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(54) AIR CONDITIONER

(57) An air conditioner in which galvanic corrosion of a connecting portion connecting pipes made of different types of metals can be easily reduced is provided. The air conditioner includes an outdoor unit having an outdoor heat exchanger; an indoor unit (20) having an indoor heat exchanger (25) and an indoor fan (28) that supplies air to the indoor heat exchanger; and a gas-refrigerant connection pipe (GP) and a liquid-refrigerant connection pipe (LP) that connect the outdoor unit and the indoor unit to each other . The air conditioner performs air-conditioning of a space to be air conditioned, in which the indoor unit is disposed, by circulating refrigerant in a refrigerant circuit including the outdoor heat exchanger, the indoor heat exchanger, and the connection pipes (GP, LP). The refrigerant circuit includes refrigerant pipes (21, 22) made of a metal material, the connection pipes (GP, LP) made of a metal material of a type different from a type of the metal material of the refrigerant pipes (21, 22), and connecting portions (21a, 22a) between the refrigerant pipes (21, 22) and the connection pipes (GP, LP). The connecting portions are disposed in an unventilated space (90).

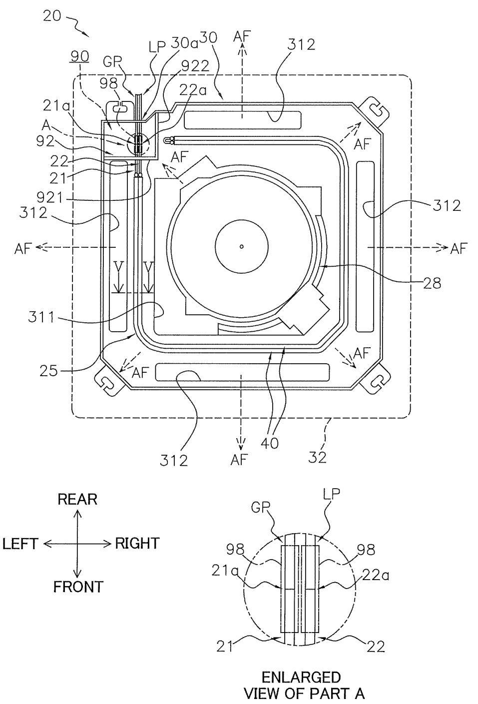

FIG. 4

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to an air conditioner, and more particularly to an air conditioner including a connecting portion at which pipes made of different types of metals are connected.

BACKGROUND ART

[0002] A refrigerant circuit of a known air conditioner may include a dissimilar metal connecting portion at which pipes made of different types of metals are connected. Different types of metals may cause galvanic corrosion due to the difference in ionization tendency therebetween. In particular, when dew condensation occurs on the pipes and when water droplets containing metal ions of one of the metals come into contact with the pipe made of the other metal material, galvanic corrosion of the pipes tends to be a problem.

[0003] To solve such a problem, Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2012-184870) describes pipes provided with U-shaped or inverted U-shaped portions to control, for example, movement of dew condensation water.

SUMMARY OF THE INVENTION

<Technical Problem>

[0004] However, Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2012-184870) does not discuss reduction of dew condensation on a dissimilar metal connecting portion.

[0005] An object of the present disclosure is to provide an air conditioner in which condensed water is not easily generated on a connecting portion at which pipes made of different types of metals are connected, and in which galvanic corrosion of the connecting portion can be easily reduced.

<Solution to Problem>

[0006] An air conditioner includes a heat-source-side unit, a use-side unit, and a connection pipe. The heat-source-side unit includes a heat-source-side heat exchanger. The use-side unit includes a use-side heat exchanger and a use-side fan that supplies air to the use-side heat exchanger. The connection pipe connects the heat-source-side unit and the use-side unit to each other. The air conditioner performs air-conditioning of a space to be air conditioned, in which the use-side unit is disposed, by circulating refrigerant in a refrigerant circuit including the heat-source-side heat exchanger, the use-side heat exchanger, and the connection pipe. The refrigerant circuit includes a first pipe made of a metal material, a second pipe made of a metal material of a type different from a type of the metal material of the first pipe, and a connecting portion between the first pipe and the second pipe. The connecting portion is disposed in an unventilated space.

[0007] The air conditioner is configured such that the dissimilar metal connecting portion is disposed in the unventilated space. Therefore, condensed water is not easily generated on the connecting portion of the air conditioner, so that galvanic corrosion of the connecting portion can be easily reduced.

[0008] Preferably, the air conditioner is configured such that the use-side unit further includes a casing. The casing accommodates the use-side heat exchanger and the use-side fan. The air conditioner further includes an air-flow-blocking member that defines the unventilated space in the casing. The connecting portion is disposed in the unventilated space defined by the air-flow-blocking member in the casing.

[0009] In this case, since the air-flow-blocking member defines the unventilated space in the casing, the connecting portion can be disposed in the casing, in which air flows are easily generated due to the presence of the use-side fan.

[0010] Preferably, the air conditioner is configured such that the air-flow-blocking member is disposed downstream of the use-side fan and upstream of the connecting portion in a direction in which air is blown out from the use-side fan. The air-flow-blocking member defines the unventilated space, in which the connecting portion is disposed, downstream of the air-flow-blocking member in the direction in which air is blown out from the use-side fan.

[0011] In this case, since the air-flow-blocking member is provided, air blown from the use-side fan does not easily hit the connecting portion. Therefore, galvanic corrosion of the connecting portion can be reduced.

[0012] Preferably, the air conditioner further includes a dew condensation prevention member that differs from the air-flow-blocking member and that is disposed around the connecting portion.

[0013] In this case, since the connecting portion is disposed in the unventilated space defined by the air-flow-blocking member in the casing and the dew condensation prevention member is provided around the connecting portion, galvanic corrosion of the connecting portion can be particularly reduced.

[0014] Preferably, the air conditioner further includes a cover member that covers a periphery of the connecting portion and in which the unventilated space is formed.

[0015] In this case, since the unventilated space is formed around the connecting portion, growth of galvanic corrosion of the connecting portion can be suppressed.

[0016] Preferably, the air conditioner is configured such that the first pipe is a pipe included in the use-side unit. The use-side unit further includes a casing. The casing accommodates the use-side heat exchanger and the use-side fan. The connecting portion is disposed outside the casing.

[0017] In this case, since the connecting portion is disposed outside the casing that accommodates the use-side fan and in which air flows are generated, the connecting portion can be easily disposed in the unventilated space.

[0018] Preferably, the air conditioner is configured such that the unventilated space is a space in which an air flow speed is 0.5 m/sec or less when the air conditioner is in operation.

[0019] In this case, since the air flow speed in the unventilated space is 0.5 m/sec or less even when the air conditioner is in operation, galvanic corrosion of the connecting portion can be reduced.

[0020] Preferably, the air conditioner is configured such that the unventilated space is a space in which an air flow speed in an operation in which the use-side fan blows air at a maximum air flow rate is 1/5 or less of an air flow speed in a ventilated space through which air blown out from the use-side fan flows in the operation in which the use-side fan blows air at the maximum air flow rate.

[0021] In this case, since the unventilated space is a space in which the air flow speed is 1/5 or less of the air flow speed in the ventilated space in the operation of the use-side fan at the maximum air flow rate, galvanic corrosion of the connecting portion can be reduced.

[0022] Preferably, the air conditioner is configured such that one of the metal material of the first pipe and the metal material of the second pipe is aluminum or an aluminum alloy, and the other of the metal material of the first pipe and the metal material of the second pipe is copper or a copper alloy.

[0023] In this case, galvanic corrosion of a connecting portion between a pipe made of aluminum or an aluminum alloy and a pipe made of copper or a copper alloy can be reduced.

[0024] Preferably, the air conditioner is configured such that the use-side unit is a ceiling-mounted unit mounted on a ceiling of the space to be air conditioned.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

[Fig. 1] Fig. 1 is a schematic diagram of an air conditioner according to an embodiment.

[Fig. 2] Fig. 2 is a perspective view of an indoor unit of the air conditioner illustrated in Fig. 1.

[Fig. 3] Fig. 3 is a schematic sectional view of the indoor unit attached to the ceiling taken along line III-III in Fig. 2.

[Fig. 4] Fig. 4 is a schematic bottom view illustrating the structure of the indoor unit illustrated in Fig. 2 and shows the indoor unit from which a decorative panel is removed.

[Fig. 5] Fig. 5 is a schematic sectional view taken along line V-V in Fig. 4.

[Fig. 6] Fig. 6 is a schematic bottom view illustrating the structure of an indoor unit according to modification B and shows the indoor unit from which a decorative panel is removed.

[Fig. 7] Fig. 7 is a perspective view of an indoor heat exchanger illustrated in Fig. 6.

[Fig. 8] Fig. 8 is a schematic bottom view illustrating the structure of an indoor unit according to modification C and shows the indoor unit from which a decorative panel is removed.

[Fig. 9] Fig. 9 is a schematic bottom view illustrating the structure of an indoor unit according to modification E and shows the indoor unit from which a decorative panel is removed.

DESCRIPTION OF EMBODIMENTS

[0026] An air conditioner 100 according to an embodiment will now be described with reference to the drawings.

[0027] In the embodiment described below, directions and positional relationships may be described using the following terms: up, down, left, right, front, and rear. The directions represented by these terms are indicated by arrows in the drawings.

(1) Overall Structure

[0028] Fig. 1 is a schematic diagram of the air conditioner 100.

[0029] The air conditioner 100 is a device that performs air-conditioning of a space to be air conditioned by performing a cooling operation or a heating operation. More specifically, the air conditioner 100 includes a refrigerant circuit RC and carries out a vapor compression refrigeration cycle.

