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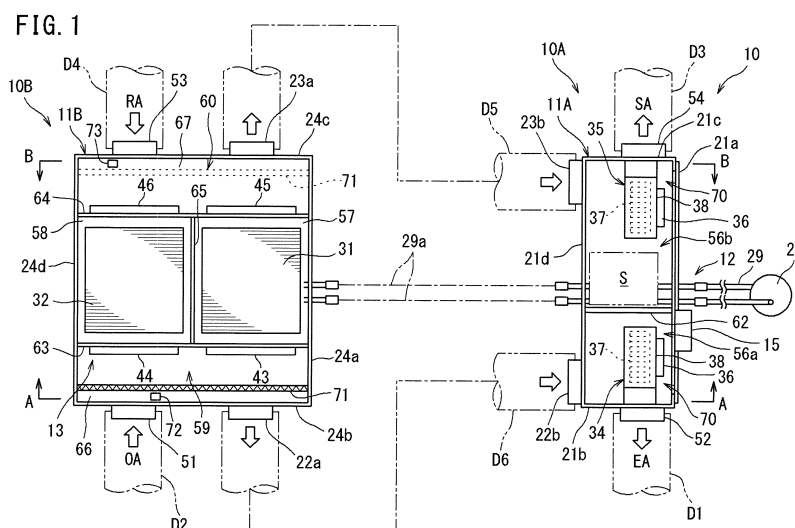
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(54) **HUMIDITY CONTROL DEVICE**

(57) An object of the invention is to enhance maintainability of a humidity control device, and the like. There is provided a humidity control device that dehumidifies one of outdoor air and indoor air and humidifies the other in adsorption heat exchangers (31, 32), and then supplies the outdoor air to an inside of a room, and exhausts the indoor air to an outside of the room, the device including casings (11A, 11B), a refrigerant circuit (12) having the adsorption heat exchangers (31, 32), a compressor (27),

a switching mechanism (26) of a circulation direction of a refrigerant, and refrigerant pipes (29), fans (34, 35), and an electric component unit (15), wherein the casings (11) include a first casing (11A) in which the fans (34, 35), the switching mechanism (26), and the electric component unit (15) are arranged, and a second casing (11B) in which the adsorption heat exchangers (31, 32) are arranged, and the first casing (11A) and the second casing (11B) are mutually connected through ducts (D5, D6).



Description

TECHNICAL FIELD

[0001] The present invention relates to a humidity control device that controls indoor humidity.

BACKGROUND ART

[0002] In Patent Literature 1, there is disclosed a humidity control device that dehumidifies one of outdoor air and indoor air, and humidifies the other in heat exchangers each carrying an adsorbent to adsorb moisture of air, and then supplies the outdoor air to an inside of a room, and exhausts the indoor air to an outside of the room.

[0003] Specifically, as shown in FIG. 18, inside a casing 111 of the humidity control device, fans 134, 135 that generate airflow, and a refrigerant circuit that circulates a refrigerant are provided. The refrigerant circuit is configured by connecting two adsorption heat exchangers 131, 132 each carrying an adsorbent, a compressor 127, an expansion valve, a four way valve and the like by refrigerant pipes. In one side surface 121 (hereinafter, referred to as a first side surface) of the casing, an outside air intake 151 to take in the outdoor air, and an inside air intake 153 to take in the indoor air are formed, and in the vicinity thereof, an air filter 171 is provided. Moreover, in two other side surfaces 122, 123 (hereinafter, referred to as second and third side surfaces) adjacent to both sides of the first side surface 121, a supply air outlet 154 to supply the outdoor air to the inside of the room, and an exhaust outlet 152 to exhaust the indoor air to the outside of the room are formed, respectively.

[0004] In the vicinity of another side surface 124 (hereinafter, referred to as a fourth side surface) opposed to the first side surface 121 of the casing 111, the two fans 134, 135 are arranged, and discharge ports of the two fans 134, 135 are connected to the supply air outlet 154 and the exhaust outlet 152, respectively. Actuation of these two fans 134, 135 generates flows of air in which the air taken in from the outside air intake 151 and the inside air intake 153 is blown out from the supply air outlet 154 and the exhaust outlet 152. Moreover, the compressor 127, the expansion valve, the four way valve and the like constituting the refrigerant circuit are arranged between the two fans 134, 135. An electric component unit (an electric component box) provided with a control board and the like of the humidity control device is normally attached to the fourth side surface 124 of the casing 11 in the vicinity of the fans 134, 135 and the compressor 127.

CITATION LIST

[PATENT LITERATURE]

[0005] Patent Literature 1: Japanese Unexamined Patent Publication No. 2009-109120

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0006] The humidity control device according to Patent Literature 1 is, for example, installed in an indoor roof space, and is connected to the inside and the outside of the room through ducts. Accordingly, sound accompanying the actuation of the fans 134, 135 (blowing sound and actuation sound) is easily propagated to the inside of the room, which causes noise. Moreover, the discharge ports of the fans 134, 135 are connected to the supply air outlet 154 and the exhaust outlet 152 of the humidity control device, so that the air blowing from the fans 134, 135 is directly exhausted outside the casing 111 from the supply air outlet 154 and the exhaust outlet 152. Accordingly, the sound accompanying the actuation of the fans 134, 135 (blowing sound and actuation sound) is easily propagated outside the casing 111, which also causes noise. Furthermore, sound generated from the compressor 127, the four way valve and the like near the supply air outlet 154 and the exhaust outlet 152 is also easily propagated to the inside of the room.

[0007] Moreover, in the conventional humidity control device, since the two heat exchangers 131, 132, the four way valve, the compressor 127 and the like are housed inside one casing 111, it has a heavy load and a large volume. Thus, handling in conveyance, keeping, installation and the like is difficult.

[0008] Moreover, the fans 134, 135, the air filter 171, the electric component unit and the like inside the casing 111 require maintenance such as inspection, part replacement, cleaning and the like, and the maintenance of these is performed in the roof space through an opening formed in a ceiling.

[0009] However, the maintenance in the roof space is very complicated because of working at a narrow, dark place. Moreover, since the electric component unit and the fans 134, 135 are arranged apart from the air filter 171, respective working spaces need to be assured by being distributed around the casing 111, and the maintenance cannot be performed at one position. Furthermore, there is a drawback that limitation on an installation place of the humidity control device becomes large because the working spaces are assured by being distributed.

[0010] The present invention is achieved in light of the above-described situations, and an object of the present invention is to enhance maintainability of a humidity control device and reduce noise to an inside of a room, and the like.

SOLUTION TO PROBLEM

[0011] The present invention provides a humidity control device that dehumidifies one of outdoor air and indoor air, and humidifies the other in adsorption heat exchangers each carrying an adsorbent to adsorb moisture of air,

and then supplies the outdoor air to an inside of a room, and exhausts the indoor air to an outside of the room, the device including:

casings;
 a refrigerant circuit having the adsorption heat exchangers, a compressor that circulates a refrigerant, a switching mechanism that switches a circulation direction of the refrigerant, and refrigerant pipes that connect the adsorption heat exchangers, the compressor, and the switching mechanism;
 fans that respectively take the outdoor air and the indoor air into one of the casings; and
 an electric component unit including control parts of the humidity control device,
 wherein the casings include:
 a first casing in which the fans, the switching mechanism, and the electric component unit are arranged; and
 a second casing in which the adsorption heat exchangers are arranged, and
 the first casing and the second casing are mutually connected through ducts.

[0012] In the humidity control device of the present invention, the fans and the electric component unit, which are parts having relatively high maintenance frequency, and the fans and the switching mechanism, which are parts generating sound, are arranged in the first casing, and the adsorption heat exchangers, which have low maintenance frequency, and hardly generate sound, are arranged in the second casing. Thus, only the second casing is arranged indoors, and the first casing is arranged outdoors where the maintenance is easy, which can enhance maintainability to the equipment inside the first casing, and reduce noise to the inside of the room. Moreover, the casings are divided into the first casing and the second casing, which can make a weight and a volume of each of the casings small, and can make handling in conveyance, keeping, installation and the like easy.

[0013] The first casing may be provided with a supply air outlet to supply the air to the inside of the room and an exhaust outlet to exhaust the air to the outside of the room, and

the second casing may be provided with an outside air intake to take in the outside air, and an inside air intake to take in the indoor air.

[0014] Alternatively, the first casing may be provided with an outside air intake to take in the outside air, and an inside air intake to take in the indoor air, and the second casing may be provided with a supply air outlet to supply the air to the inside of the room and an exhaust outlet to exhaust the air to the outside of the room.

[0015] In the latter case, it is preferable that air filters are provided on a suction side of the respective fans inside the first casing.

[0016] In this case, maintainability of the air filters,

which have relatively high maintenance frequency, can be enhanced.

[0017] The ducts can include a duct for outside air that introduces the outdoor air to the first casing, and a duct for inside air that introduces the indoor air to the first casing, the outdoor air being taken into the second casing from the outside air intake, and the indoor air being taken into the second casing from the inside air intake.

[0018] Alternatively, the ducts can include a duct for outside air that introduces the outdoor air to the second casing, and a duct for inside air that introduces the indoor air to the second casing, the outdoor air being taken into the first casing from the outside air intake, and the indoor air being taken into the first casing from the inside air intake.

[0019] The compressor may be connected to the refrigerant pipes drawn from the first casing, or may be arranged inside the first casing.

[0020] In either of the foregoing, the compressor generating sound can be arranged outdoors together with the first casing.

[0021] In the present invention, it is preferable that a plurality of second units are connected to a first unit in parallel, the plurality of second units each being configured by the second casing and internal equipment of the second casing, and the first unit being configured by the first casing, internal equipment of the first casing, and the compressor.

[0022] According to this configuration, the second units are arranged in a plurality of rooms, and the supply of the refrigerant to the adsorption heat exchangers in the respective second units can be performed, using the compressor and the like in the one first unit.

ADVANTAGEOUS EFFECTS OF INVENTION

[0023] According to the present invention, maintainability of the equipment and the like inside the casings can be enhanced, and noise to the inside of the room can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0024]

[FIG. 1] FIG. 1 is an explanatory plan view of an inside of a humidity control device according to a first embodiment of the present invention.

[FIG. 2] FIG. 2 is an explanatory view of the inside of the humidity control device viewed from an A-A line arrow direction in FIG. 1.

[FIG. 3] FIG. 3 is an explanatory view of the inside of the humidity control device viewed from a B-B line arrow direction in FIG. 1.

[FIG. 4] FIGS. 4A and 4B are piping flow diagrams each showing a refrigerant circuit of the humidity control device.

[FIG. 5] FIG. 5 is an explanatory plan view showing

a flow of air inside the humidity control device.

[FIG. 6] FIG. 6 is an explanatory plan view showing a flow of the air inside the humidity control device.

[FIG. 7] FIGS. 7A and 7B are explanatory views each showing a flow of the air between airflow paths and a heat exchange chamber inside the humidity control device.

[FIG. 8] FIGS. 8A and 8B are explanatory views each showing a flow of the air between the airflow paths and the heat exchange chamber inside the humidity control device.

[FIG. 9] FIG. 9 is a schematic diagram showing an installation example of the humidity control device.

[FIG. 10] FIG. 10 is an explanatory plan view of an inside of a humidity control device according to a second embodiment of the present invention.

[FIG. 11] FIG. 11 is an explanatory view of the inside of the humidity control device viewed from an A-A line arrow direction in FIG. 10.

[FIG. 12] FIG. 12 is an explanatory view of the inside of the humidity control device viewed from a B-B line arrow direction in FIG. 10.

[FIG. 13] FIG. 13 is an explanatory plan view showing a flow of air inside the humidity control device.

[FIG. 14] FIG. 14 is an explanatory plan view showing a flow of the air inside the humidity control device.

[FIG. 15] FIGS. 15A and 15B are explanatory views each showing a flow of the air between airflow paths and a heat exchange chamber inside the humidity control device.

[FIG. 16] FIGS. 16A and 16B are explanatory views each showing a flow of the air between the airflow paths and the heat exchange chamber inside the humidity control device.

[FIG. 17] FIG. 17 is a cross-sectional diagram showing a structure around a fan in an enlarged manner.

[FIG. 18] FIG. 18 is an explanatory plan view showing an inside of a humidity control device according to a related art.

DESCRIPTION OF EMBODIMENTS

[0025] Hereinafter, embodiments of the present invention will be described based on the drawings.

<First Embodiment>

[0026] FIG. 1 is an explanatory plan view of an inside of a humidity control device according to a first embodiment of the present invention. FIG. 2 is an explanatory view of the inside of the humidity control device viewed from an A-A line arrow direction in FIG. 1. FIG. 3 is an explanatory view of the inside of the humidity control device viewed from a B-B line arrow direction in FIG. 1.

[0027] A humidity control device 10 of the present embodiment performs dehumidification and humidification while performing indoor ventilation, and includes casings 11A, 11B, a refrigerant circuit 12, and an airflow control

mechanism 13 and the like.

[0028] Casings include the first casing 11A and the second casing 11B. The first casing 11A is arranged, for example, in a roof space of an outdoor passage or the like, in a machine room or the like, while the second casing 11B is arranged in an indoor roof space or the like. The first casing 11A and the second casing 11B are each formed into a flat rectangular parallelepiped box.

[0029] Specifically, the first casing 11A includes a bottom plate 18a, a top plate 18b, and four side plates (first to fourth side plates) 21a to 21d. Part of the refrigerant circuit 12, part of the airflow control mechanism 13, and the like are housed inside a space surrounded by these bottom plate 18a, top plate 18b, and side plates 21a to 21d. Moreover, in one side surface (an outer surface of the first side plate 21a) of the first casing 11A, an electric component unit 15 is provided.

[0030] In the following description, a direction along short sides in a planar shape (rectangular shape) of the first casing 11A is a front-back direction, and a direction along long sides is a right-left direction. Moreover, as to the front-back direction, a side of the first side plate 21a is a front side, and a side of the fourth side plate 21d is a back side. In the first casing 11A, a length in the right-left direction is longer than a length in the front-back direction, and the first casing 11A is formed into an elongated rectangular parallelepiped shape.

[0031] The second casing 11B includes a bottom plate 19a, a top plate 19b, and four side plates (fifth to eighth side plates) 24a to 24d. Part of the refrigerant circuit 12, part of the airflow control mechanism 13, and the like are housed inside a space surrounded by these bottom plate 19a, top plate 19b, and side plates 24a to 24d. As for the second casing 11B, the fifth side plate 24a is arranged in a front portion thereof, the eighth side plate 24d is arranged in a back portion thereof, and the sixth and seventh side plates 24b, 24c are arranged in right and left side portions, respectively.

[0032] The refrigerant circuit 12 housed in the first and second casings 11A, 11B will be described. FIGS. 4A and 4B are piping flow diagrams each showing the refrigerant circuit 12 of the humidity control device 10.

[0033] The refrigerant circuit 12 is configured by connecting a first heat exchanger 31, a four way valve (switching mechanism) 26, a compressor 27, a second heat exchanger 32, and an electric expansion valve (expansion mechanism) 28 by refrigerant pipes 29, and circulating a refrigerant allows a vapor compression type refrigerating cycle to be executed.

[0034] A discharge side of the compressor 27 is connected to a first port of the four way valve 26, and a suction side thereof is connected to a second port of the four way valve 26. One end of the first heat exchanger 31 is connected to a third port of the four way valve 26. The other end of the first heat exchanger 31 is connected to the electric expansion valve 28. One end of the second heat exchanger 32 is connected to a fourth port of the four way valve 26. The other end of the second heat exchang-

er 32 is connected to the electric expansion valve 28.

[0035] The compressor 27 is a so-called totally-sealed type compressor, and is a variable displacement compressor in which an operation rotation speed (operation frequency) is controlled by an inverter.

[0036] The first heat exchanger 31 and the second heat exchanger 32 are each configured by a so-called cross fin type, fin and tube type, heat exchanger including heat transfer tubes and a number of fins. Moreover, in each outer surface of the first heat exchanger 31 and the second heat exchanger 32, an adsorbent such as zeolite is carried across almost the entire surface.

[0037] The four way valve 26 is configured so as to be switchable between a state where the first port and the third port are communicated with each other and the second port and the fourth port are communicated with each other (refer to FIG. 4A), and a state where the first port and the fourth port are communicated with each other and the second port and the third port are communicated with each other (refer to FIG. 4B). The refrigerant circuit 12 inverts a refrigerant circulation direction by switching the communication state of the ports of this four way valve 26, so that a first refrigerating cycle operation in which the first heat exchanger 31 functions as a condenser, and the second heat exchanger 32 functions as an evaporator, and a second refrigerating cycle operation in which the first heat exchanger 31 functions as an evaporator, and the second heat exchanger 32 functions as a condenser can be performed.

