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(54) **ELECTRIC VACUUM CLEANER**

(57) A dust collecting device (26) includes a first centrifugally separating part (41) for separating coarse dust in air containing dust, and second centrifugally separating parts (44) communicating with the first centrifugally separating part (41) and positioned above the first centrifugally separating part (41). The second centrifugally separating part (44) separates fine dust in air containing dust which has passed through the first centrifugally separating part (41). The dust collecting device (26) includes an opening/closing lid part (71) capable of opening/closing a part positioned under the second centrifugally separating parts (44). The opening/closing lid part (71) guides dust separated by the second centrifugally separating parts (44) to the first centrifugally separating part (41) by opening the part positioned under the second centrifugally separating parts (44).

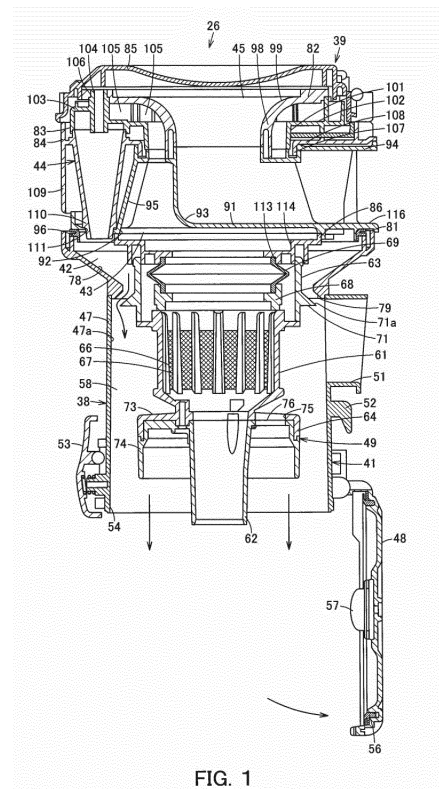


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to an electric vacuum cleaner including a dust collecting device which separates and traps dust from air containing dust sucked by operation of an electric blower.

BACKGROUND ART

[0002] Conventionally, this type of electric vacuum cleaner includes a main body case housing an electric blower, and a dust collecting device detachably attached to the main body case. The dust collecting device is a so-called dust collecting cup, and separates and traps dust from air containing dust sucked by driving of the electric blower.

[0003] As such a dust collecting device, recently, a so-called cyclone separation type device is known which turns air containing dust inside to centrifugally separate (cyclone-separate) dust. In such a cyclone separation type dust collecting device, since the size or specific gravity of each kind of dust capable of being separated is set in accordance with the size (turn diameter) of a separating part, different kinds of dust in air containing dust different in size or specific gravity can be separated by separately providing separating parts different in size.

[0004] However, in the case of accumulating these kinds of dust different in size or specific gravity in the same accumulating part, dust having a small size or specific gravity, that is, fine dust, may be stirred up in the dust collecting device when the electric blower is driven again. Therefore, fine dust and coarse dust having a large size or specific gravity are preferably accumulated in accumulating parts different from each other.

CITATION LIST

Patent Literature

[0005] Patent Literature 1: Japanese Laid-Open Patent Publication No. 2012-40443

SUMMARY OF INVENTION

Technical Problem

[0006] In an electric vacuum cleaner disclosed in Patent Document 1, a plurality of second centrifugally separating parts for centrifugally separating fine dust are circumferentially provided above a first centrifugally separating part for centrifugally separating coarse dust, fine dust separated by the second centrifugally separating parts is dropped and accumulated in an accumulating part partitioned at a central part of the first centrifugally separating part, and coarse dust is accumulated around the accumulating part. Each of these kinds of accumu-

lated dust can be simultaneously discarded by opening a lower part of the first centrifugally separating part.

[0007] However, in this structure, since a triple structure, an air passage for dropping fine dust from the second centrifugally separating parts into the accumulating part, the first centrifugally separating part and a passage for making air exhausted from the first centrifugally separating part flow to the second centrifugally separating parts, are provided at an upper part of the structure and a double structure, an annular region as an accumulating part of fine dust and an accumulating part of coarse dust, are provided at a lower part thereof, a space for coarse dust accumulated in the first centrifugally separating part is downsized. The first centrifugally separating part, that is, dust collecting device, cannot be prevented from being upsized for sufficiently securing the space.

[0008] It is an object of the present invention to provide an electric vacuum cleaner which is prevented from being upsized, secures spaces for different kinds of dust different in size, and can effectively separately accumulate these kinds of dust into the spaces and easily discard the dust.

Solution to Problem

[0009] An electric vacuum cleaner according to an embodiment has: a main body case housing an electric blower; and a dust collecting device which is detachably connected to the main body case, and separates and traps dust from air containing dust sucked by operation of the electric blower. The dust collecting device includes a first centrifugally separating part for separating part of dust in air containing dust, and second centrifugally separating parts communicating with the first centrifugally separating part and positioned above the first centrifugally separating part. The second centrifugally separating part separates dust contained in air which has passed through the first centrifugally separating part, and the dust being smaller than dust separated by the first centrifugally separating part. The dust collecting device further includes an opening/closing lid part capable of opening/closing a part under the second centrifugally separating parts. The opening/closing lid part guides dust separated by the second centrifugally separating parts to the first centrifugally separating part side by opening the part under the second centrifugally separating parts.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

Fig. 1 is a cross sectional view showing a state where dust collected in a dust collecting device of an electric vacuum cleaner according to a first embodiment is discarded.

Fig. 2 is a cross sectional view showing a use state of the dust collecting device.

Fig. 3 is a perspective view showing the electric vac-

uum cleaner.

Fig. 4 is a cross sectional view showing a state where dust collected in a dust collecting device of an electric vacuum cleaner according to a second embodiment is discarded.

Fig. 5 is a cross sectional view showing a use state of the dust collecting device.

DESCRIPTION OF EMBODIMENTS

[0011] Hereinafter, a constitution of a first embodiment will be described with reference to Figs. 1 to 3.

[0012] A reference numeral 11 in Fig. 3 denotes a so-called canister type electric vacuum cleaner, and the electric vacuum cleaner 11 has a tube part 12 as a sucked air passage body (air passage forming body) and a cleaner main body 13 to which the tube part 12 is detachably connected.

[0013] The tube part 12 includes: a connection tube part 15 connected to the cleaner main body 13; a flexible hose body 16 communicating with a tip end side of the connection tube part 15; a hand operation part 17 provided on a tip end side of the hose body 16; an extension tube 18 detachably connected to a tip end side of the hand operation part 17; and a floor brush 19 as a suction port body detachably connected to a tip end side of the extension tube 18.

[0014] A loop-shaped grip part 21 is projected to the hose body 16 side from the hand operation part 17, and a plurality of set buttons 22 for operation are provided on an upper part of the grip part 21.

[0015] The cleaner main body 13 includes a main body case 25 having large diametrical traveling wheels 23 at its both sides and a turning wheel (not shown) at its lower part, and a dust collecting device 26 which is a dust collecting cup can be attached/detached to/from an upper part of the main body case 25. The cleaner main body 13 is constituted so that it can travel (move) on a floor surface to be cleaned at least along the back and forth direction by the traveling wheels 23 and the turning wheel. Moreover, hereinafter, a vertical direction and a horizontal direction will be defined with reference to a traveling (moving) direction of the cleaner main body 13 (main body case 25).

[0016] The main body case 25 is formed of, for example, synthetic resin, and integrally has a main body part 31 positioned behind the dust collecting device 26 and a projected receiving part 32 as a dust collecting device supporting part which is projected on a front part of the main body part 31 to support a lower part of the dust collecting device 26. A main body air passage part (not shown) is arranged over the main body part 31 and the projected receiving part 32 in the main body case 25.