[0030] The air conditioner 100 mainly includes an outdoor unit 10, which is an example of a heat-source-side unit; an indoor unit 20, which is an example of a use-side unit; and a gas-refrigerant connection pipe GP and a liquid-refrigerant connection pipe LP, which are examples of a connection pipe and which connect the outdoor unit 10 and the indoor unit 20 to each other.

[0031] The gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP are pipes installed at the installation site of the air conditioner 100. The diameters and lengths of the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP are individually selected in accordance with the design specifications and installation environment. In the present embodiment, the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP are made of copper or a copper alloy.

[0032] In the air conditioner 100, the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP connect the outdoor unit 10 and the indoor unit 20 to each other to form the refrigerant circuit RC. The refrigerant circuit RC includes an outdoor heat exchanger 13 of the outdoor unit 10, which will be described below;

an indoor heat exchanger 25 of the indoor unit 20, which will be described below; and the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP. The air conditioner 100 performs air-conditioning of the space to be air conditioned, in which the indoor unit 20 is disposed, by circulating refrigerant in the refrigerant circuit RC.

[0033] For example, an HFC refrigerant, such as R32 or R410A, is sealed in the refrigerant circuit RC. The refrigerant is not limited to R32 or R410A, and may instead be, for example, HF01234yf, HF01234ze(E), or a mixture thereof.

[0034] The refrigerant circuit RC includes a first pipe made of a metal material, a second pipe made of a metal material of a type different from the type of the metal material of the first pipe, and a connecting portion between the first pipe and the second pipe.

[0035] More specifically, the refrigerant circuit RC includes a gas refrigerant pipe 21 made of aluminum or an aluminum alloy and included in the indoor unit 20, the gas-refrigerant connection pipe GP made of copper or a copper alloy, and a connecting portion 21a between the gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP. The refrigerant circuit RC also includes a liquid refrigerant pipe 22 made of aluminum or an aluminum alloy and included in the indoor unit 20, the liquid-refrigerant connection pipe LP made of copper or a copper alloy, and a connecting portion 22a between the liquid refrigerant pipe 22 and the liquid-refrigerant connection pipe LP. The connecting portion 21a and the connecting portion 22a are dissimilar metal connecting portions, and therefore tends to cause galvanic corrosion. Accordingly, the connecting portion 21a and the connecting portion 22a are disposed in an unventilated space to reduce galvanic corrosion due to condensed water. This will be further described below.

[0036] The outdoor unit 10, the indoor unit 20, and the connecting portions 21a and 22a will now be described in detail.

(2) Detailed Structure

(2-1) Outdoor Unit

[0037] The outdoor unit 10 is a unit that is installed outdoors.

[0038] The outdoor unit 10 mainly includes a compressor 11, a flow-direction-switching mechanism 12, an outdoor heat exchanger 13, an expansion mechanism 14, and an outdoor fan 15 (see Fig. 1).

[0039] The outdoor unit 10 also includes a suction pipe 16a, a discharge pipe 16b, a first gas refrigerant pipe 16c, a liquid refrigerant pipe 16d, and a second gas refrigerant pipe 16e (see Fig. 1). The suction pipe 16a connects the flow-direction-switching mechanism 12 and a suction side of the compressor 11 to each other. The discharge pipe 16b connects a discharge side of the compressor 11 and the flow-direction-switching mechanism 12 to each other. The first gas refrigerant pipe 16c connects the flow-direction-switching mechanism 12 and a gas side of the outdoor heat exchanger 13 to each other. The liquid refrigerant pipe 16d connects a liquid side of the outdoor heat exchanger 13 and the liquid-refrigerant connection pipe LP to each other. The expansion mechanism 14 is provided on the liquid refrigerant pipe 16d. The second gas refrigerant pipe 16e connects the flow-direction-switching mechanism 12 and the gas-refrigerant connection pipe GP to each other.

(2-1-1) Compressor

[0040] The compressor 11 is a device that sucks in and compresses low-pressure gas refrigerant and discharges the compressed refrigerant. The compressor 11 is an inverter-controlled compressor including a motor with an adjustable number of revolutions (adjustable displacement compressor). The number of revolutions of the compressor 11 is adjusted by a control unit (not shown) in accordance with the operational state. The compressor 11 may instead include a motor with a constant number of revolutions.

(2-1-2) Flow-Direction-Switching Mechanism

[0041] The flow-direction-switching mechanism 12 is a mechanism that switches the direction in which the refrigerant flows in the refrigerant circuit RC depending on the operating mode (cooling operation mode or heating operation mode). In the present embodiment, the flow-direction-switching mechanism 12 is a four-way switching valve.

[0042] In the cooling operation mode, the flow-direction-switching mechanism 12 switches the direction in which the refrigerant flows in the refrigerant circuit RC so that the refrigerant discharged from the compressor 11 flows to the outdoor heat exchanger 13. More specifically, in the cooling operation mode, the flow-direction-switching mechanism 12 connects the suction pipe 16a to the second gas refrigerant pipe 16e and the discharge pipe 16b to the first gas refrigerant pipe 16c (see the solid lines in Fig. 1). In the heating operation mode, the flow-direction-switching mechanism 12 switches the direction in which the refrigerant flows in the refrigerant circuit RC so that the refrigerant discharged from the compressor 11 flows to the indoor heat exchanger 25. More specifically, in the heating operation mode, the flow-direction-switching mechanism 12 connects the suction pipe 16a to the first gas refrigerant pipe 16c and the discharge pipe 16b to the second gas refrigerant pipe 16e (see broken lines in Fig. 1).

[0043] The flow-direction-switching mechanism 12 is not limited to a four-way switching valve, and may instead be structured to realize the above-described switching of the direction in which the refrigerant flows by combining a plurality of electromagnetic valves and refrigerant pipes.

(2-1-3) Outdoor Heat Exchanger

[0044] The outdoor heat exchanger 13 is an example of a heat-source-side heat exchanger. The outdoor heat exchanger 13 is a heat exchanger that functions as a refrigerant condenser in the cooling operation and as a refrigerant evaporator in the heating operation. The outdoor heat exchanger 13 includes a plurality of heat transfer tubes and a plurality of heat transfer fins (not shown).

(2-1-4) Expansion Mechanism

[0045] The expansion mechanism 14 is a mechanism that decompresses high-pressure refrigerant that flows thereinto. In the present embodiment, the expansion mechanism 14 is an electric valve with an adjustable opening degree. The opening degree of the expansion mechanism 14 is adjusted as appropriate in accordance with the operational state. The expansion mechanism 14 is not limited to an electric valve, and may instead be, for example, a capillary tube.

(2-1-5) Outdoor Fan

[0046] The outdoor fan 15 is a fan that generates an air flow that flows into the outdoor unit 10 from the outside, passes through the outdoor heat exchanger 13, and flows out of the outdoor unit 10. While in operation, the outdoor fan 15 is controlled by the control unit (not shown) so that the number of revolutions thereof is adjusted as appropriate.

(2-2) Indoor Unit

[0047] Fig. 2 is a perspective view of the indoor unit 20. Fig. 3 is a schematic sectional view of the indoor unit 20 attached to a ceiling wall CL taken along line III-III in Fig. 2. Fig. 4 is a schematic bottom view illustrating the structure of the indoor unit 20.

[0048] The indoor unit 20 is a ceiling-mounted unit that is mounted on the ceiling of the space to be air conditioned. More specifically, the indoor unit 20 is a so-called ceiling-embedded type unit. The indoor unit 20 mainly includes a casing 30, the indoor heat exchanger 25, and an indoor fan 28 (see Figs. 2 to 4).

(2-2-1) Casing

[0049] The casing 30 is a housing that accommodates various structures of the indoor unit 20. The casing 30 mainly accommodates the indoor heat exchanger 25 and the indoor fan 28 (see Fig. 3).

[0050] As illustrated in Fig. 3, the casing 30 is inserted into an opening formed in the ceiling wall CL of the space to be air conditioned, and is installed in a space CS above the ceiling that is formed between the ceiling wall CL and either the floor of the story above or the roof. The casing 30 includes a top panel 31a, a side wall 31b, a bottom plate 31c, and a decorative panel 32 (see Figs. 2 and 3).

[0051] The top panel 31a is a member that constitutes a top portion of the casing 30, and has a substantially octagonal shape including long and short sides that are alternately connected (see Fig. 4). This shape of the top panel 31a is an example, and the top panel 31a may instead have, for example, a substantially quadrangular shape.

[0052] The side wall 31b is a member that constitutes a side portion of the casing 30, and has a substantially octagonal prism shape that corresponds to the shape of the top panel 31a. The side wall 31b has an opening 30a through which the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP are inserted (extend) into the casing 30 (see Fig. 4). In the present embodiment, the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP are inserted through the opening 30a in the side wall 31b. The gas-refrigerant connection pipe GP is connected to the gas refrigerant pipe 21, and the liquid-refrigerant connection pipe LP is connected to the liquid refrigerant pipe 22 in the casing 30. Thus, in the present embodiment, the connecting portion 21a and the connecting portion 22a are disposed in the casing 30.

[0053] The bottom plate 31c is a member that constitutes a bottom portion of the casing 30, and has a large substantially quadrangular opening 311 at the center thereof (see Fig. 3). A plurality of openings 312 are formed around the large opening 311 in the bottom plate 31c (see Figs. 3 and 4). The decorative panel 32 is attached to a bottom side (a side facing the space to be air conditioned) of the bottom plate 31c (see Figs. 2 and 3).