[0038] As shown in FIGS. 1 to 3, in the airflow control mechanism 13, outdoor air and indoor air are taken into the second casing 11B, and after passing through the heat exchangers 31, 32, respectively, the outdoor air and the indoor air are sent to the first casing 11A to generate airflow that blows to an inside and an outside of a room from the first casing 11A. Specifically, the airflow control mechanism 13 has a first fan 34 and a second fan 35 that blow the air from the casings 11A, 11B.

[0039] The first fan 34 and the second fan 35 are each configured by a sirocco fan. In the sirocco fan, as shown in FIG. 1, a multiblade impeller 37 rotated by a motor 36 is provided inside a fan casing 38. The fan casing 38 is formed into a cylindrical shape, and suction ports are formed on both side surfaces of the fan casing 38, and a discharge port 38b is formed in an outer surface of the fan casing 38. Moreover, the first fan 34 and the second fan 35 are each configured so that an airflow rate can be adjusted by inverter control.

[0040] Moreover, the airflow control mechanism 13, as shown in FIGS. 1 to 3, includes a plurality of dampers 41 to 48 that control flow paths of the air taken into the casings 11A, 11B by the first and second fans 34, 35. Specific operation of these dampers 41 to 48 will be described later.

[0041] As shown in FIG. 1, in the second side plate 21b of the first casing 11A, an exhaust outlet 52 to blow the indoor air from the first casing 11A is formed. A duct D1 leading to the outside of the room is connected to this

exhaust outlet 52. Inside the first casing 11A in the vicinity of the exhaust outlet 52, the first fan 34 for exhaust blowing is arranged, and the discharge port 38b of the first fan 34 is connected to the exhaust outlet 52.

[0042] In the third side plate 21c of the first casing 11A, a supply air outlet 54 to blow the air inside the first casing 11A to the inside of the room is formed. A duct D3 leading to the inside of the room is connected to this supply air outlet 54. Moreover, inside the first casing 11A in the vicinity of the supply air outlet 54, the second fan 35 for supply air blowing is arranged, and the discharge port 38b of this second fan 35 is connected to the supply air outlet 54.

[0043] In both right and left end portions in the fourth side plate 21d of the first casing 11A, first and second relay intakes 22b, 23b are formed, respectively. One end of a duct for inside air D6, and one end of a duct for outside air D5 leading to the second casing 11B are connected to the first and second relay intakes 22b, 23b, respectively. Accordingly, air sent from the duct for inside air D6 and the duct for outside air D5 is taken into the first casing 11A through the first and second relay intakes 22b, 23b.

[0044] On a back portion side of the sixth side plate 24b in the second casing 11B, an outside air intake 51 to take in the outdoor air into the second casing 11B is formed. A duct D2 leading to the outside of the room is connected to this outside air intake 51. Moreover, on the back portion side of the seventh side plate 24c in the second casing 11B, an inside air intake 53 to take the indoor air into the second casing 11B is formed. A duct D4 leading to the inside of the room is connected to this inside air intake 53.

[0045] On a front portion side of the sixth side plate 24b and the seventh side plate 24c in the second casing 11B, first and second relay outlets 22a, 23a are formed, respectively. The other end of the duct for inside air D6 is connected to the first relay outlet 22a, and the other end of the duct for outside air D5 is connected to the second relay outlet 23a. Accordingly, the outdoor air taken into the second casing 11B from the outside air intake 51 is taken into the first casing 11A through the duct for outside air D5, and the indoor air taken into the second casing 11B from the inside air intake 53 is taken into the first casing 11A through the duct for inside air D6.

[0046] With the above-described configuration, the inside and the outside of the room are communicated with each other through the ducts D1 to D6 and the first and second casings 11A, 11B.

[0047] As shown in FIG. 1, the air taken into the second casing 11B from the outside air intake 51 may be expressed by OA, the air taken into the second casing 11B from the inside air intake 53 may be expressed by RA, the air exhausted outside the first casing 11A from the exhaust outlet 52 may be expressed by EA, and the air exhausted outside the first casing 11A from the supply air outlet 54 may be expressed by SA.

[0048] As shown in FIG. 1, inside the first casing 11A,

there are provided air blowing chambers 56a, 56b in which the first fan 34 and the second fan 35 are arranged. These air blowing chambers 56a, 56b are partitioned by a second partition wall 62 into the first air blowing chamber 56a in which the first fan 34 for exhaust blowing is arranged, and the second air blowing chamber 56b in which the second fan 35 for supply air blowing is arranged. The second air blowing chamber 56b is formed wider in the right-left direction than the first air blowing chamber 56a.

[0049] In a space S inside the second air blowing chamber 56b between the first fan 34 and the second fan 35, the four way valve 26 and the like constituting the refrigerant circuit 12 (refer to FIGS 4A and 4B) are arranged. The compressor 27 installed outside the first casing 11A is connected to refrigerant pipes 29, which penetrate the first side plate 21a and are drawn out from this space S. In the present embodiment, the first casing 11A and internal equipment of the first casing 11A, and the compressor 27 constitute a first unit (function unit) 10A. The compressor 27 may be arranged in the space S inside the first casing 11A.

[0050] Since the first and second fans 34, 35 are provided inside the first casing 11A, which is installed outdoors, actuation sound and blowing sound of the first and second fans 34, 35 can be prevented from being transmitted to the inside of the room. Particularly, the second fan 35 is connected to the distant inside of the room through the duct D3, so that the sound of the second fan 35 is attenuated through the long duct D3, which can preferably prevent the sound from being propagated to the inside of the room.

[0051] The electric component unit 15 arranged on a front surface of the first side plate 21a of the first casing 11A contains electric parts such as a control board of the whole humidity control device 10, a control board (inverter board) of the compressor 27 and the first and second fans 34, 35, and the like in an electric component box. In order to conduct inspection, part replacement and the like of this electric component unit 15, a working space for maintenance is formed in front of the first casing 11A. Moreover, detaching the first side plate 21a enables maintenance of the first and second fans 34, 35, and maintenance of the four way valve 26 and the like in the refrigerant circuit 12 to be performed in the working space in front of the first casing 11A.

[0052] Accordingly, in the present embodiment, the electric component unit 15, the first and second fans 34, 35, and part of the refrigerant circuit 12 (the four way valve 26 and the like), which have relatively high maintenance frequency, are concentratively arranged in the first casing 11A, and the working space for maintenance of these can be concentratively provided on the one side of the first casing 11A (in front of the first side plate 21a). As a result, as compared with a case where the working spaces are provided so as to be distributed around the casing, a planar area of the whole working space can be made as small as possible, and maintenance working

can be easily performed at one position. Moreover, arranging the first casing 11A at an outdoor place where the maintenance is easily performed can further enhance maintainability. Moreover, since the first casing 11A can be downsized as compared with the second casing 11B, it can be installed, using an outdoor narrow space (a dead space or the like).

[0053] As shown in FIG. 1, inside the second casing 11B, heat exchange chambers 57, 58, and airflow paths 59, 60 are formed. Specifically, a third partition wall 63 and a fourth partition wall 64 extending along the front-back direction are provided side by side in the right-left direction between the fifth side plate 24a and the eighth side plate 24d. Front ends of the third partition wall 63 and the fourth partition wall 64 are connected to the fifth side plate 24a, and back ends thereof are connected to the eighth side plate 24d. The heat exchange chambers 57, 58 where the first and second heat exchangers 31, 32 are arranged are formed between the third partition wall 63 and the fourth partition wall 64. The first airflow path 59 and the second airflow path 60 extending in the front-back direction are formed between the third partition wall 63 and the sixth side plate 24b, and between the fourth partition wall 64 and the seventh side plate 24c, respectively. In each of the first and second airflow paths 59, 60, an air filter 71 is provided.

[0054] The heat exchange chambers 57, 58 are partitioned by a fifth partition wall 65 in the front-back direction. The first heat exchanger 31 is arranged in the first heat exchange chamber 57 on a front side, and the second heat exchanger 32 is arranged in the second heat exchange chamber 58 on a back side. As shown in FIGS. 7A to 8B, the first heat exchanger 31 and the second heat exchanger 32 are each arranged in a posture inclined so that the side of the first airflow path 59 is higher than the side of the second airflow path 60. This allows the airflow inside the first and second heat exchange chambers 57, 58 to flow through the first and the second heat exchangers 31, 32 in the right-left direction and in an upper-lower direction. The first and second heat exchangers 31 may be arranged so as to be inclined reversely in the right-left direction to those shown in FIGS. 7A to 8B. Moreover, the first heat exchanger 31 and the second heat exchanger 32 may be inclined reversely to each other.

[0055] Arranging the first and second heat exchangers 31, 32 in the inclined posture in this manner can expand an area of flow-through of the air, and can enhance heat exchange efficiency and adsorption efficiency of moisture by the adsorbent. The first and second heat exchangers 31, 32 are connected to the refrigerant circuit 12 inside the first casing 11A by the refrigerant pipes 29a, as shown in FIG. 1. The electric expansion valve 28 (refer to FIGS. 4A and 4B) is also arranged between the first and second heat exchangers 31, 32 in the second casing 11B. In the present embodiment, a second unit (humidity control unit) 10B is configured by the second casing 11B and the internal equipment of the second casing 11B.

[0056] As shown in FIG. 2, the first airflow path 59 is partitioned into two upper/lower stages by a sixth partition wall 66. The first relay outlet 22a formed in the sixth side plate 24b (refer to FIG. 1) is communicated with a first airflow path 59b on the lower stage side. Moreover, the outside air intake 51 is communicated with a first airflow path 59a on the upper stage side.

[0057] As shown in FIG. 3, the second airflow path 60 is partitioned into two upper/lower stages by a seventh partition wall 67. The second relay outlet 23a formed in the seventh side plate 24c (refer to FIG. 1) is communicated with a second airflow path 60a on the upper stage side. Moreover, the inside air intake 53 is communicated with a second airflow path 60b on the lower stage side.

[0058] As shown in FIG. 1, the first relay outlet 22a and the outside air intake 51 are formed in the sixth side plate 24b, and the second relay outlet 23a and the inside air intake 53 are formed in the seventh side plate 24c. Accordingly, in the fifth and eighth side plates 24a, 24d of the second casing 11B, no opening through which the air flows is formed, and no duct is connected. Thus, no space for arranging the duct or the like is required around the fifth and eighth side plates 24a, 24d. Moreover, the maintenance such as inspection, replacement and the like to the heat exchangers 31, 32 can be performed by detaching one of the fifth side plate 24a and the eighth side plate 24d. Accordingly, while a working space for maintenance is required on one side of the fifth side plate 24a and the eighth side plate 24d, the working space need not be assured on the other side, which enables the second casing 11B to be arranged so that the other side is arranged at a window of a building or the like. This reduces limitation on an installation place of the second casing 11B, thereby increasing a degree of freedom of the installation.

[0059] FIG. 9 is a schematic diagram showing one example of an installation aspect of the humidity control device. In this figure, the plurality of second units (humidity control units) 10B are connected to the one first unit (function unit) 10A in parallel. The first unit 10A is arranged in a roof space of an outdoor passage C, in a machine room or the like. The plurality of second units 10B are installed in roof spaces of respective rooms R or the like. The first unit 10A and the second units 10B are connected by the ducts D5, D6. Since the second units 10B each include parts having less occurrence of sound such as the heat exchangers 31, 32, the expansion valve 28 and the like, it hardly causes noise to the inside of the room. Accordingly, the second units 10B can be each installed in a place where quietness is required, such as a sickroom in a hospital, a guest room of a hotel, or the like. In contrast, while the first unit 10A includes parts that generate relatively large sound, such as the fans 34, 35, the compressor 27 and the like, it can be arranged outdoors, which hardly poses a problem of noise to the inside of the room. Moreover, arranging the first unit 10A outdoors allows the maintenance of the fans 34, 35, the compressor 27 and the like to be performed

outdoors, so that the inside of the room can be used as usual during the maintenance. Moreover, configuring the humidity control device by dividing into the first unit 10A and the second unit 10B can downsize each of the units, as compared with a case where both are configured integrally. Thus, the conveyance, keeping, installation and the like of the first unit 10A and the second units 10B can be easily performed.

[0060] Next, a configuration of the airflow control mechanism 13 will be described in more detail.

[0061] As shown in FIG. 2, in the third partition wall 63 of the second casing 11B, four vent holes 81 to 84 are formed side by side in the front-back direction and in the upper-lower direction. These vent holes 81 to 84 are configured so as to be openable and closable by the dampers 41 to 44.

[0062] Moreover, as shown in FIG. 3, in the fourth partition wall 64, four vent holes 85 to 88 are formed side by side in the front-back direction and in the upper-lower direction. These vent holes 85 to 88 are configured so as to be openable and closable by the dampers 45 to 48.

[0063] As shown in FIG. 2, the vent holes 83, 84 on the upper stage side formed in the third partition wall 63 are communicated with the first airflow path 59a on the upper stage side. Moreover, the vent holes 81, 82 on the lower stage side are communicated with the first airflow path 59b on the lower stage side.

[0064] As shown in FIG. 3, the vent holes 85, 86 on the upper stage side formed in the fourth partition wall 64 are communicated with the second airflow path 60a on the upper stage side. Moreover, the vent holes 87, 88 on the lower stage side are communicated with the second airflow path 60b on the upper stage side.

[0065] Among the vent holes 81 to 88 formed in the third and fourth partition walls 63, 64, the four vent holes 81, 83, 85, 87 arranged on the front side are communicated with the first heat exchange chamber 57 on the front side (refer to FIG. 1), and the four vent holes 82, 84, 86, 88 arranged on the back side are communicated with the second heat exchange chamber 58 on the back side (refer to FIG. 1).

[0066] Each of the dampers 41 to 48 performs opening and closing operation in accordance with the following opening and closing patterns.

[0067] As shown in FIG. 2, among the dampers 41 to 44 provided in the third partition wall 63, the front and back dampers 43, 44 on the upper stage side alternately open and close (when one opens, the other closes, and when the other opens, one closes). Similarly, the front and back dampers 41, 42 on the lower stage also alternately open and close. Moreover, the upper and lower dampers 43, 41 on the front side alternately open and close, and the upper and lower dampers 44, 42 on the back side also alternately open and close.

[0068] As shown in FIG. 3, among the dampers 45 to 48 provided in the fourth partition wall 64, the front and back dampers 45, 46 on the upper stage side alternately open and close, and the front and back dampers 47, 48

on the lower stage also alternately open and close. Moreover, the upper and lower dampers 45, 47 on the front side alternately open and close, and the upper and lower dampers 46, 48 on the back side also alternately open and close.

[0069] Among the dampers 41, 42, 47, 48 on the lower stage side provided in the third and fourth partition walls 63, 64, the two dampers 41, 47 arranged on the front side form a pair to simultaneously open and close (when one opens, the other also opens, and when one closes, the other also closes), and the two dampers 42, 48 arranged on the back side form a pair to simultaneously open and close.

[0070] Similarly, among the dampers 43, 44, 45, 46 on the upper stage side provided in the third and fourth partition walls 63, 64, the two dampers 43, 45 arranged on the front side form a pair to simultaneously open and close, and the two dampers 44, 46 arranged on the back side form a pair to simultaneously open and close.

[0071] In the present embodiment, combination of the above-described opening and closing patterns of the dampers 41 to 48 allows the airflow to be switched between an aspect shown in FIG. 5 and an aspect shown in FIG. 6.

[0072] In the aspect shown in FIG. 5, the indoor air taken in from the inside air intake 53 by the first fan 34 passes through the first heat exchange chamber 57, flows into the first casing 11A through the first relay outlet 22a and the first relay intake 22b, and is exhausted from the exhaust outlet 52. Moreover, the outdoor air taken in from the outside air intake 51 by the second fan 35 passes through the second heat exchange chamber 58, flows into the first casing 11A through the second relay outlet 23a and the second relay intake 23b, and is exhausted from the supply air outlet 54.

[0073] Moreover, in the aspect shown in FIG. 6, the indoor air taken in from the inside air intake 53 by the first fan 34 passes through the second heat exchange chamber 58, flows into the first casing 11A through the first relay outlet 22a and the first relay intake 22b, and is exhausted from the exhaust outlet 52. Moreover, the indoor air taken in from the outside air intake 51 by the second fan 35 passes through the first heat exchange chamber 57, flows into the first casing 11A through the second relay outlet 23a and the second relay intake 23b, and is exhausted from the supply air outlet 54.

