



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.03.2010 Bulletin 2010/13

(51) Int Cl.:
F24F 3/147 (2006.01) F24F 3/16 (2006.01)

(21) Application number: **08763998.5**

(86) International application number:
PCT/JP2008/001401

(22) Date of filing: **03.06.2008**

(87) International publication number:
WO 2008/152777 (18.12.2008 Gazette 2008/51)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(72) Inventors:
• **NARIKAWA, Yoshinori**
Sakai-shi
Osaka 591-8511 (JP)
• **MATSUI, Nobuki**
Sakai-shi
Osaka 591-8511 (JP)

(30) Priority: **12.06.2007 JP 2007155207**
31.10.2007 JP 2007283956

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

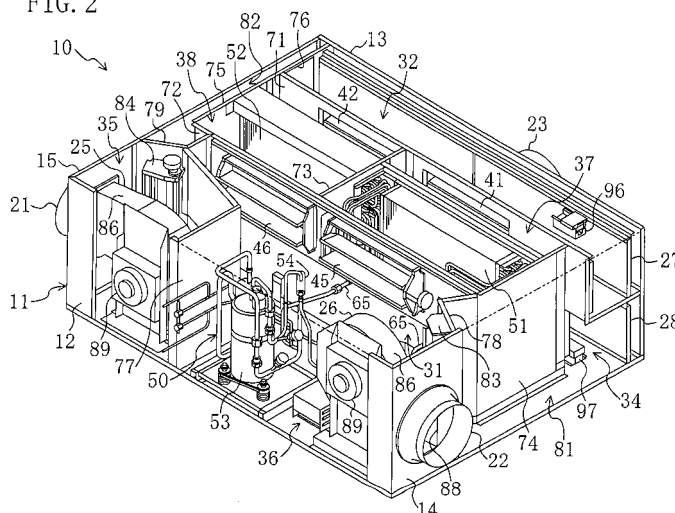
(71) Applicant: **Daikin Industries, Ltd.**
Osaka 530-8323 (JP)

(54) **HUMIDITY ADJUSTING DEVICE**

(57) In the casing (11) of a humidity controller (10), a first bypass passage (81) is provided along one of side plates facing each other, and a second bypass passage (82) is provided along the other side plate. In the casing (11), a first heat exchanger chamber (37) and a second heat exchanger chamber (38) are arranged next to each other in the left-to-right direction in a space between the two bypass passages (81, 82). A first adsorption heat exchanger (51) is accommodated in the first heat exchanger chamber (37), and a second adsorption heat

exchanger (52) is accommodated in the second heat exchanger chamber (38). Adsorbents are carried on the adsorption heat exchangers (51, 52). During the operation in which humidity of the air is not controlled, a first bypass damper (83) and a second bypass damper (84) are opened, and the air flows through the bypass passages (81, 82) to be drawn into a supply fan (26) or a exhaust fan (25). Thus, accumulation of odor substances in the adsorption heat exchangers (51, 52) during the operation in which humidity of the air is not controlled, can be reduced.

FIG. 2



Description

CITATION LIST

TECHNICAL FIELD

PATENT DOCUMENT

[0001] The present invention relates to a humidity controller which controls humidity of air using an adsorbent.

5 **[0006]**

Patent Document 1: Japanese Patent Publication No. 2006-078108

BACKGROUND ART

[0002] Humidity controllers which controls humidity using an adsorbent have been known. Patent Document 1 discloses a humidity controller which includes an adsorption heat exchanger carrying an adsorbent on its surface.

10 SUMMARY OF THE INVENTION

[0003] The humidity controller described in Patent Document 1 is provided with a refrigerant circuit which includes two adsorption heat exchangers. The refrigerant circuit alternately performs an operation in which the first adsorption heat exchanger serves as a condenser and the second adsorption heat exchanger serves as an evaporator, and an operation in which the second adsorption heat exchanger serves as a condenser and the first adsorption heat exchanger serves as an evaporator. In the adsorption heat exchanger serving as an evaporator, moisture in the air is adsorbed by the adsorbent. In the adsorption heat exchanger serving as a condenser, the moisture is desorbed from the adsorbent and is released in the air.

TECHNICAL PROBLEM

[0004] According to the humidity controller described in Patent Document 1, one of the air currents which have passed through the adsorption heat exchangers is supplied into a room and the other air current is exhausted to the outside. For example, in the humidity controller during the dehumidification operation, the flow path of the air in the casing is formed such that the air which has passed through one of the first and second adsorption heat exchangers that serves as an evaporator is supplied into a room, and the air which has passed through the adsorption heat exchanger that serves as a condenser is exhausted to the outside (see FIG. 5 and FIG. 6 in Patent Document 1).

[0007] There are cases in which humidity controllers have to continue supplying air into a room when it is not necessary to control humidity of the air to be supplied into the room. For example, a humidity controller which ventilates a room in a manner like that described in Patent Document 1 needs an operation which supplies air into a room without humidity control.

[0005] Further, the humidity controller described in Patent Document 1 ventilates a room. The humidity controller during the dehumidification operation dehumidifies the outdoor air taken therein, using the adsorption heat exchanger serving as an evaporator, and supplies the dehumidified air into a room, and exhausts the room air taken therein to the outside together with moisture desorbed from the adsorption heat exchanger serving as a condenser. On the other hand, the humidity controller during the humidification operation humidifies the outdoor air taken therein, using the adsorption heat exchanger serving as a condenser, and supplies the humidified air into a room, and dehumidifies the room air taken therein, using the adsorption heat exchanger serving as an evaporator, and exhausts the dehumidified room air to the outside.

[0008] That is, at seasons like spring and fall when the temperature and the humidity of outdoor air are comfortable, the comfort of a room is not reduced even if the outdoor air is supplied into a room without humidity control. On the other hand, tightly sealed buildings, such as office buildings, need to be continuously ventilated, whether or not the humidity control of the air is necessary. Thus, at seasons like spring and fall, humidity controllers which provide ventilation together with humidity control of the air perform an operation which supplies air into a room without humidity control.

[0009] However, in the humidity controller of the Patent Document 1, the air flowing in the casing always passes through the adsorption heat exchangers. That is, in this humidity controller, the air passes through the adsorption heat exchangers even when the operation of the adsorption heat exchangers are stopped during the operation in which humidity of the air is not controlled. As a result, if odor substances, such as ammonia, are contained in the air, the odor substances in the air are adsorbed by the adsorbent of the adsorption heat exchangers whose operation is stopped, and the odor substances are accumulated in the adsorption heat exchangers. The odor substances accumulated in the adsorption heat exchangers may be desorbed and supplied into a room when the humidity control of the air is performed thereafter, which results in reducing the comfort of the room.

[0010] The present invention was made in view of the above problem, and its object is to prevent accumulation of odor substances on the adsorbent during an operation in which the humidity of the air is not controlled, in a humidity controller configured to control humidity of the air using the adsorbent.

55 SOLUTION TO THE PROBLEM

[0011] The first aspect of the present invention is a humidity controller including: a heat transfer circuit (50)

to which adsorption heat exchangers (51, 52) each carrying an adsorbent are connected and through which a heat transfer fluid flows; and a casing (11) in which the adsorption heat exchangers (51, 52) are accommodated, wherein the heat transfer fluid is supplied to the adsorption heat exchangers (51, 52), thereby heating or cooling the adsorbents of the adsorption heat exchangers (51, 52), and air taken in the casing (11) is brought into contact with the adsorbents of the adsorption heat exchangers (51, 52) to control humidity of the air. In the casing (11), main air passages (37, 38) in which the adsorption heat exchangers (51, 52) are located, and auxiliary air passages (81, 82) through which the air flows by bypassing the adsorption heat exchangers (51, 52) are provided, and the humidity controller includes switching mechanisms (83, 84, ...) by which a flow path of the air in the casing (11) is switched between a state in which the air flows through the main air passages (37, 38) and does not flow through the auxiliary air passages (81, 82), and a state in which the air flows through the auxiliary air passages (81, 82) and does not flow through the main air passages (37, 38).

[0012] In the first aspect of the present invention, the adsorption heat exchangers (51, 52) are connected to the heat transfer circuit (50). If a heat transfer fluid for cooling is supplied to the adsorption heat exchangers (51, 52), the adsorbent carried on the adsorption heat exchangers (51, 52) is cooled by the heat transfer fluid. When the air passes through the adsorption heat exchangers (51, 52), moisture (water vapor) in the air is adsorbed by the adsorbent, and the heat of adsorption generated during the moisture adsorption is absorbed by the heat transfer fluid for cooling. If a heat transfer fluid for heating is supplied to the adsorption heat exchangers (51, 52), the adsorbent carried on the adsorption heat exchangers (51, 52) is heated by the heat transfer fluid, and the moisture is desorbed from the adsorbent. When the air passes through the adsorption heat exchangers (51, 52), moisture desorbed from the adsorbent is given to the air.

[0013] In the first aspect of the present invention, the air taken in the casing (11) flows through either the main air passages (37, 38) or the auxiliary air passages (81, 82). The flow path of the air in the casing (11) is switched by the switching mechanisms (83, 84, ...). The air which flows into the main air passages (37, 38) is dehumidified or humidified when it passes through the adsorption heat exchangers (51, 52), and thereafter flows out from the casing (11). On the other hand, the air which flows into the auxiliary air passages (81, 82) does not pass through the adsorption heat exchangers (51, 52) and flows out from the casing (11) without humidity control.

[0014] The second aspect of the present invention according to the first aspect of the present invention is that the heat transfer circuit (50) alternately performs an operation in which the adsorbent of the first adsorption heat exchanger (51) is cooled and the adsorbent of the second adsorption heat exchanger (52) is heated, and an oper-

ation in which the adsorbent of the second adsorption heat exchanger (52) is cooled and the adsorbent of the first adsorption heat exchanger (51) is heated, the first main air passage (37) in which the first adsorption heat exchanger (51) is located, the second main air passage (38) in which the second adsorption heat exchanger (52) is located, the first auxiliary air passage (81) for allowing outdoor air to flow toward a room, and the second auxiliary air passage (82) for allowing room air to flow toward the outside, are provided in the casing (11), and in the state in which the air flows through the first and second main air passages (37, 38), one of an air current which has passed through the first adsorption heat exchanger (51) and an air current which has passed through the second adsorption heat exchanger (52) is supplied into the room, and the other air current is exhausted to the outside.

[0015] In the second aspect of the present invention, the heat transfer circuit (50) alternately performs two operations. During the operation in which the adsorbent of the first adsorption heat exchanger (51) is cooled and the adsorbent of the second adsorption heat exchanger (52) is heated, the air flowing in the first main air passage (37) is dehumidified when it passes through the first adsorption heat exchanger (51), and the air flowing in the second main air passage (38) is humidified when it passes through the second adsorption heat exchanger (52). During the operation in which the adsorbent of the second adsorption heat exchanger (52) is cooled and the adsorbent of the first adsorption heat exchanger (51) is heated, the air flowing in the first main air passage (37) is humidified when it passes through the first adsorption heat exchanger (51), and the air flowing in the second main air passage (38) is dehumidified when it passes through the second adsorption heat exchanger (52). According to the humidity controller (10) of the present invention, one of an air current which has been dehumidified and an air current which has been humidified is supplied into a room, and the other air current is exhausted to the outside.

[0016] Further, according to the humidity controller (10) of the second aspect of the present invention, the outdoor air flows through the first auxiliary air passage (81) and is supplied into a room, and the room air flows through the second auxiliary air passage (82) and is exhausted to the outside, in the state in which the air taken in the casing (11) flows through the auxiliary air passages (81, 82). That is, the humidity controller (10) operating in this state ventilates a room.

[0017] The third aspect of the present invention according to the second aspect of the present invention is that the casing (11) is formed in a hollow rectangular parallelepiped shape, and in the casing (11), the first auxiliary air passage (81) is provided along one of side plate portions (14, 15) that face each other, and the second auxiliary air passage (82) is provided along the other side plate portion, and the first main air passage (37) and the second main air passage (38) are arranged next to each

other in a space between the first auxiliary air passage (81) and the second auxiliary air passage (82).

[0018] According to the third aspect of the present invention, in the interior space of the casing (11), the first auxiliary air passage (81) is provided along the side plate portion (14), and the second auxiliary air passage (82) is provided along the side plate portion (15) which is located opposite to the side plate portion (14) so as to face the side plate portion (14). In this interior space of the casing (11), the two main air passages (37, 38) are arranged next to each other in a space between the auxiliary air passages (81, 82).

[0019] The fourth aspect of the present invention according to the third aspect of the present invention is that in the casing (11), part of the side plate portion (14) that is along the first auxiliary air passage (81) is detachable, and a lead wire for electrically connecting structural components (41-44, 96, 97) accommodated in the casing (11) and electrical boards (91, 92) arranged opposite to the structural components (41-44, 96, 97) with respect to the first main air passage (37), is provided in the first auxiliary air passage (81).

[0020] In the fourth aspect of the present invention, the structural components (41-44, 96, 97) and the electrical boards (91, 92), which are arranged opposite to each other with the first main air passage (37) interposed therebetween, are electrically connected by a lead wire. The lead wire connecting the structural components (41-44, 96, 97) and the electrical boards (91, 92) is provided in the first auxiliary air passage (81) adjacent to the first main air passage (37). That is, this lead wire is not laid in the first main air passage (37) in which the first adsorption heat exchanger (51) is accommodated, but is laid in the first auxiliary air passage (81). Further, part of the side plate portion (14) of the casing (11) that is along the first auxiliary air passage (81) is detachable, and if this part is detached from the casing (11), the lead wire laid in the first auxiliary air passage (81) is exposed to the outside of the casing (11).

ADVANTAGES OF THE INVENTION

[0021] According to the humidity controller (10) of the present invention, the main air passages (37, 38) and the auxiliary air passages (81, 82) are provided in the casing (11), and the air which has flowed in the auxiliary air passages (81, 82) flows out from the casing (11) without passing through the adsorption heat exchangers (51, 52). In the situation in which humidity control of the air is not necessary, the air taken in the casing (11) is expelled from the casing (11) without passing through the adsorption heat exchangers (51, 52) if the flow path of air is set such that the air flowing in the casing (11) flows through the auxiliary air passages (81, 82). That is, according to the humidity controller (10) of the present invention, the air flowing in the casing (11) bypasses the adsorption heat exchangers (51, 52) during the operation that does not control humidity of the air.

[0022] Thus, although odor substances in the air are gradually accumulated in the adsorbent according to the conventional humidity controllers in which the air passes through the adsorption heat exchangers (51, 52) also during the operation that does not control humidity of the air, such odor substances are not accumulated in the adsorption heat exchangers (51, 52) in the humidity controller (10) of the present invention. Therefore, according to the present invention, the amount of odor substances accumulated in the adsorption heat exchangers (51, 52) during the operation that does not control humidity of the air can be reduced, and a reduction in comfort of a room due to a release of the odor substances from the adsorption heat exchangers (51, 52) after restart of humidity control of the air can be avoided.

[0023] Further, according to the fourth aspect of the present invention, part of the side plate portion (14) of the casing (11) that is along the first auxiliary air passage (81) in which a lead wire is provided, is detachable. Thus, if the part is detached from the casing (11), the lead wire provided in the first bypass passage (81) is exposed to the outside of the casing (11). As a result, work time necessary for maintaining the lead wire, such as an exchange of lead wires, can be reduced.

