

(19)



(11)

EP 2 708 172 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

19.03.2014 Bulletin 2014/12

(51) Int Cl.:

A47L 9/16 (2006.01)

(21) Application number: **12786640.8**

(86) International application number:

PCT/JP2012/058998

(22) Date of filing: **02.04.2012**

(87) International publication number:

WO 2012/157350 (22.11.2012 Gazette 2012/47)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

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(30) Priority: **13.05.2011 JP 2011108373**

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(54) **VACUUM CLEANER**

(57) An object of this invention is to provide a vacuum cleaner having a dust collection section that a user can easily perform internal maintenance of. To achieve the above object, a vacuum cleaner includes a body containing a motor-driven blower that generates a suction force, and a cyclone dust collection section that is detachable from the body. The cyclone dust collection section includes, as respective parts, a plurality of centrifugal separation sections that separate air and dust, a communication section that allows the adjacent centrifugal separation sections to communicate, and a dust collection chamber that accumulates dust that was separated by the centrifugal separation section. The cyclone dust collection section is disassemblable into the dust collection chamber, the centrifugal separation sections, and the communication section, respectively. By adopting this configuration, since the cyclone dust collection section can be disassembled into respective sections thereof, maintenance of the inside of the dust collection section can be performed with ease.

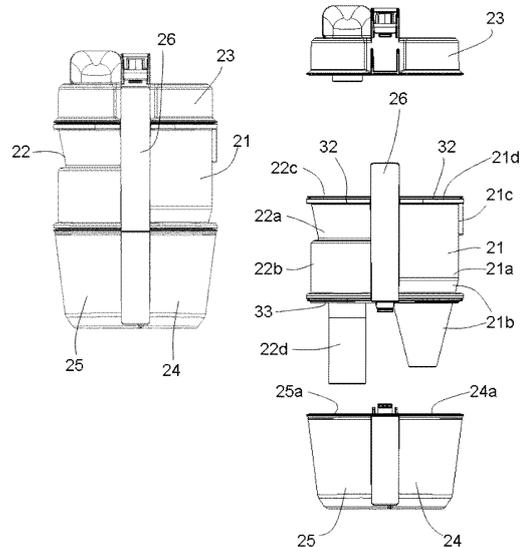


Fig.9

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Description**Technical Field**

[0001] The present invention relates to a vacuum cleaner having a cyclone dust collection section that produces a swirling flow therein, and separates air and dust and only accumulates the dust therein.

Background Art

[0002] Vacuum cleaners are already available in which a cyclone dust collection section (hereunder, referred to as "dust collection section") that produces a swirling flow internally, separates air and dust, and accumulates only dust therein is detachably provided on a body having therein a motor-driven blower that generates a suction force.

[0003] When using the above kind of vacuum cleaner, when a certain amount of dust accumulates in a dust collection chamber that accumulates dust within the dust collection section, the user detaches the dust collection chamber from the body and disposes of the dust that has accumulated inside the dust collection chamber. Thus, the vacuum cleaner can be used without using a paper bag filter that accumulates dust therein (for example, see Patent Literature 1).

Citation List**Patent Literature**

[0004] Patent Literature 1: Japanese Patent Laid-Open No. 2009-112811 (Figure 1)

Summary of Invention**Problem to be Solved by the Invention**

[0005] However, according to the configuration disclosed in Patent Literature 1, although it is possible to perform maintenance such as cleaning and washing with water by separating the dust collection chamber that accumulates dust from the dust collection section, it is not possible to disassemble a centrifugal separation section that produces a swirling flow or an air passage that connects adjacent centrifugal separation sections, and hence it is difficult to perform maintenance such as washing thereof.

[0006] In particular, in some cases light dust such as hair is not completely separated from air and remains inside a centrifugal separation section, and hence there is a demand for a vacuum cleaner that has a dust collection section that allows a user to perform maintenance on the inside of a centrifugal separation section.

[0007] In particular, because these kinds of vacuum cleaners are used by a variety of users, there is a demand for a vacuum cleaner having a dust collection section that

can be easily separated and assembled, and that is configured so that, if incorrectly assembled, is not wrongly used in that state.

[0008] The present invention has been conceived to solve the above described problems, and an object of the present invention is to provide a vacuum cleaner having a dust collection section that allows a user to easily perform maintenance on the inside thereof.

Means for Solving the Problem

[0009] To solve the above described problems, it is sufficient to provide a vacuum cleaner including a body having therein a motor-driven blower that generates a suction force, and a cyclone dust collection section that is detachable from the body; wherein the cyclone dust collection section includes, as respective parts, a plurality of centrifugal separation sections that separate air and dust, a communication section that allows the centrifugal separation sections that are adjacent to communicate, and a dust collection chamber that accumulates dust that is separated by the centrifugal separation section, and is disassemblable into the dust collection chamber, the centrifugal separation sections, and the communication section, respectively.

Advantageous Effects of Invention

[0010] According to the present invention, since the cyclone dust collection section can be disassembled into a plurality of centrifugal separation sections that separate air and dust, a communication section that allows the centrifugal separation sections that are adjacent to communicate, and a dust collection chamber that accumulates dust that is separated by the centrifugal separation section, that are respective components thereof, maintenance of the inside of the dust collection section can be performed with ease.

Brief Description of Drawings**[0011]**

Figure 1 is a general view that shows a vacuum cleaner C.

Figure 2 includes (a) a front view, (b) a side view, and (c) a cross-sectional view along a line X-X that show a dust collection section 20.

Figure 3 is a central cross-sectional view taken along the center in the transverse direction of a body 10 and the dust collection section 20, that shows a state in which the dust collection section 20 is fixed to the body 10.

Figure 4 is a perspective view of the body 10.

Figure 5 is an enlarged view of a fitting concavity 29 of the dust collection section 20 and a fitting protrusion 13a of the body 10 that are shown in Figure 3.

Figure 6 is a view that illustrates a state in which

engagement between the fitting concavity 30 and the fitting protrusion 13a that is illustrated in Figure 5 has been released.

Figure 7 is a cross-sectional view that illustrates the vicinity of a lock section 31 shown in Figure 3.

Figure 8 is a cross-sectional view of a state in which the lock section 31 shown in Figure 7 has been unlocked.

Figure 9 is a plan view illustrating a state in which the dust collection section 20 has been disassembled into respective sections thereof.

Figure 10 includes (a) a cross-sectional view along a line Y-Y, (b) a side view, and (c) and (d) partially enlarged views of the dust collection section 20.

Figure 11 is a longitudinal sectional view of the dust collection section 20.

Figure 12 is an exploded view illustrating the relationship between a dust collection chamber and a centrifugal separation section.

Figure 13 is an exploded view illustrating the relationship between centrifugal separation sections 21, 22 and a communication section 23.

Figure 14 is an exploded view illustrating the relationship between a first centrifugal separation section 21 and a discharge pipe.

Figure 15 includes (a) a plan view, (b) a cross-sectional view, and (c) a partially enlarged view of a state in which the discharge pipe is set in the first centrifugal separation section 21, as viewed from above.

Modes for Carrying Out the Invention

[0012] An embodiment is described hereunder with reference to the accompanying drawings.

[0013] Figure 1 is a general view of a vacuum cleaner C.

[0014] Figure 2 includes (a) a front view, (b) a side view, and (c) a cross-sectional view that show a dust collection section 20.

[0015] Note that the side view in Figure 2(b) is a view as seen from the side of a first centrifugal separation section 21 that is described later. Further, the cross-sectional view in Figure 2(c) is a cross-sectional view in the transverse direction of the first centrifugal separation section 21 and a second centrifugal separation section 22 that are arranged side by side as described later.

[0016] Referring to Figure 1, the vacuum cleaner C includes a body 10 inside which various functional components are housed, a cyclone dust collection section 20 (hereunder, referred to as "dust collection section 20") that is detachably attached to an upper portion of the body 10, and dust suction means 50 that forms a suction passage for sucking dust from a cleaning surface and causing the dust to flow into the body.

[0017] A control section that performs control of each section of the vacuum cleaner C, a motor-driven blower that generates a suction force as a force for sucking in dust from a site to be cleaned, a power cord for obtaining

electric power from an external power source, and a cord reel around which the power cord is wound and the like are housed inside the body 10.

[0018] A connection opening 11 to which a hose unit 51, described later, communicatively connects is formed at a front portion of the body 10. In addition, at an upper face side part of the body 10, a communication passage 12 is provided that communicates with the connection opening 11 and communicatively connects to a dust intake opening 21c formed in the first centrifugal separation section 21 that is described later.

[0019] The dust suction means 50 includes a hose unit 51, an extension pipe 52, and a floor surface suction tool 53.

[0020] In the hose unit 51, a first connection section 51b that detachably connects to the connection opening 11 of the body 10 is formed at one end of the hose 51a, a second connection section 51c that is connected to the extension pipe 52 or the like is formed at the other end of the hose 51a, and a hand-held handle 51f is provided on which an operation section 51d that a user uses to operate the vacuum cleaner C is provided integrally with the second connection section 51c.

[0021] In the extension pipe 52, two pipes having different outer-shape sizes to each other are combined so that the overall length of the extension pipe 52 can be expanded and contracted. A first connection section 52a that connects with the hose unit 51 is formed at one end of the extension pipe 52, and a second connection section 52b that connects with the floor surface suction tool 53 is formed at the other end thereof.

[0022] The floor surface suction tool 53 includes a base body 53b in which a suction opening 53a that sucks dust on the floor surface side is formed, and a connection section 53c that is provided so as to communicate with and be rotatable with respect to the base body 53b and that connects with the extension pipe 52 at one end. The floor surface suction tool 53 is configured to be capable of travelling along a floor surface that is a cleaning surface at a time of use.

[0023] The body 10, the dust collection section 20, and the dust suction means 50 that are described above are communicatively connected from the dust suction means 50 to the body 10.

[0024] That is, dust that is sucked from a site to be cleaned flows into the body 10 through the dust suction means 50 together with air, and thereafter flows into the inside of the dust collection section 20. Subsequently, in the dust collection section 20, the dust is separated from the air, the dust is accumulated inside the dust collection section 20, and the air flows into the body 10 once more and is discharged to outside of the body through a discharge port via the motor-driven blower.

[0025] Note that the floor surface suction tool 53 is not limited to the form described above, and various kinds of floor surface suction tools 53 are used in accordance with the site to be cleaned.

[0026] Next, the dust collection section 20 is described

with reference to Figure 2.

[0027] The dust collection section 20 includes the centrifugal separation sections 21, 22, a communication section 23, and dust collection chambers 24, 25.

[0028] The centrifugal separation sections 21, 22 are parts that produce a swirling flow with respect to air that has flowed into the dust collection section 20 to thereby separate the dust and air by means of a centrifugal force, and are made up of the first centrifugal separation section 21 and the second centrifugal separation section 22.

[0029] Note that the first centrifugal separation section 21 and the second centrifugal separation section 22 are communicatively connected by the communication section 23 so that air can flow down from the first centrifugal separation section 21 to the second centrifugal separation section 22.

[0030] The external shape of the first centrifugal separation section 21 is a cylindrical shape in which a circular cylindrical section 21a and a conical section 21b in which a distal end that narrows in the downward direction is open are vertically connected. That is, the cross-sectional shape of the first centrifugal separation section 21 is a circular shape.

[0031] Note that the circular cylindrical section 21a and the conical section 21b are arranged so that a cross-sectional center of the circular cylindrical section 21a and a cross-sectional center of the conical section 21b overlap when viewed from the longitudinal direction (axial direction of a central axis M1 that is described later) of the dust collection section 20. In addition, the distal end of the conical section 21b is open.

[0032] A dust intake opening 21c for causing air containing dust to flow into the first centrifugal separation section 21 from the communication passage 12 provided in the body 10 is formed in a side face of the first centrifugal separation section 21, and a communication opening 21d that connects with the communication section 23 is formed on the upper face thereof.

