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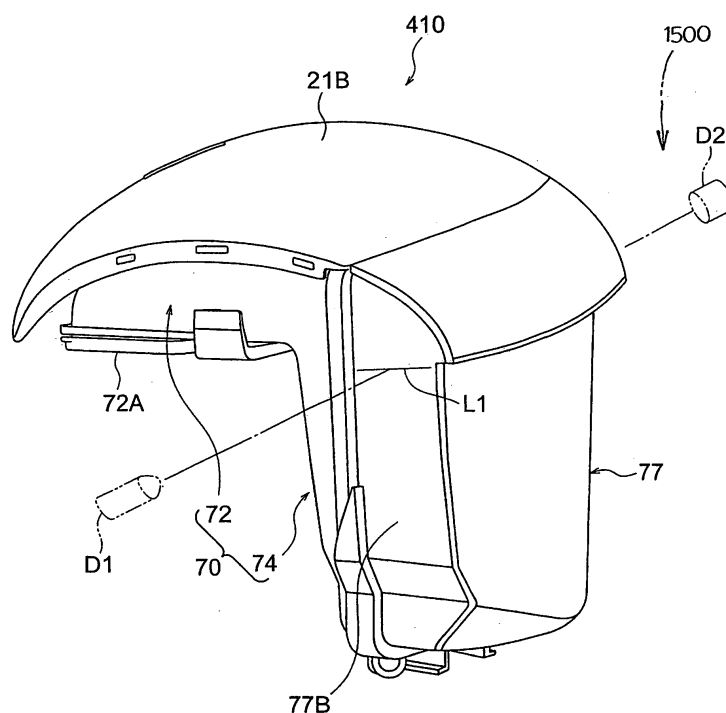
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(54) **Electric vacuum cleaner**

(57) An electric vacuum cleaner, including: a dust separating section (52) to separate a dust sucked from a suction opening with air; a dust-collecting chamber (73) for collecting the dust separated at the dust separating section (52); a light emitting diode (D1) for emitting a light into the dust-collecting chamber (73); a light receiving diode (D2) for receiving the light through the dust-collecting chamber (73); a control device (200) for judging an

amount of the dust through the suction opening /or judging whether or not the dust collected in the dust-collecting chamber (73) reached to a predetermined amount based on a light receiving condition of the light receiving device (D2); a display unit (17) for displaying the amount of the dust judged with the judging device and a alarm device (1000) for alarming in response with the judging amount detected by the control device (200).

FIG.7



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an electric vacuum cleaner provided with a dust separating section for separating sucked dust from a suction opening to dust and air, and a dust-collecting chamber for accumulating the dust separated at the dust separating section.

Description of Related Art

[0002] Conventionally, it is known that an electric vacuum cleaner includes a hand operational section on which a dust sensor is provided for detecting dust passing through an air passage (for reference, see JP-A-H7-322989).

[0003] The electric vacuum cleaner according to JP-A-H7-322989 is configured to control the electric blower based on an amount of the dust detected by the dust sensor.

[0004] In such an electric vacuum cleaner, the dust passing through the air passage is detected by the dust sensor, about whether or not the dust accumulated in the dust-collecting chamber is full, i.e. equal to or more than a predetermined amount is determined based on an input of the electric blower.

[0005] However, in a cyclonic (inertia separation) electric vacuum cleaner, there is a problem that a suction power is not reduced even dust is accumulated in a dust-collecting chamber, so that it is impossible to determine whether or not the dust accumulated in the dust-collecting chamber has reached to or more than a predetermined amount by an input of an electric blower.

SUMMARY OF THE INVENTION

[0006] An object of the present invention is to provide an electric vacuum cleaner capable of alarming reliably whether or not dust accumulated in a dust-collecting chamber has reached to or more than a predetermined amount and alarming an amount of the dust through an air passage.

[0007] To accomplish the above object, an electric vacuum cleaner according to an embodiment of the present invention comprises: a dust separating section to separate dust sucked from a suction opening to dust and air; a dust-collecting chamber to accumulate the dust separated at the dust separating section; a light emitting device to emit a light to the dust-collecting chamber; a light receiving device to receive the light passing through the dust-collecting chamber; a judging device to detect an amount of the dust passing through the suction opening /or judge whether or not the dust accumulated in the dust-collecting chamber has reached to a predetermined amount based on a light receiving condition of the light

receiving device; and a display unit to display the amount of the dust detected by the judging device.

[0008] To accomplish the above object, an electric vacuum cleaner according to another embodiment of the present invention comprises: a main body; an electric blower to suck dust from a suction opening; a dust-collecting container detachably provided in the main body, which includes a dust separating section to separate the dust sucked from the suction opening with air, a dust-collecting chamber to accumulate the dust separated at the dust separating section; a light emitting device to emit a light to the dust-collecting chamber; a light receiving device to receive the light passing through the dust-collecting chamber; a judging device to judge whether or not the dust accumulated in the dust-collecting chamber has reached to a predetermined amount based on a light receiving condition of the light receiving device; and an alarm device to alarm an alarm in accordance with a detecting value detected by the judging device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a perspective view illustrating an outer shape of an electric vacuum cleaner according to the present invention.

[0010] FIG. 2 is a longitudinal-sectional view illustrating a structure of a main body of the electric vacuum cleaner illustrated in FIG. 1.

[0011] FIG. 3 is a perspective view illustrating the main body in which a dust-collecting unit is removed.

[0012] FIG. 4 is a perspective view illustrating an outer shape of the dust-collecting unit.

[0013] FIG. 5 is a cross-sectional view of the dust-collecting unit illustrated in FIG. 4.

[0014] FIG. 6 is a perspective view illustrating an outer shape of a dust separating unit.

[0015] FIG. 7 is a perspective view of a dust-collecting container.

[0016] FIG. 8 is a perspective view of the dust-collecting container illustrated in FIG 7, as viewed from another direction.

[0017] FIG. 9 is a perspective view illustrating the dust-collecting container, with a cover removed.

[0018] FIG. 10 is a perspective view of the dust-collecting container, as viewed from backward.

[0019] FIG. 11 is a perspective view illustrating main parts of the electric vacuum cleaner main body, with the dust-collecting container removed.

[0020] FIG. 12 is an explanatory view illustrating structures of a hop up device and a lock device.

[0021] FIG. 13 is an explanatory view illustrating a structure of a lock release device.

[0022] FIG. 14 is a block view illustrating a structure of a control system of the electric vacuum cleaner.

[0023] FIG. 15 is an explanatory view illustrating the hop up device and the lock device when the dust-collecting container is hop upped.

[0024] FIG. 16 is an explanatory view illustrating the

electric vacuum cleaner when the dust-collecting container is hop upped.

[0025] FIG. 17 is an explanatory view illustrating a condition of just before the dust-collecting container is locked.

[0026] FIG. 18 is an explanatory view illustrating a structure of a judging device of the electric vacuum cleaner according to a second embodiment.

[0027] FIG. 19 is a block view illustrating a structure of a control system of the electric vacuum cleaner according to a second embodiment.

[0028] FIG. 20 is an explanatory view illustrating a structure of a judging device of another example of the electric vacuum cleaner according to a second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] Preferred embodiments of the present invention will be explained in detail with reference to the accompanying drawings below.

[FIRST EMBODIMENT]

[0030] An electric vacuum cleaner 10 as illustrated in FIG.1 includes a main body 11, a dust-collecting hose 12 which is detachably connected at one end thereof to a connecting port 11A of the main body 11 and provided at the other end with an operational tube 13 at hand, an extension tube 14 detachably connected to the operational tube 13, and a suction body 15 detachably connected to a leading end of the extension tube 14. Provided on the operational tube 13 is an operational part 13A which is provided with an operational switch 13a for stopping after mentioned operation of an electric blower 24 or a strong and weak switch 13b for setting a power of the electric blower 24.

A display unit (display device) 17 is adjacent provided to the operational part 13A and displays an amount of dust passing through an air passage.

[0031] The suction body 15 is provided with a suction chamber (not illustrated) having a suction opening (suction inlet) (not illustrated) to introduce dust on a bottom surface. The suction chamber communicates with a suction connecting port 57a of a dust-collecting unit 50 (see FIG. 6) provided in the main body 11 through the extension tube 14 and the dust-collecting hose 12 and the connecting port 11A.

[0032] The main body 11 includes a body case 20, the dust-collecting unit 50 (see FIG.4) mounted in the body case 20, and the after mentioned electric blower 24.

[0033] A front side of the body case 20 is as illustrated in FIG. 2 and FIG 3, provided with a dust-collecting unit chamber 22. A dust separating unit 400 and a dust-collecting container 410 which are described hereinafter are detachably disposed in a dust-collecting unit 22.

[0034] The electric blower 24 is provided in a back side

of the body case 20. A cylindrical connecting passage 25 having a front opening 25B is provided in a front side (right side in FIG. 2) of the electric blower 24. A sealing member 27 is attached to the front opening 25B. Formed in a back wall 25A of the connecting passage 25 is a connecting opening 25b which communicates with a suction opening 24A of the electric blower 24.

[0035] As illustrated in FIG.3, the dust-collecting unit chamber 22 is provided with a drive gear Ga, and a drive motor M1 to rotate the drive gear Ga. The dust-collecting unit chamber 22 has a front side having an inner wall 22a which is provided with a light-emitting diode (light-emitting device) D1 for emitting an infrared light.

[0036] The dust-collecting unit 22 is provided with a hop up mechanism (alarm device) 1000 (see FIG.11) for hop upping a dust-collecting part 70 described hereinafter.

[0037] The dust-collecting unit chamber 22 has an upper opening 23 (see FIG. 3) which is hermetically closed by a cover case 21A, 21B, as illustrated in FIG. 2.

[0038] As illustrated in FIG.4 and FIG 5, the dust-collecting unit 50 includes a dust separating unit 400 and a dust-collecting container 410.

[0039] The dust separating unit 400 includes a dust separating section 52 (inertia separating section), a filter part 80 formed integrally with the dust separating section 52, and the cover case 21A provided on the filter part 80.

[0040] The dust-collecting container 410 includes a dust-collecting part 70 formed with transparent resin and a cover case 21B provided on the dust-collecting part 70.

[0041] As illustrated in FIG.6, the dust separating section 52 includes a separation chamber portion 54 which is formed in a circular shape by an outer peripheral wall 53, a dust separation device 55 which has a generally conical shape and is provided in the separation chamber portion 54 along an axis of the separation chamber portion 54, a suction air trunk 56 provided in an outer side of a right side wall 54A of the separation chamber portion 54, and an air guide tube 57 to guide air from a suction connecting port 57a (dust suction inlet). The suction connecting port 57a is configured to communicate with the connecting port 11A of the main body 11 when the dust separating unit 400 is mounted on the dust-collecting unit chamber 22.

[0042] As illustrated in FIG.5, an introduction opening 53A is formed on an upper portion of the outer peripheral wall 53 of the separation chamber portion 54 to introduce dust separated from air into the dust-collecting part 70.

[0043] As illustrated in FIGS. 6, the separation chamber portion 54 has the right side wall 54A which is provided with a circular opening 154A and a sector opening 154B. The dust separation device 55 is attached to the opening 154A and a net filter NF2 (not illustrated) is attached to the opening 154B. Provided in the right side wall 54A is a connecting opening 54Aa which is connected to the air guide tube 57 to communicate the separation chamber portion 54 with the air guide tube 57.

[0044] The dust separation device 55 includes a plu-

ality of frames 55a and a net filter NF1 attached to circumferences of the frames 55a. The suction air trunk 56 communicates with the separation chamber portion 54 through the opening 154A of the right side wall 54A and the net filter NF1 (see FIG. 5), and with the separation chamber portion 54 through the net filter NF2 of the opening 154B of the right side wall 54A (not illustrated).

[0045] The suction passage 56 communicates with a containing case 81 of a filter part 80 mentioned hereinafter, and with a dust-collecting chamber 73 of a dust-collecting case portion 74 as described hereinafter through a connecting port 56A formed on a right side wall portion 156 (see FIG. 6).

[0046] As illustrated by arrow in FIG. 6, the air guide tube 57 is configured to rotate air introduced from the connecting opening 54Aa of the separation chamber portion 54 into the separation chamber portion 54 in counterclockwise direction.

[0047] As illustrated in FIGS. 5 and 7, the dust-collecting part 70 includes a communication case portion 72 having a communication passage 71 which is provided in an upper portion of the communication case portion 72 extending rightward and leftward, and the dust-collecting case portion 74 which extends from a right end portion of the communication case portion 72 downwardly and forms the dust-collecting chamber 73 to collect the dust. As illustrated in FIG. 8, a lower surface of a bottom wall 72T of the communication case portion 72 is provided with a first rib 72R projecting downward and a second rib 72M extending downward, the second rib 72M is provided with an engaging part 72Ma projecting rightward on its lower part, as illustrated in FIG. 12.

[0048] An opening 72A is provided on a lower surface of a left side of the communication case portion 72 as illustrated in FIG. 5 and FIG. 8, and the opening 72A is communicated with the introduction opening 53A of the dust separating section 52, as illustrated in FIG. 5. In addition, as illustrated in FIG. 9, the dust-collecting case portion 74 has a left side wall 74A which is provided with a connecting opening 75. The connecting opening 75 is provided with a net filter NF3.

