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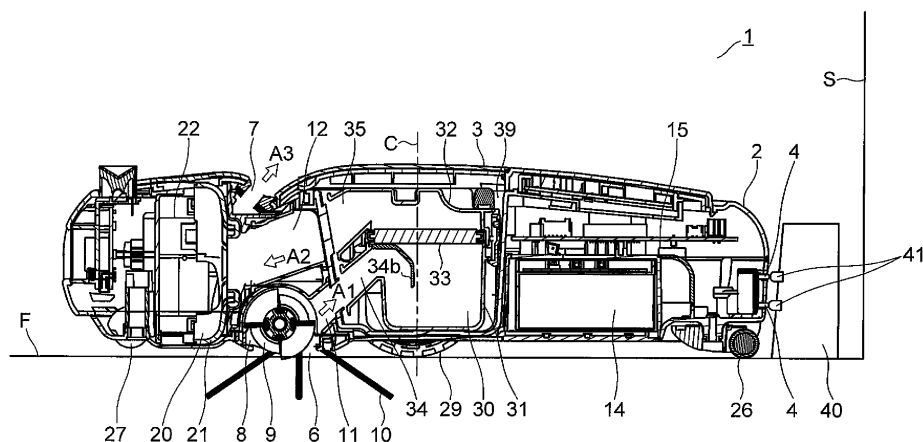
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(54) **CLEANING ROBOT**

(57) A cleaning robot that comprises: a main case (2) having a suction port (6) opened in the lower surface thereof and an exhaust port (7) opened in the upper surface thereof, that is self-propelled on a floor surface (F); an electric fan (22) arranged inside the main case (2); a dust collection unit (30) arranged in the center of the main

case (2), in a planar view, that collects dust in airflow sucked in from the suction port (6) by the driving force of the electric fan (22); and a battery (14) that supplies power to each section. The electric fan (22) is arranged on one side relative to the dust collection unit (30) and the battery (14) is arranged on the other side.

FIG.2



Description**Technical Field**

5 [0001] The present invention relates to a cleaning robot that moves by itself on a floor surface.

Background Art

10 [0002] A conventional cleaning robot is disclosed in a patent document 1. In this cleaning robot, a main body housing, which has a circular shape when viewed from top, moves by itself on a floor surface to perform cleaning. Here, to perform cleaning under a table and the like, the main body housing is formed to have a thin shape that is low in height. The main body housing is provided with a drive wheel and a driven wheel that protrude from a bottom surface. The driven wheel is disposed in front of the drive wheel in a traveling direction during a cleaning time.

15 [0003] A lower surface of a front portion of the main body housing, which is situated in front in the traveling direction during the cleaning time, is provided therethrough with a suction opening, and a circumferential surface of a rear portion of the main body housing is provided therethrough with an air exhaling opening. A dust suction portion, which has an electric fan and a dust collection portion, is disposed behind the drive wheel in the main body housing. The electric fan generates a suction air flow that is sucked from the suction opening, and the dust collection portion collects dust contained in the suction air flow.

20 [0004] The suction opening and the dust collection portion are connected with each other by a duct, the dust collection portion and the air exhaling opening are connected by the duct, and the electric fan is disposed in the duct. Here, the dust collection portion is disposed in a freely mountable and demountable manner; accordingly, an air flow-in opening and an air flow-out opening are in tight contact with the duct via a packing.

25 [0005] Besides, the main body housing is provided therein with a battery that supplies electric power to each portion of the electric fan, the drive wheel and the like, and with a control board that has a control circuit to control each portion.

30 [0006] In the cleaning robot having the above structure, when a cleaning operation is started, the drive wheel and the electric fan are driven. The main body housing moves by itself on a floor surface because of rotation of the drive wheel and driven wheel, and an air flow containing dust is sucked from the suction opening disposed in the front portion because of the driving of the electric fan. The dust contained in the air flow is collected by the dust collection portion, and the air flow, from which the dust is removed, passes through the electric fan to be exhaled backward from the air exhaling opening. In this way, the floor surface is cleaned, the dust collection portion is removed, and the dust accumulated in the dust collection portion is dumped.

Citation List

35

Patent Literature

[0007] PLT1: JP-A-2007-167617 (pages 6 to 10, Fig. 2)

40 **Summary of Invention**

Technical Problem

45 [0008] The electric fan disposed in the main body housing has a heavy weight, and the dust collection portion becomes heavy in weight because of the accumulation of dust. Because of this, according to the conventional cleaning robot that disposes the electric fan and the dust collection portion behind the drive wheel, the weight becomes heavier in the portion behind the drive wheel than in the portion in front of the drive wheel. Here, if the main body housing moves backward and stops suddenly before a step of a downward stairway and the like, there is a risk that a center of gravity shifts backward; and the main body housing falls from the step to be broken because of the weight behind the drive wheel.

50 Besides, when dust accumulates in the dust collection portion, the weight behind the drive wheel becomes further heavier; accordingly, the main body housing becomes more likely to fall from the step.

55 [0009] Likewise, also in a case where the weight of the portion in front of the drive wheel becomes heavier than the portion behind the drive wheel, there is a risk that the main body housing falls from a step of a downward stairway when moving forward.

[0010] Besides, according to the conventional cleaning robot, the main body housing is provided with the suction opening through the front portion and with the electric fan and air exhaling opening in the back portion. Because of this, an air flow path, which connects the suction opening and the air exhaling opening with each other, is formed to extend long in the main body housing. Besides, the control board is dispersed and disposed in a left-right direction and a back-

forth direction with respect to the dust collection portion, and a wiring, which connects electric components such as the electric fan, the drive wheel and the like and a plurality of the control boards, becomes long. Accordingly, there is a problem that the main body housing becomes large.

[0011] Besides, if use is continued in a state where a small air leak is occurring because of deterioration of the packing and the like, the air flow containing dust flows over the control board, so that the dust accumulates on the control board. In this way, there is also a problem that the control circuit malfunctions and the reliability of the cleaning robot declines.

[0012] It is an object of the present invention to provide a cleaning robot that is able to prevent a fall from a step. Besides, it is another object of the present invention to provide a cleaning robot that is able to achieve a small size and to improve the reliability.

Solution to Problem

[0013] To achieve the above objects, the present invention comprises: a main body housing that is provided with a suction opening and an air exhaling opening; a pair of drive wheels that have a horizontal rotary shaft and allows the main body housing to move by itself; an electric fan that is disposed in the main body housing; a dust collection portion that is disposed on the rotary shaft and collects dust of an air flow which is sucked from the suction opening because of driving of the electric fan; and a battery that supplies electric power to each portion; wherein the electric fan is disposed on one side of the dust collection portion and the battery is disposed on another side of the dust collection portion.

[0014] According to this structure, the main body housing moves forward and backward because of driving of the pair of drive wheels. For example, the electric fan is disposed in front of the dust collection portion that is disposed over the rotary shaft of both drive wheels, while the battery is disposed behind the dust collection portion. In this way, the weight of the main body housing is distributed in front of and behind the drive wheels. An air flow containing dust on a floor surface is sucked from the suction opening because of driving of the electric fan and collected by the dust collection portion. The air flow, from which the dust is removed by the dust collection portion, passes through the electric fan disposed in front of the dust collection portion to be exhaled from the air exhaling opening. If the main body housing stops suddenly before a step of a downward stairway or the like when moving forward and backward, the center of gravity shifts back and forth. Here, the weight of the main body housing is distributed in front of and behind the drive wheels; accordingly, a fall of the main body housing is prevented. Besides, the dust collection portion is disposed over the rotary shaft of the drive wheels; accordingly, even if the weight becomes large because of the dust collection, the weight balance of the main body housing is kept.

[0015] Besides, in the cleaning robot having the above structure according to the present invention, the rotary shaft is disposed on a center line of the main body housing. According to this structure, the weight of the main body housing is distributed in front of and behind the center line.