[0074] FIGS. 7A and 7B are explanatory views respectively showing air flows between the first and second airflow paths 59, 60, and the first and second heat exchange chambers 57, 58, corresponding to the aspect of the airflow shown in FIG. 5.

[0075] As shown in FIG. 7A, airflow flowing in the second airflow path 60b on the lower stage side from the inside air intake 53 flows into the first heat exchange chamber 57 through the vent hole 87 formed on the lower stage front side of the fourth partition wall 64. Thereafter, the airflow passes through the first heat exchanger 31, flows into the first airflow path 59b on the lower stage

side through the vent hole 81 formed on the lower stage front side of the third partition wall 63, and is exhausted from the first relay outlet 22a.

[0076] At the same time, as shown in FIG. 7B, airflow flowing in the first airflow path 59a on the upper stage side from the outside air intake 51 flows into the second heat exchange chamber 58 through the vent hole 84 formed on the upper stage back side of the third partition wall 63. Thereafter, the airflow passes through the second heat exchanger 32, flows into the second airflow path 60a on the upper stage side through the vent hole 86 formed on the upper stage back side of the fourth partition wall 64, and is exhausted from the second relay outlet 23a.

[0077] FIGS. 8A and 8B are explanatory views respectively showing air flows between the first and second airflow paths 59, 60, and the first and second heat exchange chambers 57, 58, corresponding to the aspect of the airflow shown in FIG. 6.

[0078] As shown in FIG. 8A, airflow flowing in the second airflow path 60b on the lower stage side from the inside air intake 53 flows into the second heat exchange chamber 58 through the vent hole 88 formed on the lower stage back side of the fourth partition wall 64. Thereafter, the airflow passes through the second heat exchanger 32, flows into the first airflow path 59b on the lower stage side through the vent hole 82 formed on the lower stage back side of the third partition wall 63, and is exhausted to the inside of the room from the first relay outlet 22a.

[0079] At the same time, as shown in FIG. 8B, airflow flowing in the first airflow path 59a on the upper stage side from the outside air intake 51 flows into the first heat exchange chamber 57 through the vent hole 83 formed on the upper stage front side of the third partition wall 63. Thereafter, the airflow passes through the first heat exchanger 31, flows into the second airflow path 60a on the upper stage side through the vent hole 85 formed on the upper stage front side of the fourth partition wall 64, and is exhausted to the outside of the room from the second relay outlet 23a.

[0080] The aspect of the airflow shown in FIG. 5 and FIGS. 7A and 7B, and the aspect of the airflow shown in FIG. 6, and FIGS. 8A and 8B are executed by being alternately repeated every predetermined time (e.g., every three minutes) in accordance with the switching operation (first and second refrigerating cycle operations) of the refrigerant circulation direction shown in FIGS. 4A and 4B. This enables the humidity control device 10 to perform dehumidification operation and humidification operation.

(Description of dehumidification)

[0081] First, the dehumidification operation will be described. In the first refrigerating cycle operation, as shown in FIG. 4A, the refrigerant discharged from the compressor 27 radiates heat and condenses in the first heat exchanger 31, and is then sent to the electric ex-

pansion valve 28 to be decompressed. The decompressed refrigerant absorbs heat and evaporates in the second heat exchanger 32, and is then sucked into the compressor 27 to be compressed, and is again discharged. Accordingly, in the first refrigerating cycle operation, the first heat exchanger 31 functions as a condenser, and the second heat exchanger 32 functions as an evaporator.

[0082] At this time, as shown in FIG. 5 and FIGS. 7A and 7B, the outdoor air OA taken in from the outside air intake 51 passes through the second heat exchanger 32, and the air SA after the heat exchange is exhausted from the supply air outlet 54. Moreover, the indoor air RA taken in from the inside air intake 53 passes through the first heat exchanger 31, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the first heat exchanger 31 as the condenser, moisture adsorbed by the adsorbent is desorbed by heat of the refrigerant, and is taken into the indoor air RA. Thereby, the adsorbent of the first heat exchanger 31 is reproduced, and the indoor air RA is humidified, and the air EA after the humidification is exhausted to the outside of the room from the exhaust outlet 52. Moreover, in the second heat exchanger 32 as the evaporator, moisture contained in the outdoor air OA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the outdoor air OA is dehumidified. The air SA after the dehumidification is supplied to the inside of the room from the supply air outlet 54.

[0083] In the second refrigerating cycle operation, as shown in FIG. 4B, the refrigerant discharged from the compressor 27 radiates heat and condenses in the second heat exchanger 32, and is then sent to the electric expansion valve 28 to be decompressed. The decompressed refrigerant absorbs heat and evaporates in the first heat exchanger 31, and is then sucked into the compressor 27 to be compressed, and is again discharged. Accordingly, in the second refrigerating cycle operation, the first heat exchanger 31 functions as an evaporator, and the second heat exchanger 32 functions as a condenser.

[0084] At this time, as shown in FIG. 6 and FIGS. 8A and 8B, the outdoor air OA taken in from the outside air intake 51 passes through the first heat exchanger 31, and the air SA after the heat exchange is exhausted from the supply air outlet 54. The indoor air RA taken in from the inside air intake 53 passes through the second heat exchanger 32, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the second heat exchanger 32 as the condenser, moisture adsorbed by the adsorbent is desorbed by heat of the refrigerant, and is taken into the indoor air RA. Thereby, the adsorbent of the second heat exchanger 32 is reproduced, and the indoor air RA is humidified, and the air EA after the humidification is exhausted to the outside of the room from the exhaust outlet 52. Moreover, in the first heat exchanger 31 as the evaporator, moisture contained in the outdoor air OA is adsorbed (collected) by

the adsorbent by heat absorption of the refrigerant, so that the outdoor air OA is dehumidified. The air SA after the dehumidification is supplied to the inside of the room from the supply air outlet 54.

(Description of humidification)

[0085] Next, humidification operation will be described. In the first refrigerating cycle operation shown in FIG. 4A, the first heat exchanger 31 functions as the condenser, and the second heat exchanger 32 functions as the evaporator. At this time, as shown in FIG. 6 and FIGS. 8A and 8B, the outdoor air OA taken in from the outside air intake 51 passes through the first heat exchanger 31, and the air SA after the heat exchange is exhausted from the supply air outlet 54. The indoor air RA taken in from the inside air intake 53 passes through the second heat exchanger 32, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the first heat exchanger 31 as the condenser, moisture adsorbed by the adsorbent is desorbed by the heat of the refrigerant, and is taken into the indoor air RA. Thereby, the adsorbent is reproduced, and the indoor air RA is humidified, and the air EA after the humidification is supplied to an inside of a room from the supply air outlet 54. Moreover, in the second heat exchanger 32 as the evaporator, moisture contained in the outdoor air OA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the outdoor air OA is dehumidified. The air EA after the dehumidification is exhausted to the outside of the room from the exhaust outlet 52.

[0086] In the second refrigerating cycle operation shown in FIG. 4B, the first heat exchanger 31 functions as the evaporator, and the second heat exchanger 32 functions as the condenser. At this time, as shown in FIG. 5 and FIGS. 7A and 7B, the outdoor air OA taken in from the outside air intake 51 passes through the second heat exchanger 32, and the air SA after the heat exchange is exhausted from the supply air outlet 54. The indoor air RA taken in from the inside air intake 53 passes through the first heat exchanger 31, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the second heat exchanger 32 as the condenser, moisture adsorbed by the adsorbent is desorbed by the heat of the refrigerant, and is taken into the indoor air RA. Thereby, the adsorbent is reproduced, and the indoor air RA is humidified, and the air EA after the humidification is supplied to the inside of the room from the supply air outlet 54. Moreover, in the first heat exchanger 31 as the evaporator, moisture contained in the outdoor air OA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the outdoor air OA is dehumidified. The air EA after the dehumidification is exhausted to the outside of the room from the exhaust outlet 52.

<Second Embodiment>

[0087] Next, a second embodiment of the present invention will be described with reference to FIGS. 10 to 17. The present embodiment is different from the first embodiment mainly in the configuration of an airflow control mechanism 13.

[0088] The airflow control mechanism 13 of the present embodiment is configured to take outdoor air and indoor air into a first casing 11A as shown in FIGS. 10 to 12, send the outdoor air and the indoor air to a second casing 11B and pass the same through the heat exchangers 31, 32, and then generate airflow blowing to an inside and an outside of a room from the second casing 11B. Specifically, a first fan 34 and a second fan 35 in the airflow control mechanism 13 suck the outdoor air and the indoor air into the first casing 11A.

[0089] The first fan 34 and the second fan 35 are each configured by a sirocco fan as in the first embodiment. In the sirocco fan, as shown in FIG. 17, a multiblade impeller 37 rotated by a motor 36 is provided inside a fan casing 38. The fan casing 38 is formed into a cylindrical shape, and in both side surfaces of the fan casing 38, suction ports 38a are formed, and in an outer surface, a discharge port 38b is formed. Moreover, the first fan 34 and the second fan 35 are each configured so that an airflow rate can be adjusted by inverter control.

[0090] Moreover, the airflow control mechanism 13, as shown in FIGS. 10 to 12, includes a plurality of dampers 41 to 48 that control flow paths of the air taken into the casings 11A, 11B by the first and second fans 34, 35. In a second side plate 21b of the first casing 11A, an outside air intake 51 to take indoor air into the first casing 11A is formed. A duct D1 leading to the outside of the room is connected to this outside air intake 51. Inside the first casing 11A in the vicinity of the outside air intake 51, the first fan 34 for outside air intake is arranged.

[0091] In a third side plate 21c of the first casing 11A, an inside air intake 53 to take indoor air into the first casing 11A is formed. A duct D3 leading to the inside of the room is connected to this inside air intake 53. Moreover, inside the first casing 11A in the vicinity of the inside air intake 53, the second fan 35 for inside air intake is arranged.

[0092] In both right and left end portions in a fourth side plate 21d of the first casing 11A, first and second relay outlets 22a, 23a are formed, respectively. The outdoor air taken into the first casing 11A from the outside air intake 51 is blown out from the first relay outlet 22a, and the indoor air taken into the first casing 11A from the inside air intake 53 is blown out from the second relay outlet 23a. One end of each of a duct for outside air D5 and a duct for inside air D6 leading to the second casing 11B is connected to each of the first and second relay outlets 22a, 23a.

[0093] On a back portion side of a sixth side plate 24b in the second casing 11B, an exhaust outlet 52 to exhaust the air to the outside of the room from the second casing 11B is formed. A duct D2 leading to the outside of the

room is connected to this exhaust outlet 52. Moreover, on a back portion side of a seventh side plate 24c in the second casing 11B, a supply air outlet 54 to exhaust the air to the inside of the room from the second casing 11B is formed. A duct D4 leading to the inside of the room is connected to this supply air outlet 54.

[0094] On a front portion side of the sixth side plate 24b and the seventh side plate 24c in the second casing 11B, first and second relay intakes 22b, 23b are formed, respectively. The other end of the duct for outside air D5 is connected to the first relay intake 22b, and the other end of the duct for inside air D6 is connected to the second relay intake 23b. Accordingly, the outdoor air taken into the first casing 11A is taken into the second casing 11B through the duct for outside air D5, and the indoor air taken into the first casing 11A is taken into the second casing 11B through the duct for inside air D6.

[0095] The above-described configuration allows the inside and the outside of the room to be communicated with each other through the ducts D1 to D6, and the first and second casings 11A, 11B.

[0096] As shown in FIG. 10, inside the first casing 11A, as in the first embodiment, first and second air blowing chambers 56a, 56b where the first fan 34 and the second fan 35 are arranged are provided by being partitioned by a second partition wall 62.

[0097] As shown in FIGS. 10 and 17, on a front side of both right and left end portions of the fourth side plate 21d, there are provided inclined plates 21dl each inclined so that a more outer portion thereof in the right-left direction is located on a more front side. The discharge ports 38b of the first and second fans 34, 35 are connected to these inclined plates 21dl. Moreover, the first and second fans 34, 35 are arranged so that a rotating shaft of each of the impellers 37 is substantially parallel to the inclined plate 21dl. Accordingly, the first and second fans 34, 35 are arranged in postures inclined to the second side plate 21b and the third side plate 21c.

[0098] Thus, the suction ports 38a formed in the side surfaces of the fan casing 38 of the first and second fans 34, 35 are arranged apart from the second side plate 21b and the third side plate 21c, and air bringing-in spaces 70 are formed between both, which spaces are each substantially triangular in planar view. These air bringing-in spaces 70 each function as a flowing space of the air before being sucked into the fan casing 38 from the suction ports 38a. Particularly, each of the air bringing-in spaces 70 effectively functions as the flowing space of the air (indicated by arrow a in FIG. 17) flowing into the suction ports 38a from an outer circumferential side of the suction ports 38a, and is useful for smoothly guiding the airflow to the suction ports 38a. Accordingly, forming the above-described air bringing-in spaces 70 effectively reduces pressure loss of the air sucked into the suction ports 38a of the first and second fans 34, 35 from the outside air intake 51 and the inside air intake 53, so that the outside air and the inside air can be efficiently taken into the first casing 11A.

[0099] Moreover, since the first and second fans 34, 35 are arranged in the vicinity of the outside air intake 51 and the inside air intake 53, actuation sound and blowing sound of the first and second fans 34, 35 are attenuated while the airflow passes through the insides of the first and second casings 11A, 11B and the ducts D5, D6. Accordingly, the sound can be prevented from being propagated outside the first and second casings 11A, 11B, thereby causing noise. In addition to the above-described arrangement of the first and second fans 34, 35, the first casing 11A in which these first and second fans 34, 35 are housed is arranged outdoors, which can surely prevent the sound of the first and second fans 34, 35 from being transmitted to the inside of the room.

[0100] In each of the air bringing-in spaces 70, an air filter 71 is arranged. These air filters 71 are arranged substantially parallel to the side surfaces of the fans 34, 35. Accordingly, the air filters 71 are also arranged so as to be inclined to the second side plate 21b and the third side plate 21c. The above-described inclined arrangement of the air filters 71 can expand an area of flow-through of the air. Moreover, part or all of a first side plate 21a of the first casing 11A is configured detachably, and by detaching part or all of the first side plate 21a, an attachment/detachment port for attaching and detaching the air filters 71 can be formed. As indicated by arrow b in FIG. 10, the air filters 71 are drawn out obliquely forward, by which the air filters 71 can be detached from the first casing 11A, so that the air filters 71 can be cleaned or replaced.

[0101] In the air bringing-in spaces 70, sensors 72, 73 and the like that measure temperature and humidity of the air taken in from the outside air intake 51 and the inside air intake 53 are provided. Electric wiring of these sensors 72, 73 and the like is drawn from the first and second air blowing chambers 56a, 56b into an electric component unit 15 provided in the first side plate 21a. In this manner, the outside air intake 51 and the inside air intake 53 are arranged in the first casing 11A together with the electric component unit 15, by which the electric wiring of the sensors 72, 73 and the like can be connected to the electric component unit 15 at short distances. Moreover, penetration of the electric wiring through the partition wall inside the first casing 11A is reduced as much as possible, so that air leakage between the partitioned spaces can be prevented from occurring.

[0102] In front of the first casing 11A, as in the first embodiment, a working space for maintenance to perform inspection, part replacement and the like of the electric component unit 15 is formed. However, as described before, since the air filters 71 are attached and detached in front of the first casing 11A, the attachment and detachment working of the air filters 71 can be performed, using the same working space.

[0103] Accordingly, in the present embodiment, the air filters 71 are concentratively arranged in the first casing 11A together with the electric component unit 15, the first and second fans 34, 35, and part of the refrigerant circuit

12 (four way valve 26 and the like), which have relatively high maintenance frequency, and the working space for maintenance of these can be concentratively formed on one side of the first casing 11A (in front of the first side plate 21a).

[0104] Configurations of first and second heat exchange chambers 57, 58 and first and second airflow paths 59, 60, arrangement of first and second heat exchangers 31, 32, and the like inside the second casing 11B are similar to those in the first embodiment.

[0105] As shown in FIGS. 11, the first airflow path 59 is partitioned by a sixth partition wall 66 into two upper/lower stages. A first relay intake 22b formed in the sixth side plate 24b (refer to FIG. 10) is communicated with a first airflow path 59b on a lower stage side. Moreover, the exhaust outlet 52 is communicated with a first airflow path 59a on an upper stage side.