[0054] The decorative panel 32 is a plate-shaped member that is exposed to the space to be air conditioned, and has a substantially quadrangular shape in plan view. The decorative panel 32 is fitted to the opening in the ceiling wall CL (see Fig. 3). The decorative panel 32 has an air intake port 33 and a plurality of blow-out ports 34. The intake port 33 has a substantially quadrangular shape and is formed in a central portion of the decorative panel 32 at a position such that the intake port 33 partially overlaps the large opening 311 of the bottom plate 31c in plan view. The blow-out ports 34 are formed in a region around the intake port 33 so as to surround the intake port 33. Each blow-out port 34 is disposed at a position corresponding to the position of one of the openings 312 of the bottom plate 31c. Air that has been sucked in through the intake port 33, passed through the indoor heat exchanger 25, and flowed out through each opening 312 is blown out from the blow-out port 34 corresponding to the opening 312 (see Fig. 3).

(2-2-2) Indoor Heat Exchanger

[0055] The indoor heat exchanger 25 is an example of a use-side heat exchanger. The overall structure of the indoor heat exchanger 25 (including heat exchanging portions 40, which will be described below, and header pipes connected to the gas refrigerant pipe 21 and the liquid refrigerant pipe 22) is made of aluminum or an aluminum alloy. Each of the gas refrigerant pipe 21 and the liquid refrigerant pipe 22, which are made of aluminum or an aluminum alloy, is connected to the indoor heat exchanger 25 at one end thereof.

[0056] The indoor heat exchanger 25 includes a plurality rows of heat exchanging portions 40 (two rows of heat exchanging portions 40 in this example) which each include a plurality of flat perforated tubes 45 arranged next to each other in the up-down direction. The heat exchanging portions 40 are arranged next to each other in the direction of indoor air flows AF generated by the indoor fan 28, which will be described below (see Fig. 5). Each heat exchanging portion 40 mainly includes the flat perforated tubes 45 and a plurality of heat transfer fins 48 (see Fig. 5).

[0057] The flat perforated tubes 45 have a flat shape in sectional view. Each flat perforated tube 45 has a plurality of refrigerant flow passages (flat-tube flow passages 451) that extend therethrough in the direction in which the flat perforated tube 45 extends (see Fig. 5). The flat-tube flow passages 451 are arranged in the direction of the indoor air flows AF in each flat perforated tube 45 (see Fig. 5).

[0058] The heat transfer fins 48 are flat plate-shaped members that serve to increase the heat transfer area between the flat perforated tubes 45 and the indoor air flows AF. The heat transfer fins 48 are made of aluminum or an aluminum alloy. Each heat transfer fin 48 extends such that the longitudinal direction thereof is the direction in which the flat perforated tubes 45 are arranged (up-down direction) so that the heat transfer fin 48 intersects the flat perforated tubes 45. Each heat transfer fin 48 has a plurality of slits 48a that are arranged with gaps therebetween in the up-down direction. Into each slit 48a, one of the flat perforated tubes 45 is inserted (see Fig. 5). The heat transfer fins 48 included in each heat exchanging portion 40 are arranged with gaps therebetween in the direction in which the flat perforated tubes 45 extend.

[0059] The indoor heat exchanger 25 (each heat exchanging portion 40) is bent about 90 degrees at three positions in plan view to form a substantially quadrangular shape (see Fig. 3). The indoor heat exchanger 25 is disposed to surround the intake port 33 and be surrounded by the blow-out ports 34 in plan view. In other words, the indoor heat exchanger 25 has a substantially rectangular shape. The indoor heat exchanger 25 is disposed to surround the indoor fan 28. When the refrigerant flows into the indoor heat exchanger 25 through the gas refrigerant pipe 21, the refrigerant that flows through the flat-tube flow passages 451 exchanges heat with air that flows outward from the region inside the indoor heat exchanger 25, and then flows out through the liquid refrigerant pipe 22. When the refrigerant flows into the indoor heat exchanger 25 through the liquid refrigerant pipe 22, the refrigerant that flows through the flat-tube flow passages 451 exchanges heat with air that flows outward from the region inside the indoor heat exchanger 25, and then flows out through the gas refrigerant pipe 21.

(2-2-3) Indoor Fan

[0060] The indoor fan 28 is an example of a use-side fan. The indoor fan 28 supplies air to the indoor heat exchanger 25, which is an example of a use-side heat exchanger.

[0061] The indoor fan 28 is a fan that generates air flows (indoor air flows AF: see Fig. 5, for example) that flows into the indoor unit 20 from the outside of the casing 30, pass through the indoor heat exchanger 25, and flow out of the indoor unit 20. While in operation, the indoor fan 28 is controlled by the control unit (not shown) so that the number of revolutions thereof is adjusted as appropriate.

[0062] The indoor fan 28 is disposed in a central region of the casing 30, and the indoor heat exchanger 25 is disposed to surround the indoor fan 28 in the casing 30. The indoor fan 28 partially overlaps the intake port 33 in plan view (see Fig. 4).

[0063] The casing 30 has intake flow passages FP1 and blow-out flow passages FP2 provided therein (see Fig. 3). The intake flow passages FP1 guide the indoor air flows AF that flows into the casing 30 through the intake port 33 to the indoor heat exchanger 25. The blow-out flow passages FP2 guide the indoor air flows AF that have passed through the indoor heat exchanger 25 to the blow-out ports 34. The blow-out flow passages FP2 are arranged outside the intake flow passages FP1 so as to surround the intake flow passages FP1. The intake flow passages FP1 and the blow-out flow passages FP2 are examples of a ventilated space.

[0064] The intake port 33, the blow-out ports 34, the intake flow passages FP1, the blow-out flow passages FP2, the indoor heat exchanger 25, and the indoor fan 28 are arranged in the above-described manner so that the indoor air flows AF pass through the indoor unit 20 along paths described below when the indoor fan 28 is in operation.

[0065] The indoor air flows AF generated by the indoor fan 28 enter the casing 30 through the intake port 33. The indoor air flows AF blown out from the indoor fan 28 flow radially from the indoor fan 28 in bottom view (see Fig. 4), and are guided to the indoor heat exchanger 25 along the intake flow passages FP1. The indoor air flows AF guided to the indoor heat exchanger 25 exchange heat with the refrigerant in the indoor heat exchanger 25, and are then guided to the blow-out ports 34 along the blow-out flow passages FP2 and blown out into the space to be air conditioned through the blow-out ports 34.

(2-3) Connecting Portion

[0066] The connecting portion 21a is a connecting portion between the gas refrigerant pipe 21, which is an example of a first pipe, of the indoor unit 20 and the gas-refrigerant connection pipe GP, which is an example of a second pipe. The gas refrigerant pipe 21 is a pipe made of aluminum or an aluminum alloy, as described above. The gas-refrigerant connection pipe GP is a pipe made of copper or a copper alloy, as described above.

[0067] The connecting portion 21a is a dissimilar metal connecting portion. In the present embodiment, the gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP are brazed together by using a brazing material. Brazing is merely an example of a method for connecting the gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP to each other. The gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP may instead be connected to each other by, for example, friction welding or eutectic welding. The gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP may instead be connected to each other by any appropriate connecting method other than the above-mentioned methods as long as the design specifications are satisfied (for example, the required connection strength can be obtained).

[0068] The connecting portion 22a is a connecting portion between the liquid refrigerant pipe 22, which is an example of a first pipe, of the indoor unit 20 and the liquid-refrigerant connection pipe LP, which is an example of a second pipe. The liquid refrigerant pipe 22 is a pipe made of aluminum or an aluminum alloy, as described above. The liquid-refrigerant connection pipe LP is a pipe made of copper or a copper alloy, as described above. The connecting portion 22a is also a dissimilar metal connecting portion. The connecting method for connecting the liquid refrigerant pipe 22 and the liquid-refrigerant connection pipe LP to each other at the connecting portion 22a may be similar to that for the connecting portion 21a.

[0069] The connecting portion 21a and the connecting portion 22a are disposed in an unventilated space 90 to prevent galvanic corrosion by suppressing generation of condensed water on the connecting portion 21a and the connecting portion 22a.

[0070] In particular, in the present embodiment, the connecting portion 21a and the connecting portion 22a are disposed in the unventilated space 90 defined in the casing 30. The unventilated space 90 is a space in the casing 30 that is different from the ventilated space including the intake flow passages FP1 and the blow-out flow passages FP2. The unventilated space 90 is a space in which the air flow speed is lower than that in the ventilated space. The unventilated space 90 is, for example, a space in which air blown out from the indoor fan 28 does not flow directly (without hitting with any object that serves as an obstacle).

[0071] The unventilated space 90 is preferably a space in which the air flow speed is 0.5 m/sec or less when the air conditioner 100 is in operation. In other words, the unventilated space 90 is a space in which the air flow speed is 0.5 m/sec or less when the air conditioner 100 is operated and when the indoor fan 28 is operated, in particular, even when the indoor fan 28 is operated at a maximum air flow rate. More preferably, the unventilated space 90 is a space in which the air flow speed is 0.25 m/sec or less when the air conditioner 100 is in operation (in particular, even when the indoor fan 28 is operated at the maximum air flow rate). Still more preferably, the unventilated space 90 is a space in which the air flow speed is 0.15 m/sec or less when the air conditioner 100 is in operation (in particular, even when the indoor fan 28 is operated at the maximum air flow rate).

[0072] Alternatively, the unventilated space 90 is preferably a space in which the air flow speed in an operation in which the indoor fan 28 blows air at the maximum air flow rate is 1/5 or less of the air flow speed in the ventilated space through which air blown out from the indoor fan 28 flows in the operation in which the indoor fan 28 blows air at the maximum air flow rate. For example, the unventilated space 90 is a space in which the average air flow speed in the operation in which the indoor fan 28 blows air at the maximum air flow rate is 1/5 or less of the average air flow speed in the ventilated space through which air blown out from the indoor fan 28 flows in the operation in which the indoor fan 28 blows air at the maximum air flow rate.

