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(54) OUTDOOR UNIT FOR AIR CONDITIONER

(57) An object of the present invention is to provide an outdoor unit of an air conditioner in which airflow volume made to permeate through an adsorption member can be ensured without relying on airflow volume passing through an outdoor heat exchanger. In an outdoor unit (30), air that does not pass through an outdoor heat exchanger (33) flows in from an intake opening (46b). As a result, when frost has begun to form on the outdoor heat exchanger (33), an air whose quantity is equivalent to the airflow volume reduced by an increase in ventilation resistance of the outdoor heat exchanger (33) is guided in from the intake opening (46b), and adsorption airflow volume increases, the opposite of what occurs in "the prior art in which adsorption airflow volume decreases when frost forms."

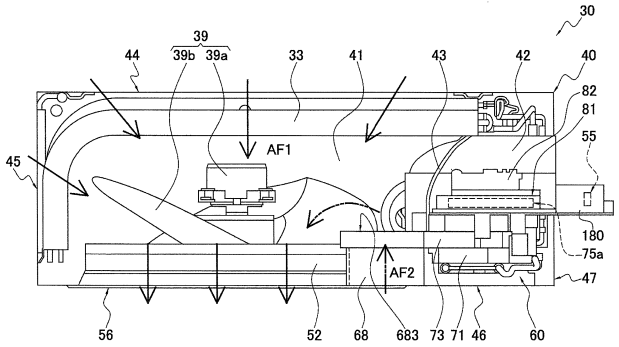

FIG. 2

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Description

TECHNICAL FIELD

[0001] The present invention relates to an outdoor unit of an air conditioner, and particularly relates to an outdoor unit of an air conditioner having a humidifying function.

BACKGROUND ART

[0002] The outdoor unit with a humidifying function disclosed in Patent Literature 1 (Japanese Laid-open Patent Publication No. 2008-190828) is configured such that air passing through an outdoor heat exchanger flows to a plate-shaped adsorption member disposed parallel with the front surface of the outdoor unit.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] However, with the configuration described above, ventilation resistance in the outdoor heat exchanger is high, it is difficult to increase the airflow volume made to permeate through the adsorption member, and ventilation resistance further increases when frost begins to accumulate on the outdoor heat exchanger, which is a hindrance to increasing humidification performance because airflow volume to the adsorption member decreases.

[0004] An object of the present invention is to provide an outdoor unit of an air conditioner in which the airflow volume made to permeate through the adsorption member can be ensured without relying on the airflow volume passing through the outdoor heat exchanger.

<Solution to Problem>

[0005] An outdoor unit of an air conditioner according to a first aspect of the present invention includes a plate-shaped adsorption member, which after adsorbing moisture in air, releases the moisture due to being heated, the adsorption member being disposed so that a surface thereof extends along a vertical plane; wherein the outdoor unit of an air conditioner comprises a main body casing which forms outer contours, an outdoor heat exchanger stored in the main body casing, and an outdoor fan. The outdoor fan is stored in the main body casing, and the outdoor fan generates an air flow that passes through the outdoor heat exchanger. The main body casing has a blow-out port and an intake opening. Air from the outdoor fan is blown out through the blow-out port. The intake opening, which is provided to a different position than the blow-out port, guides in air that does not pass through the outdoor heat exchanger. An air flow path is formed inside the main body casing by negative pressure created when the outdoor fan generates the air flow, the air flow path channels air guided in from the intake opening to the adsorption member and causes the air to pass through the interior of adsorption member.

[0006] In this outdoor unit of an air conditioner, air that does not pass through the outdoor heat exchanger flows in from the intake opening due to the effect of negative pressure when the outdoor fan is running. As a result, when frost has begun to form on the outdoor heat exchanger, an air whose quantity is equivalent to the airflow volume reduced by the increase in ventilation resistance of the outdoor heat exchanger is guided in from the intake opening, and adsorption airflow volume increases, the opposite of what occurs in "the prior art in which adsorption airflow volume decreases when frost forms."

[0007] An outdoor unit of an air conditioner according to a second aspect of the present invention is the outdoor unit of an air conditioner according to the first aspect, further comprising a bell mouth to guide air from the outdoor fan to the blow-out port. An end of the bell mouth on an upstream side in the air flow direction and an end of the air flow path on a downstream side in the air flow direction are adjacent.

[0008] In this outdoor unit of an air conditioner, the intake side of the outdoor fan, i.e., the upstream-side end of the bell mouth has negative pressure due to the running of the outdoor fan, whereby outside air is guided in from the intake opening. Therefore, the effect of the negative pressure in the upstream-side end of the bell mouth can be better received, due to the upstream-side end of the bell mouth and the downstream-side end of the air flow path being adjacent. As a result, more outside air can be caused to flow in from the intake opening.

[0009] An outdoor unit of an air conditioner according to a third aspect of the present invention is the outdoor unit of an air conditioner according to the first or second aspect, wherein the adsorption member includes an adsorption side where moisture in the air flowing through the air flow path is adsorbed, and a release side where the adsorbed moisture is released, the adsorption side being disposed near the bell mouth.

[0010] In this outdoor unit of an air conditioner, outside air is guided in from the intake opening due to the running of the outdoor fan creating negative pressure in the intake side of the outdoor fan, i.e., in the upstream-side end of the bell mouth. It is reasonable that air guided in from the intake opening would be guided to the adsorption side of the adsorption member, and the effect of negative pressure in the upstream-side end of the bell mouth can therefore be better received due to the absorption side being disposed near the bell mouth. As a result, more outside air can be caused to flow in from the intake opening.

[0011] An outdoor unit of an air conditioner according to a fourth aspect of the present invention is the outdoor unit of an air conditioner according to any of the first through third aspects, wherein the adsorption member is disposed parallel with a front-surface part of the main body casing.

[0012] An outdoor unit of an air conditioner according

to a fifth aspect of the present invention is the outdoor unit of an air conditioner according to any of the second through fourth aspects, wherein the intake opening and an opening in the bell mouth are provided in the front-surface part of the main body casing.

[0013] In this outdoor unit of an air conditioner, outside air that does not pass through the outdoor heat exchanger is guided in from the intake opening due to the running of the outdoor fan causing the intake side of the outdoor fan, i.e., the upstream-side end of the bell mouth to have negative pressure.

[0014] An outdoor unit of an air conditioner according to a sixth aspect of the present invention is the outdoor unit of an air conditioner according to the fifth aspect, wherein the adsorption member is disposed so as to face the intake opening.

<Advantageous Effects of Invention>

[0015] In the outdoor unit of an air conditioner according to the first aspect of the present invention, air that does not pass through the outdoor heat exchanger flows in from the intake opening due to the effect of negative pressure when the outdoor fan is running. As a result, when frost has begun to form on the outdoor heat exchanger, an air whose quantity is equivalent to the airflow volume reduced by the increase in ventilation resistance of the outdoor heat exchanger is guided in from the intake opening, and adsorption airflow volume increases, the opposite of what occurs in "the prior art in which adsorption airflow volume decreases when frost forms."

[0016] In the outdoor unit of an air conditioner according to the second aspect of the present invention, the intake side of the outdoor fan, i.e., the upstream-side end of the bell mouth has negative pressure due to the running of the outdoor fan, whereby outside air is guided in from the intake opening. Therefore, the effect of the negative pressure in the upstream-side end of the bell mouth can be better received, due to the upstream-side end of the bell mouth and the downstream-side end of the air flow path being adjacent. As a result, more outside air can be caused to flow in from the intake opening.

[0017] In the outdoor unit of an air conditioner according to the third aspect of the present invention, outside air is guided in from the intake opening due to the running of the outdoor fan creating negative pressure in the intake side of the outdoor fan, i.e., in the upstream-side end of the bell mouth. It is reasonable that air guided in from the intake opening would be guided to the adsorption side of the adsorption member, and the effect of negative pressure in the upstream-side end of the bell mouth can therefore be better received due to the absorption side being disposed near the bell mouth. As a result, more outside air can be caused to flow in from the intake opening.