[0033] The communication opening 21d is an opening for discharging air from which dust was removed inside the first centrifugal separation section 21 from the first centrifugal separation section 21. A mesh-shaped filter 27, described later, is provided in the communication opening 21d.

[0034] The dust intake opening 21c opens in a tangential direction of a circle that is the cross-sectional shape of the circular cylindrical section 21a. As a result, since air that flows into the first centrifugal separation section 21 flows along an inner wall of the circular cylindrical section 21a, the structure facilitates efficient generation of a swirling flow.

[0035] The first centrifugal separation section 21 configured as described above takes in air in which dust is mixed that has flowed down through the body 10 from the dust intake opening 21c, and by producing a swirling flow of the air, subjects dust that is comparatively large (for example, sand grains and balls of dust such as hair) to primary separation from the air that was taken in.

[0036] Subsequently, the air from which dust was removed by primary separation passes through the filter 27 from the communication opening 21d, and flows down to the second centrifugal separation section 22 via the communication section 23 that is described later. Further, the dust that was separated from the air in the first centrifugal separation section 21 is sent to a first dust collection chamber 24, described later, and accumulated therein.

[0037] The external shape of the second centrifugal separation section 22 is a cylindrical shape in which a conical section 22a that narrows in the downward direction and a circular cylindrical section 22b are integrally connected vertically.

[0038] That is, the cross-sectional shape of the outer form of the second centrifugal separation section 22 is a circular shape. Note that the conical section 22a forms a conical shape as far as the inside of the circular cylindrical section 22b, and a circular cylindrical section 22d is further connected thereto from an opening in the distal end thereof (see Figure 10).

[0039] The conical section 22a and the circular cylindrical section 22b are arranged so that a cross-sectional center of the conical section 22a and a cross-sectional center of the conical section 22b overlap when viewed from the longitudinal direction (axial direction of a central axis M2 that is described later) of the dust collection section 20.

[0040] In addition, a communication opening 22c that connects with the communication section 23 is formed on the upper face of the second centrifugal separation section 22.

[0041] The communication opening 22c is an opening for taking air from which dust was separated by primary separation in the first centrifugal separation section 21 into the second centrifugal separation section 22, and for discharging air from which dust was separated by secondary separation inside the second centrifugal separation section 22 towards the body 10.

[0042] The second centrifugal separation section 22 is a part that takes in air from which dust was removed by primary separation at the first centrifugal separation section 21, and by producing a swirling flow of the air internally, subjects dust that is comparatively small (for example, fine sand grains and minute dirt) to secondary separation from the air that was taken in. The air from which the dust has been removed is discharged to the body 10 via a discharge path 23b that is formed in the communication section 23 that is described later. The dust is sent to a second dust collection chamber 25, described later, and accumulated therein.

[0043] The first centrifugal separation section 21 and the second centrifugal separation section 22 configured as described above are arranged in the following manner to constitute integrated centrifugal separation sections 21, 22.

[0044] First, the first centrifugal separation section 21 and the second centrifugal separation section 22 are ar-

ranged side by side. In this state, the first centrifugal separation section 21 and the second centrifugal separation section 22 are arranged so that the central axis M1 that passes through the cross-sectional center of the circular cylindrical section 21a and the conical section 21b constituting the first centrifugal separation section 21 and the central axis M2 that passes through the cross-sectional center of the conical section 22a and the circular cylindrical section 22b constituting the second centrifugal separation section 22 are parallel.

[0045] Further, the positions of axis M1 and the axis M2 are at the same height when viewing a cross-section X-X that is perpendicular to the axes M1 and M2 of the centrifugal separation sections. That is, the axis M1 and axis M2 are in a laterally aligned positional relationship.

[0046] Further, a handle 26 is provided at a site that, when the dust collection section 20 is mounted to the body 10, is sandwiched between the first centrifugal separation section 21 and the second centrifugal separation section 22, and that is at a position that is opposite the body 10 side of the dust collection section 20. The handle 26 is used by the user to carry only the dust collection section 20 or, in a state in which the dust collection section 20 is attached to the body 10, to carry the dust collection section 20 and the body 10.

[0047] The handle 26 is arranged so as to extend in a long manner between the central axis M1 and the central axis M2 in a direction along the respective axes. That is, the central axis M1, the central axis M2, and the handle 26 are arranged side by side parallel to each other.

[0048] In a state in which the dust collection section 20 and the communication section 23 are connected, the handle 26 protrudes from the dust collection section 20 and extends so as to overlap with the communication section 23. Thus, the communication section 23 is protected by the handle 26 from a shock caused by an external impact.

[0049] In addition, between the handle 26 and the respective centrifugal separation sections 21, 22, an opening section 26a is formed that opens in a (lateral) direction that is perpendicular to the axial directions of the central axis M1 and the central axis M2.

[0050] The opening section 26a is used as a hand-grip position into which the user inserts a hand when grasping the handle 26. The opening section 26a opens so that one part thereof when the dust collection section 20 is viewed from the side overlaps with a space that is sandwiched between the first centrifugal separation section 21 and the second centrifugal separation section 22, that is, overlaps with a hollow section 20a that is the location of a hollow surrounded by the outer face of the first centrifugal separation section 21 and the outer face of the second centrifugal separation section 22.

[0051] The communication section 23 communicatively connects the first centrifugal separation section 21 and the second centrifugal separation section 22. A communication path 23a and the discharge path 23b that is independent from the communication path 23a are formed

inside the communication section 23.

[0052] In the communication section 23 configured in this manner, the communication opening 21d and the communication opening 22c communicate through the communication path 23a, and upper portions of the centrifugal separation sections 21, 22 are provided so that an opening of the discharge path 23b is positioned at the center of the communication opening 22c (see Figure 10).

[0053] The dust collection chambers 24, 25 are constituted by the first dust collection chamber 24 and the second dust collection chamber 25.

[0054] Each of the dust collection chambers 24, 25 is formed in a cup shape, and the dust collection chambers 24, 25 are arranged side by side in an integrated condition. Respective opening sections 24a, 25a of the dust collection chambers 24, 25 are arranged facing upwards at the lower parts of the centrifugal separation sections 21, 22.

[0055] The first dust collection chamber 24 accumulates dust that is separated from air in the first centrifugal separation section 21. The second dust collection chamber 25 accumulates dust that is separated from air in the second centrifugal separation section 22.

[0056] In this state, the conical section 21b enters the first dust collection chamber 24, and the circular cylindrical section 22d enters the second dust collection chamber 25.

[0057] Note that a protruding section 28 is integrally formed with the respective dust collection chambers between the first dust collection chamber 24 and the second dust collection chamber 25. The outer face of the protruding section 28 is configured as a curved surface that connects with the outer face of the handle 26 in a continuous manner. By configuring the outer face of the protruding section 28 as a curved surface in this manner, the design of the vacuum cleaner C is enhanced and, furthermore, the structure is one that makes it difficult for the vacuum cleaner C to be caught in an obstructing article.

[0058] A second handle 29 that a user grasps when detaching the dust collection chambers 24, 25 is provided between the first dust collection chamber 24 and the second dust collection chamber 25, on a side opposite to the side on which the protruding section 28 is located.

[0059] As shown in Figure 3 to Figure 8, the dust collection section 20 in which each section is configured as described above is detachably attached to the body 10 to allow the user to throw out dust that has accumulated in the dust collection section 20 and thereafter reattach the dust collection section 20 to the body 10 again. Figure 3 is a central cross-sectional view taken along the center in the transverse direction of the body 10 and the dust collection section 20, that shows a state in which the dust collection section 20 is fixed to the body 10. Figure 4 is a perspective view of the body 10. Figure 5 is an enlarged view of a fitting concavity 34 of the dust collection section 20 and a fitting protrusion 13a of the body 10 that are

shown in Figure 3. Figure 6 is a view that illustrates a state in which engagement between the fitting concavity 30 and the fitting protrusion 13a that is illustrated in Figure 5 has been released. Figure 7 is a cross-sectional view that illustrates the vicinity of a lock section 31 shown in Figure 3. Figure 8 is a cross-sectional view of a state in which the lock section 31 shown in Figure 7 has been unlocked.

[0060] Referring to Figure 3 to Figure 8, an upper face 13 of the body 10 inclines towards the front, the fitting protrusion 13a is formed at a lower end of the upper face, a concave section 13b is formed in the inclined face, and an engagement receiving section 13c is provided at an upper end of the upper face.

[0061] The fitting concavity 34 that opens in the downward direction is formed at a lower end (the left diagonal lower end in Figure 5) portion at an area constituting the dust collection chambers 24, 25 of the dust collection section 20. The lock section 31 is operably provided at an upper portion of the communication section 23 of the dust collection section 20.

[0062] The lock section 31 is constituted by a lever 31a that is operated by a user, an engagement section 31b that moves in response to movement of the lever 31a, and an erroneous operation prevention cover 31c for preventing erroneous operation of the lever 31a.

[0063] The dust collection section 20 in which each section is configured as described above is provided on the upper face 13 of the body 10 in a state in which the fitting concavity 34 and the fitting protrusion 13a fit together and the second handle 29 has entered the concave section 13b.

[0064] The dust collection section 20 is retained so as not to drop off from the body 10 by engagement of the engagement section 31b of the lock section 31 with the engagement receiving section 13c.

[0065] Note that the engagement state between the engagement section 31b and the engagement receiving section 13c can be released by operating the lever 31a, and as a result the dust collection section 20 can be detached from the body 10.

[0066] The lock section 31 is covered by the erroneous operation prevention cover 31c that is constantly urged in a closing direction (state in Figure 7), and the structure is such that the user cannot operate the lever 31a unless the erroneous operation prevention cover 31c is moved in an opening direction (state in Figure 7).

[0067] The following effects are obtained by configuring the respective sections as described above.

[0068] First, by providing the handle 26 for carrying the dust collection section 20, or the body 10 and the dust collection section 20 when the dust collection section 20 is attached thereto, between the first centrifugal separation section 21 and the second centrifugal separation section 22 that are adjacent, the amount by which the handle 26 protrudes from the dust collection section 20 can be suppressed to a minimum and the dust collection section can be made compact.

[0069] That is, since the cross-sectional shape of each of the centrifugal separation sections 21, 22 is a circular shape, by arranging the centrifugal separation sections 21, 22 adjacent to each other, the hollow section 20a is formed between the adjacent centrifugal separation sections 21, 22. By arranging the handle 26 at the position of the hollow section 20a, the handle 26 can be formed in a manner in which the protruding amount thereof from the dust collection section 20 is suppressed.

[0070] In particular, by positioning the opening 26a of the handle 26 in the hollow section 20a, a hand-grip section that a user uses to grasp the handle 26 can be adequately secured without forming the handle 26 in a large size.

[0071] Thus, since the protruding amount of the handle 26 from the dust collection section 20 is small, the overall size of the cleaner can be kept to a small size, and damage to the handle 26 can be prevented even if, during use, the cleaner overturns, the cleaner is dropped, or the cleaner comes in contact with an obstacle.

[0072] Further, the centrifugal separation sections are formed in a cylindrical shape, the adjacent centrifugal separation sections are arranged so that the central axes M1 and M2 of the respective cylinders thereof are substantially parallel, and the handle 26 is formed so that a longitudinal direction thereof is the same as the axial directions of the central axes M1 and M2. Hence, the position of the handle 26 is the center of the dust collection section 20, and thus the user can grasp the handle 26 in a well-balanced manner.

[0073] Further, by providing the handle 26 at a position on the opposite side to the side on which the dust collection section 20 is attached to the body 10, the dust collection section 20 and the body 10 can be carried in a state in which the dust collection section 20 is attached to the body 10.

[0074] It is thereby possible to use a common handle as the handle of the dust collection section 20 and the handle of the body 10, and to reduce the number of components and the weight of the cleaner C, and to also make the cleaner C a small size.

