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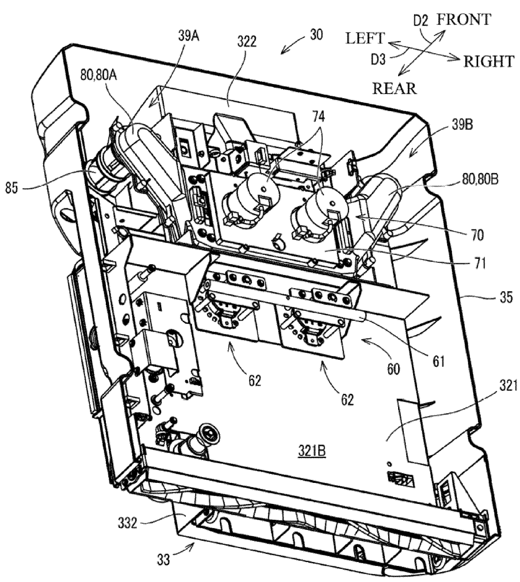
(54) **CLEANING APPARATUS**

(57) Provided is a cleaning apparatus that can reduce the force of an air flow to be discharged to the outside. A cleaning apparatus (10) includes an apparatus body (11) and a cleaning unit (30). The cleaning unit (30) includes an intake nozzle (33), an intake unit (70) that sucks in objects, along with air, from the surface to be cleaned through intake nozzle (33), a collection box (31) that separates objects that are sucked in and collects the separated objects in its inside, an air discharge duct (80) that guides air sucked in by the intake unit (70) to the inside of the cleaning unit (30), and a cover (35) that covers at least the air discharge duct (80), and forms an internal space with the air discharge duct (80).

FIG. 8



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Description

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims priority to Japanese Patent Application No. 2021-036026 filed March 8, 2021, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present invention relates to a cleaning apparatus that cleans a surface to be cleaned while moving on the surface to be cleaned.

BACKGROUND

[0003] Heretofore, autonomously moving cleaning apparatuses referred to as cleaning robots are known. This type of cleaning apparatus cleans a surface to be cleaned by sucking in dust (objects to be sucked in) from the surface to be cleaned along with taking air using an intake fan through a suction port of an intake nozzle oriented toward the surface, while moving on the surface such as a floor surface. The dust that is sucked in is guided to a dust collection box attached to the cleaning apparatus, separated from air by a filter inside the dust collection box, and collected in the collection box. The air from which dust is removed is discharged to the outside through an air discharge duct.

[0004] A known cleaning robot is configured such that an intake fan is provided in an apparatus body and a cleaning unit attached to a back face of the apparatus body is connected to the intake fan by a hose. In this configuration, the air passed through the intake fan is discharged to the outside from an outlet provided in the apparatus body through an air discharge duct that extends from the air outlet of the intake fan to the outlet.

[0005] Note that cleaners are known that include a circulation structure for circulating the air to be discharged inside the apparatus bodies by returning the air to intake nozzles.

[0006] JP 7-222696B is an example of the related art.

[0007] However, the cleaner described in JP 7-222696B is configured such that the air to be discharged is returned to the intake nozzle, and therefore a sufficient suction force cannot be obtained.

[0008] On the other hand, in the aforementioned known autonomously moving cleaning apparatus, the air discharge duct is provided inside the apparatus body, and therefore the air discharge duct needs to be laid out by bypassing other devices that are mounted inside the apparatus body, such as a control unit, a movement unit, a battery, a power supply unit, a motor, and a sensor. Therefore, the duct length increases, and the flow channel resistance also increases, and as a result, the suction force of the intake fan may decrease. Although the flow channel resistance can be reduced by increasing the inner diameter of the air discharge duct, the size of the apparatus body needs to be increased in order to provide the installation space of the air discharge duct, which hampers the reduction in size of the apparatus.

[0009] Also, when a configuration is adopted in which air is discharged from an outlet provided in the surface of the apparatus body, discharging air is sprayed around the cleaning robot, and therefore the discharging air is blown against persons in the vicinity, making those persons feel uncomfortable. Also, when the discharging air is blown against an object in the vicinity, the state of the object may change. Therefore, the suction force of the intake nozzle cannot be increased by increasing the blasting force of the intake fan. Also, discharging air may contain fine particle substances that are not removed by a filter, and therefore, if the discharging air is forcefully blasted out to the outside, fine particle substances are scattered around the apparatus.

[0010] Also, when the configuration is such that air is discharged to the outside from the outlet provided in a bottom face of the apparatus body, dust on the surface to be cleaned is scattered, and the cleaning efficiency may degrade.

[0011] An object of the present invention is to provide a cleaning apparatus in which the force of the discharging air flow to the outside can be reduced.

SUMMARY

[0012] (1) A cleaning apparatus according to one aspect of the present invention includes: a moving body configured to move on a surface to be cleaned in a moving direction; and a cleaning unit that is provided in the moving body and is configured to clean the surface to be cleaned. The cleaning unit includes an intake nozzle; an intake unit configured to suck in objects, along with air, from the surface to be cleaned through the intake nozzle; a collection container configured to separate the objects that are sucked in and collect the objects in its inside; an air discharge duct configured to guide air sucked in by the intake unit from an air outlet of the intake unit to an internal space sideward (i.e. on the side) of the collection container; and a cover member that covers at least the air discharge duct, and is configured to form the internal space with the air discharge duct.

[0013] As a result of this configuration, the air sucked in by the intake unit from the collection container passes through the air discharge duct and is discharged to an internal space of the cleaning unit. The internal space functions as a buffer chamber for reducing the force of the discharging air flow. Therefore, when air is discharged to the internal space, the force of the discharging air flow is reduced. Also, the force of the discharging air flow to the internal space is also reduced by collision with an inner face of the cover member. The air flow whose force has been reduced moves toward every corner of the internal space while the force thereof is being further reduced, and is finally gently discharged to the outside through gaps of attachment portions such as the cleaning unit and the cover member. Accordingly, the influence of the discharging air to the surrounding area of the cleaning apparatus can be minimized. Also, scattering of dust on the floor surface, and scattering of fine particle substances can be reduced. Also, air is discharged to the inside of the cleaning unit instead of the inside of the moving body, and therefore discharging air is not blown against electronic devices such as a control unit and electronic components that are provided inside the moving body, and as a result, malfunction, failure, or the like of the electronic devices due to discharging air being blown against them can be prevented.

[0014] (2) In the cleaning apparatus of the present invention, the cleaning unit is attached to a back face of the moving body. The intake unit sucks in air inside the collection container through an outlet provided in an upper portion of a front face of the collection container on the moving direction side. The air discharge duct forms a discharging air flow channel extending from the air outlet of the intake unit to an internal space sideward of the collection container.

[0015] As a result of this configuration, air can be guided to a relatively large space that is formed sideward of the collection container. As a result, the force of the discharging air flow can be effectively reduced.

[0016] (3) In the cleaning apparatus of the present invention, the cleaning unit further includes a distribution duct that is attached to an outlet of the air discharge duct and is configured to distribute a discharging air flow from the outlet into a plurality of air flows toward the internal space.

[0017] As a result of this distribution duct being provided, the discharging air flow is distributed into a plurality of flow channels. Accordingly, the force of the discharging air flow to the internal space is further reduced.

[0018] (4) In the cleaning apparatus of the present invention, the distribution duct has a tubular shape whose inside is hollow, and includes a plurality of opening portions in its outer circumferential surface.

[0019] (5) In the cleaning apparatus of the present invention, the plurality of opening portions are formed in portions, of the outer circumferential surface, that oppose an inner face of the cover member.

[0020] As a result of this configuration, the air flow discharged from the opening portions collides with the inner face of the cover member, and therefore the air flow is further distributed due to collision.

[0021] (6) The collection container is arranged at the center, in a width direction, of a back face of the moving body. The intake unit includes a first air outlet provided in a side face of its casing on one side in the width direction, and a second air outlet provided in a side face on the other side. The air discharge duct includes a first air discharge duct and a second air discharge duct. The first air discharge duct forms a first discharging air flow channel extending from the first air outlet to a space formed between the cover member and an upper portion of a first side face of the collection container on the one side. The second air discharge duct forms a second discharging air flow channel extending from the second air outlet to a space formed between the cover member and an upper portion of a second side face of the collection container on the other side.

[0022] As a result of this configuration, the air sucked in by the intake unit is distributed into two air flows that are guided to the internal spaces formed on both sides in the width direction. Accordingly, the force of the discharging air flow in the internal space can be further reduced.

[0023] (7) The cleaning apparatus according to the present invention further includes a driving force transmission unit configured to move the moving body by transmitting a driving force in the moving direction to the surface to be cleaned.

[0024] As a result of this configuration, the cleaning apparatus can move autonomously.

[0025] According to the present invention, the force of discharging air flow to the outside can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a perspective view illustrating an exterior appearance, taken from the front, of a cleaning apparatus according to an embodiment of the present invention.

FIG. 2 is a schematic diagram illustrating an internal configuration of the cleaning apparatus.

FIG. 3 is a perspective view illustrating an exterior appearance, taken from the rear side, of the cleaning apparatus.

FIG. 4 is a perspective view illustrating a state in which a collection box is removed in the perspective view in FIG. 3.

FIG. 5 is a partial enlarged view illustrating a state in which a back face cover is removed in the perspective view in FIG. 4, and shows an internal structure of a cleaning unit.

FIGS. 6A and 6B are side views of a rear portion of the cleaning apparatus, FIG. 6A is a diagram illustrating a state in which the collection box of the cleaning apparatus is attached, and FIG. 6B is a diagram illustrating a state in which the collection box of the cleaning apparatus has been removed.

FIG. 7 is a perspective view of the cleaning unit when viewed from the front, and shows an internal configuration of the cleaning unit.

FIG. 8 is a perspective view of the cleaning unit when viewed from the front, and shows the internal configuration of the cleaning unit.

FIG. 9 is a perspective view of an intake unit included in the cleaning apparatus when viewed from the rear.

FIG. 10 is a perspective view of the intake unit included in the cleaning apparatus when viewed from the front.

FIG. 11 is an enlarged perspective view illustrating a distribution duct included in the intake unit.

FIG. 12 is a cross-sectional view schematically illustrating a cross section structure obtained by horizontally sectioning an upper portion of the cleaning unit.

DETAILED DESCRIPTION

[0027] Hereinafter, an embodiment of the present invention will be described with reference to the drawings. Note that the following embodiment is merely a specific example of the present invention, and is not intended to limit the scope of the present invention. Note that a vertical direction D1, a front-back direction D2, and a horizontal direction or a width direction D3 that are shown in the drawings are used.

Cleaning apparatus 10

[0028] FIG. 1 is a perspective view illustrating an exterior appearance, taken from the front, of an autonomously moving cleaning apparatus 10 (an example of a cleaning apparatus of the present invention) according to an embodiment of the present invention. FIG. 2 is a schematic diagram illustrating an internal configuration of the cleaning apparatus 10.