[0018] In the outdoor unit of an air conditioner according to the fourth aspect of the present invention, the same effects are exhibited as those of the outdoor unit of an air conditioner according to any of the first through third aspects.

[0019] In the outdoor unit of an air conditioner according to the fifth aspect of the present invention, outside air that does not pass through the outdoor heat exchanger is guided in from the intake opening due to the running of the outdoor fan causing the intake side of the outdoor fan, i.e., the upstream-side end of the bell mouth to have negative pressure.

[0020] In the outdoor unit of an air conditioner according to the sixth aspect of the present invention, the same effects are exhibited as those of the outdoor unit of an air conditioner according to the fifth aspect.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a configuration diagram of a refrigerating apparatus provided with an outdoor unit according to an embodiment of the present invention;
FIG. 2 is a plan view of the outdoor unit with a top panel taken off;
FIG. 3 is a front view of the outdoor unit with a protective grill taken off from a front panel;
FIG. 4 is a perspective view showing the humidifying rotor and the flow of air passing through the humidifying rotor;
FIG. 5 is a perspective view of the humidifying unit with the heater taken off;
FIG. 6 is a front view of the outdoor unit according to a modification, with the front panel taken off; and
FIG. 7 is a perspective view showing the positional relationship between the bell mouth and the humidifying unit in FIG. 6.

DESCRIPTION OF EMBODIMENTS

[0022] An embodiment of the present invention is described below with reference to the drawings. The following embodiment is a specific example of the present invention and is not intended to limit the technical scope of the present invention.

(1) Summary of configuration of air conditioner 10

[0023] FIG. 1 is a configuration diagram of a refrigerating apparatus provided with an outdoor unit 30 according to an embodiment of the present invention. In FIG. 1, the refrigerating apparatus is an air conditioner 10 provided with an indoor unit 20, the outdoor unit 30, and refrigerant interconnection tubes 14, 16 connecting these two units. The air conditioner 10 has a plurality of operation modes including air-cooling operation, air-warming operation, dehumidifying operation, humidifying operation, air-supplying operation, etc., and these operation modes can be combined as appropriate.

[0024] The indoor unit 20 is provided with an indoor

heat exchanger 21, and the outdoor unit 30 is provided with a compressor 31, a four-way switching valve 32, an outdoor heat exchanger 33, an electric expansion valve 34, an accumulator 36, a liquid-side shutoff valve 37, and a gas-side shutoff valve 38.

[0025] In order to supply outside air into a room in the humidifying operation and the air-supplying operation, air moves between the indoor unit 20 and the outdoor unit 30 via an air supply hose 18. In the humidifying operation in particular, moisture is taken from the outside air in the outdoor unit 30 in order to supply high-humidity air containing much moisture from the outdoor unit 30 to the indoor unit 20.

[0026] In the present embodiment, a humidifying unit 60 is provided inside the outdoor unit 30, and the humidifying unit 60 has the function of taking moisture from the outside air.

(2) Configuration of indoor unit 20

[0027] In the indoor unit 20, an indoor fan 22 driven by a motor is provided on a downstream side of the indoor heat exchanger 21, as shown in FIG. 1. The indoor fan 22 is a cross-flow fan. When the indoor fan 22 is driven, indoor air taken in from an intake port 23 in an upper part of the indoor unit 20 passes through the indoor heat exchanger 21 to be blown out from a blow-out port 24 in a lower part of the indoor unit 20.

[0028] In the indoor unit 20, an air supply port 25 of the air supply hose 18 is provided in an upstream-side space in the indoor heat exchanger 21. The air supply hose 18 is connected to the humidifying unit 60, and high-humidity air sent from the humidifying unit 60 is supplied from the air supply port 25 to the upstream-side space in the indoor heat exchanger 21. By driving the indoor fan 22 while such high-humidity air is being supplied from the air supply port 25, the humidity of conditioned air blown out from the blow-out port 24 of the indoor unit 20 can be increased.

(3) Configuration of outdoor unit 30

(3-1) Overall configuration

[0029] FIG. 2 is a plan view of the outdoor unit 30 with a top panel 48 taken off. FIG. 3 is a front view of the same outdoor unit 30 with a protective grill 56 taken off from the outdoor unit 30.

[0030] In FIGS. 1 to 3, the outdoor unit 30 is provided with a casing 40, the outdoor heat exchanger 33, an outdoor fan 39, and the humidifying unit 60. When the outdoor fan 39 is driven, outside air is taken in from a rear-surface side of the outdoor heat exchanger 33, and the outdoor air passes through the outdoor heat exchanger 33 to be blown out from a blow-out port 46a (see FIG. 3). A front surface of the blow-out port 46a is usually covered by the protective grill 56 (see FIG. 2), and is kept from coming into contact with a propeller 39b from the exterior.

[0031] At least part of the humidifying unit 60 is disposed in an air blower compartment 41 of the outdoor unit 30, and the rest is disposed in a machinery compartment 42.

(3-2) Detailed configuration

(3-2-1) Casing 40

[0032] The casing 40 is a cabinet composed of a left-side panel 45, a front panel 46, a right-side panel 47, the top panel 48 (see FIG. 3), a bottom panel 49 (see FIG. 3), and a back-surface panel 44, the interior being divided by a partitioning member 43 into the air blower compartment 41 and the machinery compartment 42. The outdoor heat exchanger 33 and the outdoor fan 39 are disposed in the air blower compartment 41. The compressor 31 and part of the humidifying unit 60 are disposed in the machinery compartment 42.

[0033] The partitioning member 43 extends from the side of the top panel 48 to the side of the bottom panel 49, substantially in parallel with the right-side panel 47. The partitioning member 43 also extends in an arc from an inner-surface side of the front panel 46 toward a right end of the outdoor heat exchanger 33. As a result, the partitioning member 43 has a blocking function so that the airflow does not circulate into the machinery compartment 42 from the air blower compartment 41.

[0034] The circular blow-out port 46a is formed in the front panel 46, as shown in FIG. 3. A ring-shaped bell mouth 52 is attached to the blow-out port 46a so as to run along the peripheral edge thereof.

(3-2-2) Compressor 31

[0035] The compressor 31 is positioned on the side of the machinery compartment 42 and is secured to the bottom panel 49, as shown in FIG. 1. During operation, the compressor 31 is high in temperature and the machinery compartment 42 therefore has a higher temperature than the air blower compartment 41.

(3-2-3) Electric component unit 50

[0036] An electric component unit 50 is positioned in the air blower compartment 41, and is furnished with a control board on which electronic components for driving the compressor 31 and the outdoor fan 39 etc. are gathered, as shown in FIG. 3.

(3-2-4) Outdoor heat exchanger 33

[0037] The outdoor heat exchanger 33 is molded into an L shape so as to be able to face the back-surface panel 44 and the left-side panel 45 of the casing 40, as shown in FIG. 2. The height of the outdoor heat exchanger 33 has a dimension virtually equal to the distance be-

tween the top panel 48 and the bottom panel 49.

(3-2-5) Outdoor fan 39

[0038] The outdoor fan 39 has the propeller 39b driven by the fan motor 39a, and the outdoor fan is provided on a downstream side of the outdoor heat exchanger 33. Part of the propeller 39b is disposed so as to be within the space enclosed by the bell mouth 52.

(3-2-6) Protective grill 56

[0039] The protective grill 56, which is attached to the front panel 46 of the casing 40, covers the blow-out port 46a, as shown in FIG. 2. A plurality of openings are formed in the protective grill 56 in order to blow out outside air.

(3-2-7) Partitioning member 43

[0040] The partitioning member 43 partitions the interior of the casing 40 into the air blower compartment 41 and the machinery compartment 42. In the present embodiment, because the humidifying unit 60 is disposed in an upper part of the machinery compartment 42, and the humidifying unit 60 also serves as part of the upper part of the partitioning member 43.

(3-2-8) Humidifying unit 60

[0041] The humidifying unit 60 is disposed between the front panel 46 and the back-surface panel 44 so as to occupy space in both the air blower compartment 41 and the machinery compartment 42, as shown in FIG. 2. The humidifying unit 60 has a humidifying rotor 63, an adsorption duct 68, a heater 71, a humidification duct 73, a fan 75 (see FIG. 1), and a humidification second duct 180.