[0024] Further, according to the fourth aspect of the present invention, the lead wire for connecting the structural components (41-44, 96, 97) and electrical boards (91, 92), which are located opposite to each other with the first main air passage (37) interposed therebetween, is laid in the first bypass passage (81), not in the first main air passage (37). Here, if the lead wire is provided in the first main air passage (37), the lead wire is provided such that it extends from the upstream side to the downstream side of the first adsorption heat exchanger (51), and therefore, a sealing structure for preventing air leaks needs to be provided in the area where the lead wire is laid, in order to prevent the air from bypassing the first adsorption heat exchanger (51). However, the first adsorption heat exchanger (51) is not provided in the first bypass passage (81). Therefore, the sealing structure for preventing air from passing through from the upstream side to the downstream side of the first adsorption heat exchanger (51) is not necessary if the lead wire is provided in the first bypass passage (81). Thus, according to the present invention, the lead wire can be laid in the casing (11) without increasing complexity of the structure of the humidity controller (10).

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

[FIG. 1] FIG. 1 shows an oblique view of a humidity controller from the front side thereof without a top plate of a casing.

[FIG. 2] FIG. 2 shows an oblique view of the humidity controller from the front side thereof without part of the casing and a box for electrical components.

[FIG. 3] FIG. 3 shows a top view of the humidity controller without the top plate of the casing.

[FIG. 4] FIG. 4 shows a top view of a main part of the humidity controller without the top plate of the casing.

[FIG. 5] FIG. 5 shows an oblique view of the humidity controller from the rear surface side thereof without the top plate of the casing.

[FIG. 6] FIG. 6 shows schematic top, right side, and left side views of the humidity controller without part of the humidity controller.

[FIG. 7] FIG. 7 illustrates a pipe system showing a structure of the refrigerant circuit. FIG. 7A shows the operation during the first operation, and FIG. 7B shows the operation during the second operation.

[FIG. 8] FIG. 8 shows a schematic oblique view of an adsorption heat exchanger.

[FIG. 9] FIG. 9 shows schematic top, right side, and left side views of the humidity controller for illustrating an air flow during the first operation of a dehumidifying ventilation operation.

[FIG. 10] FIG. 10 shows schematic top, right side, and left side views of the humidity controller for illustrating an air flow during the second operation of the dehumidifying ventilation operation.

[FIG. 11] FIG. 11 shows schematic top, right side, and left side views of the humidity controller for illustrating an air flow during the first operation of a humidifying ventilation operation.

[FIG. 12] FIG. 12 shows schematic top, right side, and left side views of the humidity controller for illustrating an air flow during the second operation of the humidifying ventilation operation.

[FIG. 13] FIG. 13 shows schematic top, right side, and left side views of the humidity controller for illustrating an air flow during a simple ventilation operation.

[FIG. 14] FIG. 14 shows a schematic oblique view of an indoor air side filter and an outdoor air side filter.

DESCRIPTION OF REFERENCE CHARACTERS

[0026]

- 10 Humidity controller
- 11 Casing
- 14 First side panel portion (side panel portion)
- 15 Second side panel portion (side panel portion)
- 37 First heat exchanger chamber (first main air passage)
- 38 Second heat exchanger chamber (second main air passage)
- 45 First supply side damper (switching mechanism)
- 46 Second supply side damper (switching mechanism)
- 47 First exhaust side damper (switching mechanism)
- 48 Second exhaust side damper (switching mechanism)

- 50 Refrigerant circuit (heat transfer circuit)
- 51 First adsorption heat exchanger
- 52 Second adsorption heat exchanger
- 81 First bypass passage (first auxiliary air passage)
- 82 Second bypass passage (second auxiliary air passage)
- 83 First bypass damper (switching mechanism)
- 84 Second bypass damper (switching mechanism)

DESCRIPTION OF EMBODIMENTS

[0027] An embodiment of the present invention will be described in detail below based on the drawings. A humidity controller (10) of the present embodiment controls the humidity of a room and ventilates the room. The humidity controller (10) controls the humidity of outdoor air (OA) taken therein and supplies the controlled air into a room, and exhausts room air (RA) taken therein to the outside.

<General Structure of Humidity Controller>

[0028] The humidity controller (10) will be described with reference to FIGS. 1-6. The terms "upper," "lower," "left," "right," "front," "rear," "on the front of" and "behind" used in the following description indicate the directions as seen from the front side of the humidity controller (10), unless otherwise specified.

[0029] The humidity controller (10) has a casing (11). The casing (11) accommodates a refrigerant circuit (50). A first adsorption heat exchanger (51), a second adsorption heat exchanger (52), a compressor (53), a four-way selector valve (54), and an electrically-operated expansion valve (55) are connected to the refrigerant circuit (50). The details of the refrigerant circuit (50) will be described later.

[0030] The casing (11) is formed in a flattish, relatively small-height, rectangular parallelepiped shape. The dimension of the casing (11) in the left-to-right direction is slightly greater than the dimension of the casing (11) in the front-to-rear direction (see FIG. 3). In the casing (11), a side face at the lower left portion of FIG. 1 (i.e., the front surface) is a front panel portion (12), and a side face at the upper right portion of FIG. 1 (i.e., the rear surface) is a rear panel portion (13). In the casing (11), a side face at the lower right portion of FIG. 1 is a first side panel portion (14), and a side face at the upper left portion of FIG. 1 is a second side panel portion (15).

[0031] In the casing (11), the front panel portion (12) and the rear panel portion (13) face each other, and the first side panel portion (14) and the second side panel portion (15) face each other. In this casing (11), the first side panel portion (14) and the second side panel portion (15) constitute side plate portions.

[0032] The casing (11) is provided with an outdoor air intake opening (24), an indoor air intake opening (23), a supply opening (22), and an exhaust opening (21).

[0033] The outdoor air intake opening (24) and the in-

door air intake opening (23) are formed in the rear panel portion (13) (see FIG. 3 and FIG. 5). The outdoor air intake opening (24) is located at a lower portion of the rear panel portion (13). The outdoor air intake opening (24) is offset from the center of the rear panel portion (13) in the left-to-right direction to the second side panel portion (15) side. The indoor air intake opening (23) is located at an upper portion of the rear panel portion (13). The indoor air intake opening (23) is offset from the center of the rear panel portion (13) in the left-to-right direction to the first side panel portion (14) side.

[0034] The supply opening (22) is located at the first side panel portion (14) near the end on the front panel portion (12) side. The exhaust opening (21) located at the second side panel portion (15) near the end on the front panel portion (12) side.

[0035] An upstream side partition plate (71), a downstream side partition plate (72), a middle partition plate (73), a first partition plate (74), and a second partition plate (75) are provided in the interior space of the casing (11). All of these partition plates (71-75) stand on the bottom plate of the casing (11), and extend from the bottom plate to the top plate of the casing (11) to divide the interior space of the casing (11).

[0036] The upstream side partition plate (71) and the downstream side partition plate (72) are in parallel to the front panel portion (12) and the rear panel portion (13). In the interior space of the casing (11), the upstream side partition plate (71) is positioned at a location close to the rear panel portion (13), and the downstream side partition plate (72) is positioned at a location close to the front panel portion (12).

[0037] The dimension of the upstream side partition plate (71) in the left-to-right direction is smaller than the dimension of the casing (11) in the left-to-right direction. Most of the lower half of the right end portion of the upstream side partition plate (71) is cut off, and the upper half thereof is joined to the first side panel portion (14). A space is formed between the left end portion of the upstream side partition plate (71) and the second side panel portion (15).

[0038] The dimension of the downstream side partition plate (72) in the left-to-right direction is smaller than the dimension of the upstream side partition plate (71) in the left-to-right direction. A space is formed between the right end portion of the downstream side partition plate (72) and the first side panel portion (14). A space is also formed between the left end portion of the downstream side partition plate (72) and the second side panel portion (15).

[0039] The first partition plate (74) is located such that it encloses the space between the upstream side partition plate (71) and the downstream side partition plate (72) from the right. Specifically, the first partition plate (74) is positioned to be in parallel with the first side panel portion (14) and to be orthogonal to the upstream side partition plate (71) and the downstream side partition plate (72). The front end portion of the first partition plate (74) is

joined to the right end portion of the downstream side partition plate (72). The rear end portion of the first partition plate (74) is joined to the upstream side partition plate (71).

[0040] The second partition plate (75) is located such that it encloses the space between the upstream side partition plate (71) and the downstream side partition plate (72) from the left. Specifically, the second partition plate (75) is positioned to be in parallel with the second side panel portion (15) and to be orthogonal to the upstream side partition plate (71) and the downstream side partition plate (72). The front end portion of the second partition plate (75) is joined to the left end portion of the downstream side partition plate (72). The rear end portion of the second partition plate (75) is joined to the rear panel portion (13). The left end portion of the upstream side partition plate (71) is joined to the second partition plate (75).

[0041] The middle partition plate (73) is positioned between the upstream side partition plate (71) and the downstream side partition plate (72) so as to be orthogonal to the upstream side partition plate (71) and the downstream side partition plate (72). The middle partition plate (73) extends from the upstream side partition plate (71) to the downstream side partition plate (72) to divide the space between the upstream side partition plate (71) and the downstream side partition plate (72) into left and right spaces. The middle partition plate (73) is provided at a location slightly closer to the second side panel portion (15) than the centers of the upstream side partition plate (71) and the downstream side partition plate (72) in the left-to-right direction.

[0042] In the casing (11), the space between the upstream side partition plate (71) and the rear panel portion (13) are divided into two spaces, i.e., upper and lower spaces (see FIG. 2, FIG. 5 and FIG. 6). The upper space constitutes an indoor air side passage (32), and the lower space constitutes an outdoor air side passage (34). The indoor air side passage (32) and the outdoor air side passage (34) constitute an intake side space through which air to be supplied into the adsorption heat exchangers (51, 52), described later, (i.e., air before passing through the adsorption heat exchangers (51, 52)) flows.

[0043] The indoor air side passage (32) communicates with a room through a duct connected to the indoor air intake opening (23). The indoor air side passage (32) is provided with an indoor air side filter (27) for removing dust from the air. The indoor air side filter (27) is in the shape of a rectangular plate whose long sides extend in the left-to-right direction, and stands so as to extend laterally across the indoor air side passage (32). The indoor air side filter (27) divides the indoor air side passage (32) into front and rear spaces. The indoor air side passage (32) accommodates an indoor air humidity sensor (96) provided at a portion on the front side (downstream side) of the indoor air side filter (27). The indoor air humidity sensor (96) is attached to the top plate of the casing (11), and checks a relative humidity of the air.

[0044] The outdoor air side passage (34) communicates with the outside through a duct connected to the outdoor air intake opening (24). The outdoor air side passage (34) is provided with an outdoor air side filter (28) for removing dust from the air. The outdoor air side filter (28) is in the shape of a rectangular plate whose long sides extend in the left-to-right direction, and stands so as to extend laterally across the outdoor air side passage (34). The outdoor air side filter (28) divides the outdoor air side passage (34) into front and rear spaces. The outdoor air side passage (34) accommodates an outdoor air humidity sensor (97) provided at a portion on the front side (downstream side) of the outdoor air side filter (28). The outdoor air humidity sensor (97) is attached to the bottom plate of the casing (11), and checks a relative humidity of the air.

[0045] As described in the above, the space between the upstream side partition plate (71) and the downstream side partition plate (72) in the casing (11) is divided into left and right spaces by the middle partition plate (73). The space on the right side of the middle partition plate (73) constitutes a first heat exchanger chamber (37), and the space on the left side of the middle partition plate (73) constitutes a second heat exchanger chamber (38) (see FIG. 1 and FIG. 3). The width W_1 of the first heat exchanger chamber (37) in the left-to-right direction is greater than the width W_2 of the second heat exchanger chamber (38) in the left-to-right direction (see FIG. 4). The first heat exchanger chamber (37) constitutes a first main air passage, and the second heat exchanger chamber (38) constitutes a second main air passage.

[0046] The first adsorption heat exchanger (51) is accommodated in the first heat exchanger chamber (37). The second adsorption heat exchanger (52) is accommodated in the second heat exchanger chamber (38). Each of the adsorption heat exchanger (51, 52) is formed in a thick rectangular plate or a flat rectangular parallelepiped shape as a whole. The details of the adsorption heat exchangers (51, 52) will be described later.

[0047] The adsorption heat exchangers (51, 52) stand in the heat exchanger chambers (37, 38) such that the front side and the rear side thereof are parallel to the upstream side partition plate (71) and the downstream side partition plate (72). In other words, the adsorption heat exchangers (51, 52) are positioned so as to extend laterally across the heat exchanger chambers (37, 38). Each of the heat exchanger chambers (37, 38) is divided into front and rear spaces by the adsorption heat exchangers (51, 52). In the heat exchanger chambers (37, 38), the adsorption heat exchangers (51, 52) are positioned closer to the upstream side partition plate (71) than the center of the heat exchanger chambers (37, 38) in the fore and aft direction. The adsorption heat exchangers (51, 52) are substantially aligned with each other in the left-to-right direction.

[0048] The length L_d between the front surface of each of the adsorption heat exchangers (51, 52) and the down-

stream side partition plate (72) is longer than the length L_u between the rear surface of each of the adsorption heat exchangers (51, 52) and the upstream side partition plate (71) (see FIG. 4). In other words, in the heat exchanger chambers (37, 38), the lengths of the spaces on the front side (i.e., downstream side) of the adsorption heat exchangers (51, 52) in the fore and aft direction are greater than the lengths of the spaces on the rear side (i.e., upstream side) of the adsorption heat exchangers (51, 52) in the fore and aft direction.

[0049] Each of the adsorption heat exchangers (51, 52) is provided with a liquid side flow divider (61) and a gas side header (62). The entire first adsorption heat exchanger (51), including the liquid side flow divider (61) and the gas side header (62), is accommodated in the first heat exchanger chamber (37). On the other hand, although most part of the second adsorption heat exchanger (52), including all fins (57), is accommodated in the second heat exchanger chamber (38), part of the second adsorption heat exchanger (52) goes through the middle partition plate (73) and projects into the first heat exchanger chamber (37). Specifically, the liquid side flow divider (61) and the gas side header (62) of the second adsorption heat exchanger (52) are located inside the first heat exchanger chamber (37). Further, a U-tube (59) located at the end portion of the second adsorption heat exchanger (52), to which end portion the liquid side flow divider (61) and the gas side header (62) are connected, also projects into the first heat exchanger chamber (37). Moreover, the electrically-operated expansion valve (55) of the refrigerant circuit (50) is accommodated in the first heat exchanger chamber (37).

[0050] In the interior space of the casing (11), the space along the front surface of the downstream side partition plate (72) is divided into upper and lower spaces (see FIG. 2, FIG. 3 and FIG. 6). The upper space constitutes a supply side passage (31), and the lower space constitutes an exhaust side passage (33). The supply side passage (31) and the exhaust side passage (33) constitute a blowout side space through which the air having passed through the adsorption heat exchangers (51, 52) flows.

[0051] The upstream side partition plate (71) is provided with four openable dampers (41-44) (see FIG. 3 and FIG. 6). Each of the dampers (41-44) is in the shape of an approximately horizontally oriented rectangle. Specifically, a first indoor air side damper (41) and a second indoor air side damper (42) are attached to part of the upstream side partition plate (71) that faces the indoor air side passage (32) (i.e., the upper part of the upstream side partition plate (71)), the first indoor air side damper (41) being on the right side of the middle partition plate (73), and the second indoor air side damper (42) being on the left side of the middle partition plate (73). A first outdoor air side damper (43) and a second outdoor air side damper (44) are attached to part of the upstream side partition plate (71) that faces the outdoor air side passage (34) (i.e., the lower part of the upstream side

partition plate (71)), the first outdoor air side damper (43) being on the right side of the middle partition plate (73), and the second outdoor air side damper (44) being on the left side of the middle partition plate (73).