[0106] As shown in FIG. 12, the second airflow path 60 is partitioned into two upper/lower stages by a seventh partition wall 67. The second relay intake 23b formed in the seventh side plate 24c (refer to FIG. 10) is communicated with a second airflow path 60a on an upper stage side. Moreover, the supply air outlet 54 is communicated with a second airflow path 60b on a lower stage side.

[0107] As described above, since the first relay intake 22b and the exhaust outlet 52 are formed in the sixth side plate 24b, and the second relay intake 23b and the supply air outlet 54 are formed in the seventh side plate 24c, in fifth and eighth side plates 24a, 24d of the second casing 11B, no opening through which the air flows is formed, and no duct is connected, as in the first embodiment. Thus, spaces for arranging the ducts and the like are not required around the fifth and eighth side plates 24a, 24d, and maintenance of inspection, replacement and the like to the heat exchangers 31, 32 can be performed by detaching one of the fifth side plate 24a and the eighth side plate 24d.

[0108] Moreover, in the present embodiment as well, an installation aspect of the humidity control device can be configured as shown in FIG. 9. Particularly, in the present embodiment, arranging a first unit 10A outdoors allows the maintenance of the air filters 71 to be performed outdoors together with the fans 34, 35, a compressor 27 and the like, and the inside of the room can be used as usual during the maintenance.

[0109] Next, the configuration of the airflow control mechanism 13 will be described in more detail.

[0110] In the present embodiment as well, a configuration of vent holes 81 to 88 formed in the second casing 11B, and the dampers 41 to 44 that open and close the vent holes 81 to 88 is similar to that in the first embodiment.

[0111] Moreover, opening and closing patterns of the respective dampers 41 to 48 are also similar to those in the first embodiment. In the present embodiment, combination of the above-described opening and closing patterns of the dampers 41 to 48 allows the airflow to be switched between an aspect shown in FIG. 13 and an

aspect shown in FIG. 14.

[0112] In the aspect shown in FIG. 13, the outdoor air taken in from the outside air intake 51 by the first fan 34 inside the first casing 11A flows into the second casing 11B through the first relay outlet 22a and the first relay intake 22b, passes through the first heat exchange chamber 57, and is exhausted from the supply air outlet 54. Moreover, the indoor air taken in from the inside air intake 53 by the second fan 35 inside the first casing 11A flows into the second casing 11B through the second relay outlet 23a and the second relay intake 23b, passes through the second heat exchange chamber 58, and is exhausted from the exhaust outlet 52.

[0113] Moreover, in the aspect shown in FIG. 14, the outdoor air taken in from the outside air intake 51 by the first fan 34 inside the first casing 11A flows into the second casing 11B through the first relay outlet 22a and the first relay intake 22b, passes through the second heat exchange chamber 58, and is exhausted from the supply air outlet 54. Moreover, the indoor air taken in from the inside air intake 53 by the second fan 35 inside the first casing 11A flows into the second casing 11B through the second relay outlet 23a and the second relay intake 23b, passes through the first heat exchange chamber 57, and is exhausted from the exhaust outlet 52.

[0114] FIGS. 15A and 15B are explanatory views respectively showing air flows between the first and second airflow paths 59, 60, and the first and second heat exchange chambers 57, 58, corresponding to the aspect of the airflow shown in FIG. 13.

[0115] As shown in FIG. 15A, airflow flowing in the first airflow path 59b on the lower stage side from the first relay intake 22b flows into the first heat exchange chamber 57 through the vent hole 81 formed on the lower stage front side of a third partition wall 63. Thereafter, the airflow passes through the first heat exchanger 31, flows into the second airflow path 60b on the lower stage side through the vent hole 87 formed on the lower stage front side of a fourth partition wall 64, and is exhausted to the inside of the room from the supply air outlet 54.

[0116] At the same time, as shown in FIG. 15B, airflow flowing in the second airflow path 60a on the upper stage side from the second relay intake 23b flows into the second heat exchange chamber 58 through the vent hole 86 formed on the upper stage back side of the fourth partition wall 64. Thereafter, the airflow passes through the second heat exchanger 32, flows into the first airflow path 59a on the upper stage side through the vent hole 84 formed on the upper stage back side of the third partition wall 63, and is exhausted to the outside of the room from the exhaust outlet 52.

[0117] FIGS. 16A and 16B are explanatory views respectively showing air flows between the first and second airflow paths 59, 60, and the first and second heat exchange chambers 57, 58, corresponding to the aspect of the airflow shown in FIG. 14.

[0118] As shown in FIG. 16A, airflow flowing in the first airflow path 59b on the lower stage side from the first

relay intake 22b flows into the second heat exchange chamber 58 through the vent hole 82 formed on the lower stage back side of the third partition wall 63. Thereafter, the airflow passes through the second heat exchanger 32, flows into the second airflow path 60b on the lower stage side through the vent hole 88 formed on the lower stage back side of the fourth partition wall 64, and is exhausted to the inside of the room from the supply air outlet 54.

[0119] At the same time, as shown in FIG. 16B, airflow flowing in the second airflow path 60a on the upper stage side from the second relay intake 23b flows into the first heat exchange chamber 57 through the vent hole 85 formed on the upper stage front side of the fourth partition wall 64. Thereafter, the airflow passes through the first heat exchanger 31, flows into the first airflow path 59a on the upper stage side through the vent hole 83 formed on the upper stage front side of the third partition wall 63, and is exhausted to the outside of the room from the exhaust outlet 52.

[0120] The aspect of the airflow shown in FIG. 13 and FIGS. 15A and 15B, and the aspect of the airflow shown in FIG. 14 and FIGS. 16A and 16B are executed by being alternately repeated every predetermined time (e.g., every three minutes) in accordance with the switching operation (first and second refrigerating cycle operations) of the refrigerant circulation direction shown in FIGS. 4A and 4B. This enables the humidity control device 10 to perform dehumidification operation and humidification operation.

(Description of dehumidification)

[0121] Dehumidification operation in the present embodiment will be described. In the first refrigerating cycle operation shown in FIG. 4A, the refrigerant discharged from the compressor 27 radiates heat and condenses in the first heat exchanger 31, and is then sent to an electric expansion valve 28 to be decompressed. The decompressed refrigerant absorbs heat and evaporates in the second heat exchanger 32, and is then sucked into the compressor 27 to be compressed, and is again discharged. Accordingly, in the first refrigerating cycle operation, the first heat exchanger 31 functions as a condenser, and the second heat exchanger 32 functions as an evaporator.

[0122] At this time, as shown in FIG. 14 and FIGS. 16A and 16B, outdoor air OA taken in from the outside air intake 51 passes through the second heat exchanger 32, and air SA after the heat exchange is exhausted from the supply air outlet 54. Moreover, indoor air RA taken in from the inside air intake 53 passes through the first heat exchanger 31, and air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the first heat exchanger 31 as the condenser, moisture adsorbed by the adsorbent is desorbed by heat of the refrigerant, and is taken into the indoor air RA. Thereby, the adsorbent of the first heat exchanger 31 is repro-

duced, and the indoor air RA is humidified, and the air EA after the humidification is exhausted to the outside of the air from the exhaust outlet 52. Moreover, in the second heat exchanger 32 as the evaporator, moisture contained in the outdoor air OA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the outdoor air OA is dehumidified. The air SA after the dehumidification is supplied to the inside of the room from the supply air outlet 54.

[0123] In the second refrigerating cycle operation shown in FIG. 4B, the refrigerant discharged from the compressor 27 radiates heat and condenses in the second heat exchanger 32, and is then sent to the electric expansion valve 28 to be decompressed. The decompressed refrigerant absorbs heat and evaporates in the first heat exchanger 31, and is then sucked into the compressor 27 to be compressed, and is again discharged. Accordingly, in the second refrigerating cycle operation, the first heat exchanger 31 functions as an evaporator, and the second heat exchanger 32 functions as a condenser.

[0124] At this time, as shown in FIG. 13 and FIGS. 15A and 15B, the outdoor air OA taken in from the outside air intake 51 passes through the first heat exchanger 31, and the air SA after the heat exchange is exhausted from the supply air outlet 54. Moreover, the indoor air RA taken in from the inside air intake 53 passes through the second heat exchanger 32, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the second heat exchanger 32 as the condenser, moisture adsorbed by the adsorbent is desorbed by heat of the refrigerant, and is taken into the indoor air RA. Thereby, the adsorbent of the second heat exchanger 32 is reproduced, and the indoor air RA is humidified, and the air EA after the humidification is exhausted to the outside of the room from the exhaust outlet 52. Moreover, in the first heat exchanger 31 as the evaporator, moisture contained in the outdoor air OA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the outdoor air OA is dehumidified. The air SA after the dehumidification is supplied to the inside of the room from the supply air outlet 54.

(Description of humidification)

[0125] Next, humidification operation will be described. In the first refrigerating cycle operation shown in FIG. 4A, the first heat exchanger 31 functions as the condenser, and the second heat exchanger 32 functions as the evaporator. At this time, as shown in FIG. 13 and FIGS. 15A and 15B, the outdoor air OA taken in from the outside air intake 51 passes through the first heat exchanger 31, and the air SA after the heat exchange is exhausted from the supply air outlet 54. The indoor air RA taken in from the inside air intake 53 passes through the second heat exchanger 32, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the first heat exchanger 31 as the condenser, moisture ad-

sorbed by the adsorbent is desorbed by the heat of the refrigerant, and is taken into the outdoor air OA. Thereby, the adsorbent is reproduced, and the outdoor air OA is humidified, and the air SA after the humidification is supplied to the inside of the room from the supply air outlet 54. Moreover, in the second heat exchanger 32 as the evaporator, moisture contained in the indoor air RA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the indoor air RA is dehumidified. The air EA after the dehumidification is exhausted to the outside of the room from the exhaust outlet 52.

[0126] In the second refrigerating cycle operation shown in FIG. 4B, the first heat exchanger 31 functions as the evaporator, and the second heat exchanger 32 functions as the condenser. At this time, as shown in FIG. 14 and FIGS. 16A and 16B, the outdoor air OA taken in from the outside air intake 51 passes through the second heat exchanger 32, and the air SA after the heat exchange is exhausted from the supply air outlet 54. The indoor air RA taken in from the inside air intake 53 passes through the first heat exchanger 31, and the air EA after the heat exchange is exhausted from the exhaust outlet 52. Specifically, in the second heat exchanger 32 as the condenser, moisture adsorbed by the adsorbent is desorbed by the heat of the refrigerant, and is taken into the outdoor air OA. Thereby, the adsorbent is reproduced, and the outdoor air OA is humidified, and the air SA after the humidification is supplied to the inside of the room from the supply air outlet 54. Moreover, in the first heat exchanger 31 as the evaporator, moisture contained in the indoor air RA is adsorbed (collected) by the adsorbent by heat absorption of the refrigerant, so that the indoor air RA is dehumidified. The air EA after the dehumidification is exhausted to the outside of the room from the exhaust outlet 52.

[0127] The present invention is not limited to the above-described embodiments, but modifications can be made within the scope of the invention described in the claims as needed.

[0128] For example, while in the first embodiment, as shown in FIG. 1, the outside air intake 51 and the inside air intake 53 are formed in the sixth side plate 24b and the seventh side plate 24c, respectively, both of them can be formed in the eighth side plate 24d. Moreover, while in the second embodiment, as shown in FIG. 10, the exhaust outlet 52 and the supply air outlet 54 are formed in the sixth side plate 24b and the seventh side plate 24c, respectively, both of them can be formed in the eighth side plate 24d.

[0129] Moreover, in the second embodiment, the first and second fans 34, 35 may be arranged so that the side surfaces provided with the suction ports 38a are parallel to the second side plate 21b and the third side plate 21c. In this case as well, the air bringing-in spaces 70 are preferably formed between the first and second fans 34, 35, and the second and third side plates 21b, 21c of the first casing 11A.

[0130] Moreover, the specific aspects of the airflow in

the airflow control mechanism 13 can be modified as needed. For example, while in the above-described respective embodiments, the configuration is such that the airflow passing through the heat exchange chambers 57, 58 from the airflow paths 59a, 60a on the upper side flows into the airflow paths 60a, 59a on the same upper side, and the airflow passing through the heat exchange chambers 57, 58 from the airflow paths 59b, 60b on the lower side flows into the airflow paths 60b, 59b on the same lower side, unlike this, the configuration may be such that the airflow passing through the heat exchange chambers 57, 58 from the airflow paths 59a, 60a on the upper side flows into the airflow paths 60b, 59b on the lower side, and the airflow passing through the heat exchange chambers 57, 58 from the airflow paths 59b, 60b on the lower side flows into the airflow paths 60a, 59a on the upper side.

REFERENCE SIGNS LIST

[0131]

10: HUMIDITY CONTROL DEVICE
 10A: FIRST UNIT (FUNCTION UNIT)
 10B: SECOND UNIT (HUMIDITY CONTROL UNIT)
 11A: FIRST CASING
 11B: SECOND CASING
 12: REFRIGERANT CIRCUIT
 26: FOUR WAY VALVE (SWITCHING MECHANISM)
 27: COMPRESSOR
 29: REFRIGERANT PIPE

 31: FIRST HEAT EXCHANGER (ADSORPTION HEAT EXCHANGER)
 32: SECOND HEAT EXCHANGER (ADSORPTION HEAT EXCHANGER)
 34: FIRST FAN
 35: SECOND FAN
 51: OUTSIDE AIR INTAKE
 52: EXHAUST OUTLET
 53: INSIDE AIR INTAKE
 54: SUPPLY AIR OUTLET
 71: AIR FILTER
 D5: DUCT FOR OUTSIDE AIR
 D6: DUCT FOR INSIDE AIR

Claims

1. A humidity control device that dehumidifies one of outdoor air and indoor air, and humidifies the other in adsorption heat exchangers (31, 32) each carrying an adsorbent to adsorb moisture of air, and then supplies the outdoor air to an inside of a room, and exhausts the indoor air to an outside of the room, the device comprising:

casings (11A, 11B);

a refrigerant circuit (12) having the adsorption heat exchangers (31, 32), a compressor (27) that circulates a refrigerant, a switching mechanism (26) that switches a circulation direction of the refrigerant, and refrigerant pipes (29) that connect the adsorption heat exchangers (31, 32), the compressor (27), and the switching mechanism (26);

fans (34, 35) that respectively take the outdoor air and the indoor air into one of the casings (11A, 11B); and

an electric component unit (15) including control parts of the humidity control device (10), wherein the casings (11A, 11B) include:

a first casing (11A) in which the fans (34, 35), the switching mechanism (26), and the electric component unit (15) are arranged; and

a second casing (11B) in which the adsorption heat exchangers (31, 32) are arranged, and the first casing (11A) and the second casing (11B) are mutually connected through ducts (D5, D6).

2. The humidity control device according to claim 1, wherein the first casing (11A) is provided with a supply air outlet (54) to supply the air to the inside of the room and an exhaust outlet (52) to exhaust the air to the outside of the room, and the second casing (11B) is provided with an outside air intake (51) to take in the outside air, and an inside air intake (53) to take in the indoor air (53).

3. The humidity control device according to claim 1, wherein the first casing (11A) is provided with an outside air intake (51) to take in the outside air, and an inside air intake (53) to take in the indoor air, and the second casing (11B) is provided with a supply air outlet (54) to supply the air to the inside of the room and an exhaust outlet (52) to exhaust the air to the outside of the room.

4. The humidity control device according to claim 3, wherein air filters (71) are provided on a suction side of the respective fans (34, 35) inside the first casing (11A).

5. The humidity control device according to claim 2, wherein the ducts (D5, D6) include a duct for outside air (D5) that introduces the outdoor air to the first casing (11A), and a duct for inside air (D6) that introduces the indoor air to the first casing (11A), the outdoor air being taken into the second casing (11B) from the outside air intake (51), and the indoor air being taken into the second casing (11A) from the inside air intake (53).