(4) Detailed configuration of humidifying unit 60

(4-1) Humidifying rotor 63

[0042] The humidifying rotor 63, which is in the shape of a circular plate, is disposed so as to face an intake opening 46b in the front panel 46, as shown in FIG. 3, and the humidifying rotor can be rotated by the driving of a motor. The intake opening 46b has a fan shape with a center angle of approximately 240°, and the rotational center axis of the humidifying rotor 63 is positioned on the same axis as the center axis of the fan. The entire periphery of the humidifying rotor 63 is enclosed by a wall.

[0043] The humidifying rotor 63 adsorbs moisture in a fan-shaped area which faces the intake opening 46b and covers a center angle of 240°, and this area is therefore referred to as a moisture absorption area 63a. The humidifying rotor 63 also releases moisture in a fan-shaped area which is adjacent to the moisture absorption area 63a, which does not face the intake opening 46b, and which covers a center angle of 120°, and this area is therefore referred to as a moisture release area 63b. In other words, the portion of the humidifying rotor 63 that had been the moisture absorption area 63a according to rotational angle becomes the moisture release area 63b, and the portion that had been the moisture release area 63b becomes the moisture absorption area 63a.

[0044] FIG. 4 is a perspective view showing the humidifying rotor 63 and the flow of air passing through the humidifying rotor 63. In FIG. 4, a gear 63t is provided to the periphery of the humidifying rotor 63. The gear 63t meshes with a pinion gear 64a as shown in FIG. 3, and the pinion gear 64a rotates due to motive power from a rotor-driving motor 64, whereby the entire humidifying rotor 63 rotates together with the gear 63t.

[0045] The moisture absorption area 63a and the moisture release area 63b have a honeycomb structure formed by baking a zeolite or the like. An absorbent of a zeolite or the like adsorbs moisture from the air at room temperature, and releases moisture when raised in temperature by exposure to air that has been heated by a heater or the like.

[0046] Therefore, in the humidifying unit 60, the heater 71 is disposed between the front panel 46 and the moisture release area 63b of the humidifying rotor 63, so as to face the moisture release area 63b.

(4-2) Adsorption duct 68

[0047] FIG. 5 is a perspective view of the humidifying unit 60 with the heater 71 taken off. In FIG. 5, the humidifying unit 60 includes the adsorption duct 68 for guiding outside air to the moisture absorption area 63a. The adsorption duct 68 forms an air inflow port 681 which opens toward an intake opening 64b in the front panel 46. The shape of the air inflow port 681 is, similar to the intake opening 46b, that of a fan having a center angle of approximately 240°.

[0048] After being taken in from the air inflow port 681, air containing moisture flows through the adsorption duct 68 and reaches the moisture absorption area 63a of the humidifying rotor 63, the moisture is adsorbed when permeating through this area, and the moisture is expelled from an air outflow port 683 (see FIG. 3). The air outflow port 683 is adjacent to a space (i.e., an upstream-side end of the bell mouth 52) that has negative pressure when the outdoor fan 39 rotates, and air is drawn in from the air inflow port 681 due to the effect of the air pressure on the side of the air outflow port 683 being lower than on the side of the air inflow port 681. The moisture absorption area 63a is disposed nearer to the bell mouth 52 than the moisture release area 63b.

[0049] The intake opening 46b, which is provided to the upper right of the blow-out port 46a of the front panel 46, opens toward the front of the front panel 46 as does the blow-out port 46a, as shown in FIG. 3. Air pushed out forward by the outdoor fan 39 proceeds along the bell

mouth 52 to be strongly blown out from the blow-out port 46a, and air blown out from the blow-out port 46a is therefore not drawn in from the intake opening 46b.

[0050] The purpose of adopting a configuration such as is described above is to take in air that contains more moisture. Because the humidifying operation is normally performed during the air-warming operation, air that has passed through the outdoor heat exchanger 33 is low in both temperature and humidity. Therefore, when low-temperature air has been drawn in, a lesser amount of moisture can be adsorbed by the humidifying rotor 63. However, if the intake opening 64b and the air inflow port 681 are configured so as to not draw in air that has passed through the outdoor heat exchanger 33, outside air that contains more moisture can be taken in, and a decrease in the amount of moisture adsorbed by the humidifying rotor 63 can therefore be prevented.

(4-3) Heater 71

[0051] In order for moisture to be released from the moisture release area 63b of the humidifying rotor 63, the heater 71 heats the air sent to the moisture release area 63b. The heated air causes the moisture to be released from the humidifying rotor 63 when permeating through the moisture release area 63b, and as high-humidity air, enters the humidification duct 73.

(4-4) Humidification duct 73

[0052] The humidification duct 73 guides air to the moisture release area 63b via the heater 71, and also guides air that has permeated through the humidifying rotor 63 to the fan 75, as shown in FIGS. 1 and 5. The flow of air guided to the humidification duct 73 is caused by the fan 75.

[0053] The air guided to the humidification duct 73 is heated by the heater 71 to become high-temperature air, and when permeating through the humidifying rotor 63, causes the moisture to be released from the moisture release area 63b. The air then becomes high-temperature, high-humidity air, which heads toward the fan 75.

(4-5) Fan 75

[0054] The fan 75 has an impeller 75a which blows out humidified air in a predetermined direction, and a fan motor 75b which drives the impeller 75a, as shown in FIG. 1. The fan 75 is disposed in an orientation in which the rotating shaft of the impeller 75a lies horizontal, and the rotating shaft of the fan motor 75b is directly linked to the rotating shaft of the impeller 75a. The fan 75 is disposed in the machinery compartment 42.

[0055] The impeller 75a is enclosed in a fan casing 81, and this fan casing 81 and an inlet of the humidification second duct 180 are connected. The outer side of the fan motor 75b is covered by a motor cover 82.

(4-6) Humidification second duct 180

[0056] The humidification second duct 180 guides high-temperature, high-humidity air pushed out from the fan 75 to a connecting port of the air supply hose 18 (see FIG. 1). Virtually all of the humidification second duct 180 is positioned in the machinery compartment 42, but only a predetermined portion, including the connecting port of the air supply hose 18, is positioned on the opposite side of the machinery compartment 42 across from the right-side panel 47 (see FIG. 2).

[0057] The humidification second duct 180 has a horizontal duct section 181 and a vertical duct section 182, as shown in FIG. 5. The horizontal duct section 181 is a duct which guides high-temperature, high-humidity air horizontally, and the vertical duct section 182 is a duct which guides downwardly the high-temperature, high-humidity air that has flowed in to the horizontal duct section 181. The horizontal duct section 181 extends from the machinery compartment 42 toward the rear end of the right-side panel 47.

[0058] The vertical duct section 182 extends vertically downward from a port connecting with the horizontal duct section 181, and a terminal end of the vertical duct section 182 is connected with the air supply hose 18.

(5) Actions of air conditioner 10

(5-1) Air-cooling operation

[0059] During the air-cooling operation, the four-way switching valve 32 connects a discharge side of the compressor 31 and a gas side of the outdoor heat exchanger 33, and connects an intake side of the compressor 31 and a gas side of the indoor heat exchanger 21 (the state shown by solid lines in FIG. 1).

[0060] Additionally, the liquid-side shutoff valve 37 and the gas-side shutoff valve 38 are open. An opening degree of the electric expansion valve 34 is adjusted so the degree of superheating SH of refrigerant in a refrigerant outlet of the indoor heat exchanger 21 is constant at a degree of superheating target value.

[0061] When the compressor 31, the outdoor fan 39, and the indoor fan 22 are operated with the refrigerant circuit in this state, low-pressure gas refrigerant is drawn into the compressor 31 and compressed to high-pressure gas refrigerant. The high-pressure gas refrigerant is then sent through the four-way switching valve 32 to the outdoor heat exchanger 33, where the refrigerant exchanges heat with the outdoor air supplied by the outdoor fan 39, and condenses to high-pressure liquid refrigerant. This high-pressure liquid refrigerant is decompressed by the electric expansion valve 34, and is sent through the liquid-side shutoff valve 37 and the liquid refrigerant interconnection tube 14 to the indoor unit 20.