[0073] In the present embodiment, the unventilated space 90 is defined by an air-flow-blocking member 92 in the casing 30. The air-flow-blocking member 92 is disposed downstream of the indoor fan 28 and upstream of the connecting portion 21a and the connecting portion 22a in the direction in which air is blown out from the indoor fan 28 (direction of the indoor air flows AF) (see Fig. 4). The air-flow-blocking member 92 defines the unventilated space 90, in which the connecting portion 21a and the connecting portion 22a are disposed, downstream of the air-flow-blocking member 92. In other words, air blown out from the indoor fan 28 at least does not directly hit the connecting portion 21a and the connecting portion 22a disposed in the unventilated space 90.

[0074] For example, in the present embodiment, the air-flow-blocking member 92 includes two flat plates 921 and 922 that intersect each other. The flat plates 921 and 922 extend downward from the top panel 31a of the casing 30 to a position near the top surface of the bottom plate 31c. The flat plate 921 extends rightward from a left portion of the side wall 31b, and the flat plate 922 extends rearward from the right end of the flat plate 921 to a rear portion of the side wall 31b. The lengths of the flat plates 921 and 922 in the up-down and horizontal directions may be determined as appropriate so that air blown out from the indoor fan 28 at least does not directly hit the connecting portion 21a and the connecting portion 22a.

[0075] The flat plates 921 and 922 may be made of either a metal or a resin. The material of the air-flow-blocking member 92 is not limited to a metal or a resin, and may be selected as appropriate.

[0076] Dew condensation prevention members 98 that prevent dew condensation are preferably provided around the connecting portion 21a and the connecting portion 22a. The dew condensation prevention members

98 are, for example, anti-condensation tubes having a hollow tubular shape. The dew condensation prevention members 98 are attached to the pipes (the gas refrigerant pipe 21, the gas-refrigerant connection pipe GP, the liquid refrigerant pipe 22, and the liquid-refrigerant connection pipe LP) so as to cover the connecting portion 21a and the connecting portion 22a (see Fig. 5). The material of the dew condensation prevention members 98 is not limited, and may be, for example, rock wool or polystyrene foam.

(3) Flow of Refrigerant in Air Conditioner

[0077] When the air conditioner performs the cooling operation or the heating operation, the refrigerant is circulated in the refrigerant circuit RC as described below.

(3-1) Cooling Operation

[0078] In the cooling operation, the flow-direction-switching mechanism 12 is set to the state shown by the solid lines in Fig. 1, so that the discharge side of the compressor 11 is connected to the gas side of the outdoor heat exchanger 13 and the suction side of the compressor 11 is connected to the gas side of the indoor heat exchanger 25.

[0079] When the compressor 11 is driven in this state, the compressor 11 compresses low-pressure gas refrigerant into high-pressure gas refrigerant. The high-pressure gas refrigerant flows through the discharge pipe 16b, the flow-direction-switching mechanism 12, and the first gas refrigerant pipe 16c, and enters the outdoor heat exchanger 13. Then, the high-pressure gas refrigerant exchanges heat with outdoor air in the outdoor heat exchanger 13, and is thereby condensed into high-pressure liquid refrigerant (liquid refrigerant in a subcooled state). The high-pressure liquid refrigerant flows out of the outdoor heat exchanger 13 and flows to the expansion mechanism 14. The expansion mechanism 14 decompresses the refrigerant into low-pressure refrigerant. The low-pressure refrigerant flows through the liquid refrigerant pipe 16d, the liquid-refrigerant connection pipe LP, and the liquid refrigerant pipe 22 and enters the indoor heat exchanger 25. The refrigerant that has entered the indoor heat exchanger 25 exchanges heat with indoor air, and is thereby evaporated into low-pressure gas refrigerant (gas refrigerant in a superheated state). The low-pressure gas refrigerant flows out of the indoor heat exchanger 25. The refrigerant that has flowed out of the indoor heat exchanger 25 flows through the gas refrigerant pipe 21, the gas-refrigerant connection pipe GP, the second gas refrigerant pipe 16e, and the suction pipe 16a and is sucked into the compressor 11 again.

(3-2) Heating Operation

[0080] In the heating operation, the flow-direction-switching mechanism 12 is set to the state shown by the broken lines in Fig. 1, so that the discharge side of the compressor 11 is connected to the gas side of the indoor heat exchanger 25 and the suction side of the compressor 11 is connected to the gas side of the outdoor heat exchanger 13.

[0081] When the compressor 11 is driven in this state, the compressor 11 compresses low-pressure gas refrigerant into high-pressure gas refrigerant. The high-pressure gas refrigerant flows through the discharge pipe 16b, the flow-direction-switching mechanism 12, the second gas refrigerant pipe 16e, the gas-refrigerant connection pipe GP, and the gas refrigerant pipe 21 and enters the indoor heat exchanger 25. The high-pressure gas refrigerant in a superheated state that has entered the indoor heat exchanger 25 exchanges heat with indoor air, and is thereby condensed into high-pressure liquid refrigerant (liquid refrigerant in a subcooled state). Then, the high-pressure liquid refrigerant flows out of the indoor heat exchanger 25. The refrigerant that has flowed out of the indoor heat exchanger 25 flows through the liquid refrigerant pipe 22, the liquid-refrigerant connection pipe LP, and the liquid refrigerant pipe 16d and flows to the expansion mechanism 14. The high-pressure liquid refrigerant that has flowed into the expansion mechanism 14 is decompressed in accordance with the valve opening degree of the expansion mechanism 14 when the refrigerant passes through the expansion mechanism 14. Low-pressure refrigerant that has flowed out of the expansion mechanism 14 enters the outdoor heat exchanger 13. The low-pressure refrigerant that has entered the outdoor heat exchanger 13 exchanges heat with outdoor air, and is thereby evaporated into low-pressure gas refrigerant. The low-pressure gas refrigerant flows through the first gas refrigerant pipe 16c, the flow-direction-switching mechanism 12, and the suction pipe 16a and is sucked into the compressor 11 again.

(4) Features

(4-1)

[0082] The air conditioner 100 according to the present embodiment includes the outdoor unit 10, which is an example of a heat-source-side unit; the indoor unit 20, which is an example of a use-side unit; and the gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP, which are examples of a connection pipe. The outdoor unit 10 includes the outdoor heat exchanger 13, which is an example of a heat-source-side heat exchanger. The indoor unit 20 includes the indoor heat exchanger 25, which is an example of a use-side heat exchanger, and the indoor fan 28, which is an example of a use-side fan and supplies air to the indoor heat exchanger 25. The gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP connect the outdoor unit 10 and the indoor unit 20 to each other. The air conditioner 100 performs air-conditioning of the space to be air conditioned, in which the indoor unit 20 is disposed, by circulating the refrigerant in the refrigerant circuit RC including the outdoor heat exchanger 13, the indoor heat exchanger 25, the gas-refrigerant connection pipe GP, and the liquid-refrigerant connection pipe LP. The refrigerant circuit RC includes a first pipe made of a metal material, a second pipe made of a metal material of a type different from the type of the metal material of the first pipe, and a connecting portion between the first pipe and the second pipe. In the present embodiment, the refrigerant circuit RC includes the gas refrigerant pipe 21 made of a metal material, the gas-refrigerant connection pipe GP made of a metal material of a type different from the type of the metal material of the gas refrigerant pipe 21, and the connecting portion 21a between the gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP. The refrigerant circuit RC also includes the liquid refrigerant pipe 22 made of a metal material, the liquid-refrigerant connection pipe LP made of a metal material of a type different from the type of the metal material of the liquid refrigerant pipe 22, and the connecting portion 22a between the liquid refrigerant pipe 22 and the liquid-refrigerant connection pipe LP. The connecting portions 21a and 22a are disposed in the unventilated space 90.

[0083] The air conditioner 100 is configured such that the dissimilar metal connecting portions 21a and 22a are disposed in the unventilated space 90. Therefore, condensed water is not easily generated on the connecting portions 21a and 22a of the air conditioner 100, so that galvanic corrosion of the connecting portions 21a and 22a can be easily reduced.

(4-2)

[0084] In the air conditioner 100 according to the present embodiment, the indoor unit 20 includes the casing 30. The casing 30 accommodates the indoor heat exchanger 25 and the indoor fan 28. The air conditioner 100 includes the air-flow-blocking member 92 that defines the unventilated space 90 in the casing 30. The connecting portions 21a and 22a are disposed in the unventilated space 90 defined by the air-flow-blocking member 92 in the casing 30.

[0085] Since the air-flow-blocking member 92 defines the unventilated space 90 in the casing 30, the connecting portions 21a and 22a can be disposed in the casing 30, in which air flows are easily generated due to the presence of the indoor fan 28.

(4-3)

[0086] In the air conditioner 100 according to the present embodiment, the air-flow-blocking member 92 is disposed downstream of the indoor fan 28 and upstream of the connecting portions 21a and 22a in the direction in which air is blown out from the indoor fan 28 (direction of the indoor air flows AF). The air-flow-blocking member 92 defines the unventilated space 90, in which the connecting portions 21a and 22a are disposed, in a region downstream of the air-flow-blocking member 92 in the direction in which air is blown out from the indoor fan 28.

[0087] Since the air-flow-blocking member 92 is provided, air blown out from the indoor fan 28 does not easily come into contact with the connecting portions 21a and 22a. Therefore, galvanic corrosion of the connecting portions 21a and 22a can be reduced.