[0075] In addition, since the handle 26 is positioned between the adjacent centrifugal separation sections 21, 22, when the plurality of centrifugal separation sections are integrally formed to constitute a single unit, the handle 26 can serve as a reinforcing member that links the respective centrifugal separation sections.

[0076] Next, essential portions of the embodiment of the present invention are described with reference to Figure 9 to Figure 15. Figure 9 is a plan view illustrating a state in which the dust collection section 20 has been disassembled into respective sections thereof. Figure 10 includes a cross-sectional view and partially enlarged views of the dust collection section 20. Figure 11 is a longitudinal sectional view of the dust collection section 20. Figure 12 is an exploded view illustrating the relationship between a dust collection chamber and a centrifugal separation section. Figure 13 is an exploded view illus-

trating the relationship between the centrifugal separation sections 21, 22 and the communication section 23. Figure 14 is an exploded view illustrating the relationship between the first centrifugal separation section 21 and the discharge pipe. Figure 15 includes a cross-sectional view and a partially enlarged view of a state in which the discharge pipe is set in the first centrifugal separation section 21.

[0077] Referring to Figure 9 and Figure 10, the dust collection section 20 is disassemblable into three components thereof, namely, the centrifugal separation sections 21, 22, the communication section 23, and the dust collection chambers 24, 25.

[0078] A first groove section 32 is formed in the respective opening edges on a side that fits together with the communication section 23 of the centrifugal separation sections 21, 22 that have the first centrifugal separation section 21 and the second centrifugal separation section 22. A first seal member 32a for maintaining airtightness between both members when the communication section 23 and the centrifugal separation sections 21, 22 are fitted together is press-fitted into the first groove section 32.

[0079] Further, a second groove section 33 is formed in an opening edge that fits together with the dust collection chambers 24, 25 of the centrifugal separation sections 21, 22. A second seal member 33a for maintaining airtightness between both members when the dust collection chambers 24, 25 and the centrifugal separation sections 21, 22 are fitted together is press-fitted into the second groove section 33.

[0080] These seal members 32a and 33a are configured to be detachable from the respective groove sections 32 and 33, and maintenance thereof such as washing with water or replacement can be performed.

[0081] Referring to Figure 11 and Figure 12, a claw receiving section 35 that opens in the direction of the centrifugal separation sections 21, 22 is formed at a site that is on an opposite side to a face that attaches to/detaches from the body 10 of the dust collection chambers 24, 25.

[0082] Further, a dust collection chamber lock section 37 is provided at a site on a side that attaches to/detaches from the body 10 of the dust collection chambers 24, 25. The dust collection chamber lock section 37 is constituted by an engagement claw section 37a that protrudes in the direction of the centrifugal separation sections 21, 22 and an engagement release button 37b that actuates the engagement claw section 37a.

[0083] Note that the dust collection chamber lock section 37 is provided on the second handle 29 for carrying the dust collection chambers 24, 25.

[0084] A claw section 36 that protrudes in the direction of the dust collection chambers 24, 25, and a claw receiving section 39 that opens in the direction of the dust collection chambers 24, 25 are formed in the centrifugal separation sections 21, 22.

[0085] That is, the dust collection chamber lock section 37 is provided on a side that joins with the centrifugal

separation sections 21, 22 of the second handle 39 for carrying the dust collection chambers 24, 25, and the engagement claw section 37a that rotates has a structure that is urged in a direction of engagement with the claw receiving section 39 and engages with the claw receiving section 39.

[0086] The centrifugal separation sections 21, 22 and the dust collection chambers 24, 25 that are configured in this manner are fitted together and fixed in the following manner. First, the claw section 36 is inserted into the claw receiving section 35 and engaged therein. Next, the engagement claw section 37a is inserted into the claw receiving section 39 and engaged therein.

[0087] Note that in this state, opening edges 24b, 25b of the dust collection chambers 24, 25 are in intimate contact with the second seal member 33a. As a result, the centrifugal separation sections 21, 22 and the dust collection chambers 24, 25 are coupled and held in a state in which airtightness is maintained between both members.

[0088] Further, since engagement between the claw receiving section 39 and the engagement claw section 37a can be released by operating the engagement release button 37b in a state in which the user holds the second handle 29, it is possible to easily separate the centrifugal separation sections 21, 22 and the dust collection chambers 24, 25 by using the hand that holds the second handle 29 as a pivot.

[0089] Further, since the engagement release button 37b is positioned on the side of the second handle that is provided at the dust collection chambers 24, 24, in a state in which the dust collection section 20 is attached to the body 10, the engagement release button 37b is positioned at a site that is sandwiched between the dust collection section 20 and the body 10 and therefore cannot be operated by the user.

[0090] Consequently, when cleaning using the vacuum cleaner C, a situation does not arise in which the user mistakenly operates the engagement release button 37b and dust that has accumulated inside the dust collection chambers 24, 25 is released.

[0091] Referring to Figure 11 and Figure 13, a first claw receiving section 40 and a second claw receiving section 41 are provided on the communication section 23. A communication section lock section 42 is provided on the centrifugal separation sections 21, 22. The communication section lock section 42 includes a first claw 43, a second claw 44, and an interlocking rod 45.

[0092] By engaging the first claw 43 into the first claw receiving section 40 and engaging the second claw 44 into the second claw receiving section 42, the communication section 23 and the centrifugal separation sections 21, 22 are retained in a connected state.

[0093] Note that in this state an opening edge 23d of the communication section 23 intimately contacts the first seal member 32a. As a result, the centrifugal separation sections 21, 22 and the communication section 23 are coupled in a state in which airtightness is maintained be-

tween both members.

[0094] In this case, the interlocking rod 45 is provided so that the second claw 44 moves in response to movement of the first claw 43. Therefore, when releasing an engaged state between the second claw receiving section 42 and the second claw 44 in a state in which the first claw receiving section 40 and the first claw 43 are engaged, the user can release the engaged state of the second claw 44 by merely moving the first claw 43 to release the engaged state.

[0095] The dust collection section 20 configured as described above separates air and dust that have been drawn into the inside thereof in the following manner.

[0096] Referring to Figure 10 in which the flow of air is indicated by a thick line R, first, air containing dust that flows into the first centrifugal separation section 21 from the dust intake opening 21c forms a swirling flow along the inner wall of the first centrifugal separation section 21 that is a circular cylindrical shape, and flows in the downward direction.

[0097] As the swirling flow flows in the downward direction, the swirling flow approaches a portion that is a conical shape of the first centrifugal separation section 21. As a result, the swirl radius of the swirling flow of air containing dust decreases, and hence the swirling speed increases and the centrifugal force strengthens due to the increase in the swirling force and dust is separated from inside the air.

[0098] The dust that is separated from the air is pushed in the downward direction and is accumulated in the first dust collection chamber 24. Minute dust that was not completely separated from the air flows upward through the center of the swirling flow, is discharged from the first centrifugal separation section 21 via the filter 27 provided in the opening 21d, passes through the communication section 23, and flows down to the second centrifugal separation section 22.

[0099] The air that includes minute dust that flowed down to the second centrifugal separation section 22 forms a swirling flow in a similar manner as the air inside the first centrifugal separation section 21, and the dust separates from the air by means of the centrifugal force that is produced by the swirling flow.

[0100] The dust that is separated from the air is accumulated in the second dust collection chamber 25. The air from which the dust was removed flows upward through the center of the swirling flow, passes along the discharge path 23b formed in the communication section 23, and flows down into the inside of the body 10 from a discharge/intake port 15 that opens into the body 10.

[0101] The air that flowed into the body 10 is discharged to outside the body 10 from a discharge port that opens into the body 10, via the motor-driven blower.

[0102] Note that since the second centrifugal separation section 22 is configured to be smaller than the inner diameter of the first centrifugal separation section 21, a swirling flow flows therein at a higher speed than the swirling flow in the first centrifugal separation section 21.

Thus, the configuration of the second centrifugal separation section 22 enables the removal of minute dust that can not be completely separated in the first centrifugal separation section 21.

[0103] In this case, referring to Figure 14 and Figure 15, the filter 27 is constituted by a filter section in which a cylindrical mesh-like opening constituted by a circular cylindrical section 27a and a conical section 27b that is integrally connected to the circular cylindrical section 27a, and a flange-shaped base section 27c that spreads from an opening end of the circular cylindrical section 27a.

[0104] By making the shape of the filter 27 a circular cylindrical shape in this manner, generation of a swirling flow inside the first centrifugal separation section 21 can be facilitated. In addition, by forming the filter 27 in a cylindrical shape, a wide area in which the mesh-like opening is formed can be secured, and the flow of air that flows through the filter 27 can be increased.

[0105] A groove section 27d having a cross-sectional shape that is a reversed C shape that opens towards the outside is formed at the outer edge of the base section 27c. A seal member 52 is provided in the groove section 27d.

[0106] The seal member 52 is a member for securing airtightness between the filter 27 and the first centrifugal separation section 21 when the filter 27 is fitted in the communication opening 21d of the first centrifugal separation section 21, by joining with an inner wall face 21h of the first centrifugal separation section 21 to fill a gap between the filter 27 and the first centrifugal separation section 21.

[0107] The seal member 52 has a packing section 52a. The packing section 52a contacts against the first centrifugal separation section 21 to secure the aforementioned airtightness. An end of the packing section 52a is housed inside the groove section 27d, and an area of the packing section 52a that serves as a sealing surface protrudes to the outside from the groove section 27d. The protruding area contacts with the inner wall face 21h of the first centrifugal separation section 21.

[0108] Note that when the filter 27 is fitted in the communication opening 21d, the seal member 52 is mounted inside the groove section 27d without projecting (protruding) from the space that is surrounded by the groove section 27d and the inner wall face 21h of the first centrifugal separation section 21.

[0109] That is, the seal member 52 is in a state in which the seal member 52 is surrounded by the groove section 27d and a wall face of the first centrifugal separation section 21, and is not exposed inside the first centrifugal separation section 21.

[0110] The filter 27 configured in this manner is provided in the communication opening 21d so that the central axis M1 of the first centrifugal separation section 21 and the axial center of the circular cylindrical section 27a and the conical section 27b coincide.

[0111] In this case, referring to Figure 13, a rotary baffle

plate 54 that is constantly urged in a slanting direction with respect to the central axis M1 of the first centrifugal separation section 21 is provided in the vicinity of the communication opening 21d of the first centrifugal separation section 21.

[0112] When the rotary baffle plate 54 is in a slanting state, if the user attempts to attach the communication section 23 to the centrifugal separation sections 21, 22, a baffle plate end 55 interferes with a rib 56 that is formed on the communication section 23, and the communication section 23 can not be attached to the centrifugal separation sections 21, 22. That is, in a state in which the filter 27 is not attached to the centrifugal separation sections 21, 22, the rotary baffle plate 54 serves as attachment restriction means that inhibits attachment of the communication section 23 to the centrifugal separation sections 21, 22.

[0113] In this state, when the filter 27 is attached to the first centrifugal separation section 21, an interference plate 57 provided on the filter 27 contacts against the rotary baffle plate 54.

[0114] As a result, the rotary baffle plate 54 is rotated so as to become approximately parallel with the central axis M1, and when attaching the communication section 23 to the centrifugal separation sections 21, 22 a positional relationship is entered such that the baffle plate end 55 and the rib 56 do not interfere with each other and it is therefore possible to attach the communication section 23 to the centrifugal separation sections 21, 22.

[0115] Note that it is possible to utilize the interference plate 57 as a grip when removing the filter 27.

[0116] The following actions and effects are obtained by configuring the respective sections in the above described manner.

[0117] When dust has accumulated in the dust collection chambers 24, 25, the user first detaches the dust collection section 20 from the body 10. Thereafter, the user grips the handle 26 and moves the dust collection section 20 to a location at which to dispose of the dust. After moving the dust collection section 20, the user holds the handle 26 with one hand and, with the other hand, releases the engagement between the engagement claw section 37a and the claw receiving section 39 by pushing the engagement release button 37b of the dust collection chamber lock section 37 while holding the second handle 29 provided on the dust collection chambers 24, 25. Thereby, the user releases the connection between the dust collection chambers 24, 25 and the centrifugal separation sections 21, 22 to separate the dust collection chambers 24, 25 and the centrifugal separation sections 21, 22, and disposes of the dust that is inside the dust collection chambers.