[0062] This low-pressure refrigerant sent to the indoor unit 20 enters the indoor heat exchanger 21 as gas-liquid two-phase refrigerant, exchanges heat with indoor air in

the indoor heat exchanger 21, and evaporates to low-pressure gas refrigerant.

[0063] This low-pressure gas refrigerant is sent through the gas refrigerant interconnection tube 16 to the outdoor unit 30, and the refrigerant then flows through the gas-side shutoff valve 38 and the four-way switching valve 32 into the accumulator 36. The low-pressure gas refrigerant that has flowed into the accumulator 36 is then again taken into the compressor 31.

[0064] Thus, in the air conditioner 10, an air-cooling operation can be performed in which the outdoor heat exchanger 33 is caused to function as a refrigerant condenser and the indoor heat exchanger 21 is caused to function as a refrigerant evaporator.

(5-2) Air-warming operation

[0065] During the air-warming operation, the four-way switching valve 32 connects the discharge side of the compressor 31 and the gas side of the indoor heat exchanger 21, and connects the intake side of the compressor 31 and the gas side of the outdoor heat exchanger 33 (the state shown by dashed lines in FIG. 1).

[0066] Additionally, the opening degree of the electric expansion valve 34 is adjusted so that refrigerant flowing into the outdoor heat exchanger 33 is decompressed to a pressure at which the refrigerant can be evaporated in the outdoor heat exchanger 33. The liquid-side shutoff valve 37 and the gas-side shutoff valve 38 are open.

[0067] When the compressor 31, the outdoor fan 39, and the indoor fan 22 are operated with the refrigerant circuit in this state, low-pressure gas refrigerant is drawn into the compressor 31 and compressed to high-pressure gas refrigerant, which is sent through the four-way switching valve 32, the gas-side shutoff valve 38, and the gas refrigerant interconnection tube 16 to the indoor unit 20.

[0068] The high-pressure gas refrigerant sent to the indoor unit 20 exchanges heat with indoor air in the indoor heat exchanger 21 and condenses to high-pressure liquid refrigerant, which is sent through the liquid refrigerant interconnection tube 14 to the outdoor unit 30.

[0069] The liquid refrigerant passes through the liquid-side shutoff valve 37 and enters the electric expansion valve 34. The liquid refrigerant flows into the outdoor heat exchanger 33 after being decompressed by the electric expansion valve 34. The low-pressure, gas-liquid two-phase refrigerant flowing into the outdoor heat exchanger 33 exchanges heat with outdoor air supplied by the outdoor fan 39 and evaporates to low-pressure gas refrigerant, which flows through the four-way switching valve 32 into the accumulator 36. The low-pressure gas refrigerant flowing into the accumulator 36 is again drawn into the compressor 31.

(5-3) Humidifying operation

[0070] In the air conditioner 10, the humidifying operation is performed together with the air-warming operation. The air inflow port 681 (see FIG. 5) of the adsorption duct 68 opens toward the intake opening 64b (see FIG. 3) of the front panel 46, and the air outflow port 683 (see FIG. 2) is adjacent to the upstream-side end of the bell mouth 52, which has negative pressure when the outdoor fan 39 rotates, as shown in FIGS. 2, 3, and 5. When the outdoor fan 39 is running, air pressure on the side of the air outflow port 683 is lower than on the side of the air inflow port 681, the effect of which causes "moisture-containing outside air that has not passed through the outdoor heat exchanger 33" to be drawn in from the air inflow port 681.

[0071] The humidifying rotor 63 is positioned between the air inflow port 681 and the air outflow port 683 and in proximity to the air outflow port 683, and during the humidifying operation is rotated at a predetermined rotational speed by motive power of the rotor-driving motor 64. The rotation of the humidifying rotor 63 causes moisture adsorbed on the humidifying rotor 63 in the moisture absorption area 63a to be carried to the moisture release area 63b along with the rotation of the humidifying rotor 63, and to arrive at a position of facing the heater 71.

[0072] Because the fan 75 is driven as well, the outside air encircles the periphery of the heater 71 and is heated. The heated air passes through the moisture release area 63b of the humidifying rotor 63, and moisture is therefore released from the portion exposed to the heated air. The moisture-containing air (referred to below as humidified air) is drawn into the fan 75, and blown out to the air supply hose 18 via the humidification second duct 180. The humidified air is guided through the air supply hose 18 to the indoor unit 20.

(6) Characteristics

(6-1)

[0073] In the outdoor unit 30, air that does not pass through the outdoor heat exchanger 33 flows in from the intake opening 46b. As a result, when frost has begun to form on the outdoor heat exchanger 33, an air quantity equivalent to the airflow volume reduced by the increase in ventilation resistance of the outdoor heat exchanger 33 is guided in from the intake opening 46b, and adsorption airflow volume increases, the opposite of what occurs in "the prior art in which adsorption airflow volume decreases when frost forms."

(6-2)

[0074] In the outdoor unit 30, the intake side of the outdoor fan 39, i.e., the upstream-side end of the bell mouth 52 has negative pressure due to the running of the outdoor fan 39, the effect of which causes outside air to be guided in from the intake opening 46b. Particularly, because the upstream-side end of the bell mouth 52 and the air outflow port 683 of the adsorption duct 68, which

is the downstream-side end of the air flow path AF2, are adjacent, the effect of the negative pressure in the upstream-side end of the bell mouth 52 can be better received. As a result, more outside air can be caused to flow in from the intake opening 46b.

(6-3)

[0075] It is reasonable that air guided in from the intake opening 46b would be guided to the moisture absorption area 63a of the humidifying rotor 63, and the effect of negative pressure in the upstream-side end of the bell mouth 52 can therefore be better received due to the moisture absorption area 63a side being disposed near the bell mouth 52. As a result, more outside air can be caused to flow in from the intake opening 46b.

(7) Modifications

[0076] FIG. 6 is a front view of the outdoor unit 30 according to a modification, with the front panel taken off. FIG. 7 is a perspective view showing the positional relationship between the bell mouth 52 and the humidifying unit 60 in FIG. 6.

[0077] In the outdoor unit 30 of FIGS. 6 and 7, when minimizing dead space is considered, it is unreasonable for the blow-out port 46a and the intake opening 46b in the front panel 46 to be aligned along the vertical axis or horizontal axis of the blow-out port 46a, and the intake opening 46b is disposed between the blow-out port 46a and the upper right corner of the front panel 46.

[0078] The distance between the centers of the blow-out port 46a and the intake opening 46b is the same as the distance between the centers of the bell mouth 52 and the adsorption duct 68, and in the above embodiment, these distances are set to the shortest possible distance at which the outer peripheries of these components do not interfere with each other.

[0079] In order to utilize negative pressure to take outside air in from the intake opening 46b, the peripheral edge of the upstream-side end of the bell mouth 52 and the peripheral edge of the air outflow port 683 of the adsorption duct 68 are brought close together so that negative pressure is exerted on the air outflow port 683. The matters disclosed heretofore are applied to the above embodiment as well.

[0080] In this modification, for the ideal configuration in which the negative pressure in the upstream-side end of the bell mouth 52 is effectively exerted on the air outflow port 683, the center axis of the bell mouth 52 and the center axis of the adsorption duct 68 intersect at a single point.

[0081] However, because of the structural limitation that the humidifying unit 60, excluding the moisture absorption area 63a of the humidifying rotor 63, must be stored in the machinery compartment 42, it is not possible to employ a configuration in which the center axis of the bell mouth 52 and the center axis of the adsorption duct 68 intersect at a single point.

[0082] In view of this, in the present modification, the humidifying rotor 63 is slanted so that the negative pressure in the upstream-side end of the bell mouth 52 is effectively exerted on the air outflow port 683 of the adsorption duct 68. A panel surface of the humidifying rotor 63 is slanted at a predetermined angle θ relative to the open surface of the bell mouth 52 as shown in FIG. 7, this predetermined angle θ being within a range of 5° to 45°, and the recommended angle being 30°.