6. The humidity control device according to claim 3 or 4, wherein the ducts (D5, D6) include a duct for outside air (D5) that introduces the outdoor air to the second casing (11B), and a duct for inside air (D6) that introduces the indoor air to the second casing (11B), the outdoor air being taken into the first casing (11A) from the outside air intake (51), and the indoor air being taken into the first casing (11A) from the inside air intake (53). 5
7. The humidity control device according to any one of claims 1 to 6, wherein the compressor (27) is connected to the refrigerant pipes (29) drawn from the first casing (11A). 10
8. The humidity control device according to any one of claims 1 to 6, wherein the compressor (27) is arranged inside the first casing (11A). 15
9. The humidity control device according to claim 7 or 8, wherein a plurality of second units (10B) are connected to a first unit (10A) in parallel, the plurality of second units (10B) each being configured by the second casing (11B) and internal equipment of the second casing (11B), and the first unit (10A) being configured by the first casing (11A), internal equipment of the first casing (11A), and the compressor (27). 20 25

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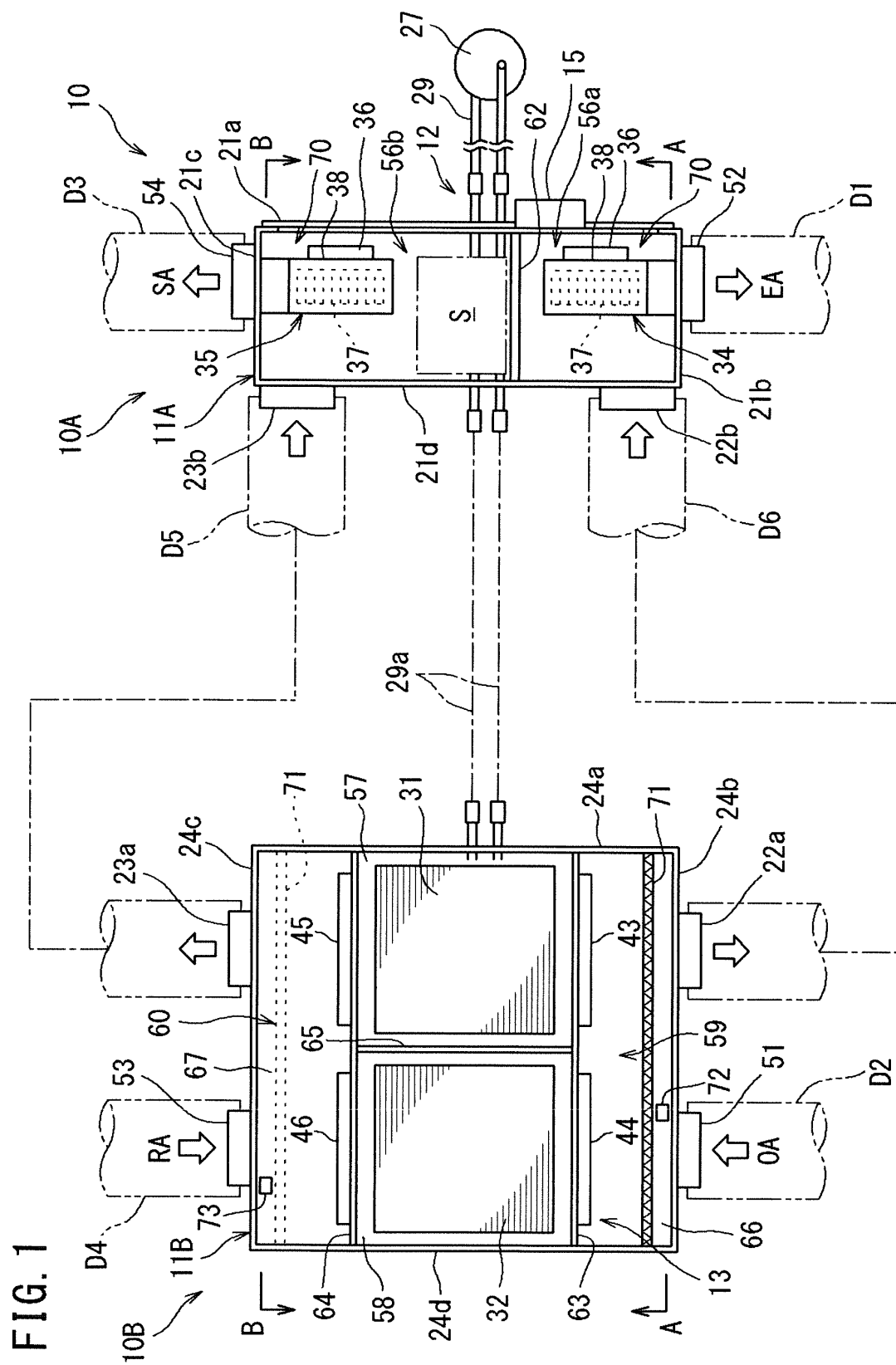