[0049] A cover plate 170 is attached to an outer wall portion of the dust-collecting case portion 74 in an outer side of the net filter NF3 and at a portion remote from the net filter NF3 a predetermined interval. An opening 170A is formed in a lower portion of the cover plate 170 (see FIG. 8).

[0050] The opening 170A of the cover plate 170 is connected to the connecting opening 56A of the suction air trunk 56, as illustrated in FIG. 5.

[0051] An opening 76 is provided on a right side surface of the dust-collecting case portion 74, as illustrated in FIG. 9. A cover plate 77 is attached to the opening 76 which is capable of opening and closing thereof (see FIG. 7). The cover plate 77 is configured to open and close by rotating the cover plate 77 about a shaft 77J.

[0052] When the dust-collecting container 410 is mounted in the dust-collecting unit chamber 22 of the

main body 11 in which the dust separating unit 400 is mounted, as illustrated in FIG. 5, the introduction opening 53A of the dust separating section 52 is connected to the opening 72A of the dust-collecting container 410, and the opening 170A of the cover plate 170 of the dust-collecting container 410 is connected to the connecting opening 56A of the suction air trunk 56 of the dust separating unit 400.

[0053] As illustrated in FIG. 10, the filter part 80 includes a cylindrical containing case 81 having a back surface which is opened, a pleated filter structure 100 (secondary filter) rotatably provided in the containing case 81. The dust separating section 52 is formed on a front surface of a front wall portion 84 of the containing case 81 integrally (see FIG. 5 and FIG. 6).

[0054] Formed in the front wall portion 84 of the containing case 81 is a connecting opening 84A. The connecting opening 84A is connected to the suction air trunk 56 (see FIG. 5). The suction air trunk 56 communicates with the containing case 81 through the connecting opening 84A.

[0055] An edge part of the connecting opening 84A of the front wall portion 84 is provided with a projection T (see FIG. 2) which projecting towards to the pleated filter structure 100. An end part of the projection is configured to contact with after mentioned a mountain part of a pleated filter 104. In addition, a front surface of the front wall portion 84 is provided with a light-receiving diode (light receiving device: first light-receiving part) D2 (see FIG. 6).

[0056] As illustrated in FIG. 10, the pleated filter structure 100 includes a cylindrical frame 101, a shaft 101A provided at a central position of the cylindrical frame 101, the pleated filter 104 to form pleats radially extending from the shaft 101A.

[0057] As illustrated in FIG. 2, a shaft 84J provided on the front wall portion 84 is relatively and rotatably inserted in a hole 101Aa of the shaft portion 101A, and the pleated filter structure 100 is configured to be rotated about the shaft 84J in the containing case 81.

[0058] A back end surface of the frame 101 is provided with a gear 107 which projects outwardly from the containing case 81, and is engaged with a drive gear Ga of the dust-collecting unit chamber 22 of the main body 11. The pleated filter structure 100 is rotated in the containing case 81 by the driving of the motor M1.

[0059] When the dust separating unit 400 is disposed in the dust-collecting unit chamber 22 of the main body 11, through the seal member 27, the back end surface of the containing case 81 of the dust separating unit 400 is jointed to the front opening 25B of the connecting passage 25 of the main body 11 to communicate the suction opening 24A of the electric blower 24 and the containing case 81 through the connecting passage 25.

[0060] As illustrated in FIG. 3, the light-emitting diode D1 is configured to emit the infrared light toward the dust-collecting case portion 74 of the dust-collecting part 70 of the dust separating unit 400 which is mounted in the

dust-collecting unit 22, and pass through the dust-collecting container 74 along a level of a dust disposal line L1 (see FIG.7) of the dust-collecting chamber 73. The infrared light passed through the dust-collecting case portion 74 is configured to be received by the light-receiving diode D2 of the front wall portion 84 of the dust separating unit 400. The light-emitting diode D1 and light-receiving diode D2A form a dust detecting device 1500 (see FIG.5 and FIG.7).

[0061] As illustrated in FIG.11, the hop up mechanism (alarm device) 1000 includes a hop up device 1100 for hop upping the dust-collecting container 410, a lock device 1200 for fixing the dust-collecting container 410 to a mounting position, and a releasing device 1300 for releasing a lock of the lock device 1200.

[0062] The hop up device 1100 includes a cylindrical guide case 1101 which is provided on an upper wall surface of the air guide tube 57 of the dust separating unit 400 extending upwardly and downwardly and has a square-tube cross section, a moving board 1102 which is provided in the guide case 1101 movably seesaw, a spring 1103 which is disposed in the guide case 1101 and for biases the moving board 1102 upwardly. The hop up device 1100 is configured to hop up the dust-collecting container 410 by moving the moving board 1102 upwardly by a biasing force of the spring 1103.

[0063] The guide case 1101 includes an upper end board 1104 which is provided with a notch 1105. A notch 1107 is formed on a side wall 1106 of the guide case 1101 extending upwardly and downwardly and continuing to the notch 1105.

[0064] The lock device 1200 includes an arm 1201 which is rotatably provided on an outer surface of the air guide tube 57 and extends upwardly, and a spring (not illustrated) biasing the arm 1201 in a counterclockwise direction. The arm 1201 has an upper part which is provided with an engaging claw 1202. The dust-collecting part 70 has the second rib 72M having an engaging part 72Ma. The engaging claw 1202 is engaged with the engaging part 72Ma to lock the dust-collecting container 410, as illustrated in FIG. 12. The engaging claw 1202 has an upper surface which is formed like circular arc. The arm 1201 is not to be rotated in the counterclockwise direction from a position illustrated in FIG. 12 by the stopper 1204.

[0065] When the dust-collecting container 410 is pushed from the opening 23 of the main body 11 into the dust-collecting unit chamber 22, the first rib 72R of the dust-collecting part 70 of the dust-collecting container 410 is entered into the notches 1105, 1107 of the guide case 1101, and the moving board 1102 is pushed downwardly against the biasing force of the spring 1103, as illustrated in FIG.17. Then, when the dust-collecting container 410 is pushed further, as illustrated in FIG. 12, the engaging claw 1202 of the arm 1201 is engaged with the engaging part 72Ma of the second rib 72M to lock the dust-collecting container 410.

[0066] The releasing device 1300 includes a sliding

member 1301 which is movably provided on the upper surface of the air guide tube 57 in an anteroposterior direction (horizontal direction in FIG.11), a motor M2 arranged on the front part of the main body 11 and provided on an under side of an upper cover-case 11D, as illustrated in FIG.11 and FIG.13, and an arm member 1302 which is provided on a driving shaft of the motor M2.

[0067] As illustrated in FIG.11, the sliding member 1301 includes a pair of guide hole 1303 which extend backward and forward. A guide pin 1304 disposed on the upper surface of the air guide tube 57 is inserted into the guide hole 1303. By the guide pin 1304 moving relatively along the guide hole 1303, thereby the sliding member 1301 is guided in the forward and backward direction. The sliding member 1301 has a back end which is contacted with the front part of the engaging claw 1202 of the arm 1201 as illustrated in FIG.12. In addition, an abutting part 1301A is formed on the end part of the sliding member 1301.

[0068] As illustrated in FIG.11, the arm member 1302 is formed in L shape, and has an end part 1302A which is contacted with the abutting part 1301A of the slide member 1301. The arm member 1302 has an end part which is provided with a shaft receiving part 1302B mounted on the driving shaft M2a of the motor M2.

[0069] When the motor M2T is driven, the arm member 1302 is rotated in a clockwise direction illustrating in FIG. 11, and the slide member 1301 is moved backwardly (rightward in FIG.11). By the backward movement of the slide member 1301, the engaging claw 1202 of the arm 1201 is released from the engaging part 72Ma of the second rib 72M of the dust-collecting part 70 and the lock of the dust-collecting part 70 is released.

[0070] FIG. 14 is a block view illustrating a structure of a control system of the electric vacuum cleaner. In FIG.14, reference number 200 presents a control device (judging device) which controls the electric blower 24 or the motors M1, M2, based on operation of the operational switches 13a (see FIG. 1) of the operational part 13A or a light receiving signal of the light receiving diode. In addition, the control device 200 detects an amount of the dust passing through the communication case portion 72 of the dust-collecting part 70 based on a light receiving condition of the light receiving diode D2 and displays the amount of the dust on the display unit 17.

[0071] The control device 200 detects the amount of the dust accumulated in the dust-collecting chamber 73 based on a light receiving amount of the light receiving diode D2, when the amount of the dust reaches to the dust disposal line L1, the motor M2 is driven, and then hop ups the dust-collecting part 70.

[Operation]

[0072] Next, operation of the electric vacuum cleaner structured as mentioned above will be explained.

[0073] As illustrated in FIG. 2, the dust-collecting unit 50 is mounted in the dust-collecting unit chamber 22 of

the main body 11, and as illustrated in FIG. 1, one end of the dust-collecting hose 12 is connected to the connection port 11A of the main body 11 and the operational tube 13 is connected to the suction body 15 through the extension tube 14.

[0074] The light emitting diode D1 is emitted by the control device 200 when a power plug (not illustrated) is connected to an outlet. The infrared light emitted from the light emitting diode D1 is received by the light receiving diode D2.

[0075] The electric blower 24 is driven when the operational switch 13b of the operational part 13A of the operational tube 13 is operated. By the driving of the electric blower 24, air is sucked from the suction opening 24A of the electric blower 24 to generate a negative pressure in the containing case 81 of the dust-collecting unit 50 through the connecting passage 25 and in the dust-collecting case portion 74 and the suction chamber portion 54 of the dust separating section 52 through the suction passage portion 56. The negative pressure acts in the dust-collecting hose 12, the extension tube 14 and the suction body 15 through the air guide tube 57, thereby the dust together with air are sucked into the suction body 15.

[0076] The sucked dust and air are sucked into the suction connecting port 57a of the dust-collecting unit 50 through the extension tube 14 and the dust-collecting hose 12. The dust and air sucked into the suction connecting port 57a are guided into the separation chamber portion 54 of the dust separating section 52 through the air guide tube 57 and rotated counterclockwise in the separation chamber portion 54, as illustrated in FIG. 6.

[0077] This rotation causes the dust and air to be separated by inertia, the separated air passes through the net filter NF1 (see FIG. 5) of the dust separation device 55 and the net filter NF2 of the opening 154B (not illustrated) and further passes through the suction passage portion 56, and is sucked into the containing case 81 of the filter part 80.

[0078] On the other hand, the separated dust together with a part of air pass through the introduction opening 53A of the separation chamber portion 54 and it is introduced into the communicating case portion 72 of the dust-collecting part 70 by inertia. The introduced dust and air are sucked into the dust-collecting chamber 73 through the communication passage 71 of the communicating case portion 72, and the dust is collected in the dust-collecting chamber 73.

[0079] The air sucked into the dust collecting chamber 73 is sucked into the suction passage portion 56 through the net filter NF3 and the opening 170A of the lower portion of the cover plate 170, and further into the containing case 81 of the filter part 80.

[0080] The air sucked into the containing case 81 is sucked into the connecting passage 25 of the main body 11 through the pleated filter 104 of the pleated filter structure 100, further into the suction opening 24A of the electric blower 24.

[0081] The air sucked into the suction opening 24 A of the electric blower 24 is exhausted from an exhaust port 20H of the main body 11 illustrated in FIG. 2 through the electric blower 24.

5 **[0082]** On the other hand, when the dust is collected into the dust-collecting chamber 73, the dust shields the infrared light which is received by the light receiving diode D2, thereby the infrared light is intermittently received by the light receiving diode D2. When the dust collected in the dust-collecting chamber 73 is accumulated and reaches to the dust disposal line L1, the light receiving diode D2 does not receive the infrared light since the dust shields the infrared light continually.

10 **[0083]** The control device 200 calculates the amount of the dust passing through the communication passage 71 which is in the communication case portion 72 of the dust-collecting part 70, i.e. the amount of the dust passing through the suction connecting port (dust suction port) 57a based on the light receiving condition of the light receiving diode D2 and displays the amount on the display unit 17 of the operational tube 13. Here, within a predetermined time, the amount of the passed dust is calculated based on a total of shielding time during which the light receiving diode D2 is shielded. That it to say, the control device 200 judges that the amount of the passed dust will be big if a totaled shielding time is long and the amount of the passed dust will be small if a totaled shielding time is short in the predetermined time, and then displays the amount of passed dust on the display unit 17.

25 **[0084]** Whether or not a subject surface which is being cleaned is still dirty or not, i.e. whether or not the dust is still attached to the subject surface are judged, by displaying the amount of the passed dust on the display unit 17.

30 **[0085]** When the dust passing through the communication passage 71 of the dust-collecting portion 70 is collected in the dust-collecting chamber 73 and the dust accumulated in the dust-collecting chamber 73 reaches to the dust disposal line L1, the dust shields the infrared light continuously, thereby the light receiving diode D2 does not receive the infrared light.