[0016] Besides, the cleaning robot having the above structure according to the present invention comprises: a rotary brush that is disposed at the suction opening arranged in front of the drive wheels; and a rear wheel that is disposed behind the drive wheels; wherein the rotary brush, the drive wheel and the rear wheel contact a floor surface, so that the main body housing moves by itself on the floor surface. According to this structure, dust on the floor surface is stirred up by rotation of the rotary brush and guided to the suction opening. If the main body housing stops suddenly when moving forward, the center of gravity of the main body housing shifts forward, and the rotary brush is deformed, so that the main body housing is inclined forward. Here, the weight of the main body housing is distributed back and forth; accordingly, the main body housing returns to the original attitude.

[0017] Besides, the cleaning robot having the above structure according to the present invention comprises a control board that controls each portion; wherein the control board is disposed on the same side as the battery with respect to the dust collection portion. According to this structure, the heavy-weight electric fan is disposed on one side of the drive wheels and the battery is disposed on the other side of the drive wheels.

[0018] Besides, the cleaning robot having the above structure according to the present invention comprises an air flow path that connects the suction opening with the dust collection portion, and connects the dust collection portion with the air exhaling opening; wherein the air flow path is disposed on one side with respect to the dust collection portion.

[0019] According to this structure, the main body housing moves by itself on the floor surface to perform cleaning because of control by the control board disposed, for example, behind the dust collection portion. Because of the driving of the electric fan, the air flow is sucked into the air flow path from the suction opening that opens in front of the dust collection portion, and exhaled, via the dust collection portion, from the air exhaling opening that opens through the front portion of the main body housing.

[0020] Besides, the present invention comprises: a main body housing that is provided with a suction opening disposed through a lower surface and an air exhaling opening disposed through an upper surface and moves by itself on a floor surface; an electric fan that is disposed in the main body housing; a dust collection portion that collects dust of an air flow which is sucked from the suction opening because of driving of the electric fan; an air flow path that connects the suction opening with the dust collection portion, and connects the dust collection portion with the air exhaling opening;

and a control board that controls each portion; wherein the air flow path is disposed on one side of the dust collection portion and the control board is disposed on another side of the dust collection portion.

[0021] According to this structure, because of control by the control board that is disposed, for example, behind the dust collection portion, the main body housing moves by itself on the floor surface and the electric fan is driven. Because of the driving of the electric fan, the air flow containing dust of the floor surface is sucked into the air flow path from the suction opening that opens in front of the dust collection portion. The dust contained in the air flow is collected by the dust collection portion disposed behind the suction opening. The air flow, from which the dust is removed by the dust collection portion, passes through the electric fan disposed in front of the dust collection portion and is exhaled from the air exhaling opening that opens through the front portion of the main body housing.

[0022] Besides, the cleaning robot having the above structure according to the present invention comprises a dust collection chamber that houses the dust collection portion in a freely mountable and demountable manner and extends in a direction to partition an inside of the main body housing; wherein a wall surface, which extends in a longitudinal direction of the dust collection chamber, is provided with a first air inhaling path through which the air flow flows in and a second air inhaling path through which the air flow flows out; and another wall surface of the dust collection chamber is closed.

[0023] According to this structure, the air flow sucked from the suction opening flows through the first air inhaling path disposed through, for example, the front wall of the dust collection chamber and flows into the dust collection portion. The air flow, from which the dust is removed by the dust collection portion, flows through the second air inhaling path disposed through the front wall of the dust collection chamber and is guided to the electric fan.

[0024] Besides, in the cleaning robot having the above structure according to the present invention, the dust collection portion includes: a dust collection vessel which is provided with an air flow-in opening and in which the dust accumulates; an upper cover which opens and closes an upper surface of the dust collection vessel and is provided with an air flow-out opening; and a filter which is disposed on a lower surface of the upper cover and collects the dust.

[0025] According to this structure, the air flow sucked from the suction opening flows into the dust collection vessel via the air flow-in opening, the dust accumulates in the dust collection chamber and is collected by the filter. The air flow, from which the dust is removed, flows out via the air flow-out opening disposed through the upper cover. The dust collection portion is demounted from the main body housing, the upper cover is opened, and the dust in the dust collection vessel is dumped.

[0026] Besides, in the cleaning robot having the above structure according to the present invention, the opening surfaces of the air flow-in opening and air flow-out opening include an inclined surface; and a packing is disposed on circumferential rims of the opening surfaces. According to this structure, when the dust collection portion is mounted, the packing closes tightly a portion between the air flow-in opening and the wall surface of the dust collection chamber, and a portion between the air flow-out opening and the wall surface of the dust collection chamber. Here, the opening surfaces of the air flow-in opening and air flow-out opening include the inclined surface; accordingly, sliding between the packing and the wall surface of the dust collection chamber is prevented when the dust collection portion is mounted and demounted.

Advantageous Effects of Invention

[0027] According to the present invention, the electric fan is disposed on one side and the battery is disposed on the other side with respect to the dust collection portion that is disposed over the rotary shaft of the drive wheels; accordingly, the weight of the main body housing is balanced and distributed in front of and behind the drive wheels. In this way, even if the main body housing moving forward and backward stops suddenly before a step and the center of gravity shifts back and forth, it is possible to keep the attitude and prevent the fall of the main body housing. Besides, even if the weight of the dust collection portion becomes large because of the dust collection, the weight balance of the main body housing 2 is kept, so that it is possible to prevent more surely the fall of the main body housing.

[0028] Besides, according to the present invention, the air flow path is disposed on one side and the control board is disposed on the other side with respect to the dust collection portion; the air flow path and the control board are gathered and disposed. In this way, it is possible to shorten the air flow path and achieve the small size of the main body housing by reducing wirings and the like. Besides, the air flow path is far from the control board; accordingly, even if the air flow leaks, it is possible to reduce the adhering of the dust to the control board and reduce the malfunction of the control circuit.

Brief Description of Drawings

[0029]

[Fig. 1] is a perspective view showing a cleaning robot according to an embodiment of the present invention.

[Fig. 2] is a side sectional view showing the cleaning robot according to the embodiment of the present invention.

[Fig. 3] is a bottom view showing the cleaning robot according to the embodiment of the present invention.

[Fig. 4] is a side sectional view showing a state in which a dust collection portion of the cleaning robot according to the embodiment of the present invention is demounted.

[Fig. 5] is a perspective view showing a motor unit of the cleaning robot according to the embodiment of the present invention.

[Fig. 6] is a front view showing the motor unit of the cleaning robot according to the embodiment of the present invention.

[Fig. 7] is a top view showing the motor unit of the cleaning robot according to the embodiment of the present invention.

[Fig. 8] is a side view showing the motor unit of the cleaning robot according to the embodiment of the present invention.

Description of Embodiments

[0030] Hereinafter, an embodiment of the present invention is described with reference to the drawings. Fig. 1 is a perspective view showing a cleaning robot according to the embodiment of the present invention. A cleaning robot 1 has a main body housing 2 which has a circular shape when viewed from top and drives drive wheels 29 (see Fig. 2 as to both) by means of a battery 14 to move by itself. An upper surface of the main body housing 2 is provided with a lid portion 3 that is opened and closed when a dust collection portion 30 (see Fig. 2) is put in and taken out.

[0031] Fig. 2 and Fig. 3 show a side sectional view and a bottom view of the cleaning robot 1, respectively. The main body housing 2 is provided with a pair of drive wheels 29 that protrude from a bottom surface and rotate on a horizontal rotary shaft 29a. The rotary shaft 29a of the drive wheels 29 is disposed on a center line C of the main body housing 2. When both drive wheels 29 rotate in the same direction, the main body housing 2 moves forward and backward, while when both drive wheels 29 rotate in directions opposite to each other, the main body housing 2 rotates about the center line C.

