembly for generating a suction force and a detergent supply portion for supplying a detergent; 15
 - a dust-collecting tank installed within the main body to separate water and foreign substances from air sucked through a nozzle assembly and collect the separated water and foreign substances; 20
 - a floater provided within the dust-collecting tank to selectively shut off communication between the dust-collecting tank and the motor assembly; 25
 - a filtering means for filtering out the foreign substances and passing only air therethrough within the dust-collecting tank; and 30
 - a water-blocking wall surrounding at least one side of the filtering means to prevent the water from being transferred directly to the filtering means. 35
18. The vacuum cleaner as claimed in claim 17, further comprising a main body cover installed at one side of the main body to selectively shield the inner space of the main body. 40
19. The vacuum cleaner as claimed in claim 18, wherein the main body cover is provided with a tank cover portion for selectively shielding a dust-collecting space of the dust-collecting tank, and a connection flow passage for causing the dust-collecting space of the dust-collecting tank to communicate with the motor assembly. 45
20. The vacuum cleaner as claimed in claims 18 or 19, wherein the water-blocking wall is formed integrally with the main body cover. 50
21. The vacuum cleaner as claimed in one of claims 17 through 20, wherein a supporting structure is further formed on at least one of the dust-collecting tank and the filtering means to firmly support the filtering means within the dust-collecting tank. 55
22. The vacuum cleaner as claimed in claim 21, wherein the supporting structure includes ribs formed integrally with a partition plate for dividing the interior of the dust-collecting tank into upper and lower spaces and with the filtering means, respectively.