[0083] Due to the panel surface of the humidifying rotor 63 being inclined at a predetermined angle θ relative to the open surface of the bell mouth 52, the upstream-side end of the bell mouth 52 and the air outflow port 683 are nearer to each other, and the air outflow port 683 can therefore better receive the effect of the negative pressure in the upstream-side end of the bell mouth 52. As a result, more outside air can be caused to flow in from the intake opening 46b.

INDUSTRIAL APPLICABILITY

[0084] As described above, the invention of the present application is useful not only in an outdoor unit of an air conditioner provided with a humidifying unit, but also in a device in which a casing divided into two spaces by a partitioning member contains another unit arranged so as to occupy both of the two spaces.

REFERENCE SIGNS LIST

[0085]

10	Air conditioner
30	Outdoor unit
33	Outdoor heat exchanger
39	Outdoor fan
40	Main body casing
46a	Blow-out port
46b	Intake opening
52	Bell mouth
63	Humidifying rotor (adsorption member)

CITATION LIST

PATENT LITERATURE

[0086] [Patent Literature 1] Japanese Laid-open Patent Application No. 2008-190828

Claims

1. An outdoor unit of an air conditioner in which a plate-shaped adsorption member (63), which after adsorbing moisture in air, releases the moisture due to being heated, is disposed so that a surface thereof extends along a vertical plane, wherein the outdoor unit of an air conditioner comprises:

   a main body casing (40) which forms outer contours;
   an outdoor heat exchanger (33) stored in the main body casing (40); and
   an outdoor fan (39) which is stored in the main body casing (40) and which generates an air flow that passes through the outdoor heat exchanger (33);
   the main body casing (40) having:

      a blow-out port (46a) through which air from the outdoor fan (39) is blown out; and
      an intake opening (46b) which is provided to a different position than the blow-out port (46a) and which guides in air that does not pass through the outdoor heat exchanger (33); and

   an air flow path formed inside the main body casing (40) by negative pressure created when the outdoor fan (39) generates the air flow, which channels air guided in from the intake opening (46b) to the adsorption member (63), and causes the air to pass through the interior of adsorption member (63).

2. The outdoor unit of an air conditioner according to claim 1, further comprising:

   a bell mouth (52) to guide air from the outdoor fan (39) to the blow-out port (46a);
   an end of the bell mouth (52) on an upstream side in the air flow direction and an end of the air flow path on a downstream side in the air flow direction being adjacent.

3. The outdoor unit of an air conditioner according to claim 2, wherein

   the adsorption member (63) includes an adsorption side where moisture in the air flowing through the air flow path is adsorbed, and a release side where the adsorbed moisture is released, the adsorption side being disposed near the bell mouth (52).

4. The outdoor unit of an air conditioner according to any of claims 1 to 3, wherein

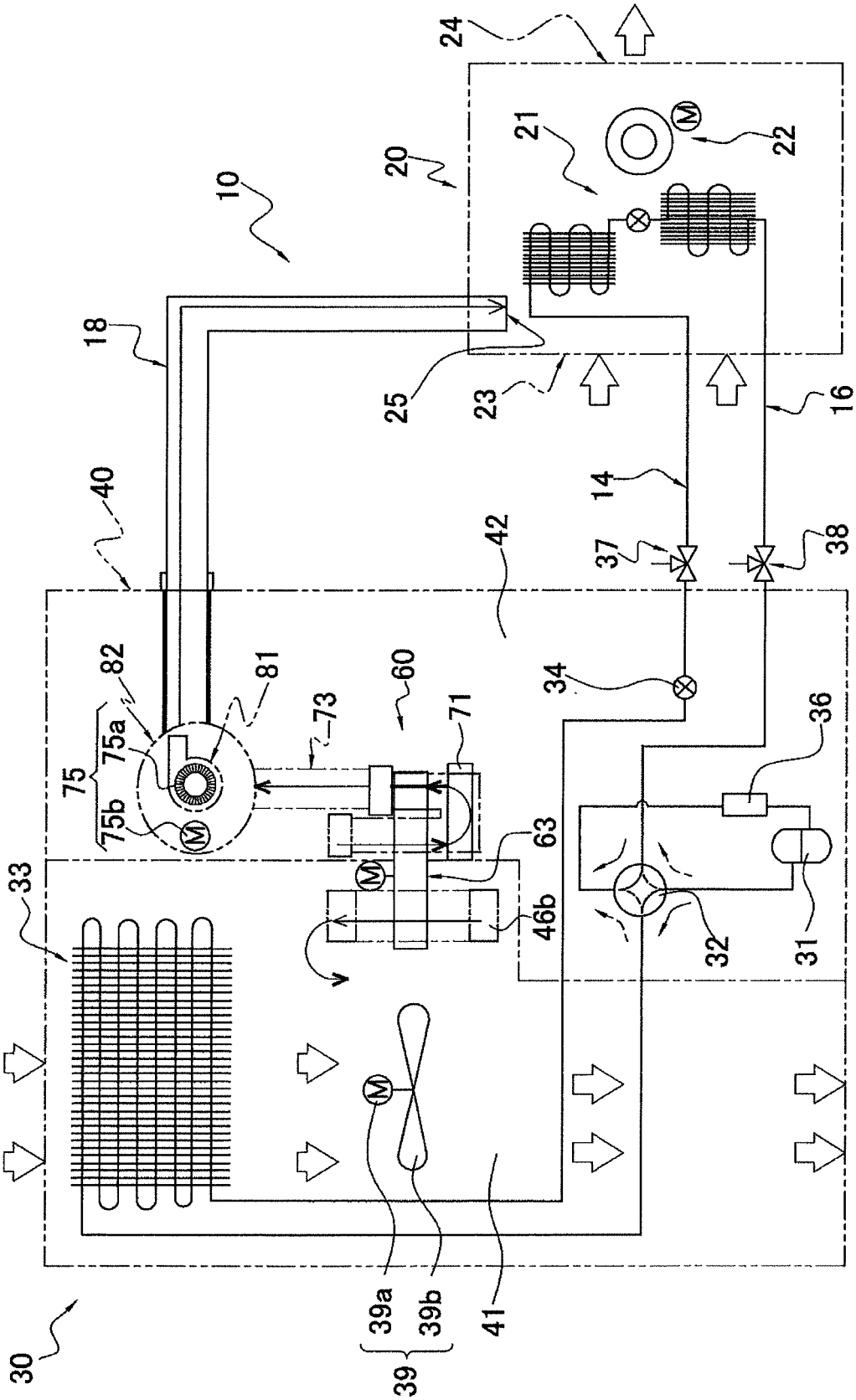
   the adsorption member (63) is disposed parallel with a front-surface part of the main body casing (40).

5. The outdoor unit of an air conditioner according to any of claims 2 to 4, wherein

   the intake opening (46b) and an opening in the bell mouth (52) are provided in the front-surface part of the main body casing (40).