[0032] A suction opening 6 is disposed through a front portion of the main body housing 2 that is situated in front in a traveling direction when cleaning is performed. The suction opening 6 is formed to oppose a floor surface F by means of an open surface of a recessed portion 8 that is formed to be recessed on the bottom surface of the main body housing 2. A rotary brush 9, which rotates on a horizontal rotary shaft, is disposed in the recessed portion 8, and side brushes 10, which rotate on a vertical rotary shaft, are disposed on both sides of the recessed portion 8, respectively.

[0033] A roller-shaped front wheel 27 is disposed in front of the recessed portion 8. A rear end of the main body housing 2 is provided with a rear wheel 26 that includes a universal wheel. As described later, the main body housing 2 disperses a weight in a back-forth direction with respect to the drive wheels 29 disposed at the center; the front wheel 27 goes away from the floor surface F, while the rotary brush 9, the drive wheels 29 and the rear wheel 26 contact the floor surface F to perform the cleaning. Because of this, dust present in front in the traveling path can be guided to the suction opening 6 without being blocked by the front wheel 27. The front wheel 27 moves onto a step that appears on the traveling path, so that the main body housing 2 can easily go over the step.

[0034] A floor surface detection sensor 18 for detecting the floor surface F is disposed in front of the front wheel 27. Similar floor surface detection sensors 19 are disposed in front of both drive wheels 29. If a step of a downward stairway or the like appears in the traveling path, the drive wheels 29 are stopped because of detection by the floor surface detection sensor 18. Besides, if the floor surface detection sensor 18 malfunctions, the drive wheels 29 are stopped because of detection by the floor surface detection sensors 19.

[0035] A rear end of a circumferential surface of the main body housing 2 is provided with a charge terminal 4 for charging the battery 14. The main body housing 2 moves by itself to return to a charge stand 40 installed in a room, and the charge terminal 4 comes into contact with a terminal portion 41 disposed on the charge stand 40 to charge the battery 14. The charge stand 40 connected to commercial power supply is usually installed along a side wall S of the room.

[0036] The main body housing 2 is provided therein with the dust collection portion 30 that collects dust. The dust collection portion 30 is disposed on the rotary shaft 29a of the drive wheels 29 and housed in a dust collection chamber 39 that is disposed in the main body housing 2. The dust collection chamber 39 includes an isolated chamber whose circumferential surfaces in four directions and bottom surface are covered, and is formed to extend in a left-right direction to partition an inside of the main body housing 2. Wall surfaces of the dust collection chamber 39 are closed except for a front wall that extends in a longitudinal direction. The dust collection chamber 39 is provided, through the front wall thereof, with a first air inhaling path 11 that communicates with the recessed portion 8 and a second air inhaling path 12 that is disposed over the recessed portion 8 and communicates with a motor unit 20 described later.

[0037] The dust collection portion 30 is disposed on the center line C of the main body housing 2, and can be put into and taken out with the lid portion 3 of the main body housing 2 opened as shown in Fig. 4. The dust collection portion 30 is provided with an upper cover 32 that has a filter 33 on an upper surface of a bottomed cylindrical dust collection vessel 31. The upper cover 32 engages with the dust collection vessel 31 by means of a movable engagement portion 32a, opens and closes an upper surface of the dust collection vessel 31 by means of operation of the engagement

portion 32a. In this way, it is possible to dump the dust accumulated in the dust collection vessel 31.

[0038] The dust collection vessel 31 is provided, through a circumferential surface thereof, with a flow-in path 34 whose tip end is equipped with a flow-in opening 34a to communicate with the first air inhaling path 11. The dust collection vessel 31 is provided therein with a flow-in portion 34b that communicates with the flow-in path 34 to guide an air flow downward by means of a bend. In this way, it is possible to make large dust and heavy-weight dust easily accumulate in a bottom portion of the dust collection vessel 31. The upper cover 32 is provided, through a circumferential surface thereof, with a flow-out path 35 whose tip end is equipped with a flow-out opening 35a to communicate with the second air inhaling path 12.

[0039] The flow-in opening 34a and the flow-out opening 35a are provided therearound with a packing (not shown) which comes into tight contact with the front wall of the dust collection chamber 39. In this way, the dust collection chamber 39 housing the dust collection portion 30 is tightly closed. The opening surface of the flow-in opening 34a, the opening surface of the flow-out opening 35a, and the front wall of the dust collection chamber 39 are each formed to have an inclined surface, so that it is possible to prevent the packing from being deteriorated by sliding when the dust collection portion 30 is put in and taken out.

[0040] A control board 15 is disposed in an upper portion behind the dust collection chamber 39 in the main body housing 2. The control board 15 is provided with a control circuit that controls each portion of the cleaning robot 1. The battery 14 freely mountable and demountable is disposed in a lower portion behind the dust collection chamber 39. The battery 14 is charged by the charge stand 40 via the charge terminal 4 and supplies electric power to each portion of the control board 15, the drive wheels 29, the rotary brush 9, the side brushes 10, the electric fan 22 and the like.

[0041] The motor unit 20 is disposed in the front portion of the main body housing 2. Fig. 5, Fig. 6, Fig. 7 and Fig. 8 show a perspective view, top view, front view, and side view of the motor unit 20, respectively. The motor unit 20 includes a housing 21 formed of a resin and the electric fan 22 housed in the housing 21. The electric fan 22 is formed of a turbo-fan that is covered by a motor case 22a.

[0042] The motor case 22a of the electric fan 22 is provided, through one end in a shaft direction thereof, with an air inhaling opening (not shown) and provided, through a circumferential surface thereof, with two air exhaling openings (not shown). The housing 21 is provided, through a front surface thereof, with an opening portion 23 that opposes the air inhaling opening of the motor case 22a. The electric fan 22 of the housing 21 is provided, on both sides thereof, with a first air exhaling path 24a and a second air exhaling path 24b that communicate with the air exhaling openings of the motor case 22a, respectively. The first and second air exhaling paths 24a, 24b communicate with an air exhaling opening 7 (see Fig. 2) provided through the upper surface of the main body housing 2.

[0043] Because of this, the first and second air exhaling paths 24a, 24b and the second air inhaling path 12 (see Fig. 2) compose air flow paths that connect the dust collection portion 30 and the air exhaling opening 7 with each other. Besides, the first air inhaling path 11 (see Fig. 2) composes an air flow path that connects the suction opening 6 and the dust collection portion 30 with each other.

[0044] In this way, the air flow paths including the electric fan 22 are gathered in front of the dust collection chamber 39 and disposed in the front portion of the main body housing 2, so that it is possible to shorten the air flow paths. Besides, the control board 15 and the battery 14 are gathered behind the dust collection chamber 39 and disposed in the rear portion of the main body housing 2, so that it is possible to reduce wirings and the like. Accordingly, it is possible to achieve the small size of the main body housing 2. Besides, the air flow paths are far from the control board 15; accordingly, even if the air flow leaks, it is possible to alleviate the dust adhering to the control board 15 and to reduce the malfunction of the control circuit.

[0045] Besides, the heavy-weight electric fan 22 and battery 14 are dispersed and disposed in front of and behind the rotary shaft 29a of the drive wheels 29; accordingly, the weight is balanced and distributed in a back-forth direction of the main body housing 2 with respect to the rotary shaft 29a that passes the center line C of the main body housing 2. Because of this, the rotary brush 9, the drive wheels 29 and the rear wheel 26 contact the floor surface and the main body housing 2 moves forward and backward; and even if the rotary brush 9 or the rear wheel 26 loses its foothold because of a step or the like, it is possible to prevent a fall of the main body housing 2.