[0118] When disposing of dust from inside the dust collection chambers 24, 25 in this manner, because a handle is provided on the dust collection chambers 24, 25 and the centrifugal separation sections 21, 22, respectively, the operability of the various release buttons is favorable.

[0119] In particular, since the dust collection chamber

lock section 37 that releases the engagement state between the dust collection chambers 24, 25 and the centrifugal separation sections 21, 22 is arranged on the handle 29 of the dust collection chamber, the dust collection chambers 24, 25 can be separated from the centrifugal separation sections 21, 22 in a state in which the handle 29 of the dust collection chambers 24, 25 is grasped.

[0120] Therefore, dust is not liable to spill out from inside the dust collection chambers 24, 25, and a user can empty the dust without dirtying their hands.

[0121] In addition, when executing maintenance such as washing the entire dust collection section with water, in addition to separating the dust collection chambers 24, 25 and the centrifugal separation sections 21, 22 as described above, by operating the first claw 43 of the centrifugal separation sections 21, 22 in a releasing direction, the connection between the first claw 43 and the first claw receiving section 40 and the connection between the second claw 44 and the second claw receiving section 41 can each be released, and the communication section 23 can be easily separated from the centrifugal separation sections 24, 25.

[0122] Thus, since the dust collection section 20 can be disassembled into the communication section 23, the centrifugal separation sections 21, 22, and the dust collection chambers 24, 25 that have respectively separate functions, maintenance can be performed in accordance with the characteristics of the respective sections.

[0123] Further, since the dust collection section 20 can be disassembled into components for respective functions, such as the centrifugal separation sections 21, 22 that separate air and dust, the communication section 23 that serves as an air passage that allows the respective centrifugal separation sections to communicate, and the dust collection chambers 24, 25 that accumulate dust that was separated from air, the operability with respect to disassembly and assembly of the dust collection section 20 is favorable, and it is easy for the user to perform maintenance that is suited for the respective functional parts.

[0124] In addition, since the first seal member 32a and the second seal member 33a can be removed from the centrifugal separation sections 21, 22, meticulous maintenance can be performed.

[0125] Furthermore, when a large amount of comparatively large dust such as hair on which it is difficult for a centrifugal force to act is sucked into the first centrifugal separation section 21, since the dust cannot be carried by a centrifugal force into the first dust collection chamber 24 from the first centrifugal separation section 21 and also cannot pass through the mesh-like opening of the filter 27, in some cases the dust remains inside the first centrifugal separation section 21 in that state.

[0126] However, according to the configuration of the present embodiment, because the filter 27 can be removed, maintenance of the inside of the first centrifugal separation section 21 can easily be performed.

[0127] In addition, when fitting the filter 27 in the open-

ing 21d of the first centrifugal separation section 21, since the configuration is such that an end of the packing section 53 of the seal member 52 provided in the filter 27 does not project from the groove section, that is, the packing section 53 fits inside the groove section and does not protrude from the groove section, the packing section 53 does not get turned up when attaching or detaching the filter 27.

[0128] Further, since the seal member 52 is not exposed in a space in which dust swirls inside the first centrifugal separation section 21, deterioration of the seal member can be prevented.

[0129] Furthermore, since the structure of the dust collection section 20 is one in which the communication section 23 can not be attached to the centrifugal separation sections 21, 22 unless the filter 27 is attached to the first centrifugal separation section 21, a situation does not arise in which the vacuum cleaner C is used in an incorrect state in which the filter 27 is not fitted therein.

Description of Reference Characters

[0130]

- C vacuum cleaner
- 10 body
- 20 dust collection section
- 21 first centrifugal separation section
- 22 second centrifugal separation section
- 23 communication section
- 24 first dust collection chamber
- 25 second dust collection chamber
- 26 handle
- 27 filter
- 29 second handle
- 31 lock section
- 37 dust collection chamber lock section
- 50 dust suction means
- 51 hose unit
- 52 extension pipe
- 53 floor surface suction tool
- 54 rotary baffle plate
- 56 rib
- 57 interference plate

Claims

1. A vacuum cleaner according to claim 1, comprising:
 - a body having therein a motor-driven blower that generates a suction force, and a cyclone dust collection section that is detachable from the body;
 - wherein the cyclone dust collection section comprises, as respective parts, a plurality of centrifugal separation sections that separate air and dust, a communication section that allows the

centrifugal separation sections that are adjacent to communicate, and a dust collection chamber that accumulates dust that is separated by the centrifugal separation section, and is disassemblable into the dust collection chamber, the centrifugal separation section, and the communication section, respectively.

2. The vacuum cleaner according to claim 1, wherein a joining section that joins with each of the dust collection chamber and the communication section is formed in the centrifugal separation section, and a seal member is provided in the joining section.
3. The vacuum cleaner according to claim 1 or 2, wherein a handle for carrying the dust collection chamber is provided on the dust collection chamber.
4. The vacuum cleaner according to claim 3, wherein at least one of the plurality of centrifugal separation sections has a filter in which a mesh-like opening is formed, and the filter is detachable from the centrifugal separation section.
5. The vacuum cleaner according to claim 4, wherein:
 - a groove section is formed in the filter;
 - a seal member that joins with the centrifugal separation section in a state in which the filter is attached to the centrifugal separation section is provided in the groove section; and
 - in a state in which the filter is attached to the centrifugal separation section, the seal member is surrounded by the filter and the centrifugal separation section.
6. The vacuum cleaner according to claim 4 or 5, wherein attachment restriction means that inhibits attachment of the communication section to the centrifugal separation section in a state in which the filter is not attached to the centrifugal separation section is provided in the centrifugal separation section.