6. The outdoor unit of an air conditioner according to claim 5, wherein

   the adsorption member (63) is disposed so as to face the intake opening (46b).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46b
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39a
39b
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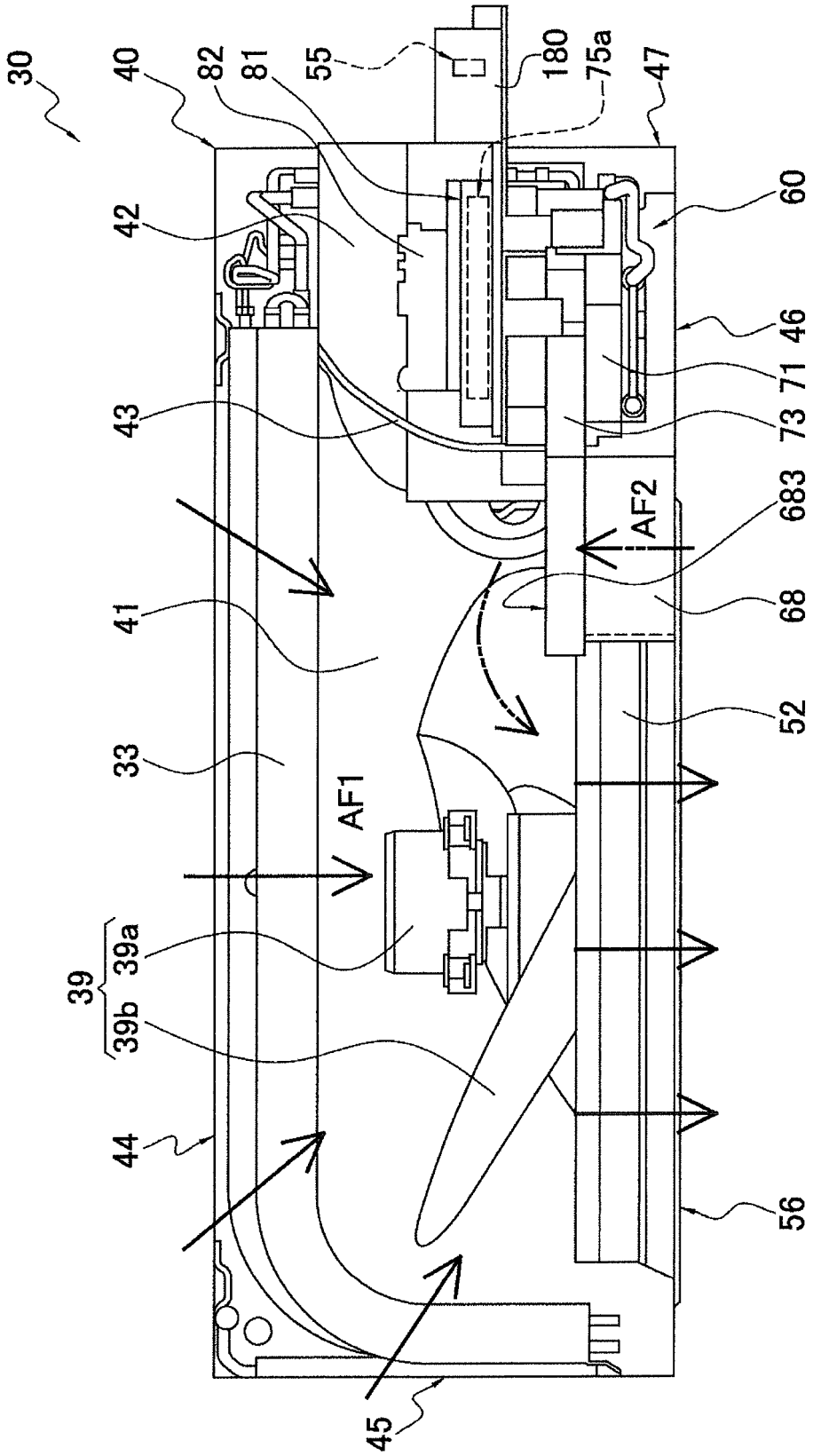
FIG. 1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AF1
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39a
39b
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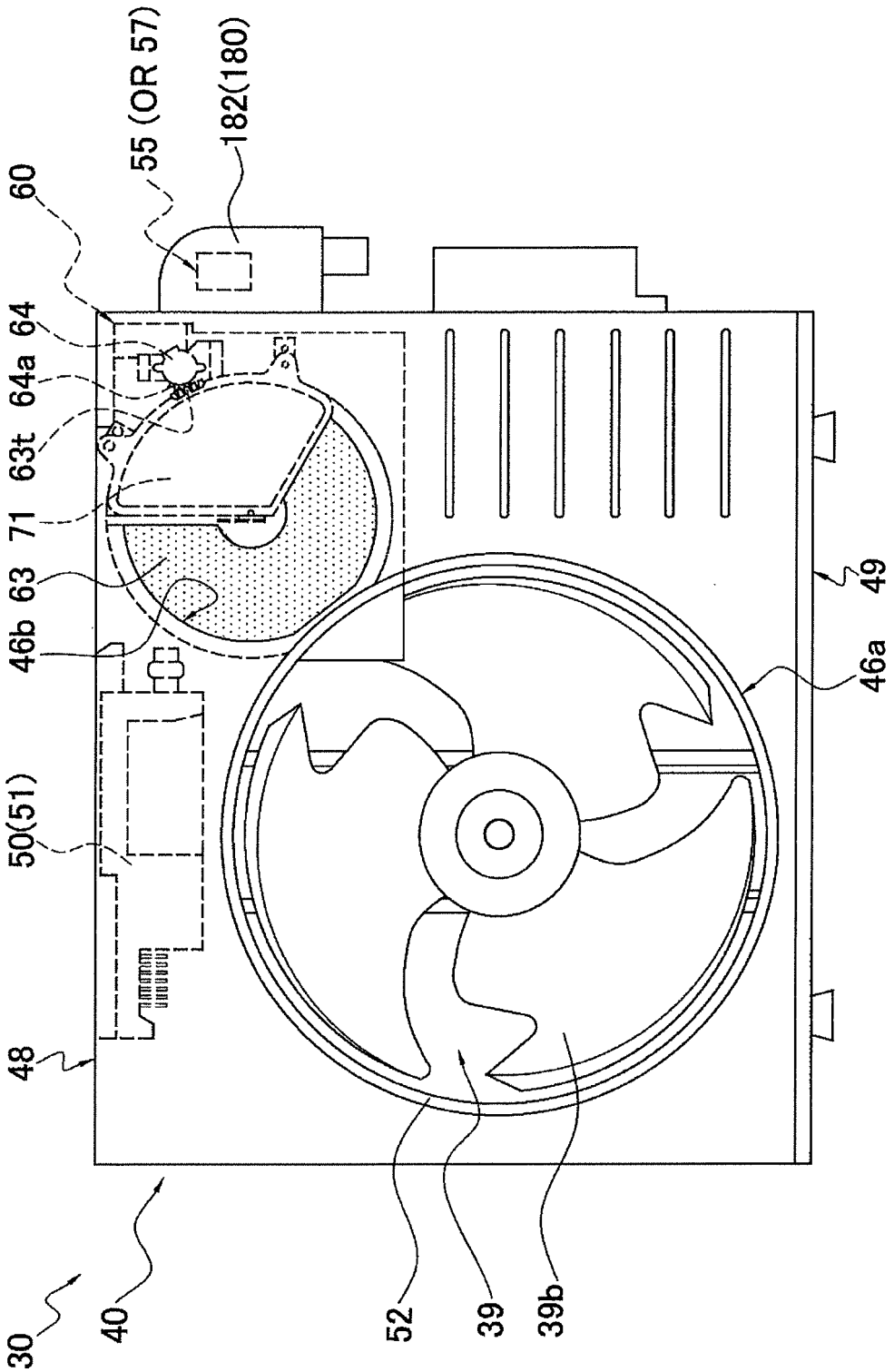
FIG. 2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182(180)
60
64
64a
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71
63
46b
50(51)
48
30
40
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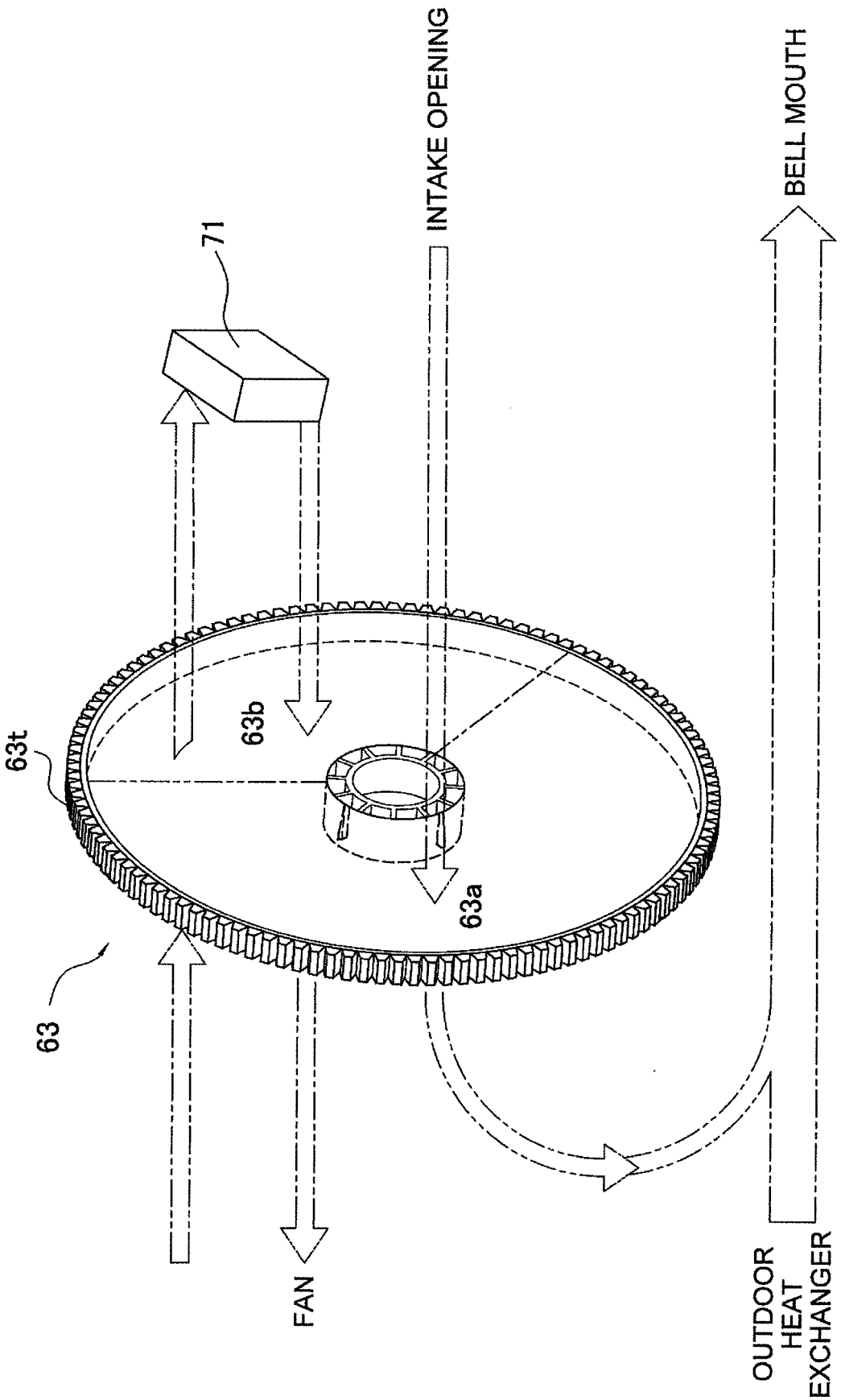
39
39b
46a
49