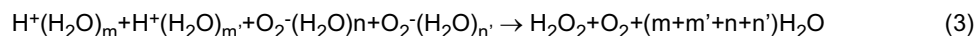
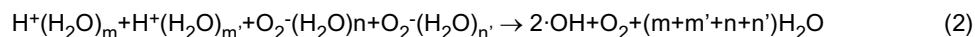
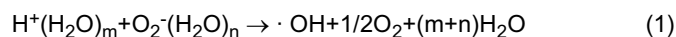
[0046] The dust collection portion 30 is disposed on the center line C; accordingly, even if the weight of the dust collection portion 30 changes because of the collecting and dumping of dust, it is possible to keep the weight balance of the main body housing 2. In the meantime, the weight of the electric fan 22 is large; accordingly, it is possible to achieve a better weight balance by disposing the control board 15 and the battery 14 behind the rotary shaft 29a of the drive wheels 29.

[0047] The first air exhaling path 24a is provided with an ion generation apparatus 28 that has a pair of electrodes 28a. A voltage having an a.c. waveform or an impulse waveform is applied to the electrodes 28a, and ions generated by a corona discharge from the electrodes 28a are emitted into the first air exhaling path 24a.

[0048] A positive voltage is applied to one electrode 28a, so that hydrogen ions due to the corona discharge combine with moisture in the air to generate positive ions formed mainly of $H^+(H_2O)_m$. A negative voltage is applied to the other electrode 28a, so that oxygen ions due to the corona discharge combine with moisture in the air to generate negative

ions formed mainly of $O_2^-(H_2O)_n$. Here, m, n are each an arbitrary natural number. $H^+(H_2O)_m$ and $O_2^-(H_2O)_n$ condensate on surfaces of floating germs and odor components in the air to capture them.

[0049] And as indicated by formulas (1) to (3), $[OH]$ (hydroxyl radical) and H_2O_2 (hydrogen peroxide), which are active species, are made to condensate and occur on surfaces of microbes and the like by means of collision to break the floating germs and odor components. Here, m', n' are each an arbitrary natural number. Accordingly, by generating the positive ions and negative ions and sending them out from the air exhaling opening 7 (see Fig. 2), it is possible to perform the germ removal and deodorization of the room.



[0050] Besides, a lower portion of the first air exhaling path 24a is provided with a return opening 25 whose front surface is opened. An upper portion of the return opening 25 is covered by a protrusion portion 25a that protrudes from the front surface of the housing 21, and an opening surface is formed to be a curved surface along a wall surface of the recessed portion 8 (see Fig. 2). In this way, the return opening 25 is opened to the recessed portion 8 via a hole portion (not shown) disposed through the wall surface of the recessed portion 8, so that a portion of the air flow, which flows in the first air exhaling path 24a and contains ions, is guided to the air inhaling side.

[0051] In the cleaning robot 1 having the above structure, when a cleaning operation is instructed, the electric fan 22, the ion generation apparatus 28, the drive wheels 29, the rotary brush 9, and the side brushes 10 are driven. In this way, the rotary brush 9, the drive wheels 29, and the rear wheel 26 contact the floor surface F and the main body housing 2 moves by itself in a predetermined cleaning area, so that the air flow containing dust on the floor surface F is sucked from the suction opening 6. At this time, the dust on the floor surface F is stirred up and guided into the recessed portion 8 because of rotation of the rotary brush 9. Besides, dust on both sides of the suction opening 6 is guided into the suction opening 6 because of rotation of the side brushes 10.

[0052] The air flow sucked from the suction opening 6 flows backward in the first air inhaling path 11 as indicated by an arrow A1 and flows into the dust collection portion 30 via the flow-in opening 34a. The air flow flowing into the dust collection portion 30 has the dust collected by the filter 33 and flows out from the dust collection portion 30 via the flow-out opening 35a. In this way, the dust is collected and accumulated in the dust collection vessel 31. The air flow flowing out from the dust collection portion 30 flows forward in the second air inhaling path 12 as indicated by an arrow A2 and flows into the electric fan 22 of the motor unit 20 via the opening portion 23.

[0053] The air flow passing through the electric fan 22 flows into the first air exhaling path 24a and the second air exhaling path 24b, and the air flow flowing in the first air exhaling path 24a contains ions. And the air flow containing the ions is exhaled upward and backward in an oblique direction as indicated by an arrow A3 from the air exhaling opening 7 disposed through the upper surface of the main body housing 2. In this way, the room is cleaned, and the ions contained in the exhaled air from the main body housing 2 moving by itself spread throughout the room to perform the germ removal and deodorization of the room. At this time, the air flow is exhaled upward from the air exhaling opening 7; accordingly, it is possible to prevent the dust on the floor surface F from being stirred up and to improve a cleanliness degree of the room.

[0054] A portion of the air flow flowing in the first air exhaling path 24a is guided to the recessed portion 8 via the return opening 25 as indicated by an arrow A4. Because of this, the air flow guided from the suction opening 6 to the first air inhaling path 11 contains ions. In this way, it is possible to perform the germ removal and deodorization of the dust collection vessel 31 and filter 33 of the dust collection portion 30.

[0055] Besides, in a case where the main body housing 2 reaches a circumferential edge of the cleaning area or collides with an obstacle in the traveling path, the drive wheels 29 are stopped. And, both drive wheels 29 rotate in directions opposite to each other, and the main body housing 2 rotates about the center line C to change its direction. In this way, it is possible to make the main body housing 2 move by itself in the entire cleaning area and move by itself avoiding the obstacle. In the meantime, it is also possible to make the main body housing 2 move backward by rotating backward both drive wheels 29 that are rotating forward so far.

[0056] If the main body housing 2 stops suddenly before a step of a downward stairway or the like when moving forward and backward, the center of gravity shifts back and forth. Here, the weight of the main body housing 2 is balanced and distributed in front of and behind the drive wheels 29; accordingly, the fall of the main body housing 2 is prevented. Besides, the dust collection portion 30 is disposed over the rotary shaft 29a of the drive wheels 29; accordingly, even if the weight becomes large because of the dust collection, the weight balance of the main body housing 2 is kept.

[0057] When the cleaning ends, the main body housing 2 moves by itself and returns to the charge stand 40. In this way, the charge terminals 4 come into contact with the terminal portions 41 to charge the battery 14.

[0058] Besides, when the main body housing 2 is in the return state, it is possible, by setting, to drive the electric fan

22 and the ion generation apparatus 28 during the charge and after the charge ends. In this way, the air flow containing the ions is sent out upward and backward from the air exhaling opening 7. The charge terminals 4 are disposed at the rear end of the main body housing 2; accordingly, the air flow containing the ions flows toward the charge stand 40 and ascends along the side wall S. This air flow flows along a ceiling wall and side walls opposite to each other of the room.

Accordingly, the ions spread throughout the room and can improve the germ removal and deodorization effects.

[0059] According to the present invention, the electric fan 22 is disposed on one side and the battery 14 is disposed on the other side with respect to the dust collection portion 30 that is disposed over the rotary shaft 29a of the drive wheels 29; accordingly, the weight of the main body housing 2 is balanced and distributed in front of and behind the drive wheels 29. In this way, even if the main body housing 2 moving forward and backward stops suddenly before the step and the center of gravity shifts back and forth, it is possible to keep an attitude and prevent the fall of the main body housing 2. Besides, even if the weight of the dust collection portion 30 becomes large because of the dust collection, the weight balance of the main body housing 2 is kept, so that it is possible to prevent more surely the fall of the main body housing 2 from the step.

[0060] Besides, the rotary shaft 29a of the drive wheels 29 may be deviated from the center line C of the main body housing 2 and disposed; however, it is more desirable that the rotary shaft 29a is disposed on the center line C as in the present embodiment. In this way, the weight of the main body housing 2 is balanced and distributed in front of and behind the center, so that it is possible to prevent more surely the fall of the main body housing 2 from the step.