[0029] The cleaning apparatus 10 shown in FIG. 1 is an autonomous moving apparatus that autonomously moves forward (in a moving direction) of a floor surface 23 (see FIG. 2) of a concourse of an airport, a station, a shopping mall, or the like, and is also referred to as a mobile robot. The cleaning apparatus 10 sucks up waste matters (objects to be sucked in) such as dust and filth on the floor surface 23, which is a surface to be cleaned, while moving autonomously, separates the waste matters using a filter, and collects the waste matters in a collection box 31 (see FIG. 2). The cleaning apparatus 10 automatically cleans the floor surface 23 while moving on the floor surface 23 based on various types of cleaning information such as a moving route, a cleaning area, a cleaning time slot, or a home position to which the cleaning apparatus 10 returns for charging.

[0030] Note that the cleaning apparatus 10 is merely an example of a cleaning apparatus of the present invention, and the present invention can also be applied to a cleaning apparatus that cleans an indoor floor surface 23 while autonomously moving thereon, a cleaning apparatus that cleans road surfaces of an outdoor footway and a road while autonomously moving thereon, and the like. Also, the cleaning apparatus 10 need only be an autonomously moving mobile robot that has at least a cleaning function, and is not limited to a cleaning apparatus 10 that has only a cleaning function. For example, the present invention may also be applied to an autonomously moving mobile robot that has other functions for the purpose of other applications, in addition to the cleaning function. For example, the present invention can also be applied to autonomously moving apparatuses such as a mobile robot that has a guarding function while autonomously moving, a mobile robot that has a caretaking function, a mobile robot that has a load carriage function, and a mobile robot that has a display and guide function, in addition to the cleaning function. Also, the present invention can also be applied to a manual type cleaning apparatus that cleans a floor surface 23 while being moved by manual pushing by a worker, for example, in addition to mobile robots that move autonomously.

[0031] As shown in FIG. 2, the cleaning apparatus 10 includes an apparatus body 11, which is an example of a moving body, and a cleaning unit 30 provided in the apparatus body 11. The apparatus body 11 is provided with a moving unit 12 (an example of a driving force transmission unit of the present invention), motors 13, a battery 14, a console unit 20, a display panel 21, an operating handle 22, a control unit 40, and the like. The cleaning apparatus 10 also includes a sliding mechanism 50 (see FIG. 2) that supports the cleaning unit 30 so that it is movable in the vertical direction D1, and a position adjustment mechanism 60 (see FIG. 7) that can adjust the height position of the cleaning unit 30, and keeps the cleaning unit 30 at the adjusted position.

[0032] As shown in FIG. 1, the apparatus body 11 includes an exterior cover 11A that constitutes the exterior thereof. Also, as shown in FIG. 2, the apparatus body 11 includes a chassis 11B in its lower portion. The chassis 11B is provided substantially in parallel to the floor surface 23. Also, support frames for supporting the aforementioned functional units are provided, as appropriate, inside the apparatus body 11.

[0033] The apparatus body 11 is configured to move on the floor surface 23, which is a surface to be cleaned, in a predetermined moving direction. In the present embodiment, the apparatus body 11 can move using the moving unit 12. As shown in FIG. 2, the moving unit 12 is provided in a lower portion of the apparatus body 11. The moving unit 12 is for transmitting the driving force, in the moving direction, to the floor surface 23 while keeping the moving posture of the apparatus body 11, and is attached to the chassis 11B. The moving unit 12 includes a pair of wheels 121 for movement and four casters 122.

[0034] The wheels 121 are attached rotatably on both sides of the chassis 11B in the horizontal direction D3 (width direction), at the center in the front-back direction. The four casters 122 are for keeping the moving posture of the apparatus body 11, and are attached rotatably on both sides at the forward end of the chassis 11B, and on both sides at the rear end of the chassis 11B. The outer circumferential surfaces of the wheels 121 and the casters 122 are supported by the floor surface 23 in a state in which the cleaning apparatus 10 is placed on the floor surface 23. Accordingly, the apparatus body 11 is kept in the moving posture, as shown in FIGS. 1 and 2.

[0035] Rotating shafts of the wheels 121 are respectively connected to output shafts of the motors 13 via transmission mechanisms such as reduction gears.

Therefore, when the motors 13 are driven, and rotational driving forces are output from the output shafts, the rotational driving forces of the motors 13 are transmitted to the wheels 121. In the present embodiment, the motors 13 are provided individually to the two wheels 121. Therefore, the rotating speeds of the wheels 121 are controlled by individually controlling the driving of the motors 13. For example, when the rotating speeds of the wheels 121 are controlled to be the same, the cleaning apparatus 10 moves straight, and when the rotating speeds of the wheels 121 are controlled to be different, the cleaning apparatus 10 turns to the side of the wheel 121 that rotates more slowly.

[0036] The battery 14 is provided in a central portion of the apparatus body 11. The battery 14 supplies driving power to the motors 13 and motors 74 of intake fans 72 of an intake unit 70 (see FIG. 10), which will be described later.

[0037] The console unit 20 is provided in an upper portion of the apparatus body 11. The console unit 20 is attached to the exterior cover 11A. The console unit 20 is a device to be operated by a worker, and is a terminal apparatus including a touch panel on which a touch operation can be performed, for example. Various types of registration information (information such as a moving route, a cleaning area, a cleaning time slot, and home position information) for the cleaning apparatus 10 can be input through the console unit 20. The input registration information is transferred to the control unit 40, and is used for movement control performed by the control unit 40.

[0038] The display panel 21 is provided in a front face of the apparatus body 11. The display panel 21 is a liquid crystal panel, for example. Various types of announcement information are displayed in the display panel 21 by the control unit 40 while cleaning is performed. The announcement information is information indicating the fact that cleaning is underway, guidance information regarding the floor on which cleaning is performed, and the like.

[0039] The operating handle 22 is provided in an uppermost portion of a back face of the apparatus body 11. The operating handle 22 is an operation member that is held by a worker when the worker performs cleaning by manually operating the cleaning apparatus 10, or when the worker performs a teaching operation (instructing operation) for instructing the moving route to the cleaning apparatus 10. The operating handle 22 is provided with various operation buttons for receiving driving operations from a worker. Information regarding operations performed on the operation buttons is transferred to the control unit 40, and is used for movement control performed by the control unit 40.

[0040] As shown in FIG. 2, the control unit 40 is provided in the upper portion of the apparatus body 11. The control unit 40 controls movement of the cleaning apparatus 10, driving of the motors 74 of the intake unit 70, screen display of the display panel 21, and the like. The control unit 40 includes a control board (control circuit board) in which control devices such as a CPU, a ROM, and a RAM are mounted on a circuit board, storage devices such as an HDD and a flash memory, a GPS receiver, and the like. The CPU is a processor that executes various types of computational processes. The ROM is a nonvolatile memory in which control programs such as a BIOS and an OS for causing the CPU to execute various types of processes are stored in advance. The RAM is a volatile or nonvolatile memory for storing various types of information, and is used as a temporary memory (work area) for the various types of processes to be executed by the CPU. The control unit 40 controls movement of the cleaning apparatus 10, driving of the motors 74 of the intake fans 72, screen display of the display panel 21 and the like by causing the CPU to execute the various types of control programs that are stored in the ROM or a storage apparatus in advance.

Cleaning unit 30

[0041] FIG. 3 is a perspective view illustrating an exterior appearance of, taken from the rear side, the cleaning apparatus 10. As shown in FIGS. 2 and 3, the cleaning unit 30 is provided on the back face of the apparatus body 11. The cleaning unit 30 is supported by a back face frame 11C included in the apparatus body 11 via the sliding mechanism 50 and is movable in the vertical direction D1.

[0042] The cleaning unit 30 includes a collection box 31 (an example of a collection container of the present invention), a support holder 32, an intake nozzle 33, an extension nozzle 34 (see FIG. 3), the intake unit 70 (an example of an intake unit of the present invention), an air discharge duct 80, and a cover 35 (an example of a cover member of the present invention).

[0043] The support holder 32 is provided on the back face of the apparatus body 11. The support holder 32 is a supporting member that supports the collection box 31 such that the collection box 31 can be attached and removed. The collection box 31 is attached to the support holder 32 and is removable.

[0044] FIG. 4 is a perspective view illustrating a state in which the collection box 31 is removed from the support holder 32, and FIG. 5 is a partial enlarged view illustrating a state in which the cover 35 is removed in the perspective view in FIG. 4.

[0045] As shown in FIGS. 4 and 5, a housing portion 322 that can accommodate the collection box 31 is provided at the center, with respect to the horizontal direction D3 (width direction), of the support holder 32. The collection box 31 can be attached to the housing portion 322. That is, the collection box 31 is arranged at the center, with respect to the width direction D3, of the back face of the apparatus body 11.

[0046] The cover 35 is attached to the support holder 32. As a result of the cover 35 being attached to the support holder 32, components provided inside the cleaning unit 30 such as the air discharge duct 80 and a distribution duct 85, which will be described later, are covered, and an internal space is formed between the support holder 32 and an inner face of the cover 35.

[0047] In a state in which the cover 35 is attached to the support holder 32, the housing portion 322, together with the cover 35, forms a recessed housing space extending in the vertical direction D1. The collection box 31 is attached removably to the housing portion 322, and is accommodated in the recessed housing space of the housing portion 322 when it is attached to the housing portion 322.

[0048] As shown in FIG. 3, the intake nozzle 33 is provided in a lower portion of the support holder 32. In the present embodiment, the intake nozzle 33 is integrally formed with the support holder 32. Also, the extension nozzle 34 is provided in a side portion of the support holder 32.

[0049] The intake nozzle 33 is a portion for sucking up waste matters such as dust from the floor surface 23 along with air when the intake fans 72 operate. The intake nozzle 33 includes a suction port 331 at a position separated from the floor surface 23 upward by a gap ΔT. The intake nozzle 33 extends in the width direction D3, and is constituted by a rectangular tube-shaped outer circumferential wall 332 that protrude downward from an outer circumferential portion of a bottom plate 324 of a base portion 321.

[0050] An elastic sheet-like seal member 335 extending toward the floor surface 23 is provided on an edge portion, on the rear side, of the suction port 331 of the intake nozzle 33. The seal member 335 is rectangular and elongated in the width direction D3. The gap ΔT between the edge portion of the suction port 331 on the rear side and the floor surface 23 is closed by the seal member 335.

[0051] A pair of rotary brushes 26 (see FIG. 2) that are arranged side by side in the front-back direction D2 are rotatably provided in the intake nozzle 33. The rotary brushes 26 rotate by a rotational driving force of a motor (not illustrated) included in the cleaning unit 30, the driving force being transmitted via a transmission mechanism 39 such as belts and pulleys (see FIG. 5). As a result of the rotation of the rotary brushes 26 when the cleaning apparatus 10 moves, waste matters on the floor surface 23 can be collected well.

[0052] As shown in FIGS. 3 and 4, the extension nozzle 34 is provided on the left of the support holder 32, when the cleaning apparatus 10 is viewed from the front. The housing space 38 is provided on the left of the support holder 32, and the extension nozzle 34 can be housed in the housing space 38. The extension nozzle 34 is supported by the support holder 32 and is turnable. Specifically, the extension nozzle 34 is supported by the support holder 32 such that its orientation can be changed between a housed orientation (orientation shown in FIGS. 3 and 4) in which the extension nozzle 34 is housed in the housing space 38 and a side cleaning orientation (not illustrated) that is achieved by turning the extension nozzle 34 leftward from the housing space 38 and in which the floor surface 23 on the left of the apparatus body 11 can be cleaned.