(4-4)

[0088] The air conditioner 100 according to the present embodiment includes the dew condensation prevention members 98 that differ from the air-flow-blocking member 92 and that are disposed around the connecting portions 21a and 22a.

[0089] The connecting portions 21a and 22a are disposed in the unventilated space 90 defined by the air-flow-blocking member 92 in the casing 30, and the dew condensation prevention members 98 are provided around the connecting portions 21a and 22a. Therefore, galvanic corrosion of the connecting portions 21a and 22a can be particularly easily reduced.

(4-5)

[0090] In the air conditioner 100 according to the present embodiment, the unventilated space 90 is a space in which the air flow speed is 0.5 m/sec or less when the air conditioner 100 is in operation.

[0091] Since the air flow speed in the unventilated space 90 is 0.5 m/sec or less even when the air conditioner 100 is in operation, galvanic corrosion of the connecting portions 21a and 22a can be reduced.

[0092] More preferably, the unventilated space 90 is a space in which the air flow speed is 0.25 m/sec or less when the air conditioner 100 is in operation. Still more preferably, the unventilated space 90 is a space in which the air flow speed is 0.15 m/sec or less when the air conditioner 100 is in operation.

(4-6)

[0093] In the air conditioner 100 according to the present embodiment, the unventilated space 90 is a space in which the air flow speed in the operation of the indoor fan 28 at the maximum air flow rate is 1/5 or less of the air flow speed in the ventilated space (intake flow passages FP1 and blow-out flow passages FP2) through which air blown out from the indoor fan 28 flows in the operation of the indoor fan 28 at the maximum air flow rate. For example, the unventilated space 90 is a space in which the average air flow speed in the operation of the indoor fan 28 at the maximum air flow rate is 1/5 or less of the average air flow speed in the ventilated space (intake flow passages FP1 and blow-out flow passages FP2) through which air blown out from the indoor fan 28 flows in the operation of the indoor fan 28 at the maximum air flow rate.

[0094] Since the unventilated space 90 is a space in which the air flow speed is 1/5 or less of the air flow speed in the ventilated space in the operation of the indoor fan 28 at the maximum air flow rate, galvanic corrosion of the connecting portions 21a and 22a can be reduced.

(4-7)

[0095] In the air conditioner 100 according to the present embodiment, the gas refrigerant pipe 21 and the liquid refrigerant pipe 22, which are examples of a first pipe, are made of aluminum or an aluminum alloy. The gas-refrigerant connection pipe GP and the liquid-refrigerant connection pipe LP, which are examples of a second pipe, are made of copper or a copper alloy.

[0096] In this case, galvanic corrosion of the connecting portions 21a and 22a, which are each a connecting portion between a pipe made of aluminum or an aluminum alloy and a pipe made of copper or a copper alloy, can be reduced.

(4-8)

[0097] In the air conditioner 100 according to the present embodiment, the indoor unit 20 is a ceiling-mounted unit that is mounted on the ceiling of the space to be air conditioned.

(5) Modifications

[0098] The above-described embodiment may be modified as in modifications described below. Each modification may be applied in combination with other modifications as long as there is no conflict.

(5-1) Modification A

[0099] In the above-described embodiment, the connecting portion 21a and the connecting portion 22a are respectively a connecting portion between the gas refrigerant pipe 21 and the gas-refrigerant connection pipe GP that are connected to each other at the installation site of the air conditioner 100 and a connecting portion between the liquid refrigerant pipe 22 and the liquid-refrigerant connection pipe LP that are also connected to each other at the installation site of the air conditioner 100. However, the connecting portion 21a and the connecting portion 22a are not limited to this.

[0100] For example, the connecting portion 21a and the connecting portion 22a may each be a connecting portion between a first pipe and a second pipe that are connected to each other in, for example, a factory, the first pipe being made of aluminum or an aluminum alloy and connected to the indoor heat exchanger 25 of the indoor unit 20 at one end thereof, the second pipe being made of copper or a copper alloy and connected to an end of the first pipe that is opposite to the end connected to the indoor heat exchanger 25. In such a case, the connection pipes GP and LP made of copper or a copper alloy may, for example, be connected to the respective second pipes made of copper or a copper alloy at the installation site of the air conditioner 100, and it is not necessary that the connecting portions between the second pipes and the connection pipes GP and LP be disposed in an unventilated space.

(5-2) Modification B

[0101] In the above-described embodiment, the unventilated space 90 is roughly separated from the ventilated space (intake flow passages FP1 and blow-out flow passages FP2) by the air-flow-blocking member 92. However, the unventilated space 90 is not limited to this.

[0102] For example, the above-described indoor heat exchanger 25 includes a section in which the heat exchanging portions 40 are not disposed in a left rear region thereof (see Fig. 4). As illustrated in Figs. 6 and 7, an air-flow-blocking member 92a (flat plate) that extends from the top panel 31a of the casing 30 to a position near the bottom plate 31c may be placed in this section to form an unventilated space 90 such that air blown out from the indoor fan 28 does not directly hit the connecting portion 21a and the connecting portion 22a. In this case, the air flow speed in the unventilated space 90 may be higher than when the ventilated space (intake flow passages FP1 and blow-out flow passages FP2) and the unventilated space 90 are separated from each other by the air-flow-blocking member 92. However, in this example, the unventilated space 90 can be formed with a component having a simple structure.

(5-3) Modification C

[0103] Although the unventilated space 90 is formed by attaching the flat plates 921 and 922 of the air-flow-blocking member 92 to, for example, the casing 30 in the above-described embodiment, the unventilated space 90 is not limited to this.

[0104] For example, instead of attaching an air-flow-blocking member to the casing 30, a cover member 96, which is an example of an air-flow-blocking member, may be attached to the pipes 21, 22, GP, and LP so that the connecting portions 21a and 22a are surrounded by the cover member 96 and that an unventilated space 90 is formed inside the cover member 96 (see Fig. 8). The cover member 96 is, for example, a rectangular-parallelepiped-shaped or cylindrical housing having a hollow portion in which the connecting portions 21a and 22a are disposed. The cover member 96 may be provided for each of the connecting portion 21a and the connecting portion 22a individually, or a common cover member 96 may be provided for both the connecting portion 21a and the connecting portion 22a. The cover member 96 may be made of a metal that does not easily cause galvanic corrosion when in contact with aluminum, an aluminum alloy, copper, or a copper alloy, or be made of, for example, a resin. The material of the cover member 96 may be selected as appropriate. A dew condensation prevention member is preferably disposed in the cover member 96.

(5-4) Modification D

[0105] Although the unventilated space 90 is defined by the flat plates 921 and 922 of the air-flow-blocking member 92 in the above-described embodiment, the unventilated space 90 is not limited to this.

[0106] For example, the air-flow-blocking member that defines the unventilated space 90 may be a guide member that guides the indoor air flows AF to change the direction in which air flows. Such a guide member is not necessarily disposed downstream of the indoor fan 28 and upstream of the connecting portions 21a and 22a in the direction in which air is blown out from the indoor fan 28.

[0107] The air-flow-blocking member that defines the unventilated space 90 may be, for example, a mesh member having a high airflow resistance instead of a plate-shaped member having no holes.

(5-5) Modification E

[0108] Although the unventilated space 90 is formed in the casing 30 in the above-described embodiment, as illustrated in Fig. 9, an unventilated space 94 may instead be formed outside the casing 30. Referring to Fig. 9, the gas refrigerant pipe 21 and the liquid refrigerant pipe 22 extend to the outside of the casing 30 through the opening 30a in the casing 30, and the connecting portions 21a and 22a are disposed outside the casing 30.

[0109] Since air blown out from the indoor fan 28 is blocked by the side wall 31b in the region outside the casing 30, the air flow speed is lower in the region outside the casing 30 than in the ventilated space inside the casing 30. When the connecting portions 21a and 22a are disposed outside the casing 30 in this manner, the connecting portions 21a and 22a can be easily disposed in the unventilated space 94.

(5-6) Modification F

[0110] Although not described in the above embodiment, the outdoor heat exchanger 13 may also be a heat exchanger made of aluminum or an aluminum alloy including a plurality of flat perforated tubes and a plurality of fins. In addition, the outdoor unit 10 may also include a dissimilar metal connecting portion between a pipe made of aluminum or an aluminum alloy that extends from the outdoor heat exchanger 13 and a pipe made of copper or a copper alloy.

[0111] In such a case, similar to the connecting portions 21a and 22a described in the above embodiment, the dissimilar metal connecting portion of the outdoor unit 10 is also preferably disposed in an unventilated space. The manner in which the dissimilar metal connecting portion may be disposed in the unventilated space is described in the above embodiment and modifications, and description thereof will not be repeated.

(5-7) Modification G

[0112] Although the connecting portions 21a and 22a are each a portion at which a pipe made of aluminum or an aluminum alloy and a pipe made of copper or a copper alloy are connected to each other in the above-described embodiment, the connecting portions 21a and 22a are not limited to this. The combination of metals of different types connected at the connecting portion disposed in the unventilated space may be other combinations of metals that may cause galvanic corrosion.

(5-8) Modification H

[0113] In the above-described embodiment, the indoor heat exchanger 25 is disposed to surround the indoor fan 28. However, the indoor heat exchanger 25 is not necessarily disposed to surround the indoor fan 28, and the shape and arrangement thereof may be changed as appropriate as long as the heat exchange between the refrigerant and the indoor air flows AF is possible.