[0017] There are housed in the main body part 31: an electric blower 35; a power source part (not shown) such as a cord reel device or secondary battery capable of supplying power to the electric blower, etc.; a control circuit part as a control unit for controlling operation of the

electric blower 35; and the like. In addition, above the projected receiving part 32 at the front part of the main body part 31, an intake opening part (not shown) airtightly connected to a downstream side of the dust collecting device 26 attached to the main body case 25 and a communication opening part airtightly connected to an upstream side of the dust collecting device 26 are opened so as to be positioned above and below. An exhaust hole (not shown) for exhausting air exhausted from the electric blower 35 outside of the main body case 25 is formed at a rear end of the main body part 31.

[0018] Operation of the electric blower 35 is controlled by the control circuit part in accordance with operation of the set button 22. A suction side of the electric blower 35 communicates with the intake opening part, and a downstream side thereof communicates with the exhaust hole.

[0019] The control circuit part is electrically connected to the set button 22 and is constituted so as to set operation of the electric blower 35 to an operation mode (for example, strong mode, medium mode, weak mode, automatic mode, or stop mode) set by operation of the set button 22.

[0020] A main body suction port 36, to which the connection tube part 15 of the tube part 12 is connected, is formed on a front face of the projected receiving part 32, and serves as an opening of an upstream end of the main body air passage part. Accordingly, the main body suction port 36 communicates with the communication opening part via the main body air passage part and can communicate with the upstream side of the dust collecting device 26 via the communication opening part.

[0021] As shown in Figs. 1 to 3, the dust collecting device 26 includes a lower side main body part 38 as a first main body part positioned at its lower side and an upper side main body part 39 as a second main body part positioned at its upper side of the lower side main body part 38, the main body parts 38 and 39 being attachable/detachable to/from each other. A first centrifugally separating part 41 and a fine dust accumulating part 42 as a dust accumulating part are provided in the lower side main body part 38, and a ventilation air passage part 43, for example, a plurality of second centrifugally separating parts 44, and an air passage part 45 are provided in the upper side main body part 39. The dust collecting device 26 is constituted so as to be detachably locked to the main body case 25 by a locking mechanism (not shown).

[0022] The lower side main body part 38 is formed in a unit form integrally including the first centrifugally separating part 41 positioned at its lower side and the fine dust accumulating part 42 positioned at its upper side.

[0023] The first centrifugally separating part 41 mainly centrifugally separates and accumulates dust which is part of air containing dust sucked in by driving of the electric blower 35 and relatively large, that is, coarse dust. The first centrifugally separating part 41 has an approximately cylindrical case part 47, a lower lid part 48 as a lid body attached to a lower end of the case part 47, and

an approximately cylindrical shade part 49 which is a connection body as a structure housed in the case part 47.

[0024] The case part 47 is formed of a material such as (transparent) synthetic resin having transmittance. Accordingly, the inside of the first centrifugally separating part 41 can be visually recognized from the outside. An introduction port 51 for sucking air containing dust is opened at a rear part of the case part 47, and a hook part 52 as a locking part for locking the dust collecting device 26 to the main body case 25 is projected under the introduction port 51. A dust discarding button part 53 as a lid body locking unit for locking the lower lid part 48 is arranged at a front part of the case part 47. The lower end of the case body 47 is a dust discarding port 54 which is opened/closed by the lower lid part 48.

[0025] The introduction port 51 approximately horizontally extends rearward to be airtightly connected to the communication opening part with the dust collecting device 26 attached to the main body case 25. Accordingly, the introduction port 51 is airtightly connected to the main body suction port 36 via the communication opening part.

[0026] The hook part 52 is bent downward, and is constituted so that, when the dust collecting device 26 is attached to the main body case 25, the hook part 52 is inserted, from above, into an insertion opening (not shown) provided at the front part of the main body part 31.

[0027] The dust discarding button part 53 is positioned at the lower end of the case part 47, and the lock between the dust discarding button part 53 and the lower lid part 48 can be released by external operation by a user.

[0028] The dust discarding port 54 is an opening through which dust accumulated in the first centrifugally separating part 41 and the fine dust accumulating part 42 can be discarded.

[0029] The lower lid part 48 is formed in the shape of, for example, a disk, and a rear end thereof is pivotally supported on the lower end of the case part 47. Accordingly, the lower lid part 48 opens the dust discarding port 54 by its own weight by operation of the dust discarding button part 53. The lower lid part 48 has: a packing 56 for airtightly closing the dust discarding port 54, at its circumferential edge of the upper side of the lower lid part 48; and a circular engagement supporting part 57, with which a lower end side of the shade part 49 engages, is projected at its central part.

[0030] The shade part 49 forms a turning air passage 58 for turning air containing dust between an outer circumference of the shade part 49 and an inner circumferential surface 47a of the case part 47, and the first centrifugally separating part 41 and each second centrifugally separating part 44 (ventilation air passage 43) side are connected to each other through the inside of the shade part 49. The shade part 49 includes integrally: a shade part main body 61 which is an approximately cylindrical structure main body; a supported part 62 provided on a lower end side of the shade part main body 61; a guided part 63 provided on an upper end side of the

shade part main body 61; and a compression part 64 provided on an outer circumference of the supported part 62. That is, the shade part 49 is positioned at the center of turning in the first centrifugally separating part 41.

[0031] The shade part main body 61 includes in the circumferential direction a plurality of openings 66 through which air containing dust turning in the turning air passage 58 passes inward, and all the openings 66 are covered with a filter 67. A cylindrical connection part 68 is coaxially projected on an upper part of the shade part main body 61, and this cylindrical connection part 68 is suspended from the ventilation air passage part 43 of the upper side main body part 39 via a cylindrical connection body 69 and the ventilation air passage part 43 of the upper side main body part 39 supports the cylindrical connection part 68 via a cylindrical connection body 69.

[0032] The connection body 69 is formed, in a bellows shape, of material such as soft synthetic resin such as rubber or elastomer, and is elastic in an axis direction. Accordingly, the shade part 49 can vertically move to the case part 47 and the upper side main body part 39 by elasticity of the connection body 69. The connection body 69 is constituted so as to airtightly maintain a connection between the shade part main body 61 (shade part 49) and the ventilation air passage part 43 even with elasticity of the connection body 69.

[0033] The supported part 62 is arranged coaxially with the shade part main body 61. The supported part 62 has a diameter smaller than that of the shade part main body 61, and a lower end side thereof is projected downward to the compression part 64, engaged with the engagement supporting part 57 of the lower lid part 48 closing the dust discarding port 54, and thus supported by the lower lid part 48 from below.

[0034] The guided part 63 guides a vertical movement of the shade part 49, is formed cylindrically, projected upward from an outer circumference of an upper side of the shade part main body 61 and connected to the ventilation air passage part 43 outside the connection body 69. An opening/closing lid part 71 is projected on an outer circumference of the guided part 63, the opening/closing lid part 71 vertically moving in conjunction with the vertical movement of the shade part 49 so as to open/close a lower part of the fine dust accumulating part 42 positioned under the second centrifugally separating parts 44. The opening/closing lid part 71 is in the shape of a flange over the circumference of the guided part 63. The whole of an upper surface of the opening/closing lid part 71 becomes an inclined surface 71a inclined downward to the outside. That is, a vertical cross sectional view of the opening/closing lid part 71 is triangular.

[0035] The compression part 64 compresses coarse dust, which is separated by the first centrifugally separating part 41, with use of negative pressure generated by driving of the electric blower 35, has integrally a circular top plate part 73 radially projected in a flange shape from the outer circumference of the supported part 62

and a circumferential plate part 74 projected downward from an outer circumferential edge of the top plate part 73, and is opened downward. The top plate part 73 has a plurality of ventilation openings 75 in the circumferential direction arranged at approximately equal intervals, and the ventilation openings 75 are covered with a compression filter 76. In the compression part 64, part of air containing dust turning in the turning air passage 58 circulates and passes through the ventilation openings 75 from the lower side, and thus coarse dust is pressed against the compression filter 76, compressed and accumulated around the supported part 62.