Fig. 1

Related Art

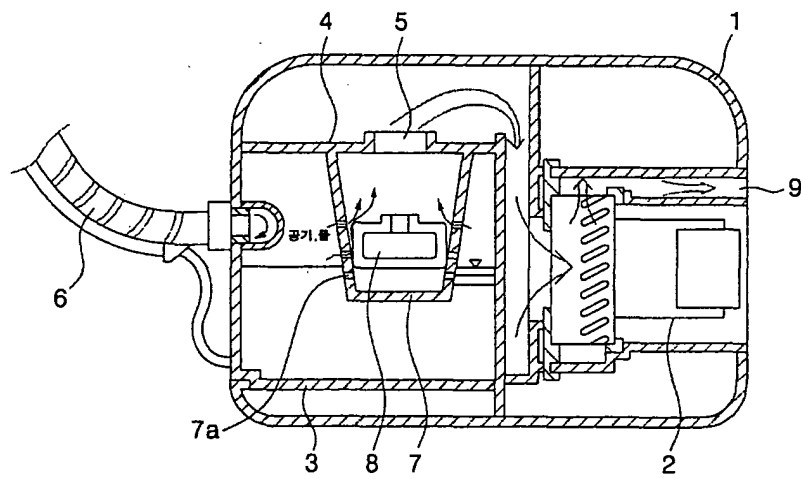


Fig. 2

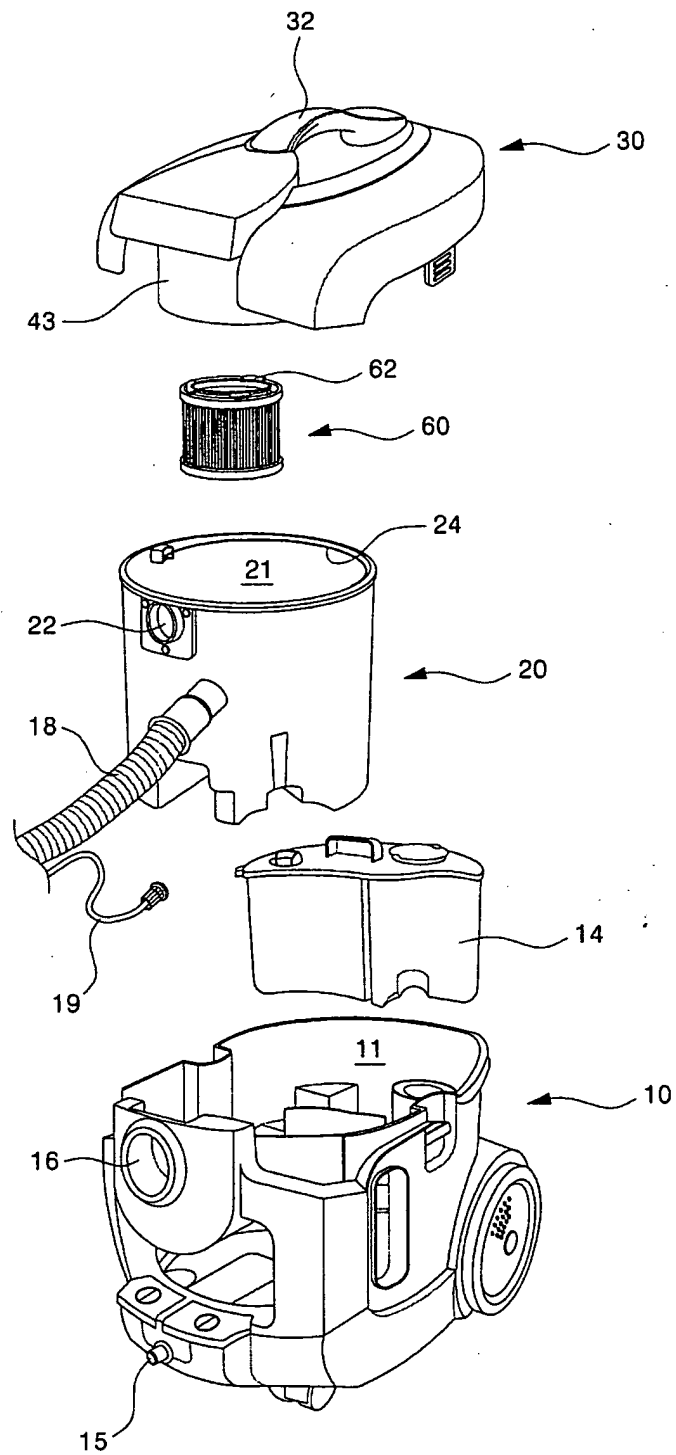


Fig. 3

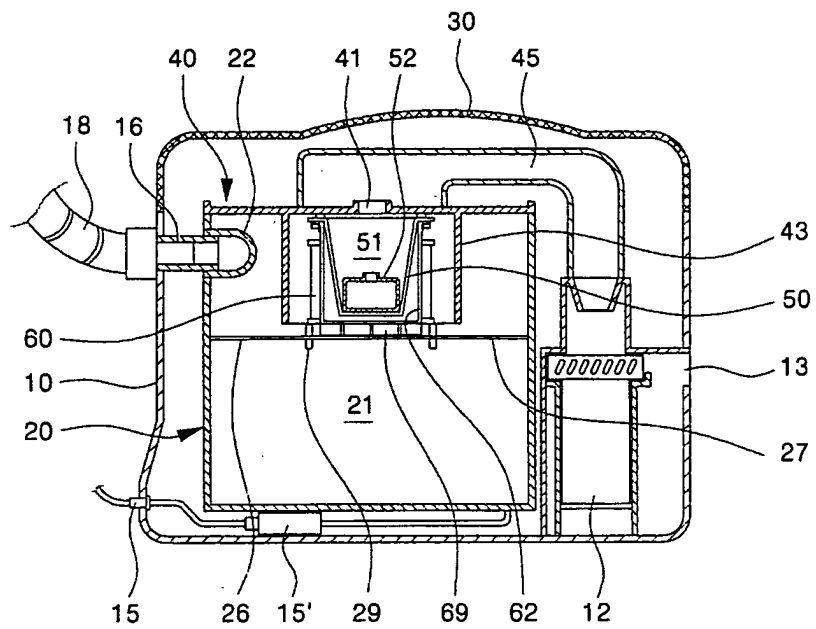


Fig. 4