[0053] As shown in FIG. 5, the support holder 32 is provided on the back face side of the cleaning apparatus 10. A plate-shaped back face frame 11C that extends upward from the rear end portion of the chassis 11B is provided inside the apparatus body 11. The support holder 32 is attached to the back face frame 11C. In the present embodiment, the support holder 32 is supported by the back face frame 11C of the apparatus body 11 and is movable in the vertical direction D1 by the sliding mechanism 50 (see FIG. 2). Accordingly, the cleaning unit 30 itself can be moved in the vertical direction D1. A known slide rail can be used as the sliding mechanism 50, for example.

[0054] The support holder 32 includes a plate-shaped base portion 321 extending in the vertical direction D1. The base portion 321 is attached to the back face frame 11C (see FIG. 2) via the sliding mechanism 50 (see FIG. 2).

[0055] The housing portion 322 is integrally formed in the base portion 321. The housing portion 322 is provided on a face 321A on the rear side of the base portion 321, and is arranged at the center, with respect to the width direction D3, of the base portion 321. The housing portion 322 includes a pair of side plates 322A and a retaining board 322B. The two side plates 322A are spaced apart from each other in the width direction D3 by a predetermined distance. The retaining board 322B, which extends in the width direction D3, is attached to the rear end portions of the lower portions of the side plates 322A. Also, a bottom plate 324 that forms an upper face of the intake nozzle 33 is provided in a lower portion of the base portion 321. The collection box 31 is housed in a housing space that is surrounded by the pair of side plates 322A, the retaining board 322B, and the bottom plate 324.

[0056] The rear side of the housing portion 322 is open in a state in which the cover 35 is attached, and the upper side is also open (see FIG. 4). Therefore, as shown in FIGS. 6A and 6B, the collection box 31 can be attached to or removed from the housing portion 322 from or to a region obliquely upward and rearward of the housing portion 322. Here, FIGS. 6A and 6B are side views of the rear portion of the cleaning apparatus 10, FIG. 6A shows a state in which the collection box 31 is housed in the housing portion 322, and FIG. 6B shows a state in which the collection box 31 is removed from the housing portion 322.

[0057] As shown in FIG. 4, two intake ports 73 are exposed in the support holder 32 in a state in which the collection box 31 is removed. The two intake ports 73 are through holes formed in the base portion 321, and function as inlets of a fan body 71 included in the intake unit 70, which will be described later. The two intake ports 73 are spaced apart from each other in the width direction D3 by a predetermined distance.

[0058] In the present embodiment, in a state in which the collection box 31 is attached to the housing portion 322, two outlets (not illustrated) provided in a side face on the front side (front face) of the collection box 31 are connected to the intake ports 73. Accordingly, the intake unit 70 is connected to the collection box 31 such that air can be sucked from the collection box 31.

[0059] An air filter for capturing and removing waste matters such as dust from the air discharged from the outlet is provided inside the collection box 31. In other words, the collection box 31 separates the dust or the like with this air filter. As a result, clean air is obtained. A chemical filter, a HEPA filter, an ULPA filter, or the like can be used as the air filter.

[0060] A rectangular opening 323 elongated in the width direction D3 is formed in a bottom face of the housing portion 322. The opening 323 is in communication with the intake nozzle 33, which will be described later. In a state in which the collection box 31 is attached to the housing portion 322, an inlet 311 provided in a bottom face of the collection box 31 is aligned to the opening 323. Accordingly, the intake nozzle 33 is brought into communication with the collection box 31. When air is sucked in by driving the intake fans 72, the pressure inside the collection box 31 decreases, and as a result, waste matters such as dust are sucked up through the intake nozzle 33 along with air. Then, the sucked up waste matters flow into the collection box 31 through the inlet 311, and are collected in the collection box 31.

Position adjustment mechanism 60

[0061] FIGS. 7 and 8 are perspective views when the cleaning unit 30 is viewed from the front, and the internal structure of the cleaning unit 30 is shown. As shown in FIGS. 7 and 8, the position adjustment mechanism 60 is broadly separated into a support shaft 61 provided in the apparatus body 11 and a dial unit 62 provided in the cleaning unit 30. Note that the support shaft 61 is shown in FIGS. 7 and 8 for the sake of description, but the support shaft 61 is not provided in the cleaning unit 30, but is a member provided in the apparatus body 11.

[0062] The support shaft 61 is a member for positioning the cleaning unit 30 to a cleaning position when cleaning is performed. Downward movement of the cleaning unit 30 from the cleaning position is restricted as a result of a rotating cam (not illustrated) included in the dial unit 62 engaging with the support shaft 61.

[0063] The support shaft 61 is a horizontal shaft member extending in the width direction D3, and is fixed to a support frame or the like of the apparatus body 11. As a result of the rotating cam included in the dial unit 62 being supported by an upper face of the support shaft 61, the cleaning unit 30 supported by the sliding mechanism 50 is kept at the cleaning position.

[0064] Two dial units 62 are provided in the cleaning unit 30. The two dial units 62 are attached to a bracket 325 that is fixed to a face 321B on the forward side of the base portion 321. The two dial units 62 are arranged side by side in the width direction D3.

[0065] The dial units 62 include adjustment dials 69 (see FIG. 5) that are provided on the face 321A of the base portion 321 and are rotatable. The rotating cams are attached to the rotating shafts of the adjustment dials 69. When the adjustment dials 69 are operated by a worker, the rotating cams rotate according to the directions and the amounts of operations performed on the adjustment dials 69. Accordingly, the cleaning unit 30 moves upward or downward according to the lift amounts at the cam faces that are in contact with the support shaft 61. Note that the adjustment dials 69 are locked to the position after adjustment by a lock mechanism, which is not illustrated.

Intake unit 70

[0066] The intake unit 70 is provided in an upper portion of the cleaning unit 30, and specifically is attached to the base portion 321 of the support holder 32. The intake unit 70 is for generating a suction force for causing air to be sucked in through the intake nozzle 33 of the cleaning unit 30, and sucks in waste matters such as dust (objects to be sucked in) from the floor surface 23 through the intake nozzle 33 along with air.

[0067] FIGS. 9 and 10 are perspective views of the intake unit 70. As shown in FIGS. 9 and 10, the intake unit 70 includes a fan body 71 including the intake fans 72 (72A, 72B), and the motors 74 (74A, 72B) for causing the intake fans 72 to rotate. The fan body 71 includes a rectangular box-shaped casing 711 that is elongate in the width direction D3, and the two intake fans 72 are rotatably supported inside the casing 711. The two intake fans 72 are arranged inside the casing 711, spaced apart from each other by a predetermined distance in the width direction D3.

[0068] The driving of the motors 74 is controlled by the control unit 40 provided in the apparatus body 11. As shown in FIG. 2, a portion of the fan body 71 on the forward side and the entirety of the motors 74 are brought into the inside of the apparatus body 11 through an opening (not illustrated) formed in the back face frame 11C, and therefore the air to be discharged from an air discharge duct 80, which will be described later, will not be blown against the motors 74 and the like.

[0069] The intake fans 72 are centrifugal fans or sirocco fans (multiblade fans) that blast air in a direction perpendicular to an intake direction D11, for example. The intake fans 72 are arranged such that their inlets face the intake ports 73. Rotation support portions are provided at the respective centers of the intake fans 72, and the output shafts of the motors 74 are attached to the respective rotation support portions. As shown in FIGS. 9 and 10, an intake fan 72A and a motor 74A that are arranged on the left side are coupled, and an intake fan 72B and a motor 74B that are arranged on the right side are coupled.

[0070] As shown in FIG. 9, a partition plate 712 for suppressing turbulent flows that are generated when the intake fans 72 are operated is provided between the two intake fans 72. The partition plate 712 is positioned at the center, with respect to the width direction, of the casing 711, and extends in the vertical direction D1.

[0071] An opening 713 is formed in a face on the rear side of the casing 711, and a seal member 714 is provided at circumferential edges of the opening 713. In the present embodiment, the casing 711 is fixed to the base portion 321 such that the opening 713 is closed by the face 321B of the base portion 321 of the support holder 32. When the motors 74 are driven in this state and the intake fans 72 rotate, the air inside the collection box 31 is sucked in through the intake ports 73, and is conveyed to the later-described air discharge ducts 80. Also, the partition plate 712 is provided in the casing 711, and therefore, when the intake fan 72A rotates, air will not flow to the intake fan 72B side, but be conveyed toward an air discharge duct 80A located on the left side. Also, when the intake fan 72B rotates, air will not flow to the intake fan 72A side, but be conveyed toward an air discharge duct 80B located on the right side.

[0072] As shown in FIG. 10, the intake unit 70 is provided with two air discharge ducts 80 (80A, 80B). The air discharge ducts 80 are integrally formed with the casing 711. Note that the configuration may also be such that the air discharge ducts 80 are members that are different from the casing 711 and are attached to the casing 711.

[0073] The air discharge ducts 80 are duct members that guide air that is sucked into the inside of the casing 711 by the intake unit 70 to an internal space of the cleaning unit 30 through air discharge ports 76 (air outlets, see FIG. 12) of the casing 711. The two air discharge ducts 80 are spaced apart from each other in the width direction D3, an air discharge duct 80A located on the left side guides air from an air discharge port 76A provided in a left side face of the casing 711 to an upper portion of the internal space of the cleaning unit 30, and an air discharge port 76 provided in a right side face of the casing 711 to an upper portion of the internal space of the cleaning unit 30.

[0074] As shown in FIGS. 2, 7, and 8, in the internal space of the cleaning unit 30, an upper space 39A is laid out on an upper left side of the collection box 31, and an upper space 39B is laid out on an upper right side thereof. The upper spaces 39A, 39B are bounded by the cover 35 and the support holder 32. Specifically, the upper space 39A is a space formed between a left side face (first side face) of the collection box 31 and an inner face of the cover 35. Also, the upper space 39B is a space formed between a right side face (second side face) of the collection box 31 and the inner face of the cover 35.

[0075] In the present embodiment, the air discharge duct 80A guides air to the upper space 39A. That is, the air discharge duct 80A is a duct member that forms an air flow channel (first discharging air flow channel) that extends from the air discharge port 76A to the upper space 39A. Also, the air discharge duct 80B guides air to the upper space 39B. That is, the air discharge duct 80B is a duct member that forms an air flow channel (second discharging air flow channel) that extends from the air discharge port 76 in the right side face of the casing 711 to the upper space 39B. Note that the air discharge ports 76 are examples of a first air outlet and a second air outlet of the present invention. Also, the air discharge ducts 80A, 80B are examples of a first air discharge duct and a second air discharge duct of the present invention.

[0076] As a result of these air discharge ducts 80 being provided, as shown in FIG. 12, the air sucked in from the collection box 31 by the intake unit 70 passes the air discharge ducts 80 and is discharged to the upper spaces 39A, 39B through distribution ducts 85, which will be described later (see white arrows). The upper spaces 39A, 39B function as buffer chambers for reducing the flow force of discharging air. Therefore, when air is discharged to the upper spaces 39A, 39B, the air flow force is reduced. Also, the flow of air discharged to the upper spaces 39A, 39B collides with the inner face of the cover 35, as a result, the flow force is reduced. The air flow whose force has been reduced is directed from the upper spaces 39A, 39B to the entire internal space of the cleaning unit 30 while the force is being further reduced, and is finally discharged to the outside through a gap between the cover 35 and the support holder 32, a gap between the support holder 32 and the back face frame 11C, and the like.