[0036] The fine dust accumulating part 42 accumulates relatively small, that is, fine dust which is centrifugally separated in air containing dust by each second centrifugally separating part 44, and is provided in a ring shape, and expands its opening upward with respect to the case part 47 continuing over the whole circumferential edge part of an upper end of the case part 47 of the first centrifugally separating part 41. That is, the fine dust accumulating part 42 includes an inclined surface part 78 inclined downward from the outside to the inside. The fine dust accumulating part 42 has an opened upper side, and communicates with lower ends of all the second centrifugally separating parts 44. The whole of the upper side (except a part communicating with the second centrifugally separating parts 44) of the fine dust accumulating part 42 is closed by the upper side main body part 39. A contact surface part 79 inclined toward the first centrifugally separating part 41 side is provided at a lower end of the fine dust accumulating part 42, that is, under the inclined surface part 78. The contact surface part 79 is a part for coming into contact with the inclined surface 71a of the opening/closing lid part 71, and inclined downward from the inside to the outside.

[0037] The upper side main body part 39 is formed in a unit form integrally including a first air passage body 81, a second air passage body 82, an introduction air passage body 83, a separation air passage body 84, an upper lid part 85 and a communication air passage body 86 as a structure holding part.

[0038] The first air passage body 81 includes integrally: a disk-shaped lower plate part 91 constituting a lower end of the upper side main body part 39; an opening part 92 circularly opened on a central part of the lower plate part 91 and airtightly connected to the communication air passage body 86; a cylindrical part 93 as a ventilation part positioned at a central part of the opening part 92 and erected upward from the lower plate part 91; a duct part 94 as a communication ventilation part communicating with a rear part of the cylindrical part 93, extending rearward and connected to the lower plate part 91; and a cylindrical air guiding part 95 erected outside the cylindrical part 93, concentrically with the cylindrical part 93, and upward from an edge part of the opening part 92. A seal member 96 for closing a gap between the upper side main body part 39 and an upper part (fine dust accumulating part 42) of the lower side main body part 38 is

attached to a lower part of the lower plate part 91. The air guiding part 95 is inclined upward so as to approach the center side of the opening part 92, that is, an outer circumference of the cylindrical part 93.

[0039] The second air passage body 82 includes integrally: a cylindrical ventilation cylinder part 98 as a rectifying part of which a lower end is airtightly connected to an upper end of the cylindrical part 93 of the first air passage body 81; and a flange part 99 extending in the shape of a flange which extends in diameter gradually bending up and outward from an upper end of the ventilation cylinder part 98 and of which the diameter of an upper part is larger than that of a lower part. An outer circumference of the flange part 99 comes into contact with an inner edge part of the upper lid part 85.

[0040] The introduction air passage body 83 includes integrally: a cylindrical connection cylinder part 101 as a ventilation connection part airtightly connected to an upper end of the air guiding part 95 of the first air passage body 81; a circular extension part 102 which extends outward from an upper end of the connection cylinder part 101 in the shape of a flange so as to face a lower part of the flange part 99 and covers an upper side of the separation air passage body 84; a plurality of turning parts 103 each spirally provided on the extension part 102 and constituting an upper end of the second centrifugally separating part 44; exhaust cylinder parts 104 each as an exhaust part provided cylindrically integrally with a central part of the turning part 103; and branch introduction parts 105, each of which is provided so as to communicate with the turning part 103 along an upper part of the extension part 102 in a tangential direction of the turning part 103 and introduces air containing dust into the turning part 103. An upper end of the ventilation cylinder part 104 is airtightly inserted and connected into a circular connection hole 106 opened on the flange part 99 of the second air passage body 82.

[0041] The separation air passage part 84 includes integrally: a cylindrical connection cylinder part 107 connected to the upper end of the air introducing part 95 of the first air passage body 81 outside the connection cylinder part 101; a circular projecting part 108 extending in a flange shape outward from an upper end of the connection cylinder part 107 and overlapping with an upper part of the duct part 94 of the first air passage body 81; an outer wall part 109 projecting downward from an outer circumferential edge of the projecting part 108 and constituting an outer circumference of the upper side main body part 39; and a plurality of turn cylinder parts 110, each of which is provided on the projecting part 108 inside the outer wall part 109 and is a separating chamber part as a second centrifugally separating part main body constituting the lower end of the second centrifugally separating part 44. The turn cylinder part 110 has a diameter smaller than that of the case part 47 of the first centrifugally separating part 41, and the diameter thereof gradually decreases from its upper end to the lower end. The turning parts 103 of the introduction air passage part 83

are respectively engaged with the upper ends of the turn cylinder parts 110, and the lower ends of the turn cylinder parts 110 are respectively inserted in insertion holes 111 circularly opened on the lower plate part 91 of the first air passage body 81 and communicate with the fine dust accumulating part 42.

[0042] The upper lid part 85 covers an upper side of the introduction air passage body 83 and is connected to an upper end of the separation air passage body 84.

[0043] The communication air passage body 86 is approximately cylindrically formed, and includes integrally a cylindrical connection body fixation part 113 to which an upper end side of the connection body 69 is fixed, and a guide part 114 which is positioned outside the connection body fixation part 113, into which the guided part 63 is inserted and prevented from coming off, and which guides the vertical movement of the shade part 49.

[0044] The ventilation air passage part 43 airtightly connects the first centrifugally separating part 41 and each second centrifugally separating part 44 to each other. The ventilation air passage part 43 is airtightly partitioned from the communication air passage body 86 to the opening part 92 of the first air passage body 81; between the cylindrical part 93 and the duct part 94; and between the ventilation cylinder part 98 and flange part 99 of the second air passage body 82 and the connection cylinder part 101, extension part 102 and turning parts 103 of the introduction air passage body 83, and communicates with each second centrifugally separating part 44 (the inside of the turn cylinder part 110) via the branch introduction part 105 and the turning part 103. Accordingly, the ventilation air passage part 43, while reducing the flow of air containing dust, rectifies the air from the upstream side (downstream side of the first centrifugally separating part 41) to the downstream side (upstream side of the second centrifugally separating part 44).

[0045] Each second centrifugally separating part 44 has a turning radius of air containing dust smaller than that of the first centrifugally separating part 41, and turning speed higher than that of the first centrifugally separating part 41. Thus, dust contained in air which has passed through the first centrifugally separating part 41 and (relatively) smaller than dust which has been centrifugally separated by the first centrifugally separating part 41, in air containing dust passing through the first centrifugally separating part 41, that is, fine dust, is centrifugally separated by each second centrifugally separating part 44 to be dropped into the fine dust accumulating part 42. In other words, each second centrifugally separating part 44 centrifugally separates dust which cannot be separated by the first centrifugally separating part 41 from air containing dust. The second centrifugally separating part 44 is partitioned between the turning part 103 and exhaust cylinder part 104 of the introduction air passage body 83 and the turn cylinder part 110 of the separation air passage body 84 above the first centrifugally separating part 41, introduces air containing dust, which has passed through the ventilation air passage

part 43, thereinto from the branch introduction part 105 and the turning part 103, turns the air in the turn cylinder part 110, drops centrifugally separated fine dust from the lower end into the fine dust accumulating part 42, and exhausts fresh air, which is obtained by separation of fine dust, from the exhaust cylinder part 104 to the air passage part 45. The second centrifugally separating parts 44 are arranged in an arc shape, at a position except a rear part (duct part 94) of a circumference of a center axis of the dust collecting device 26 (first centrifugally separating part 41), at approximately equal intervals.

[0046] The air passage part 45 is airtightly partitioned by the upper lid part 85, a part between the flange part 99 and ventilation cylinder part 98 of the second air passage body 82, the cylindrical part 93, duct part 94 and lower plate part 91 of the first air passage body 81 and communicates with each exhaust cylinder part 104. That is, the air passage part 45 communicates with the downstream sides of all the second centrifugally separating parts 44, extends so as to gradually reduce the amount of air flowing from above each second centrifugally separating parts 44 to the side of the second centrifugally separating parts 44, in the embodiment, to the center of second centrifugally separating parts 44 arranged in an arc shape (approximate circle), and bends rearward. A downstream end side of the air passage part 45 is an exhaust opening 116 for exhausting air from the dust collecting device 26, and the opening 116 is positioned between the rear second centrifugally separating parts 44. The exhaust opening 116 is airtightly connected to the intake opening part with the dust collecting device 26 attached to the main body case 25. Accordingly, the exhaust opening 116 is airtightly connected to the suction side of the electric blower 35 via the intake opening part. The exhaust opening 116 is positioned at a rear side, which is the same side as that of the introduction port 51, of the dust collecting device 26, and faces the front part of the main body part 31 of the main body case 25 with the dust collecting device 26 attached to the main body case 25.