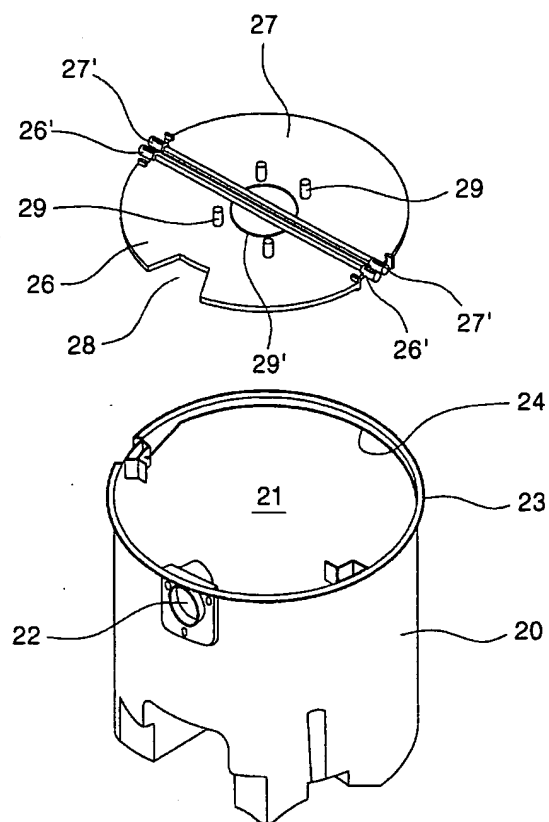


Fig. 5

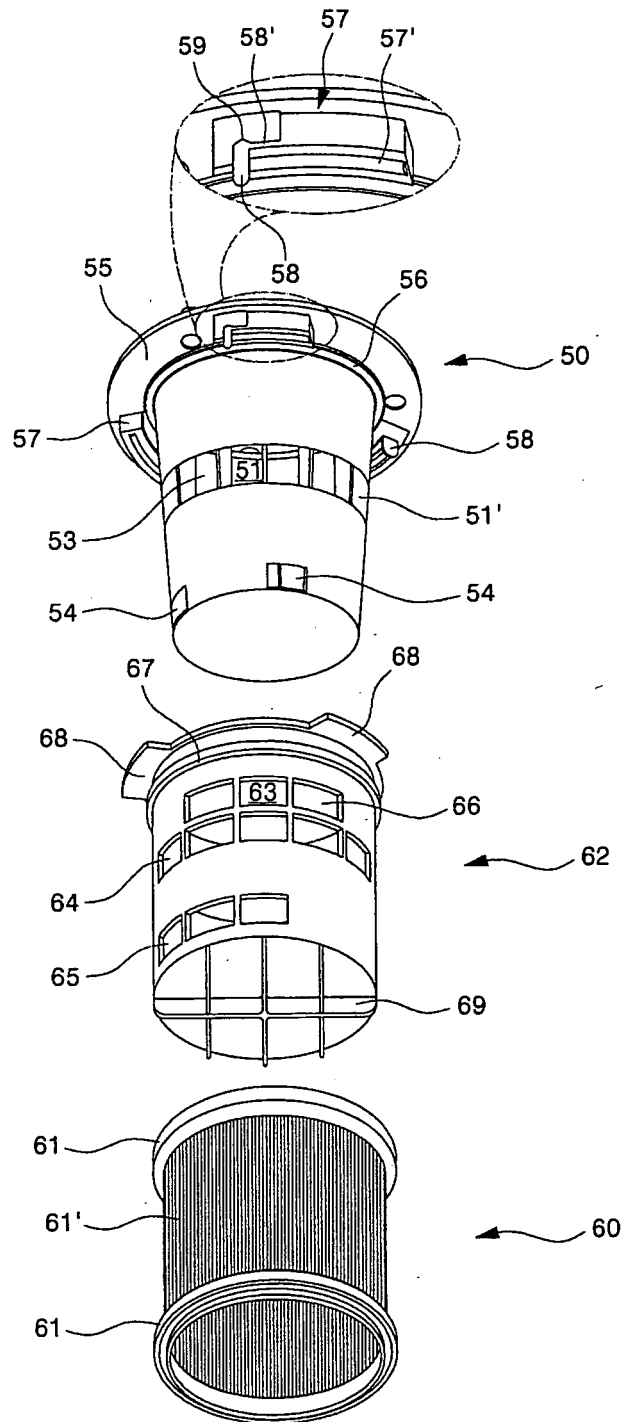


Fig. 6a

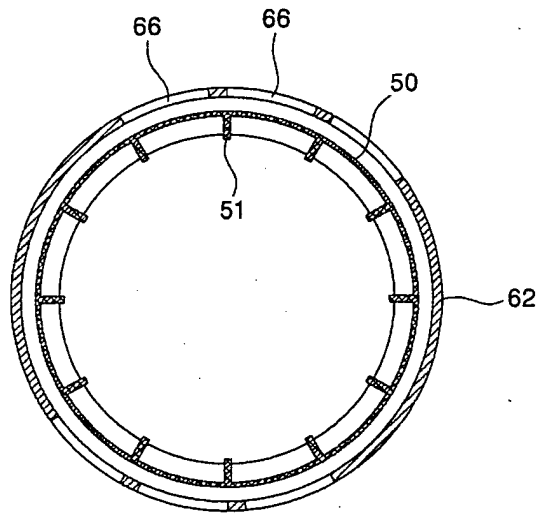


Fig. 6b

