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(54) **ELECTRIC CLEANER**

(57) An electric vacuum cleaner (1) is provided with a cleaner main body (2) including a dust-suction port (5). A motor-driven blower (6) and dust-separation case (12) are contained in the cleaner main body (2). The dust-separation case (12) is provided with a separation chamber (15) for separating dust contained in air drawn from the dust-suction port (5) from the air by means of centrifugal force, and a filter (31) which makes the separation chamber (15) and a vent chamber (23) communicate with

each other. A dust-collection case (71) for collecting the separated dust is attached to the dust-separation case (12). Cleaning tools (51a, 51b) in contact with the filter (31) are provided in the separation chamber (15). The filter (31) and cleaning tools (51a, 51b) are relatively rotated through a filter drive mechanism (41) in synchronization with an action for detaching/attaching the dust-collection case (71) from/to the dust-separation case (12). By virtue of this rotation, dust adhering to the filter (31) is removed by the cleaning tools (51a, 51b).

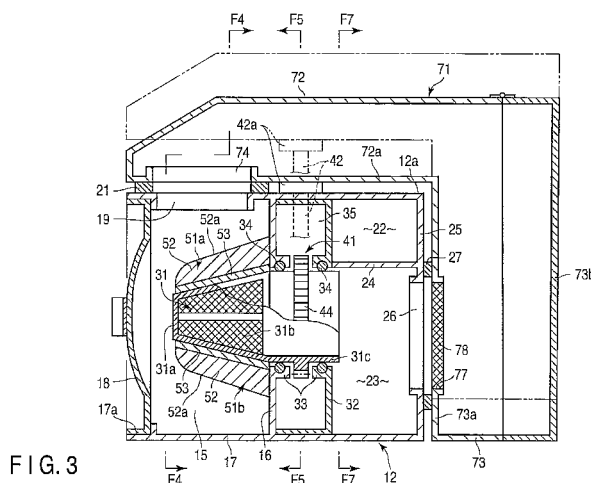


FIG. 3

Description

Technical Field

[0001] The present invention relates to an electric vacuum cleaner including a dust-separation case for separating dust contained in air by utilizing centrifugal force, and dust-collection case for collecting the dust separated from the air inside the dust-separation case. More particularly, the present invention relates to a structure for removing dust adhering to a filter contained in the dust-separation case by utilizing an action of detaching the dust-collection case from the dust-separation case, and action of attaching the dust-collection case to the dust-separation case.

Background Art

[0002] Heretofore, an electric vacuum cleaner in which dust contained in air drawn by a motor-driven blower is separated by utilizing inertial force, and which makes a bag-like pack-filter unnecessary is known. An example of an electric vacuum cleaner of this kind is disclosed in, for example, Japanese Patent No. 3999791.

[0003] The electric vacuum cleaner disclosed in this patent publication is provided with a dust-separation means for separating dust in air drawn by a motor-driven blower, and pleated filter for capturing dust passing through the dust-separation means. The pleated filter is arranged between the dust-separation means and motor-driven blower.

[0004] The dust-separation means is provided with a dust-separation case, and dust-collection case. The dust-separation case includes an airflow inlet through which air is drawn, separation chamber communicating with the airflow inlet, and airflow-passage opening positioned on the downstream side of the separation chamber in the airflow direction. The separation chamber includes a cylindrical wall surface, and an air-suction cylinder is arranged at a central part of the separation chamber surrounded by the wall surface. The air-suction cylinder includes a large number of vent holes. The airflow-passage opening is opposed to the pleated filter, and communicates with the inside of the air-suction cylinder. Furthermore, a dust outlet is formed at an upper end of the dust-separation case. The dust outlet communicates with the separation chamber.

[0005] The dust-collection case is detachably attached to the dust-separation case from above the dust-separation case. The dust-collection case includes a dust inlet, and vent window. The dust inlet is connected to the dust outlet of the dust-separation case. The vent window is covered with a filter, and is connected to the airflow-passage opening of the dust-separation case through a vent opening opened in the dust-separation case.

[0006] In such an electric vacuum cleaner, when the motor-driven blower starts an operation, air containing dust is drawn through the airflow inlet into the separation

chamber. The air drawn into the separation chamber flows to whirl along the wall surface. Centrifugal force is imparted to the air by the flow, and hence the dust heavier than the air is guided by the inertia to the dust outlet through the wall surface.

[0007] On the other hand, part of the air drawn into the separation chamber is filtered in the process of passing through the vent holes of the air-suction cylinder, and is thereafter guided to the airflow-passage opening through the inside of the air-suction cylinder. Accordingly, the dust contained in the air is separated in the process in which the air drawn into the dust-separation case passes through the separation chamber.

[0008] In the conventional electric vacuum cleaner, it is inevitable that fine dust adheres to the outer circumferential surface of the air-suction cylinder exposed to the separation chamber when the air passes through the separation chamber. When the dust adhering to the air-suction cylinder grows, the amount of air passing through the air-suction cylinder is reduced.

[0009] Furthermore, the air guided from the separation chamber to the dust-collection case together with the dust flows into the airflow-passage opening of the dust-separation case through the vent window of the dust-collection case, and vent opening of the dust-separation case. Thus, the air passing through the air-suction cylinder joins the air returning from the dust-collection case to the dust-separation case at the airflow-passage opening.

[0010] At this time, if a state where the vent window of the dust-collection case is clogged by the dust collected inside the dust-collection case is brought about, the flow of air flowing from the dust-collection case toward the airflow-passage opening is largely restrained. As a result of this, the air inside the separation chamber is drawn by the motor-driven blower wholly through the air-suction cylinder, and hence the dust becomes more liable to adhere to the outer circumferential surface of the air-suction cylinder.

[0011] As a result of this, clogging of the air-suction cylinder is caused, and it becomes impossible to efficiently separate dust in the air inside the separation chamber. However, in the electric vacuum cleaner disclosed in the above patent publication, removal of the dust adhering to the air-suction cylinder is not assumed, and hence lowering of the dust collection capability is undeniable.

[0012] On the other hand, with an electric vacuum cleaner of this kind, if the electric vacuum cleaner is provided with a sensor for detecting the volume or pressure of the air to be drawn into the dust-separation case, it is possible to detect by the sensor that the volume or the pressure of the air drawn into the dust-separation case becomes lower than a predetermined level. Furthermore, it is possible to give notification, on the basis of the detection result of the sensor, that the air-suction cylinder needs cleaning.

[0013] However, the worker using the electric vacuum cleaner is forced to carry out the work of disassembling

the dust-separation case, and removing the dust adhering to the air-suction cylinder each time the notification is given. Accordingly, a great deal of time and labor is needed for the cleaning work of the air-suction cylinder, and improvement of such a circumstance is demanded.

Disclosure of Invention

[0014] An object of the present invention is to obtain an electric vacuum cleaner in which it is easily possible to remove dust adhering to a filter in a separation chamber by utilizing an action of detaching/attaching a dust-collection case, and carry out maintenance of the filter.

[0015] In order to achieve the object described above, an electric vacuum cleaner according to an aspect of the present invention comprises (1) a cleaner main body including a dust-suction port, (2) a motor-driven blower contained in the cleaner main body, for drawing therein air from the dust-suction port, (3) a dust-separation case contained in the cleaner main body, and including a separation chamber for separating dust contained in the air drawn from the dust-suction port from the air by means of centrifugal force, and vent chamber positioned on the downstream side of the separation chamber in the flow direction of the air, (4) a dust-collection case to be detachably attached to the dust-separation case, for collecting the dust separated in the separation chamber, and (5) a filter provided with air permeability, and provided in the dust-separation case to make the separation chamber and vent chamber communicate with each other.

[0016] Cleaning means for removing dust adhering to the filter by being in contact with the filter is provided in the separation chamber. The filter and cleaning means are relatively rotated through drive means in synchronization with an action for detaching/attaching the dust-collection case from/to the dust-separation case. By virtue of this rotation, dust adhering to the filter is removed by the cleaning means.

[0017] According to the present invention, it is possible to automatically remove the dust adhering to the filter by utilizing the detaching/attaching action of the dust-collection case. Accordingly, this makes such troublesome work as to require cleaning of the filter to be carried out by artificial work accompanied by disassembly of the dust-separation case unnecessary to thereby facilitate maintenance of the filter.

Brief Description of Drawings

[0018]

FIG. 1 is a perspective view of an electric vacuum cleaner showing the state where a cleaner main body, dust-separation case, and dust-collection case are separated from each other in a first embodiment of the present invention.

FIG. 2 is a perspective view showing the state where

the dust-separation case, and dust-collection case are separated from each other in the first embodiment of the present invention.

FIG. 3 is a cross-sectional view showing the state where the dust-collection case is attached to the dust-separation case in the first embodiment of the present invention.

FIG. 4 is a cross-sectional view taken along line F4-F4 in FIG. 3.

FIG. 5 is a cross-sectional view taken along line F5-F5 in FIG. 3.

FIG. 6 is a cross-sectional view showing the state where the dust-collection case is upwardly pushed from the dust-separation case along line F5-F5 in FIG. 3 in the first embodiment of the present invention.

FIG. 7 is a cross-sectional view showing the state where the dust-collection case is separated from the dust-separation case along line F7-F7 in FIG. 3 in the first embodiment of the present invention.

FIG. 8 is a cross-sectional view showing the state where a dust-collection case is attached to a dust-separation case in a second embodiment of the present invention.

FIG. 9 is a cross-sectional view taken along line F9-F9 in FIG. 8.

FIG. 10 is a cross-sectional view showing the state where a dust-collection case is attached to a dust-separation case in a third embodiment of the present invention.

Best Mode for Carrying Out the Invention

[0019] A first embodiment of the present invention will be described below on the basis of FIGS. 1 to 7.

[0020] FIG. 1 shows an electric vacuum cleaner 1 movable along, for example, a floor surface to be cleaned. The electric vacuum cleaner 1 includes a cleaner main body 2, dust-separation unit 11, and well-known suction unit (not shown). The suction unit includes a suction head provided with a dust-suction opening, dust-suction hose, and extension pipe. The extension pipe connects the suction head and dust-suction hose to each other.

[0021] The cleaner main body 2 includes a pair of wheels 3 (only one of them is shown) in contact with the floor surface, caster (not shown), and unit-containing chamber 2a. The unit-containing chamber 2a is opened toward the position above the cleaner main body 2. A top cover 4 is supported on the cleaner main body 2. The top cover 4 can be moved in a rotating manner between a closed position at which the cover 4 covers the unit-containing chamber 2a from above, and an open position at which the cover 4 steps back from the unit-containing chamber 2a to open the chamber 2a.

[0022] As shown in FIG. 1, a dust-suction port 5 is formed in the front end wall of the cleaner main body 2. The dust-suction port 5 is used to connect the dust-suction hose, and communicates with the unit-containing

chamber 2a.

[0023] A motor-driven blower 6 shown in FIG. 7 is contained at a rear part of the cleaner main body 2. The motor-driven blower 6 includes a suction opening 6a for drawing air. The suction opening 6a is positioned at the back of the unit-containing chamber 2a, and is opened toward the unit-containing chamber 2a. Air discharged from the motor-driven blower 6 is ejected from an exhaust port (not shown) opened at a rear end part of the cleaner main body 2 to the outside of the cleaner main body 2.

[0024] The cleaner main body 2 is further provided with a sensor for detecting the pressure of air to be drawn into the motor-driven blower 6, and display device for notifying clogging. In this embodiment, when the sensor detects that a state where the pressure of the air drawn into the motor-driven blower 6 is less than a predetermined value continues for a predetermined period of time, the display device is operated by regarding the state as dust-clogging.