[0077] As shown in FIGS. 9 and 10, the air discharge ducts 80 (80A, 80B) are provided with the respective distribution ducts 85. The distribution ducts 85 are attached to outlets 81 (see FIG. 12) of the air discharge ducts 80. The distribution ducts 85 are members for distributing the air flows that pass through the air discharge ducts 80 and are discharged from the outlets 81 into a plurality of flows toward the upper spaces 39A, 39B.

[0078] FIG. 11 is an enlarged perspective view illustrating a left half of the intake unit 70, and shows the structure of one distribution duct 85. As shown in FIG. 11, the distribution duct 85 is formed as a tubular shape extending rearward from the outlet 81 (see FIG. 12). The inside of the distribution duct 85 is hollow, and is a flow channel for air. A plurality of opening portions 86 are formed in an outer circumferential surface of the distribution duct 85. Note that a rear wall 88 is provided at the rear end of the distribution duct 85, and the distribution duct 85 is closed by the rear wall 88.

[0079] In the present embodiment, the distribution duct 85 is cylindrical, and four opening portions 86 are formed in its outer circumferential surface. Also a sheet-like filter 87 (see FIG. 9) is attached to the distribution duct 85, covering its outer circumferential surface. The filter 87 is constituted by a non-woven fabric, a porous member such as a sponge member, or the like. Note that FIG. 11 shows a state in which the filter 87 is removed.

[0080] As shown in FIG. 11, two opening portions 86, of the four opening portions 86, on one side (left side) in the width direction D3 are arranged side by side in the front-back direction D2, and the remaining two opening portions 86 on the other side (right side) in the width direction D3 are arranged side by side in the front-back direction D2. The filter 87 is wound around the outer circumferential surface of the distribution duct 85, closing these opening portions 86.

[0081] As shown in FIG. 12, in the present embodiment, the plurality of opening portions 86 are formed in the outer circumferential surface of the distribution duct 85, in at least a portion opposing the inner face of the cover 35. Note that not all of the plurality of opening portions 86 need to oppose the inner face of the cover 35, and it is sufficient if at least one opening portion 86 is arranged to oppose the inner face of the cover 35.

[0082] As a result of these distribution ducts 85 being attached to the air discharge ducts 80, the flow of air flowing into the distribution ducts 85 from the air discharge ducts 80 is distributed toward the plurality of opening portions 86, and the distributed flow is blasted out from the opening portions 86 (see white arrows). Accordingly, as a result of the air flow passing through the distribution ducts 85 being distributed into a plurality of flow channels, the force thereof can be reduced. Also, the force of the air blasted out from the opening portions 86 is further reduced in the upper spaces 39A, 39B, as described above, and is yet further reduced by collision with the inner face of the cover 35, and the air is finally discharged to the outside through a gap between the cover 35 and the support holder 32, the gap between the support holder 32 and the back face frame 11C, and the like.

[0083] Accordingly, the influence of the discharging air flow to the surrounding area of the cleaning apparatus 10 can be minimized. Also, scattering of dust on the floor surface 23, and scattering of fine particle substances included in the discharging air can be suppressed.

[0084] Also, since the air discharge ducts 80 are laid out inside the cleaning unit 30, the flow channel resistance can be reduced compared to the case where the duct is laid out from the cleaning unit 30 to the apparatus body 11, and therefore the suction efficiency of the intake fan 72 can be prevented from decreasing. Also, even if the inner diameter of the air discharge duct is increased in order to increase the suction force of the intake fan 72, a small-sized cleaning apparatus 10 can be realized without increasing the size of the cleaning unit 30 or the apparatus body 11.

[0085] Also, as a result of discharging air to the inside of the cleaning unit 30 instead of the inside of the apparatus body 11, the discharging air will not be blown against electronic devices such as a control unit and electronic components that are provided inside the apparatus body 11. Also, the motors 74 are arranged inside the apparatus body 11 through openings of the back face frame 11C, and therefore, even if air is discharged to the inside of the cleaning unit 30, malfunction or failure due to discharging air will not occur in the motors 74.

[0086] Note that, in the present embodiment, a configuration in which a plurality of air discharge ducts 80 are provided in the cleaning unit 30 is illustrated, but the present invention can also be applied to other configurations. For example, the present invention can also be applied to a configuration in which one air discharge duct 80 is provided, or a configuration in which three or more air discharge ducts 80 are provided.

INDEX TO THE REFERENCE NUMERALS

[0087]

10	Cleaning apparatus
11	Apparatus body
11C	Back face frame
12	Moving unit
13	Motor
14	Battery
15	Intake unit
23	Floor surface
30	Cleaning unit
31	Collection box
32	Support holder
33	Intake nozzle
35	Cover
39A	Upper space
39B	Upper space
40	Control unit
70	Intake unit
71	Fan body
72	Intake fan
73	Intake port
74	Motor
76	Air discharge port
80	Air discharge duct
81	Outlet
85	Distribution duct
86	Opening portion
87	Filter
88	Rear wall

Claims

1. A cleaning apparatus (10) comprising:

a moving body (11) configured to move, on a surface to be cleaned, in a moving direction; and
a cleaning unit (30) that is provided in the moving body (11) and is configured to clean the surface to be cleaned,
wherein the cleaning unit (30) includes:

an intake nozzle (33);
an intake unit (70) configured to suck in objects, along with air, from the surface to be cleaned through the intake nozzle (33);
a collection container (31) configured to

separate the objects that are sucked in and collect the objects in its inside;
an air discharge duct (80) configured to guide air sucked in by the intake unit (70) from an air outlet (76) of the intake unit (70) to an internal space sideward of the collection container (31); and
a cover member (35) that covers at least the air discharge duct (80), and is configured to form the internal space together with the air discharge duct (80).

2. The cleaning apparatus (10) according to claim 1,

wherein the cleaning unit (30) is attached to a back face of the moving body (11),
the intake unit (70) sucks in air inside the collection container (31) through an outlet provided in an upper portion of a front face of the collection container(31) on the moving direction side, and
the air discharge duct (80) forms a discharging air flow channel extending from the air outlet (76) of the intake unit (70) to an internal space sideward of the collection container (31).

3. The cleaning apparatus (10) according to claim 1, wherein the cleaning unit (30) further includes a distribution duct (85) that is attached to an outlet (81) of the air discharge duct (80) and is configured to distribute a discharging air flow from the outlet into a plurality of air flows toward the internal space.

4. The cleaning apparatus (10) according to claim 3, wherein the distribution duct (85) has a tubular shape whose inside is hollow, and includes a plurality of opening portions in its outer circumferential surface.

5. The cleaning apparatus (10) according to claim 4, wherein the plurality of opening portions are formed in portions, of the outer circumferential surface, that oppose an inner face of the cover member.

6. The cleaning apparatus (10) according to claim 1,

wherein the collection container (31) is arranged at the center, in a width direction, of a back face of the moving body (11),
the intake unit (70) includes a first air outlet (76) provided in a side face of its casing on one side in the width direction, and a second air outlet (76) provided in a side face on the other side, and
the air discharge duct (80) includes:

a first air discharge duct that forms a first discharging air flow channel extending from the first air outlet (76) to a space formed between the cover member and an upper portion of a first side face of the collection container (31) on the one side, and
a second air discharge duct that forms a second discharging air flow channel extending from the second air outlet (76) to a space formed between the cover member and an upper portion of a second side face of the collection container (31) on the other side.

7. The cleaning apparatus (10) according to claim 1, further comprising:
a driving force transmission unit configured to move the moving body (11) by transmitting a driving force in the moving direction to the surface to be cleaned.