[0052] When the first indoor air side damper (41) is opened/closed, the indoor air side passage (32) and the first heat exchanger chamber (37) are connected to/disconnected from each other. When the second indoor air side damper (42) is opened/closed, the indoor air side passage (32) and the second heat exchanger chamber (38) are connected to/disconnected from each other. When the first outdoor air side damper (43) is opened/closed, the outdoor air side passage (34) and the first heat exchanger chamber (37) are connected to/disconnected from each other. When the second outdoor air side damper (44) is opened/closed, the outdoor air side passage (34) and the second heat exchanger chamber (38) are connected to/disconnected from each other.

[0053] At the upstream side partition plate (71), the first outdoor air side damper (43) is positioned directly under the first indoor air side damper (41). The first indoor air side damper (41) and the first outdoor air side damper (43) are positioned such that the center of each of the first indoor air side damper (41) and the first outdoor air side damper (43) in the left-to-right direction is closer to the middle partition plate (73) than the center of the first heat exchanger chamber (37) in the left-to-right direction (i.e., positioned closer to the second side panel portion (15)) (see FIG. 3).

[0054] At the upstream side partition plate (71), the second outdoor air side damper (44) is positioned directly under the second indoor air side damper (42). The second indoor air side damper (42) and the second outdoor air side damper (44) are positioned such that the center of each of the second indoor air side damper (42) and the second outdoor air side damper (44) in the left-to-right direction is closer to the middle partition plate (73) than the center of the second heat exchanger chamber (38) in the left-to-right direction (i.e., positioned closer to the first side panel portion (14)) (see FIG. 3).

[0055] The downstream side partition plate (72) is provided with four openable dampers (45-48) (see FIG. 3 and FIG. 6). Each of the dampers (45-48) is in the shape of an approximately horizontally oriented rectangle. Specifically, a first supply side damper (45) and a second supply side damper (46) are attached to part of the downstream side partition plate (72) that faces the supply side passage (31) (i.e., the upper part of the downstream side partition plate (72)), the first supply side damper (45) being on the right side of the middle partition plate (73), and second supply side damper (46) being on the left side of the middle partition plate (73). A first exhaust side damper (47) and a second exhaust side damper (48) are attached to part of the downstream side partition plate (72) that faces the exhaust side passage (33) (i.e., the lower part of the downstream side partition plate (72)), the first exhaust side damper (47) being on the right side of the middle partition plate (73), and the second exhaust side

damper (48) being on the left side of the middle partition plate (73).

[0056] When the first supply side damper (45) is opened/closed, the supply side passage (31) and the first heat exchanger chamber (37) are connected to/disconnected from each other. When the second supply side damper (46) is opened/closed, the supply side passage (31) and the second heat exchanger chamber (38) are connected to/disconnected from each other. When the first exhaust side damper (47) is opened/closed, the exhaust side passage (33) and the first heat exchanger chamber (37) are connected to/disconnected from each other. When the second exhaust side damper (48) is opened/closed, the exhaust side passage (33) and the second heat exchanger chamber (38) are connected to/disconnected from each other.

[0057] At the downstream side partition plate (72), the first exhaust side damper (47) is positioned directly under the first supply side damper (45). The first supply side damper (45) and the first exhaust side damper (47) are positioned such that the center of each of the first supply side damper (45) and the first exhaust side damper (47) in the left-to-right direction is closer to the middle partition plate (73) than the center of the first heat exchanger chamber (37) in the left-to-right direction (i.e., positioned closer to the second side panel portion (15)) (see FIG. 3).

[0058] At the downstream side partition plate (72), the second exhaust side damper (48) is positioned directly under the second supply side damper (46). The second exhaust side damper (48) and the second supply side damper (46) are positioned such that the center of each of the second exhaust side damper (48) and the second supply side damper (46) in the left-to-right direction is closer to the middle partition plate (73) than the center of the second heat exchanger chamber (38) in the left-to-right direction (i.e., positioned closer to the first side panel portion (14)) (see FIG. 3).

[0059] In the casing (11), the space between the supply side passage (31) and the exhaust side passage (33), and the front panel portion (12) is divided into right and left spaces by a partition plate (77). The space on the right side of the partition plate (77) constitutes a supply fan chamber (36), and the space on the left side of the partition plate (77) constitutes an exhaust fan chamber (35). The partition plate (77) is positioned so as to stand closer to the second side panel portion (15) than the middle partition plate (73) is. Both of the supply fan chamber (36) and the exhaust fan chamber (35) are spaces that extend from the bottom plate to the top plate of the casing (11).

[0060] A supply fan (26) is accommodated in the supply fan chamber (36). An exhaust fan (25) is accommodated in the exhaust fan chamber (35). Both of the supply fan (26) and the exhaust fan (25) are a centrifugal type multi-blade fan (so called, sirocco fan).

[0061] Specifically, each of these fans (25, 26) has a fan rotor, a fan casing (86), and a fan motor (89). Although not shown, the fan rotor has a cylinder shape whose axial

length is shorter than its diameter and which has many blades on its circumferential surface. The fan rotor is accommodated in the fan casing (86). One of the side faces of the fan casing (86) (i.e., side faces which are orthogonal to the axial direction of the fan rotor) has an inlet (87). The fan casing (86) has a portion which outwardly protrudes from the circumferential surface of the fan casing (86), and the end of that portion has an outlet (88). The fan motor (89) is attached to the side face of the fan casing (86) that is opposite to the side face having the inlet (87). The fan motor (89) is connected to the fan rotor to rotate the fan rotor.

[0062] When the fan rotor of each of the supply fan (26) and the exhaust fan (25) is rotated by the fan motor (89), air is drawn into the fan casing (86) through the inlet (87), and the air in the fan casing (86) is expelled from the outlet (88).

[0063] In the supply fan chamber (36), the supply fan (26) is positioned such that the inlet (87) of the fan casing (86) faces the downstream side partition plate (72). The outlet (88) of the fan casing (86) of the supply fan (26) is attached to the first side panel portion (14) such that the outlet (88) communicates with the supply opening (22).

[0064] In the exhaust fan chamber (35), the exhaust fan (25) is positioned such that the inlet (87) of the fan casing (86) faces the downstream side partition plate (72). The outlet (88) of the fan casing (86) of the exhaust fan (25) is attached to the second side panel portion (15) such that the outlet (88) communicates with the exhaust opening (21).

[0065] The compressor (53) and the four-way selector valve (54) of the refrigerant circuit (50) are accommodated in the supply fan chamber (36). The compressor (53) and the four-way selector valve (54) are positioned in the supply fan chamber (36) between the supply fan (26) and the partition plate (77).

[0066] A connecting pipe (65) extending from the gas side header (62) of each of the adsorption heat exchangers (51, 52) is connected to the four-way selector valve (54). The connecting pipe (65) goes through the downstream side partition plate (72). Specifically, the connecting pipe (65) goes through part of the downstream side partition plate (72) that faces the supply side passage (31) (i.e., the upper part), specifically the part on the right side of the middle partition plate (73) (i.e., the part that faces the first heat exchanger chamber (37)). One of the liquid side flow dividers (61) of the adsorption heat exchangers (51, 52) is connected to one end of the electrically-operated expansion valve (55), and the other liquid side flow divider (61) is connected to the other end of the electrically-operated expansion valve (55).

[0067] In the casing (11), the space between the first partition plate (74) and the first side panel portion (14) constitutes a first bypass passage (81) as a first auxiliary air passage (see FIG. 2 and FIG. 3). In the casing (11), the space between the second partition plate (75) and the second side panel portion (15) constitutes a second bypass passage (82) as a second auxiliary air passage

(see FIG. 3 and FIG. 5). The first bypass passage (81) and the second bypass passage (82) are spaces that extend from the bottom plate to the top plate of the casing (11). The width W_{b1} of the first bypass passage (81) (i.e., the distance between the first partition plate (74) and the first side panel portion (14)) is greater than the width W_{b2} of the second bypass passage (82) (i.e., the distance between the second partition plate (75) and the second side panel portion (15)) (see FIG. 4).

[0068] The starting end of the first bypass passage (81) (i.e., the end of the first bypass passage (81) on the rear panel portion (13)) communicates with only the outdoor air side passage (34) and is blocked from the indoor air side passage (32). The first bypass passage (81) communicates with a downstream side of the outdoor air side filter (28) in the outdoor air side passage (34). The terminating end of the first bypass passage (81) (i.e., the end of the first bypass passage (81) on the front panel portion (12)) is separated from the supply side passage (31), exhaust side passage (33), and supply fan chamber (36) by a partition plate (78). A first bypass damper (83) is provided on the surface of the partition plate (78) that faces the supply fan chamber (36). The first bypass damper (83) is in the shape of an approximately vertically oriented rectangle. When the first bypass damper (83) is opened/closed, the first bypass passage (81) and the supply fan chamber (36) are connected to/disconnected from each other.

[0069] The starting end of the second bypass passage (82) (i.e., the end of the second bypass passage (82) on the rear panel portion (13)) communicates with only the indoor air side passage (32) and is blocked from the outdoor air side passage (34). The second bypass passage (82) communicates with a downstream side of the indoor air side filter (27) in the indoor air side passage (32), through a communication opening (76) formed in the second partition plate (75). The terminating end of the second bypass passage (82) (i.e., the end of the second bypass passage (82) on the front panel portion (12)) is separated from the supply side passage (31), the exhaust side passage (33), and the exhaust fan chamber (35) by a partition plate (79). A second bypass damper (84) is provided on the surface of the partition plate (79) that faces the exhaust fan chamber (35). The second bypass damper (84) is in the shape of an approximately vertically oriented rectangle. When the second bypass damper (84) is opened/closed, the second bypass passage (82) and the exhaust fan chamber (35) are connected to/disconnected from each other.

[0070] The first bypass passage (81), the second bypass passage (82), the first bypass damper (83), and the second bypass damper (84) are not shown in the right side view and the left side view of FIG. 6.

[0071] In the humidity controller (10), the first bypass damper (83), the second bypass damper (84), the first supply side damper (45), the second supply side damper (46), first exhaust side damper (47), and the second exhaust side damper (48) constitute a switching mecha-

nism. That is, in the state where the first supply side damper (45), the second supply side damper (46), the first exhaust side damper (47) and the second exhaust side damper (48) are closed and the first bypass damper (83) and the second bypass damper (84) are opened, the air flowing in the casing (11) does not pass through the first heat exchanger chamber (37) and the second heat exchanger chamber (38), but passes through the first bypass passage (81) or the second bypass passage (82). In the state where the first bypass damper (83) and the second bypass damper (84) are closed and one of the supply side dampers (45, 46) and one of the exhaust side dampers (47, 48) are opened, the air flowing in the casing (11) does not pass through the first bypass passage (81) and the second bypass passage (82), but passes through the first heat exchanger chamber (37) or the second heat exchanger chamber (38).

[0072] Part of the first side panel portion (14) of the casing (11) that faces the indoor air side passage (32) and the outdoor air side passage (34) is constituted by an openable panel (17) for filters. Further, part of the first side panel portion (14) that faces the first bypass passage (81) is constituted by a main openable panel (16). The openable panel (17) for filters and the main openable panel (16) are detachable from the casing (11).

[0073] A box (90) for electrical components is attached to the right portion of the front panel portion (12) of the casing (11). The box (90) for electrical components is not shown in FIG. 2 and FIG. 6. The box (90) for electrical components is a box having a rectangular parallelepiped shape, and a control board (91) and a power supply board (92) are accommodated in the box (90) for electrical components. The control board (91) and the power supply board (92) are attached to the inner surface of a side plate of the box (90) for electrical components, the side plate being adjacent to the front panel portion (12) (i.e., the rear plate of the box (90) for electrical components). A heat dissipating fin (93) is provided for the inverter of the power supply board (92). The heat dissipating fin (93) protrudes from the rear surface of the power supply board (92), and goes through the rear plate of the box (90) for electrical components and the front panel portion (12) of the casing (11) to project into the supply fan chamber (36) (see FIG. 3 and FIG. 5).

[0074] In the casing (11), lead wires connected to the compressor (53), the fans (25, 26), the dampers (41-48), the humidity sensors (96, 97), etc., extend into the box (90) for electrical components, and are electrically connected to the control board (91), power supply board (92), etc., which are circuit boards. Among the lead wires, lead wires which are connected, for power supply, to a drive motor for the dampers (41-44) attached to the upstream side partition plate (71), and lead wires which are connected, for signal transmission, to the humidity sensors (96, 97) are brought together to constitute a wire harness (99) and are laid in the first bypass passage (81). The wire harness (99) goes through the lower end portion of the partition plate (78). Parts of the wire harness (99) that

are connected to the first and second indoor air side dampers (41, 42) and the indoor air humidity sensor (96) go through the partition between the indoor air side passage (32) and the outdoor air side passage (34).

[0075] In the humidity controller (10) according to the present embodiment, the lead wires which are connected, for power supply, to a drive motor for the dampers (41-44), and the lead wires which are connected, for signal transmission, to the humidity sensors (96, 97) are provided in one wire harness (99). However, the lead wires connected to the dampers (41-44) and the lead wires connected to the humidity sensors (96, 97) may be provided in different wire harnesses, and the two wire harnesses may be laid in the first bypass passage (81).

[0076] In the humidity controller (10) according to the present embodiment, the control board (91) and the power supply board (92) are accommodated in the box (90) for electrical components which is attached to the front panel portion (12) of the casing (11). The dampers (41-44) and the humidity sensors (96, 97), which are structural components located opposite to the front panel portion (12) with the first heat exchanger chamber (37) and the second heat exchanger chamber (38) arranged next to each other in the left-to-right direction interposed therebetween, are electrically connected to the control board (91) and the power supply board (92) via the wire harness (99), and the wire harness (99) is provided in the first bypass passage (81).

[0077] The indoor air side filter (27) and the outdoor air side filter (28) will be explained with reference to FIG. 14. The structure of the indoor air side filter (27) and the structure of the outdoor air side filter (28) are the same. Specifically, these filters (27, 28) have a filter body (101) and a filter frame (102). The filter body (101) is in the form of mesh, nonwoven fabric, or coarse sponge, to catch dust in the air passing through the filter body (101). The filter frame (102) is a member made of resin in the form of a horizontally oriented rectangular frame. The filter body (101) is attached to the filter frame (102). Each of the upper and lower surfaces of the filter frame (102) is provided with three notches (103) arranged at approximately equal intervals along the long dimension of the filter frame (102). The filter frame (102) can be bent at locations where the notches (103) are formed. To detach the filters (27, 28) from the casing (11), the filters (27, 28) are bent at the locations where the notches (103) are formed, and pulled out from the casing (11).

<Configuration of Refrigerant Circuit>

[0078] The refrigerant circuit (50) will be described with reference to FIG. 7.

[0079] The refrigerant circuit (50) is a closed circuit that includes the first adsorption heat exchanger (51), the second adsorption heat exchanger (52), the compressor (53), the four-way selector valve (54), and the electrically-operated expansion valve (55). The refrigerant circuit (50) performs a vapor compression refrigeration cycle by

circulating the refrigerant with which the refrigerant circuit (50) is filled. The refrigerant circuit (50) constitutes a heat transfer circuit in which a refrigerant as a heat transfer fluid flows.