(5-9) Modification I

[0114] Although the air conditioner 100 including the ceiling-embedded type indoor unit 20 is described as an example in the above embodiment, the indoor unit of the air conditioner is not limited to a ceiling-embedded type indoor unit.

[0115] The indoor unit of the air conditioner may instead be a ceiling-mounted indoor unit of another type, for example, a ceiling-suspended indoor type unit that is fixed to the ceiling wall CL.

[0116] Alternatively, the indoor unit of the air conditioner may be various types of indoor units other than a ceiling-mounted indoor unit, such as a wall-mounted indoor unit that is mounted on a side wall, a duct-type indoor unit, or a floor-standing indoor unit. In addition, the indoor unit may be configured to blow out air in four directions as does the indoor unit 20 of the above-described embodiment, or be configured to blow out air in one or two directions.

[0117] When, for example, the indoor fan of the indoor unit is an indoor fan that blows out air in one direction, the unventilated space may be formed at an end of the indoor fan that is opposite to the end from which air is blown out from the indoor fan or at a lateral side of the indoor fan. In such a case, the dissimilar metal connecting portion can be disposed in the unventilated space without using an air-flow-blocking member.

(5-10) Modification J

[0118] In the above-described embodiment, the air conditioner 100 is an apparatus capable of performing both the cooling operation and the heating operation. However, the refrigeration apparatus according to the present disclosure is not limited to this, and may instead be an air-conditioning apparatus that performs only one of the heating operation and the cooling operation.

[0119] Although an embodiment and modifications are described above, it is to be understood that various alterations of the configurations and details are possible without departing from the spirit and scope of the claims.

INDUSTRIAL APPLICABILITY

[0120] The present disclosure is widely applicable to and useful in air conditioners including connecting portions that connect pipes made of different types of metals.

REFERENCE SIGNS LIST

[0121]

10	outdoor unit (heat-source-side unit)
13	outdoor heat exchanger (heat-source-side heat exchanger)
20	indoor unit (use-side unit)
21	gas refrigerant pipe (first pipe)
21a	connecting portion
22	liquid refrigerant pipe (first pipe)
22a	connecting portion
25	indoor heat exchanger (use-side heat exchanger)
28	indoor fan (use-side fan)
30	casing
90, 94	unventilated space
92, 92a	air-flow-blocking member
96	cover member (air-flow-blocking member)
98	dew condensation prevention member
100	air conditioner
GP	gas-refrigerant connection pipe (second pipe)
LP	liquid-refrigerant connection pipe (second pipe)
RC	refrigerant circuit

CITATION LIST

PATENT LITERATURE

[0122] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2012-184870

Claims

1. An air conditioner (100) comprising a heat-source-side unit (10) including a heat-source-side heat exchanger (13); a use-side unit (20) including a use-side heat exchanger (25) and a use-side fan (28) that supplies air to the use-side heat exchanger; and a connection pipe (GP, LP) that connects the heat-source-side unit and the use-side unit to each other, the air conditioner performing air-conditioning of a space to be air conditioned, in which the use-side unit is disposed, by circulating refrigerant in a refrigerant circuit (RC) including the heat-source-side heat exchanger, the use-side heat exchanger, and the connection pipe,

   wherein the refrigerant circuit includes a first pipe (21, 22) made of a metal material, a second pipe (GP, LP) made of a metal material of a type different from a type of the metal material of the first pipe, and a connecting portion (21a, 22a) between the first pipe and the second pipe, and wherein the connecting portion is disposed in an unventilated space (90, 94).

2. The air conditioner according to claim 1, wherein

   the use-side unit further includes a casing (30) that accommodates the use-side heat exchanger and the use-side fan,
   the air conditioner further comprises an air-flow-blocking member (92, 92a, 96) that defines the unventilated space in the casing, and
   wherein the connecting portion is disposed in the unventilated space (90) defined by the air-flow-blocking member in the casing.

3. The air conditioner according to claim 2, wherein the air-flow-blocking member is disposed downstream of the use-side fan and upstream of the connecting portion in a direction in which air is blown out from the use-side fan, and defines the unventilated space, in which the connecting portion is disposed, downstream of the air-flow-blocking member in the direction in which air is blown out from the use-side fan.

4. The air conditioner according to claim 2 or 3, further comprising
   a dew condensation prevention member (98) that differs from the air-flow-blocking member and that is disposed around the connecting portion.

5. The air conditioner according to claim 1, further comprising
   a cover member (96) that covers a periphery of the connecting portion and in which the unventilated space is formed.

6. The air conditioner according to claim 1, wherein

the first pipe is a pipe included in the use-side unit,
the use-side unit further includes a casing (30) that accommodates the use-side heat exchanger and the use-side fan, and
the connecting portion is disposed outside the casing.

7. The air conditioner according to any one of claims 1 to 6, wherein
the unventilated space is a space in which an air flow speed is 0.5 m/sec or less when the air conditioner is in operation.

8. The air conditioner according to any one of claims 1 to 6, wherein
the unventilated space is a space in which an air flow speed in an operation in which the use-side fan blows air at a maximum air flow rate is 1/5 or less of an air flow speed in a ventilated space through which air blown out from the use-side fan flows in the operation in which the use-side fan blows air at the maximum air flow rate.

9. The air conditioner according to any one of claims 1 to 8, wherein
one of the metal material of the first pipe and the metal material of the second pipe is aluminum or an aluminum alloy, and other of the metal material of the first pipe and the metal material of the second pipe is copper or a copper alloy.

10. The air conditioner according to any one of claims 1 to 9, wherein
the use-side unit is a ceiling-mounted unit (20) that is mounted on a ceiling of the space to be air conditioned.