35 **[0086]** When the light receiving diode D2 does not receive the infrared light more than the predetermined time continuously, the control device 200 judges that the dust accumulated in the dust-collecting chamber 73 has reached to the predetermined amount, i.e. the dust disposal line L1. That it to say, the control device 200 detects whether or not the amount of the dust accumulated in the dust-collecting chamber 73 has reached to the predetermined amount.

40 **[0087]** Like this, the control device 200 is configured to detect the amount of the dust passing through the communication passage 71 of the dust-collecting portion 70 and judge whether or not the dust accumulated in the dust-collecting chamber 73 has reached to the predetermined amount, based on the light receiving condition of the one light receiving diode D2. Thereby, it is capable

of providing a cheaper electric vacuum cleaner without individual special light receiving diode.

[0088] When the operational switch 13a of the operational part 13A is operated, the control device 200 drives the motor M2 of the hop up mechanism 1000 for a predetermined time only, and stops the driving of the electric blower 24. By the driving of the motor M2, the arm member 1302 is rotated in the clockwise direction in the FIG. 11, the slide member 1301 is moved backwardly from a position illustrated in FIG. 12, and the engaging claw 1202 of the arm 1201 is pushed backwardly. Thereby, the arm 1201 is rotated in the clockwise direction against a biasing force of a spring not shown, the engaging claw 1202 of the arm 1201 is released from the engaging part 72Ma of the second rib 72M of the dust-collecting part 70, and the lock of the dust-collecting container 410 is released.

[0089] When the lock is released, the moving board 1102 in the guide case 1101 is moved upwardly by a biasing force of the spring 1103, and as illustrated in FIG. 15, the first rib 72R is pushed upwardly with the dust-collecting container 410. That it to say, the dust-collecting container 410 is hop upped, as illustrated in FIG. 16. By the hop up, the user knows that in the dust-collecting chamber 73 of the dust-collecting container 410 the dust is accumulated to the level of the dust disposal line L1 (see FIG. 7), and is capable of dumping the dust accumulated in the dust-collecting chamber 73 quickly, and thus it is possible to prevent that the dust accumulated in the dust-collecting chamber 73 is filled over.

[0090] After the amount of the dust accumulated in the dust-collecting chamber 73 has reached to the level of the dust disposal line L1, or the operational switches 13a of the operational part 13A is not operated even a preliminarily set time (a predetermined time) lapsed, the control device 2000 stops the driving of the electric blower 24 forcibly and drives the motor M2 to hop up the dust-collecting container 410.

[0091] Consequently, even the operational switches 13a of the operational part 13A is not operated, it is possible to prevent that the dust accumulated in the dust-collecting chamber 73 is filled over.

[0092] However, when the driving of the electric blower 24 is stopped, the motor M1 is driven in a specified time. By the driving of the motor M1, the driving gear Ga is rotated, and the pleated filter structure 100 is rotated.

[0093] By the rotation of the pleated filter structure 100, the protrusion T (see FIG. 2) provided on the front wall portion 84 of the dust separating unit 400 is in contact with the mountain portion of the pleated filter 104, to give vibrations to the pleated filter 104, thereby to remove the dust attached to the pleated filter 104.

[0094] In the above-mentioned embodiment, the alarm is carried out by hop upping the dust-collecting container 410, to alarm that the dust accumulated in the dust-collecting chamber 73 has reached to the level of the dust disposal line L1. However, the present invention is not limited to those embodiments. For example, the alarm can be carried out by ringing a buzzer or lighting a lamp.

[0095] In addition, in the above-mentioned embodiment, the alarm is carried out when the dust accumulated in the dust-collecting chamber 73 has reached to the level of the dust disposal line L1, however it is possible to arrange a plurality of light receiving diodes upwardly and downwardly to judge an amount of the dust accumulated in the dust-collecting chamber 73, and carry out an alarm corresponding to the amount thereof. Further, in the above-mentioned embodiment, the electric vacuum cleaner separates the dust by inertia. However, it is not limited to this embodiment, it can be a type of trapping the dust with the filter or a type of sucking the dust into the dust-collecting chamber 73 directly without passing through the separating section.

[SECOND EMBODIMENT]

[0096] Next, a second embodiment of the electric vacuum cleaner according to the present invention will be described.

[0097] FIG. 18 is an explanatory view illustrating a structure of a judging device 1600 of the electric vacuum cleaner according to the second embodiment. In FIG. 18, a light emitting device 1601 includes a light emitting diode D1 to emit an infrared light to the communication case portion 72 and the dust-collecting chamber 73 of the dust-collecting part 70, and a projecting lens DL1 and so on. The infrared light emitted from the light emitting device 1601 passes through a region illustrated by a dashed line, and passes through the dust-collecting container portion 74 along the level of the dust disposal line L1 (see FIG. 7) of the dust-collecting chamber 73.

[0098] A light receiving device 1602 receives the infrared light passed through the communication case portion 72. The light receiving device 1602 includes a light receiving diode (a first light receiving device) D3 and a collecting lens DL3, and so on. A light receiving device 1603 receives the infrared light passed through the communication case portion 73. The light receiving device 1603 includes a light receiving diode (a second light receiving device) D4 and a collecting lens DL4, and so on. The light receiving device 1602 is then disposed on an upstream side than the light receiving device 1603.

[0099] FIG. 19 is a block view illustrating a structure of a control system of the electric vacuum cleaner according to the second embodiment. As illustrated in FIG. 19, the control device 210 calculates the amount of the dust passing through the communication case portion 72 based on the light receiving condition of the light receiving device 1602 and displays the amount on the display unit 17. In addition, the control device 210 judges that the dust accumulated in the dust-collecting chamber 73 reached to the position of the dust disposal line L1, and then drives the motor M2.

[0100] According to the second embodiment, even the dust accumulated has reached to the position of the dust disposal line L1 of the dust-collecting chamber 73, it is possible to calculate the amount of the dust passing

through the communication case portion 72, and since the light emitting device 1601 is provided only one, the judging device 1600 is made cheaper.

[0101] FIG. 20 is an explanatory view illustrating a structure of a judging device 1610 of another example of the electric vacuum cleaner according to the second embodiment. In the embodiment, the light receiving device 1602 is configured to receive an infrared light which is reflected by the dust passing through the communication case portion 72. According to the embodiment, it is possible to detect the dust passing through the communication case portion 72 in a broad range. In the embodiment, also the light receiving device 1602 is disposed on the upstream side than the light receiving device 1603.

[0102] According to the invention, even the electric vacuum cleaner is of the inertia separation type, it is possible to alarm certainly that whether or not the dust accumulated in the dust-collecting chamber 73 is reached to or more than the predetermined amount, and also to inform the amount of the dust passing through the dust suction inlet.

[0103] According to the invention, since the alarm device alarms corresponding to the detected amount of the dust accumulated in the dust-collecting chamber 73, it is possible to prevent that the dust accumulated in the dust-collecting chamber 73 is filled over.

[0104] Although the preferred embodiments of the present invention have been mentioned, the present invention is not limited to these embodiments, various modifications and changes can be made to the embodiments.

[0105] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. An electric vacuum cleaner, comprising:

a dust separating section (52) to separate dust sucked from a suction opening with air;
a dust-collecting chamber (73) to accumulate the dust separated at the dust separating section (52);
an light emitting device (D1) to emit a light to the dust-collecting chamber (73);
a light receiving device (D2) to receive the light passing through the dust-collecting chamber (73);

a judging device (200) to detect an amount of the dust passing through the suction opening /or judge whether or not the dust accumulated in the dust-collecting chamber (73) has reached to a predetermined amount based on a light receiving condition of the light receiving device (D2); and

a display unit (17) to display the amount of the dust detected by the judging device (200).

2. The electric vacuum cleaner according to claim 1, wherein

the light receiving device includes: a first light receiving device (D3) to detect the amount of the dust passing through the suction opening; and

a second light receiving device (D4) to judge whether or not the dust accumulated in the dust-collecting chamber (73) has reached to the predetermined amount,

the first light receiving device (D3) being provided at an upstream side than the second light receiving device (D4).

3. The electric vacuum cleaner according to claim 1, wherein

the first light receiving device (D3) receives a light reflected by the dust.

4. The electric vacuum cleaner, comprising:

a main body (11);

a dust-collecting container (410) detachably provided on the main body including:

an electric blower (24) to suck dust from a suction opening;

a dust separating section (52) to separate dust sucked from the suction opening with air;

a dust-collecting chamber (73) to accumulate the dust separated at the dust separating section;

a light emitting device (D1) to emit a light to the dust-collecting chamber;

a light receiving device (D2) to receive the light through the dust-collecting chamber;

a judging device (200) to judge whether or not the dust accumulated in the dust-collecting chamber has reached to a predetermined amount based on a light receiving condition of the light receiving device;

an alarm device (1000) to alarm an alarm in accordance with a detected amount of the dust detected by the judging device.

5. The electric vacuum cleaner according to claim 4, wherein

the alarm device hop ups the dust-collecting device to alarm.

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6. The electric vacuum cleaner according to claim 5, wherein

the alarm device carries out the alarm when the amount of the dust accumulated in the dust-collecting chamber is equal to or more than the predetermined amount, or when the electric blower is switched on.

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7. The electric vacuum cleaner according to claim 4, wherein

the alarm device carries out the alarm when the amount of the dust accumulated in the dust-collecting chamber is equal to or more than the predetermined amount, or when stops an operation of the electric blower after a predetermined time lapsed.

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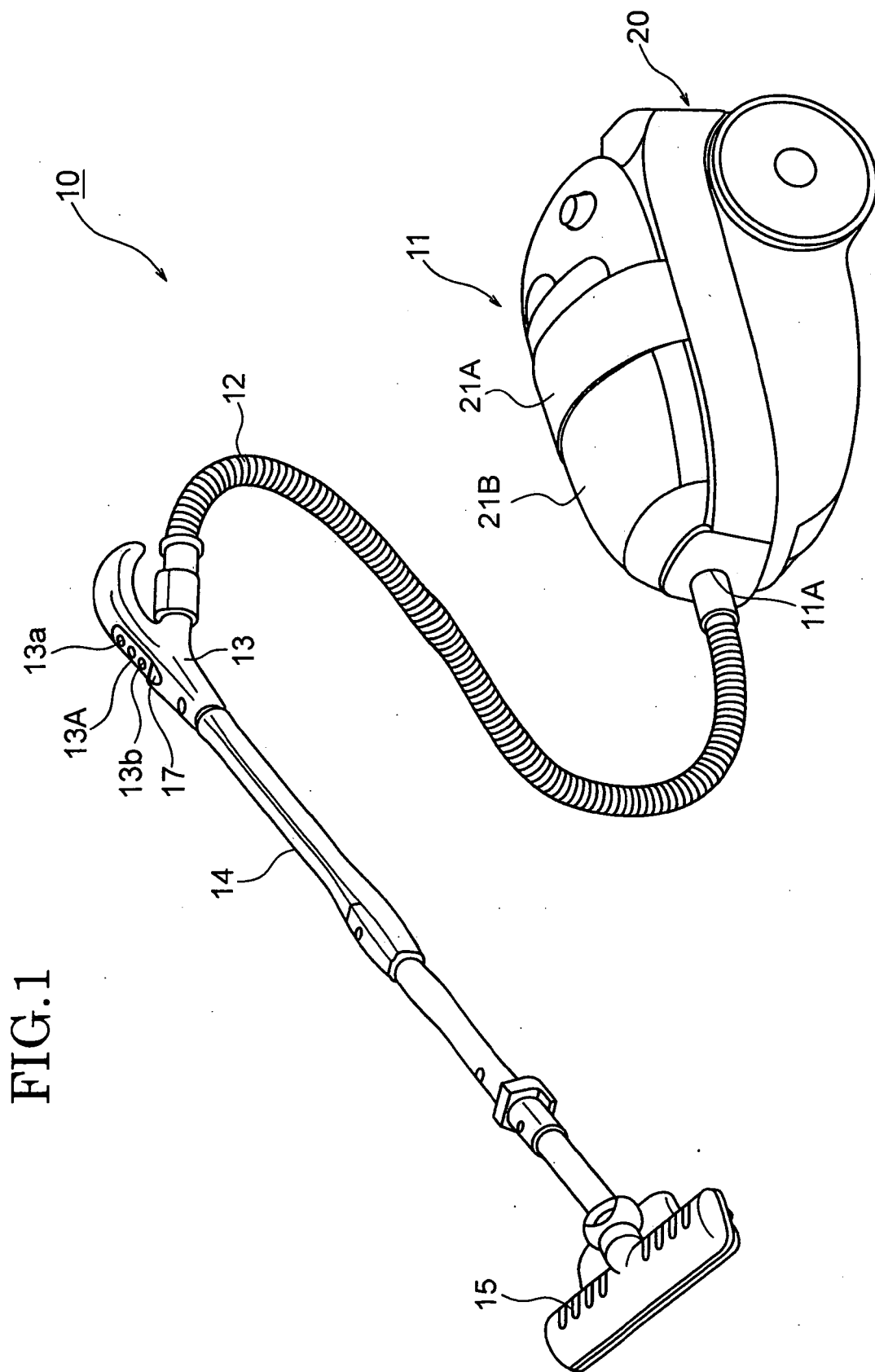