[0080] In the refrigerant circuit (50), the discharge side of the compressor (53) is connected to a first port of the four-way selector valve (54), and the suction side of the compressor (53) is connected to a second port of the four-way selector valve (54). One end of the first adsorption heat exchanger (51) is connected to a third port of the four-way selector valve (54). The other end of the first adsorption heat exchanger (51) is connected to one end of the second adsorption heat exchanger (52) through the electrically-operated expansion valve (55). The other end of the second adsorption heat exchanger (52) is connected to a fourth port of the four-way selector valve (54).

[0081] The four-way selector valve (54) can be switched between the first state (the state shown in FIG. 7A) in which the first port and the third port are connected and the second port and the fourth port are connected, and the second state (the state shown in FIG. 7B) in which the first port and the fourth port are connected and the second port and the third port are connected.

[0082] As shown in FIG. 8, both of the first adsorption heat exchanger (51) and the second adsorption heat exchanger (52) are constituted by a cross fin type fin-and-tube heat exchanger. The adsorption heat exchangers (51, 52) include a heat transfer pipe (58) made of copper and fins (57) made of aluminum. Each of the plurality of fins (57) provided in the adsorption heat exchangers (51, 52) is in the shape of a rectangular plate, and the plurality of fins (57) are arranged at predetermined intervals. The heat transfer pipe (58) meanders along the array direction of the fins (57). In other words, the heat transfer pipe (58) includes, in an alternating manner, straight portions each going through the fins (57), and U-shaped portions (59) each connecting a pair of straight portions adjacent to each other.

[0083] In the adsorption heat exchangers (51, 52), an adsorbent is carried on the surface of each fin (57), and air passing through between the fins (57) comes in contact with the adsorbent carried on the fins (57). As the materials for the adsorbent, zeolite, silica gel, activated carbon, and organic polymeric materials with hydrophilic functional groups, etc., which can adsorb vapor in air may be used.

[0084] In the humidity controller (10) of the present embodiment, the refrigerant circuit (50) constitutes a heat transfer circuit. In the refrigerant circuit (50), a high-pressured gas refrigerant is supplied as a heat transfer fluid for heating to one of the adsorption heat exchangers (51, 52) that serves as a condenser, and a low-pressured, gas-liquid two-phase refrigerant is supplied as a heat transfer fluid for cooling to the adsorption heat exchanger that serves as an evaporator.

-Operational Behavior-

[0085] The humidity controller (10) of the present embodiment selectively performs a dehumidifying ventilation operation, a humidifying ventilation operation, and a simple ventilation operation. The humidity controller (10) during the dehumidifying ventilation operation or the humidifying ventilation operation controls the humidity of the outdoor air (OA) taken therein, and supplies the controlled outdoor air (OA) to a room as supply air (SA), and exhausts the room air (RA) taken therein to the outside as exhaust air (EA). On the other hand, the humidity controller (10) during the simple ventilation operation supplies the outdoor air (OA) taken therein to the room as supply air (SA) without humidity control, and exhausts the room air (RA) taken therein to the outside as exhaust air (EA) without humidity control.

<Dehumidifying Ventilation Operation>

[0086] In the humidity controller (10) during the dehumidifying ventilation operation, a first operation and a second operation, described later, are alternately repeated at predetermined time intervals (e.g., every three minutes). During the dehumidifying ventilation operation, the first bypass damper (83) and the second bypass damper (84) are always closed.

[0087] In the humidity controller (10) during the dehumidifying ventilation operation, the outdoor air is taken into the casing (11) as a first air through the outdoor air intake opening (24) by driving the supply fan (26). The room air is taken into the casing (11) as a second air through the indoor air intake opening (23) by driving the exhaust fan (25).

[0088] First, the first operation during the dehumidifying ventilation operation will be described. During the first operation, as shown in FIG. 9, the first indoor air side damper (41), the second outdoor air side damper (44), the second supply side damper (46), and the first exhaust side damper (47) are opened, and the second indoor air side damper (42), the first outdoor air side damper (43), the first supply side damper (45), and the second exhaust side damper (48) are closed.

[0089] In the refrigerant circuit (50) during the first operation, the four-way selector valve (54) is set to the first state as shown in FIG. 7A. The refrigerant circuit (50) in this state circulates the refrigerant to perform a refrigeration cycle. In the refrigerant circuit (50) in this state, the refrigerant discharged from the compressor (53) passes through the first adsorption heat exchanger (51), the electrically-operated expansion valve (55), and the second adsorption heat exchanger (52) in this order, and the first adsorption heat exchanger (51) serves as a condenser, and the second adsorption heat exchanger (52) serves as an evaporator.

[0090] The first air having flowed into the outdoor air side passage (34) and passed through the outdoor air side filter (28) passes through the second outdoor air

side damper (44) to flow into the second heat exchanger chamber (38), and thereafter, passes through the second adsorption heat exchanger (52). In the second adsorption heat exchanger (52), moisture in the first air is adsorbed by the adsorbent, and the heat of adsorption generated during the moisture adsorption is taken by the refrigerant. The first air dehumidified by the second adsorption heat exchanger (52) flows into the supply side passage (31) through the second supply side damper (46), passes through the supply fan chamber (36), and is then supplied into the room through the supply opening (22).

[0091] On the other hand, the second air having flowed into the indoor air side passage (32) and passed through the indoor air side filter (27) passes through the first indoor air side damper (41) to flow into the first heat exchanger chamber (37), and thereafter, passes through the first adsorption heat exchanger (51). In the first adsorption heat exchanger (51), moisture is desorbed from the adsorbent heated by the refrigerant, and the desorbed moisture is given to the second air. The second air to which moisture has been given by the first adsorption heat exchanger (51) flows into the exhaust side passage (33) through the first exhaust side damper (47), passes through the exhaust fan chamber (35), and is then exhausted to the outside through the exhaust opening (21).

[0092] Next, the second operation during the dehumidifying ventilation operation will be described. During the second operation, as shown in FIG. 10, the second indoor air side damper (42), the first outdoor air side damper (43), the first supply side damper (45), and the second exhaust side damper (48) are opened, and the first indoor air side damper (41), the second outdoor air side damper (44), the second supply side damper (46), and the first exhaust side damper (47) are closed.

[0093] In the refrigerant circuit (50) during the second operation, the four-way selector valve (54) is set to the second state as shown in FIG. 7B. The refrigerant circuit (50) in this state circulates the refrigerant to perform a refrigeration cycle. In the refrigerant circuit (50) in this state, the refrigerant discharged from the compressor (53) passes through the second adsorption heat exchanger (52), the electrically-operated expansion valve (55), and the first adsorption heat exchanger (51) in this order, and the first adsorption heat exchanger (51) serves as an evaporator, and the second adsorption heat exchanger (52) serves as a condenser.

[0094] The first air having flowed into the outdoor air side passage (34) and passed through the outdoor air side filter (28) passes through the first outdoor air side damper (43) to flow into the first heat exchanger chamber (37), and thereafter, passes through the first adsorption heat exchanger (51). In the first adsorption heat exchanger (51), moisture in the first air is adsorbed by the adsorbent, and the heat of adsorption generated during the moisture adsorption is taken by the refrigerant. The first air dehumidified by the first adsorption heat exchanger (51) flows into the supply side passage (31) through the

first supply side damper (45), passes through the supply fan chamber (36), and is then supplied into the room through the supply opening (22).

[0095] On the other hand, the second air having flowed into the indoor air side passage (32) and passed through the indoor air side filter (27) passes through the second indoor air side damper (42) to flow into the second heat exchanger chamber (38), and thereafter, passes through the second adsorption heat exchanger (52). In the second adsorption heat exchanger (52), moisture is desorbed from the adsorbent heated by the refrigerant, and the desorbed moisture is given to the second air. The second air to which moisture has been given by the second adsorption heat exchanger (52) flows into the exhaust side passage (33) through the second exhaust side damper (48), passes through the exhaust fan chamber (35), and is then exhausted to the outside through the exhaust opening (21).

<Humidifying Ventilation Operation>

[0096] In the humidity controller (10) during the humidifying ventilation operation, a first operation and a second operation, described later, are alternately repeated at predetermined time intervals (e.g., every three minutes). During the humidifying ventilation operation, the first bypass damper (83) and the second bypass damper (84) are always closed.

[0097] In the humidity controller (10) during the humidifying ventilation operation, the outdoor air is taken into the casing (11) as a second air through the outdoor air intake opening (24) by driving the supply fan (26). The room air is taken into the casing (11) as a first air through the indoor air intake opening (23) by driving the exhaust fan (25).

[0098] First, the first operation during the humidifying ventilation operation will be described. During the first operation, as shown in FIG. 11, the second indoor air side damper (42), the first outdoor air side damper (43), the first supply side damper (45), and the second exhaust side damper (48) are opened, and the first indoor air side damper (41), the second outdoor air side damper (44), the second supply side damper (46), and the first exhaust side damper (47) are closed.

[0099] In the refrigerant circuit (50) during the first operation, the four-way selector valve (54) is set to the first state as shown in FIG. 7A. In this refrigerant circuit (50), the first adsorption heat exchanger (51) serves as a condenser, and the second adsorption heat exchanger (52) serves as an evaporator, as in the case of the first operation during the dehumidifying ventilation operation.

[0100] The first air having flowed into the indoor air side passage (32) and passed through the indoor air side filter (27) passes through the second indoor air side damper (42) to flow into the second heat exchanger chamber (38), and thereafter, passes through the second adsorption heat exchanger (52). In the second adsorption heat exchanger (52), moisture in the first air is adsorbed

by the adsorbent, and the heat of adsorption generated during the moisture adsorption is taken by the refrigerant. The first air whose moisture is taken by the second adsorption heat exchanger (52) flows into the exhaust side passage (33) through the second exhaust side damper (48), passes through the exhaust fan chamber (35), and is then exhausted to the outside through the exhaust opening (21).

[0101] On the other hand, the second air having flowed into the outdoor air side passage (34) and passed through the outdoor air side filter (28) passes through the first outdoor air side damper (43) to flow into the first heat exchanger chamber (37), and thereafter, passes through the first adsorption heat exchanger (51). In the first adsorption heat exchanger (51), moisture is desorbed from the adsorbent heated by the refrigerant, and the desorbed moisture is given to the second air. The second air humidified by the first adsorption heat exchanger (51) flows into the supply side passage (31) through the first supply side damper (45), passes through the supply fan chamber (36), and is then supplied to the room through the supply opening (22).

[0102] Next, the second operation during the humidifying ventilation operation will be described. During the second operation, as shown in FIG. 12, the first indoor air side damper (41), the second outdoor air side damper (44), the second supply side damper (46), and the first exhaust side damper (47) are opened, and the second indoor air side damper (42), the first outdoor air side damper (43), the first supply side damper (45), and the second exhaust side damper (48) are closed.

[0103] In the refrigerant circuit (50) during the second operation, the four-way selector valve (54) is set to the second state as shown in FIG. 7B. In this refrigerant circuit (50), the first adsorption heat exchanger (51) serves as an evaporator, and the second adsorption heat exchanger (52) serves as a condenser, as in the case of the second operation during the dehumidifying ventilation operation.

[0104] The first air having flowed into the indoor air side passage (32) and passed through the indoor air side filter (27) passes through the first indoor air side damper (41) to flow into the first heat exchanger chamber (37), and thereafter, passes through the first adsorption heat exchanger (51). In the first adsorption heat exchanger (51), moisture in the first air is adsorbed by the adsorbent, and the heat of adsorption generated during the moisture adsorption is taken by the refrigerant. The first air whose moisture is taken by the first adsorption heat exchanger (51) flows into the exhaust side passage (33) through the first exhaust side damper (47), passes through the exhaust fan chamber (35), and is then exhausted to the outside through the exhaust opening (21).

[0105] On the other hand, the second air having flowed into the outdoor air side passage (34) and passes through the outdoor air side filter (28) passes through the second outdoor air side damper (44) to flow into the second heat exchanger chamber (38), and thereafter, passes through

the second adsorption heat exchanger (52). In the second adsorption heat exchanger (52), moisture is desorbed from the adsorption heated by the refrigerant, and the desorbed moisture is given to the second air. The second air humidified by the second adsorption heat exchanger (52) flows into the supply side passage (31) through the second supply side damper (46), passes through the supply fan chamber (36), and is then supplied to the room through the supply opening (22).

<Simple Ventilation Operation>

[0106] The operation of the humidity controller (10) during the simple ventilation operation will be described with reference to the FIG. 13. The simple ventilation operation is carried out at a time when outdoor air can be supplied, without humidity control, to the room without reducing comfort of the room (e.g., in moderate seasons such as spring and fall). In other words, this simple ventilation operation is carried out when humidity of the air to be supplied into a room does not have to be controlled, but the room air needs to be ventilated.

[0107] In this simple ventilation operation, the first bypass damper (83) and the second bypass damper (84) are opened, and the first indoor air side damper (41), the second indoor air side damper (42), the first outdoor air side damper (43), the second outdoor air side damper (44), the first supply side damper (45), the second supply side damper (46), the first exhaust side damper (47), and the second exhaust side damper (48) are closed. The operation of the compressor (53) of the refrigerant circuit (50) is stopped during the simple ventilation operation. In other words, the compressor (53) does not perform a refrigeration cycle during the simple ventilation operation.

[0108] In the humidity controller (10) during the simple ventilation operation, outdoor air is taken into the casing (11) through the outdoor air intake opening (24) by driving the supply fan (26). The outdoor air having flowed into the outdoor air side passage (34) through the outdoor air intake opening (24) passes through the outdoor air side filter (28) to flow into the first bypass passage (81), and passes through the first bypass damper (83) to flow into the supply fan chamber (36). The outdoor air having flowed into the supply fan chamber (36) is drawn into the supply fan (26) to be supplied to the room through the supply opening (22).

[0109] In the humidity controller (10) during the simple ventilation operation, room air is taken into the casing (11) through the indoor air intake opening (23) by driving the exhaust fan (25). The room air having flowed into the indoor air side passage (32) through the indoor air intake opening (23) passes through the indoor air side filter (27) to flow into the second bypass passage (82), and passes through the second bypass damper (84) to flow into the exhaust fan chamber (35). The room air having flowed into the exhaust fan chamber (35) is drawn into the exhaust fan (25) to be exhausted to the outside through the

exhaust opening (21).

-Effects of Embodiment-

[0110] In the humidity controller (10) according to the present embodiment, bypass passages (81, 82) are provided in the casing (11), and the air which has flowed into the bypass passages (81, 82) is expelled from the casing (11) without passing through the adsorption heat exchangers (51, 52). If the simple ventilation operation is carried out in the situation in which humidity control of the air is not needed, the air taken into the casing (11) flows through the casing (11) without passing through the adsorption heat exchangers (51, 52). In other words, the air flowing in the casing (11) bypasses the adsorption heat exchangers (51, 52) in the humidity controller (10) during the simple ventilation operation in which humidity of air is not controlled.

[0111] In the conventional humidity controllers in which air passes through adsorption heat exchangers also during the operation that does not control humidity of the air, odor substances in the air are gradually accumulated in the adsorbent of the adsorption heat exchangers during the operation, whereas according to the humidity controller (10) of the present embodiment, such odor substances are not accumulated in the adsorption heat exchangers (51, 52). Thus, according to the present embodiment, the amount of odor substances accumulated in the adsorption heat exchangers (51, 52) during the simple ventilation operation that does not control humidity of the air can be reduced, and therefore, a reduction in comfort of a room due to a release of the odor substances from the adsorption heat exchangers (51, 52) after restart of humidity control of the air can be avoided.