[0025] As shown in FIG. 1, the dust-separation unit 11 is detachably contained in the unit-containing chamber 2a of the cleaner main body 2. The dust-separation unit 11 is provided with a dust-separation case 12, filter 31, filter drive mechanism 41, first and second cleaning tools 51a and 51b, retention means 61, release means 65, and dust-collection case 71.

[0026] As shown in FIGS. 2 and 3, the dust-separation case 12 includes a case main body 12a, and filter case 12b. The filter case 12b has a substantially cylindrical shape, and is provided to continue from the rear part of the case main body 12a. As shown in FIGS. 3, 4, and 7, the case main body 12a includes an airflow inlet 13, airflow outlet 14, separation chamber 15, dust outlet 19, first vent chamber 22, and second vent chamber 23.

[0027] The airflow inlet 13 is opened in a front wall of the case main body 12a. When the dust-separation unit 11 is contained in the unit-containing chamber 2a, the airflow inlet 13 is connected to a rear end part of the dust-suction port 5.

[0028] The airflow outlet 14 is opened in a rear wall of the case main body 12a, and communicates with the inside of the filter case 12b. The airflow outlet 14 is positioned on the downstream side of the airflow inlet 13 on the basis of the flow direction of the air inside the case main body 12a.

[0029] The filter case 12b contains therein a pleated filter 69 as shown in FIG. 7. The pleated filter 69 is positioned between the suction opening 6a of the motor-driven blower 6, and the airflow outlet 14. The filter case 12b includes an outlet (not shown) positioned at a downstream position of the pleated filter 69. The outlet of the filter case 12b communicates with the suction opening 6a of the motor-driven blower 6.

[0030] As shown in FIGS. 3 and 4, the case main body 12a is provided with a first sidewall 16, and guide wall 17 protruding sideward from the first sidewall 16. The guide wall 17 has a substantially cylindrical shape, and includes an opening part 17a opposed to the first sidewall 16. The

opening part 17a of the guide wall 17 is closed by a detachable cover 18. The first sidewall 16, guide wall 17, and cover 18 collaborate with each other to define the separation chamber 15 inside the case main body 12a.

5 The first sidewall 16 is opposed to the cover 18, and is positioned at the inner part of the separation chamber 15.

[0031] As shown best in FIG. 4, an inlet 20 opened to the separation chamber 15 is formed in the first sidewall 16. When the separation chamber 15 is viewed from the direction of the cover 18, the inlet 20 is positioned at the rear part of the case main body 12a, and is backwardly shifted from the central part of the separation chamber 15.

[0032] The dust outlet 19 is formed at an upper end of the case main body 12a. The dust outlet 19 is opened toward the position above the case main body 12a, and communicates with the separation chamber 15. Furthermore, when the separation chamber 15 is viewed from the direction of the cover 18 as shown in FIG. 4, the dust outlet 19 is positioned at a front part of the case main body 12a, and is positioned at an upper end of the separation chamber 15. An annular sealing member 21 which can be elastically deformed is provided at the upper end of the case main body 12a. The sealing member 21 surrounds the dust outlet 19 to seal the outlet 19.

[0033] As shown in FIGS. 3 and 7, the first vent chamber 22 is formed in the case main body 12a to connect the airflow inlet 13 and inlet 20 of the separation chamber 15 to each other. The first vent chamber 22 extends in the front-back direction of the case main body 12a at the same height position as the upper part of the separation chamber 15. The first vent chamber 22 is continuous, at a front end thereof, with the airflow inlet 13. As shown in FIG. 7, a rear part of the first vent chamber 22 is curved in such a manner that the air passing through the first vent chamber 22 is guided in the obliquely downward direction with respect to the inlet 20. At the same time, the bottom wall of the rear part of the first vent chamber 22 is inclined in such a manner that the bottom wall becomes gradually lower toward the separation chamber 15.

[0034] As shown best in FIG. 4, the inlet 20 opened to the separation chamber 15 includes first to fourth opening edge parts 20a, 20b, 20c, and 20d. The position of the first opening edge part 20a coincides with the lowest position of the bottom wall of the first vent chamber 22. The second opening edge part 20b is positioned above the first opening edge part 20a so that the edge part 20b can be closer to the airflow inlet 13 than the first opening edge part 20a. Furthermore, the second opening edge part 20b is shifted farther toward the rear of the separation chamber 15 than the dust outlet 19. The third opening edge part 20c connects one end of the first opening edge part 20a and one end of the second opening edge part 20b to each other, and is arcuately curved along the guide wall 17. The fourth opening edge part 20d is arcuately curved to connect the other end of the first opening edge part 20a and the other end of the second opening edge

part 20b to each other. The fourth opening edge part 20d is opposed to the third opening edge part 20c. As a result of this, the second opening edge part 20b of the inlet 20 is positioned at an upstream end in the flow direction of the air flowing from the inlet 20 into the separation chamber 15.

[0035] As shown in FIGS. 3 and 7, the second vent chamber 23 is positioned under the first vent chamber 22. The first vent chamber 22 and second vent chamber 23 are separated from each other by a partition wall 24 belonging to the case main body 12. The separation chamber 15, first vent chamber 22, and second vent chamber 23 collaborate with each other to constitute a passage by which the airflow inlet 13 and airflow outlet 14 communicate with each other. In other words, the separation chamber 15 is positioned between the airflow inlet 13 and airflow outlet 14.

[0036] As shown in FIG. 3, the case main body 12a includes a second sidewall 25. The second sidewall 25 is parallel with the first sidewall 16, and is positioned on the opposite side of the first sidewall 16 with respect to the separation chamber 15. The second sidewall 25 collaborates with the partition wall 24 to define the second vent chamber 23. A vent opening 26 is formed in the second sidewall 25. The vent opening 26 is opened to the second vent chamber 23. An annular sealing member 27 which can be elastically deformed is provided on the outer surface of the second sidewall 25. The sealing member 27 surrounds the vent opening 26 to seal the opening 26.

[0037] As shown in FIGS. 3 and 4, the filter 31 is provided with a filter frame 31a made of synthetic resin, and filter member 31b. The filter frame 31a has a hollow cylindrical shape similar to a circular cone as a desirable example in order to secure a sufficient filtration area. A major diameter part of the filter frame 31a is formed at one end thereof in the axial direction. A base part 31c is formed integral with the major diameter part of the filter frame 31a. The base part 31c is formed into a hollow cylindrical shape sharing the same axis with the filter frame 31a.

[0038] The filter member 31b is constituted of, for example, a synthetic resin member formed into a reticulate form or a metallic member such as stainless steel in which a large number of tiny holes are formed, and is provided with air permeability. The filter member 31b is fixed to an outer circumferential surface of the filter frame 31a by means of adhesion or the like. Thus, the filter member 31b has a conic external shape covering the filter frame 31a.

[0039] When the filter member 31b is made of stainless steel, the durability thereof is enhanced as compared with the case where the filter member 31b is made of synthetic resin. Furthermore, there can be obtained an advantage that dust hardly adheres to the filter member 31b, and even when dust adheres to the filter member 31b, the dust easily peels off the filter member 31b.

[0040] As shown in FIG. 3, the filter 31 is rotatably sup-

ported on the case main body 12a to be positioned at a central part of the separation chamber 15. More specifically, a support wall 32 is provided inside the case main body 12a. The support wall 32 is opposed to the first sidewall 16 on the opposite side of the separation chamber 15, and forms a drive chamber 35 between itself and the first sidewall 16. The drive chamber 35 is separated from the separation chamber 15 by the first sidewall 16. Likewise, the drive chamber 35 is separated from the first and second vent chambers 22 and 23 by the support wall 32. Furthermore, the drive chamber 35 is formed in such a manner that the flow of air directed from the first vent chamber 22 toward the separation chamber 15 is not obstructed.

[0041] The base part 31c of the filter frame 31a extends from the first sidewall 16 to the support wall 32. The base part 31c penetrates the drive chamber 35, and is opened to the second vent chamber 23. Each of the first sidewall 16 and support wall 32 includes a filter support part 33. The filter support part 33 rotatably supports the base part 31c by surrounding the base part 31c of the filter frame 31a from outside.

[0042] An O-ring 34 is fixed to each filter support part 33. The O-ring 34 is in contact with the outer circumferential surface of the base part 31c to allow the filter 31 to be rotated. The O-ring 34 intercepts the communication between the drive chamber 35 and separation chamber 15, and also intercepts the communication between the drive chamber 35 and second vent chamber 23.

[0043] As shown in FIG. 3, the filter frame 31a covered with the filter member 31b protrudes from the first sidewall 16 toward the central part of the separation chamber 15. The diameter of the filter frame 31a becomes smaller from the first sidewall 16 toward the cover 18. Accordingly, the diameter of the filter frame 31a is the smallest at the distal end thereof opposed to the cover 18.

[0044] The base part 31c of the filter frame 31a is opened to the second vent chamber 23, and hence the separation chamber 15 and second vent chamber 23 communicate with each other through the filter 31. In other words, the inside of the filter 31 can be regarded as an upstream part of the second vent chamber 23. Therefore, the filter member 31b of the filter 31 is positioned at the boundary between the separation chamber 15 and second vent chamber 23.

[0045] As shown in FIGS. 5 and 6, a depression part 36 is formed in the upper end of the case main body 12a of the dust-separation case 12. The depression part 36 is opened toward a part above the case main body 12a. A bottom wall 32a of the depression part 36 is formed by part of the support wall 32 defining the drive chamber 35.

[0046] As shown in FIGS. 3, 5, and 6, the filter drive mechanism 41 includes an ascent/descent rod 42, compression coil spring 43, and gear 44. The ascent/descent rod 42 penetrates the bottom wall 32a of the depression part 36 through a square hole 32b formed in the wall 32a. Thus, the ascent/descent rod 42 is prevented from freely rotating around an axis thereof by the square hole 32b.

A disk-like head 42a is formed at an upper end of the ascent/descent rod 42. The head 42a has a diameter larger than the ascent/descent rod 42. A lower part of the ascent/descent rod 42 is inserted into the drive chamber 35. A rack 45 is formed on the side surface of the ascent/descent rod positioned at the drive chamber 35. The rack 45 moves linearly in accordance with the ascending/descending motion of the ascent/descent rod 42.

[0047] The compression coil spring 43 is interposed between the bottom wall 32a of the depression part 36 and the head 42a of the ascent/descent rod 42, and pushes the ascent/descent rod 42 up. As a result of this, the head 42a at the upper end of the ascent/descent rod 42 is located above the top surface of the case main body 12a in the free state of the ascent/descent rod 42.

[0048] The gear 44 is formed integral with the outer circumferential surface of the base part 31c of the filter frame 31a. The gear 44 shares the same axis with the base part 31c, and is engaged with the rack 45 inside the drive chamber 35. By this engagement, when the ascent/descent rod 42 carries out the ascending/descending motion, the gear 44 and rack 45 convert the linear motion of the ascent/descent rod 42 into rotational motion, and transmit the rotational motion to the filter 31.

[0049] More specifically, when the ascent/descent rod 42 is downwardly pushed against the impelling force of the compression coil spring 43, the filter 31 is rotated in a first direction as indicated by an arrow in FIG. 5. The first direction corresponds to the clockwise direction. Conversely, when the ascent/descent rod 42 is upwardly pushed by the compression coil spring 43, the filter 31 is rotated in a second direction as indicated by an arrow in FIG. 6. The second direction is a direction opposite to the first direction, and corresponds to the counterclockwise direction. It is desirable that the filter 31 be rotated one rotation or more. However, the number of rotation of the filter may be less than one.