FIG. 1

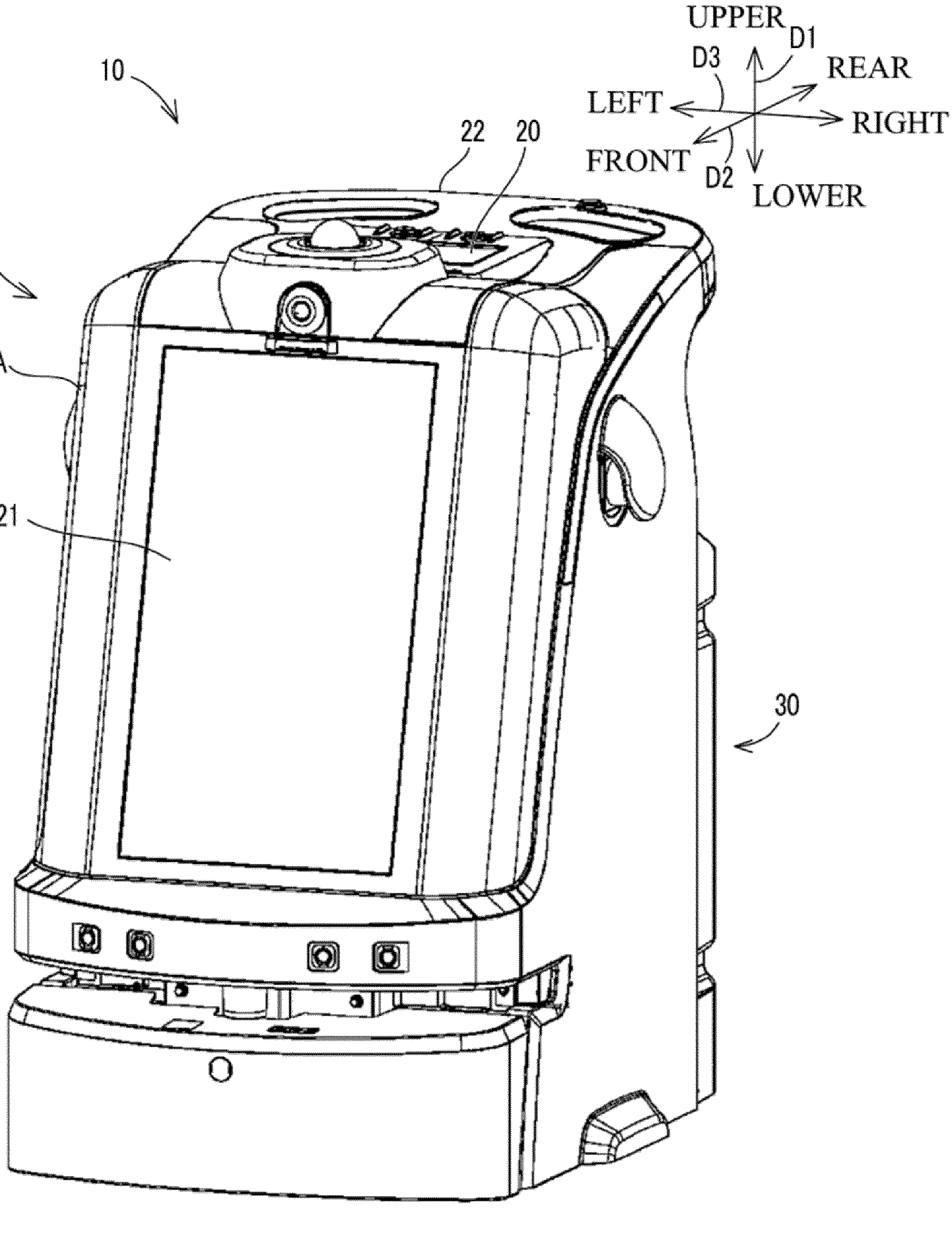

FIG. 2

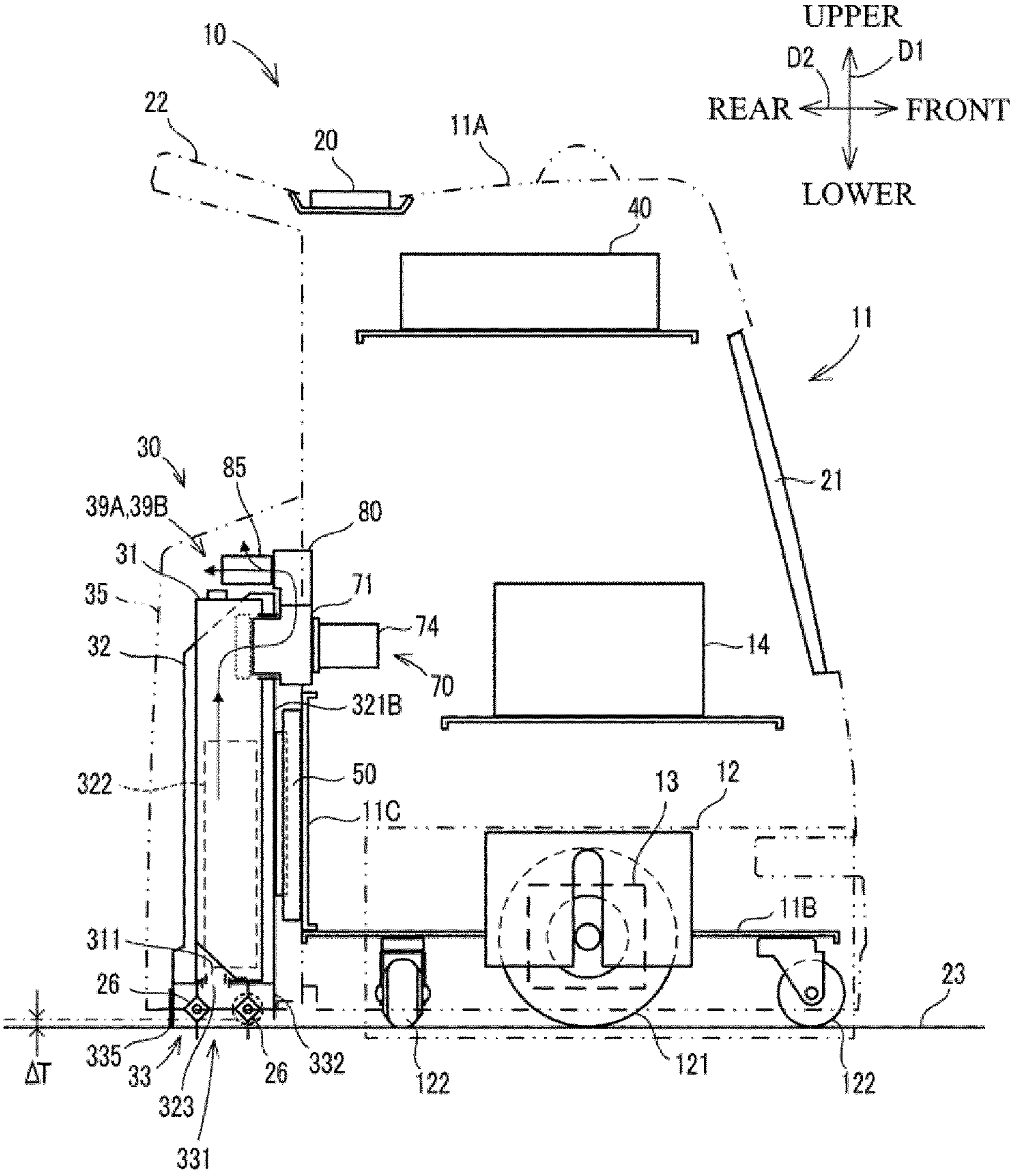
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FIG. 3

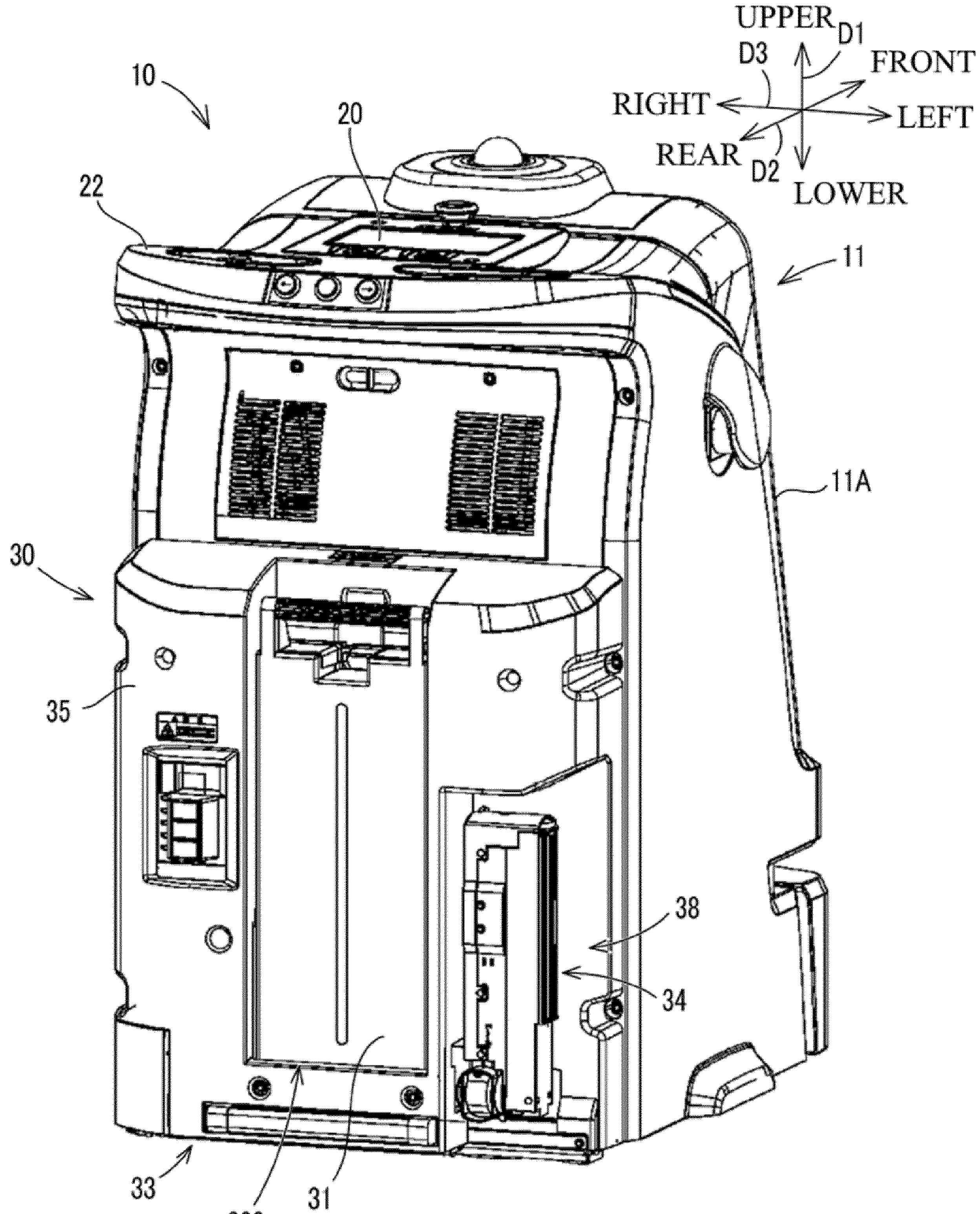
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FIG. 4

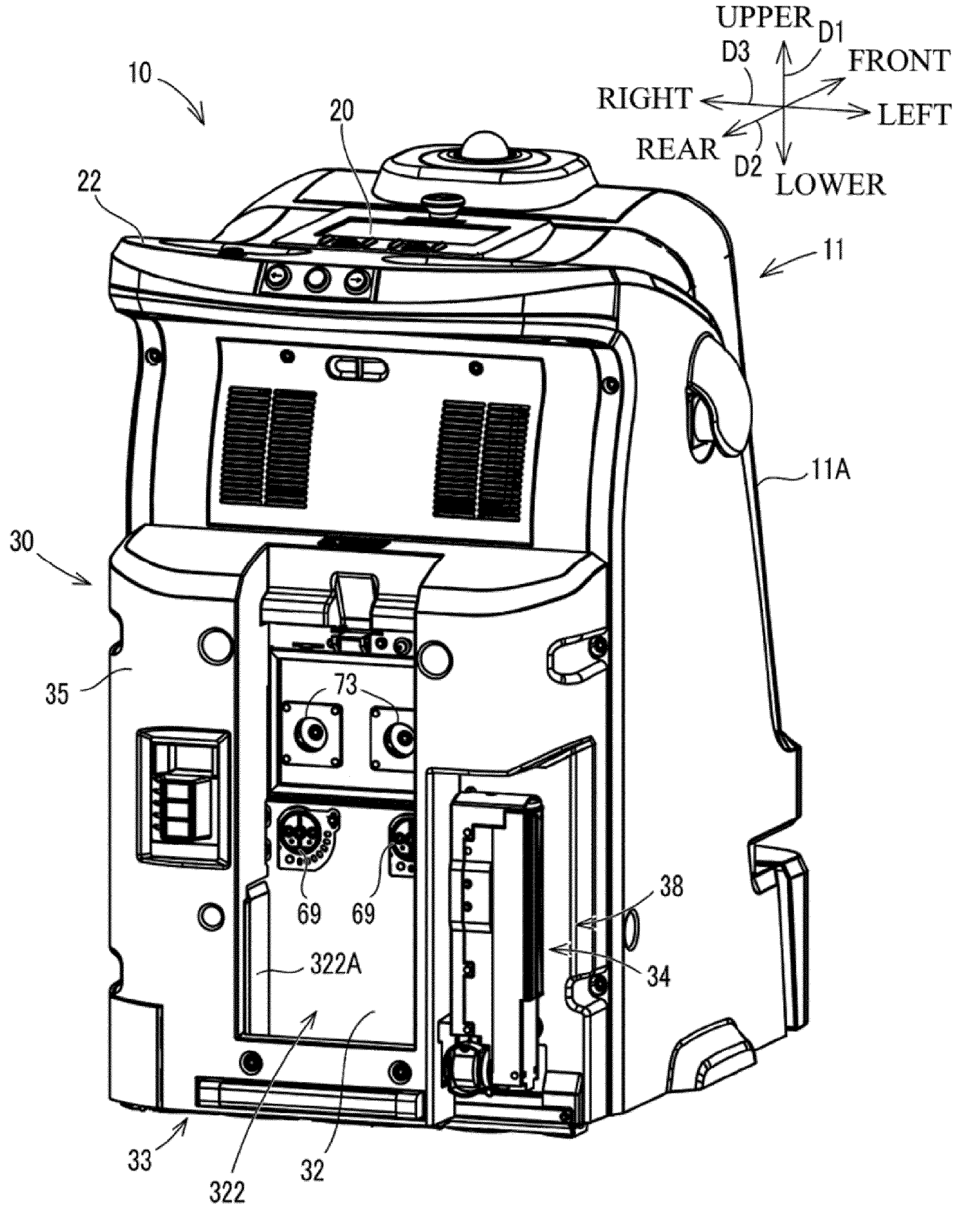
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FIG. 5