FIG. 1

FIG.2

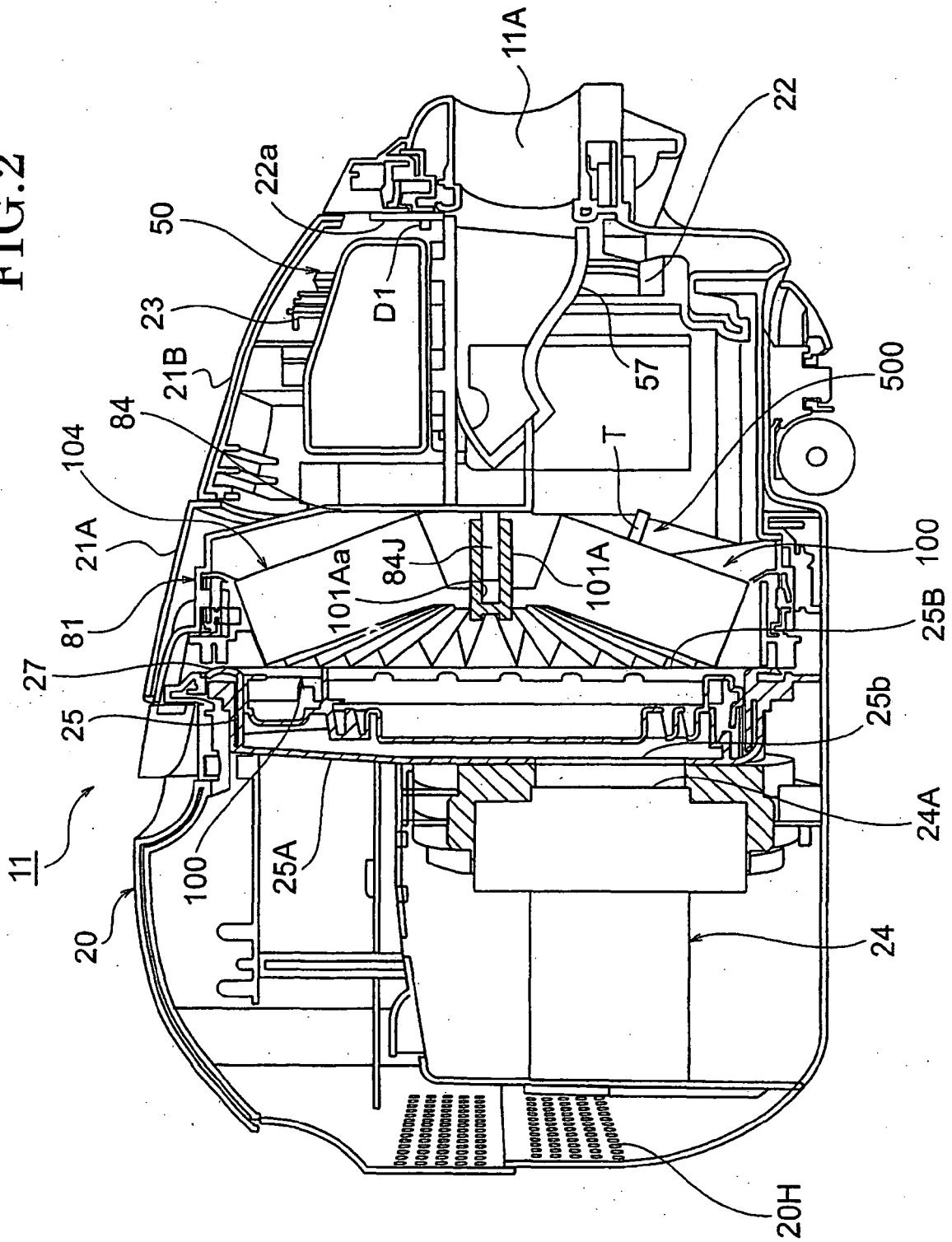


FIG.3

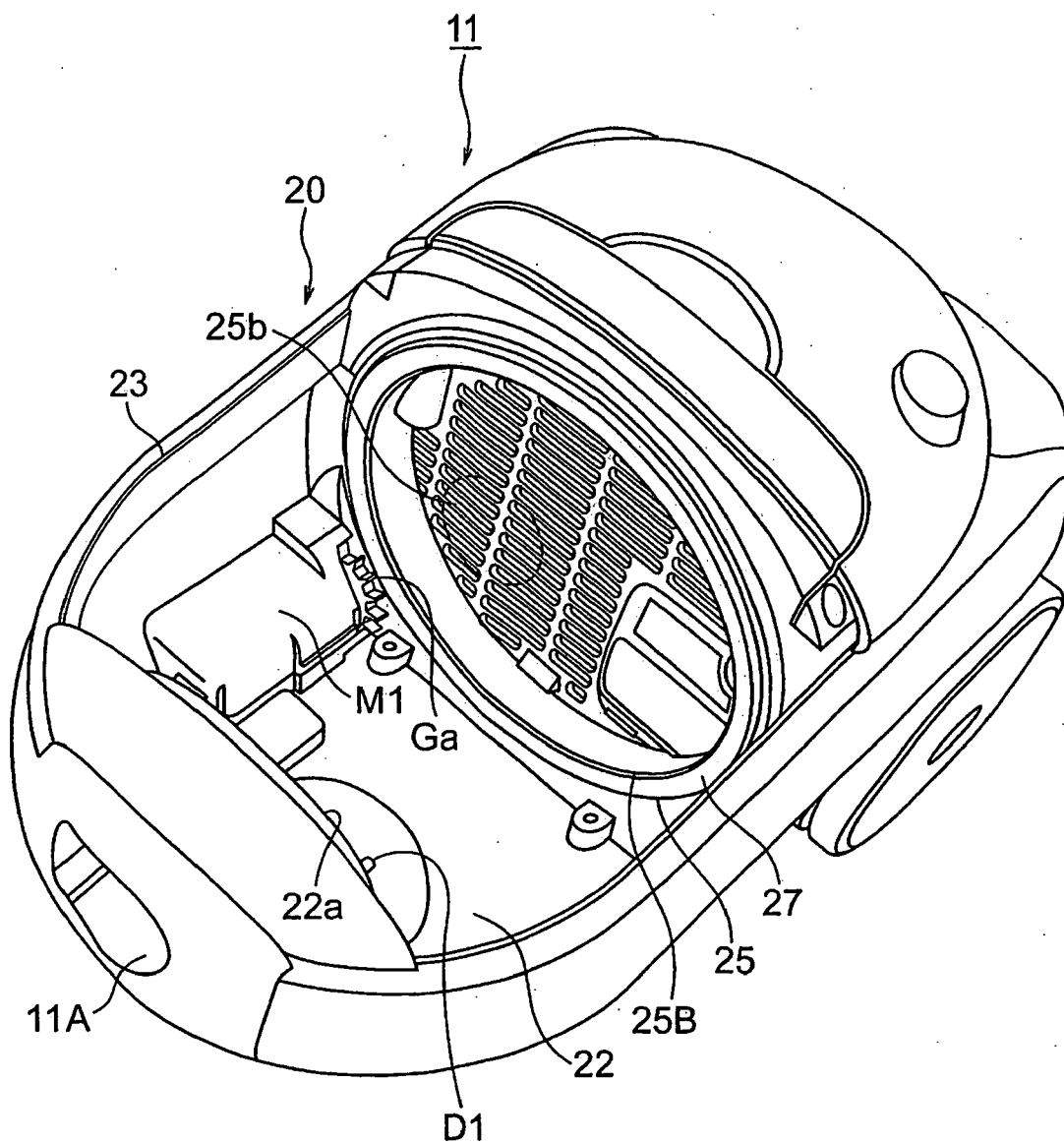
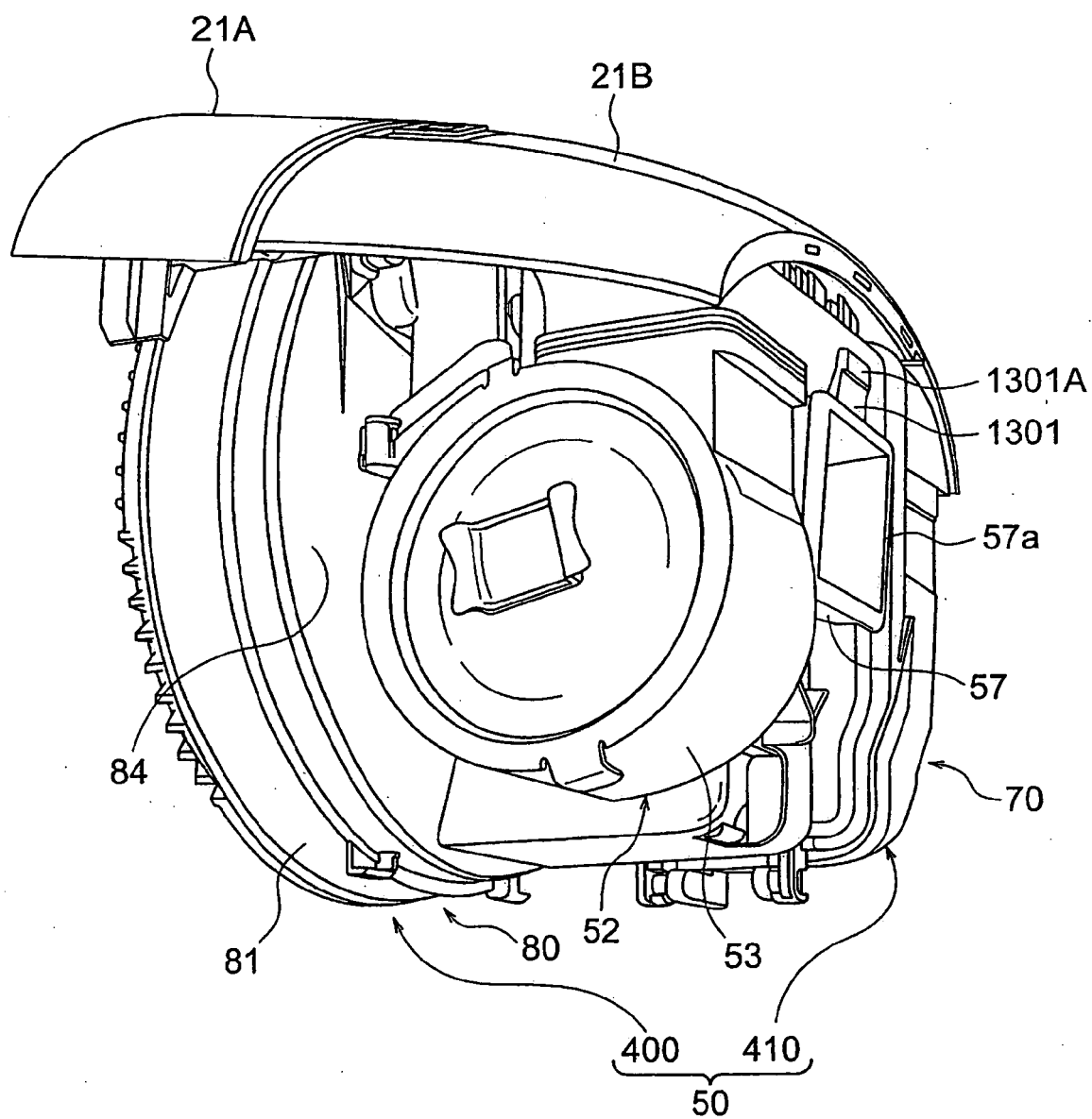