[0050] Each of the first and second cleaning tools 51a and 51b is an example of the cleaning means. As shown in FIGS. 3 and 4, the first and second cleaning tools 51a and 51b are fixed to the first sidewall 16 of the case main body 12a, and are exposed to the separation chamber 15. The first cleaning tool 51a is positioned on the upper side of the filter 31, and is adjacent to the second opening edge part 20b of the inlet 20 opened to the separation chamber 15. The second cleaning tool 51b is arranged at a position on the underside of the filter 31, and is 180° apart from the first cleaning tool 51a in the circumferential direction. As a result of this, the first cleaning tool 51a and second cleaning tool 51b are opposed to each other in the radial direction of the filter 31.

[0051] Each of the first and second cleaning tools 51a and 51b includes a base 52, and filter contact member 53. The base 52 is formed of, for example, a synthetic resin material. The base 52 has a plate-like shape extending in the axial direction of the filter frame 31a, and one end thereof in the longitudinal direction is fixed to the sidewall 16.

[0052] Furthermore, the base 52 includes an edge part 52a facing the guide wall 17 of the separation chamber 15. The edge part 52a extends in the axial direction of the filter frame 31a. Furthermore, the edge part 52a has an acute triangular shape a width of which becomes smaller toward the outside of the filter frame 31a in the radial direction thereof. As a result of this, it is possible to prevent the edge part 52a of the base 52 from disturbing the flow of air passing through the separation chamber 15.

[0053] The filter contact member 53 is used to remove dust adhering to the outer circumferential surface of the filter member 31b by bringing the member 53 into contact with the outer circumferential surface of the filter member 31b. The filter contact member 53 is made of a soft material, such as a brush formed by binding a plurality of hairs, or cloth. When the filter 31 is rotated, the soft filter contact member 53 is deformed to conform to the outer circumferential surface of the filter member 31b. As a result of this, the soft filter contact member 53 makes it possible to remove the dust adhering to the outer circumferential surface of the filter member 31b without damaging the filter member 31b.

[0054] Particularly, when the brush is used as the filter contact member 53, hair ends of the brush get into the meshes of the filter member 31b. Thus, the use of the brush is desirable in the point that the dust adhering to the filter member 31b can be securely removed.

[0055] As shown in FIGS. 2 and 3, the dust-collection case 71 is detachably attached from above to the case main body 12a of the dust-separation case 12. The dust-collection case 71 is provided with an upper case 72, and side case 73. The upper case 72 is placed on the case main body 12a to cover the top surface of the case main body 12a. The upper case 72 includes a handle 71a to be gripped by a hand when the dust-collection case 71 is detached from the dust-separation case 12.

[0056] The side case 73 downwardly extends from one end of the upper case 72 to cover the second sidewall 25 of the case main body 12a from the lateral direction. The side case 73 includes a side cover 73b. The side cover can be rotated between a closed position and open position around an upper end thereof serving as a hinge. At the closed position, the side cover 73b stands along the side case 73 to tightly cover up the inside of the side case 73. At the open position, the side cover 73b separates from the side case 73 so that the dust collected in the side case 73 can be disposed of.

[0057] As shown in FIG. 3, the upper case 72 includes a lower wall 72a facing the top surface of the case main body 12a. A dust inlet 74 is formed in the lower wall 72a. The dust inlet 74 is positioned at an end part of the upper case 72 on the opposite side of the side case 73. The dust inlet 74 coincides with the dust outlet 19 of the case main body 12a when the dust-collection case 71 is attached to the case main body 12a of the dust-separation case 12. A connection part between the dust outlet 19 and dust inlet 74 is sealed by the sealing member 21.

[0058] As shown in FIG. 7, a hook 75 and convex part 76 are formed integral with the lower wall 72a of the upper case 72. The hook 75 downwardly protrudes from the lower wall 72a. Likewise, the convex part 76 has a plate-like shape downwardly protruding from the lower wall 72a, and is adjacent to the hook 75.

[0059] As shown in FIG. 3, the side case 73 includes an inner sidewall 73a facing the second sidewall 25 of the case main body 12a. A ventilation hole 77 is formed in the inner sidewall 73a. The ventilation hole 77 is covered with a net-like filter 78. The ventilation hole 77 coincides with the vent opening 26 of the second sidewall 25 when the dust-collection case 71 is attached to the case main body 12a of the dust-separation case 12. A connection part between the ventilation hole 77 and vent opening 26 is sealed by the sealing member 27.

[0060] The retention means 61 is used to retain the state where the dust-collection case 71 is attached to the dust-separation case 12, and is incorporated in an upper part of the case main body 12a. As shown in FIGS. 2 and 7, the retention means 61 includes a hook receiver 62. The hook receiver 62 upwardly protrudes from the top surface of the case main body 12a. The hook receiver 62 can be moved in the front-back direction of the case main body 12a between an engagement position and engagement release position as indicated by arrows in FIG. 7. At the engagement position, the hook receiver 62 is engaged with the hook 75 of the dust-collection case 71. At the engagement release position, the hook receiver 62 separates from the hook 75. The hook receiver 62 is pressed in the forward direction of the case main body 12a by a spring (not shown) to be held at the engagement position.

[0061] The release means 65 is used to separate the dust-collection case 71 from the dust-separation case 12, and is incorporated at the top part of the case main body 12a. As shown in FIGS. 2 and 7, the release means 65 is provided with a slide plate 65a. The slide plate 65a is supported at the top part of the case main body 12a to be linearly slidable in the front-back direction of the case main body 12a. The slide range of the slide plate 65a is specified by a regulation section (not shown).

[0062] A front end of the slide plate 65a forwardly protrudes from the front wall of the case main body 12a directly above the airflow inlet 13. A rear end of the slide plate 65a is in contact with the front end of the hook receiver 62 in order not to disturb the engagement of the hook 75 with the hook receiver 62, or release of the engagement. As a result of this, the slide plate 65a is forwardly pressed at all times by the spring possessed by the retention means 61.

[0063] As shown in FIG. 1, an operation piece 66 is rotatably supported on the front end wall of the cleaner main body 2. The operation piece 66 is an example of an operation part for artificially operating the release means 65. The operation piece 66 is positioned directly above the dust-suction port 5, and is in contact with the front end of the slide plate 65a. When the operation piece

66 is pressed by a fingertip of a hand, the slide plate 65a is slid toward the hook receiver 62 in the rear against the impelling force of the spring. As a result of this, the hook receiver 62 is forcibly moved from the engagement position to the engagement release position, and the engagement of the hook 75 with the hook receiver 62 is released.

[0064] As shown in FIG. 2, the case main body 12a is provided with a guide part 67. The guide part 67 upwardly protrudes toward the upper part of the case main body 12a. A groove 67a is formed in the guide part 67. The groove 67a is used to receive the convex part 76 of the dust-collection case 71 to be inserted therein from above, and is opened at the upper end face, and side face of the guide part 67.

[0065] Furthermore, a receiving plate and pop-up spring (both of them are not shown) are contained inside the groove 67a. The receiving plate is used to receive a tip of the convex part 76, and is supported by the guide part 67 in such a manner that the plate is ascendable/descendible along the groove 67a. The pop-up spring upwardly pushes the receiving plate at all times.

[0066] The dust-collection case 71 can be attached to the dust-separation case 12 by the following procedure. First, the upper case 72 of the dust-collection case 71 is opposed to the case main body 12a from above, and the tip of the convex part 76 of the upper case 72, and the upper end of the groove 67a of the guide part 67 are aligned with each other.

[0067] In this state, the dust-collection case 71 is lowered toward the case main body 12a, and the convex part 76 is inserted in the groove 67a. The dust inlet 74 of the dust-collection case 71 is connected to the dust outlet 19 of the case main body 12a concomitantly with the lowering of the dust-collection case 71, and the ventilation hole 77 of the dust-collection case 71 is further connected to the vent opening 26 of the case main body 12a. Furthermore, the hook 75 of the dust-collection case 71 is engaged with the hook receiver 62. By this engagement, the dust-collection case 71 is held at the predetermined position on the top surface of the case main body 12a.

[0068] When the dust-collection case 71 is lowered toward the case main body 12a, the tip of the convex part 76 hits against the receiving plate inside the groove 67a. As a result of this, the receiving plate is depressed against the impelling force of the pop-up spring. At the same time, the lower wall 72a of the upper case 72 of the dust-collection case 71 hits against the head 42a of the ascent/descent rod 42 protruding from the case main body 12a. As a result of this, the ascent/descent rod 42 is depressed against the impelling force of the compression coil spring 43.

[0069] Accordingly, in the state where the dust-collection case 71 is held by the dust-separation case 12 through the hook 75 and hook receiver 62, the dust-collection case 71 is upwardly pushed by the pop-up spring and compression coil spring 43. As a result of this, in the

state where the hook 75 of the dust-collection case 71 is engaged with the hook receiver 62, the hook 75 is pushed at all times in the direction in which the engagement of the hook 75 with the hook receiver 62 is maintained.

[0070] On the other hand, in order to detach the dust-collection case 71 from the dust-separation case 12, the operation piece 66 of the cleaner main body 2 is pressed by the fingertip of the hand. By this pressing, the slide plate 65a is slid toward the hook receiver 62, and the hook receiver 62 is moved from the engagement position toward the engagement release position. As a result of this, the hook receiver 62 separates from the hook 75, and the attachment of the dust-collection case 71 to the dust-separation case 12 is released.

[0071] When the hook receiver 62 is disengaged from the hook 75, the dust-collection case 71 is pushed up by the pop-up spring, and compression coil spring 43, and pops up above the dust-separation case 12. As a result of this, the worker lifts up the dust-collection case 71 by gripping the handle 71a thereof by his or her hand, whereby the dust-collection case 71 can be detached from the dust-separation case 12.

[0072] Next, an operation of the electric vacuum cleaner 1 will be described below.

[0073] When the motor-driven blower 6 starts the operation thereof, air inside the dust-separation case 12 is drawn through the pleated filter 69, and the pressure inside the first vent chamber 22, and second vent chamber 23 becomes the negative pressure. As a result of this, for example, dust on the floor to be cleaned is drawn from the suction head together with the air. The air containing dust is drawn into the separation chamber 15 from the inlet 20 after passing through the dust-suction port 5, airflow inlet 13, and first vent chamber 22.

[0074] The air that has been drawn into the separation chamber 15 flows to whirl along the cylindrical guide wall 17. As a result of this, centrifugal force is applied to the dust contained in the air. Consequently, coarse dust with large mass is attracted to the guide wall 17, and moves along the inner circumferential surface of the guide wall 17 to the dust outlet 19. The dust with large mass flows into the upper case 72 of the dust-collection case 71 together with the air from the dust outlet 19 through the dust inlet 74.

[0075] On the other hand, fine dust and part of the air inside the separation chamber 15 are drawn into the second vent chamber 23 through the base part 31c of the filter frame 31a after passing through the filter member 31b at the central part of the separation chamber 15. As a result of this, the dust with large mass is removed inside the separation chamber 15 from the air.