[0061] Besides, the rotary shaft 9 disposed at the suction opening formed in front of the drive wheels 29, the rear wheel 26 disposed behind the drive wheels 29, and the drive wheels 29 contact the floor surface and the main body housing 2 move by itself on the floor surface F; accordingly, the dust in front in the traveling path can be guided to the suction opening 6 without being blocked. If the main body housing 2 moves forward and stops suddenly, the center of gravity of the main body housing 2 shifts forward, and the rotary brush 9 is deformed, so that the main body housing 2 is inclined forward. Here, the weight of the main body housing 2 is distributed back and forth; accordingly, the main body housing 2 returns to the original attitude. Accordingly, even if the main body housing 2 loses its foothold in front of the suction opening 6 and is easily inclined forward at the sudden stop, it is possible to prevent the fall from the step.

[0062] Besides, the control board 15 is disposed on the same side as the battery 14 with respect to the dust collection portion 30; accordingly, by disposing the heavy-weight electric fan 22 in front and disposing the control board 15 and the battery 14 behind, it is possible to obtain a better weight balance in front of and behind the drive wheels 29. Accordingly, it is possible to prevent more surely the fall of the main body housing 2 from the step.

[0063] Besides, the air flow paths (first and second air inhaling paths 11, 12 and first and second air exhaling paths 24a, 24b) are disposed in front of the dust collection portion 30, and the control board 15 is disposed behind the dust collection portion 30. Because of this, the air flow paths and the control board 15 are gathered and disposed. In this way, it is possible to shorten the air flow paths and achieve the small size of the main body housing 2 by reducing the wirings and the like. Besides, the air flow paths are far from the control board 15; accordingly, even if the air flow leaks, it is possible to alleviate the dust adhering to the control board 15 and to reduce the malfunction of the control circuit.

[0064] Besides, the dust collection chamber 39 extends in one direction to partition the inside of the main body housing 2a; accordingly, it is possible to easily isolate the air flow paths from the control board 15. Besides, the first and second air inhaling paths 11, 12 are disposed through the front wall of the dust collection chamber 39 that extends in the longitudinal direction, while the other wall surfaces are closed. In this way, even if an air flow leak occurs through the flow-in opening 34a and flow-out opening 35a, the dust is confined in the dust collection chamber 39. Accordingly, it is possible to further prevent adhering of the dust to the control board 15.

[0065] Besides, the dust collection vessel 31 is provided with the flow-in opening 34a, and the upper cover 32 having the filter 33 is provided with the flow-out opening 35a; accordingly, by opening the upper cover 32, it is possible to easily dump the dust accumulated in the dust collection vessel 31.

[0066] Besides, the opening surfaces of the flow-in opening 34a and flow-out opening 35a are formed to have the inclined surface, and the packing is disposed on the circumferential rims of the opening surfaces; accordingly, it is possible to prevent the packing from being deteriorated by the sliding when the dust collection portion 30 is put in and taken out.

[0067] In the present embodiment, the electric fan 22 is disposed in front of the dust collection portion 30, and the battery 14 and the control board 15 are disposed behind the dust collection portion 30; however, the electric fan 22 may be disposed on one side and the battery 14 and the control board 15 may be disposed on the other side with respect to the dust collection portion 30.

[0068] Besides, the air flow paths are disposed in front of the dust collection portion 30 and the control board 15 is disposed behind the dust collection portion 30; however, the air flow paths may be disposed on one side and the control board 15 may be disposed on the other side with respect to the dust collection portion 30.

Industrial Applicability

[0069] The present invention is usable for a cleaning robot that moves by itself on a floor surface.

5 **Reference Signs List**

[0070]

	1	cleaning robot
10	2	main body housing
	3	lid portion
	4	charge terminal
	6	suction opening
	7	air exhaling opening
15	8	recessed portion
	9	rotary brush
	10	side brush
	11	first air inhaling path
	12	second air inhaling path
20	14	battery
	15	control board
	18, 19	floor surface detection sensors
	20	motor unit
	21	housing
25	22	electric fan
	23	opening portion
	24a	first air exhaling path
	24b	second air exhaling path
	25	return opening
30	28	ion generation apparatus
	29	drive wheel
	30	dust collection portion
	31	dust collection vessel
	32	upper cover
35	33	filter
	34	flow-in path
	35	flow-out path
	40	charge stand
40	41	terminal portion

Claims

45 **1.** A cleaning robot comprising:

a main body housing that is provided with a suction opening and an air exhaling opening;
 a pair of drive wheels that have a horizontal rotary shaft and allows the main body housing to move by itself;
 an electric fan that is disposed in the main body housing;
 a dust collection portion that is disposed on the rotary shaft and collects dust of an air flow which is sucked from
 50 the suction opening because of driving of the electric fan; and
 a battery that supplies electric power to each portion; wherein
 the electric fan is disposed on one side of the dust collection portion and the battery is disposed on another
 side of the dust collection portion.

55 **2.** The cleaning robot according to claim 1, wherein
 the rotary shaft is disposed on a center line of the main body housing.

3. The cleaning robot according to claim 2, further comprising:

a rotary brush that is disposed at the suction opening arranged in front of the drive wheels; and
a rear wheel that is disposed behind the drive wheels; wherein
the rotary brush, the drive wheels and the rear wheel contact a floor surface, so that the main body housing
moves by itself on a floor surface.

4. The cleaning robot according to any one of claim 1 to claim 3, further comprising:

a control board that controls each portion; wherein
the control board is disposed on the same side as the battery with respect to the dust collection portion.

5. The cleaning robot according to claim 4, further comprising:

an air flow path that connects the suction opening with the dust collection portion, and connects the dust collection
portion with the air exhaling opening; wherein
the air flow path is disposed on one side with respect to the dust collection portion.

6. A cleaning robot comprising:

a main body housing that is provided with a suction opening disposed through a lower surface and an air exhaling
opening disposed through an upper surface and moves by itself on a floor surface;
an electric fan that is disposed in the main body housing;
a dust collection portion that collects dust of an air flow which is sucked from the suction opening because of
driving of the electric fan;
an air flow path that connects the suction opening with the dust collection portion, and connects the dust collection
portion with the air exhaling opening; and
a control board that controls each portion; wherein
the air flow path is disposed on one side of the dust collection portion and the control board is disposed on
another side of the dust collection portion.

7. The cleaning robot according to claim 6, further comprising:

a dust collection chamber that houses the dust collection portion in a freely mountable and demountable manner
and extends in a direction to partition an inside of the main body housing; wherein
a wall surface, which extends in a longitudinal direction of the dust collection chamber, is provided with a first
air inhaling path through which the air flow flows in and a second air inhaling path through which the air flow
flows out; and
another wall surface of the dust collection chamber is closed.

8. The cleaning robot according to claim 7, wherein
the dust collection portion includes:

a dust collection vessel which is provided with an air flow-in opening and in which the dust accumulates;
an upper cover which opens and closes an upper surface of the dust collection vessel and is provided with an
air flow-out opening; and
a filter which is disposed on a lower surface of the upper cover and collects the dust.

9. The cleaning robot according to claim 8, wherein
opening surfaces of the air flow-in opening and air flow-out opening include an inclined surface; and
a packing is disposed on circumferential rims of the opening surfaces.