FIG.4



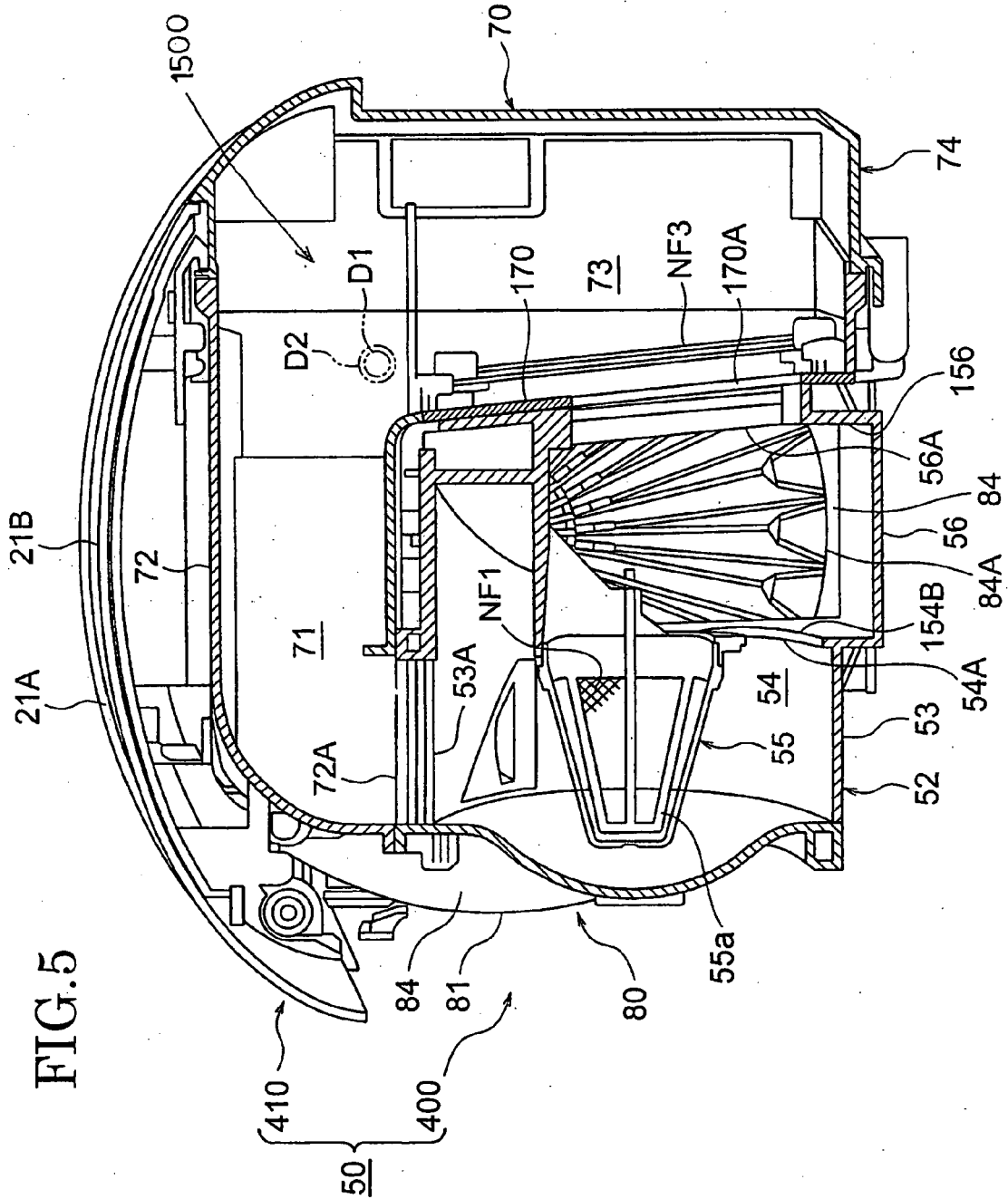


FIG.6

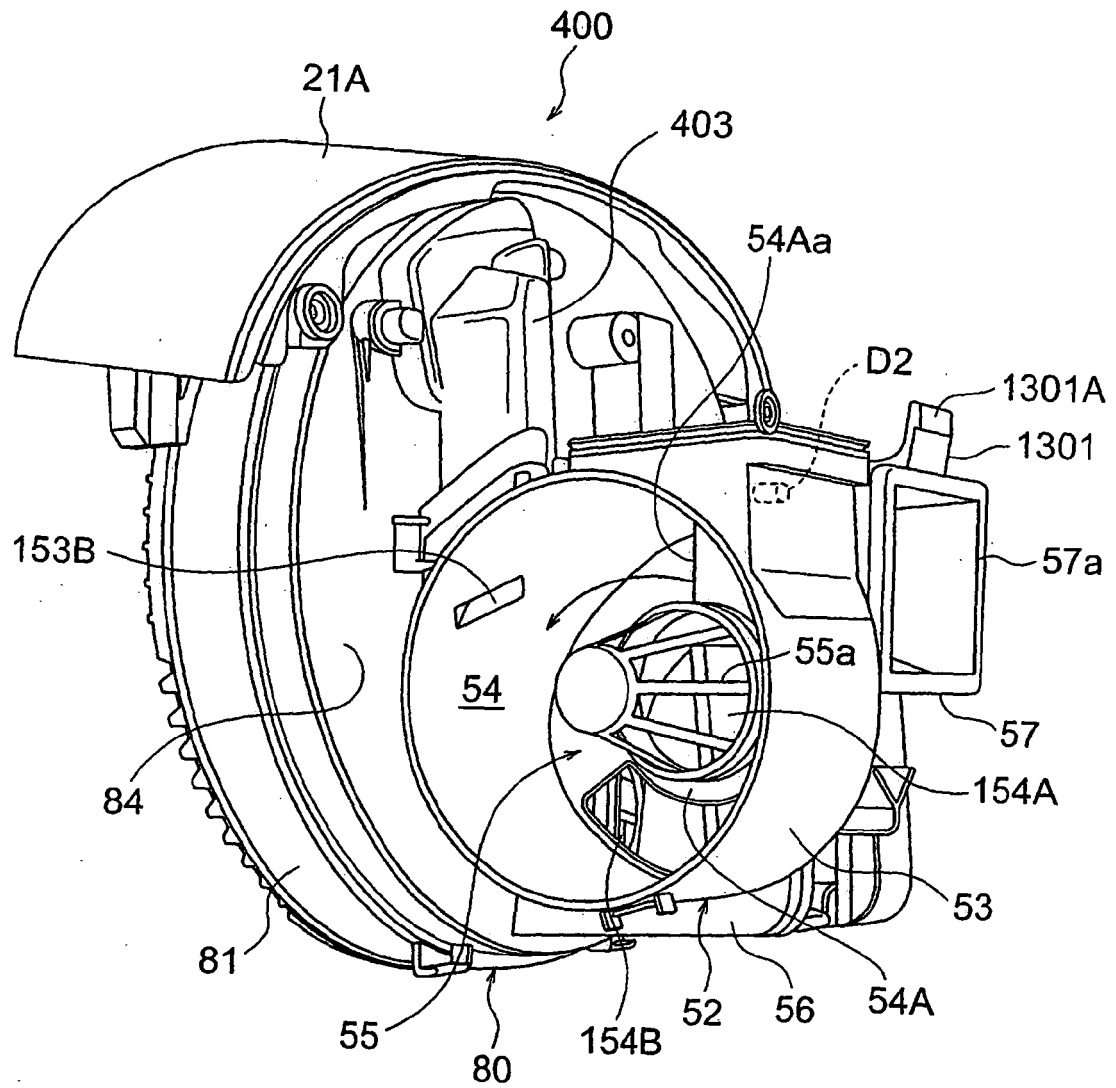


FIG.7

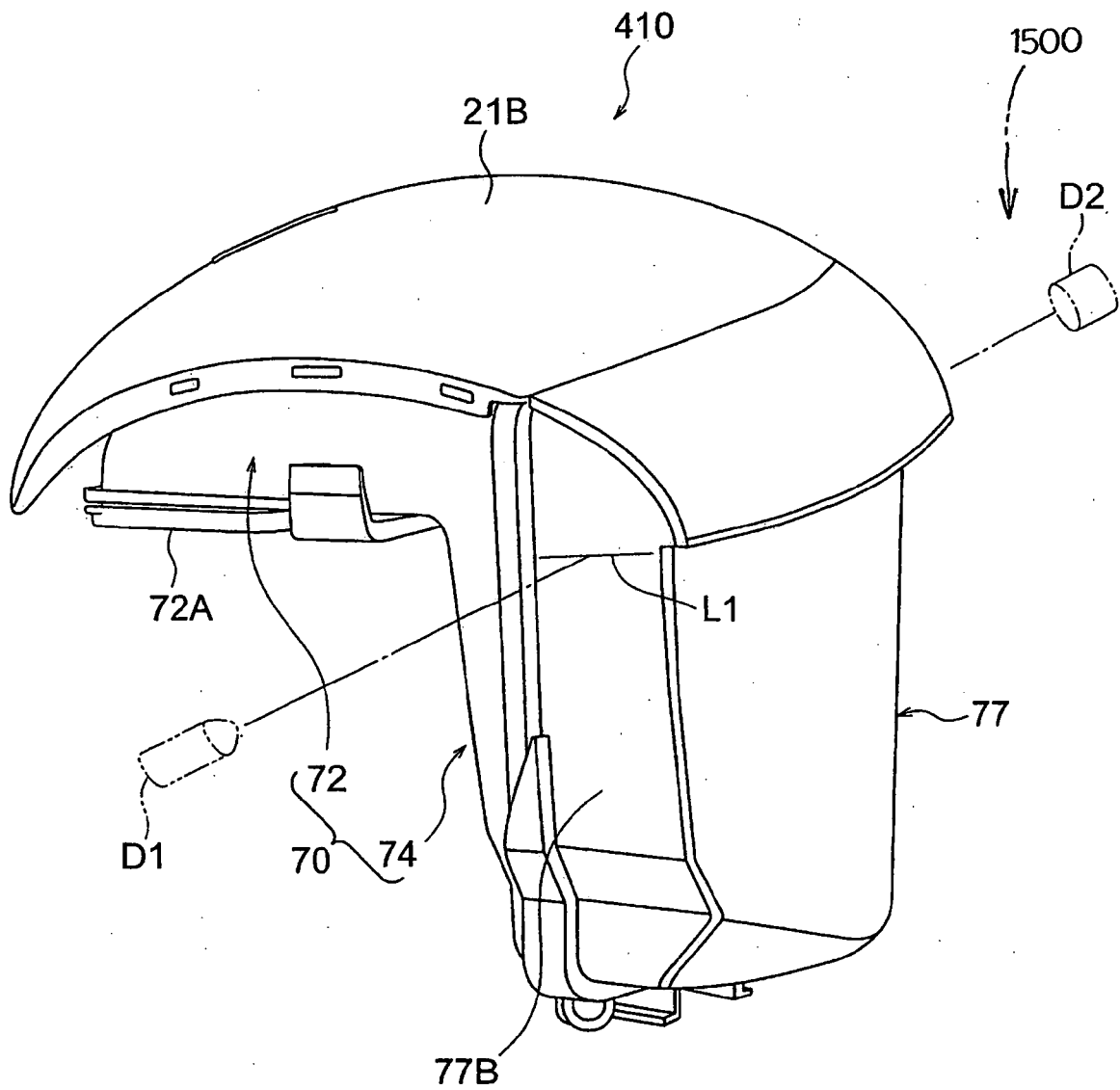


FIG.8

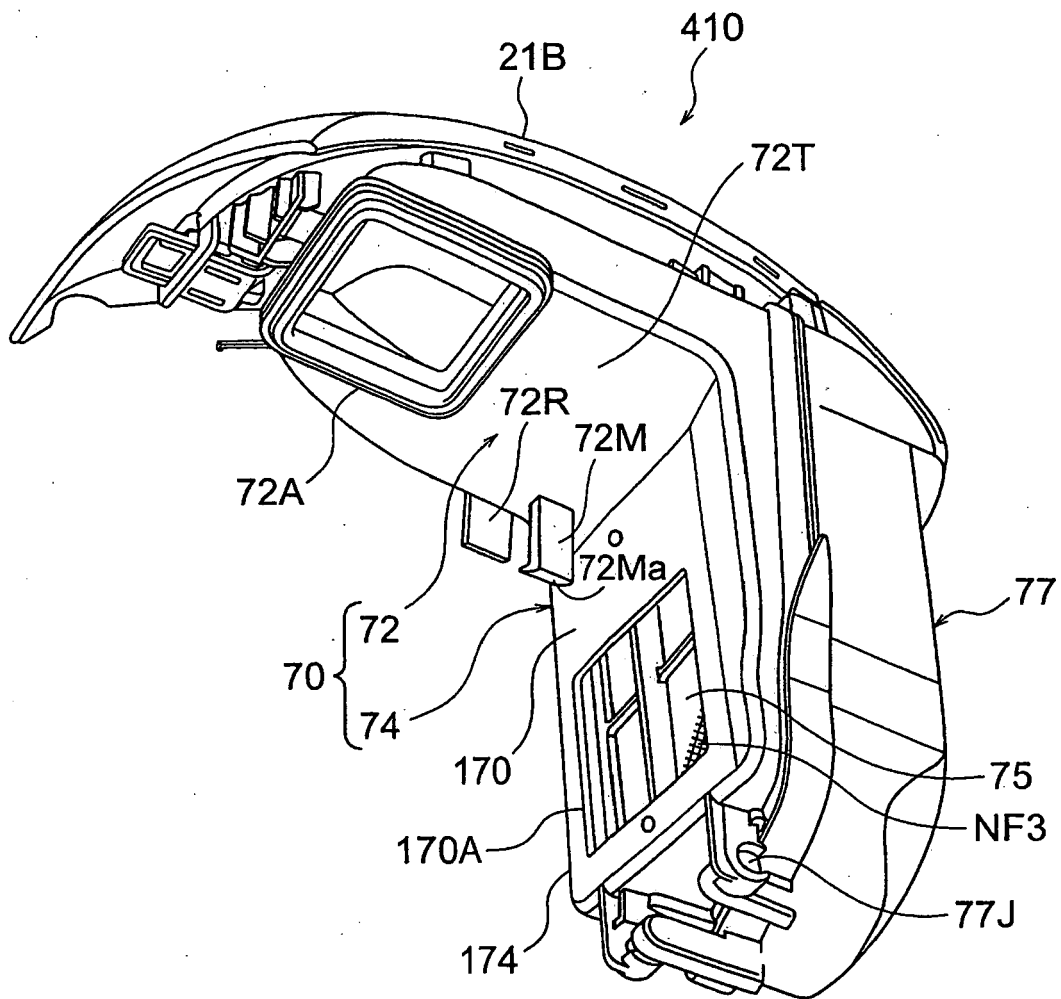


FIG.9