[0076] The air containing the dust with large mass that has flowed into the upper case 72 of the dust-collection case 71 reaches the side case 73 serving as a dust collection part. Furthermore, the air inside the side case 73 is drawn into the second vent chamber 23 through the net-like filter 78 from the vent opening 26, and joins, inside the second vent chamber 23, the air that has passed

through the filter member 31b. The dust with large mass that has been guided to the inside of the side case 73 is captured by the net-like filter 78, and stays inside the side case 73. Accordingly, the air from which the dust with large mass has already been removed is drawn into the second vent chamber 23 of the dust-separation case 12 from the dust-collection case 71.

[0077] The air passing through the filter 31 that has been drawn into the second vent chamber 23, and the air that has been drawn into the second vent chamber 23 via the side case 73 join each other inside the second vent chamber 23, and are drawn into the filter case 12b through the airflow outlet 14. Furthermore, the air drawn into the filter case 12b passes through the pleated filter 69. As a result of this, fine dust that has passed through the filter 31, and dust-collection case 71 is captured by the pleated filter 69.

[0078] The air filtered by the pleated filter 69 is drawn into the suction opening 6a of the motor-driven blower 6 from the outlet of the filter case 12b. The air drawn into the suction opening 6a passes through the inside of the motor-driven blower 6, and is then discharged from the exhaust port opened at the rear end part of the cleaner main body 2 to the outside of the electric vacuum cleaner 1.

[0079] In the case where the current input to the motor-driven blower 6 is set low, and the operation mode of the electric vacuum cleaner 1 is 'low', the flow rate of the air passing through the separation chamber 15 is low. Accordingly, dust adheres to the outer circumferential surface of the filter member 31b of the filter 31 in some cases. In such a case, when the operation mode of the electric vacuum cleaner 1 is switched from 'low' to 'high', and the current input to the motor-driven blower 6 is made higher, the negative pressure acting on the separation chamber 15 is enhanced, and the flow rate of the air passing through the separation chamber 15 becomes correspondingly higher.

[0080] As a result of this, the dust adhering to the outer circumferential surface of the filter member 31b is blown off by the pressure of the air passing through the separation chamber 15, and is guided to the dust-collection case 71 from the dust outlet 19. However, such a dust removal function is deficient in certainty, and hence there is the possibility of the dust adhering to the outer circumferential surface of the filter member 31b growing with an elapse of operating time of the electric vacuum cleaner 1.

[0081] Furthermore, when the inside of the dust-collection case 71 is filled with dust, the dust collected in the dust-collection case 71 act as resistance, and the flow of the air inside the dust-collection case 71 is disturbed. This reduces the amount of air to be drawn from the dust-collection case 71 into the second vent chamber 23. The amount of air drawn from the separation chamber 15 into the second vent chamber 23 through the filter 31 is increased concomitantly with this. As a result of this, it is undeniable that dust increasingly becomes liable to

adhere to the outer circumferential surface of the filter member 31b of the filter 31, to thereby clog the filter member 31b. Accordingly, the amount of air drawn into the motor-driven blower 6 is reduced, and hence the display device for notifying the clogging is operated in some cases.

[0082] When the display device is operated, the worker using the electric vacuum cleaner 1 opens the top cover 4 to expose the dust-separation unit 11. Then, the worker detaches the dust-collection case 71 from the dust-separation case 12, and opens the side cover 73b to thereby carry out the work for throwing away the dust inside the dust-collection case 71.

[0083] After throwing away the dust inside the dust-collection case 71, the worker carries out the work for attaching the dust-collection case 71 to the dust-separation case 12. According to this embodiment, at the time of the work for detaching the dust-collection case 71, and the work for attaching the dust-collection case 71 to be necessarily carried out when the dust is thrown away, it is possible to automatically remove the dust that has adhered to the filter member 31b by using the first and second cleaning tools 51a and 51b.

[0084] More specifically, when the operation piece 66 of the cleaner main body 2 is pushed by the fingertip of the hand, and the slide plate 65a is slid toward the hook receiver 62, the hook receiver 62 is disengaged from the hook 75. As a result of this, the attachment of the dust-collection case 71 to the dust-separation case 12 is released. The dust-collection case 71 receives the impelling force of the pop-up spring and compression coil spring 43 concomitantly with this, and is shifted from the retained state shown in FIG. 5 to the lifted state shown in FIG. 6. The two-dot chain lines in FIGS. 3 and 4 each show the state where the dust-collection case 71 is pushed up from the dust-separation case 12.

[0085] When the dust-collection case 71 is pushed up from the dust-separation case 12, the ascent/descent rod 42 linearly ascends as shown in FIG. 6. The linear motion of the ascent/descent rod 42 is converted into rotational motion by the engagement of the rack 45 and gear 44 with each other. This causes the filter 31 together with the gear 44 to be rotated in the second direction.

[0086] In other words, the filter 31, and first and second cleaning tools 51a and 51b are relatively rotated in accordance with the ascending movement of the ascent/descent rod 42 for pushing up the dust-collection case 71. As a result of this, the filter contact members 53 of the first and second cleaning tools 51a and 51b move along the outer circumferential surface of the filter member 31b while being in contact with the outer circumferential surface. Thus, the dust that has adhered to the outer circumferential surface of the filter member 31b is removed by the filter contact members 53. The removed dust is collected at the side surfaces of the filter contact members 53.

[0087] On the other hand, when the dust-collection case 71 is attached to the dust-separation case 12, the

ascent/descent rod 42 is linearly pushed down by the dust-collection case 71. The linear motion of the ascent/descent rod 42 is converted into rotational motion by the engagement of the rack 45 and gear 44 with each other, and is transmitted to the filter 31. As a result of this, the filter 31 is rotated in the first direction opposite to the direction at the time of detaching the dust-collection case 71. As a result of this, the outer circumferential surface of the filter member 31b is cleaned by the filter contact members 53 of the first and second cleaning tools 51a and 51b again.

[0088] As described above, it is possible to automatically remove the dust that has adhered to the outer circumferential surface of the filter member 31b concomitantly with the action for detaching/attaching the dust-collection case 71 from/to the dust-separation case 12.

[0089] The dust removed from the outer circumferential surface of the filter member 31b, and collected at the side surfaces of the filter contact members 53 falls from the outer circumferential surface of the filter member 31b to the bottom of the separation chamber 13 as lumps. Further, even when the dust removed from the filter member 31b does not fall from the filter member 31b, the dust is collected at the side surfaces of the filter contact members 53, and hence the dust is kept in a state where the dust is subject to the pressure of the air passing through the separation chamber 15.

[0090] When the motor-driven blower 6 restarts the operation thereof after the dust-collection case 71 is attached to the dust-separation case 12, the dust that has fallen from the filter member 31b to the bottom of the separation chamber 15, or the dust that has been collected at the side surfaces of the filter contact members 53 is carried away from the dust outlet 19 to the dust-collection case 71 by taking a ride on the flow of air passing through the separation chamber 15.

[0091] According to this embodiment, the filter frame 31a to which the filter member 31b is fixed is formed into a conic shape in which the diameter thereof becomes smaller from the first sidewall 16 toward the cover 18. As a result of this, the outer circumferential surface of the filter member 31b is inclined with respect to the axial line of the filter frame 31a. Accordingly, when the filter contact members 53 have removed the dust on the outer circumferential surface of the filter member 31b, it becomes easy for the removed dust to move owing to the inclination of the outer circumferential surface of the filter member 31b.

[0092] Particularly, at the upper part of the filter member 31b, the removed dust becomes liable to collect at the distal end part of the filter frame 31a with the small diameter. Accordingly, it becomes easy for the dust removed from the outer circumferential surface of the filter member 31b to fall to the bottom of the separation chamber 15 as lumps.

[0093] Moreover, the air flowing through the first vent chamber 22 is drawn into the separation chamber 15 from the inlet 20 opened in the first sidewall 16. Thus,

the mainstream of the air passing through the separation chamber 15, and flowing toward the dust outlet 19 passes through a part rather closer to the cover 18 than to the first sidewall 16 in a concentrated manner. The distal end part of the filter frame 31a with the small diameter is adjacent to the cover 18, and hence it is possible to securely carry away the dust collected at the distal end part of the filter frame 31a with the small diameter to the inside of the dust-collection case 71 by utilizing the flow of the air.

[0094] From the above description, according to the electric vacuum cleaner 1 of this embodiment, it is possible to automatically remove the dust that has adhered to the filter 31 inside the separation chamber 15 by utilizing the action for detaching/attaching the dust-collection case 71 from/to the dust-separation case 12. This makes the work for, after detaching the dust-separation unit 11 from the cleaner main body 2, detaching the cover 18 from the case main body 12 to expose the filter 31 inside the separation chamber 15, and the work for putting a hand into the inside of the separation chamber 15 from the opening part 17a to remove the dust adhering to the outer circumferential surface of the filter member 31b by the hand unnecessary. Accordingly, it is possible to easily carry out the maintenance of the filter 31 without requiring much time and labor in the cleaning work of the filter 31.

[0095] According to this embodiment, when a brush is used as the filter contact member 53, the dust removed from the outer circumferential surface of the filter member 31b may possibly twist about the hairs of the brush in some cases. However, when the dust-collection case 71 is attached to the dust-separation case 12, the filter 31 is rotated in the direction opposite to the direction in the case where the dust-collection case 71 is detached from the dust-separation case 12. Accordingly, the dust adhering to the hairs of the brush becomes more liable to come off the hairs concomitantly with the reversal of the filter 31.

[0096] At the same time, the brush is directly exposed to the flow of air passing through the separation chamber 15, and hence much of the dust adhering to the hairs of the brush is subjected to the pressure of the air passing through the separation chamber 15 to be blown off. As a result of this, it is possible to prevent the dust from being left unremoved from the hairs of the brush, and prevent the dust adhering to the brush from growing.

[0097] The present invention is not particularly limited to the first embodiment, and can be variously modified and implemented within the scope not deviating from the gist of the invention.

[0098] FIGS. 8 and 9 disclose a second embodiment of the present invention. The second embodiment differs from the first embodiment in the point that a filter 31 is cleaned by using one cleaning tool 51. The configurations of a dust-separation case 12 other than the above are identical with the first embodiment. Accordingly, in the second embodiment, constituent elements identical with those of the first embodiment are denoted by the identical

reference symbols, and a description of them will be omitted.

[0099] As shown in FIGS. 8 and 9, the cleaning tool 51 is positioned on the upper side of the filter 31, and is adjacent to a second opening edge part 20b of an inlet 20 opened to a separation chamber 15. A filter contact member 53 of the cleaning tool 51 is in contact with an outer circumferential surface of a filter member 31b from above the filter 31.

[0100] Furthermore, in cleaning the outer circumferential surface of the filter member 31b having a conic shape by using the one cleaning tool 51, it is desirable that the number of teeth of each of a gear 44 and rack 45 be set so that the filter 31 can be rotated at least one rotation.

[0101] According to the second embodiment, when a dust-collection case 71 is detached from the dust-separation case 12, or when the dust-collection case 71 is attached to the dust-separation case 12, the filter 31 is rotated in the circumferential direction. Accordingly, it is possible to remove dust adhering to the outer circumferential surface of the filter member 31b by means of the filter contact member 53.

[0102] As a result of this, it is possible to easily carry out the cleaning work of the filter 31 by utilizing the detaching action, and attaching action of the dust-collection case 71. Accordingly, like the first embodiment, it is possible to omit the work for exposing the filter 31 inside the separation chamber 15, and manually removing the dust adhering to the outer circumferential surface of the filter member 31b, thereby facilitating the maintenance of the filter 31.

[0103] Furthermore, according to the above-mentioned configuration, the one cleaning tool 51 is arranged adjacent to the second opening edge part 20b of the inlet 20 opened to the separation chamber 15, and hence it is possible to prevent the cleaning tool 51 from adversely affecting the dust separation function.