[0047] Next, cleaning operation according to the first embodiment will be described.

[0048] When cleaning is started, the dust collecting device 26 is attached to the main body case 25 first.

[0049] At this time, in the dust collecting device 26, when the lower lid part 48 is closed, the engagement supporting part 57 of the lower lid part 48 is inserted in the lower end of the shade part 49 and pushes up the shade part 49. Thus, the guided part 63 is guided by the guide part 114, thereby the shade part 49 moves upward while the connection body 69 is contracted upward.

[0050] The lower lid part 48 is locked to the lower end of the case part 47 by the dust discarding button part 53, and thus the dust discarding port 54 is closed. At this time, the inclined surface 71a of the opening/closing lid part 71 of the shade part 49 is brought into pressure-contact with the contact surface part 79 of the fine dust accumulating part 42, a lower end side of the fine dust

accumulating part 42 is closed, and communication between the turn air passage 58 (first centrifugally separating part 41) and the fine dust accumulating part 42 is blocked (Fig. 2).

[0051] Then, the dust collecting device 26 is mounted and supported on the projected receiving part 32 of the main body case 25 while being positioned by inserting the hook part 52 into the insertion opening of the main body case 25, and is locked to the main body case 25 by the locking mechanism, and thus the introduction port 51 and the exhaust opening 116 of the dust collecting device 26 are respectively airtightly connected to the communication opening part and the intake opening part of the main body case 25. Accordingly, the dust collecting device 26 is attached to the main body case 25 in a state of being airtightly connected between the suction side of the electric blower 35 and the main body suction port 36.

[0052] Moreover, these operations are not required in the case where the dust collecting device 26 has already been attached to the main body case 25.

[0053] In this state, the tube part 12 is connected to the main body suction port 36 of the cleaner main body 13 (main body case 25). Specifically, the tube part 12 inserts and connects the connection tube part 15 into the main body suction port 36, and, if necessary, successively connects the extension tube 18 and the floor brush 19 to the tip end side of the hand operation part 17. In this state, the set buttons 22 on the hand operation part 17 are electrically connected to the control circuit part or the like in the cleaner main body 13 (main body case 25). Moreover, these operations are not required in the case where the tube part 12 has already been connected to the cleaner main body 13.

[0054] A user sets the operation mode of the electric blower 35 by gripping the grip part 21 and operating a desired set button 22. The control circuit part controls input of the electric blower 35 in response to the set operation mode to start up the electric blower 35 by the set operation mode.

[0055] Negative pressure generated by starting-up of the electric blower 35 acts on the tube part 12 via the intake opening part, the exhaust opening 116, the air passage part 45, the second centrifugally separating parts 44, the ventilation air passage part 43, the first centrifugally separating part 41, the introduction port 51, the communication opening part, the main body air passage part and the main body suction port 36.

[0056] A user then sucks dust with air by operation of the negative pressure from the tip end side of the floor brush 19, the extension tube 18 or the hand operation part 17.

[0057] The air containing dust is introduced from the tube part 12 to the introduction port 51 via the main body suction port 36, the main body air passage part and the communication opening part, and sucked from the introduction port 51 into the dust collecting device 26, that is, into the first centrifugally separating part 41.

[0058] In the first centrifugally separating part 41, air

containing dust turns in the turn air passage 58, and thus coarse dust in the air containing dust is particularly centrifugally separated, dropped along the inner circumferential surface 47a of the case part 47 and accumulated onto the lower lid part 48. Moreover, the coarse dust is carried from the turn air passage 58 to the compression part 64 of the shade part 49 by part of air containing dust, and compressed in the compression part 64 around the supported part 62 by the compression filter 76 by passing of the air containing dust through the ventilation opening 75 of the compression part 64.

[0059] Air containing dust from which coarse dust has been separated is filtrated by the filter 67 when passing through the opening 66 of the shade part 49. Air containing dust which has passed through the filter 67 is carried to the ventilation air passage part 43 through the insides of the connection part 68, the connection body 69 and the communication air passage part 86. The air containing dust is gradually reduced in flow and rectified in the ventilation air passage part 43, and branched and flows into each second centrifugally separating part 44 (turn cylinder part 110) from each branch introduction port 105 along a tangential direction of each turning part 103.

[0060] In the second centrifugally separating part 44 (turn cylinder part 110), air containing dust is turned along an inner circumferential surface (inner circumferential surface of the turn cylinder part 110), and fine dust in the air containing dust is centrifugally separated. The fine dust is dropped along the second centrifugally separating part 44 (inner circumferential surface of the turn cylinder part 110) and accumulated in the fine dust accumulating part 42. Moreover, fine dust accumulated in the fine dust accumulating part 42 is guided downward along the inclined surface part 78 of the fine dust accumulating part 42 and positioned on the inclined surface 71a of the opening/closing lid part 71.

[0061] Fresh air obtained by centrifugal separation of fine dust is exhausted from the exhaust cylinder part 104 of the central part of each second centrifugally separating part 44 to the air passage part 45, converges in the air passage part 45, is guided rearward while being reduced in flow by the air passage part 45, and is exhausted from the exhaust opening 116 outside the dust collecting device 26.

[0062] Then, the air is sucked from the intake opening part into the electric blower 35, passes through the electric blower 35 while cooling the inside, becomes air to be exhausted, and is exhausted from the electric blower 35 outside the main body case 25 via the exhaust hole.

[0063] When cleaning is finished, a user operates a predetermined set button 22, and the control circuit part reduces input of the electric blower 35 to stop the electric blower 35.

[0064] When a predetermined amount of dust is accumulated in the dust collecting device 26, a user detaches the dust collecting device 26 from the main body case 25 by externally operating the locking mechanism.

[0065] When a user carries the dust collecting device

26 to a discarding spot such as a trash can and then externally operates the dust discarding button part 53, the lower lid part 48 rotates by its own weight so as to open, the shade part 49 loses support from below, and the shade part 49 moves downward by its own weight while the guided part 63 is guided by the guide part 114 and the connection body 69 is stretched by the shade part 49 (Fig. 1). Accordingly, the inclined surface 71a of the opening/closing lid part 71 is separated from the contact surface part 79 of the fine dust accumulating part 42, and fine dust accumulated in the fine dust accumulating part 42 is guided downward (to the first centrifugally separating part 41 side) by the inclined surface 71a and discarded from the dust discarding port 54 together with coarse dust compressed and accumulated on the lower lid part 48.

[0066] As described above, according to the first embodiment, in conjunction with opening/closing of a lower part of the first centrifugally separating part 41 by the lower lid part 48, the opening/closing lid part 71 opens/closes the lower part of the fine dust accumulating part 42 under each second centrifugally separating part 44, thereby fine dust accumulated in the fine dust accumulating part 42 is guided to the first centrifugally separating part 41 side and can be easily discarded from the dust discarding port 54 together with coarse dust by the user performing only one action of opening the lower lid part 48 to discard the coarse dust.

[0067] Further, since the lower part of the fine dust accumulating part 42 can be reliably closed by the opening/closing lid part 71 with the lower lid part 48 closed, for example, in a state where the dust collecting device 26 is attached to the main body case 25, the lower part of the fine dust accumulating part 42 is constantly closed and fine dust accumulated in the fine dust accumulating part 42 can be reliably prevented from leaking to the first centrifugally separating part 41. Thus, coarse dust and fine dust can be constantly separately accumulated, and discarded together only when the lower lid part 48 is opened for discarding the dust. In other words, unless a user intends to discard dust, coarse dust and fine dust do not mix with each other in the dust collecting device 26 (first centrifugally separating part 41), and there is no possibility that, when the electric blower 35 is driven, the fine dust is stirred up in the dust collecting device 26 to circulate to each second centrifugally separating part 44.