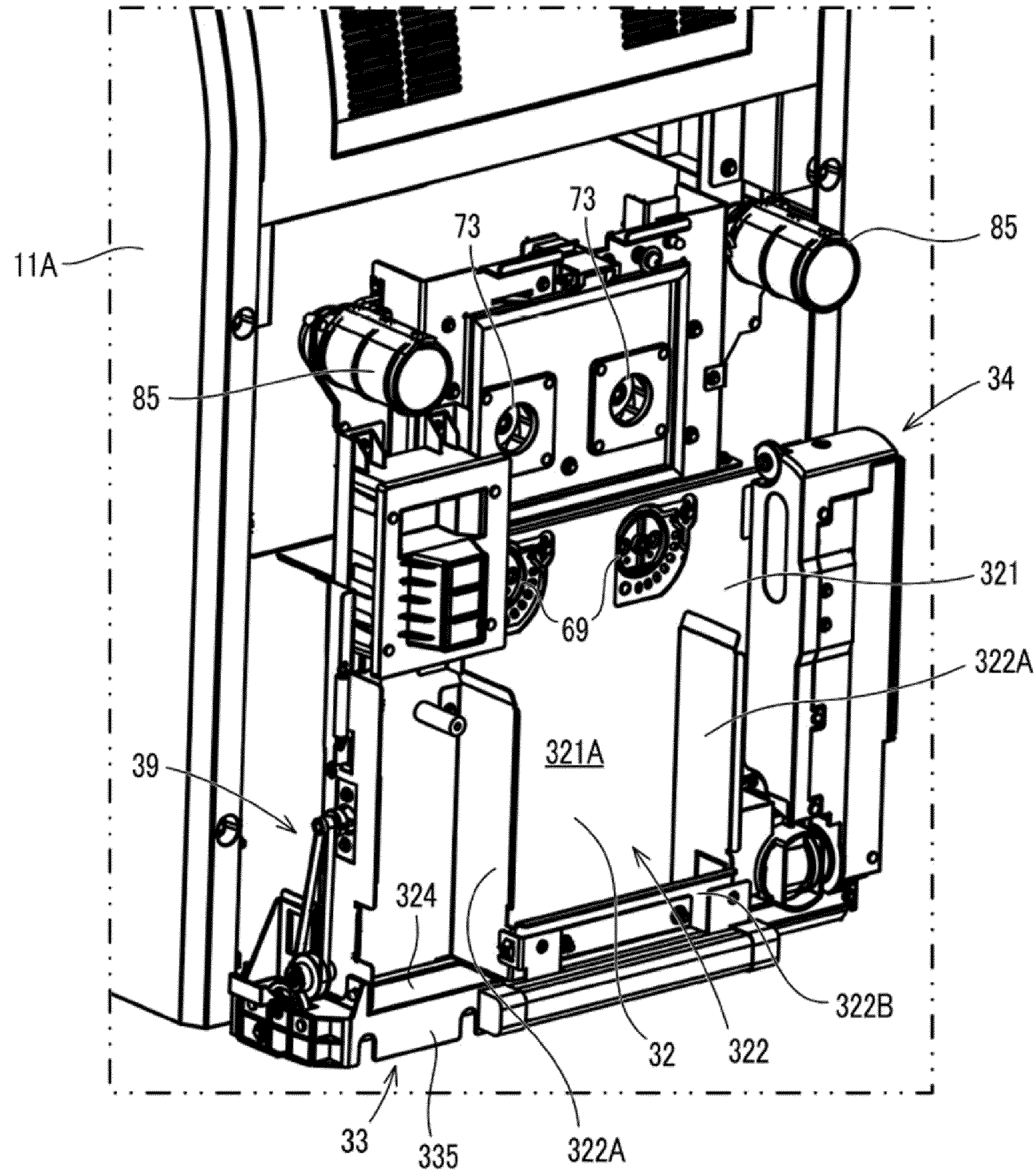

FIG. 6A

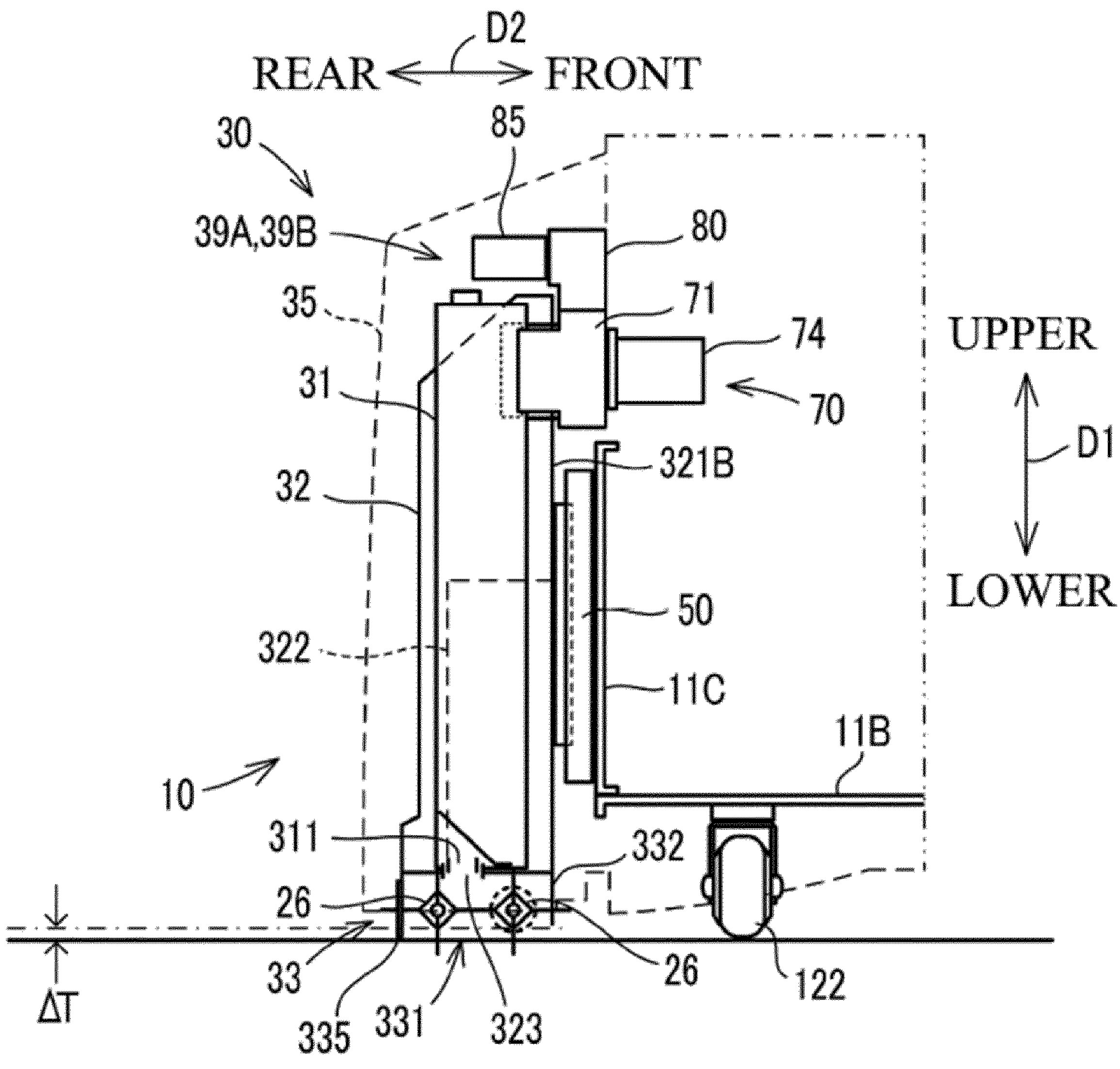
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FIG. 6B

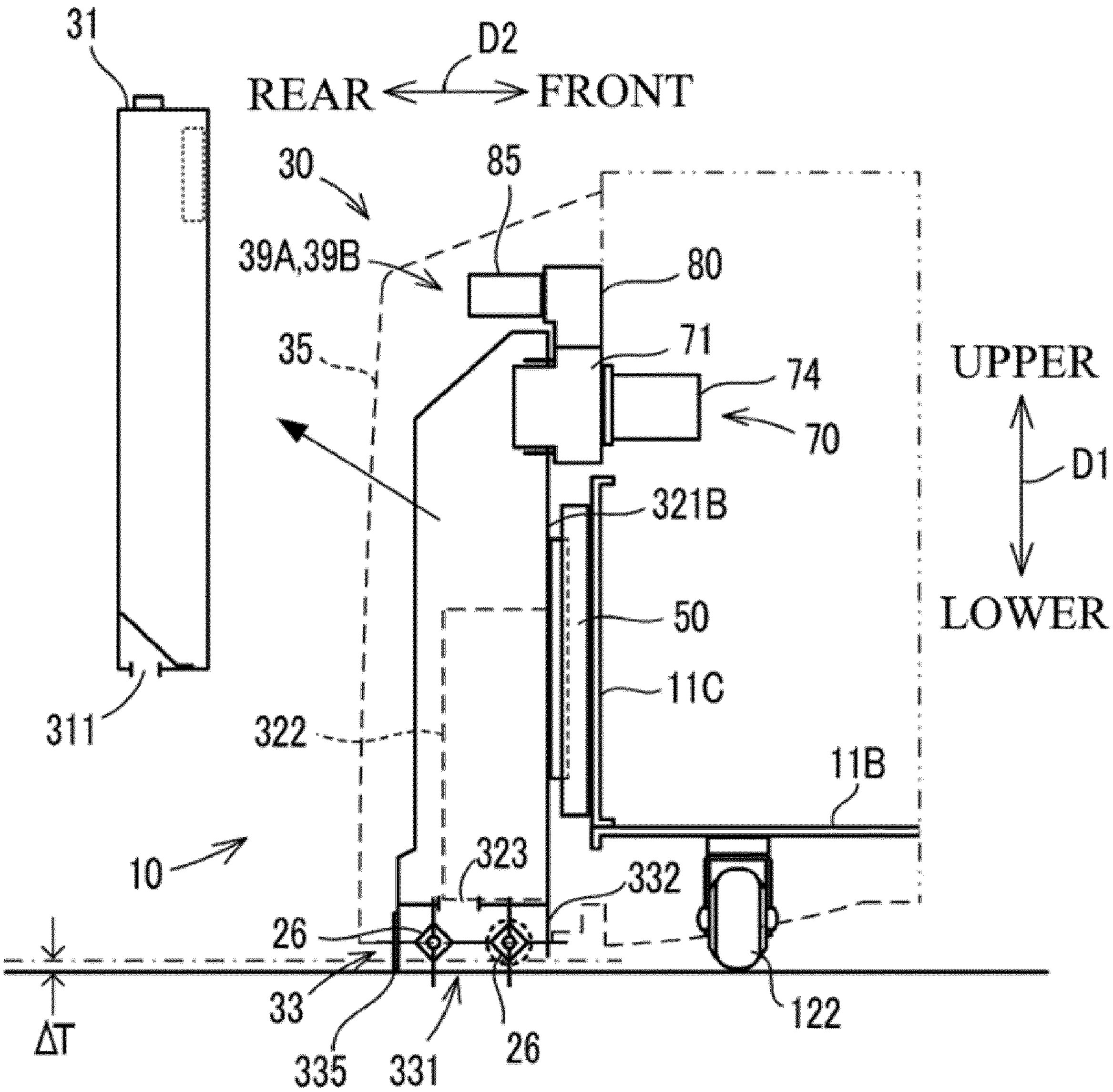
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FIG. 7