FIG. 2

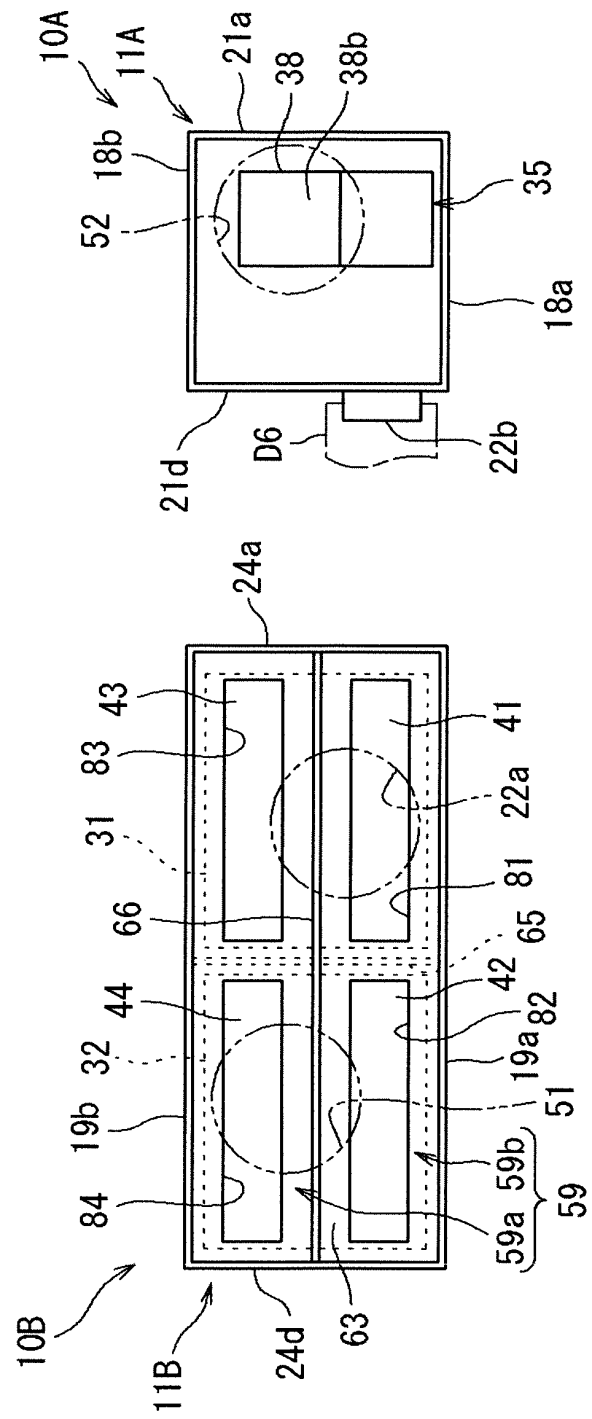


FIG. 3

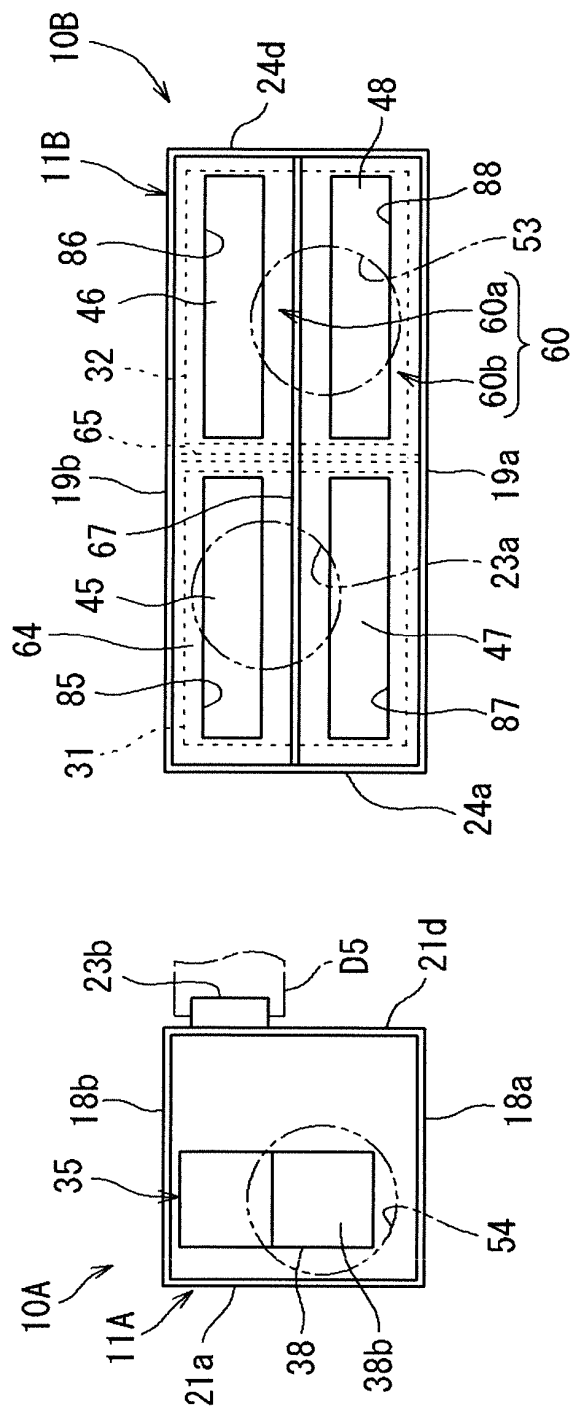


FIG. 4A

FIRST REFRIGERATING CYCLE

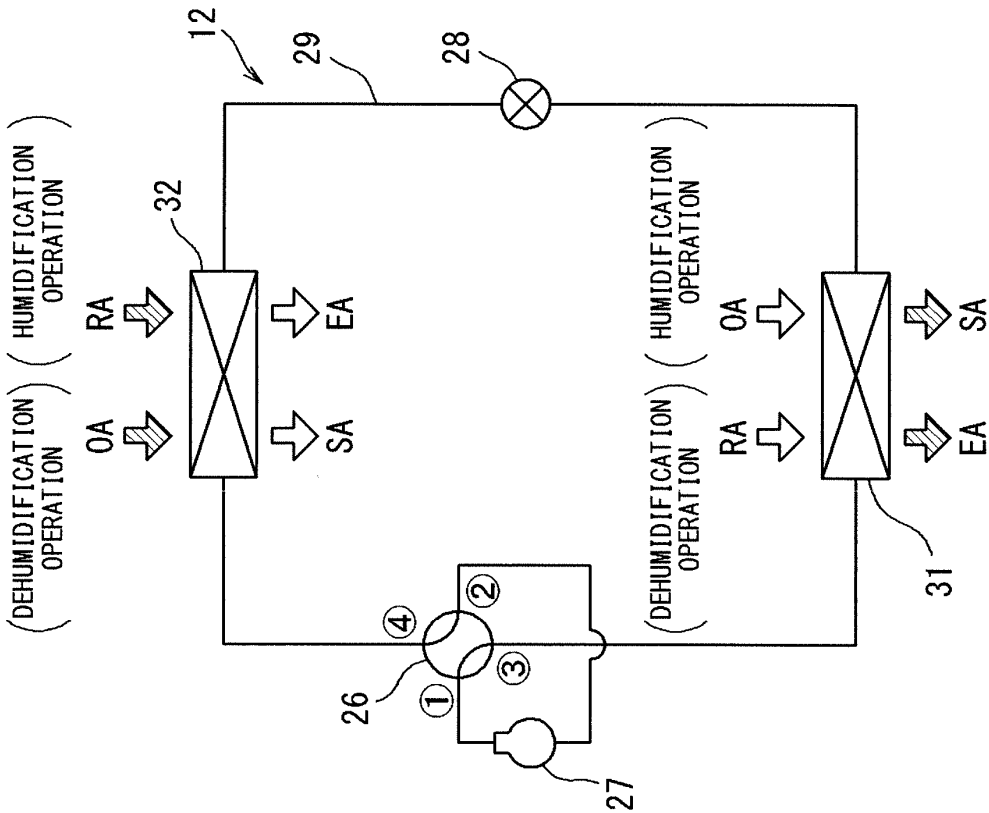


FIG. 4B

SECOND REFRIGERATING CYCLE

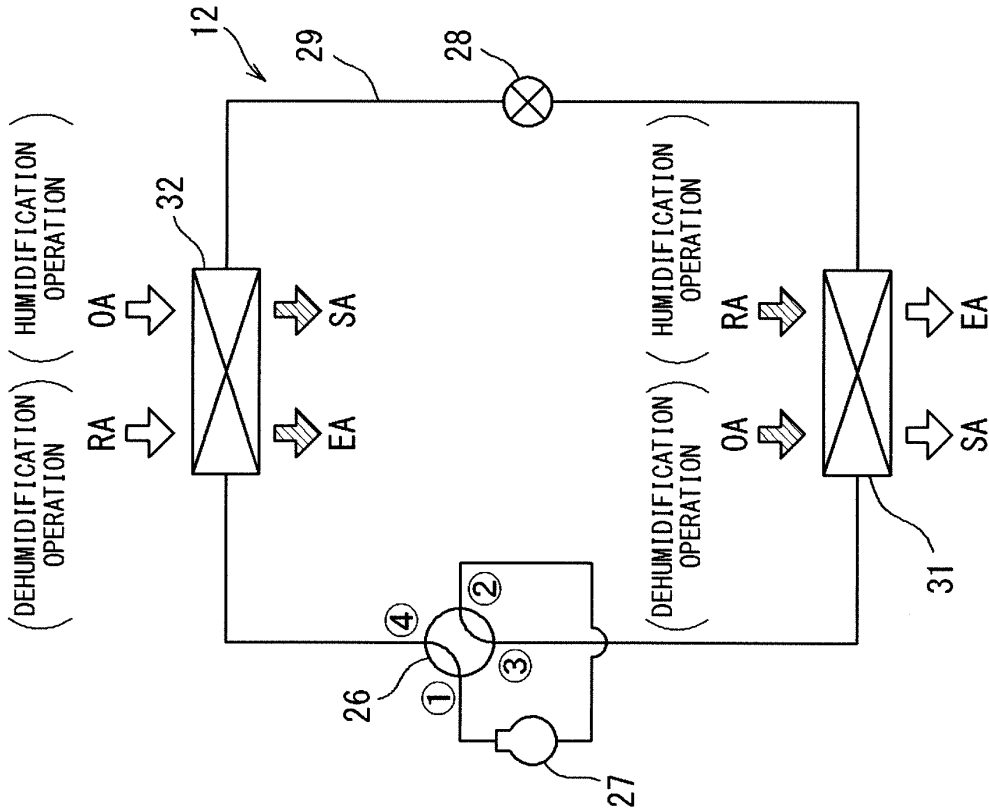


FIG. 5

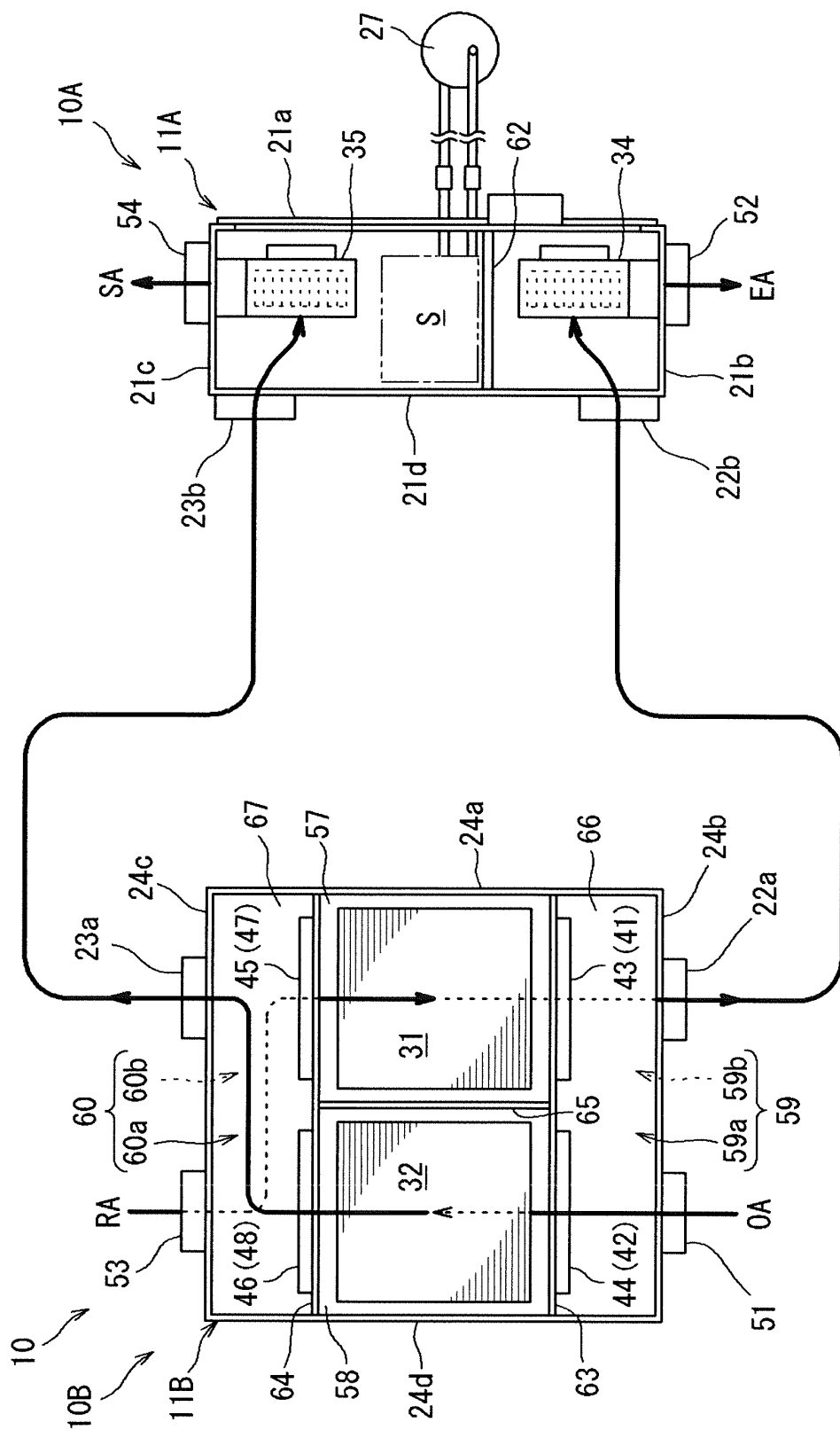


FIG. 6

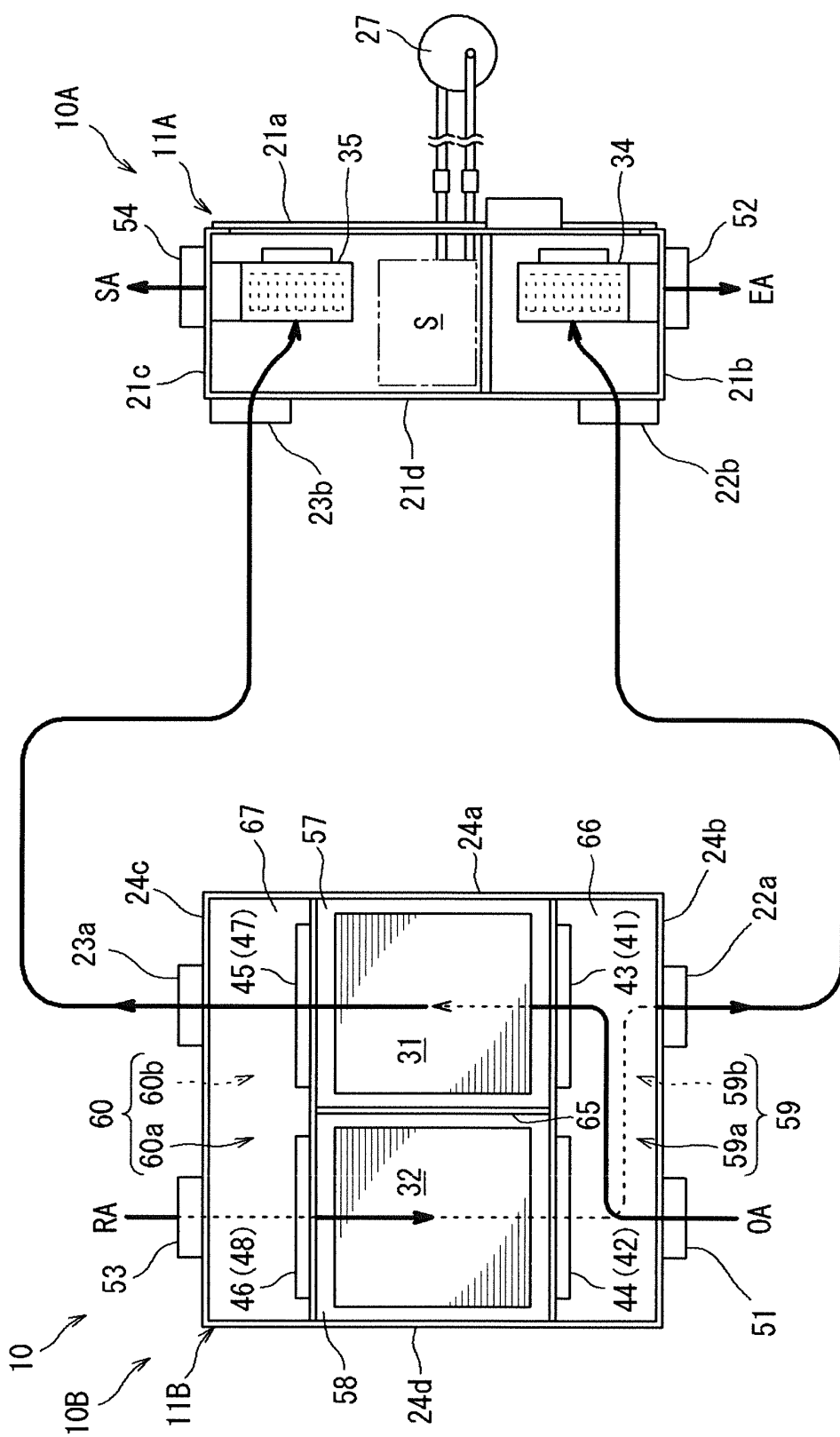


FIG. 7A

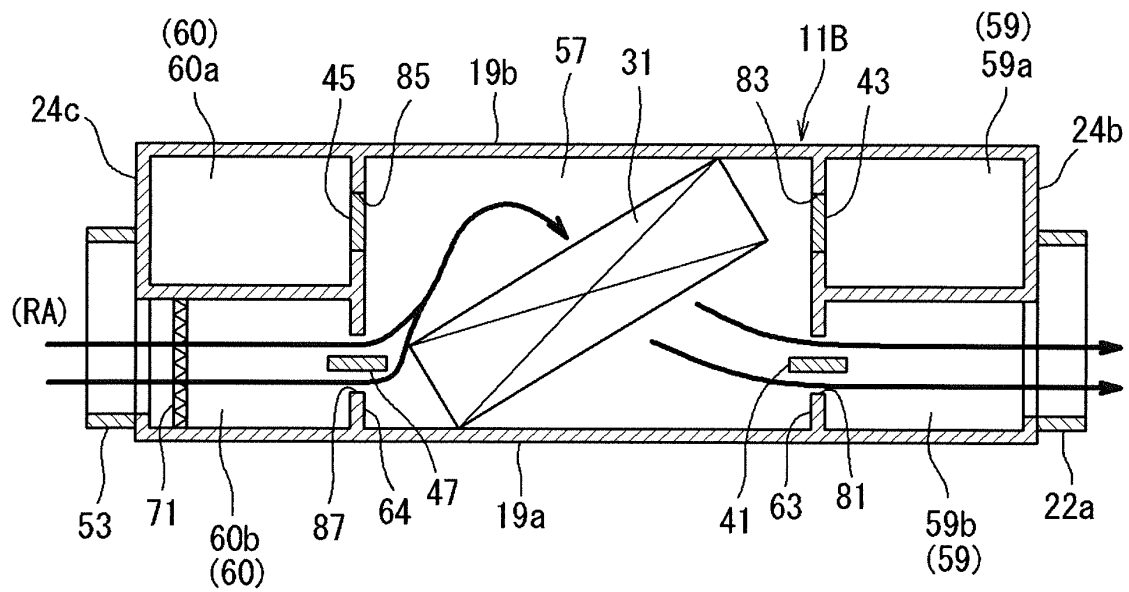


FIG. 7B

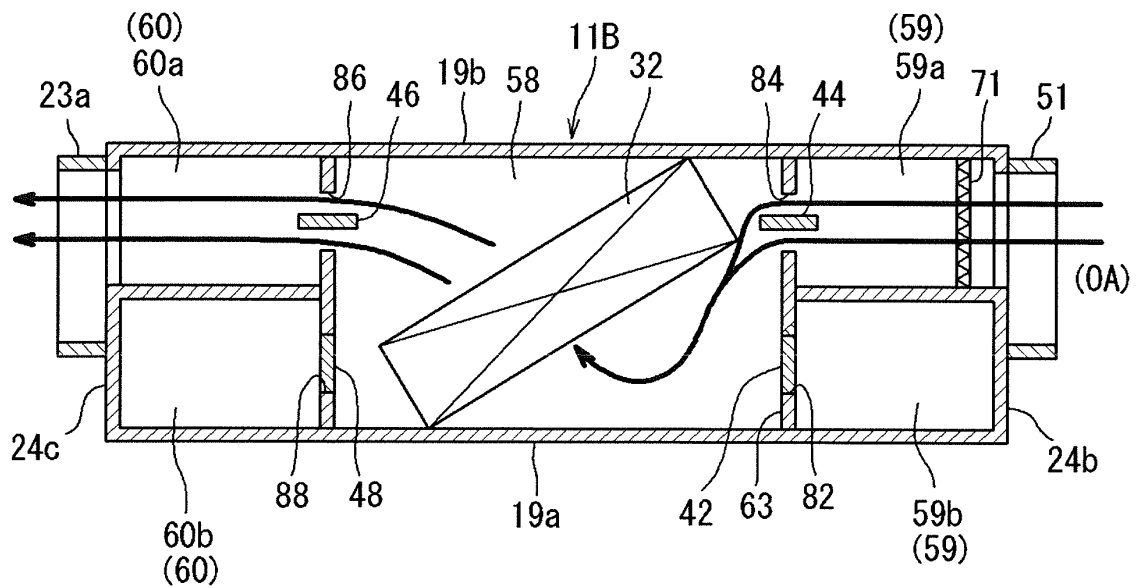


FIG. 8A

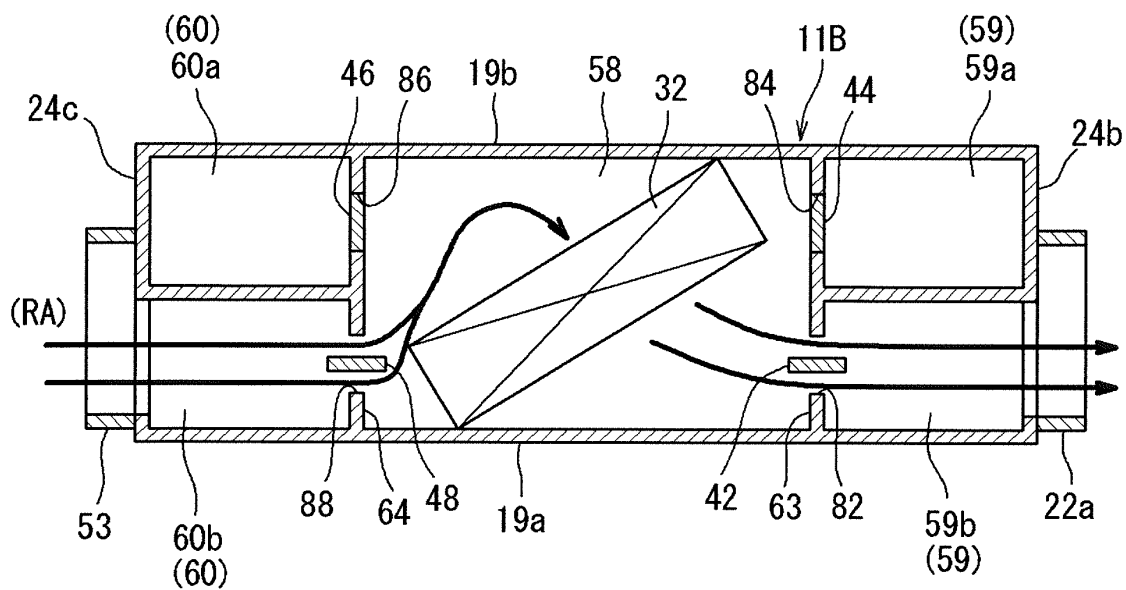


FIG. 8B

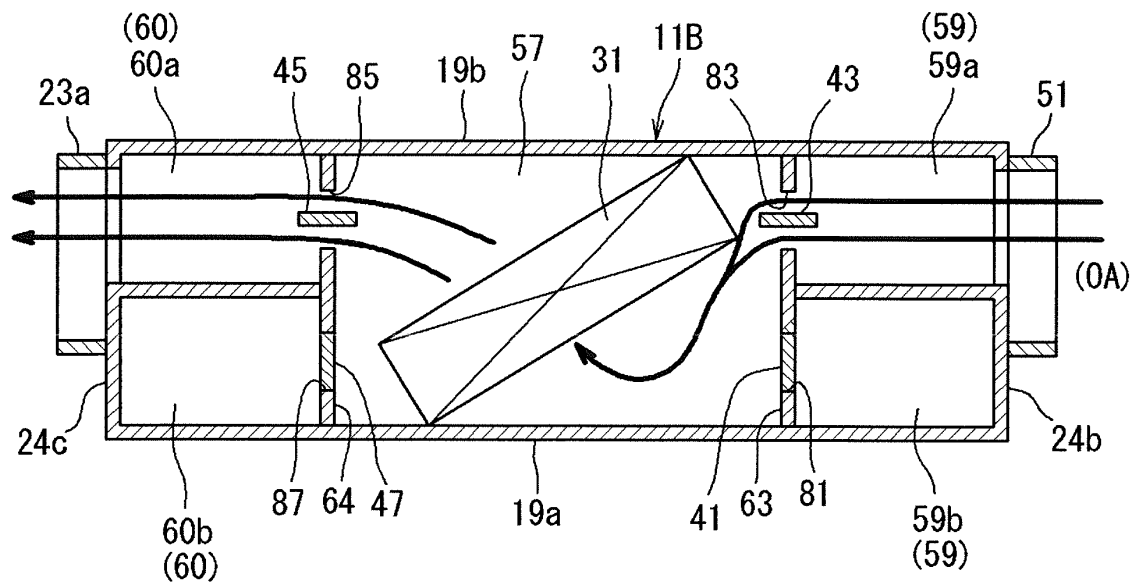


FIG. 9

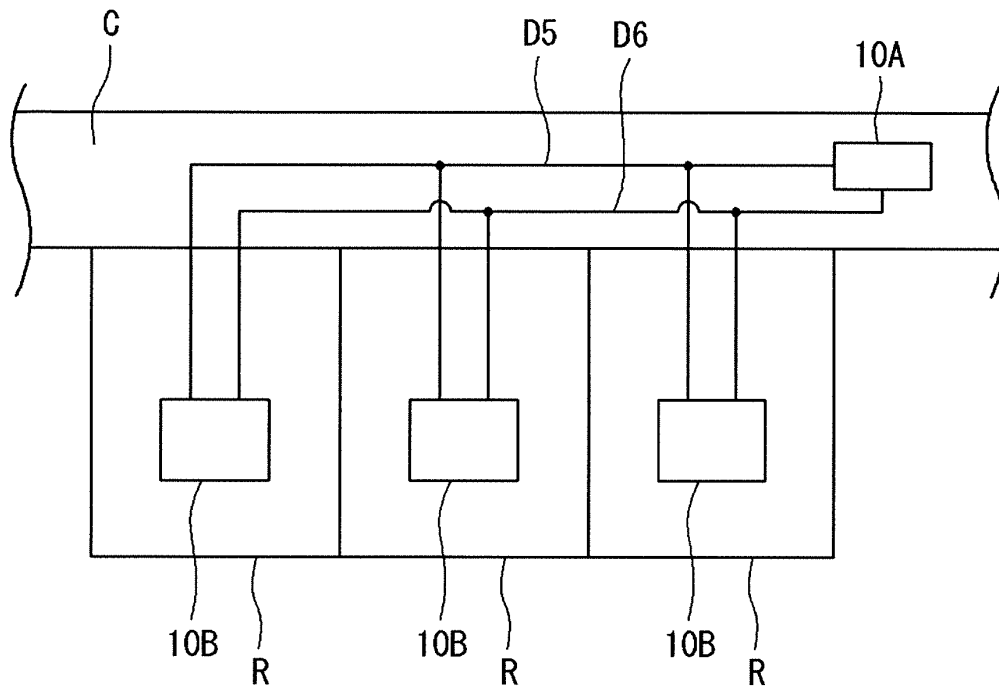


FIG. 10

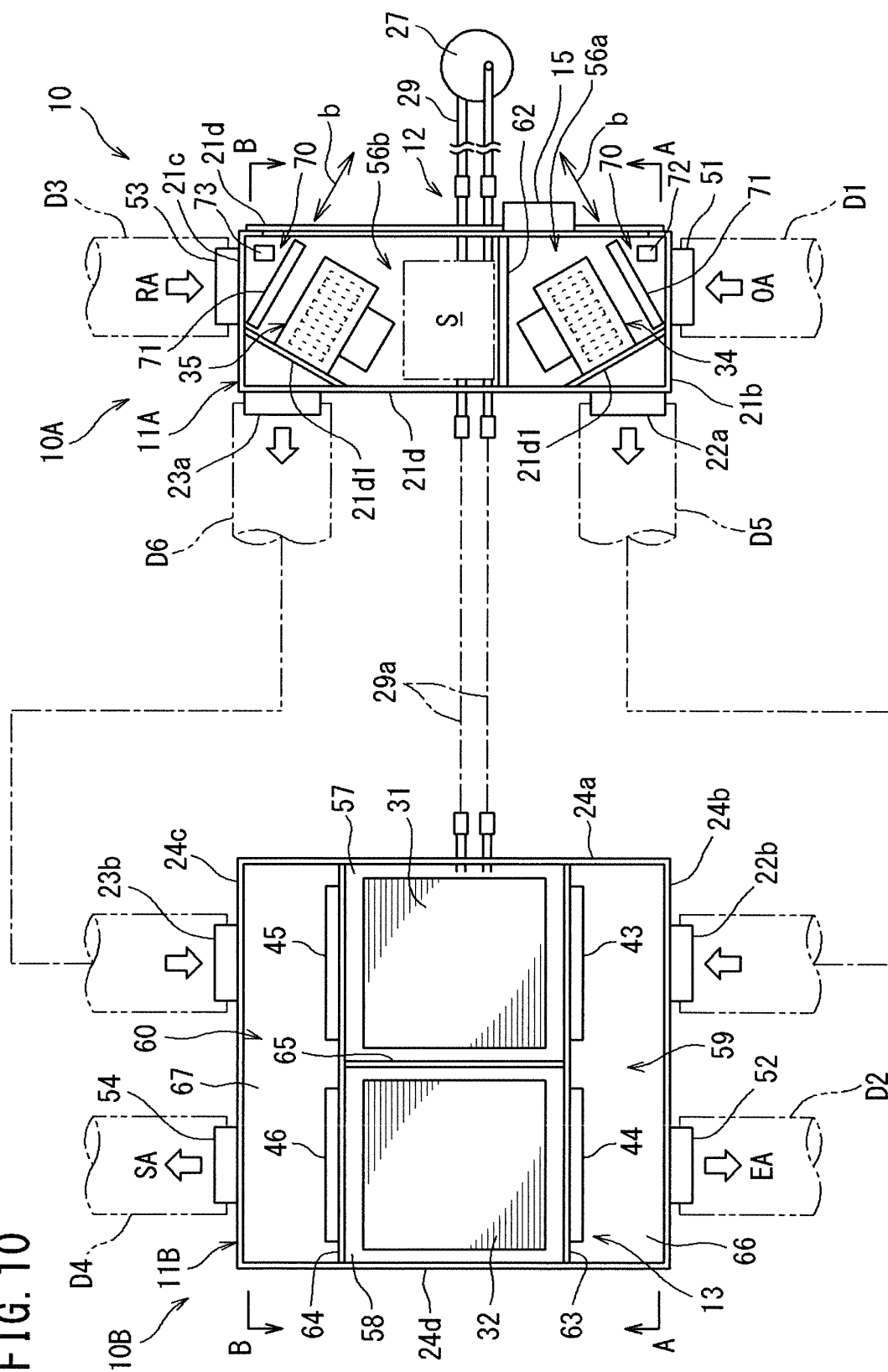


FIG. 11

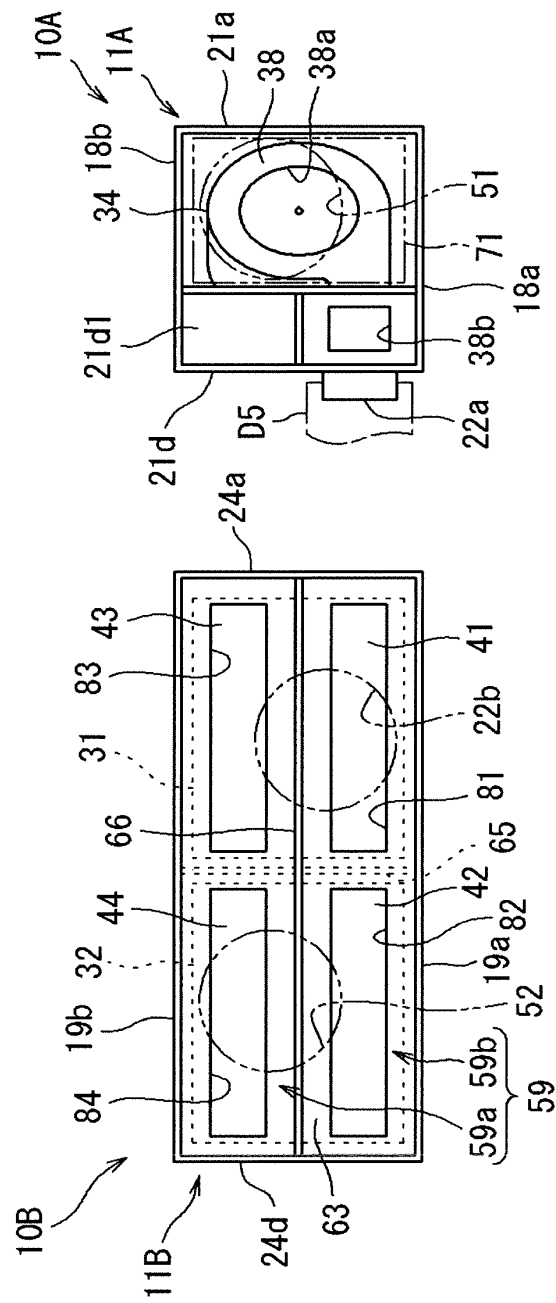


FIG. 12

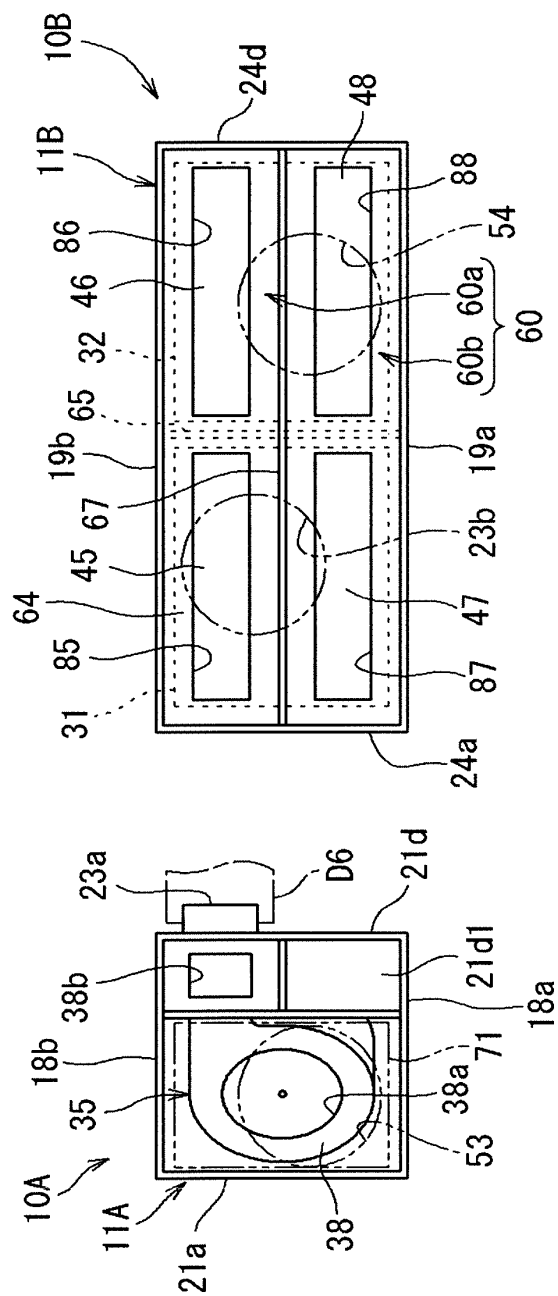


FIG. 13

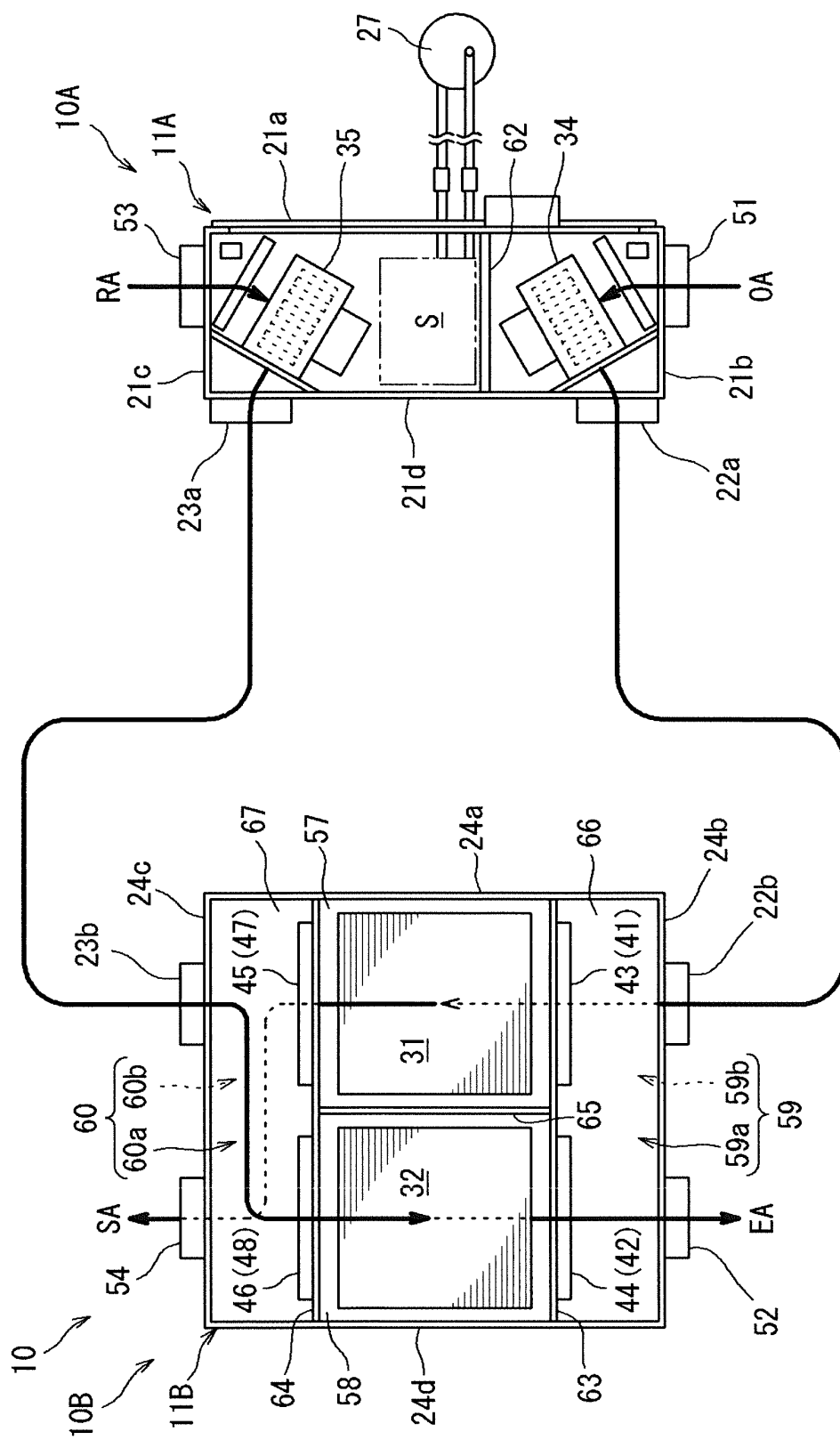


FIG. 14

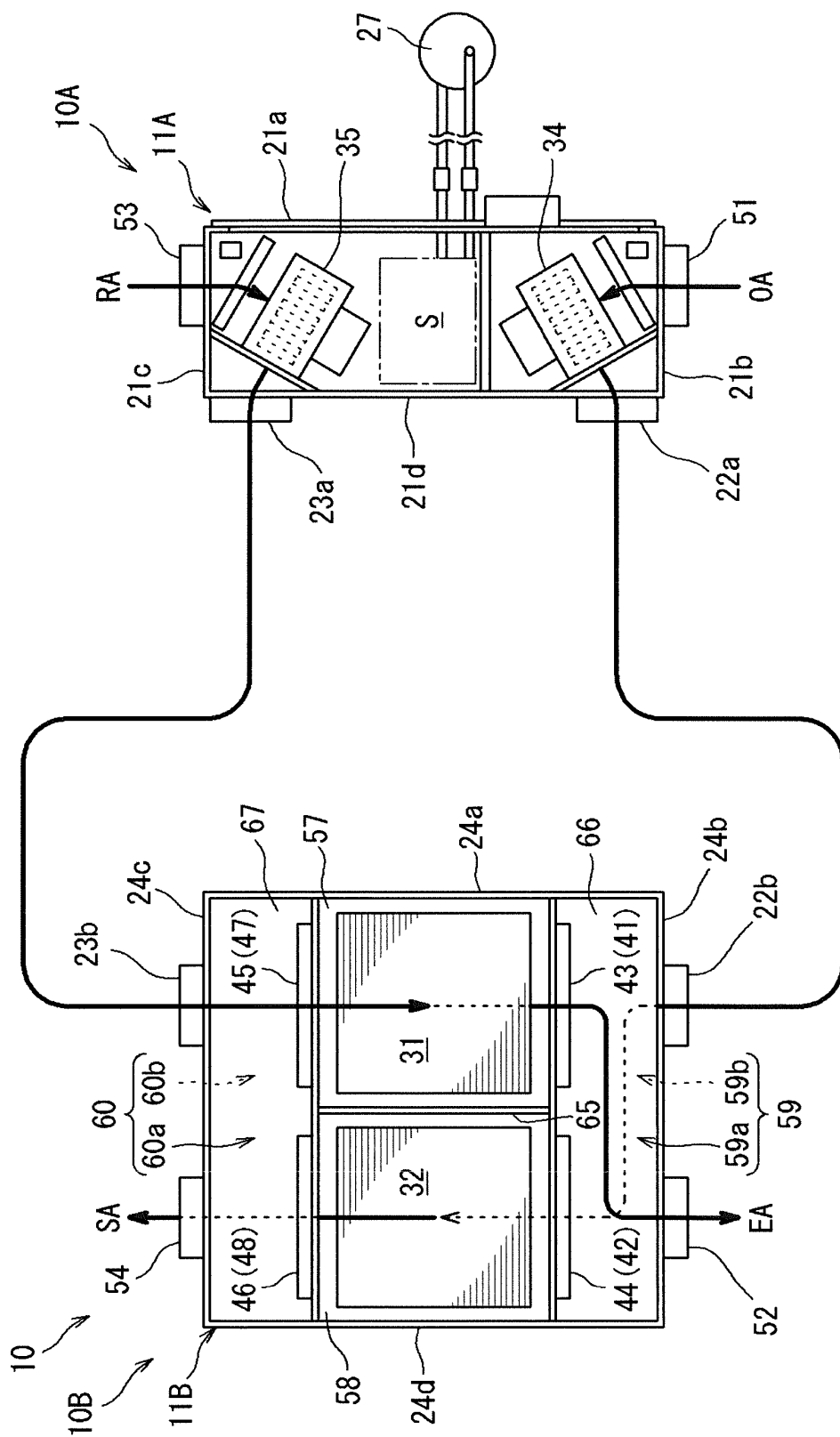


FIG. 15A

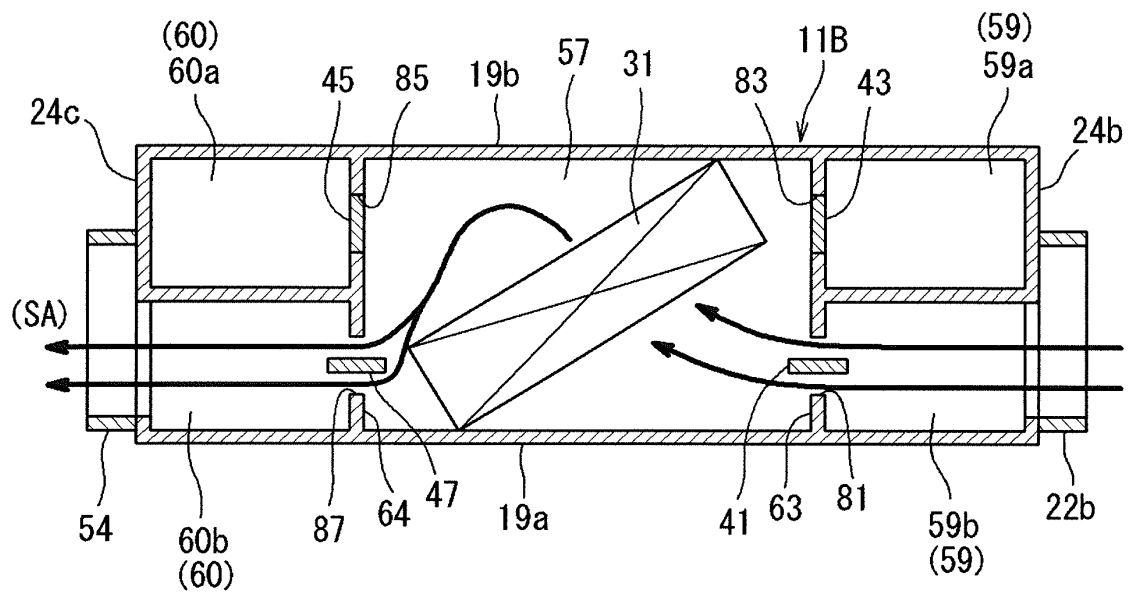