[0068] Since the shade part 49 is connected to the second centrifugally separating 44 side via the elastic connection body 69, no slide part is required to be provided between the shade part 49 and the ventilation air passage part 43 (communication air passage body 86), the slide part maintaining airtightness of a connection between the shade part 44 and the second centrifugally separating part 44 side and permitting a vertical movement of the shade part 49, operation performance of the vertical movement of the shade part 49 (opening/closing lid part 71) and the airtightness of the connection between the shade part 49 and each second centrifugally separating

part 44 is excellent, and time degradation of the airtightness hardly occurs.

[0069] Next, a second embodiment will be described with reference to Figs. 4 and 5. Moreover, the same symbols are attached to the same configurations and operations as those of the above-described first embodiment, and description thereof will be omitted.

[0070] In the second embodiment, the shade part 49 is not supported by the lower lid part 48, and is vertically movably suspended from and held on the communication air passage body 86 of the upper side main body part 39.

[0071] That is, the shade part 49 is held on the guide part 114 of the communication air passage body 86 via the guided part 63 so as to be prevented from coming off from the guide part 114, and is airtightly connected to the ventilation air passage part 43. In other words, the guided part 63 is vertically slidably connected to the guide part 114 so that the shade part 49 is airtightly connected to the ventilation air passage part 43. In addition, the shade part 49 moves upward so as to be sucked to the fine dust accumulating part 42 side by a difference between negative pressures generated by driving of the electric blower 35, so that the inclined surface 71a of the opening/closing lid part 71 is brought into pressure-contact with the contact surface part 79 of the fine dust accumulating part 42 and the lower part of the fine dust accumulating part 42 is airtightly closed. The shade part 49 drops by its own weight in response to stopping of the electric blower 35, and the pressure-contact between the inclined surface 71a of the opening/closing lid part 71 and the contact surface part 79 of the fine dust accumulating part 42 is released.

[0072] Before cleaning, similar to the first embodiment, in the dust collecting device 26 attached to the main body case 25, the shade part 49 drops downward by its own weight. However, when the electric blower 35 is started up, by a difference between negative pressure in the first centrifugally separating part 41 and negative pressure in the fine dust accumulating part 42 communicating with each second centrifugally separating part 44 positioned at the downstream side from the first centrifugally separating part 41 (the degree of vacuum of the fine dust accumulating part 42 (second centrifugally separating part 44) is higher than that of the first centrifugally separating part 41), the shade part 49 is sucked upward instantaneously, the inclined surface 71a of the opening/closing lid part 71 is brought into pressure-contact with the contact surface part 79 of the fine dust accumulating part 42, and the lower part of the fine dust accumulating part 42 is airtightly closed.

[0073] When cleaning is finished and the electric blower 35 is stopped, no negative pressure acts, the shade part 49 automatically drops by its own weight, and the inclined surface 71a of the opening/closing lid part 71 is separated from the contact surface part 79 of the fine dust accumulating part 42. Accordingly, fine dust separated by each second centrifugally separating part 44 and accumulated in the fine dust accumulating part 42

is guided downward (to the first centrifugally separating part 41 side) by the inclined surface 71a to be accumulated on the lower lid part 48 (in the first centrifugally separating part 41). Accordingly, when a user detaches the dust collecting device 26 from the main body case 25 by externally operating the locking mechanism, carries the dust collecting device 26 to a discarding spot such as a trash can and then externally operates the dust discarding button part 53, the lower lid part 48 rotates by its own weight so as to open and fine dust is discarded from the dust discarding port 54 together with coarse dust compressed and accumulated on the lower lid part 48.

[0074] As described above, according to the second embodiment, the shade part 49 is closed by being sucked to the second centrifugally separating part 44 side by negative pressure generated by driving of the electric blower 35, and separated from the second centrifugally separating part 44 side by loss of negative pressure in response to stopping of the electric blower 35, the opening/closing lid part 71, which vertically moves to open/close the lower part of the fine dust accumulating part 42 positioned under each second centrifugally separating part 44, can be easily formed by a simple constitution, and fine dust accumulated in the fine dust accumulating part 42 can be reliably prevented from leaking to the first centrifugally separating part 41 side while the electric blower 35 is driven, that is, cleaning is performed.

[0075] In at least one of the above-described embodiments, the opening/closing lid part 71 for opening/closing the fine dust accumulating part 42 positioned under each second centrifugally separating part 44 is provided. Thus, in a state where the fine dust accumulating part 42 positioned under the second centrifugally separating parts 44 is closed by the opening/closing lid part 71, fine dust centrifugally separated by each second centrifugally separating part 44 can be accumulated in the fine dust accumulating part 42, and thus the coarse dust centrifugally separated by the first centrifugally separating part 41 and the fine dust centrifugally separated by each second centrifugally separating part 44 can be separately accumulated. Accordingly, the dust collecting device 26 is prevented from becoming unnecessarily large, spaces for fine dust and coarse dust are ensured, to allow for each of these kinds of dust to be effectively separately accumulated. In addition, in a state where the fine dust accumulating part 42 positioned under the second centrifugally separating parts 44 is opened by the opening/closing lid part 71, fine dust centrifugally separated by each second centrifugally separating part 44 can be guided to the first centrifugally separating part 41 side, and thus coarse dust centrifugally separated by the first centrifugally separating part 41 can be discarded together with the fine dust centrifugally separated by each second centrifugally separating part 44. Therefore, each of these kinds of dust can be easily discarded.

[0076] That is, by only opening/closing the fine dust accumulating part 42 positioned under the second centrifugally separating parts 44 by the opening/closing lid

part 71, switching can be easily performed between a state where coarse dust and fine dust different in size are separately accumulated and a state where each of these kinds of dust can be discarded together. Thus, since coarse dust and fine dust can be discarded together, it is not required to structure the dust collecting device 26 so that fine dust centrifugally separated by each second centrifugally separating part 44 is forcibly accumulated in a space of the first centrifugally separating 41 side. Therefore, without upsizing the dust collecting device 26, a space for accumulating coarse dust and a space for accumulating fine dust are ensured and each of these kinds of dust can be easily discarded together.

[0077] Since the opening/closing lid part 71 is provided integrally with the shade part 49 for turning air containing dust along its outer side (outer circumference) in the first centrifugally separating part 41, another opening/closing lid part is not required to be separately provided by effective use of the constitution of the shade part 49 used for centrifugal separation by the first centrifugally separating part 41, and a simple constitution can be realized.

[0078] Since the whole of the upper surface of the opening/closing lid part 71 is formed into the inclined surface 71a inclined downward to the first centrifugally separating part 41 side, when the lower part of the fine dust accumulating part 42 is opened, fine dust accumulated in the fine dust accumulating part 42 can be reliably dropped and guided to the first centrifugally separating part 41 side without remaining on an upper side of the opening/closing lid part 71.

[0079] Since the lower part of the fine dust accumulating part 42 is formed into the inclined surface part 78 inclined downward to the first centrifugally separating part 41, fine dust can be accumulated in the fine dust accumulating part 42 in a state of being reliably moved toward the opening/closing lid part 71 for opening/closing the lower part of the fine dust accumulating part 42. Accordingly, when the lower part of the fine dust accumulating part 42 is opened by the opening/closing lid part 71, fine dust accumulated in the fine dust accumulating part 42 can be reliably dropped to the first centrifugally separating part 41 side without remaining in the fine dust accumulating part 42.

[0080] That is, fine dust accumulated in the fine dust accumulating part 42 can be easily guided to the first centrifugally separating part 41 side without provision of a driving body for moving the fine dust to the first centrifugally separating part 41 side, thereby preventing an increase in the number of components and weighting of the dust collecting device 26, etc.