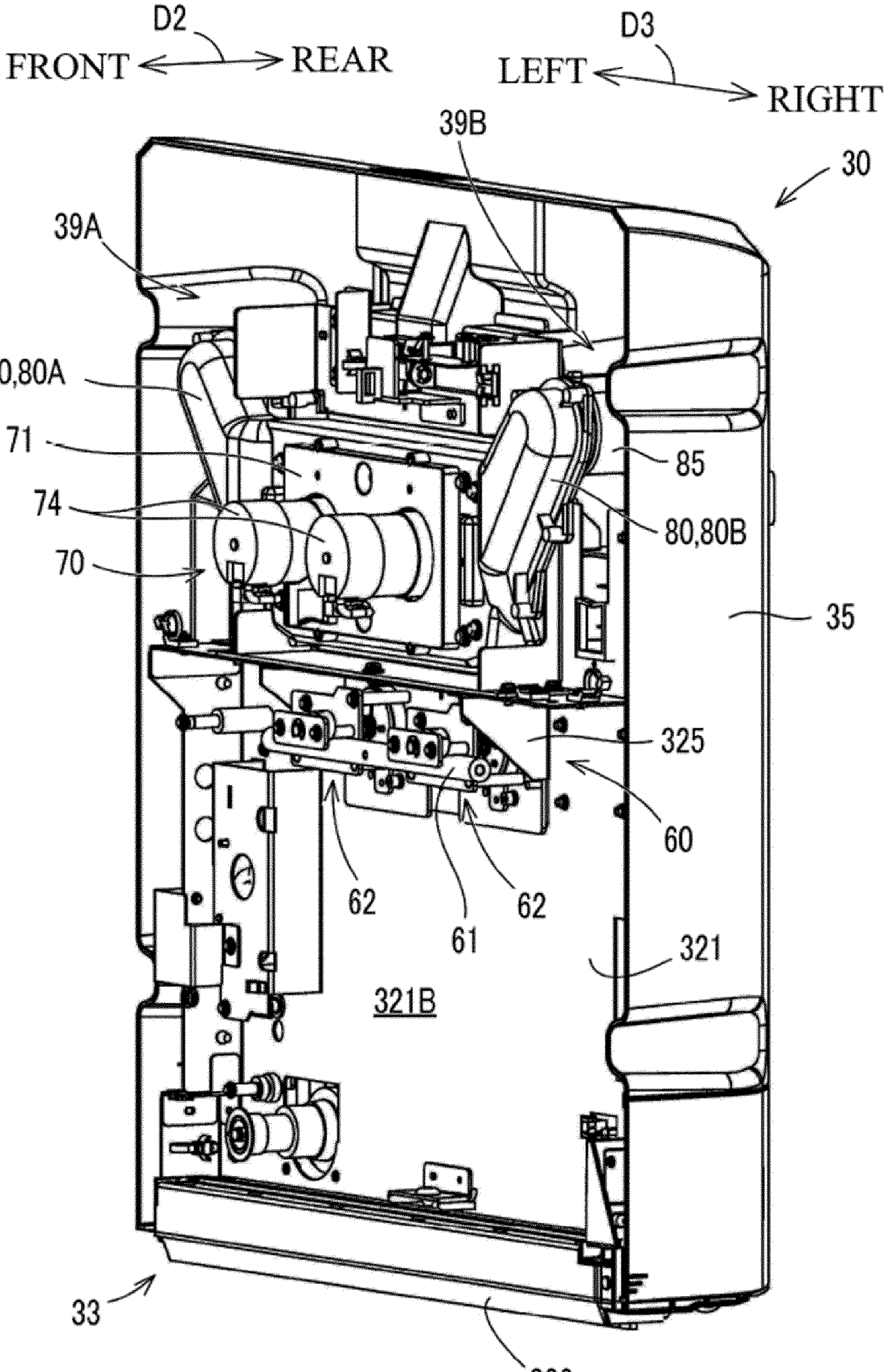
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FIG. 8

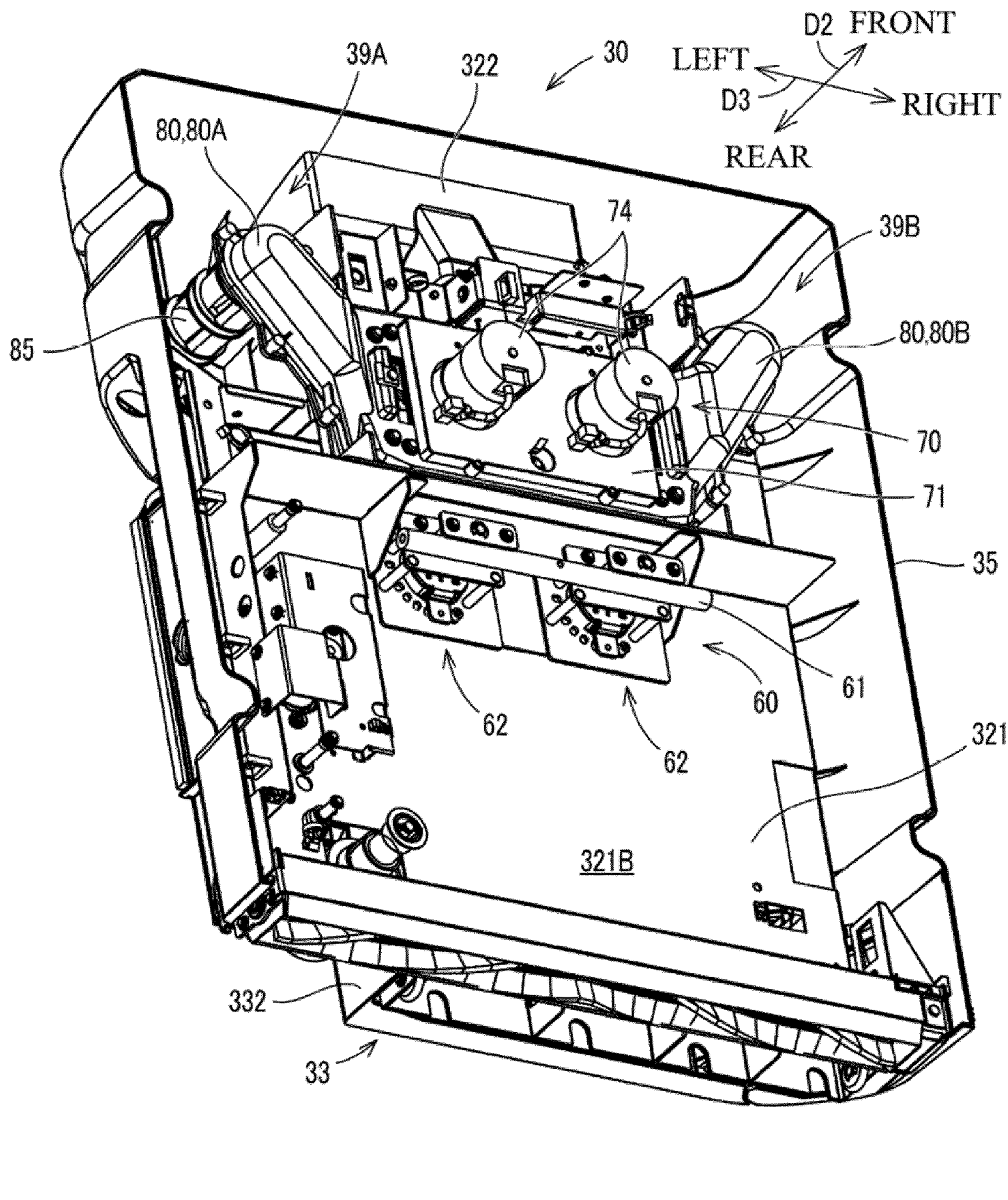
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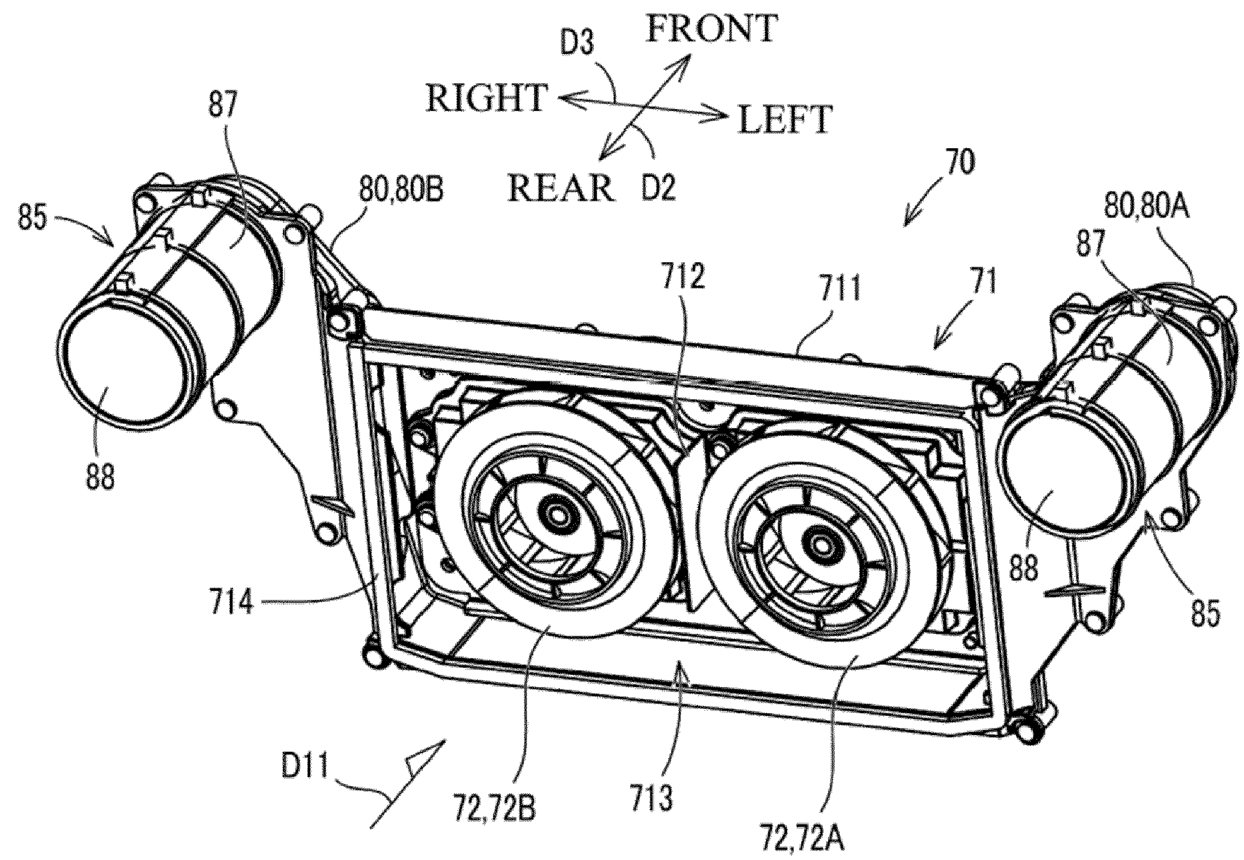
FIG. 9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72,72A