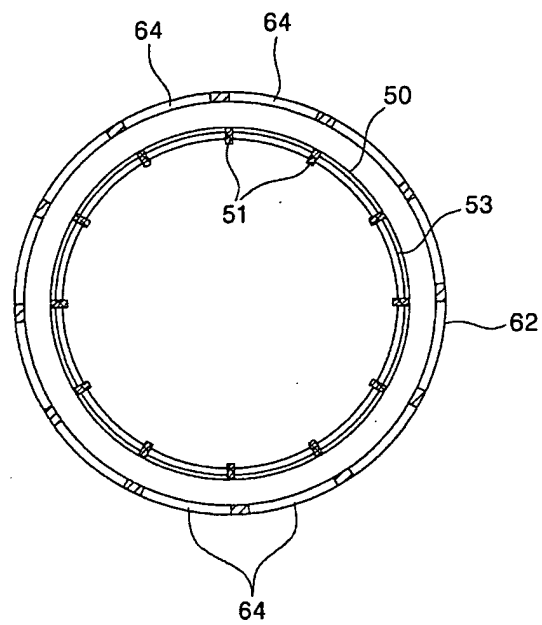


Fig. 6c

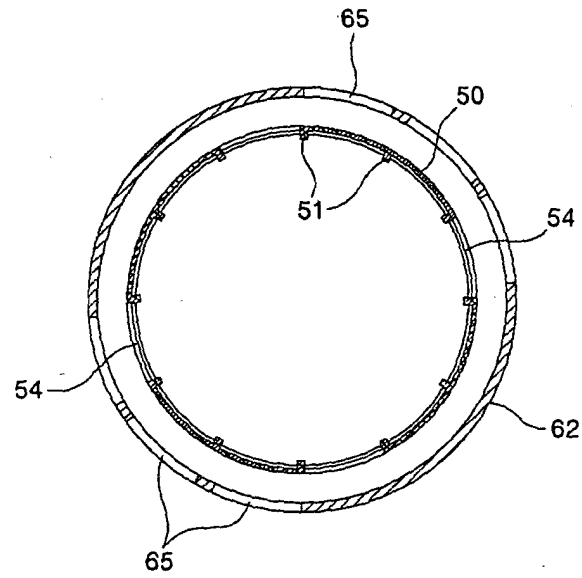


Fig. 7

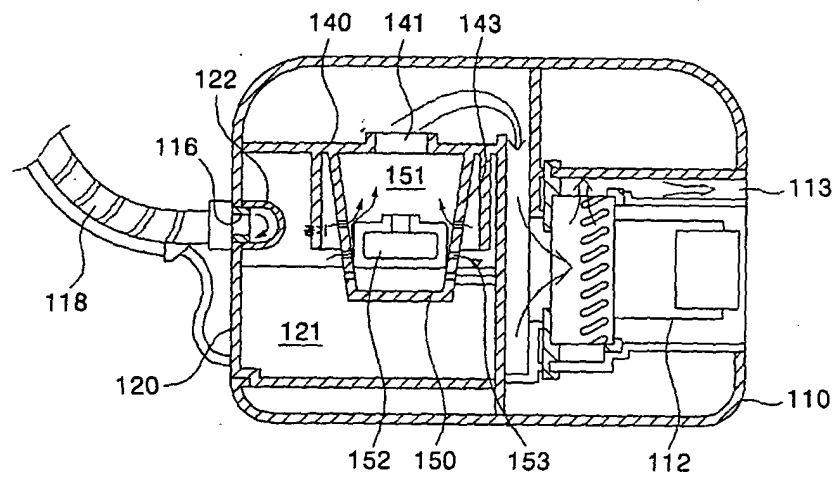


Fig. 8

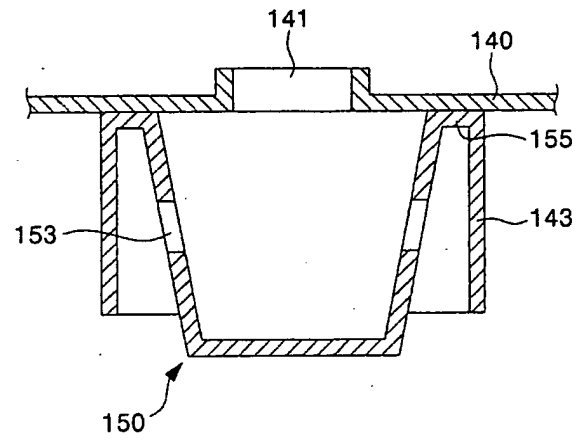