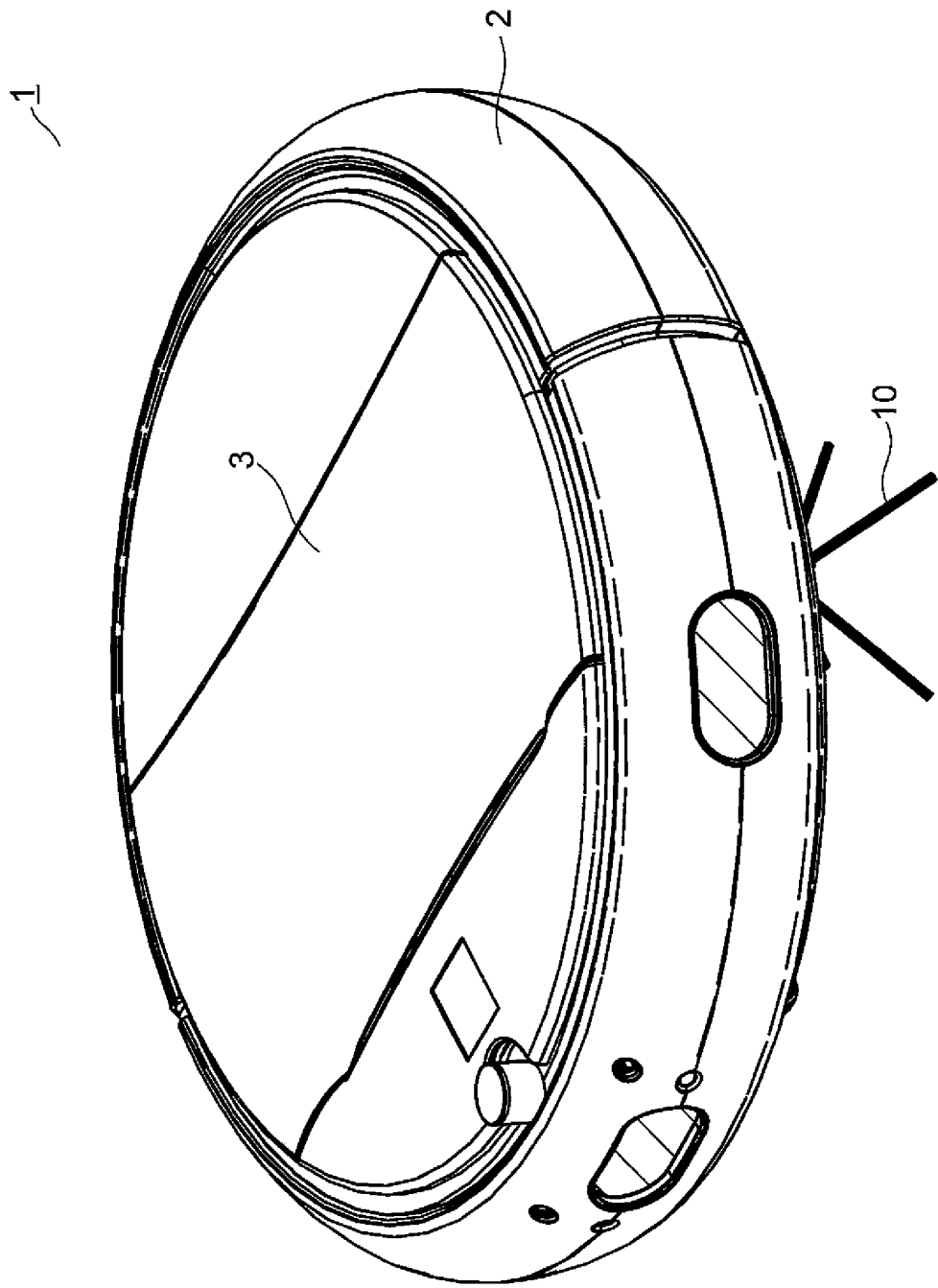


FIG.1

FIG.2

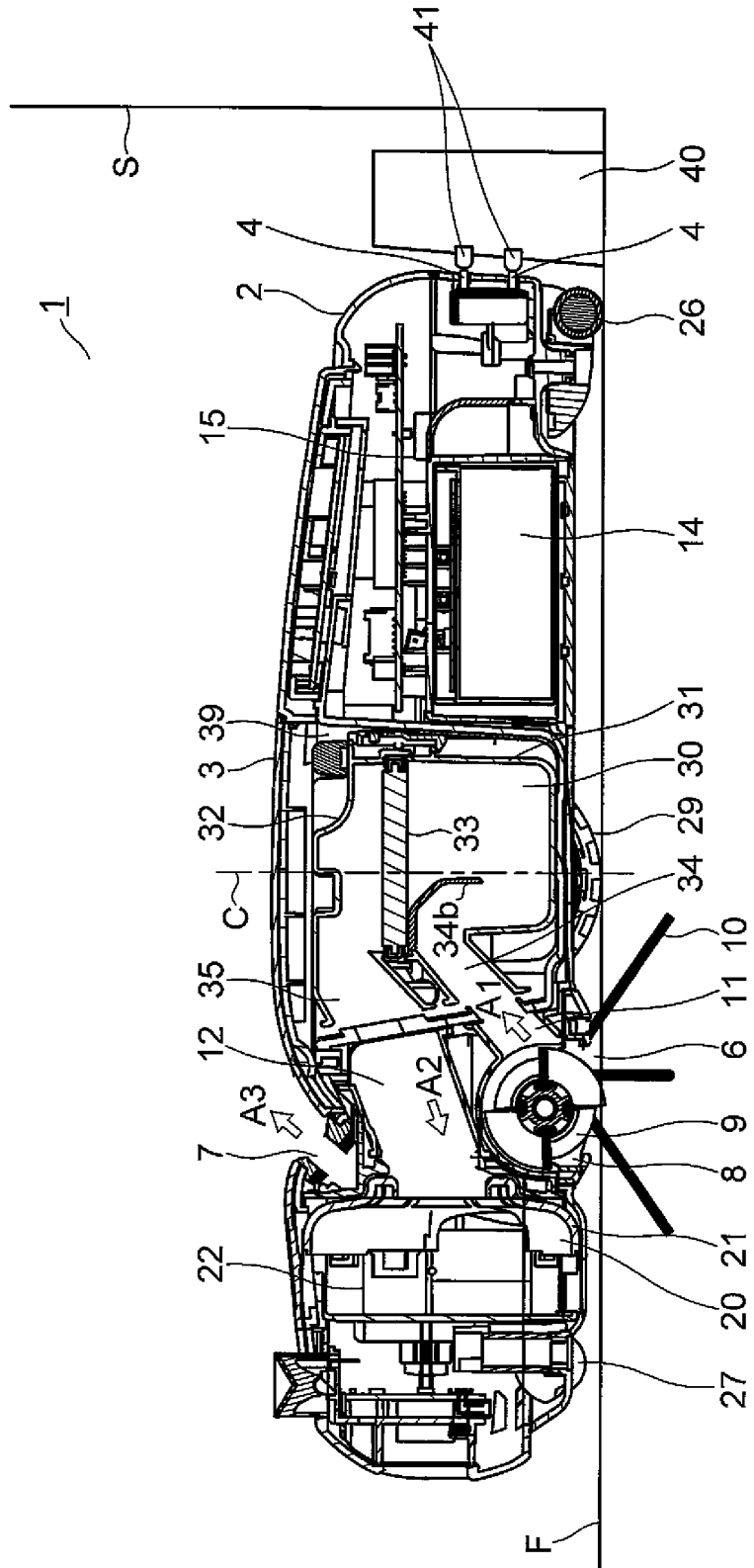


FIG.3

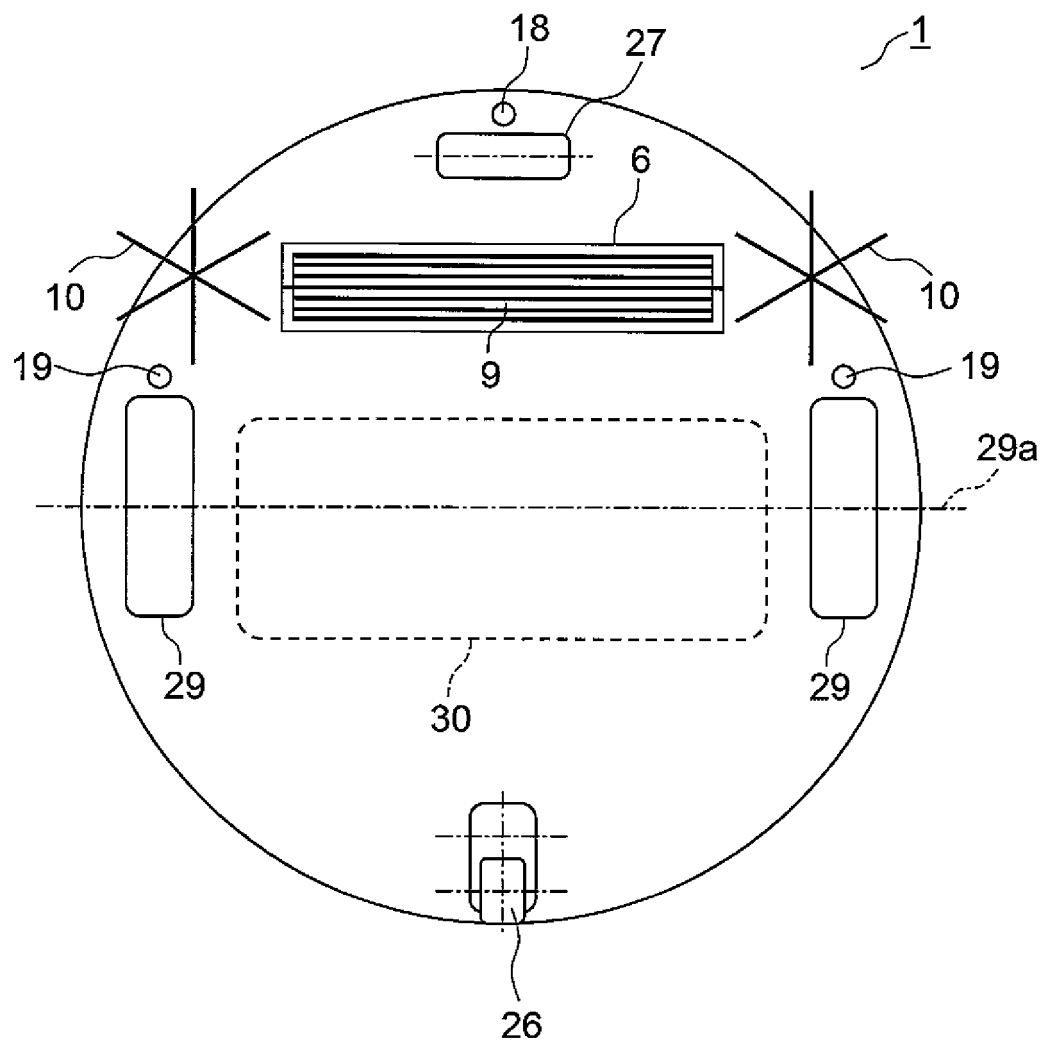


FIG.4

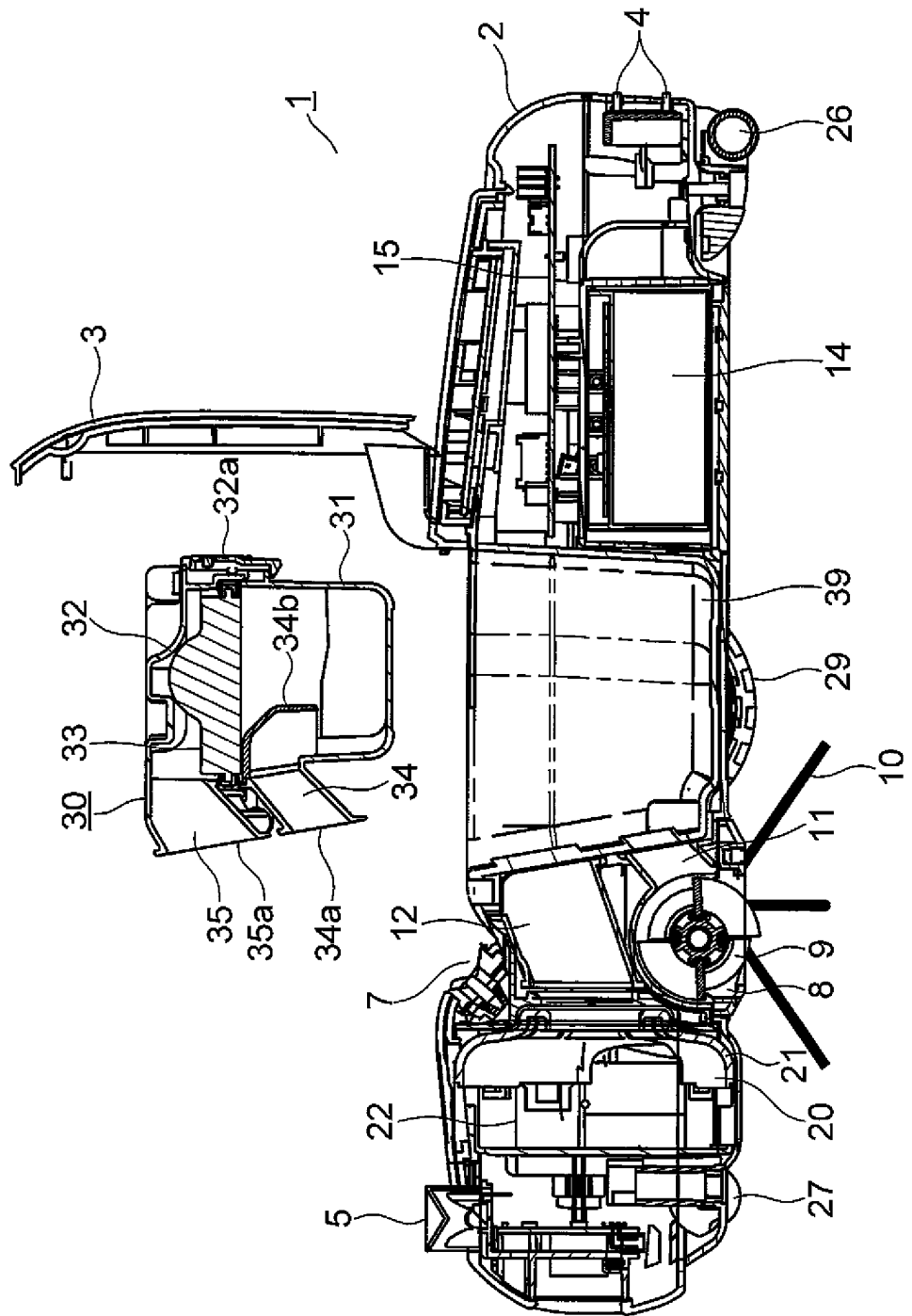


FIG.5

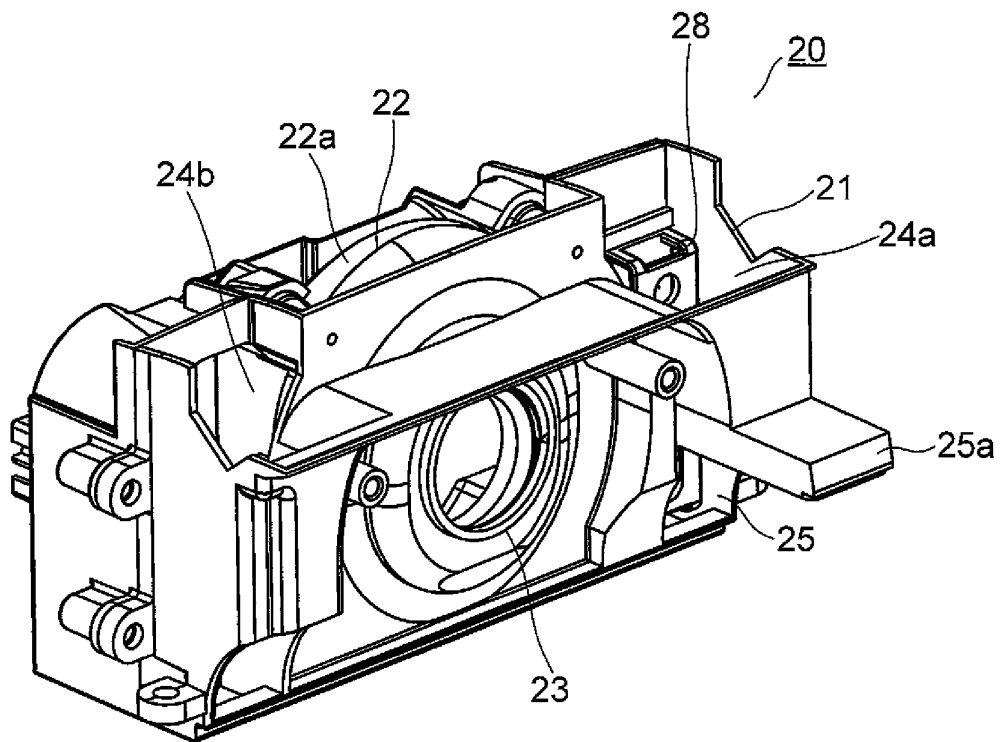


FIG.6

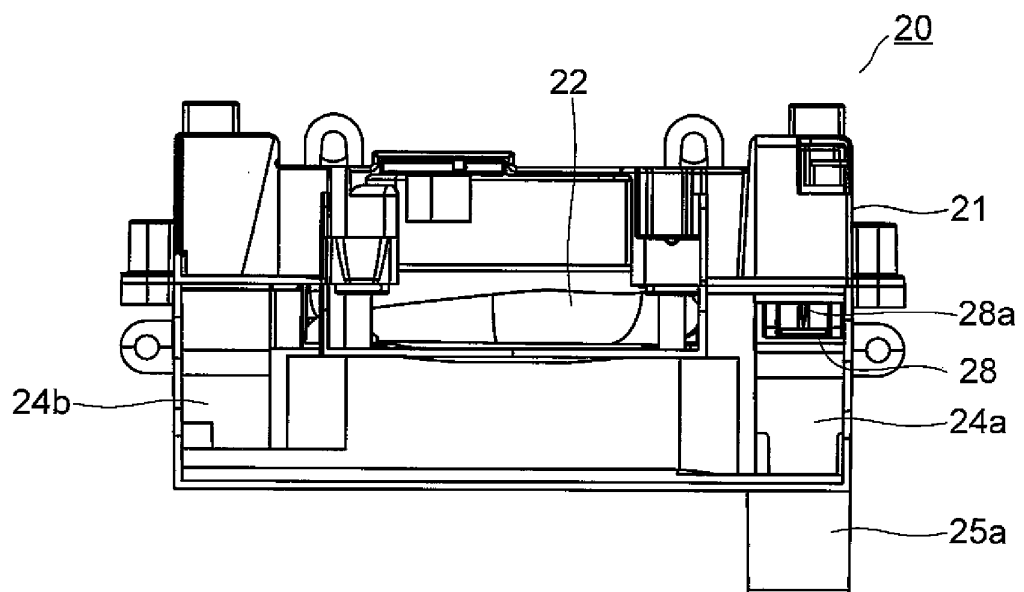


FIG.7

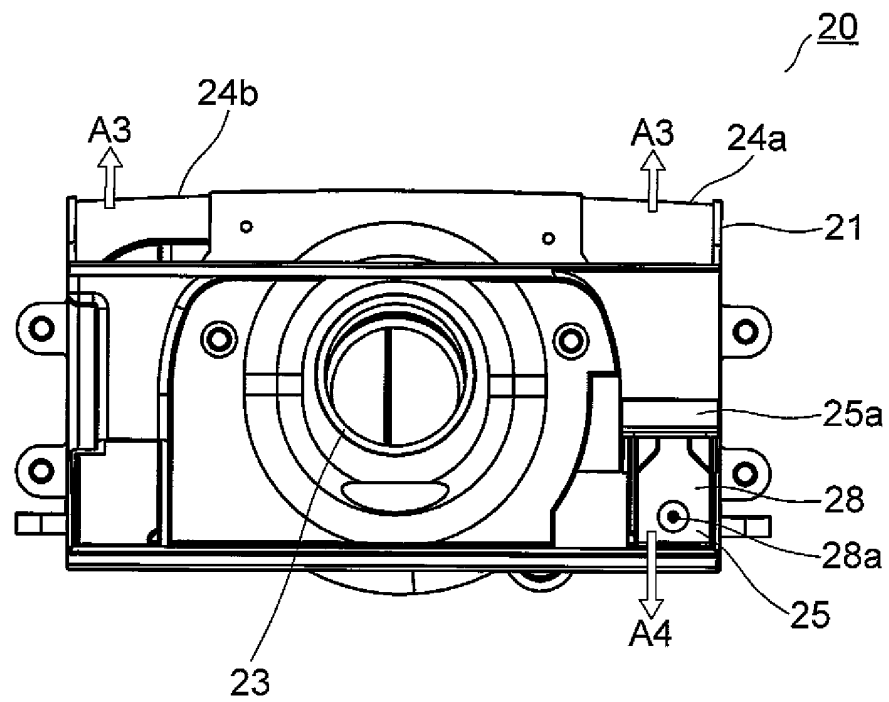
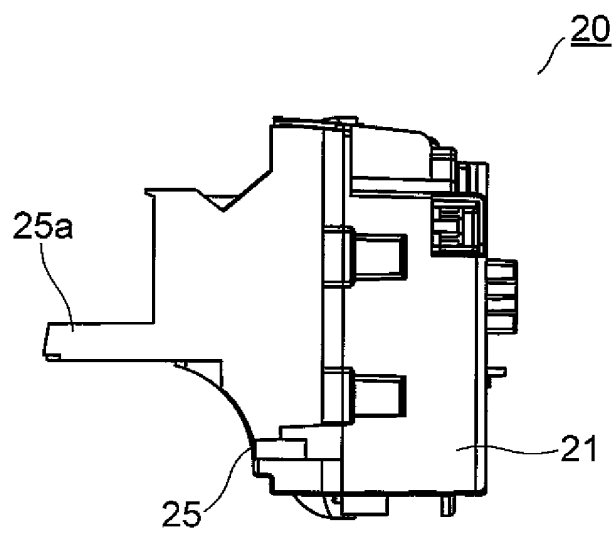


FIG.8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/071945

A. CLASSIFICATION OF SUBJECT MATTER

A47L9/28(2006.01) i, A47L9/00(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)

A47L9/28, A47L9/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-57647 A (Hitachi Appliances, Inc.), 18 March 2010 (18.03.2010), (Family: none)	1-9
A	JP 2007-325701 A (Matsushita Electric Industrial Co., Ltd.), 20 December 2007 (20.12.2007), (Family: none)	1-9
A	JP 2007-275361 A (Toshiba Battery Co., Ltd.), 25 October 2007 (25.10.2007), (Family: none)	1-9
A	JP 4268911 B2 (Hitachi Appliances, Inc.), 27 May 2009 (27.05.2009), (Family: none)	1-9

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

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Date of the actual completion of the international search
19 November, 2012 (19.11.12)Date of mailing of the international search report
04 December, 2012 (04.12.12)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/071945

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 2006-204758 A (Toshiba Tec Corp.), 10 August 2006 (10.08.2006), (Family: none)	1-9
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REFERENCES CITED IN THE DESCRIPTION

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