[0104] That is, the mainstream of the air passing through the separation chamber 15 from the inlet 20 toward the dust outlet 19 flows along the guide wall 17 as if the mainstream detours the cleaning tool 51. Accordingly, although the cleaning tool 51 outwardly protrudes in the radial direction of the filter 31, it is possible to prevent the flow of the air passing through the separation chamber 15 from being disturbed by the cleaning tool 51. As a result of this, it becomes hard for the flow rate of the air passing through the separation chamber 15 to lower, and hence it is possible to efficiently separate the dust contained in the air in the separation chamber 15.

[0105] Furthermore, when the dust-collection case 71 is detached or attached from or to the dust-separation case 12, the filter 31 is rotated at least one rotation. Accordingly, it is possible to clean the outer circumferential surface of the filter member 31b over the entire circumference thereof by means of the one cleaning tool 51 positioned in the vicinity of the inlet 20.

[0106] FIG. 10 discloses a third embodiment of the present invention.

[0107] The third embodiment differs from the first embodiment in the manner of attaching first and second cleaning tools 51a and 51b to a case main body 12a. The configurations of a dust-separation case 12 other than the above are identical with the first embodiment. Accordingly, in the third embodiment, constituent elements identical with those of the first embodiment are denoted by the identical reference symbols, and a description of them will be omitted.

[0108] As shown in FIG. 10, a base 52 of each of the first and second cleaning tools 51a and 51b is supported on a first sidewall 16 of the case main body 12a through a hinge 81. Accordingly, each of the first and second cleaning tools 51a and 51b is rotatable between a first position at which a filter contact member 53 is in contact with an outer circumferential surface of a filter member 31b, and second position at which the filter contact member 53 separates from the outer circumferential surface of the filter member 31b.

[0109] Furthermore, the hinge 81 includes a spring not shown. The spring impels each of the first and second cleaning tools 51a and 51b toward the first position at all times. As a result of this, the filter contact member 53 is pressed against the outer circumferential surface of the filter member 31b by appropriate elastic force. It is desirable that the force of pressing the filter contact member 53 against the outer circumferential surface of the filter member 31b be of such magnitude as not to give excessive resistance to the rotation of the filter 31.

[0110] In the third embodiment configured as described above too, the filter 31 is rotated in accordance with the detaching action of the dust-collection case 71, and attaching action of the dust-collection case 71. Thus, it is possible to easily carry out the cleaning work of the filter 31 by utilizing the detaching action, and attaching action of the dust-collection case 71.

[0111] Accordingly, like the first embodiment, it is possible to omit the work for exposing the filter 31 inside a separation chamber 15, and manually removing the dust adhering to the outer circumferential surface of the filter member 31b, thereby facilitating the maintenance of the filter 31.

[0112] Furthermore, each of the first and second cleaning tools 51a and 51b can be moved to the second position at which the cleaning tool 51a or 51b is separated from the outer circumferential surface of the filter member 31b. As a result of this, even if, for example, hard dust is interposed between the outer circumferential surface of the filter member 31b and filter contact member 53, the cleaning work of the filter 31 is not adversely affected.

[0113] That is, in the process in which the filter 31 is rotated in accordance with the detaching action of the dust-collection case 71, when the hard dust that has adhered to the outer circumferential surface of the filter member 31b collides against the filter contact member 53, the filter contact member 53 is pushed by the dust. As a result of this, each of the first and second cleaning tools 51a and 51b is rotated from the first position toward

the second position around the hinge 81. In other words, the filter contact member 53 separates from the outer circumferential surface of the filter member 31b to avoid the hard dust.

[0114] Accordingly, the hard dust is never caught between the filter contact member 53 and outer circumferential surface of the filter member 31b. Thus, it is possible to continue the rotation of the filter 31, and prevent the filter member 31b from being damaged by the hard dust.

[0115] Furthermore, after passing the filter contact member 53 concomitantly with the rotation of the filter 31, the hard dust falls from the filter member 31b. Accordingly, the hard dust is never caught again between the filter contact member 53 and outer circumferential surface of the filter member 31b.

[0116] At the same time, when the hard dust has passed the filter contact member 53, each of the first and second cleaning tools 51a and 51b is retained again at the first position by the spring. Accordingly, it is possible to continue carrying out the cleaning work of rotating the filter 31.

[0117] In the third embodiment, the filter frame 31a to which the filter member 31b is fixed, and the base part 31c may be separably coupled to each other.

[0118] According to this configuration, it is possible to take out the filter frame 31a to which the filter member 31b is fixed from the separation chamber 15 by manually rotating each of the first and second cleaning tools 51a and 51b from the first position to the second position. Accordingly, it becomes possible to wash the filter frame 31a and filter member 31b with water, or repair them, thereby improving the workability in the maintenance of the filter 31.

[0119] In each of the first to third embodiments, the cleaning tool and filter member are relatively moved by rotating the filter in accordance with the detaching action and attaching action of the dust-collection case. However, the present invention is not particularly limited to this. For example, the filter may be fixed to the first sidewall, and the cleaning tool may be rotated in accordance with the detaching action and attaching action of the dust-collection case. In this manner too, the filter and the cleaning tool are relatively rotated, and hence it is possible to remove the dust adhering to the filter by means of the cleaning tool.

[0120] Furthermore, the filter frame to which the filter member is to be fixed is not limited to the conic shape, and may be cylindrical.

[0121] Moreover, in the first embodiment, the dust-collection case is upwardly pushed by the pop-up spring included in the retention means, and the compression coil spring included in the filter drive mechanism. However, for example, the pop-up spring may be disused, and the dust-collection case may be pushed up by using only the compression coil spring.

Industrial Applicability

[0122] According to the present invention, in an electric vacuum cleaner for separating dust contained in air by utilizing centrifugal force generated in a separation chamber, it is possible to easily remove the dust adhering to a filter in the separation chamber, and easily carry out the maintenance of the filter.

Claims

1. An electric vacuum cleaner **characterized by** comprising:

a cleaner main body including a dust-suction port;
 a motor-driven blower contained in the cleaner main body, for drawing therein air from the dust-suction port;
 a dust-separation case contained in the cleaner main body, and including a separation chamber for separating dust contained in the air drawn from the dust-suction port from the air by means of centrifugal force, and vent chamber positioned on the downstream side of the separation chamber in the flow direction of the air;
 a dust-collection case to be detachably attached to the dust-separation case, for collecting the dust separated in the separation chamber;
 a filter provided with air permeability, and provided in the dust-separation case to make the separation chamber and vent chamber communicate with each other;
 cleaning means for removing dust adhering to the filter by being in contact with the filter in the separation chamber; and
 drive means for relatively rotating the filter and cleaning means in synchronization with an action for detaching/attaching the dust-collection case from/to the dust-separation case.

2. The electric vacuum cleaner of claim 1, **characterized by** further comprising:

retention means provided in the dust-separation case, for retaining the attachment of the dust-collection case to the dust-separation case by being engaged with the dust-collection case;
 release means for releasing the engagement of the retention means with the dust-collection case; and
 impelling means for impelling the dust-collection case in a direction in which the dust-collection case is separated from the dust-separation case.

3. The electric vacuum cleaner of claim 2, **character-**

ized in that the cleaner main body includes an operation part for artificially operating the release means.

4. The electric vacuum cleaner of claim 1, **characterized in that** the filter has a hollow cylindrical shape protruding inside the separation chamber, and the cleaning means includes at least one cleaning tool in contact with an outer circumferential surface of the filter.

5. An electric vacuum cleaner **characterized by** comprising:

a cleaner main body including a dust-suction port;
 a motor-driven blower contained in the cleaner main body, for drawing therein air from the dust-suction port;
 a dust-separation case contained in the cleaner main body, and including a separation chamber for separating dust contained in the air drawn from the dust-suction port from the air by means of centrifugal force, and vent chamber positioned on the downstream side of the separation chamber in the flow direction of the air;
 a dust-collection case to be detachably attached to the dust-separation case, for collecting the dust separated in the separation chamber;
 a filter provided with air permeability, and rotatably supported in the dust-separation case to make the separation chamber and vent chamber communicate with each other;
 a drive mechanism for rotating the filter in synchronization with an action for detaching/attaching the dust-collection case from/to the dust-separation case; and
 cleaning means in contact with the filter in the separation chamber, for removing dust adhering to the filter when the filter is rotated.

6. The electric vacuum cleaner of claim 5, **characterized in that** the filter is rotated in a first direction when the dust-collection case is detached from the dust-separation case, and is rotated in a second direction opposite to the first direction when the dust-collection case is attached to the dust-separation case.

7. The electric vacuum cleaner of claim 6, **characterized in that** the drive mechanism is provided with (1) a gear which rotates together with the filter, and (2) rod which is supported by the dust-separation case, carries out linear motion in accordance with the detaching action and attaching action of the dust-collection case, and includes a rack engaged with the gear.

8. The electric vacuum cleaner of claim 7, **characterized by** further comprising:

retention means provided in the dust-separation case, for retaining the attachment of the dust-collection case to the dust-separation case by being engaged with the dust-collection case; release means for releasing the engagement of the retention means with the dust-collection case; and impelling means for impelling the dust-collection case in a direction in which the dust-collection case is separated from the dust-separation case.

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9. The electric vacuum cleaner of claim 5, **characterized in that** the filter has a hollow cylindrical shape protruding inside the separation chamber, the cleaning means includes a pair of cleaning tools in contact with an outer circumferential surface of the filter, the cleaning tools extend in an axial direction of the filter at positions opposed to each other in a radial direction of the filter, and each of the cleaning tools includes an edge part having an acute shape a width of which becomes smaller toward the outside in the radial direction of the filter.

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10. The electric vacuum cleaner of claim 9, **characterized in that** the dust-separation case includes an inlet opened to the separation chamber, the inlet includes an opening edge part positioned at an upstream end in a flow direction of air flowing into the separation chamber, and one of the cleaning tools is positioned in the vicinity of the opening edge part.

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11. The electric vacuum cleaner of claim 9, **characterized in that** the cleaning tool is supported by the dust separation case in such a manner that the cleaning tool is rotatable in a direction in which the cleaning tool is away from the outer circumferential surface of the filter.

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12. The electric vacuum cleaner of claim 5, **characterized in that** the filter has a hollow cylindrical shape protruding inside the separation chamber, the cleaning means includes a single cleaning tool in contact with an outer circumferential surface of the filter, and the cleaning tool extends in an axial direction of the filter, and includes an edge part having an acute shape a width of which becomes smaller toward the outside in the radial direction of the filter.

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13. The electric vacuum cleaner of claim 12, **characterized in that** the dust-separation case includes an inlet opened to the separation chamber, the inlet includes an opening edge part positioned at an upstream end in a flow direction of air flowing into the separation chamber, and the cleaning tools is posi-

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tioned in the vicinity of the opening edge part.

14. The electric vacuum cleaner of claim 12, **characterized in that** the cleaning tool is rotated at least one rotation in a circumferential direction of the filter.