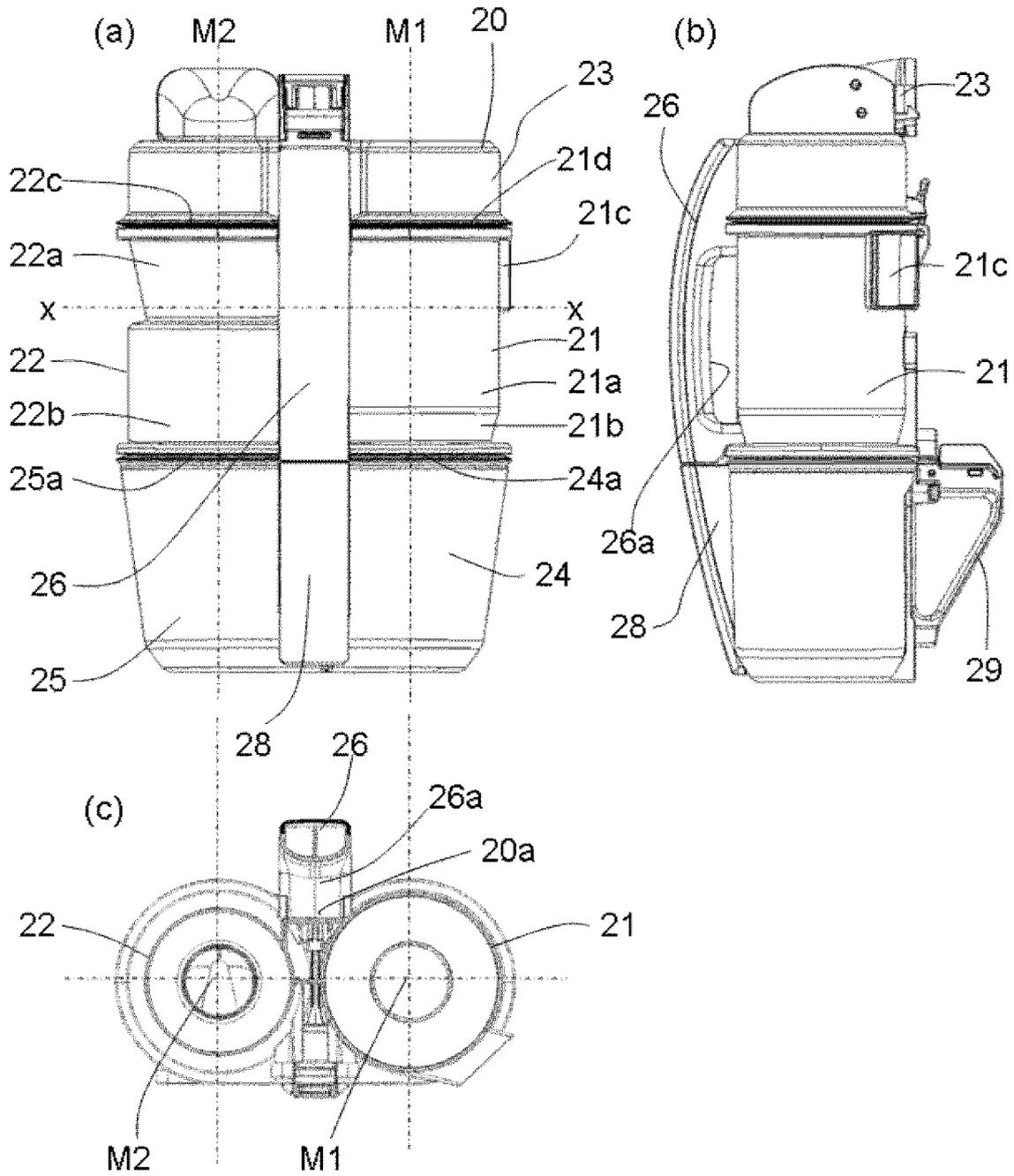


Fig.2

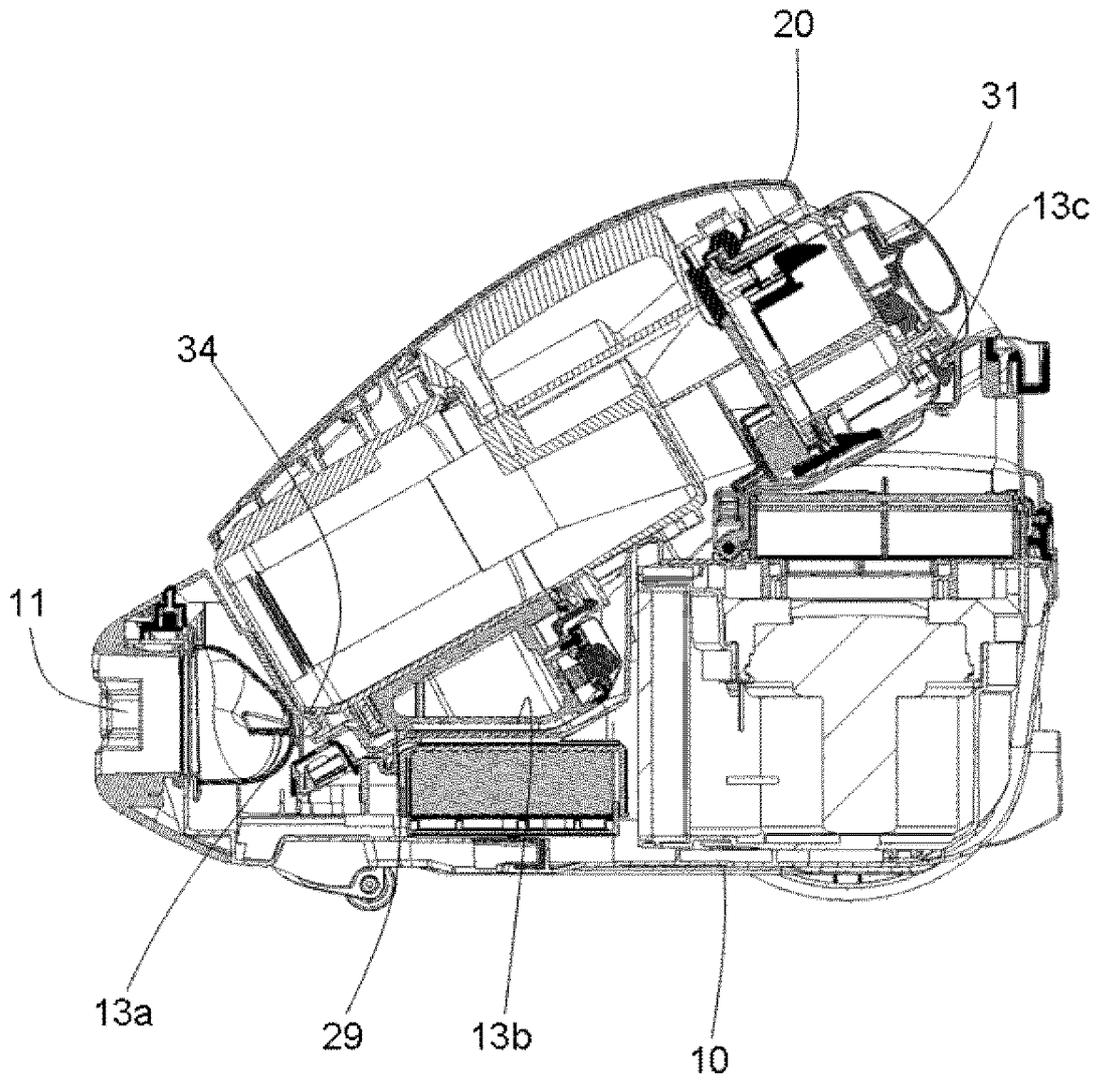


Fig.3

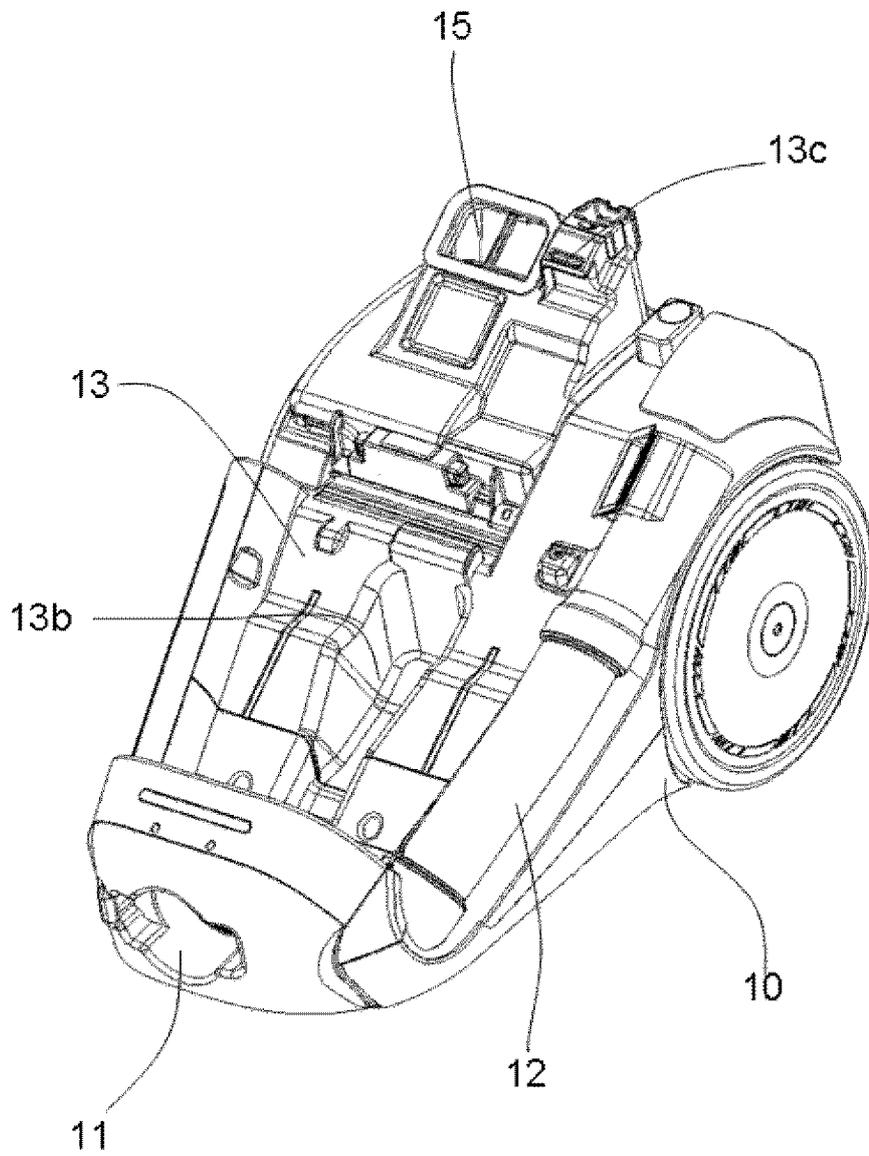


Fig.4

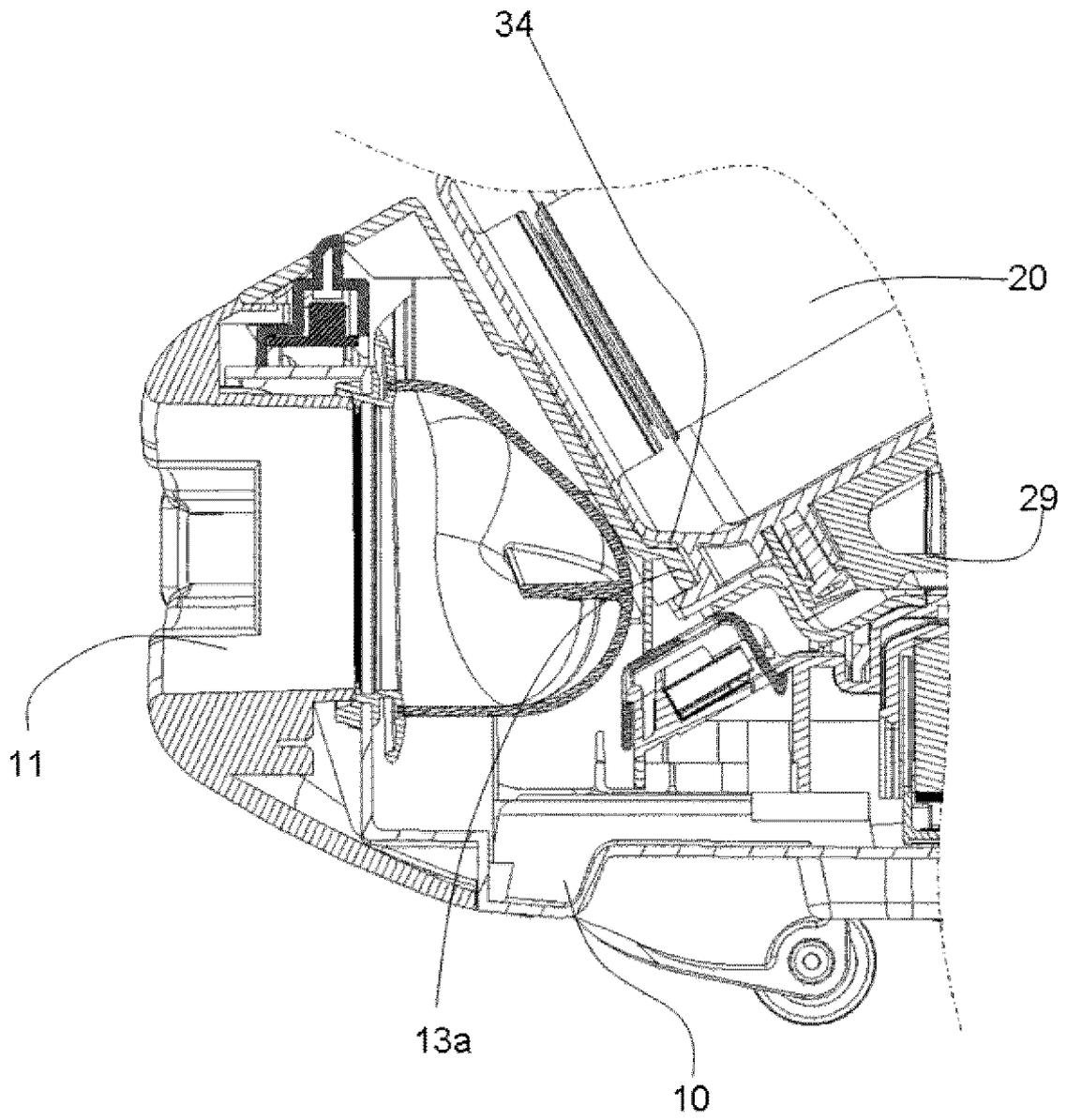


Fig.5

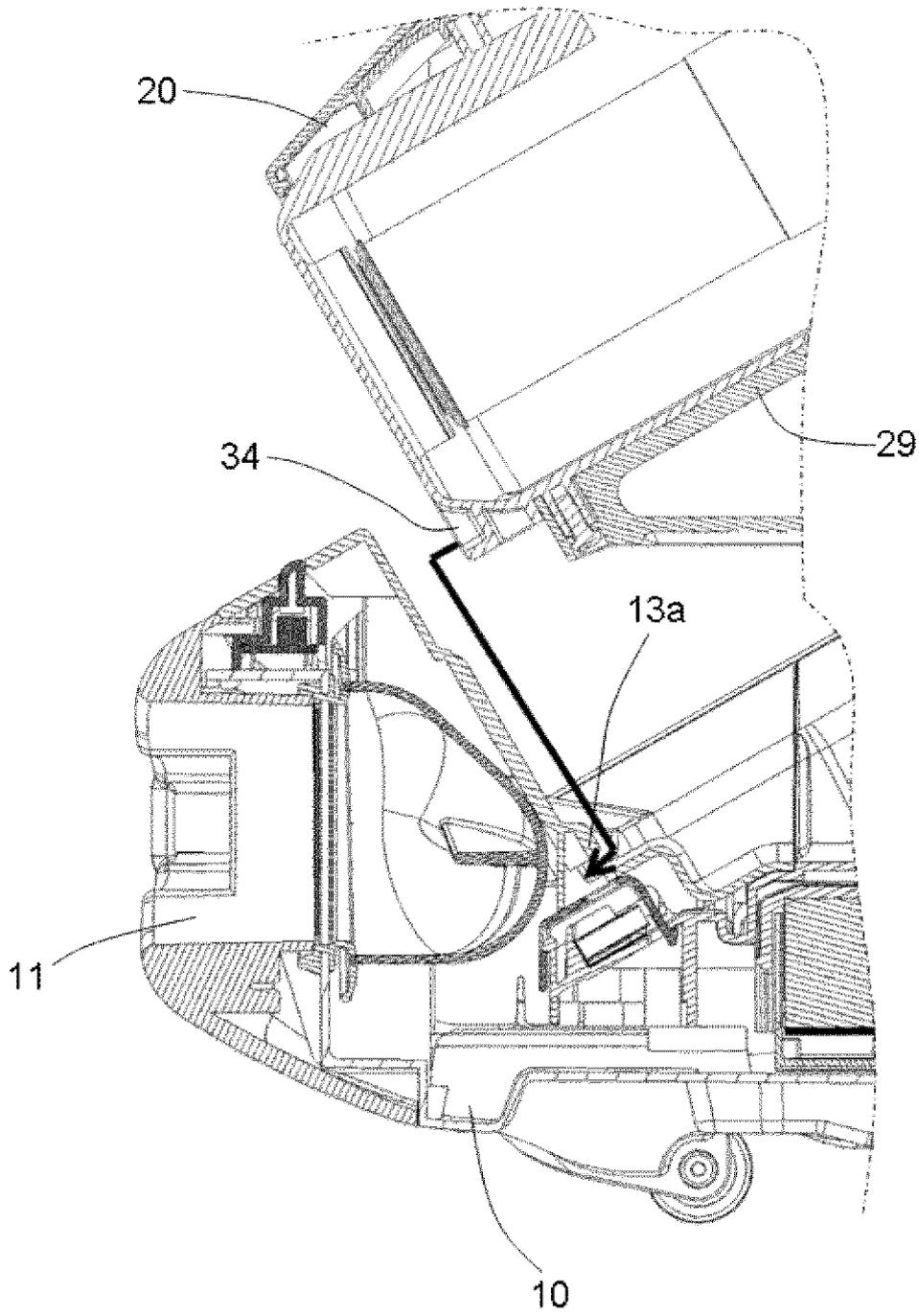


Fig.6

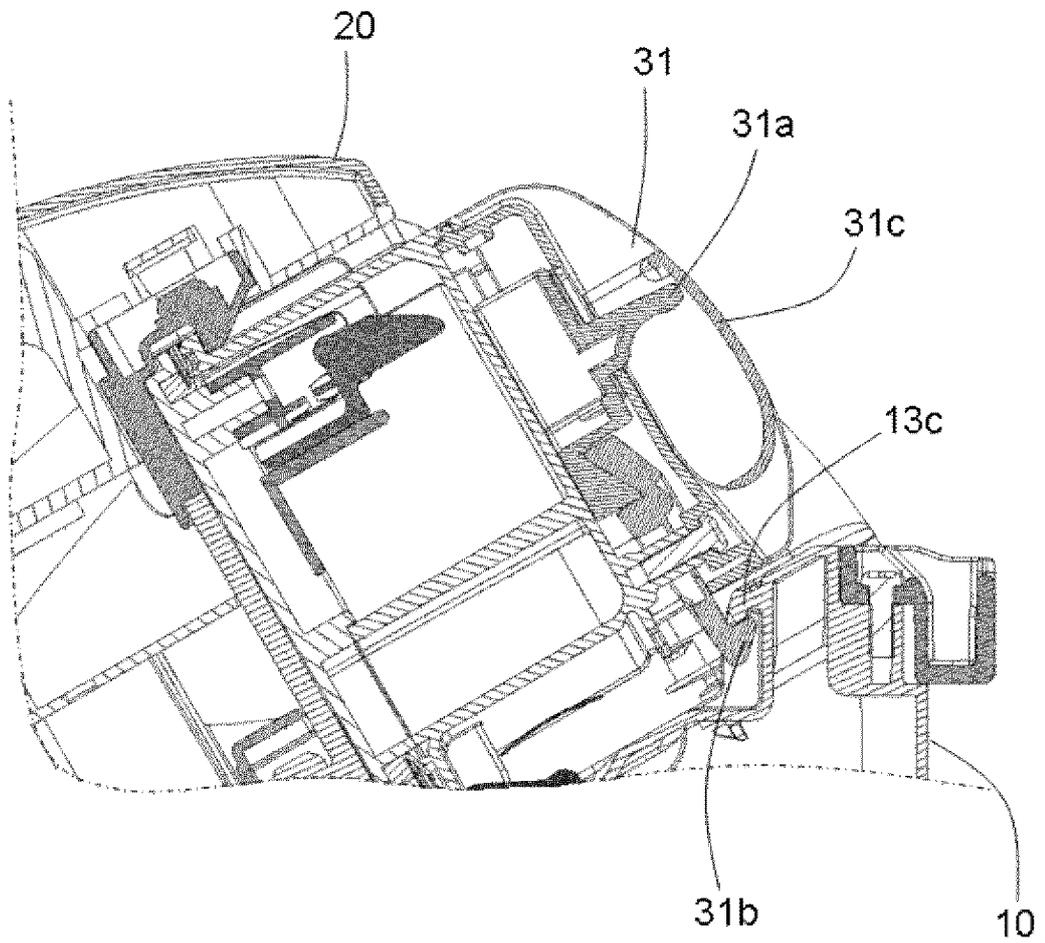


Fig.7

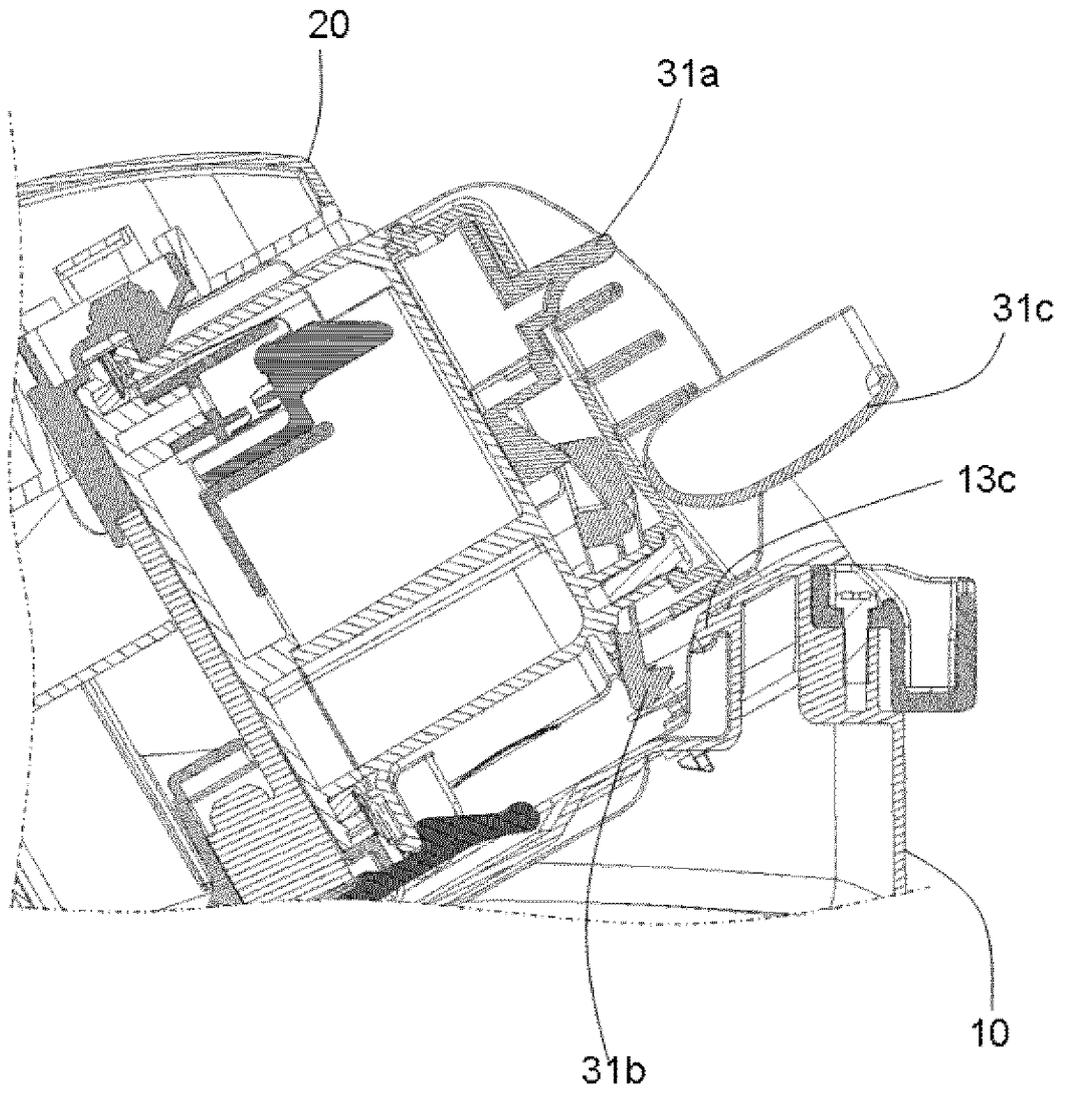


Fig.8

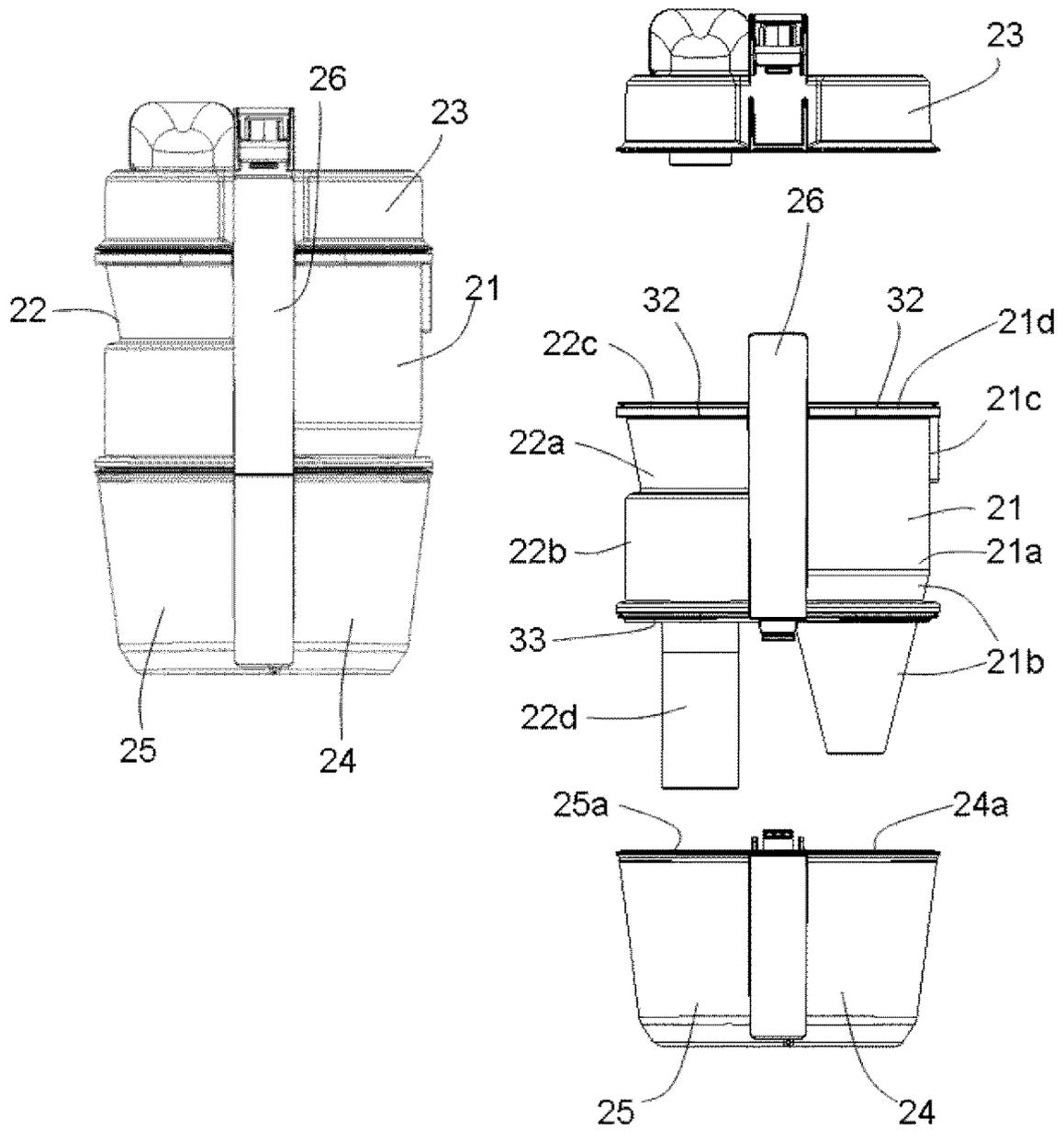


Fig.9

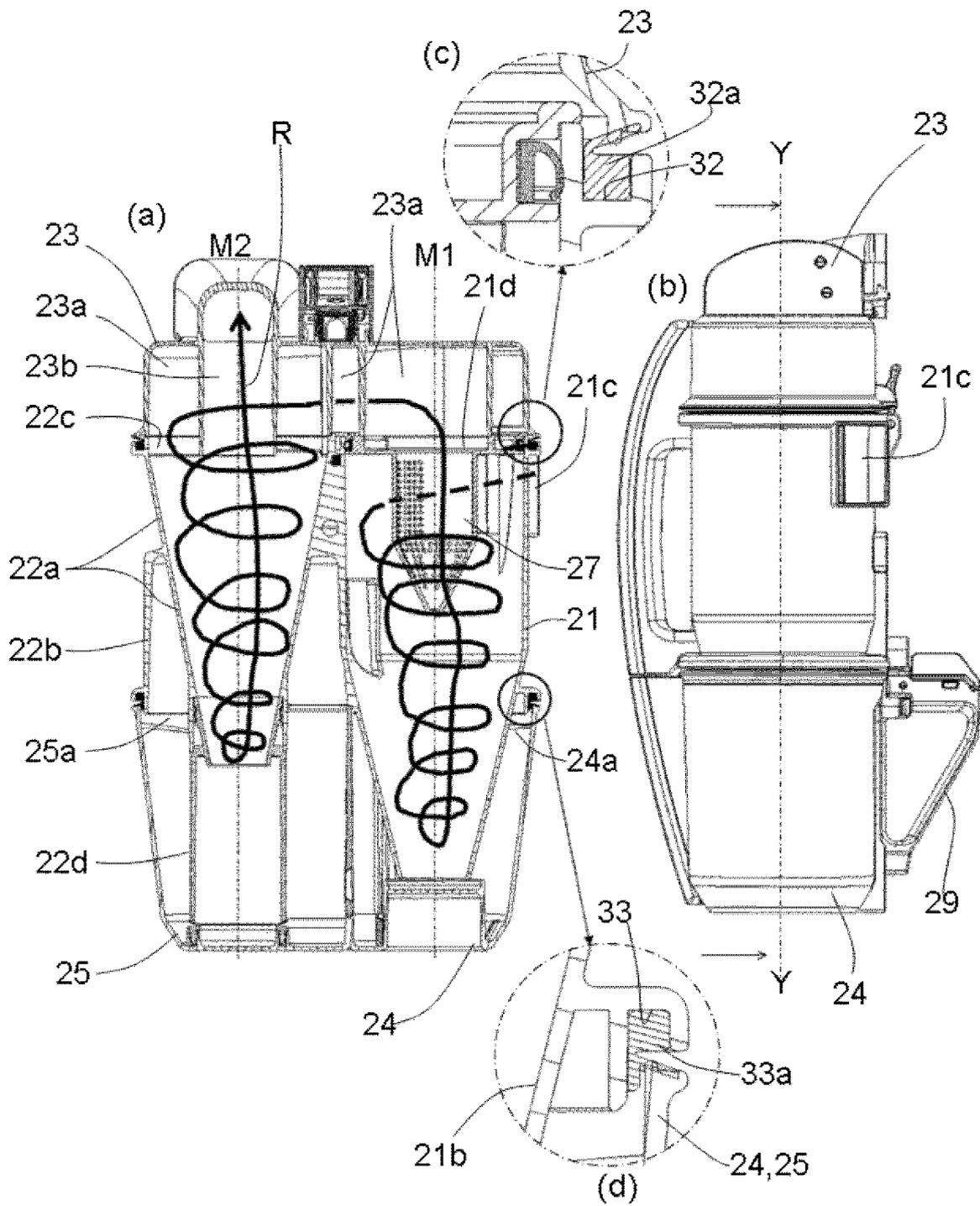


Fig.10

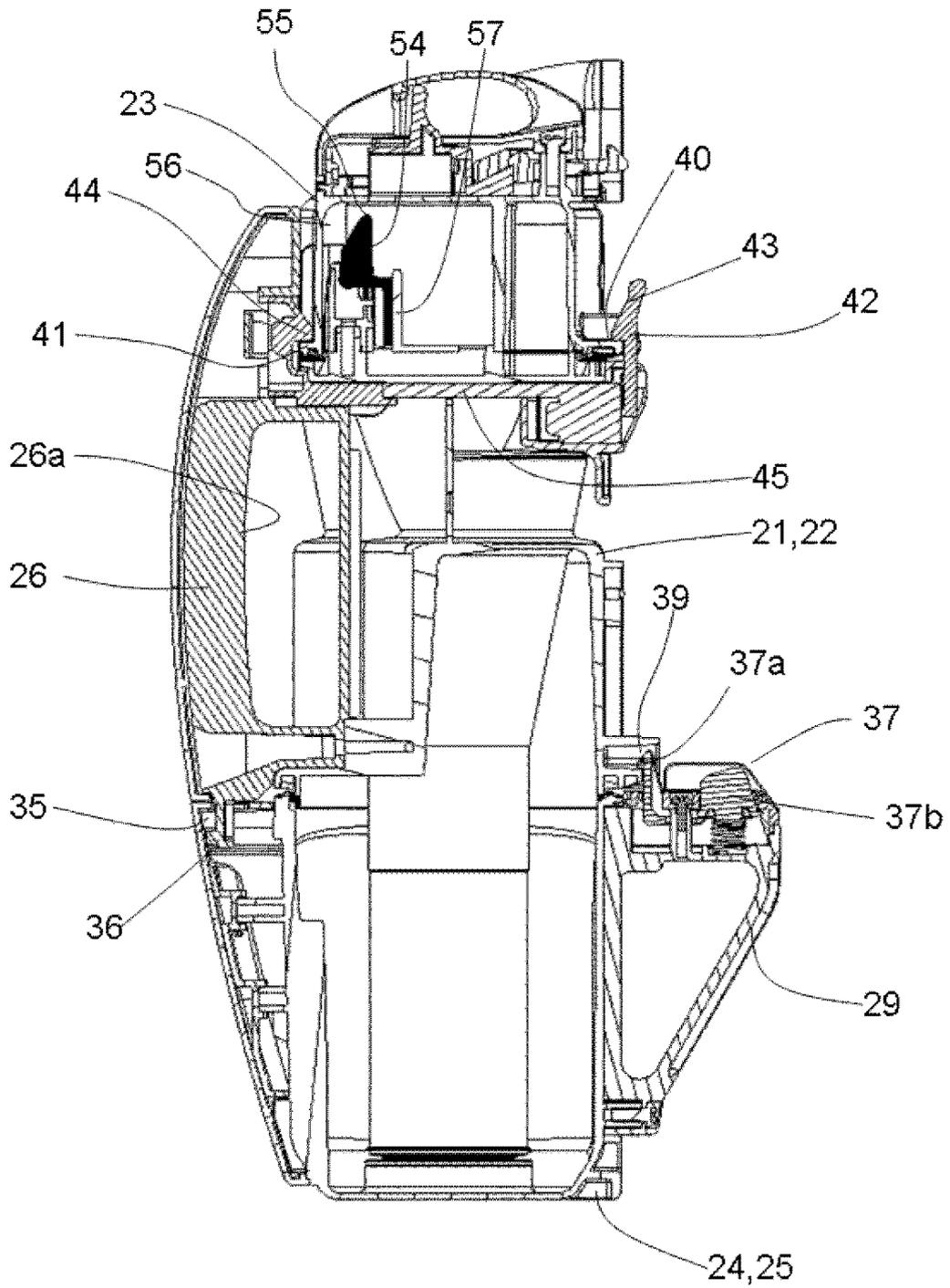


Fig.11

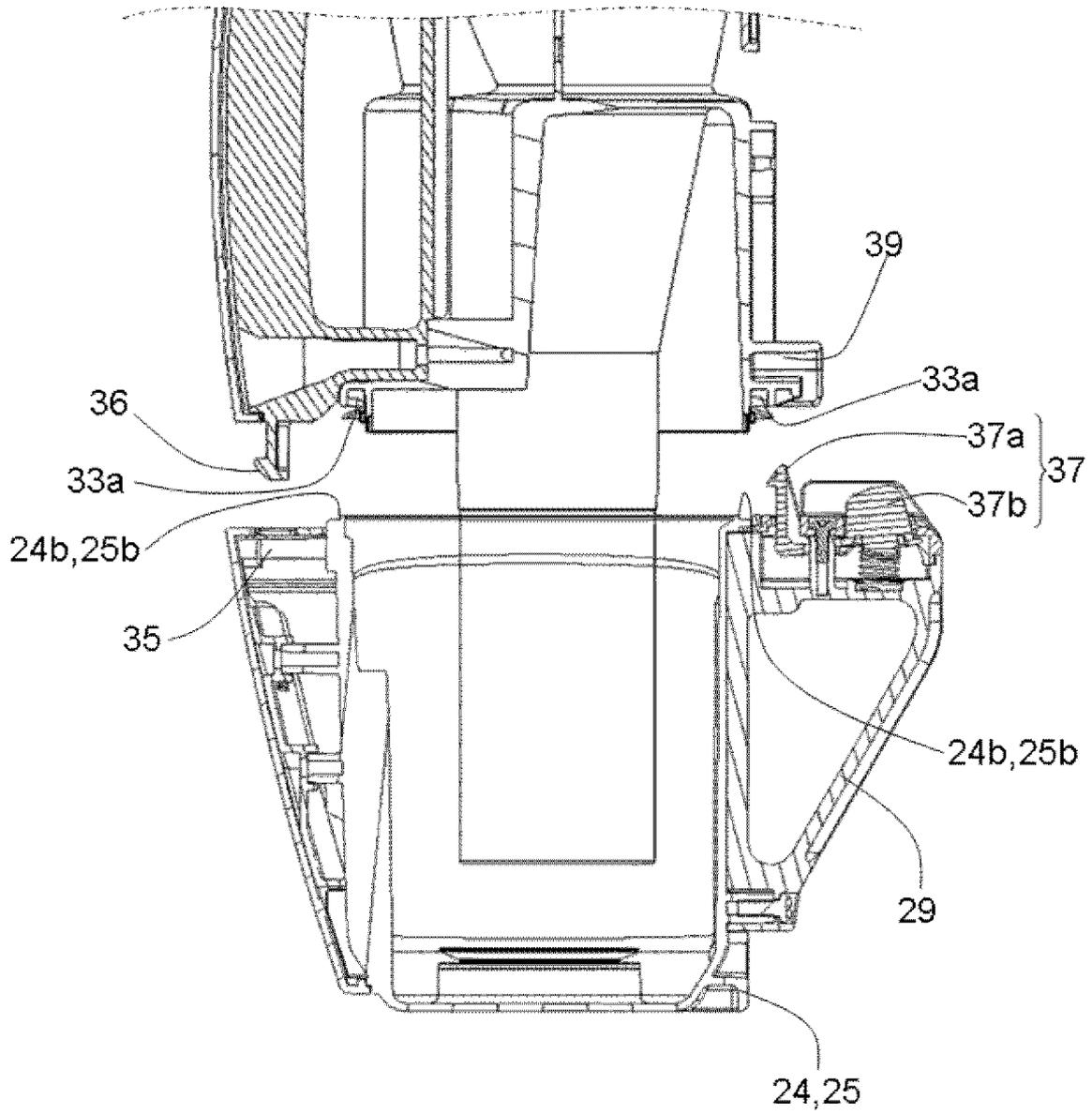


Fig.12

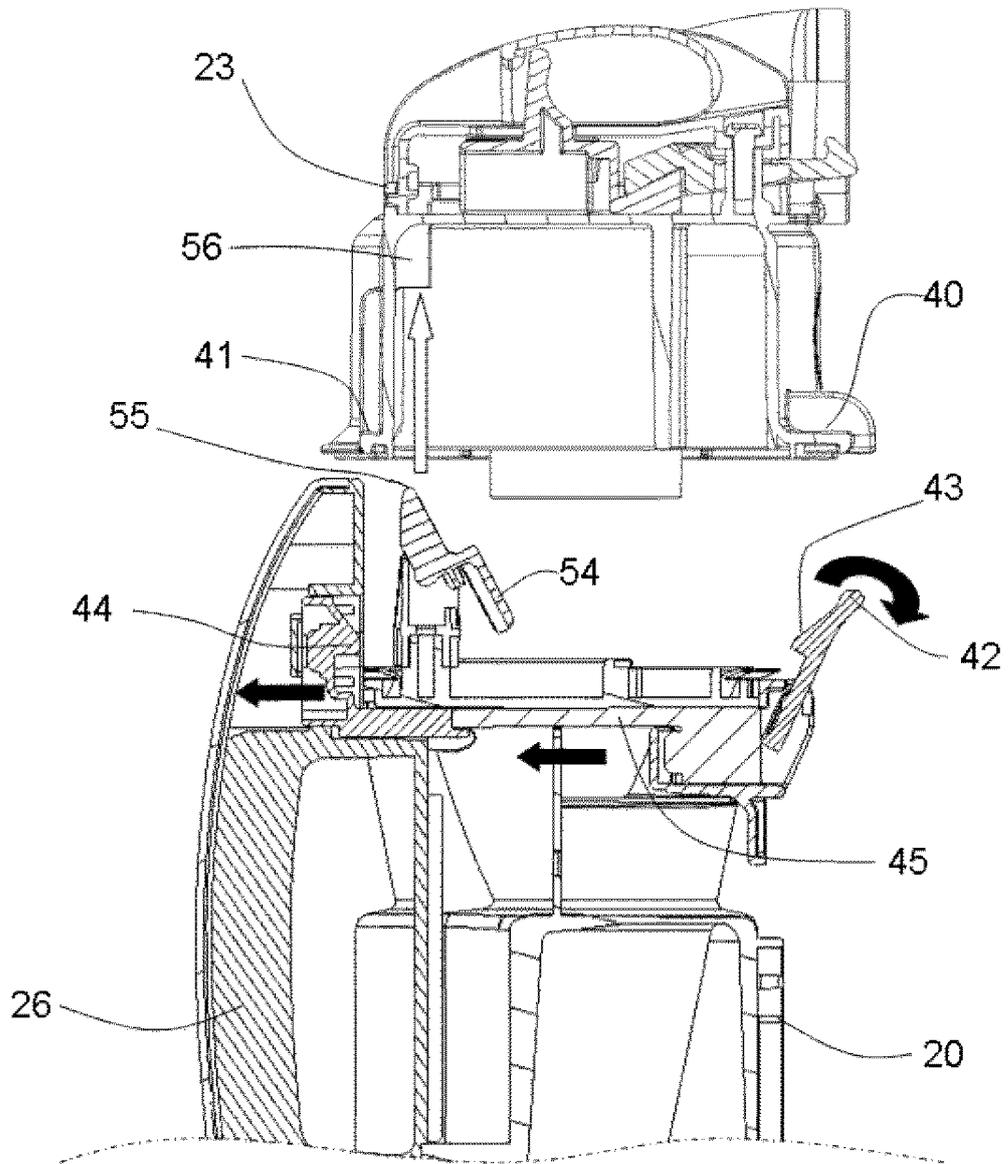


Fig.13