[0081] When the electric blower 35 (electric vacuum cleaner 11) is driven, the degree of vacuum of the fine dust accumulating part 42 communicating with each second centrifugally separating part 44 is higher than that of the first centrifugally separating part 41, thereby force is applied to the shade part 49 in a direction that the opening/closing lid part 71 is sucked to the fine dust accumulating part 42 side, that is, upward, and thus the lower

end of the fine dust accumulating part 42 can be more reliably closed by the opening/closing lid part 71.

[0082] Moreover, in each of the above-described embodiments, not a plurality of second centrifugally separating parts but only one second centrifugally separating part 44 may be arranged above the first centrifugally separating part 41.

[0083] Although the opening/closing lid part 71 is constituted so as to move integrally with the shade part 49, the opening/closing lid part 71 may be provided so that, separately from the shade part 49, it opens/closes the lower part of the fine dust accumulating part 42 in conjunction with opening/closing of the lower part of the first centrifugally separating part 41 by the lower lid part 48, or by operation by, for example, negative pressure generated by driving of the electric blower 35.

[0084] Although the opening/closing lid part 71 opens/closes the lower part of the fine dust accumulating part 42 under the second centrifugally separating parts 44, it may be constituted, for example, so as to directly open/close the lower end of the turn cylinder part 110 of each second centrifugally separating part 44.

[0085] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. An electric vacuum cleaner comprising:

a main body case housing an electric blower;
and
a dust collecting device which is detachably provided on the main body case, and separates and traps dust from air containing dust sucked by operation of the electric blower, wherein
the dust collecting device includes:

a first centrifugally separating part for separating part of dust in air containing dust;
second centrifugally separating parts which communicate with the first centrifugally separating part, are positioned above the first centrifugally separating part, and separate dust contained in air which has passed through the first centrifugally separating part and is smaller than dust separated by the first centrifugally separating part; and
an opening/closing lid part which can

open/close a part positioned under the second centrifugally separating parts and guides dust separated by the second centrifugally separating parts to the first centrifugally separating part side by opening the part positioned under the second centrifugally separating parts.

2. The electric vacuum cleaner according to claim 1, wherein
the first centrifugally separating part includes, at its central part, a structure for turning air containing dust along its outside, and the opening/closing lid part is provided integrally with the structure.
3. The electric vacuum cleaner according to claim 2, comprising
an elastic connection body for connecting the structure to the second centrifugally separating part side.
4. The electric vacuum cleaner according to any one of claims 1 to 3, wherein
the dust collecting device includes a lid body for opening/closing a lower part of the first centrifugally separating part, and the opening/closing lid part opens/closes a part positioned under the second centrifugally separating parts in conjunction with opening/closing of the lower part of the first centrifugally separating part by the lid body.