[0112] As mentioned in the above, in the humidity controller (10) during the dehumidifying ventilation operation or the humidifying ventilation operation, the operation in which the air having passed through the first heat exchanger chamber (37) is drawn into the supply fan (26) and simultaneously the air having passed through the second heat exchanger chamber (38) is drawn into the exhaust fan (25), and the operation in which the air having passed through the first heat exchanger chamber (37) is drawn into the exhaust fan (25) and simultaneously the air having passed through the second heat exchanger chamber (38) is drawn into the supply fan (26), are repeated alternately.

[0113] Further, in the humidity controller (10) of the present embodiment, the first indoor air side damper (41), the first outdoor air side damper (43), the first supply side damper (45), and the first exhaust side damper (47), which face the first heat exchanger chamber (37), are positioned at locations close to the middle partition plate (73) (i.e., locations positioned as far as possible from the supply fan (26) and as close as possible to the exhaust fan (25)). In addition, in the humidity controller (10), the second indoor air side damper (42), the second outdoor air side damper (44), the second supply side damper

(46), and the second exhaust side damper (48), which face the second heat exchanger chamber (38), are positioned at locations close to the middle partition plate (73) (i.e., locations positioned as far as possible from the exhaust fan (25) and as close as possible to the supply fan (26)).

[0114] Thus, in the humidity controller (10) of the present embodiment, a pressure loss of the air flowing from the first heat exchanger chamber (37) through the first supply side damper (45) to the supply fan (26), and a pressure loss of the air flowing from the second heat exchanger chamber (38) through the second supply side damper (46) to the supply fan (26) are equalized. Also, a pressure loss of the air flowing from the first heat exchanger chamber (37) through the first exhaust side damper (47) to the exhaust fan (25), and a pressure loss of the air flowing from the second heat exchanger chamber (38) through the second exhaust side damper (48) to the exhaust fan (25) are equalized. Thus, according to the humidity controller (10) of the present embodiment, the amount of air flow expelled from the supply opening (22) and the exhaust opening (21) can be maintained approximately constant without adjusting the rotational speed of the supply fan (26) and the exhaust fan (25), even if the operation is alternately switched between the first operation and the second operation during the dehumidifying ventilation operation and the humidifying ventilation operation.

[0115] Further, in the humidity controller (10) of the present embodiment, the length L_d between the front surface of the first adsorption heat exchanger (51) or the front surface of the second adsorption heat exchanger (52) and the downstream side partition plate (72) is longer than the length L_u between the rear surface of the first adsorption heat exchanger (51) or the rear surface of the second adsorption heat exchanger (52) and the upstream side partition plate (71) (see FIG. 4). In other words, in each of the heat exchanger chambers (37, 38), the length of the passage on the downstream side of the adsorption heat exchangers (51, 52) is longer than the length of the passage on the upstream side of the adsorption heat exchangers (51, 52). Thus, in each of the heat exchanger chambers (37, 38), the space on the downstream side of the adsorption heat exchangers (51, 52), the space being close to the supply fan (26) and the exhaust fan (25), is relatively wide, and the air flow speed is equalized over the entire part of each of the adsorption heat exchangers (51, 52). Thus, according to the present embodiment, capabilities of the adsorption heat exchangers (51, 52) can be fully exploited.

[0116] Further, in the humidity controller (10) of the present embodiment, the supply fan (26) and the exhaust fan (25) are positioned such that the respective inlets (87) face the downstream side partition plate (72). This allows the air which has passed through the dampers (45-48) provided in the downstream side partition plate (72) to smoothly flow to the inlets (87) of the supply fan (26) and the exhaust fan (25). Thus, according to the

present embodiment, turbulence of air flowing from the supply side passage (31) to the supply fan (26) or flowing from the exhaust side passage (33) to the exhaust fan (25) can be reduced, and therefore, a pressure loss at a time when the air passes through the casing (11) can be reduced.

[0117] Further, in the humidity controller (10) of the present embodiment, the heat dissipating fin (93) for cooling the inverter of the power supply board (92) projects into the supply fan chamber (36), and the air flowing through the supply fan chamber (36) takes heat from the heat dissipating fin (93). Thus, according to the present embodiment, it is not necessary to provide another means that sends the air for cooling the heat dissipating fin (93) to the heat dissipating fin (93), and therefore, the structure of the humidity controller (10) can be simplified.

[0118] In the humidity controller (10) of the present embodiment, part of the first side panel portion (14) of the casing (11) that is along the first bypass passage (81) in which the wire harness (99) is provided, is detachable. Thus, if the part of the first side panel portion (14) is detached from the casing (11), the wire harness (99) provided in the first bypass passage (81) is exposed to the outside of the casing (11). As a result, work time necessary for maintaining the wire harness (99), such as an exchange of wire harnesses (99), can be reduced.

[0119] Further, in the humidity controller (10) of the present embodiment, the wire harness (99) for connecting the indoor air side dampers (41-44) and the humidity sensors (96, 97), and the control board (91) and the power supply board (92), which are located opposite to each other with the first heat exchanger chamber (37) interposed therebetween, is laid in the first bypass passage (81), not in the first heat exchanger chamber (37). Here, if the wire harness (99) is provided in the first heat exchanger chamber (37), the wire harness (99) is provided such that it extends from the upstream side to the downstream side of the first adsorption heat exchanger (51), and therefore, a sealing structure for preventing air leaks needs to be provided in the area where the wire harness (99) is laid, in order to prevent the air from bypassing the first adsorption heat exchanger (51). However, the first adsorption heat exchanger (51) is not provided in the first bypass passage (81). Therefore, the sealing structure for preventing air from passing through from the upstream side to the downstream side of the first adsorption heat exchanger (51) is not necessary if the wire harness (99) is provided in the first bypass passage (81). Thus, according to the present embodiment, the wire harness (99) can be laid in the casing (11) without increasing complexity of the structure of the humidity controller (10).

[0120] Further, according to the humidity controller (10) of the present embodiment, if the wire harness (99) is provided in the first heat exchanger chamber (37), the wire harness (99) goes through both of the upstream side partition plate (71) and the downstream side partition plate (72). However, according to the present embodi-

ment in which the wire harness (99) is laid in the first bypass passage (81), the wire harness (99) goes through only the partition plate (78) that partitions the first bypass passage (81) from the supply fan chamber (36). Thus, according to the present embodiment, the number of partition plates which the wire harness (99) goes through can be reduced to a minimum, and as a result, the work for locating the wire harness (99) in the casing (11) can be simplified. In addition, part of the partition plate at which the wire harness (99) goes through needs to be sealed to prevent air leaks. Thus, if the number of partition plates which the wire harness (99) goes through can be reduced to a minimum, it can reduce the number of parts where sealing is necessary. As a result, complexity of the structure of the humidity controller (10) can be reduced.

-Modification of Embodiment-

[0121] In the refrigerant circuit (50) of the present embodiment, a supercritical cycle may be performed in which a high pressure of the refrigeration cycle is set to be a value higher than a critical pressure of the refrigerant. In that case, one of the first adsorption heat exchanger (51) and the second adsorption heat exchanger (52) serves as a gas cooler, and the other serves as an evaporator.

[0122] In the humidity controller (10) of the present embodiment, the adsorbent may be heated or cooled by supplying hot water or cold water to the first adsorption heat exchanger (51) and the second adsorption heat exchanger (52). In this case, a pipeline through which the hot water or the cold water is supplied to the adsorption heat exchangers (51, 52) constitutes a heat transfer circuit through which hot water or cold water as a heat transfer fluid flows.

[0123] The embodiment described in the above is an essentially preferable example, and is not intended to limit the present invention, its application, or its range of use.

INDUSTRIAL APPLICABILITY

[0124] As explained in the above, the present invention is useful as a humidity controller for controlling humidity of room air.

Claims

1. A humidity controller comprising:

a heat transfer circuit (50) to which adsorption heat exchangers (51, 52) each carrying an adsorbent are connected and through which a heat transfer fluid flows; and
a casing (11) in which the adsorption heat exchangers (51, 52) are accommodated, wherein

- the heat transfer fluid is supplied to the adsorption heat exchangers (51, 52), thereby heating or cooling the adsorbents of the adsorption heat exchangers (51, 52), and air taken in the casing (11) is brought into contact with the adsorbents of the adsorption heat exchangers (51, 52) to control humidity of the air, in the casing (11), main air passages (37, 38) in which the adsorption heat exchangers (51, 52) are located, and auxiliary air passages (81, 82) through which the air flows by bypassing the adsorption heat exchangers (51, 52) are provided, and the humidity controller includes switching mechanisms (83, 84, ...) by which a flow path of the air in the casing (11) is switched between a state in which the air flows through the main air passages (37, 38) and does not flow through the auxiliary air passages (81, 82), and a state in which the air flows through the auxiliary air passages (81, 82) and does not flow through the main air passages (37, 38).
2. The humidity controller of claim 1, wherein the heat transfer circuit (50) alternately performs an operation in which the adsorbent of the first adsorption heat exchanger (51) is cooled and the adsorbent of the second adsorption heat exchanger (52) is heated, and an operation in which the adsorbent of the second adsorption heat exchanger (52) is cooled and the adsorbent of the first adsorption heat exchanger (51) is heated, the first main air passage (37) in which the first adsorption heat exchanger (51) is located, the second main air passage (38) in which the second adsorption heat exchanger (52) is located, the first auxiliary air passage (81) for allowing outdoor air to flow toward a room, and the second auxiliary air passage (82) for allowing room air to flow toward the outside, are provided in the casing (11), and in the state in which the air flows through the first and second main air passages (37, 38), one of an air current which has passed through the first adsorption heat exchanger (51) and an air current which has passed through the second adsorption heat exchanger (52) is supplied into the room, and the other air current is exhausted to the outside.
3. The humidity controller of claim 2, wherein the casing (11) is formed in a hollow rectangular parallelepiped shape, and in the casing (11), the first auxiliary air passage (81) is provided along one of side plate portions (14, 15) that face each other, and the second auxiliary air passage (82) is provided along the other side plate portion, and the first main air passage (37) and the second main air passage (38) are arranged next to each other in a space between the first auxiliary air passage (81) and the second auxiliary air passage (82).
4. The humidity controller of claim 3, wherein in the casing (11), part of the side plate portion (14) that is along the first auxiliary air passage (81) is detachable, and a lead wire for electrically connecting structural components (41-44, 96, 97) accommodated in the casing (11) and electrical boards (91, 92) arranged opposite to the structural components (41-44, 96, 97) with respect to the first main air passage (37), is provided in the first auxiliary air passage (81).