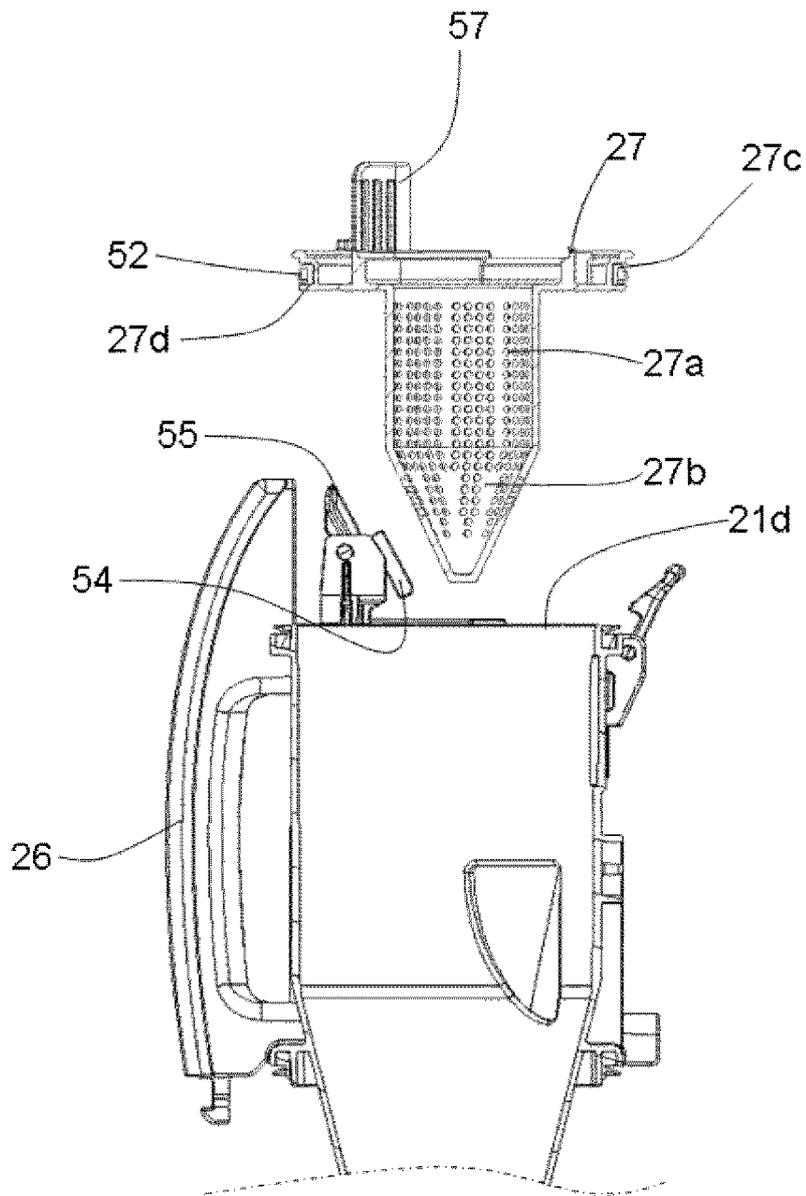


Fig.14

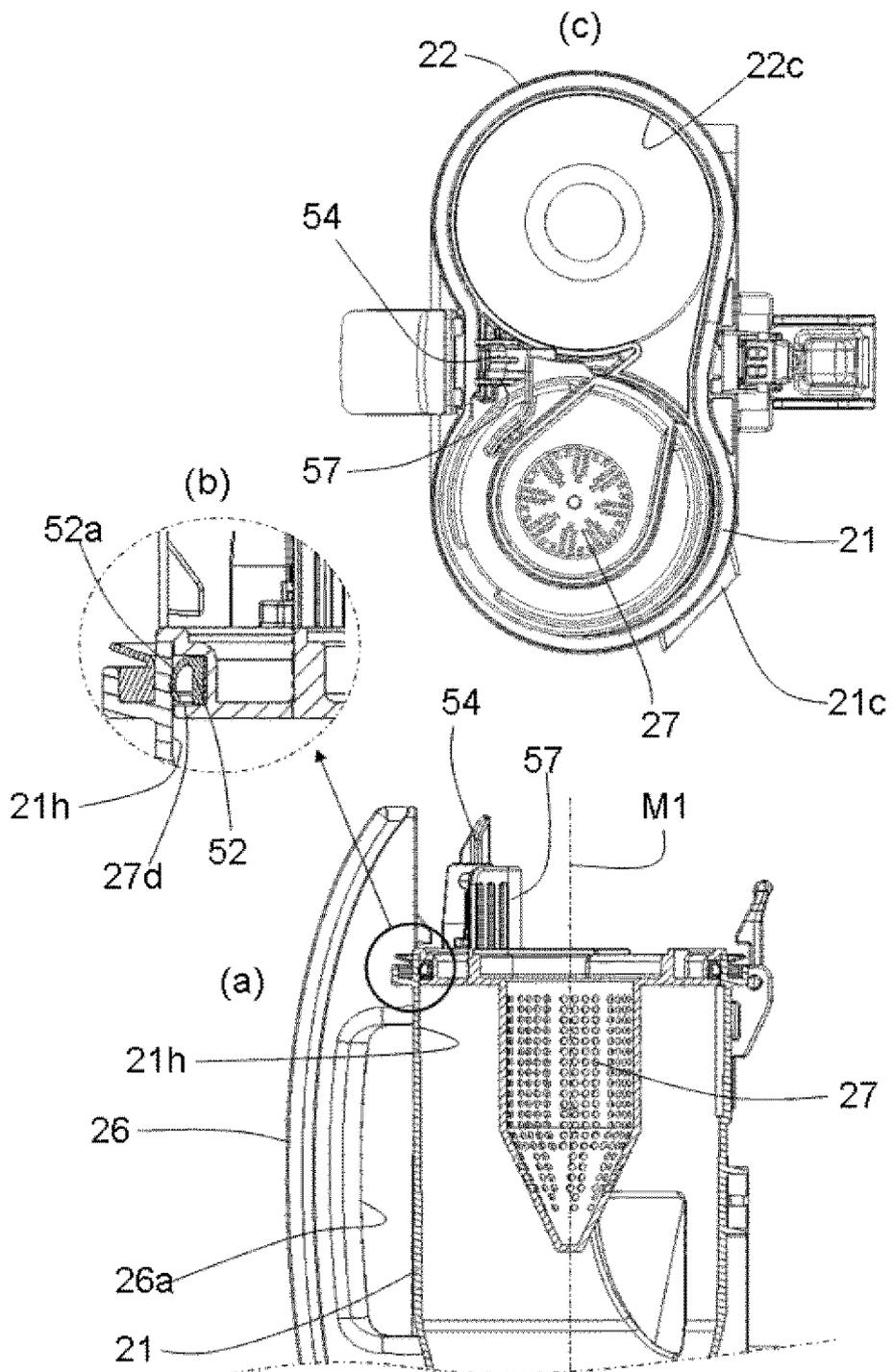


Fig.15

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/058998

A. CLASSIFICATION OF SUBJECT MATTER

A47L9/16(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

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	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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.
X Y	JP 2011-41766 A (Mitsubishi Electric Corp.), 03 March 2011 (03.03.2011), paragraph [0014]; fig. 15 (Family: none)	1, 4, 6 2, 3, 5