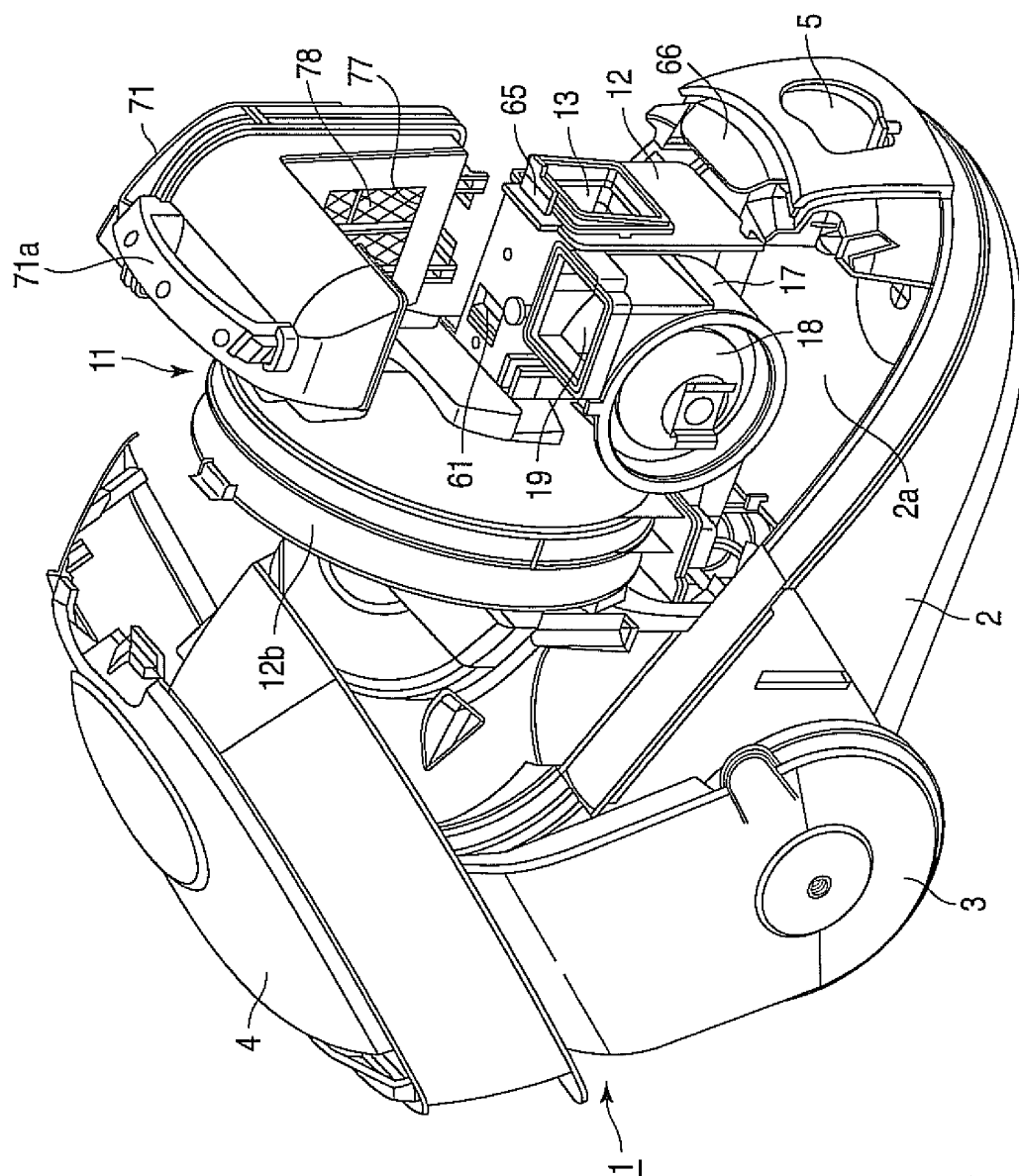


FIG. 1

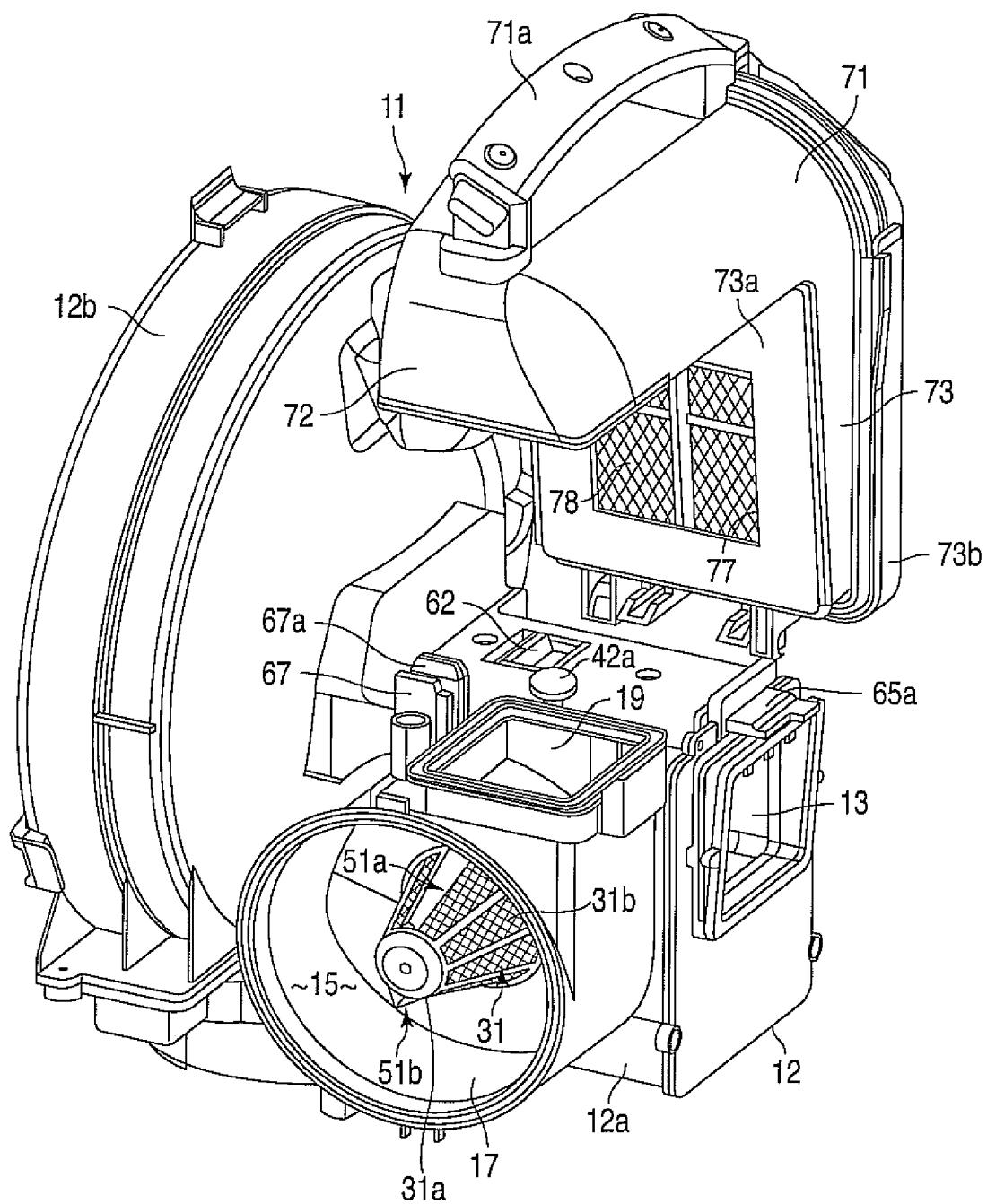


FIG. 2

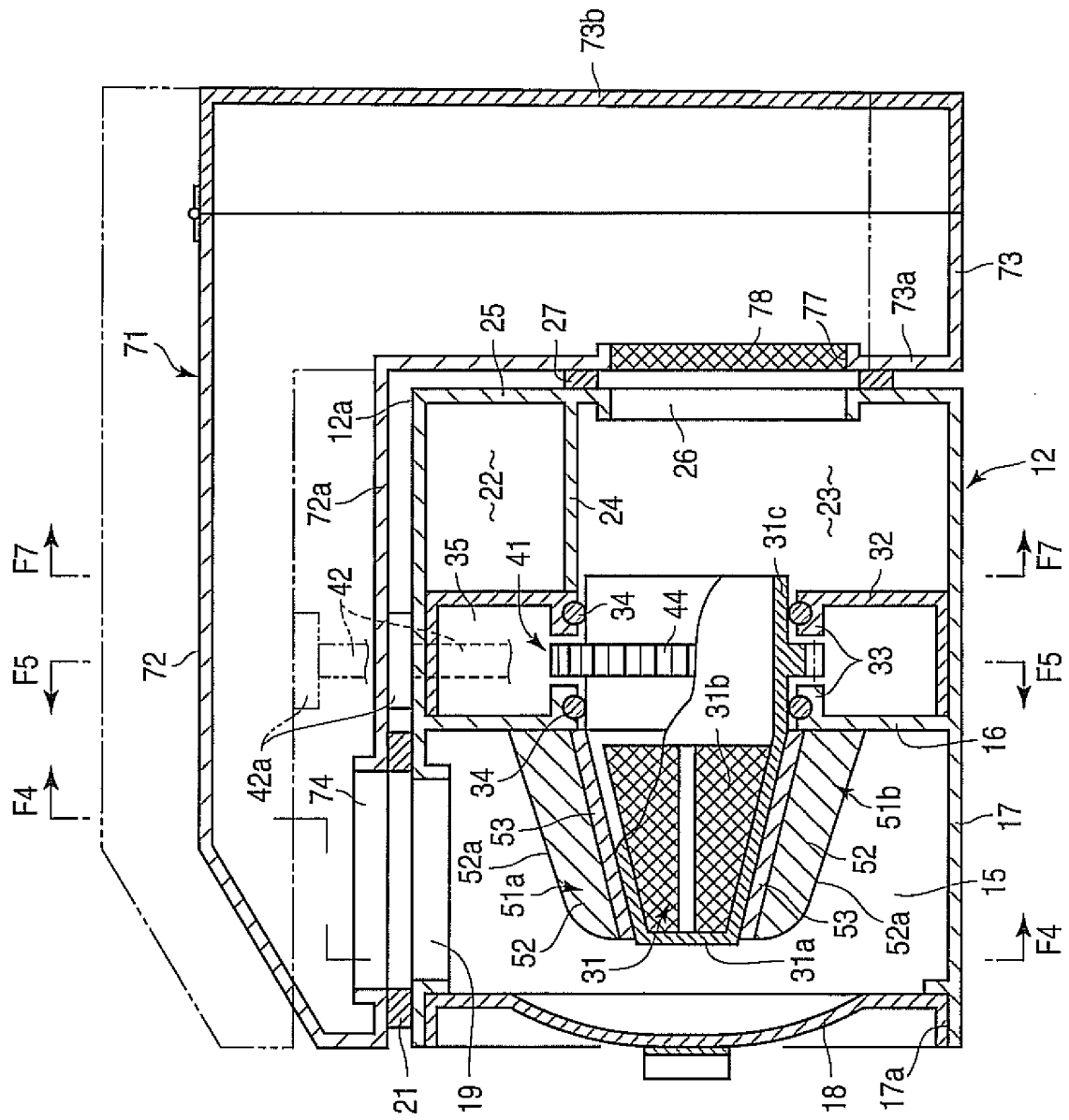


FIG. 3

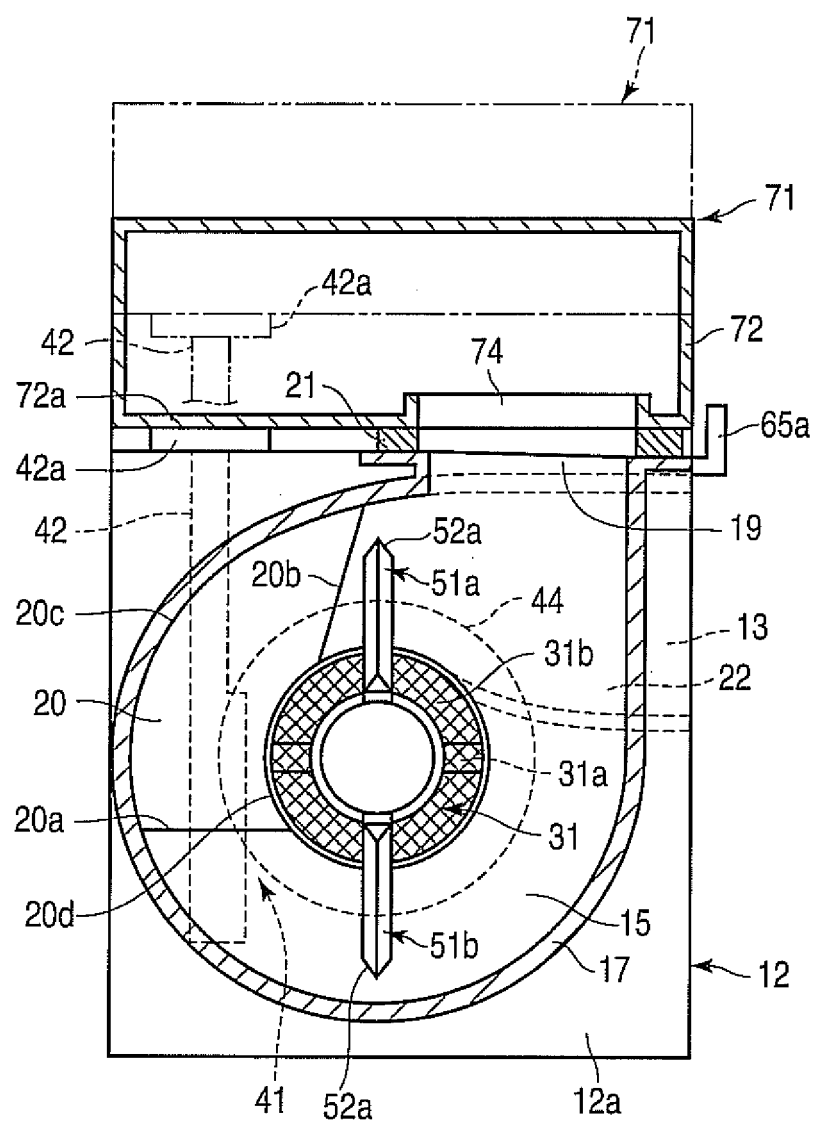


FIG. 4

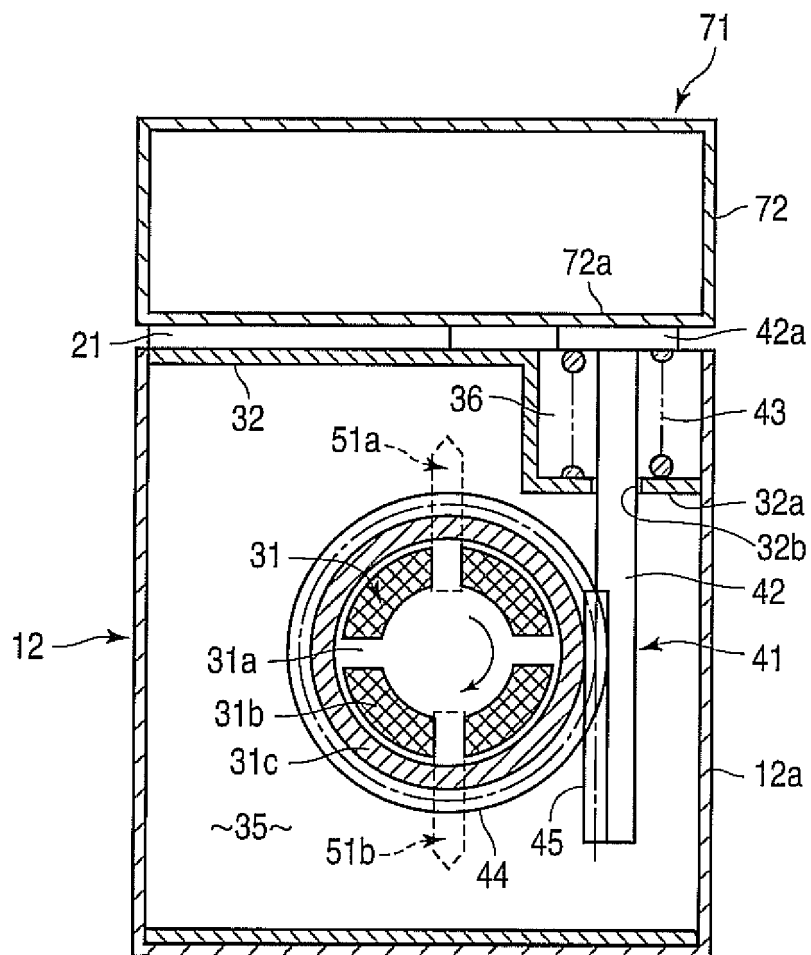


FIG. 5

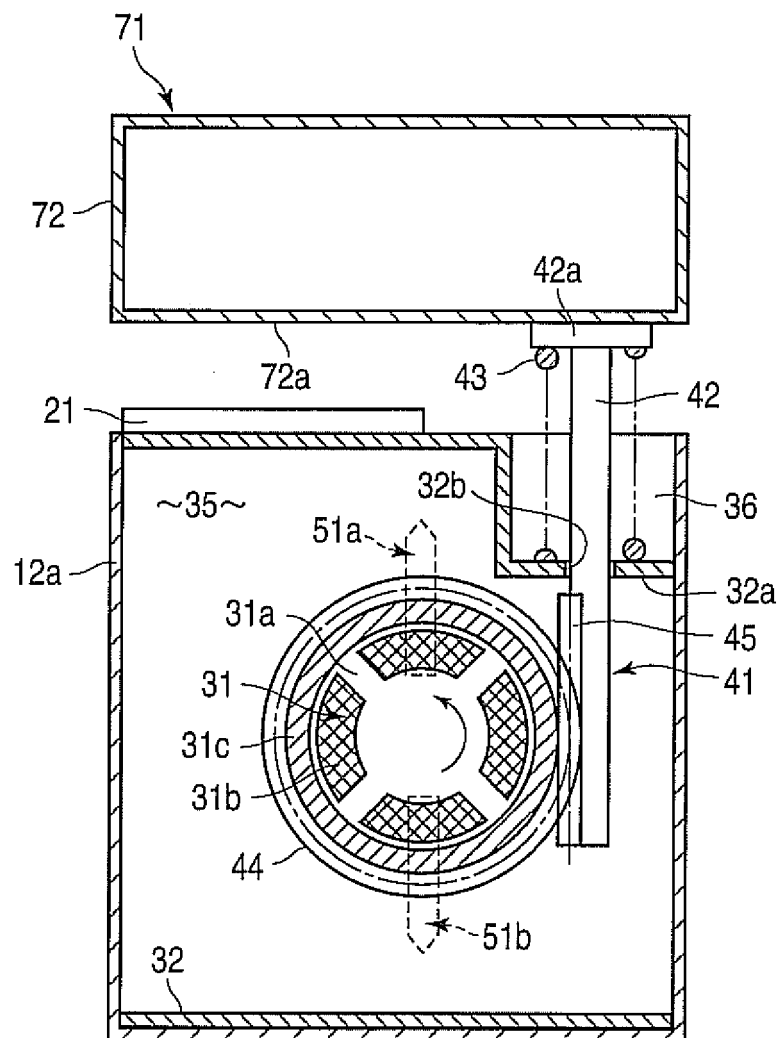


FIG. 6

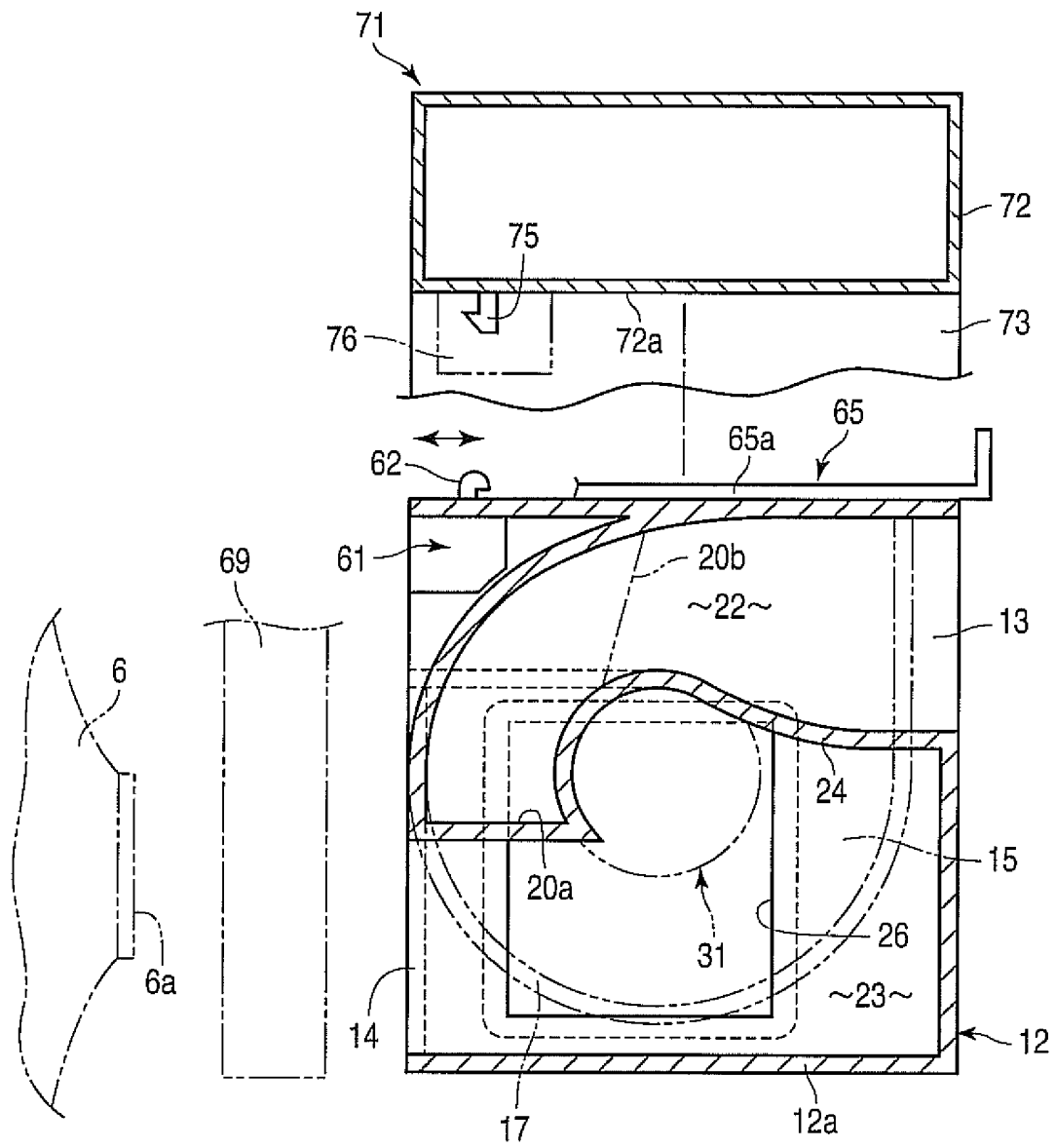


FIG. 7

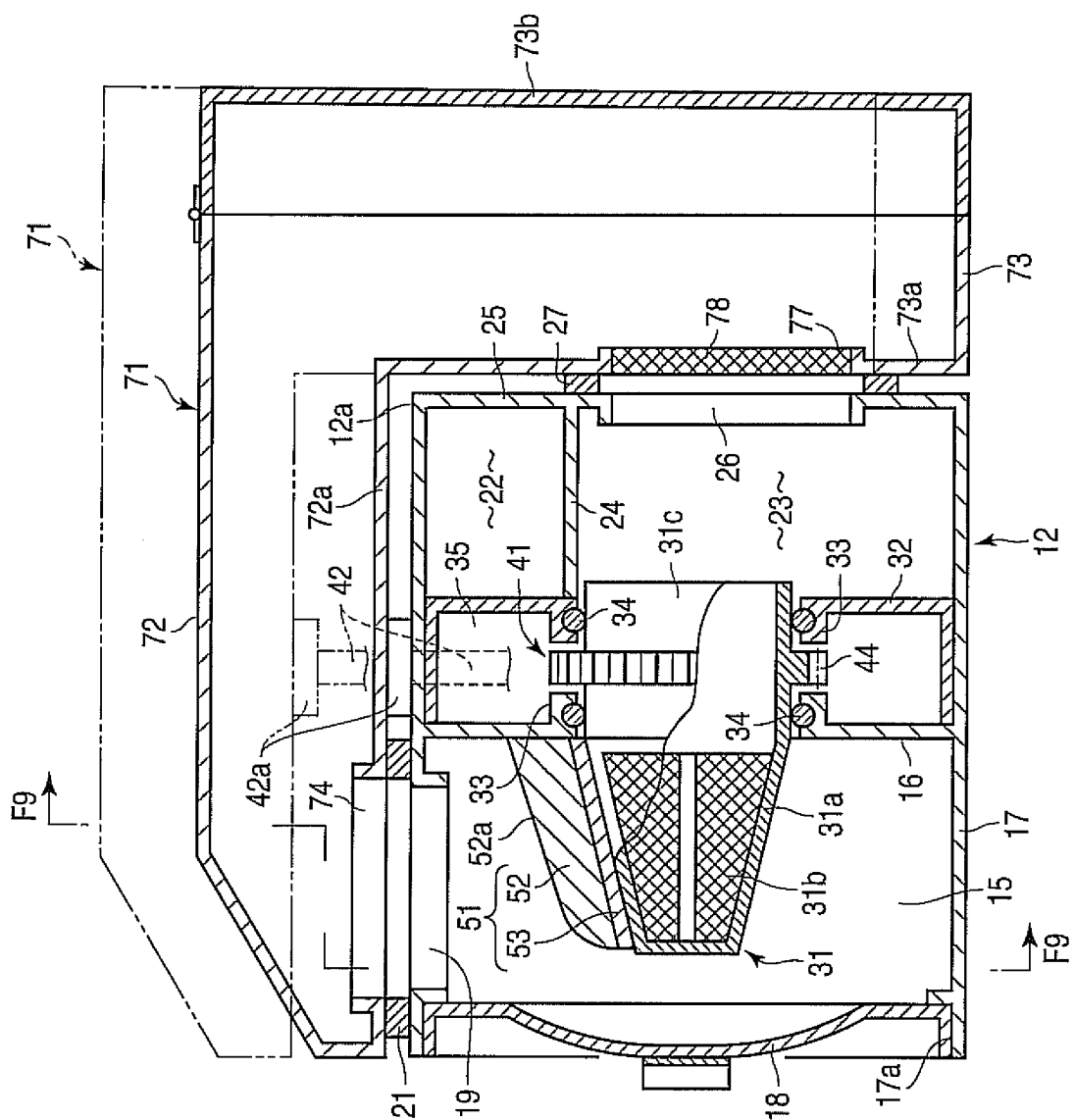


FIG. 8

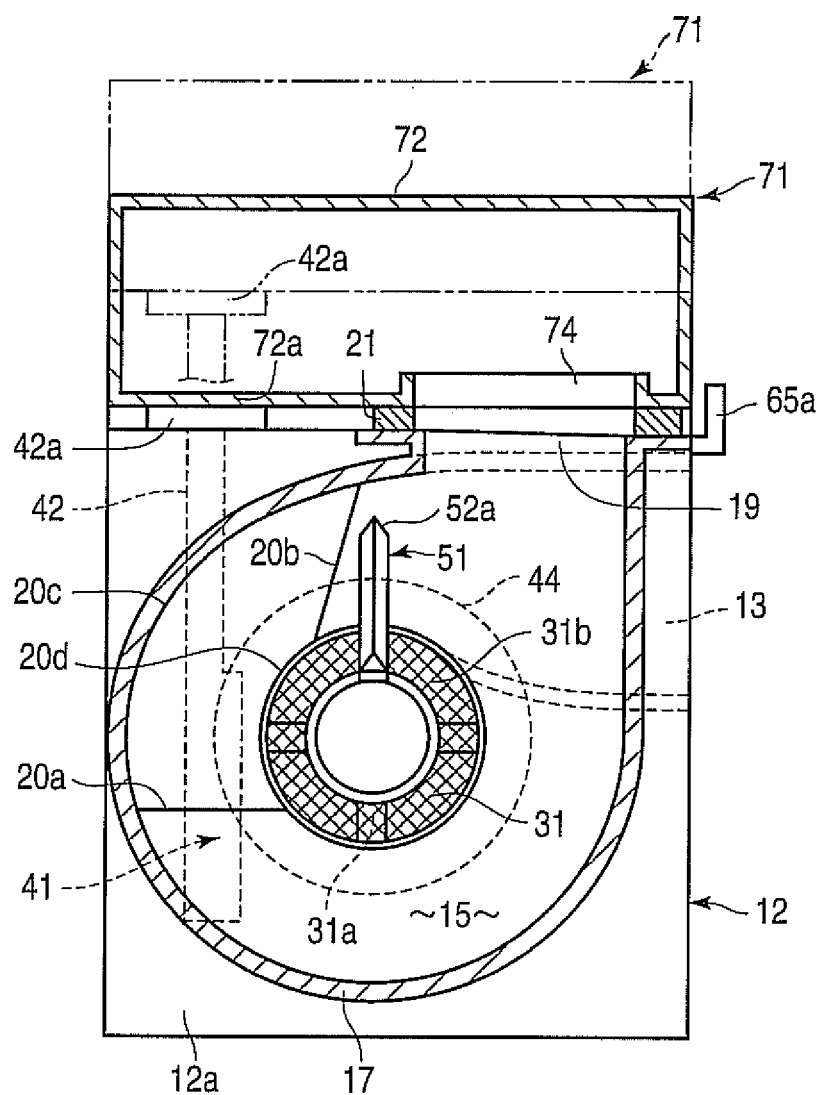


FIG. 9

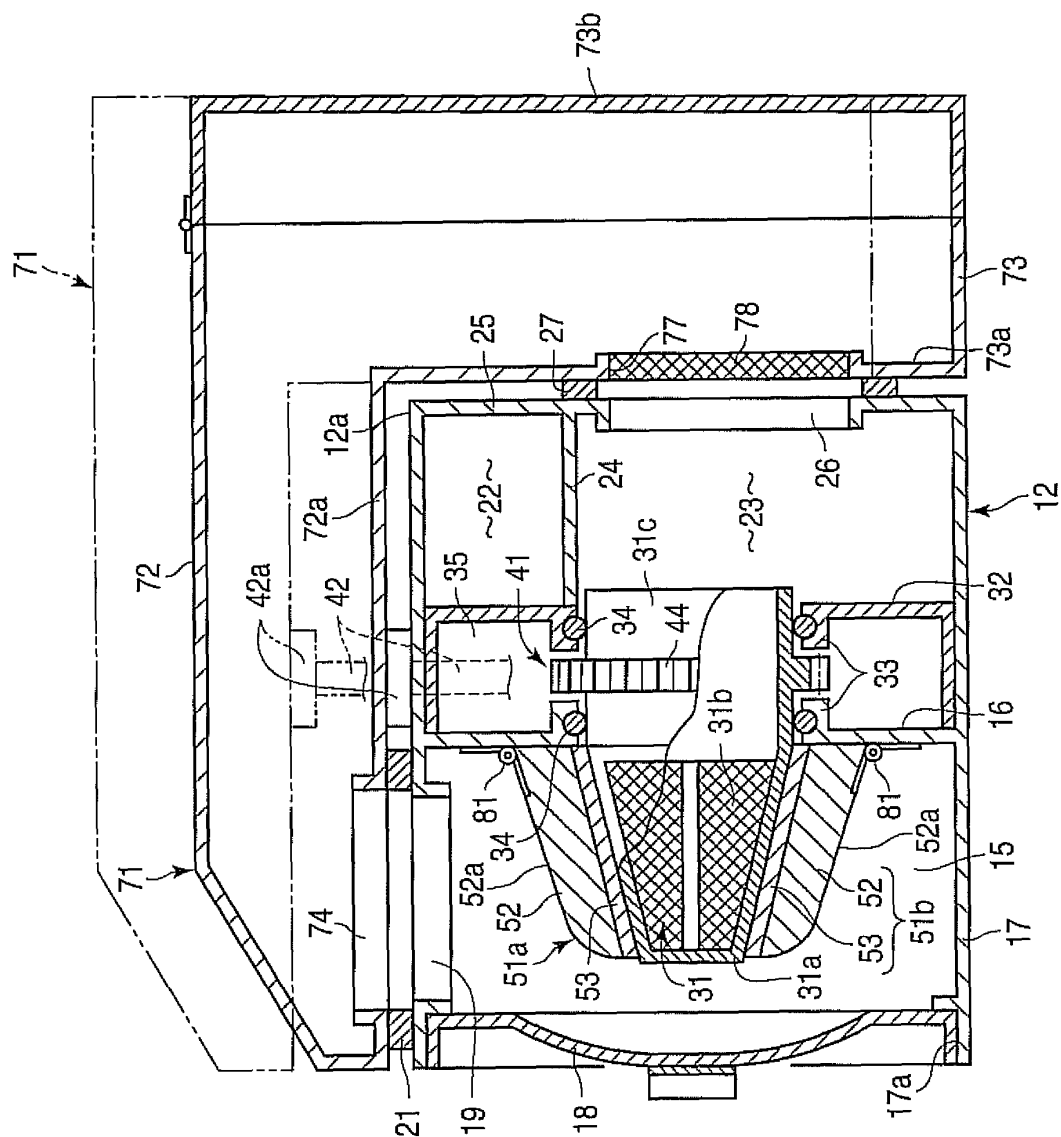


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/073462

A. CLASSIFICATION OF SUBJECT MATTER A47L9/20 (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) A47L9/20		
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 1996-2009 Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009		
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.
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 123766/1979 (Laid-open No. 40746/1981) (Tokyo Electric Co., Ltd.), 15 April, 1981 (15.04.81), Full text; all drawings (Family: none)	1-10, 12-14 11
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 20050/1977 (Laid-open No. 114870/1978) (Mitsubishi Electric Corp.), 12 September, 1978 (12.09.78), Full text; all drawings (Family: none)	1-10, 12-14 11
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 30 March, 2009 (30.03.09)		Date of mailing of the international search report 07 April, 2009 (07.04.09)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3999791 B [0002]