FIG. 3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INTAKE OPENING
BELL MOUTH
63t
63b
63a
63
FAN
OUTDOOR HEAT EXCHANGER

FIG. 4

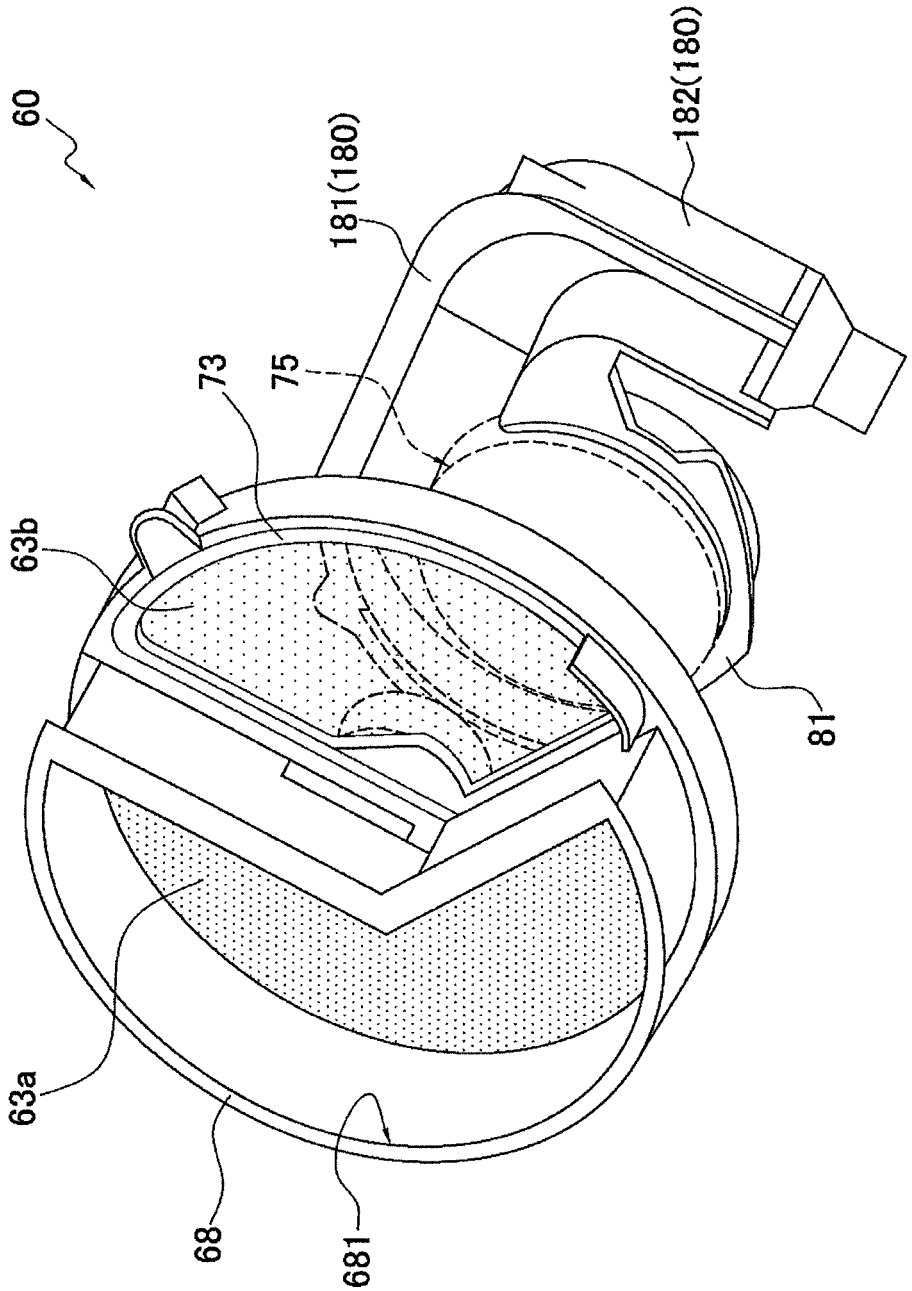

FIG. 5

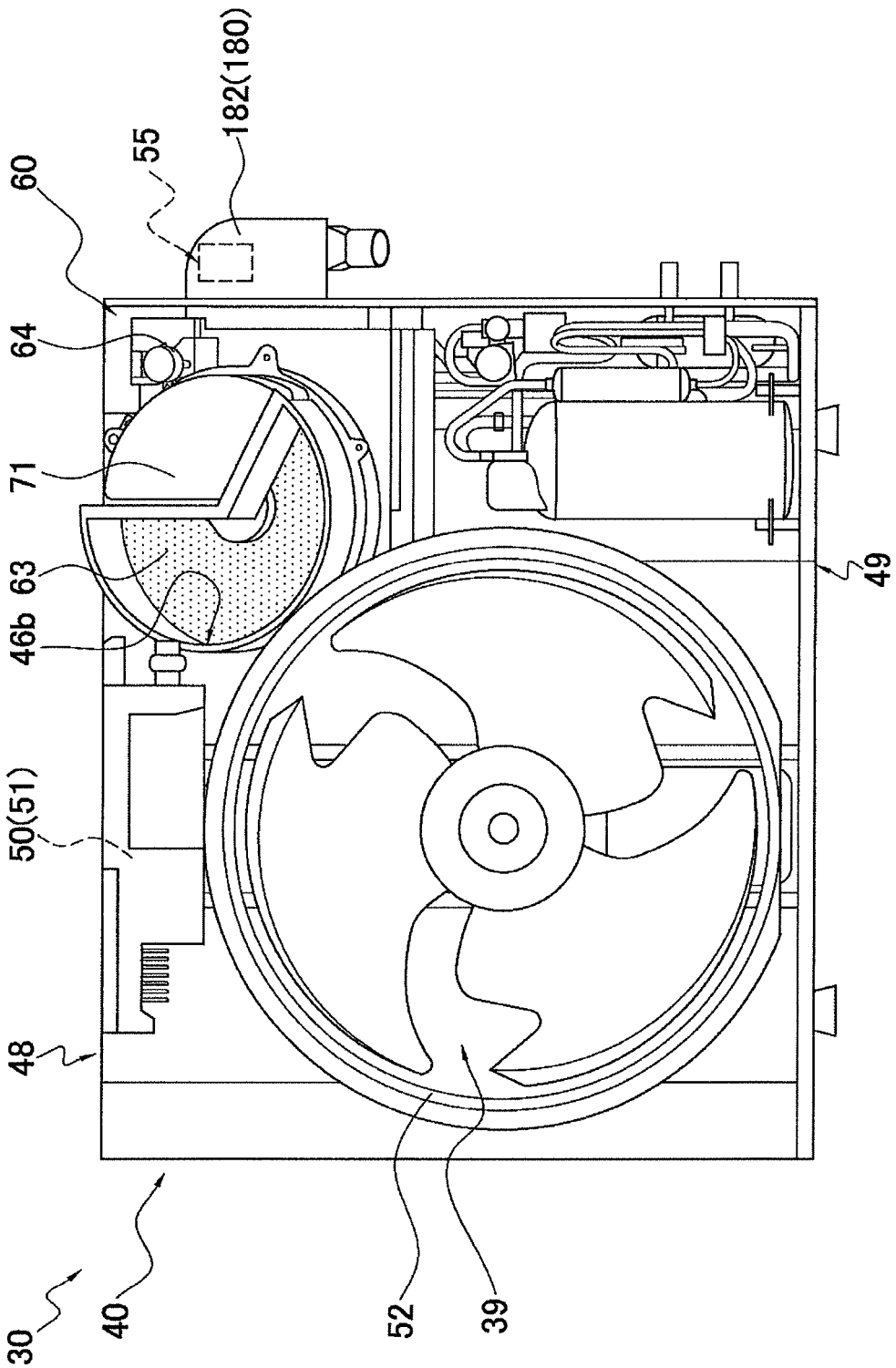

FIG. 6

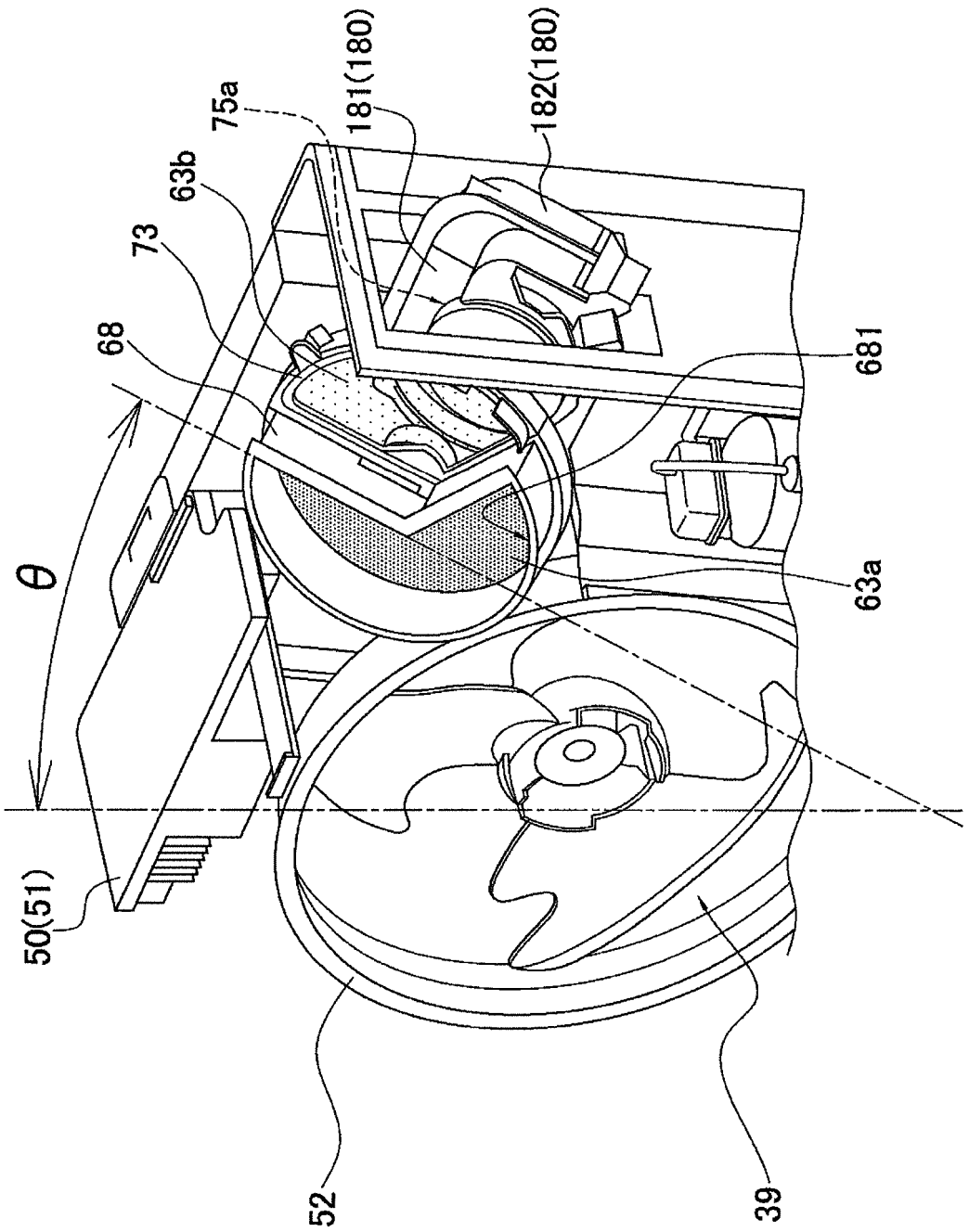

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/084928

A. CLASSIFICATION OF SUBJECT MATTER
F24F3/14(2006.01)i, *F24F1/06*(2011.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F3/14, F24F1/06

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 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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 2012-251691 A (Daikin Industries, Ltd.), 20 December 2012 (20.12.2012), claims; paragraphs [0026] to [0084]; fig. 1 to 22 (Family: none)	1-6
Y	JP 2002-89902 A (Daikin Industries, Ltd.), 27 March 2002 (27.03.2002), paragraphs [0035] to [0036]; fig. 3 to 5 (Family: none)	1-6
Y	JP 2008-190828 A (Toshiba Carrier Corp.), 21 August 2008 (21.08.2008), paragraphs [0045] to [0060]; fig. 4 to 5 (Family: none)	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 March 2016 (03.03.16)	15 March 2016 (15.03.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/084928

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-249211 A (Toshiba Carrier Corp.), 16 October 2008 (16.10.2008), paragraphs [0047] to [0049]; fig. 1 to 3 (Family: none)	1-6
A	JP 2009-156538 A (Toshiba Carrier Corp.), 16 July 2009 (16.07.2009), paragraph [0025]; fig. 1 (Family: none)	1-6
A	JP 10-267331 A (Sharp Corp.), 09 October 1998 (09.10.1998), paragraphs [0052] to [0053]; fig. 1 to 2, 7 (Family: none)	1-6
A	JP 8-128681 A (Sharp Corp.), 21 May 1996 (21.05.1996), claims; fig. 1 to 3 (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008190828 A **[0002] [0086]**