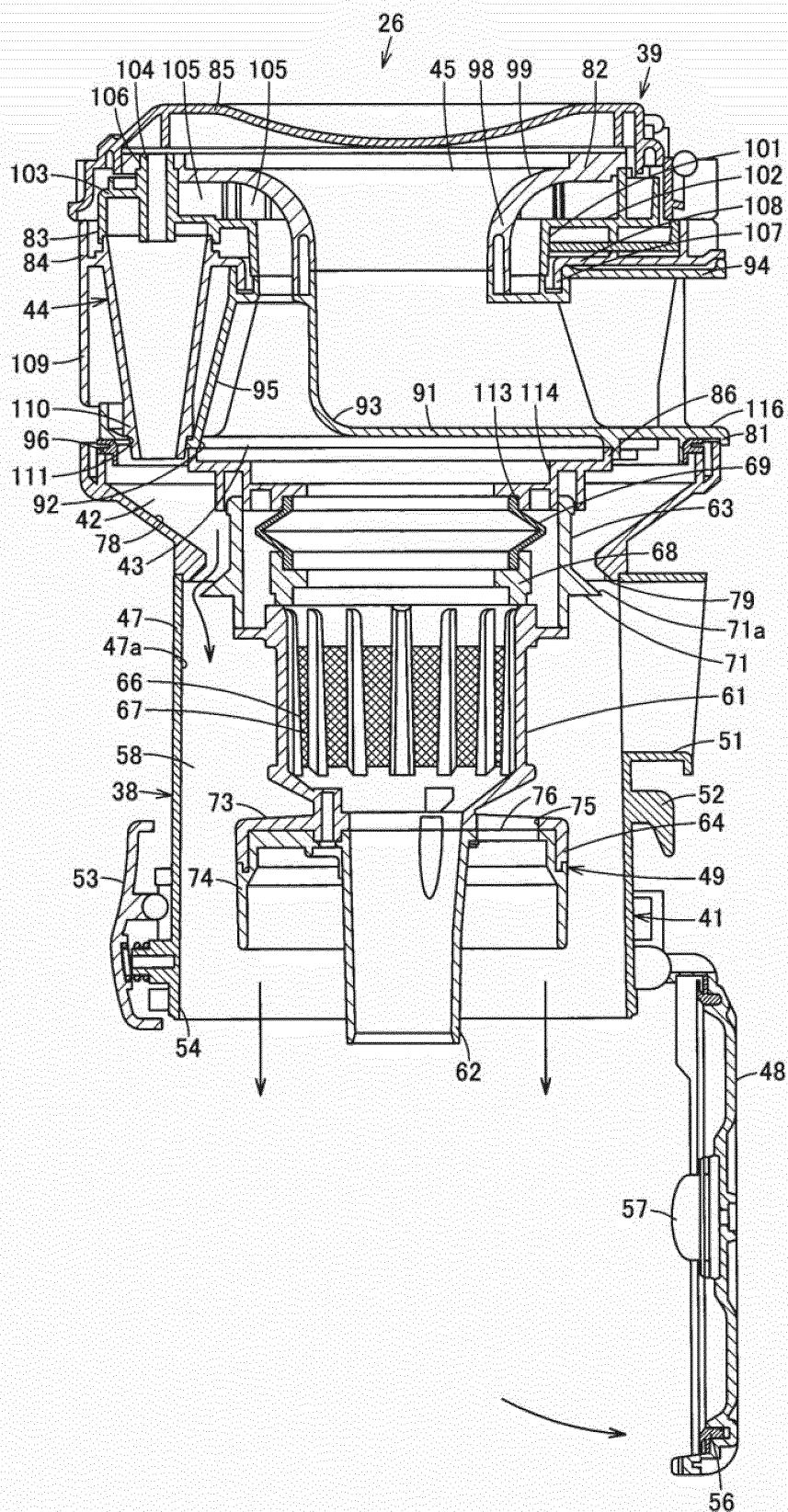


FIG. 1

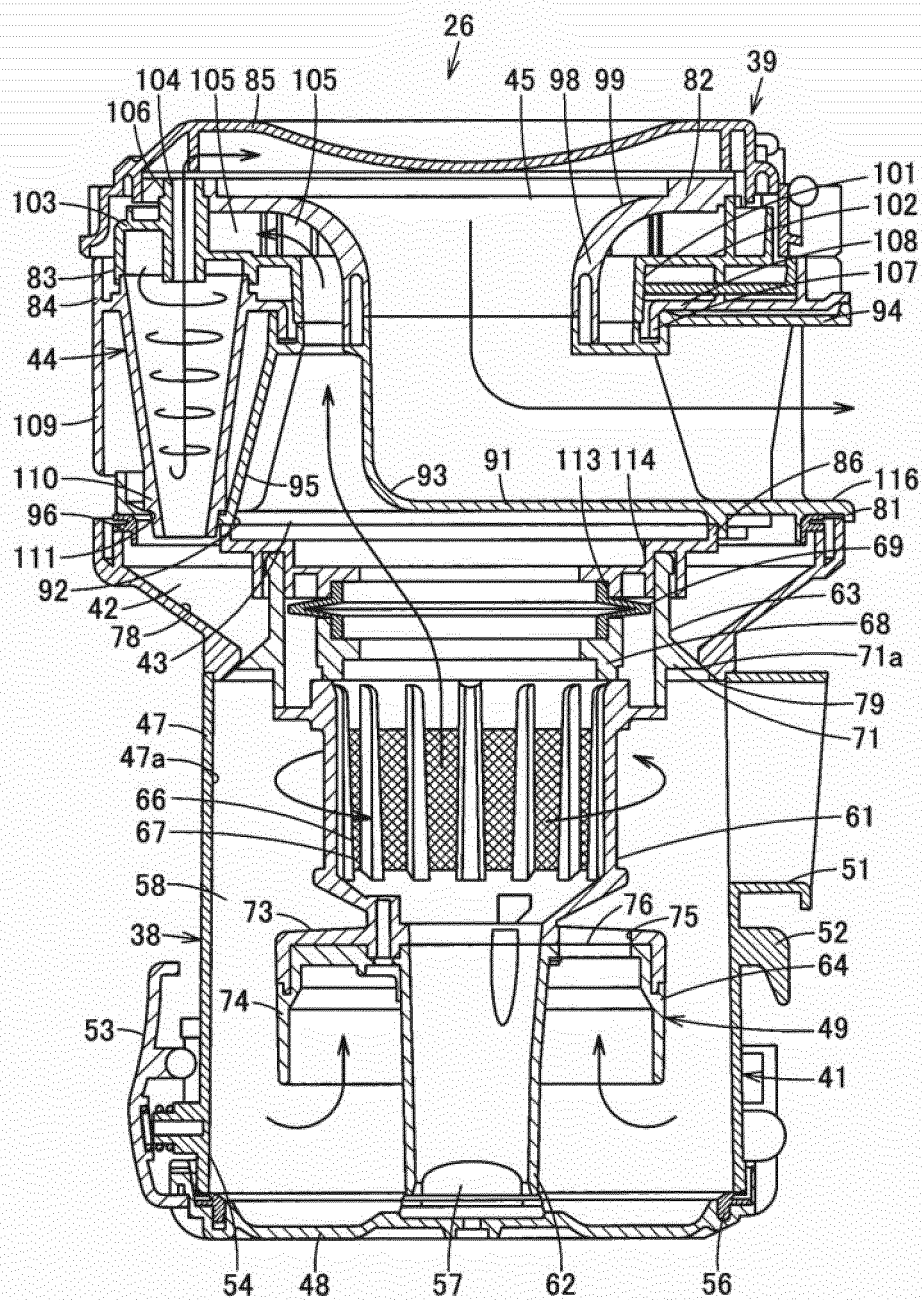


FIG. 2

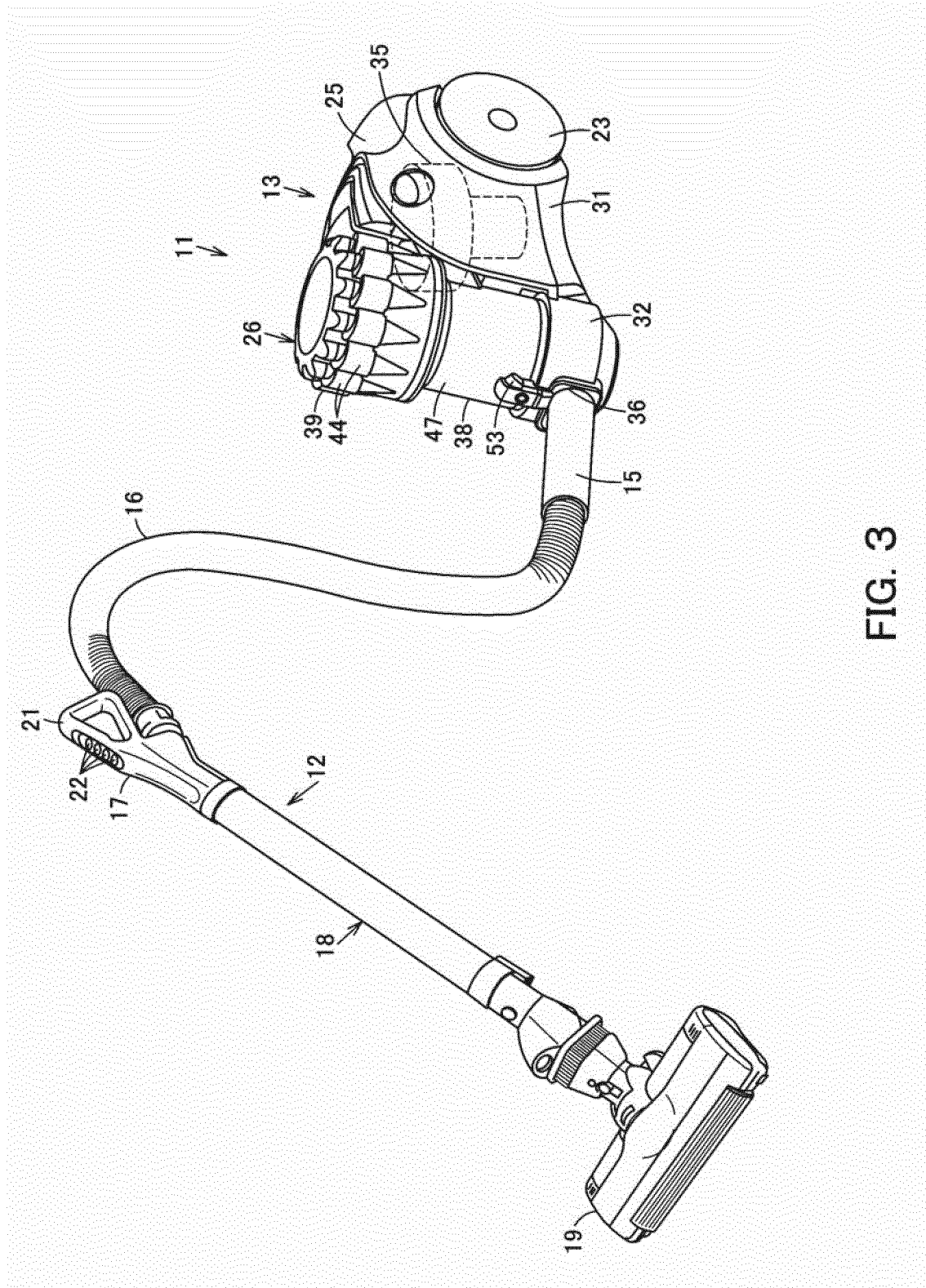


FIG. 3

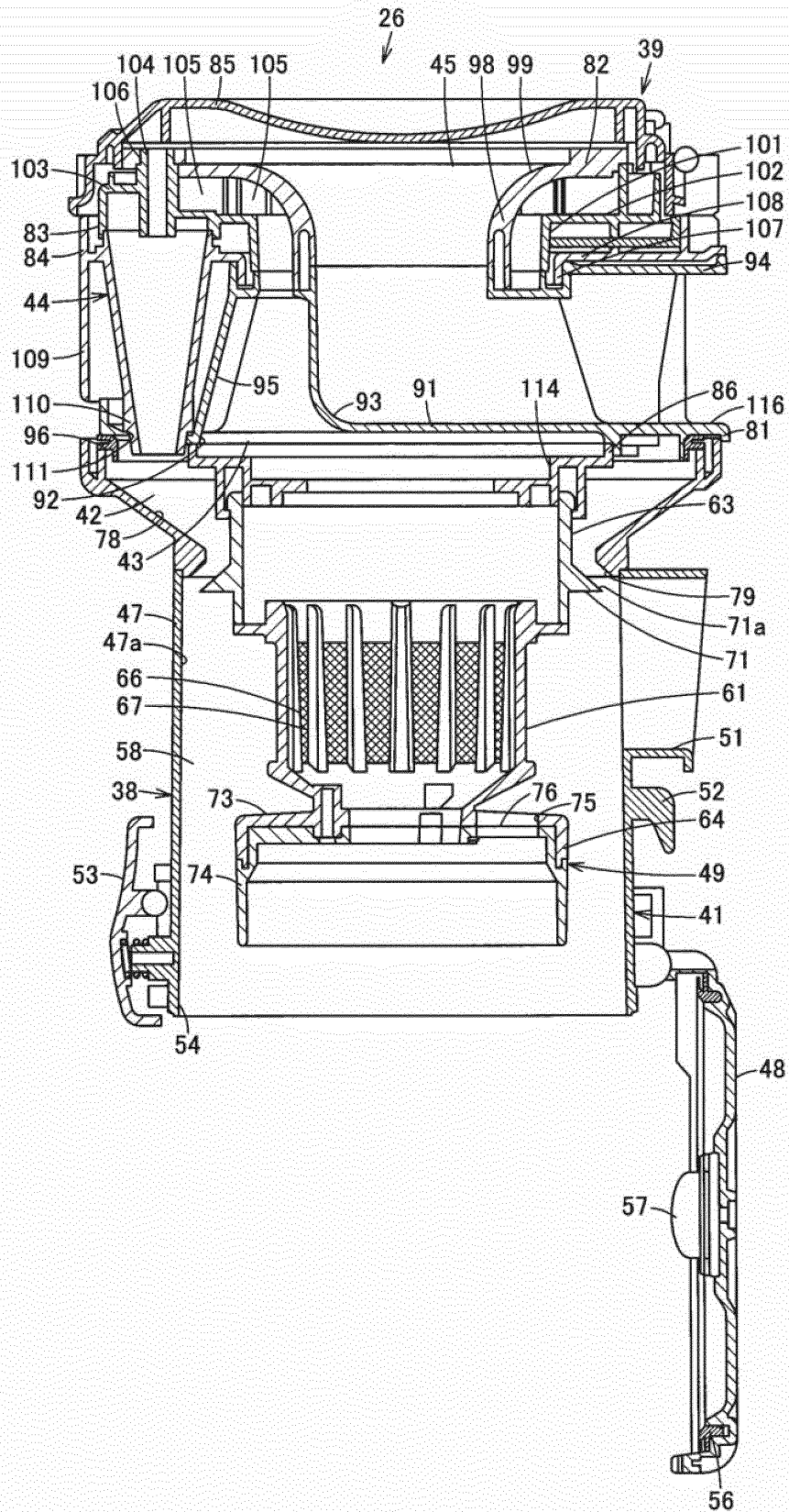


FIG. 4

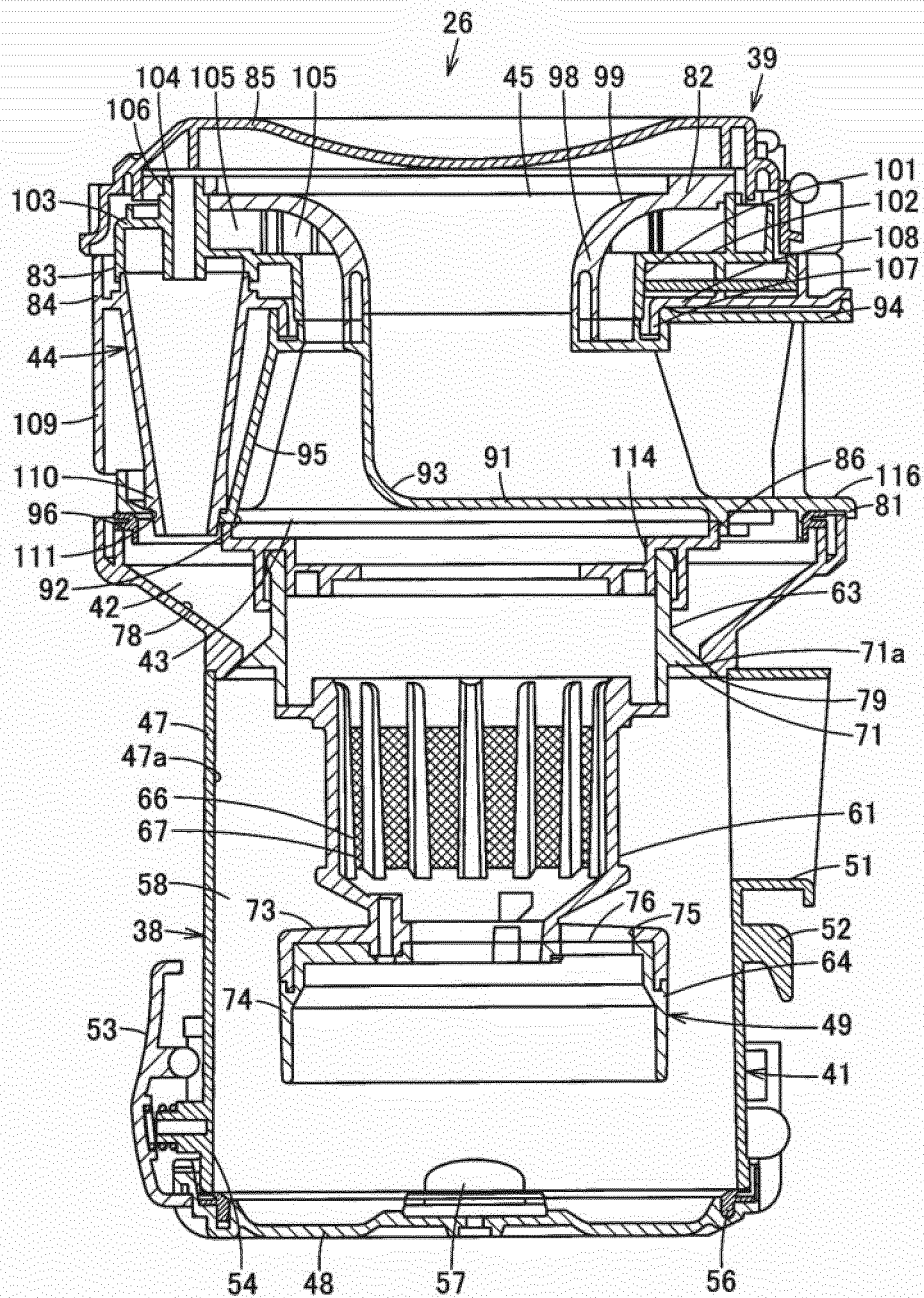


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/063003

A. CLASSIFICATION OF SUBJECT MATTER

A47L9/16(2006.01) i, A47L9/10(2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47L9/16, A47L9/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 011335/1980 (Laid-open No. 114753/1981) (Matsushita Electric Industrial Co., Ltd.), 03 September 1981 (03.09.1981), specification, page 1, line 12 to page 11, line 3; fig. 1 to 2, 4 to 6, 8 (Family: none)	1-4
A	JP 2006-346669 A (Samsung Kwangju Electronics Co., Ltd.), 28 December 2006 (28.12.2006), paragraphs [0025] to [0055]; fig. 2 to 3 & US 2006/0286499 A1 & EP 1733672 A2 & KR 10-0647197 B1 & CN 1879541 A & RU 2316993 C2 & AU 2006200986 A1	1-4

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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Date of the actual completion of the international search
02 August, 2013 (02.08.13)Date of mailing of the international search report
13 August, 2013 (13.08.13)Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006-320713 A (Samsung Kwangju Electronics Co., Ltd.), 30 November 2006 (30.11.2006), paragraphs [0002], [0032] to [0057]; fig. 3 to 8 & US 2006/0254226 A1 & EP 1726245 A2 & KR 10-0598600 B1 & CN 1864619 A & AU 2006201929 A1	1-4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 114847/1979 (Laid-open No. 30861/1981) (Matsushita Electric Industrial Co., Ltd.), 25 March 1981 (25.03.1981), entire text; fig. 3 (Family: none)	1-4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 142792/1979 (Laid-open No. 60447/1981) (Matsushita Electric Industrial Co., Ltd.), 22 May 1981 (22.05.1981), entire text; all drawings (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012040443 A [0005]