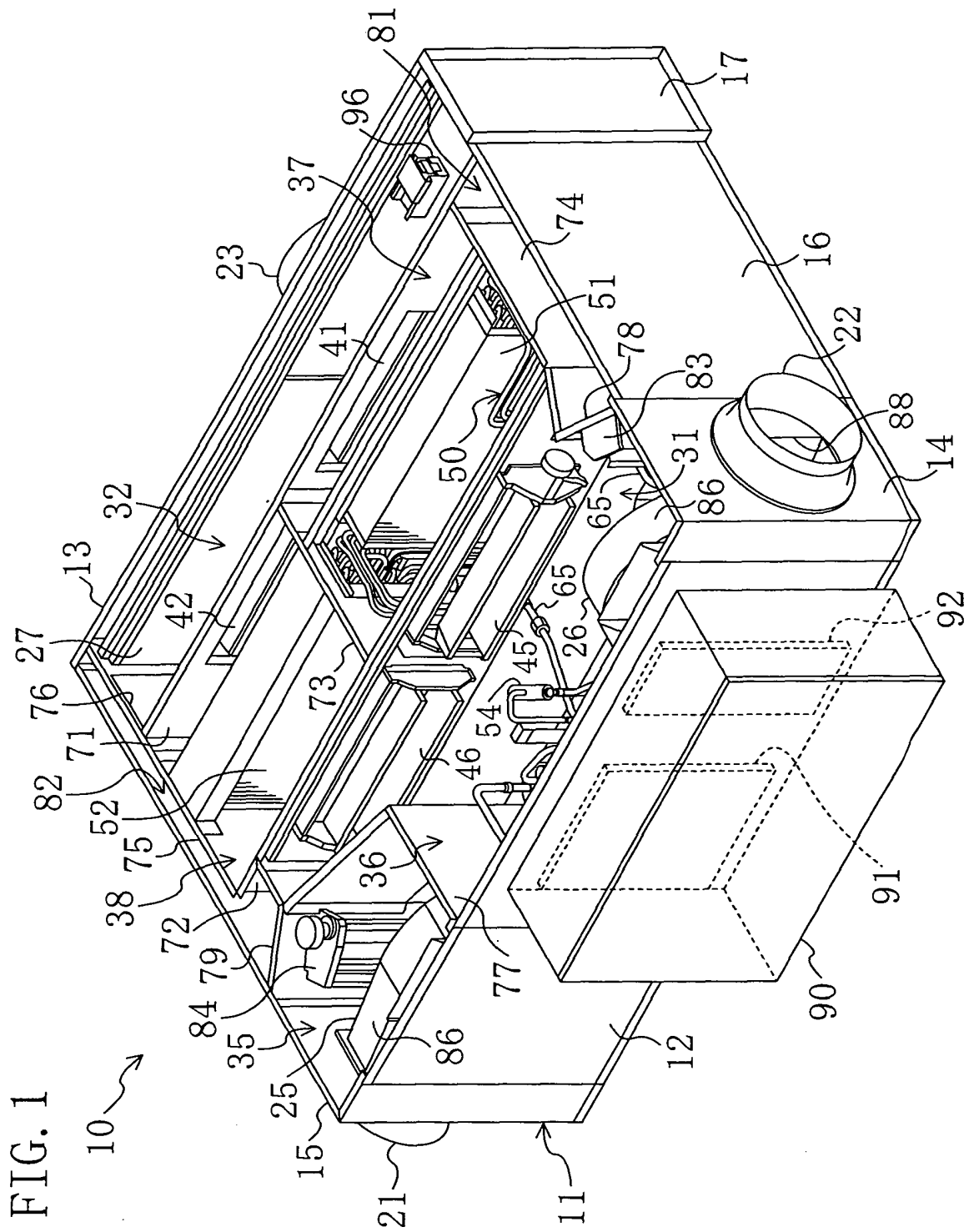


FIG. 2

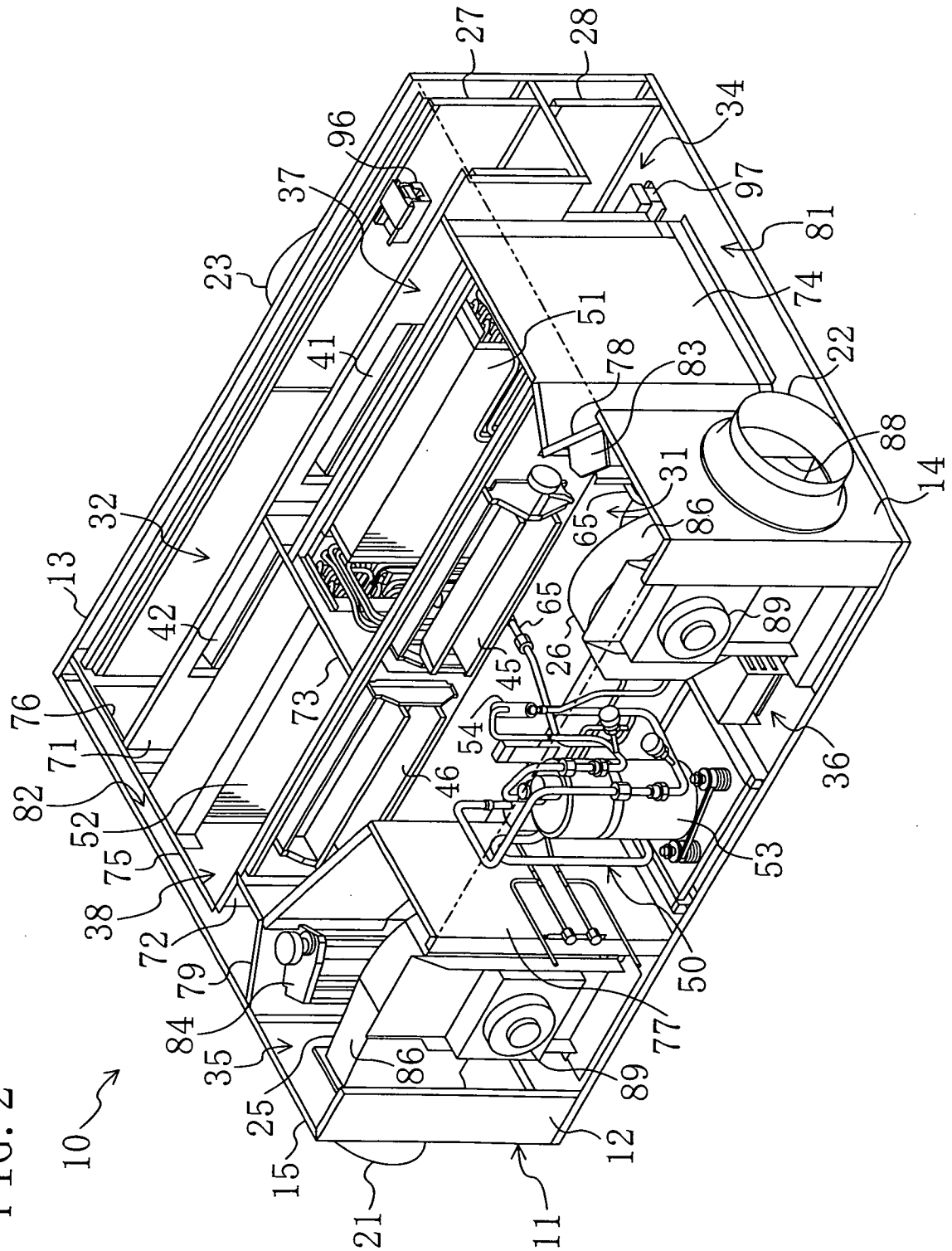


FIG. 4

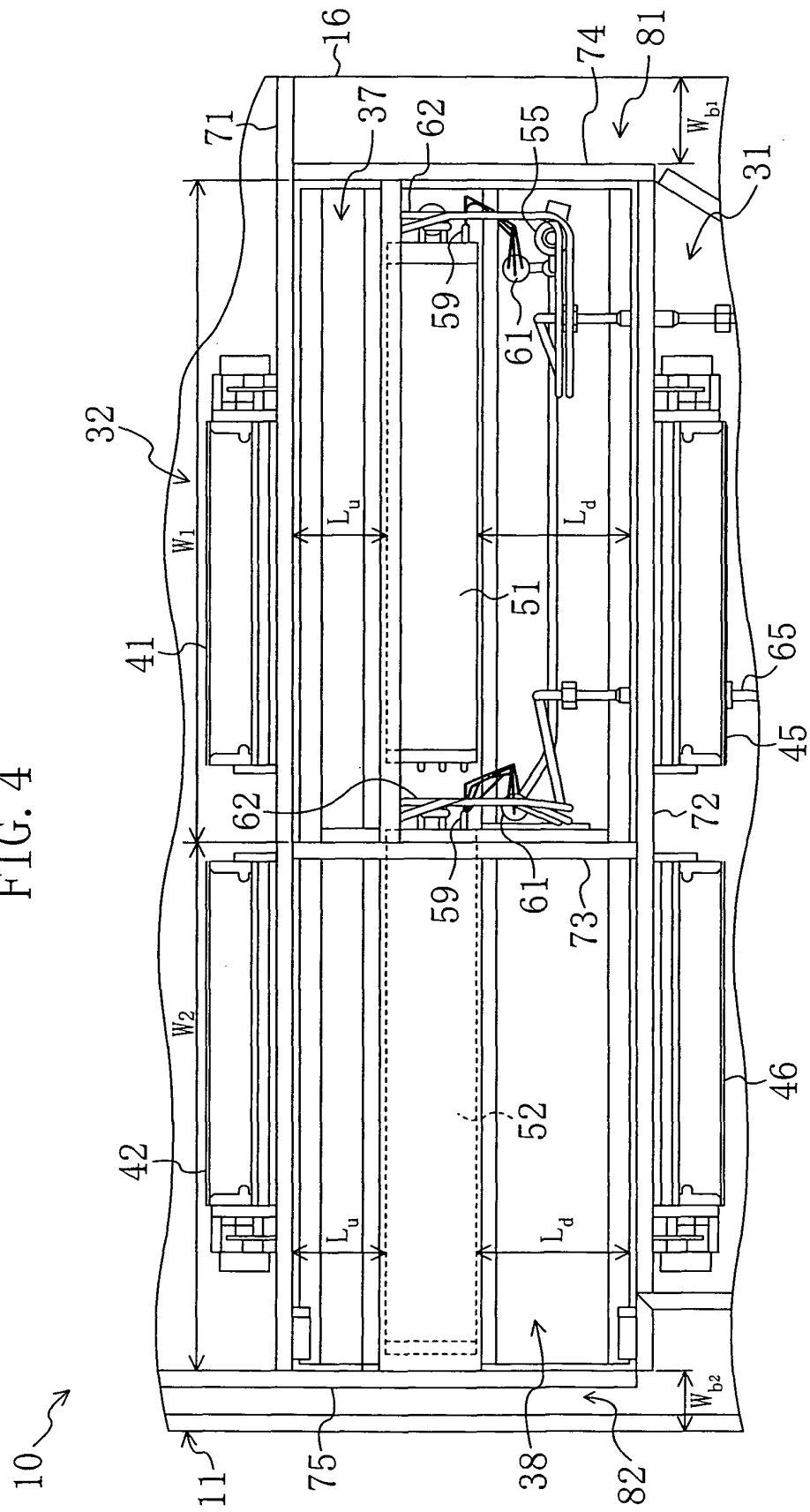


FIG. 5

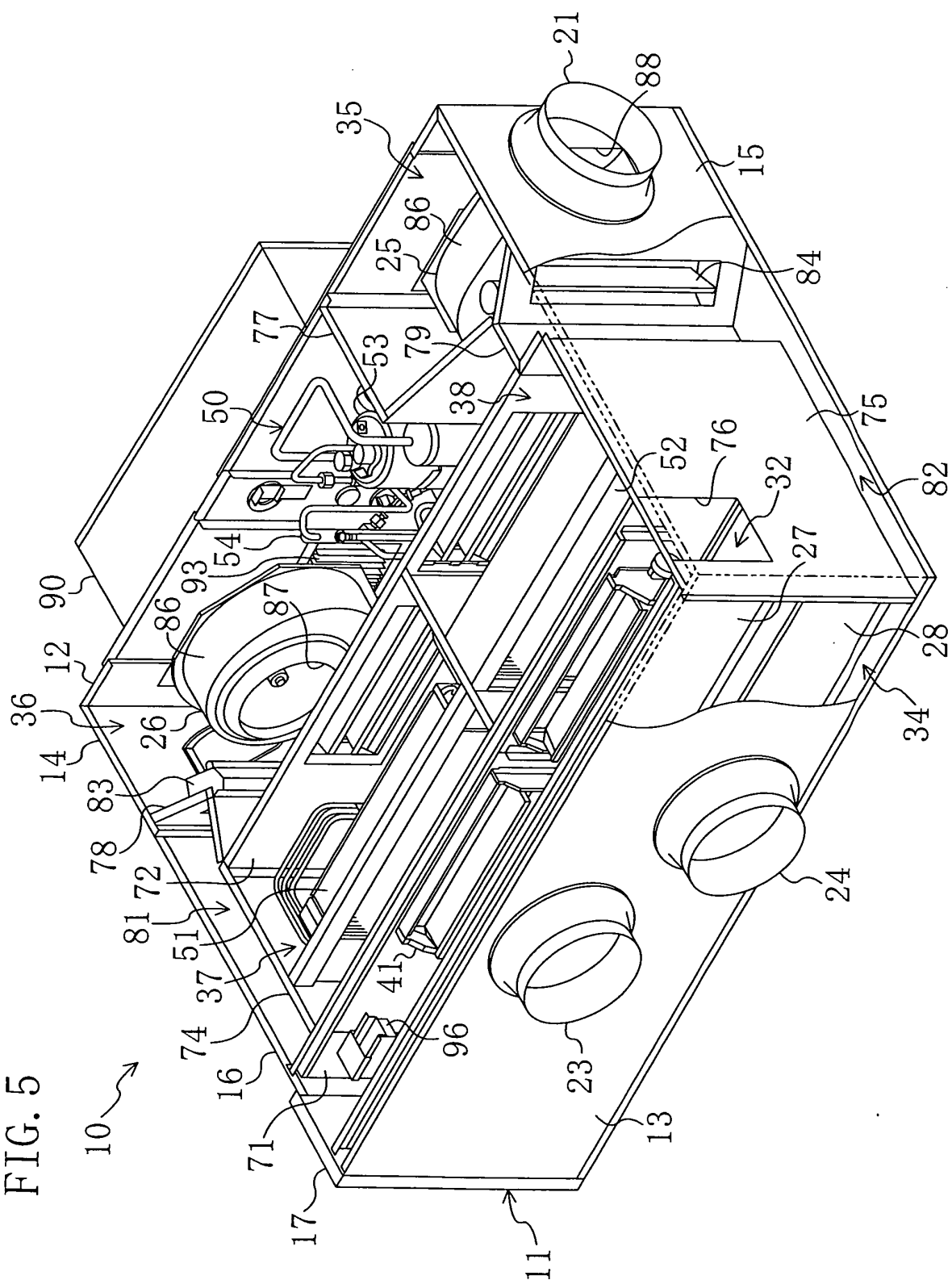


FIG. 6

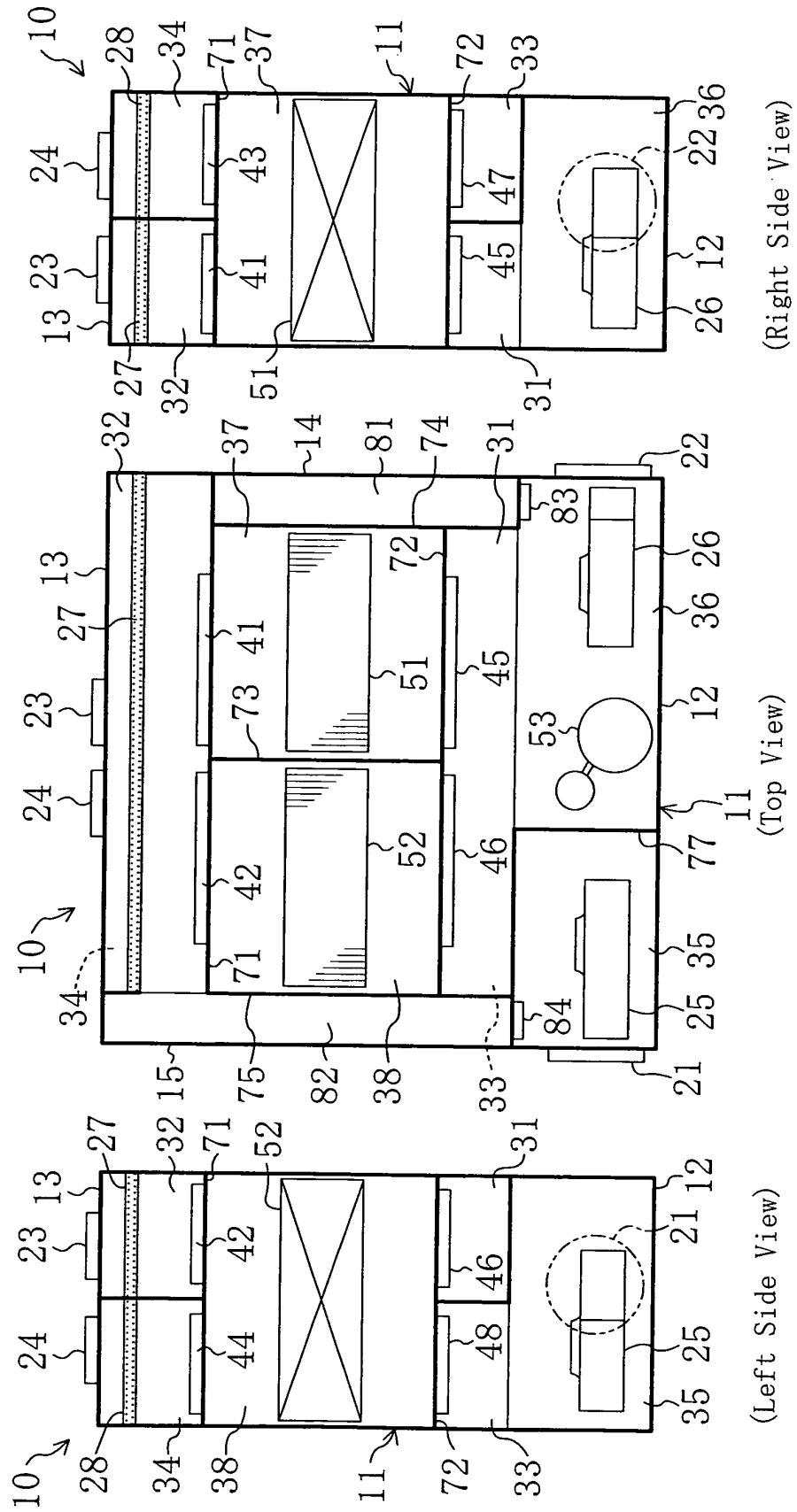


FIG. 7B
Second Operation

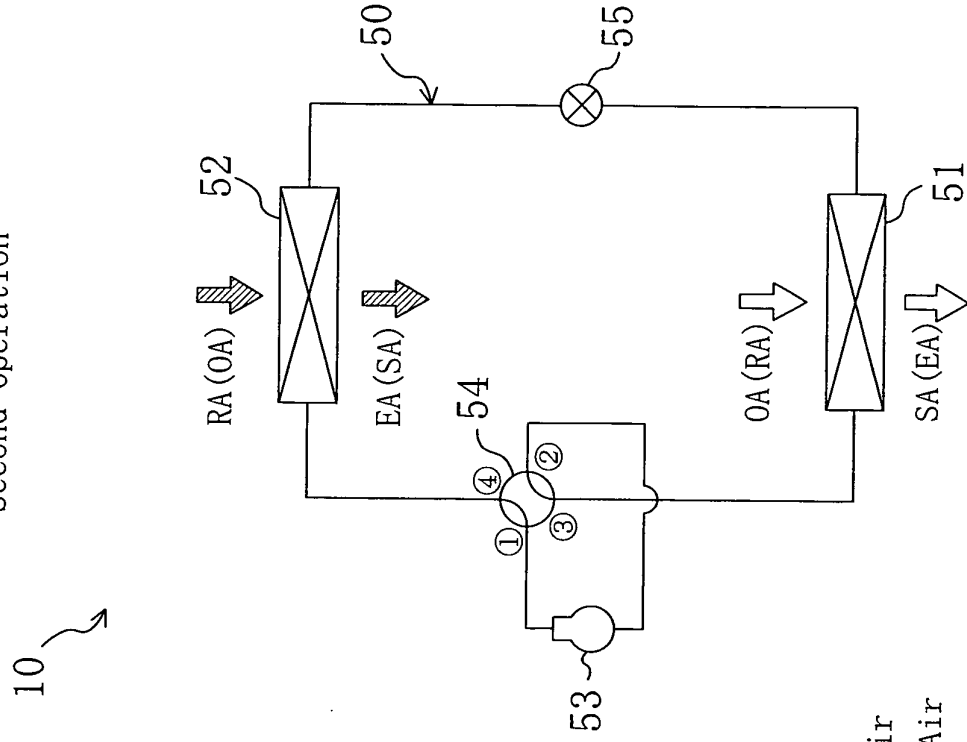