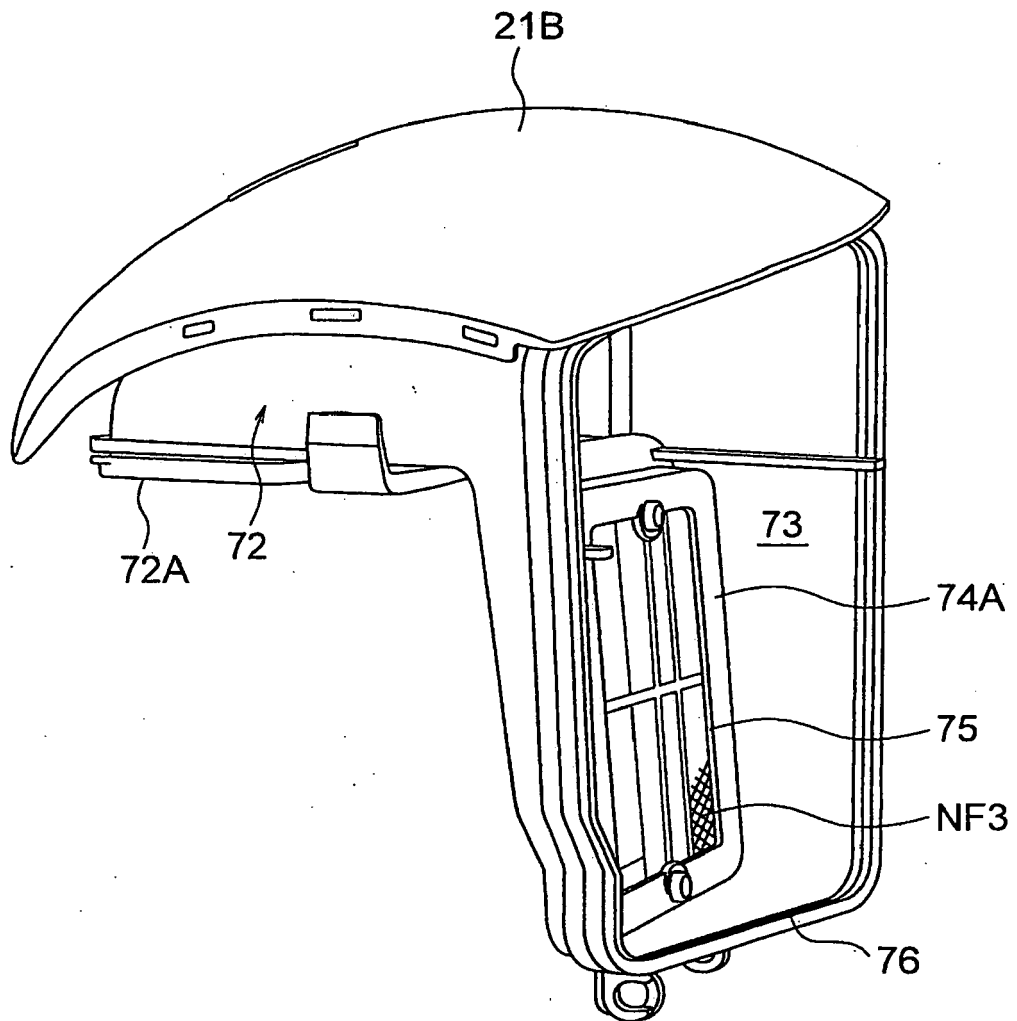


FIG.10

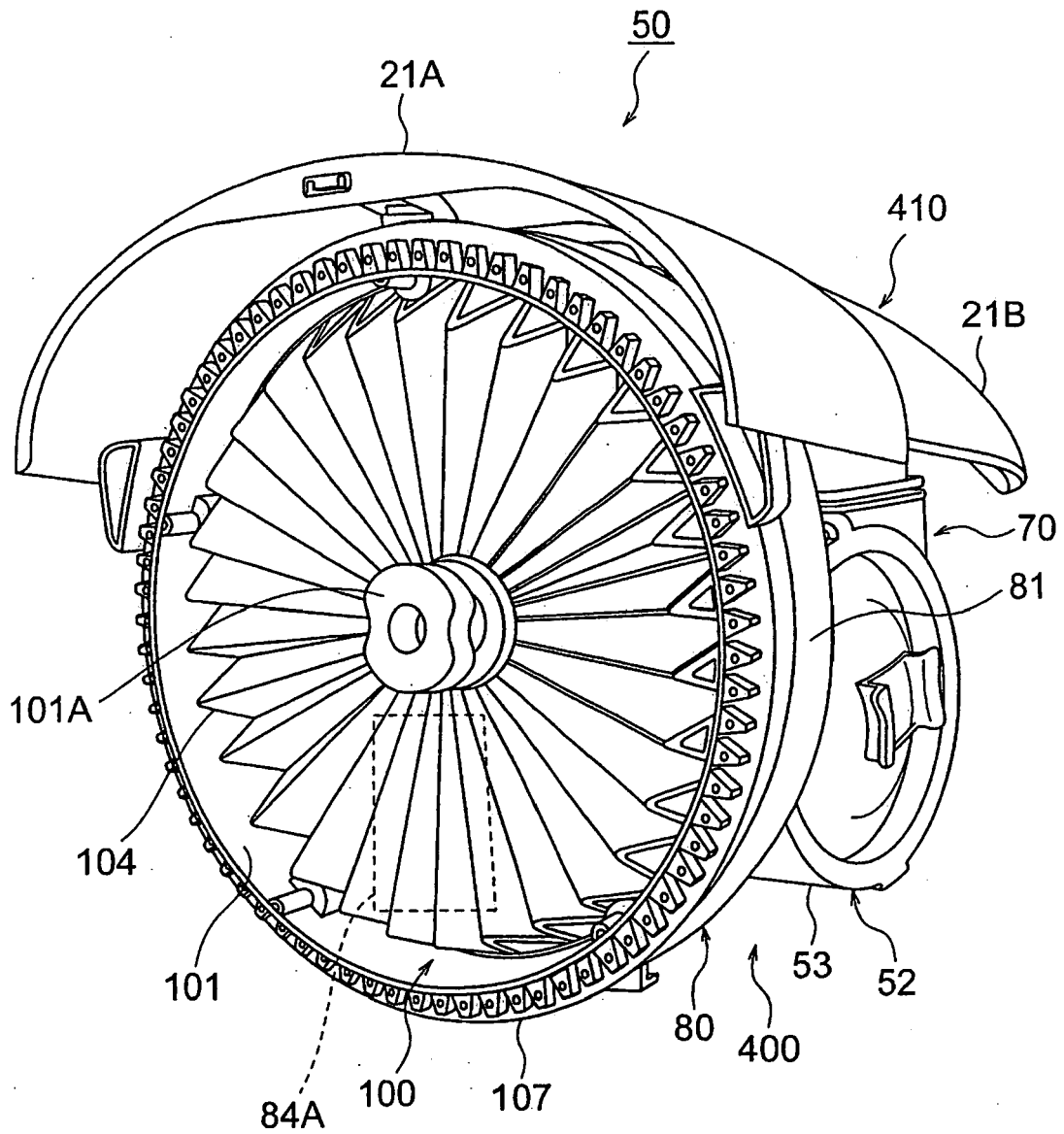


FIG. 11

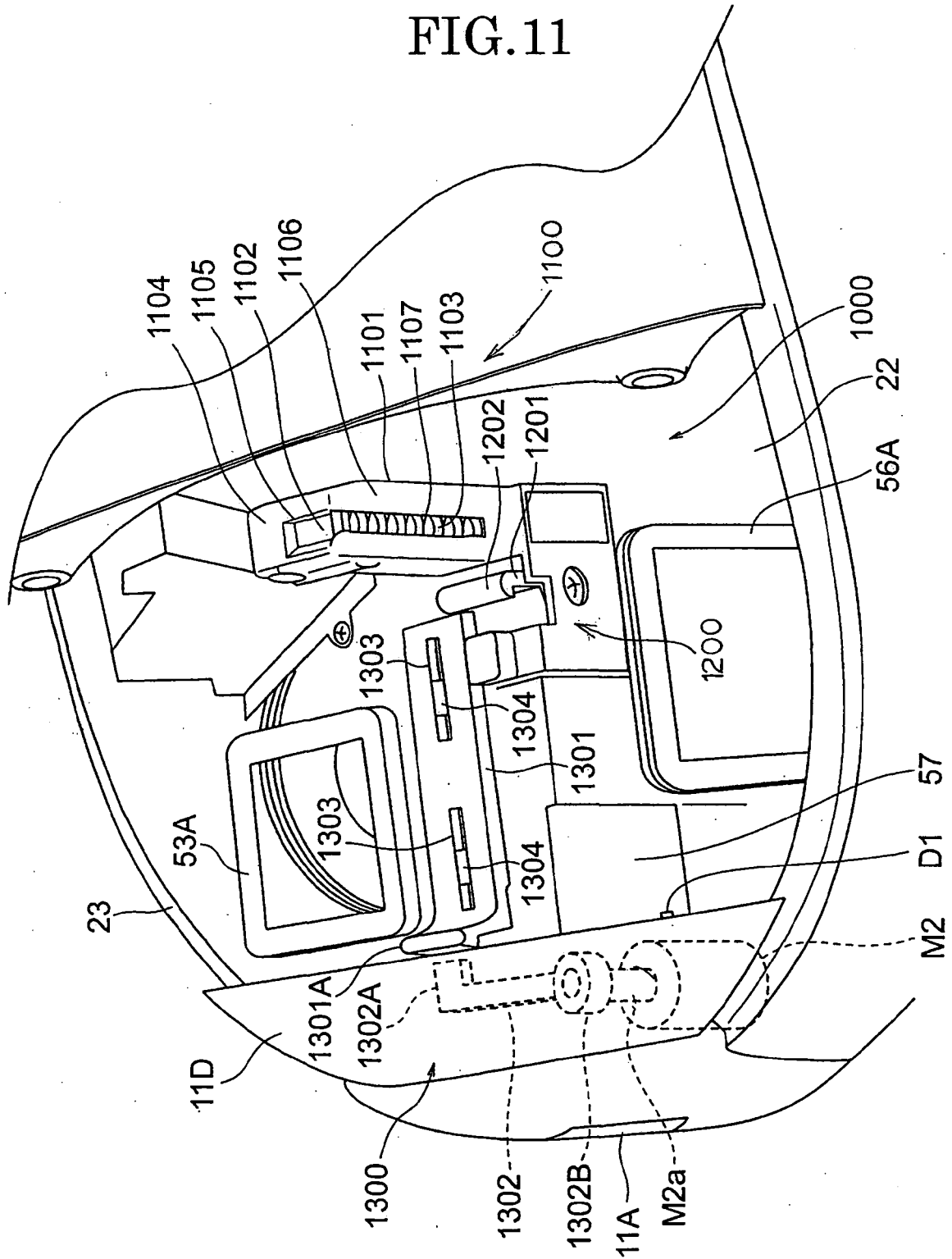


FIG.12

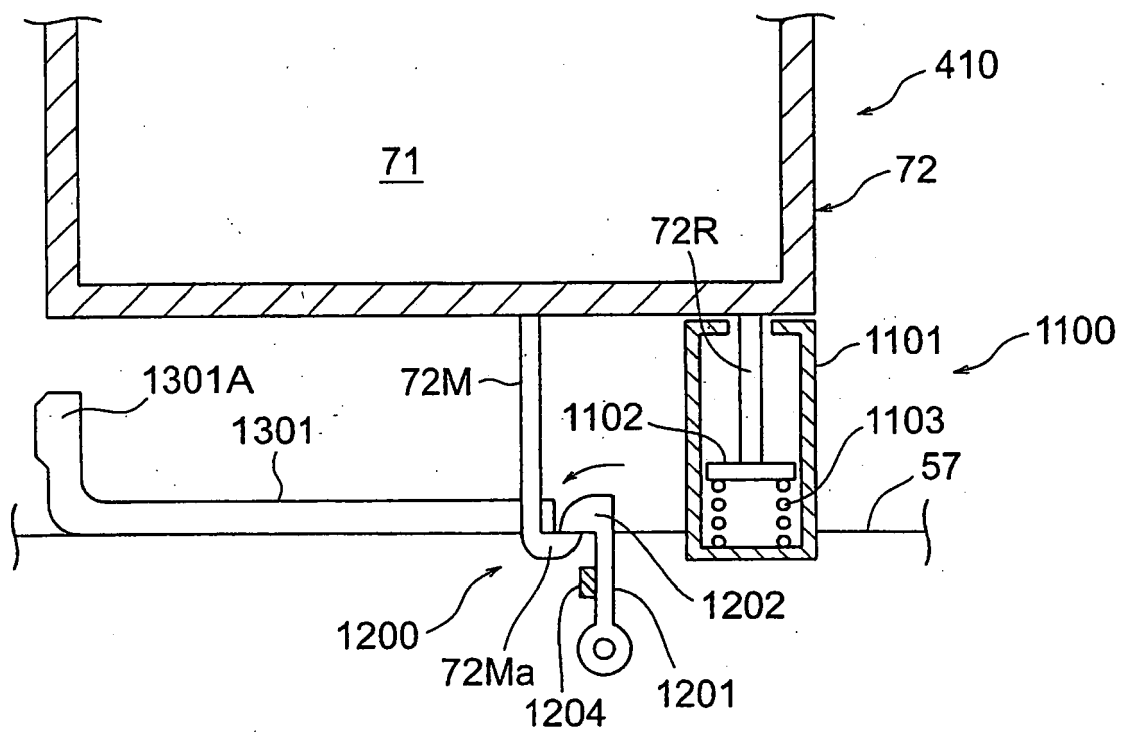


FIG.13