Fig. 9a

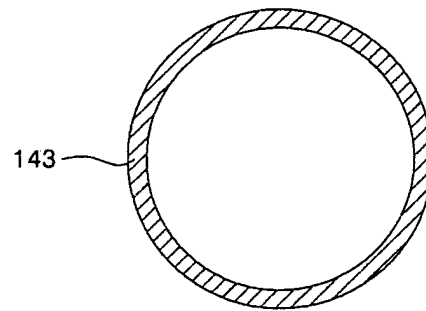


Fig. 9b

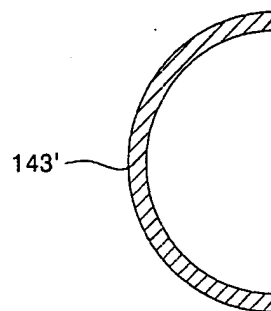


Fig. 10

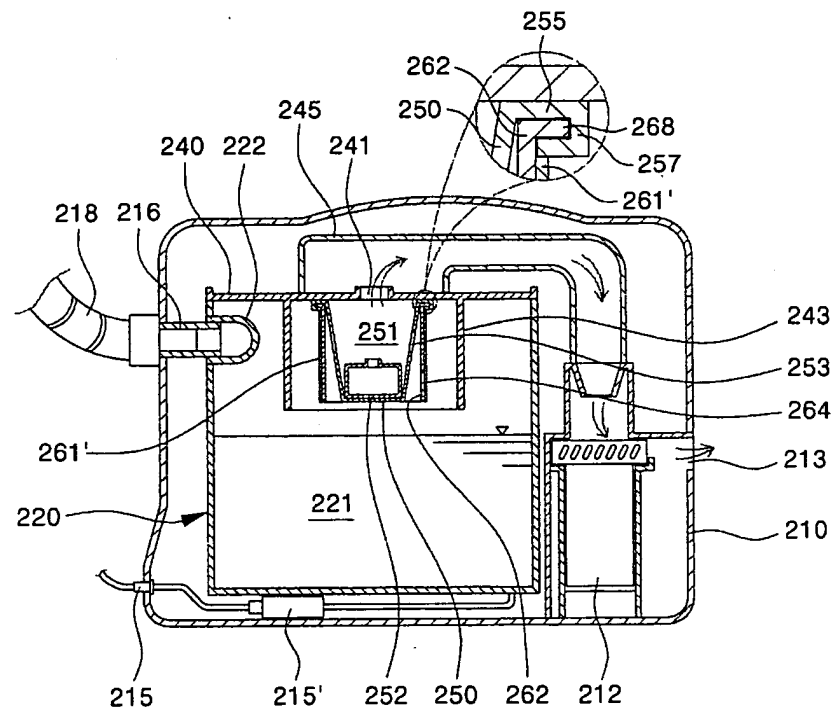


Fig. 11