FIG. 7A
First Operation

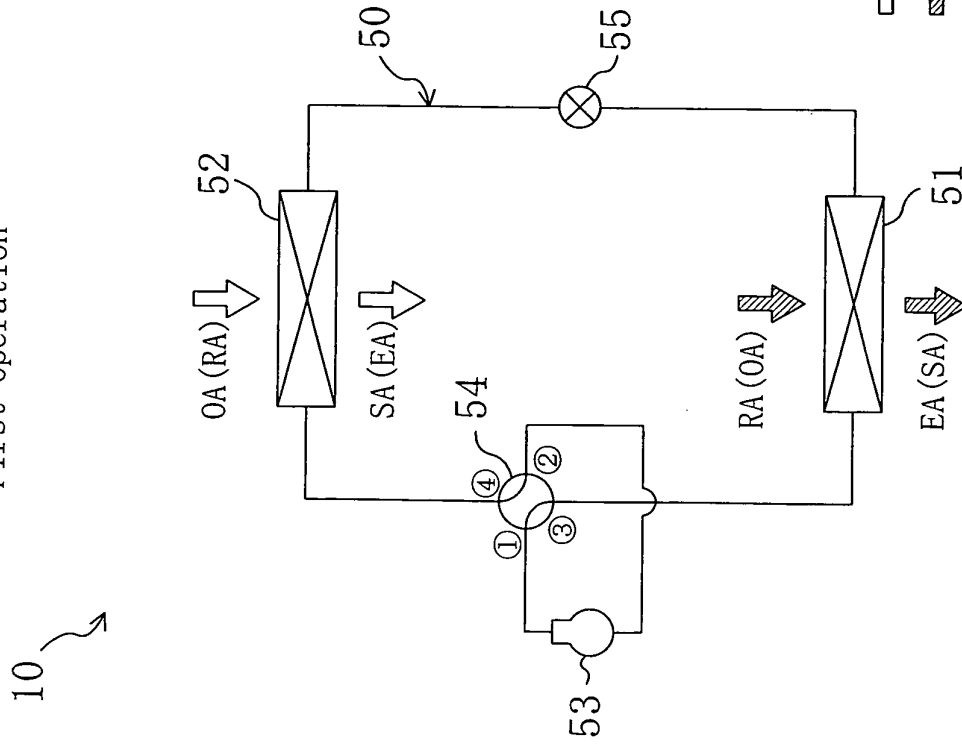


FIG. 8

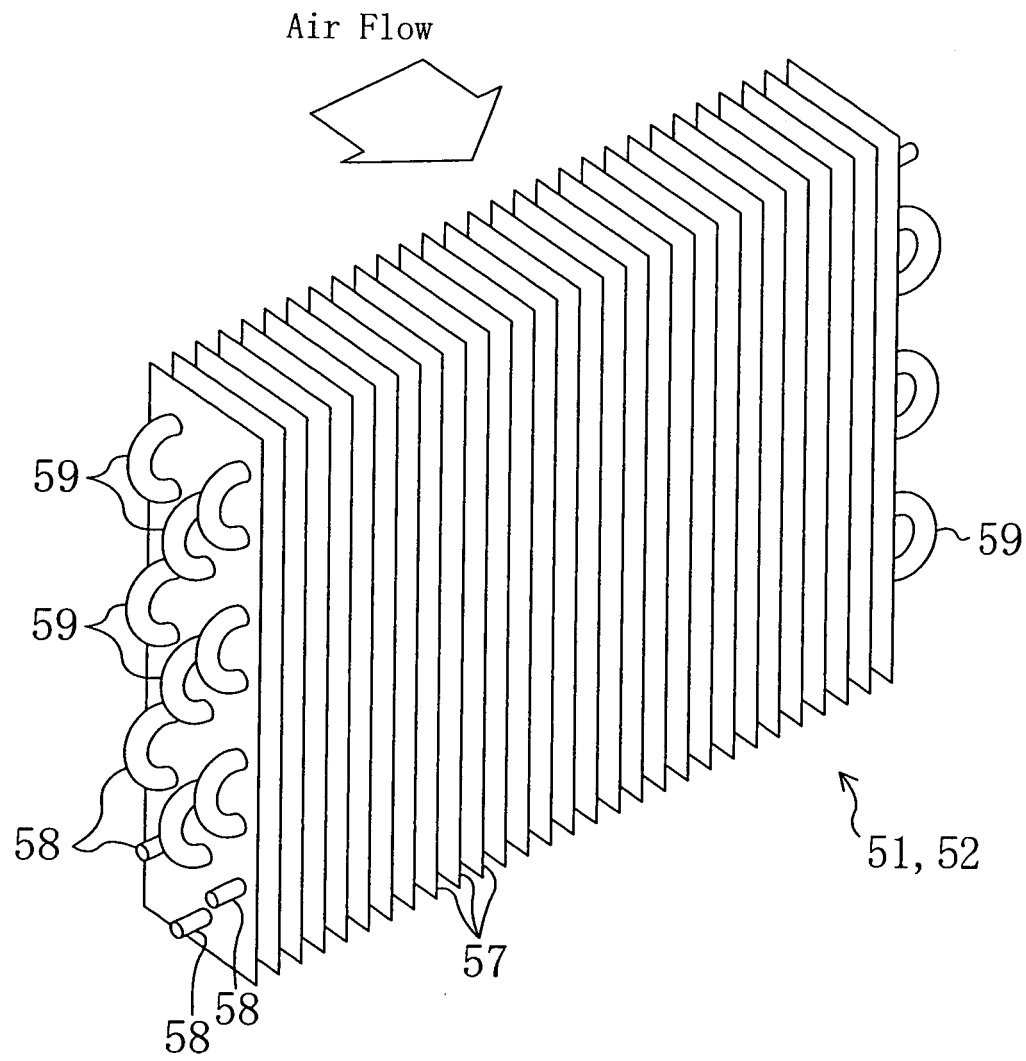


FIG. 9

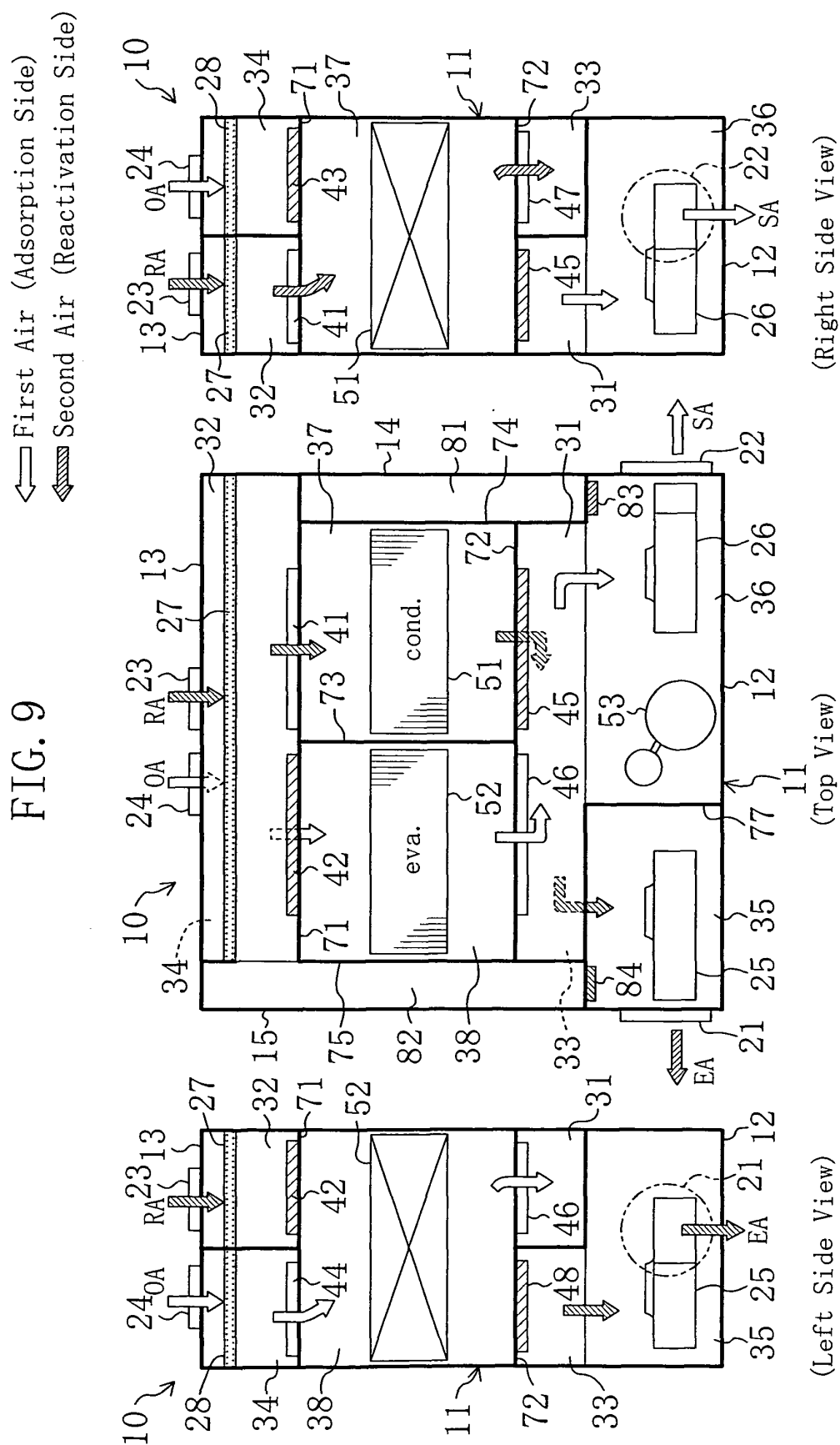


FIG. 10

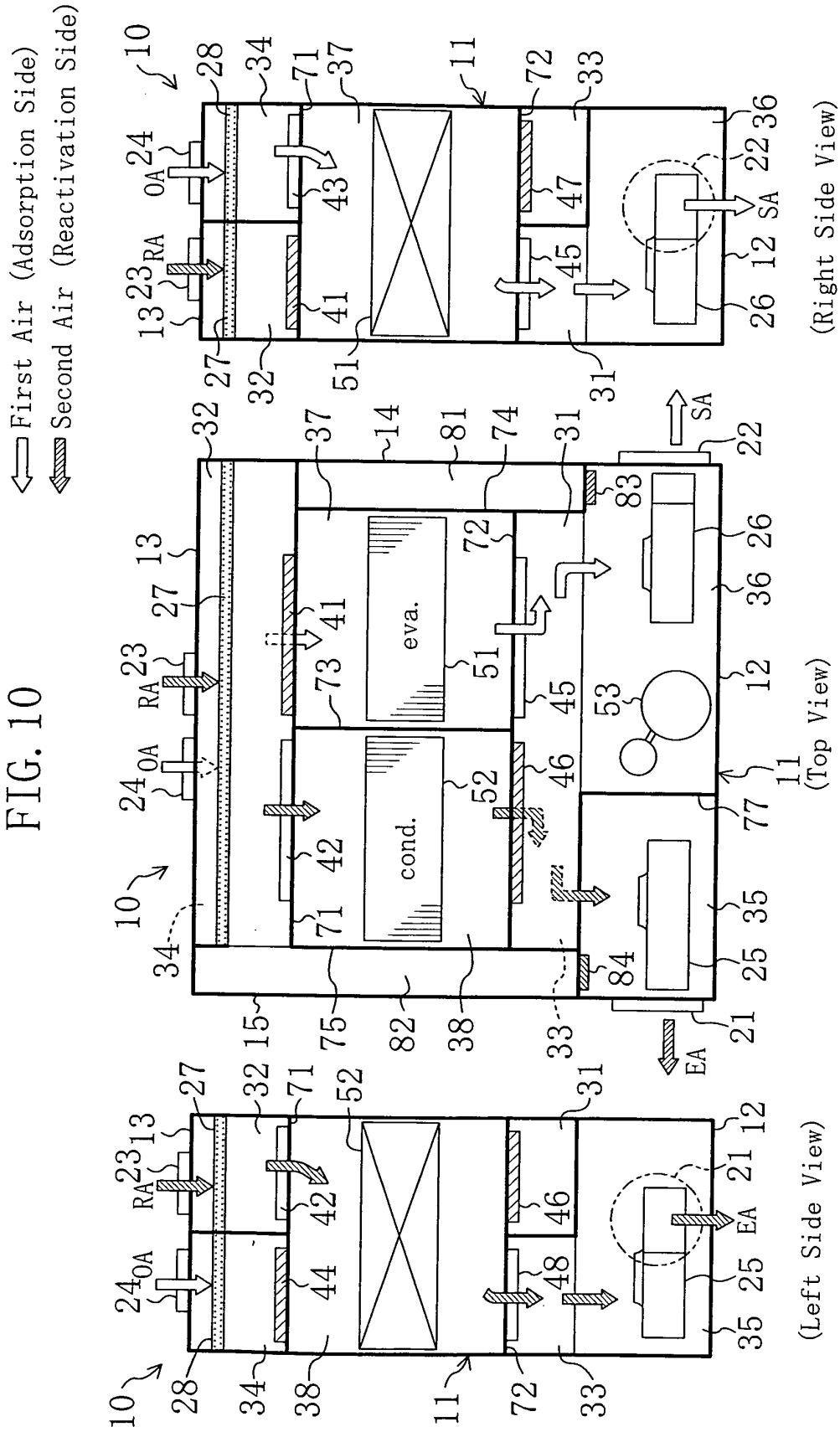


FIG. 11

First Air (Adsorption Side)
 Second Air (Reactivation Side)