Y	JP 2004-321777 A (Samsung Kwangju Electronics Co., Ltd.), 18 November 2004 (18.11.2004), fig. 3, 4 & US 2004/0211025 A1 & GB 2401076 A & GB 400888 D0 & DE 10331725 B & FR 2854047 A & KR 10-0470561 B1 & CA 2435482 A & ES 2241462 A & RU 2003124585 A & CN 1541607 A & AU 2003211907 A & IT MI20040783 A	1-6

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Date of the actual completion of the international search
23 May, 2012 (23.05.12)Date of mailing of the international search report
05 June, 2012 (05.06.12)Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/058998

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 3960984 B2 (Samsung Kwangju Electronics Co., Ltd.), 15 August 2007 (15.08.2007), fig. 3 & US 2004/0231091 A1 & GB 2402636 A & GB 410226 D0 & DE 102004024888 A & FR 2855037 A & KR 10-0471142 B1 & CA 2466820 A & ES 2255812 A & RU 2004122471 A & CN 1572221 A & AU 2004201748 A & IT MI20040970 A	1-6
A	JP 2010-154940 A (Interport-International, Inc.), 15 July 2010 (15.07.2010), (Family: none)	1-6
A	JP 2010-155173 A (Sharp Corp.), 15 July 2010 (15.07.2010), (Family: none)	1-6
A	JP 2010-88952 A (Sanyo Electric Co., Ltd.), 22 April 2010 (22.04.2010), (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009112811 A [0004]