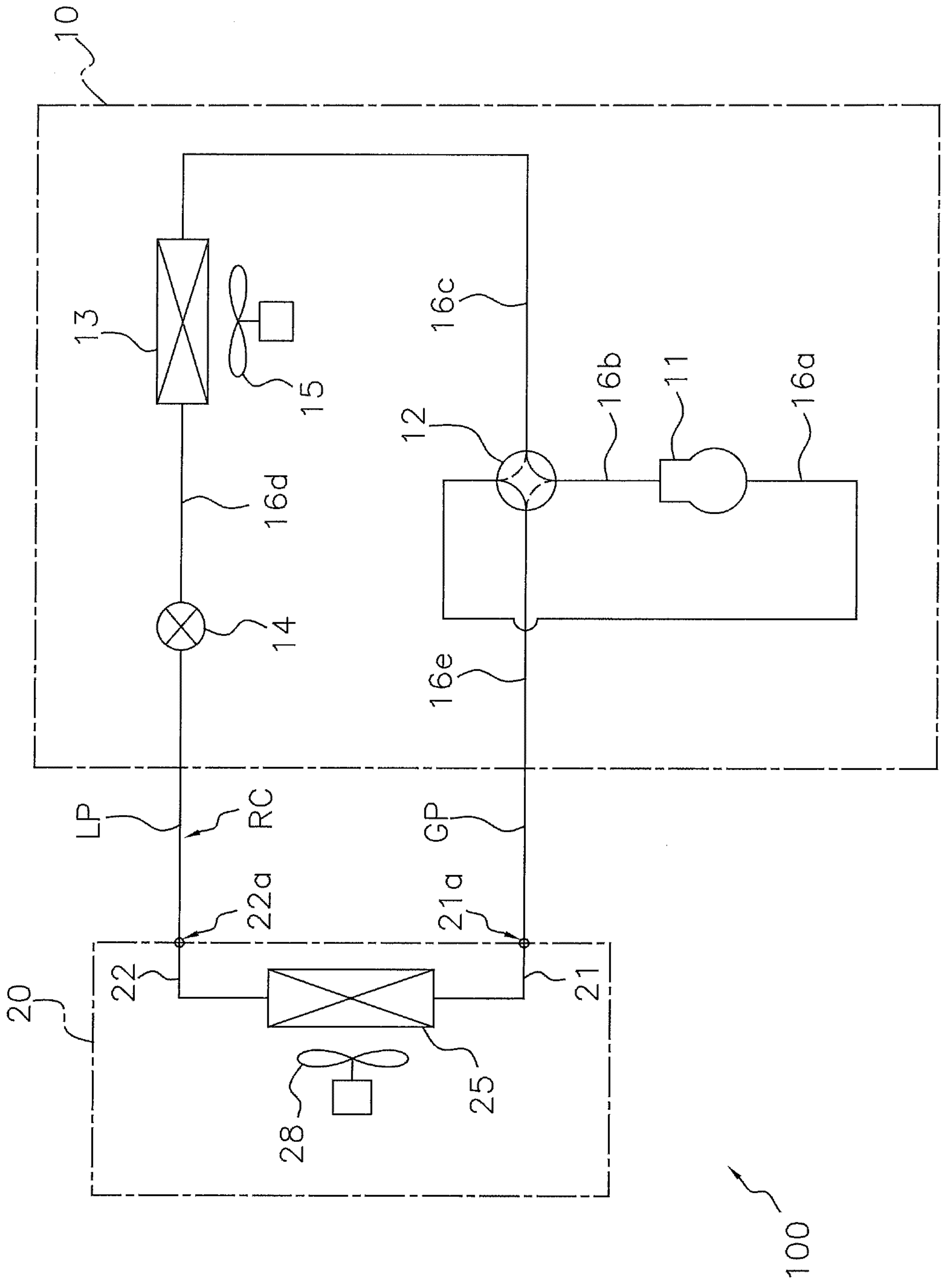

10
13
15
16c
16b
11
16a
12
16d
14
16e
LP
RC
GP
22a
21a
20
22
21
25
28
100

FIG. 1

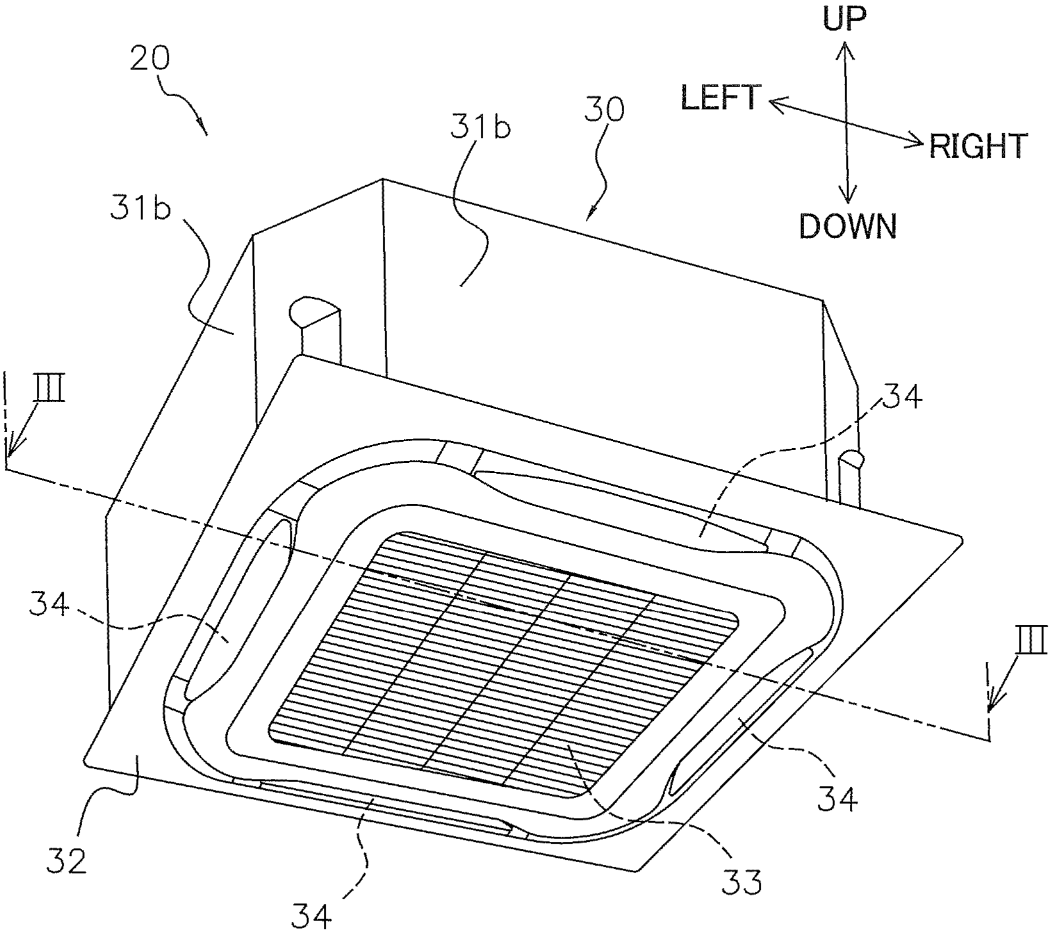
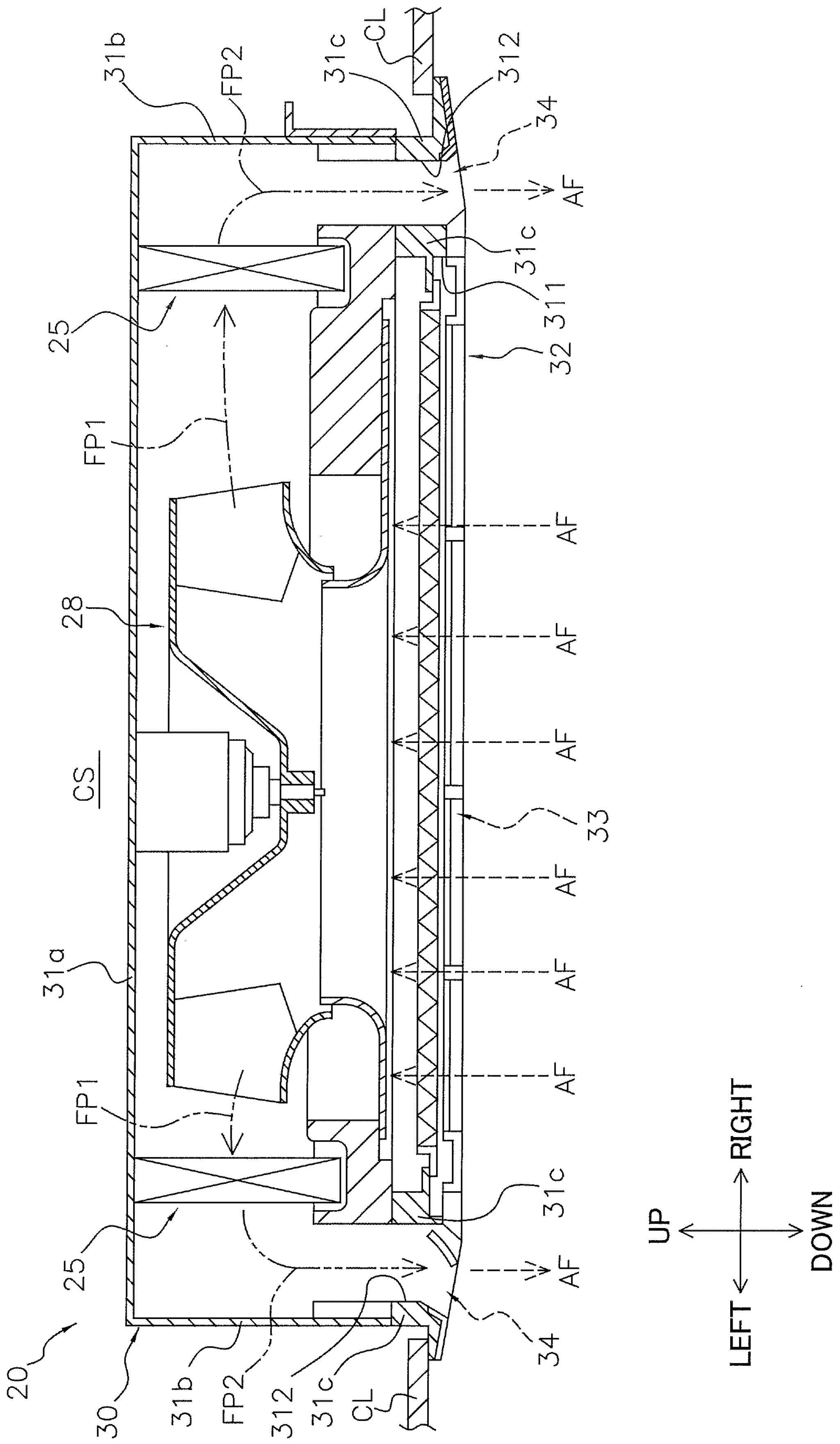


FIG. 2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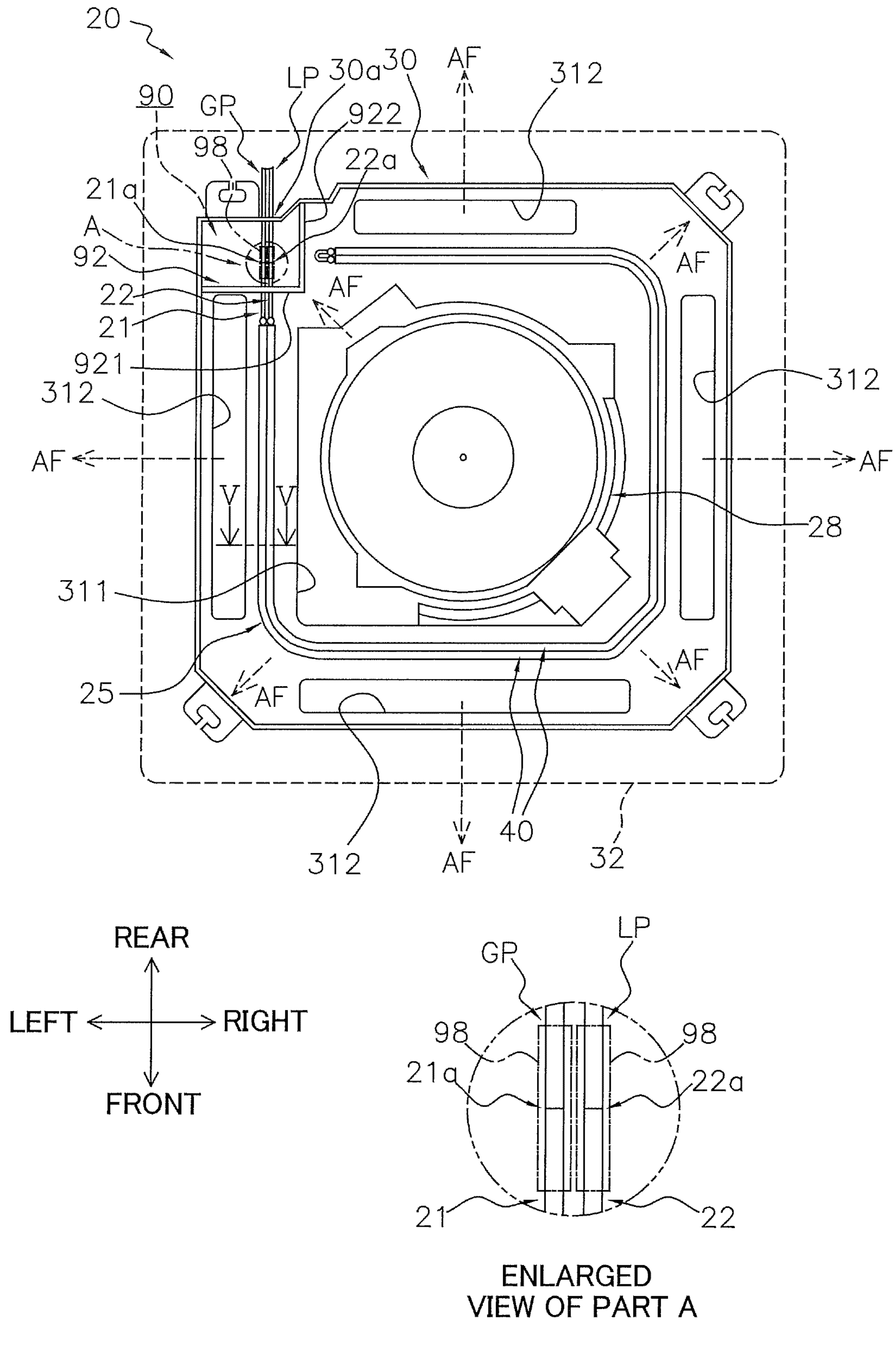
FP2
31c
CL
312
34
AF
31c
311
32
25
FP1
28
CS
AF
33
31a
FP1
31c
25
34
20
30
31b
FP2
312
31c
CL
UP
RIGHT
LEFT
DOWN