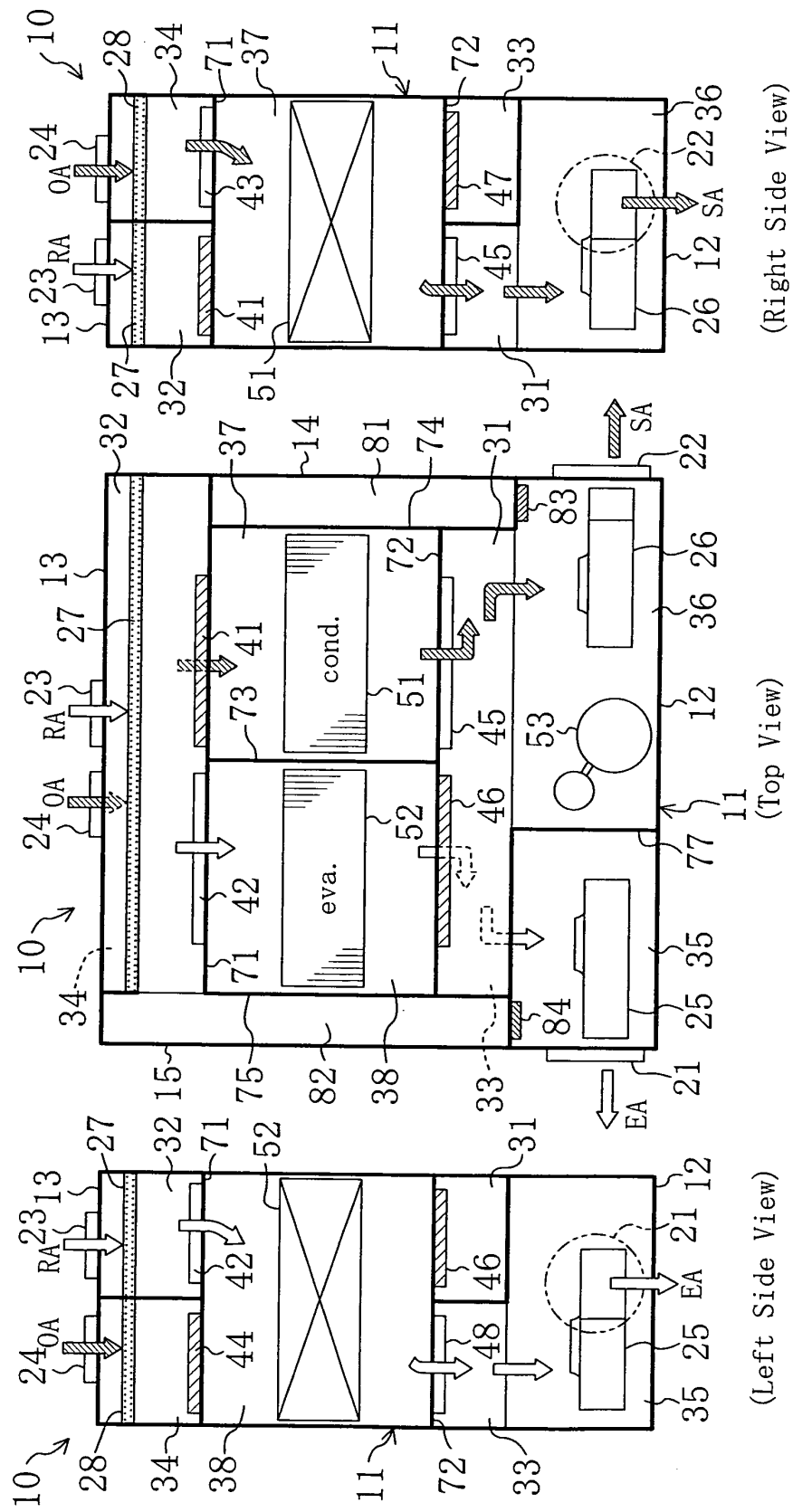


FIG. 12

First Air (Adsorption Side)
 Second Air (Reactivation Side)

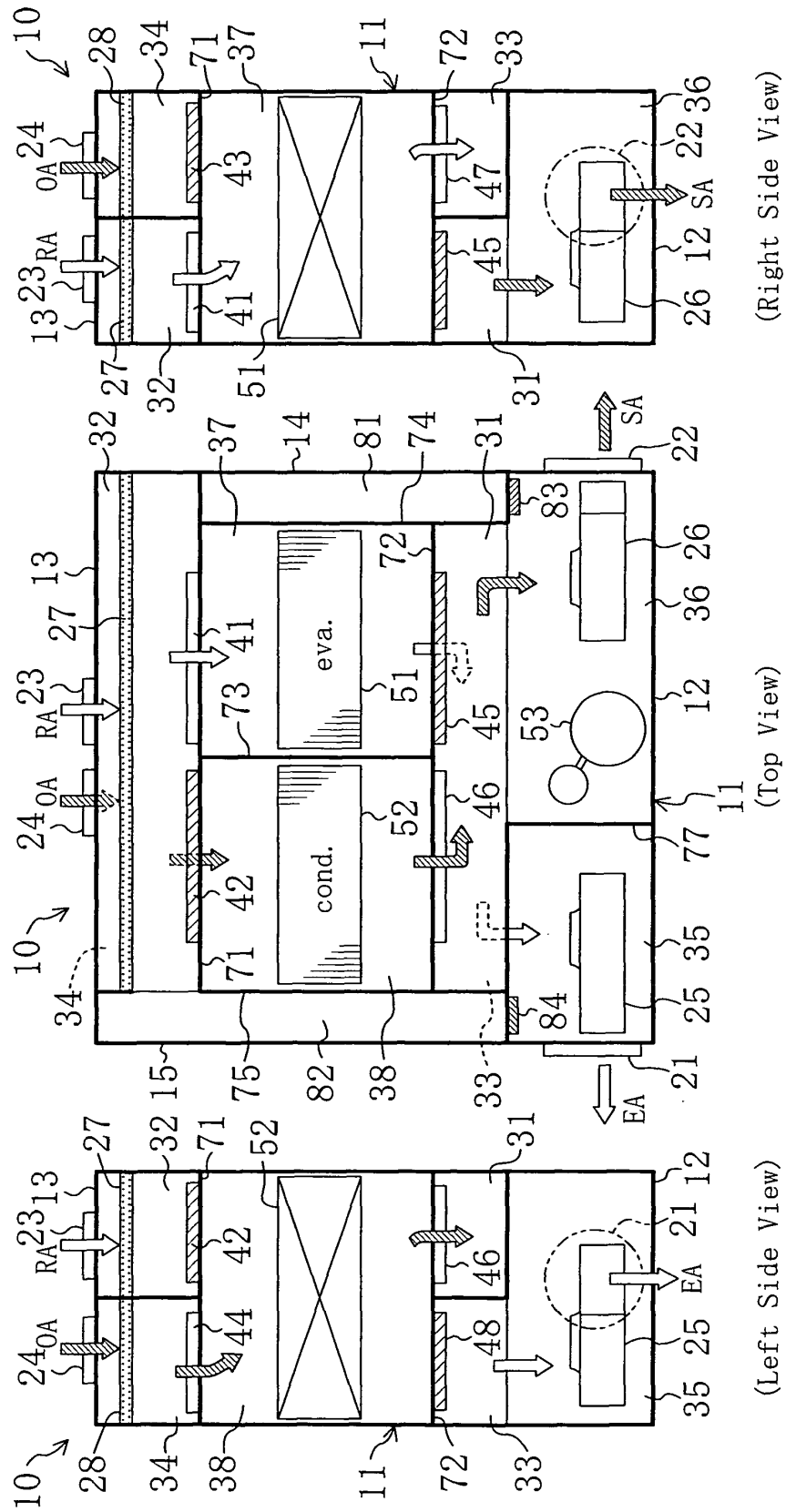
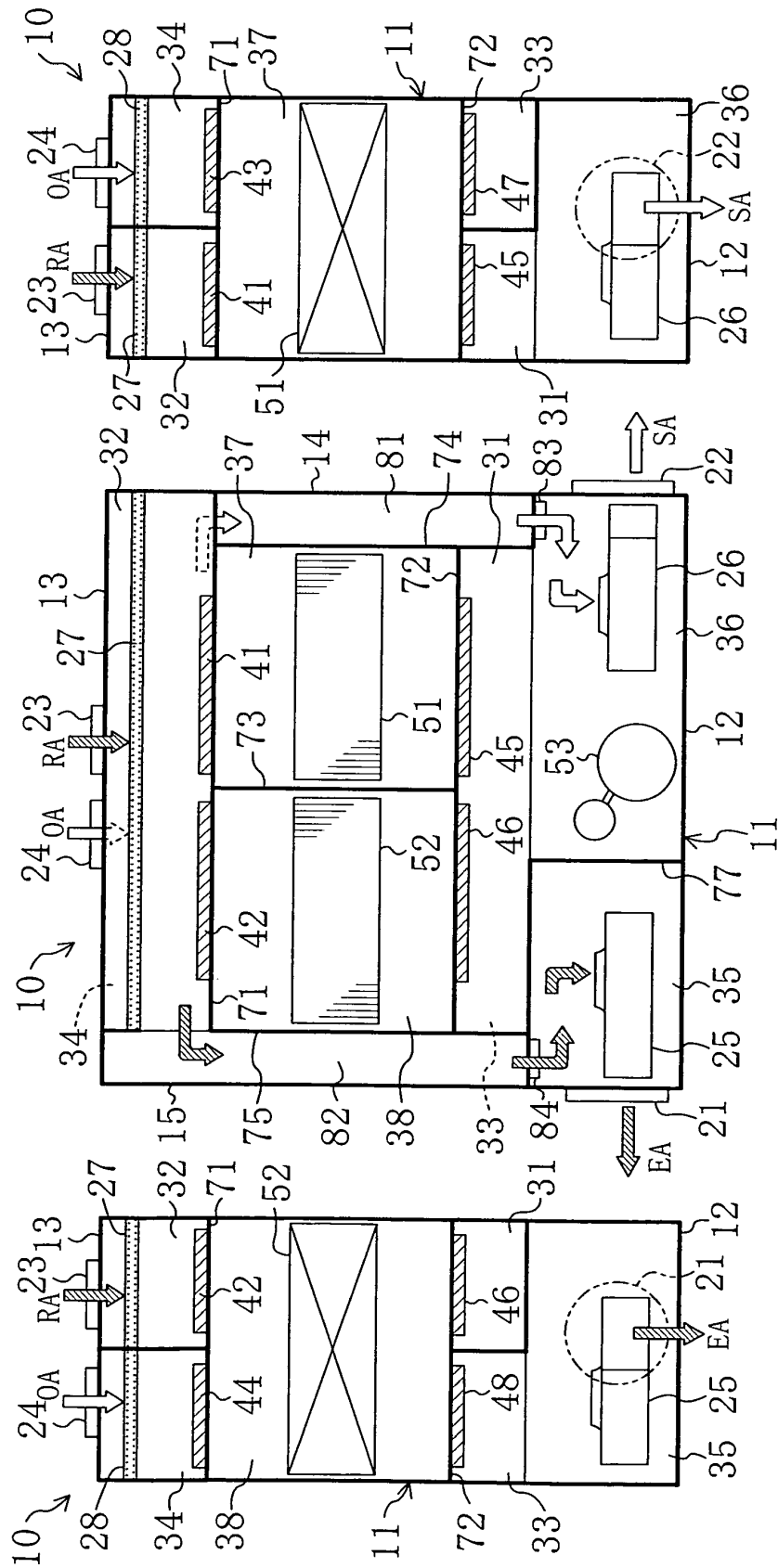


FIG. 13

 First Air (Intake Air)
 Second Air (Exhaust Air)

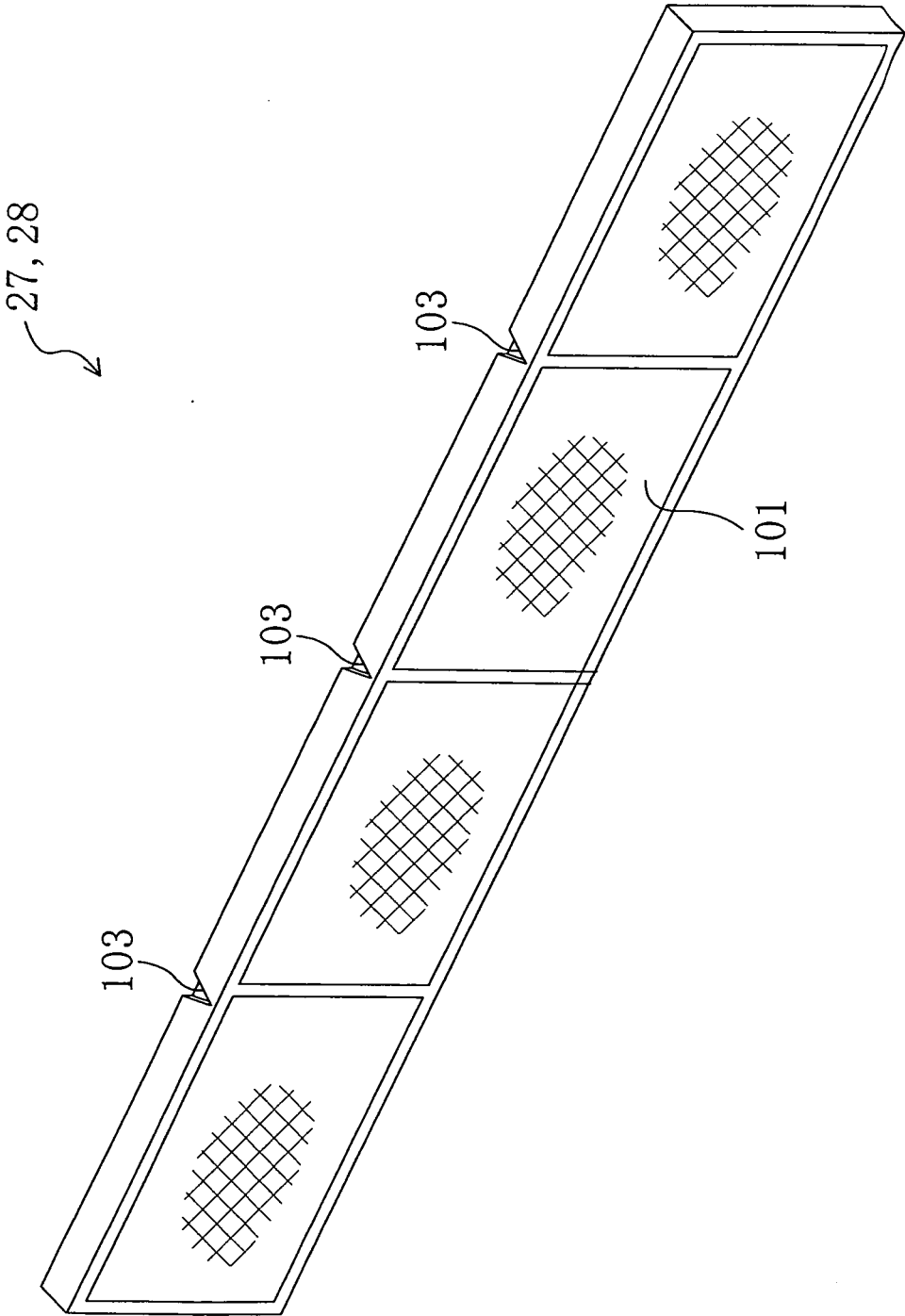


(Right Side View)

(Top View)

(Left Side View)

FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/001401

A. CLASSIFICATION OF SUBJECT MATTER

F24F3/147(2006.01)i, F24F3/16(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F3/147, F24F3/16

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 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-78108 A (Daikin Industries, Ltd.), 23 March, 2006 (23.03.06), Full text; Figs. 1 to 12 (Family: none)	1-4
Y	JP 2001-165484 A (Mitsubishi Electric Corp.), 22 June, 2001 (22.06.01), Par. Nos. [0016] to [0019] (Family: none)	1-4
Y	JP 2005-30734 A (Daikin Industries, Ltd.), 03 February, 2005 (03.02.05), Full text; Figs. 1, 2, 11, 12 (Family: none)	1-4

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

23 June, 2008 (23.06.08)

Date of mailing of the international search report

26 August, 2008 (26.08.08)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/001401

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 4-222339 A (Mitsubishi Electric Corp.), 12 August, 1992 (12.08.92), Fig. 5 (Family: none)	1-4
Y	JP 2005-331142 A (Mitsubishi Electric Corp.), 02 December, 2005 (02.12.05), Par. No. [0004] (Family: none)	1-4
Y	JP 2005-291532 A (Daikin Industries, Ltd.), 20 October, 2005 (20.10.05), Par. No. [0058] (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006078108 A [0006]