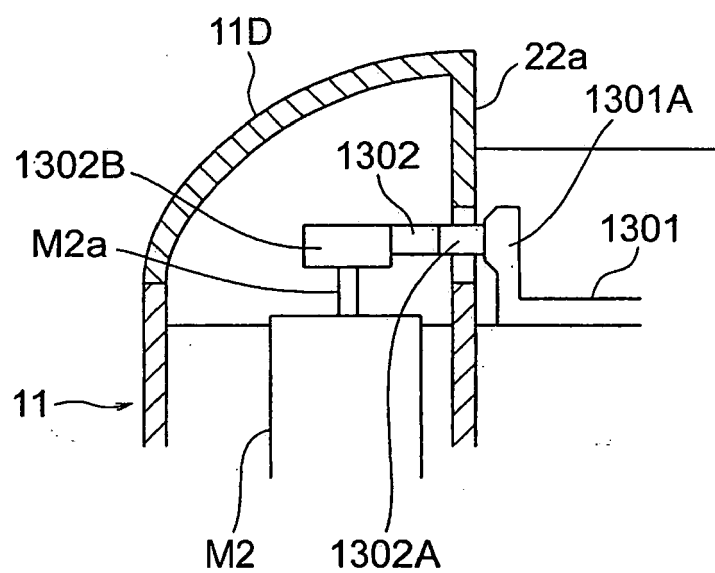


FIG.14

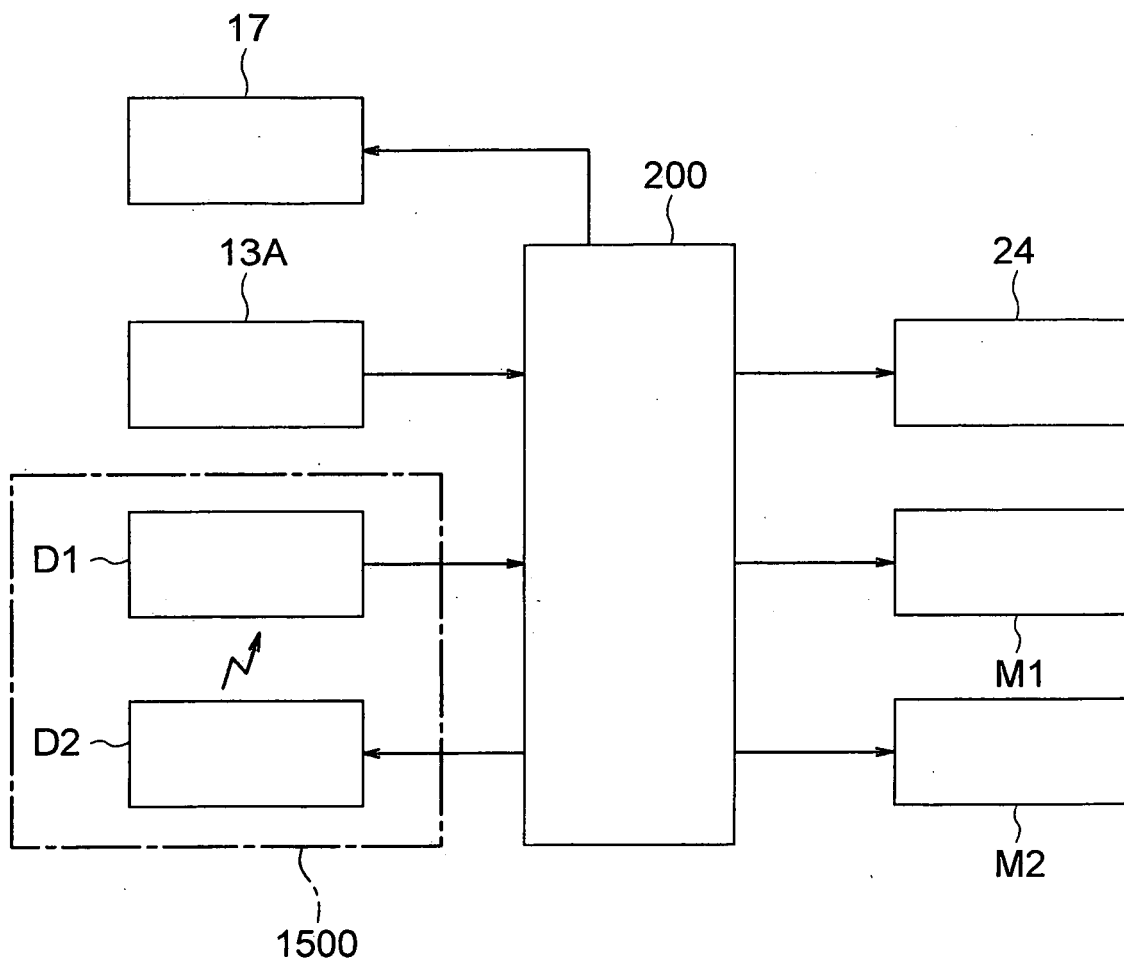
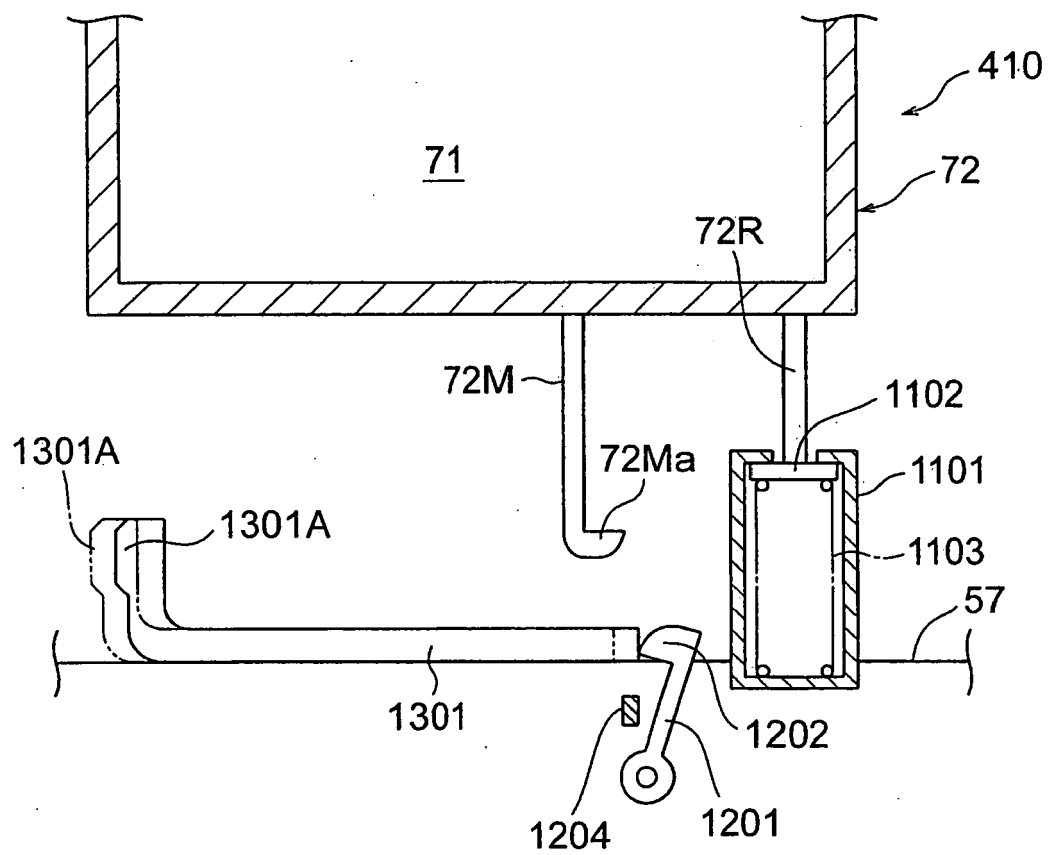


FIG.15



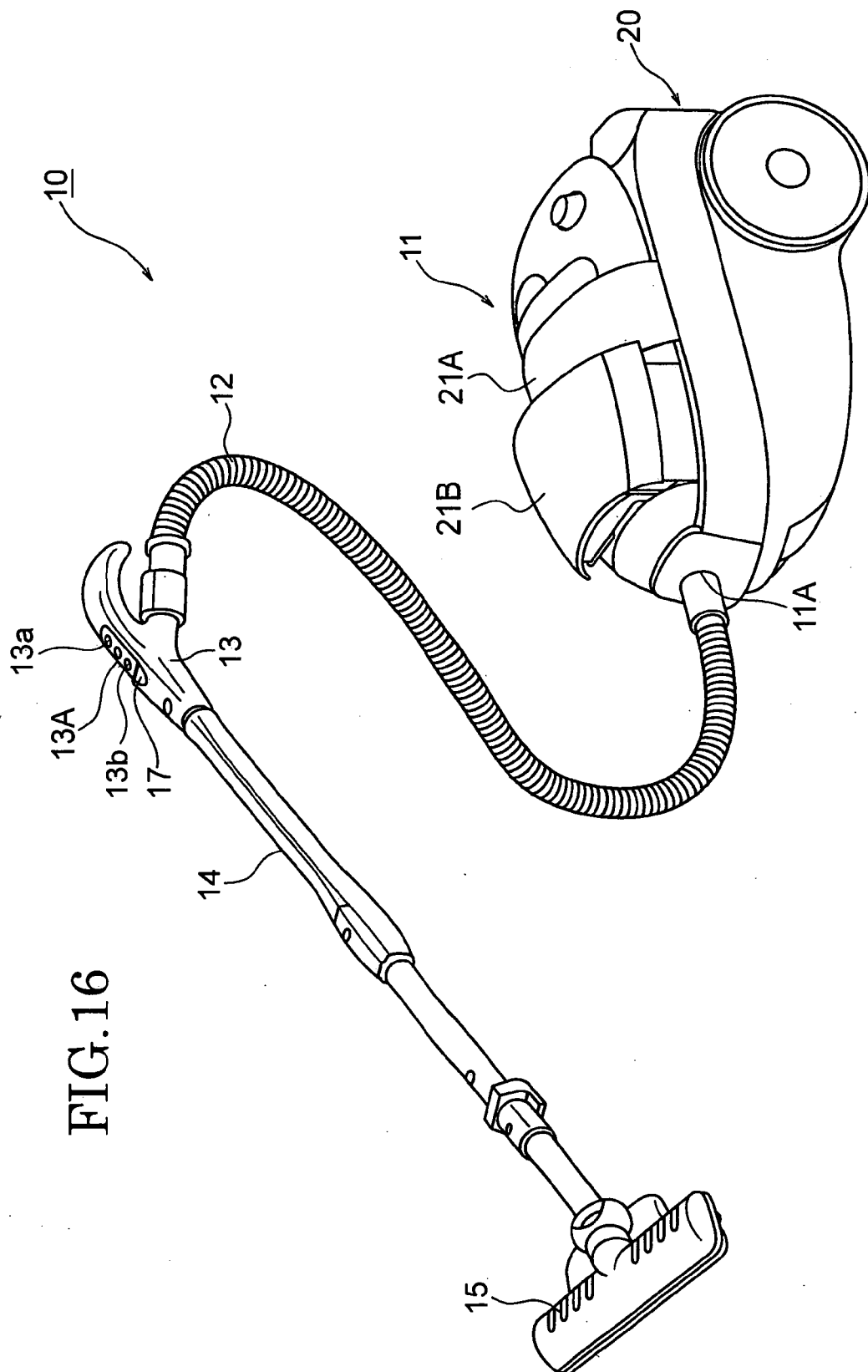
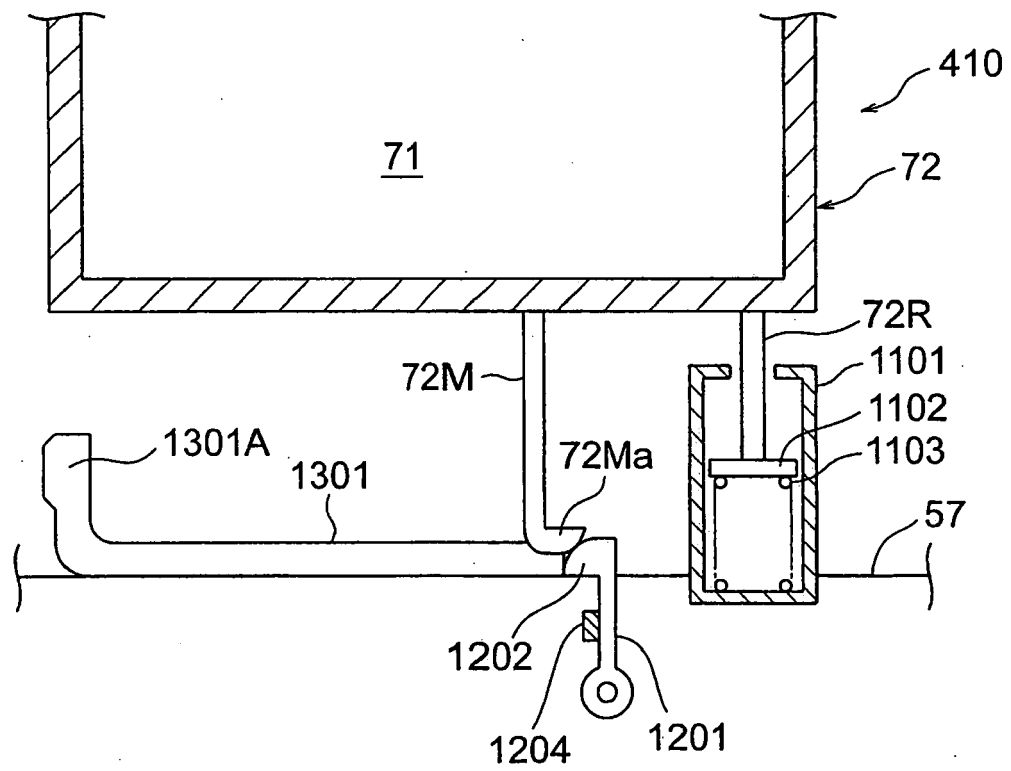