FIG. 10

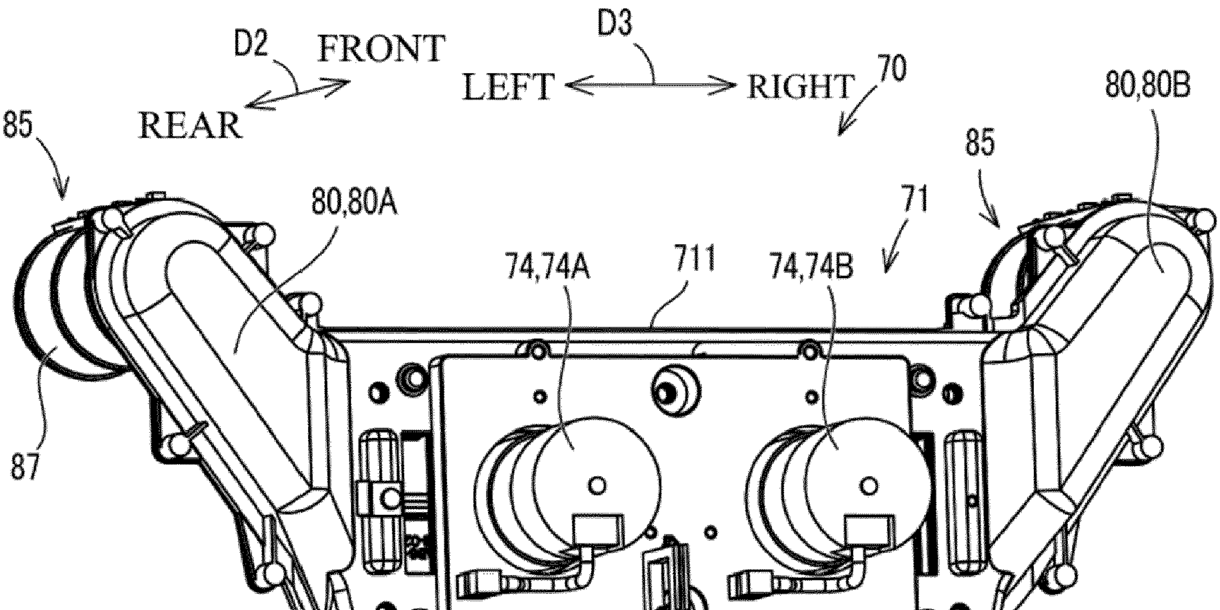
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FIG. 11

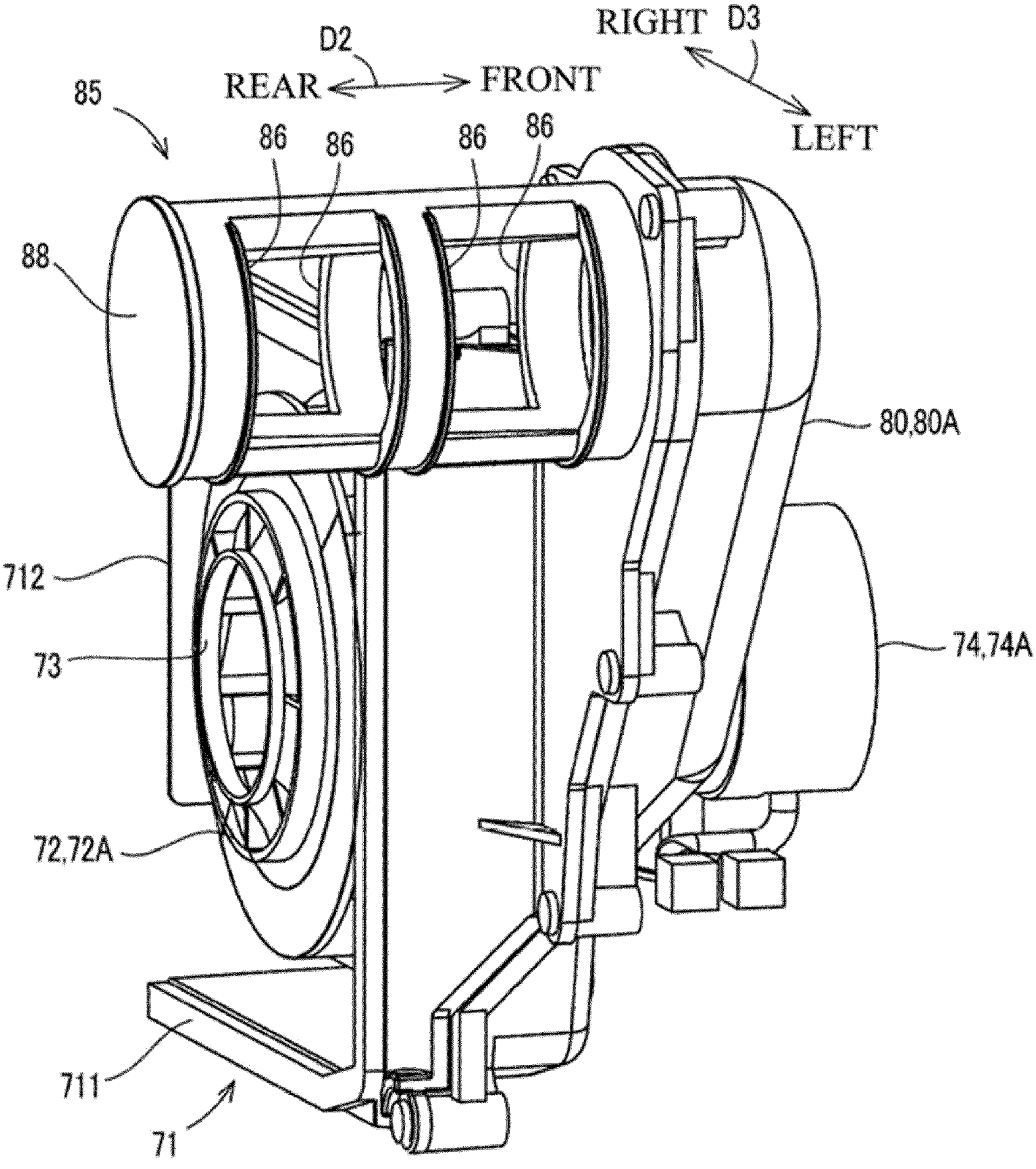

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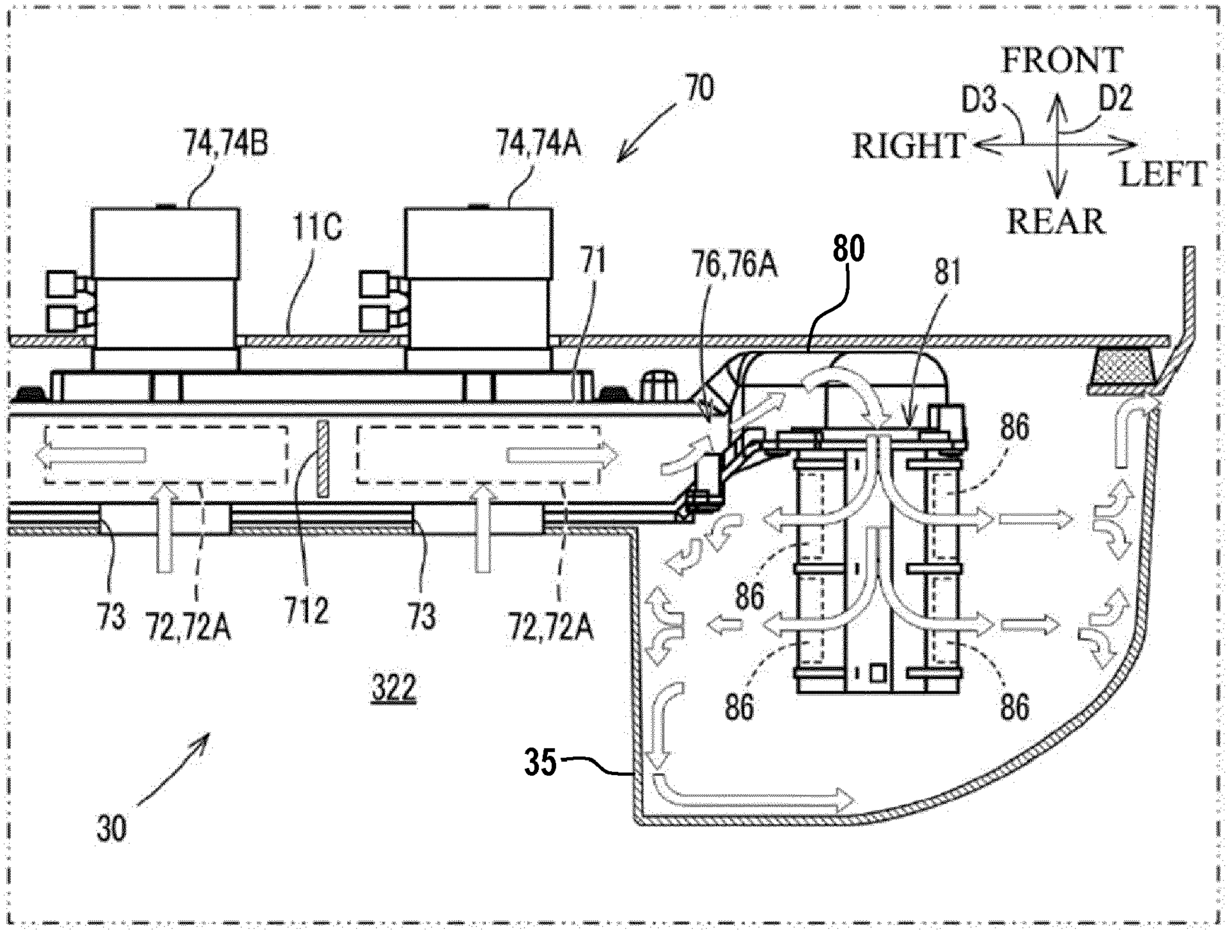
FIG. 12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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 5433

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A47L

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
Munich	14 July 2022	Hubrich, Klaus

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