FIG. 15B

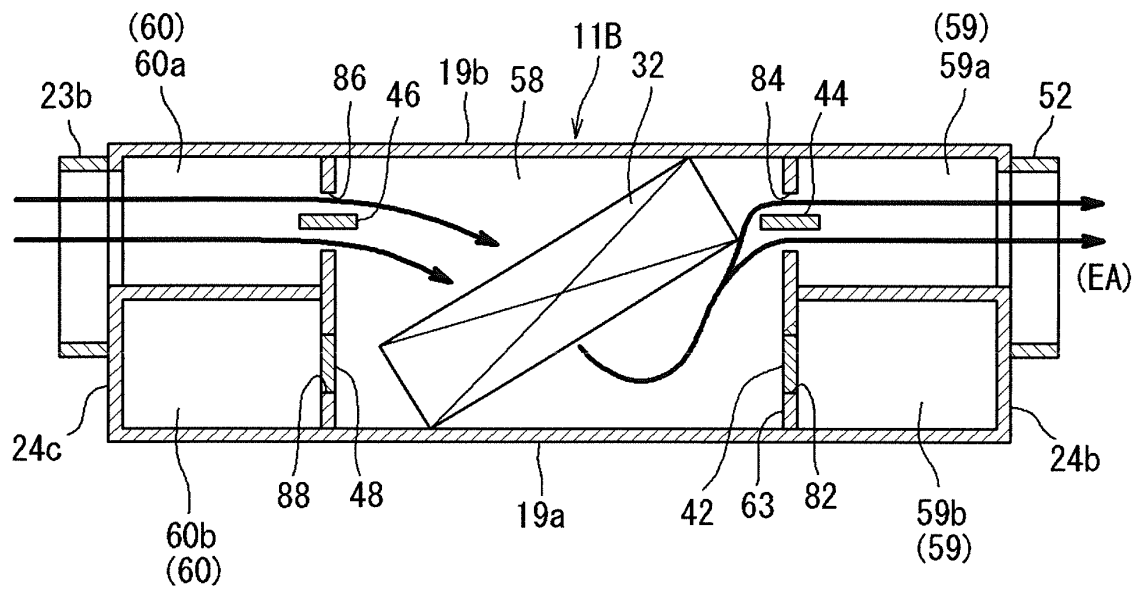


FIG. 16A

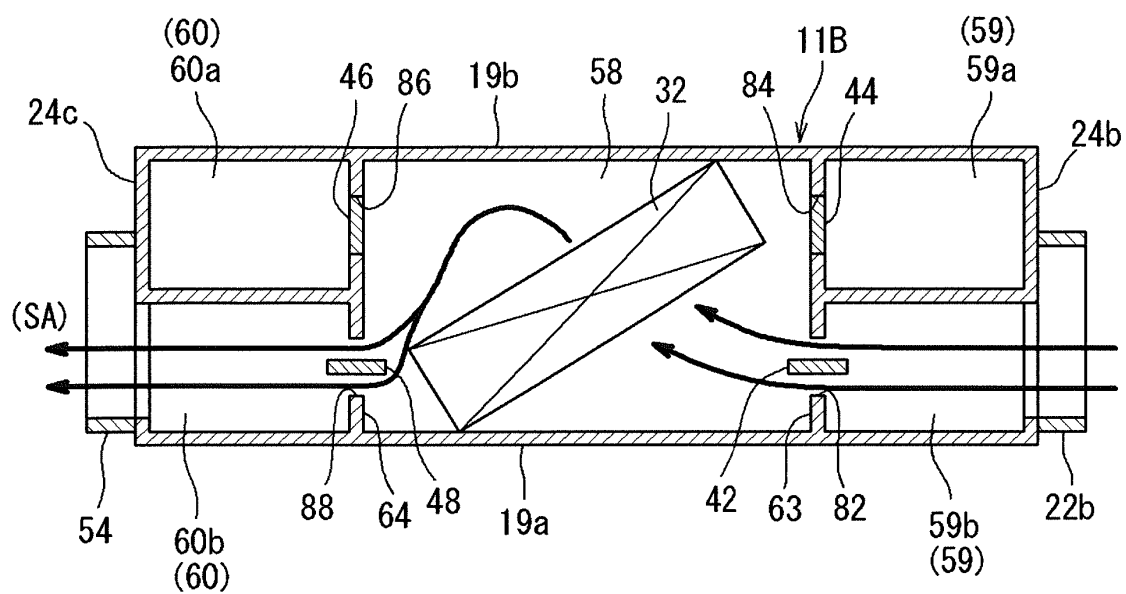


FIG. 16B

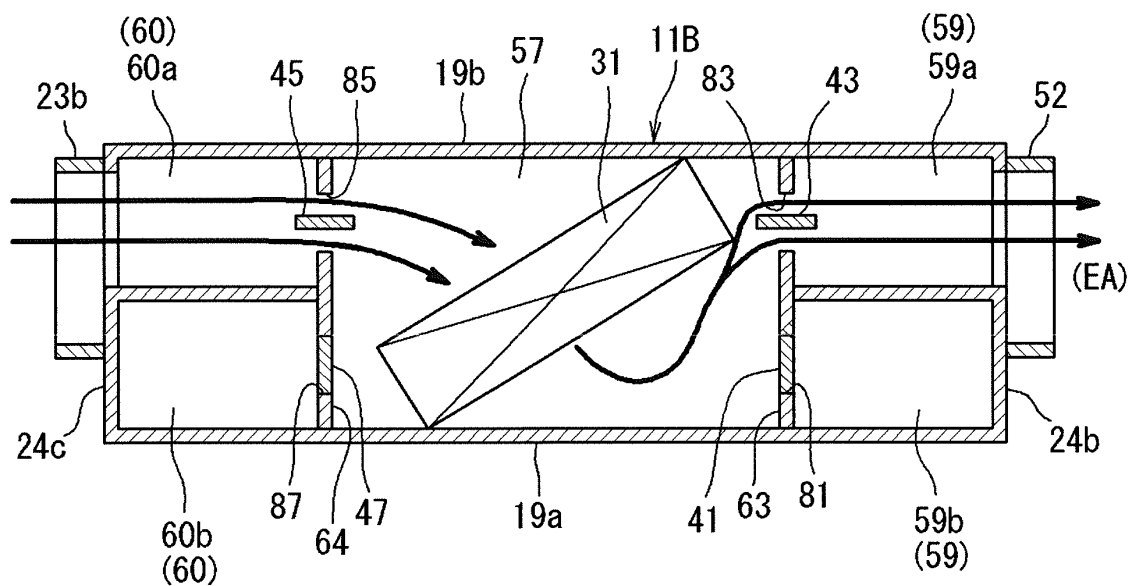


FIG. 17

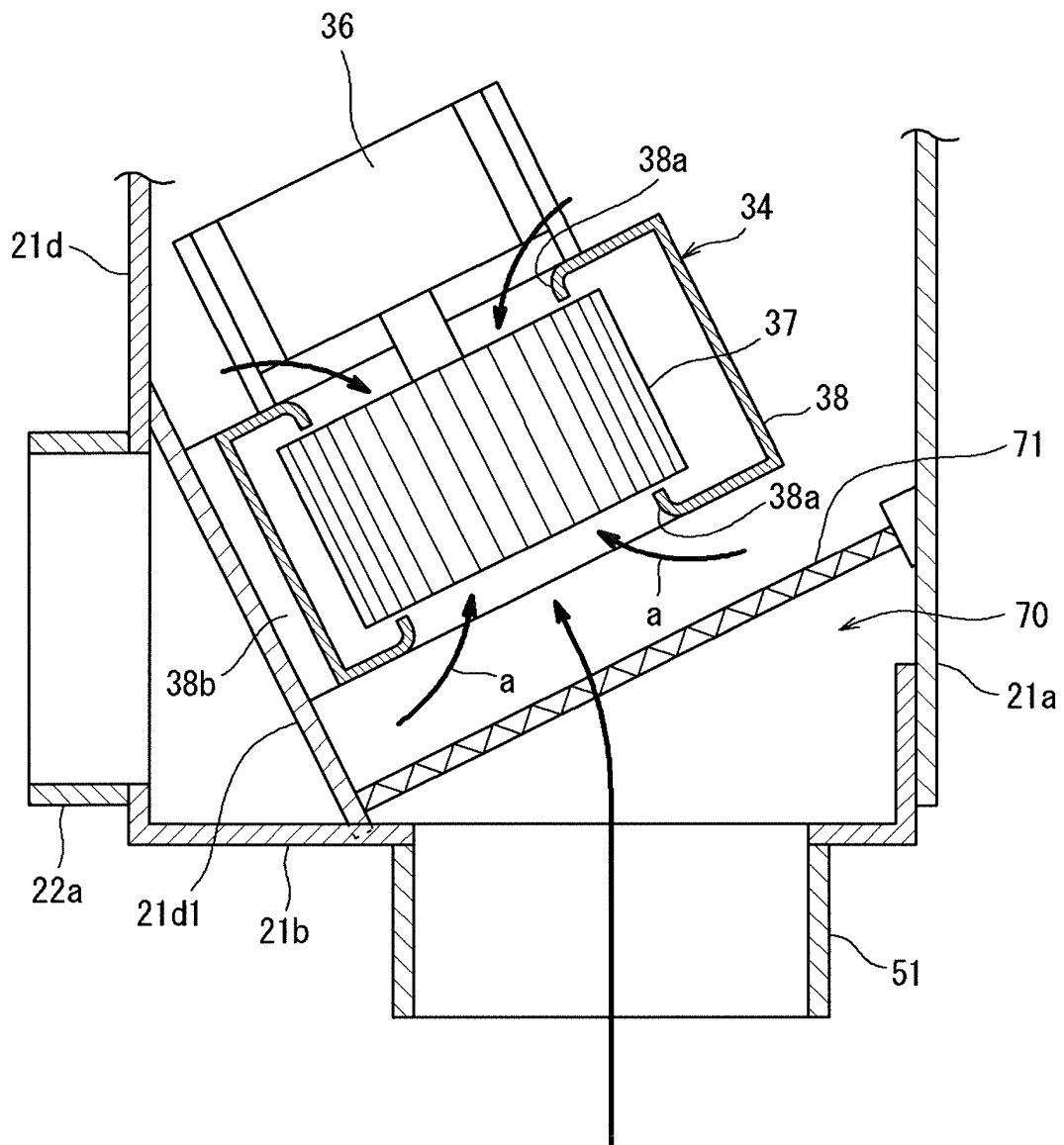
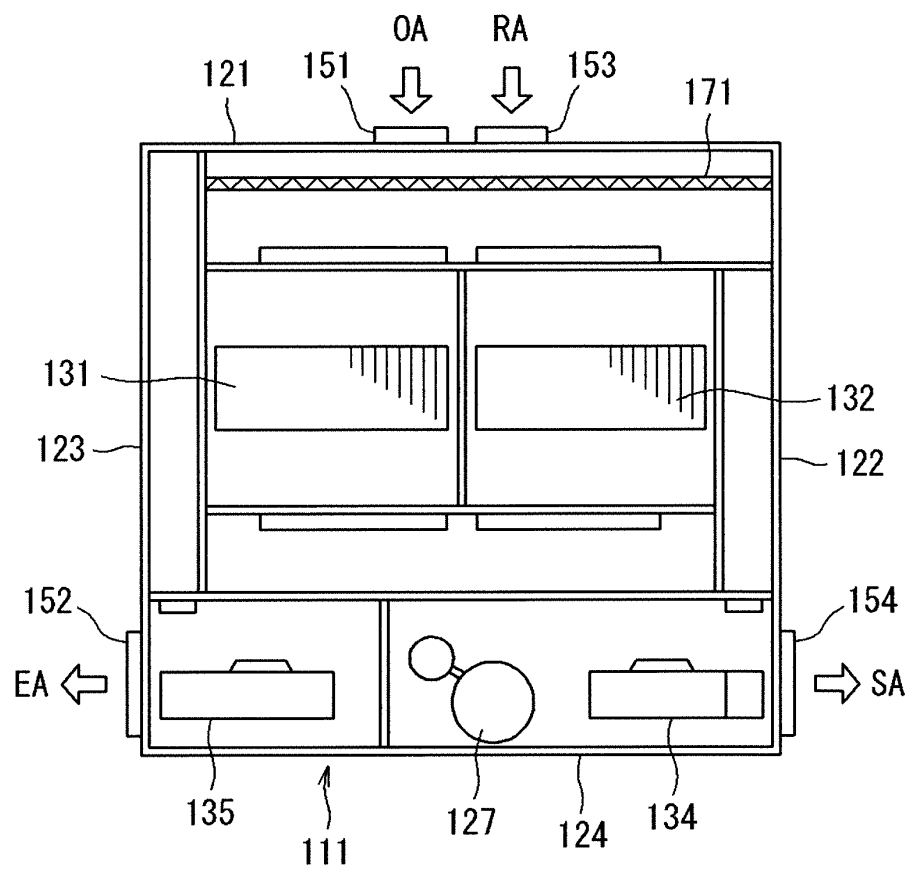


FIG. 18



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/073199

A. CLASSIFICATION OF SUBJECT MATTER

F24F3/14(2006.01)i, F24F1/00(2011.01)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)

F24F3/14, F24F1/00

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 1996-2013

Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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 2010-085034 A (Daikin Industries, Ltd.), 15 April 2010 (15.04.2010), paragraphs [0039] to [0119]; fig. 1 to 12 (Family: none)	1-9
A	JP 2005-164165 A (Daikin Industries, Ltd.), 23 June 2005 (23.06.2005), paragraphs [0039] to [0138]; fig. 1 to 16 & US 2008/0307814 A1 & EP 1804005 A1 & WO 2005/054752 A1 & KR 10-0711625 B1 & CN 1890508 A & AU 2004295536 A	1-9
A	JP 2010-019479 A (Sanyo Electric Co., Ltd.), 28 January 2010 (28.01.2010), paragraphs [0011] to [0039]; fig. 1 to 4 (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

07 November, 2013 (07.11.13)

Date of mailing of the international search report

19 November, 2013 (19.11.13)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/073199

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 04-281142 A (Mitsubishi Electric Corp.), 06 October 1992 (06.10.1992), paragraphs [0010] to [0016]; fig. 1 (Family: none)	1-9
A	JP 2005-233549 A (Daikin Industries, Ltd.), 02 September 2005 (02.09.2005), paragraphs [0019] to [0056]; fig. 1 to 6 (Family: none)	1-9

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REFERENCES CITED IN THE DESCRIPTION

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