FIG.17



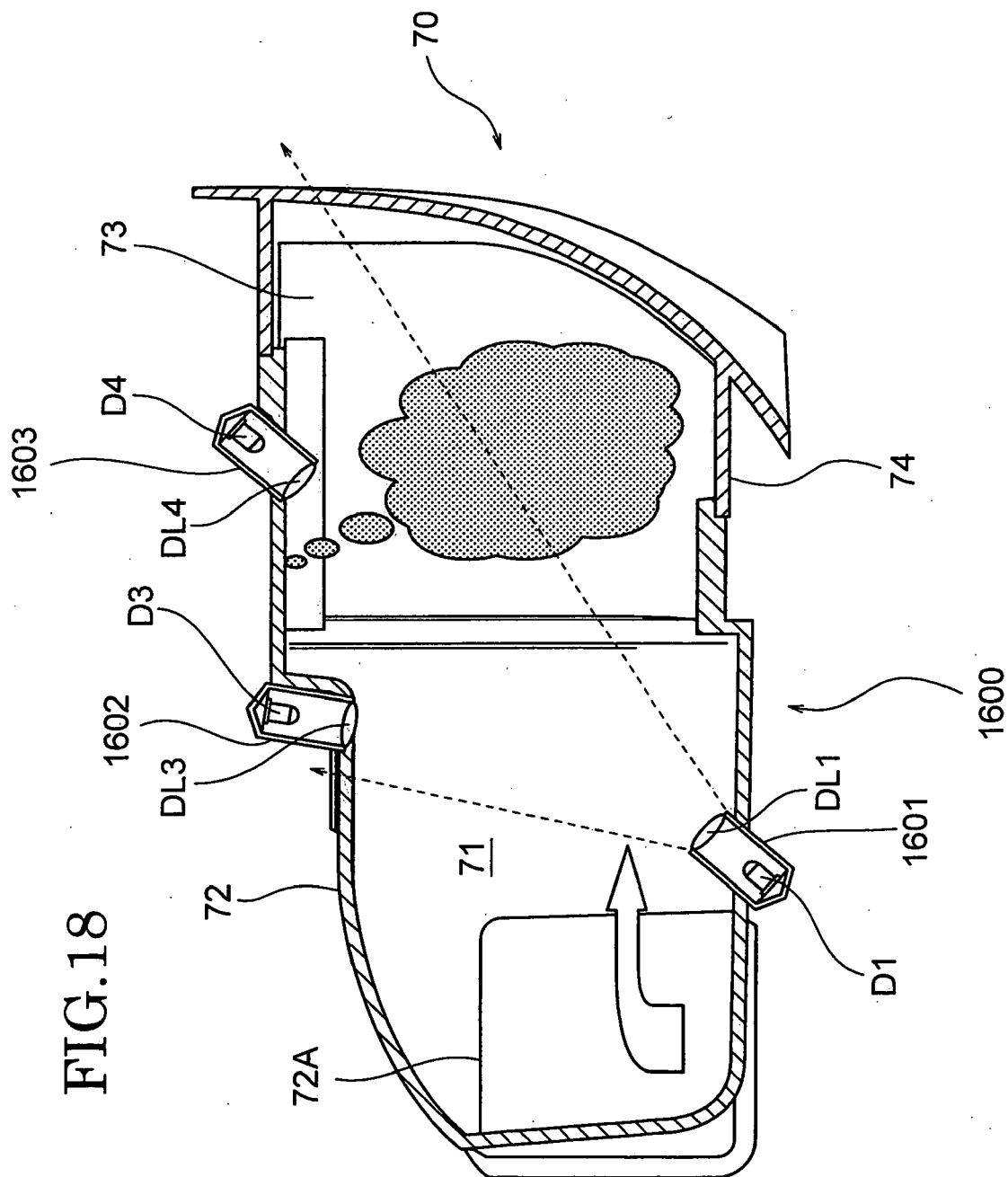
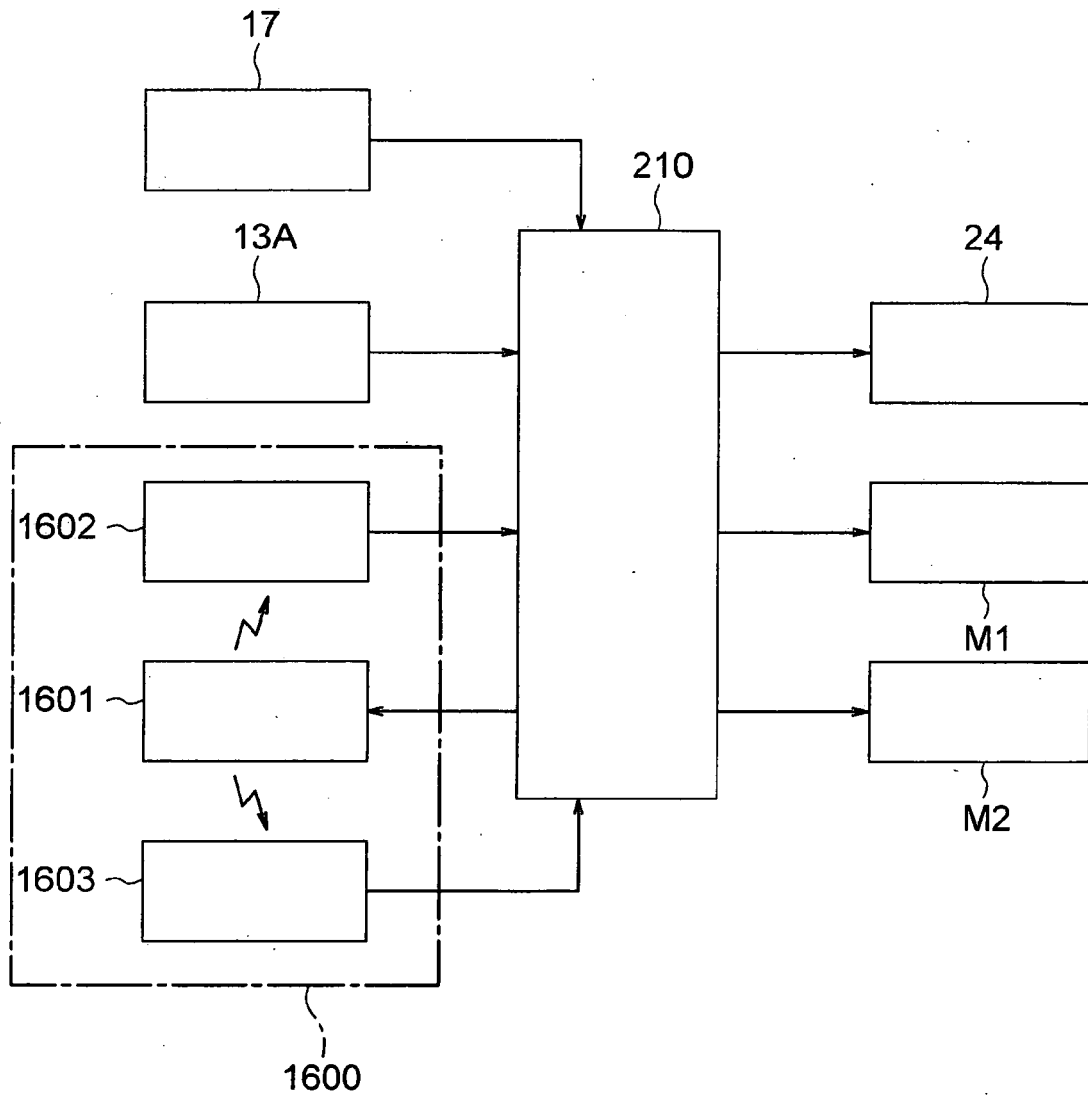
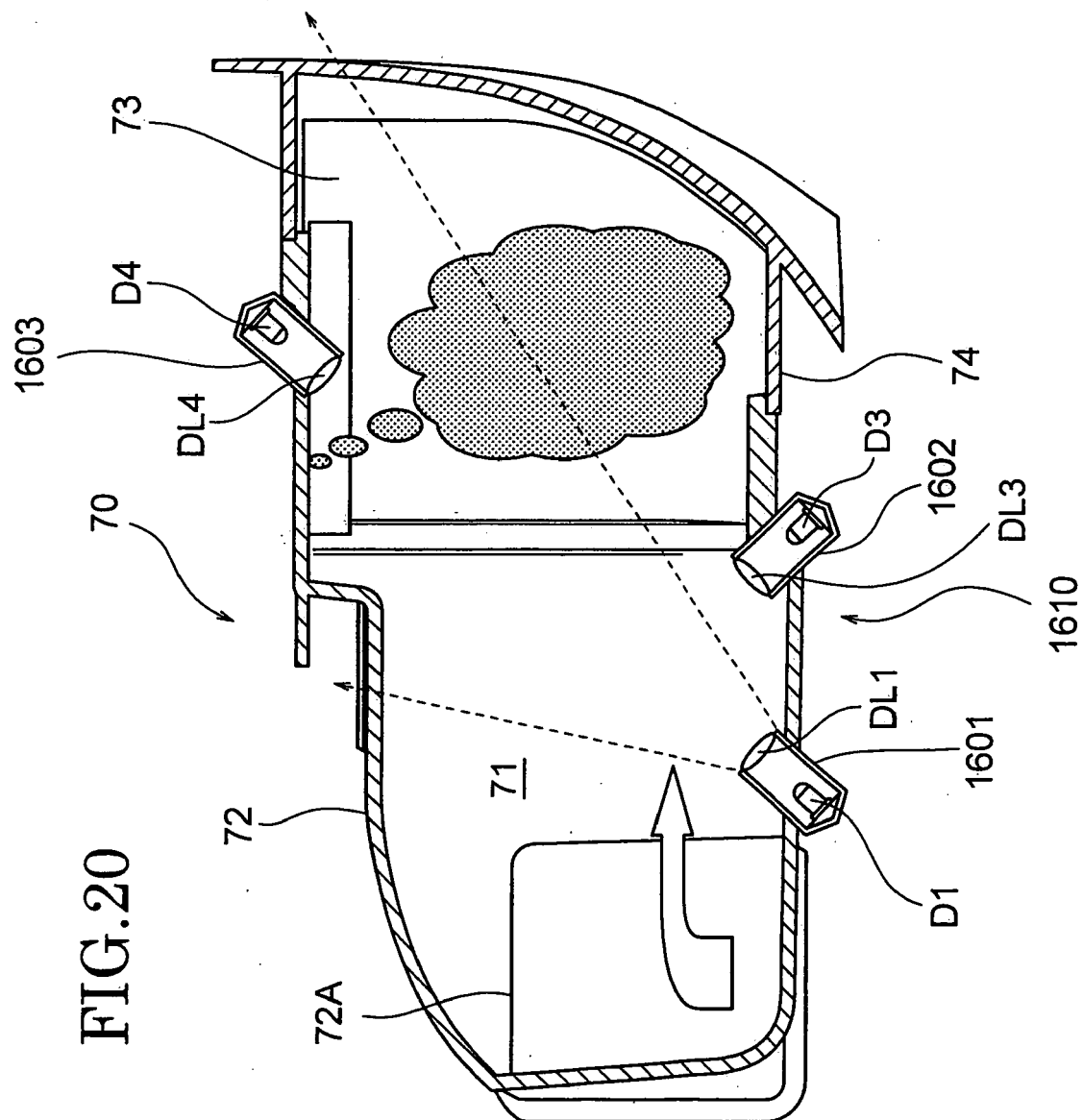


FIG.19





REFERENCES CITED IN THE DESCRIPTION

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