FIG. 3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90
GP
LP
30a
30
AF
312
922
98
22a
21a
A
92
22
21
921
311
28
25
40
32
REAR
LEFT
RIGHT
FRONT
ENLARGED
VIEW OF PART A

FIG. 4

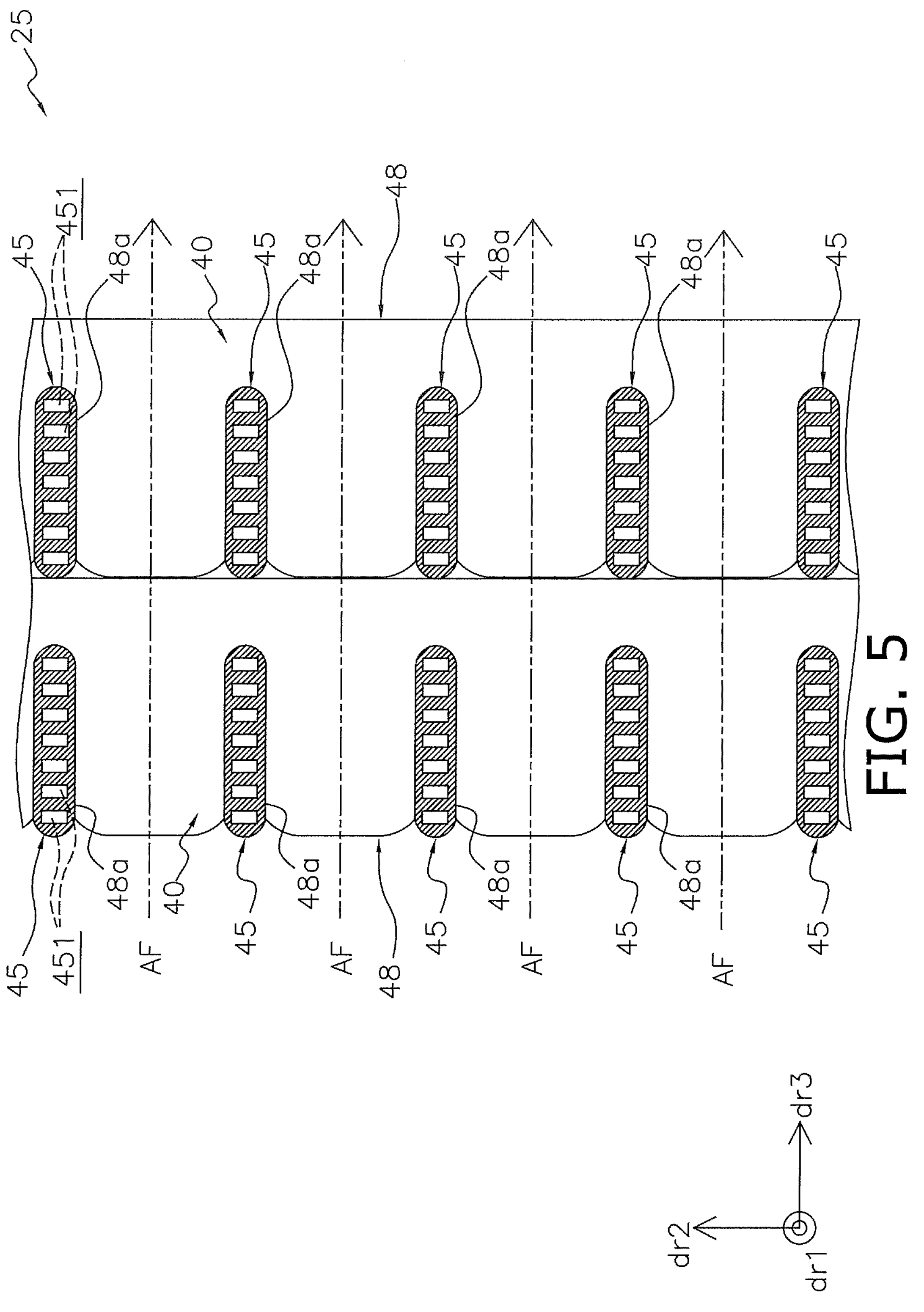
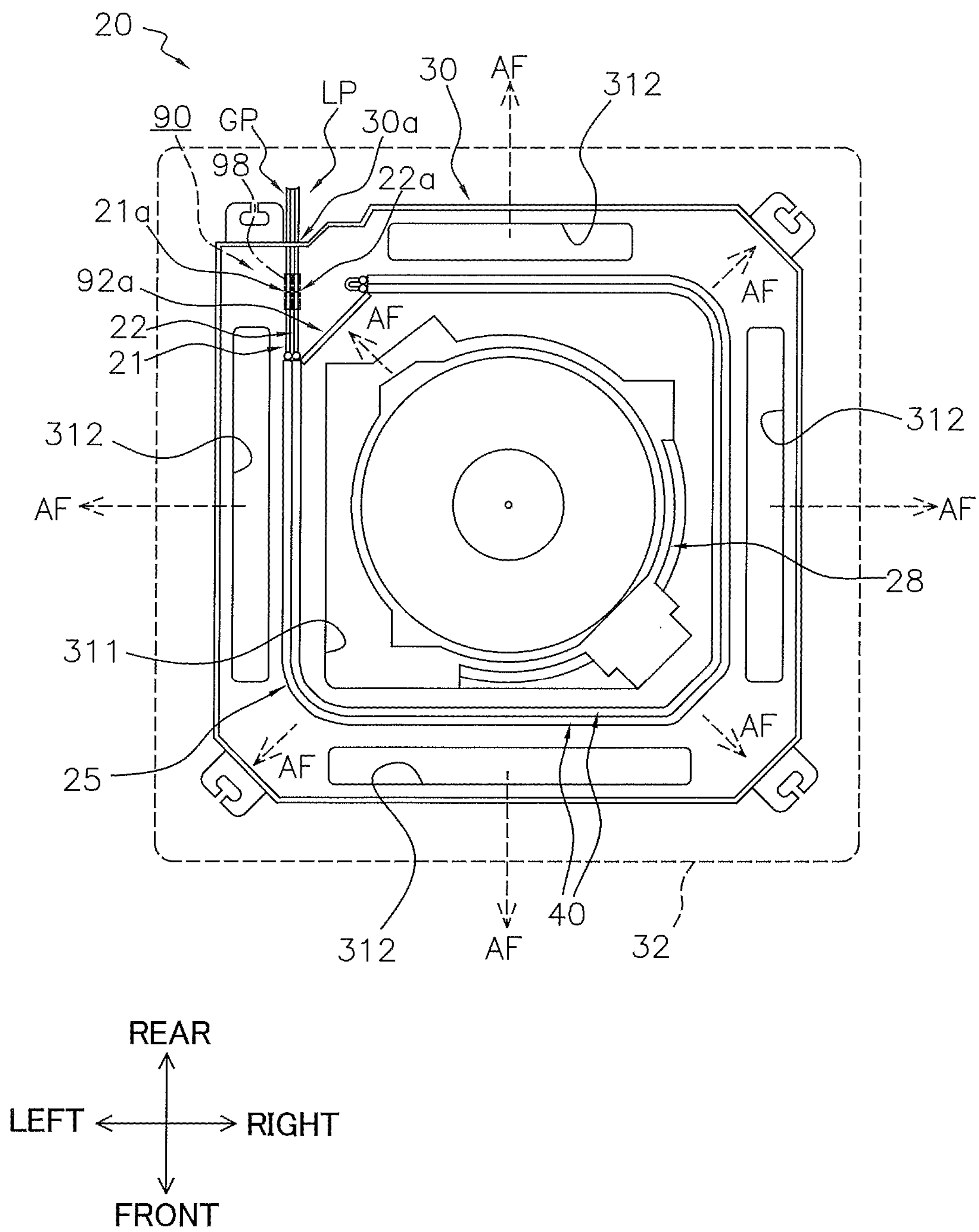


FIG. 5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AF
312
LP
90
GP
30a
98
22a
21a
92a
AF
AF
22
21
312
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AF
AF
28
311
AF
AF
25
312
AF
40
32
REAR
LEFT
RIGHT
FRONT

FIG. 6

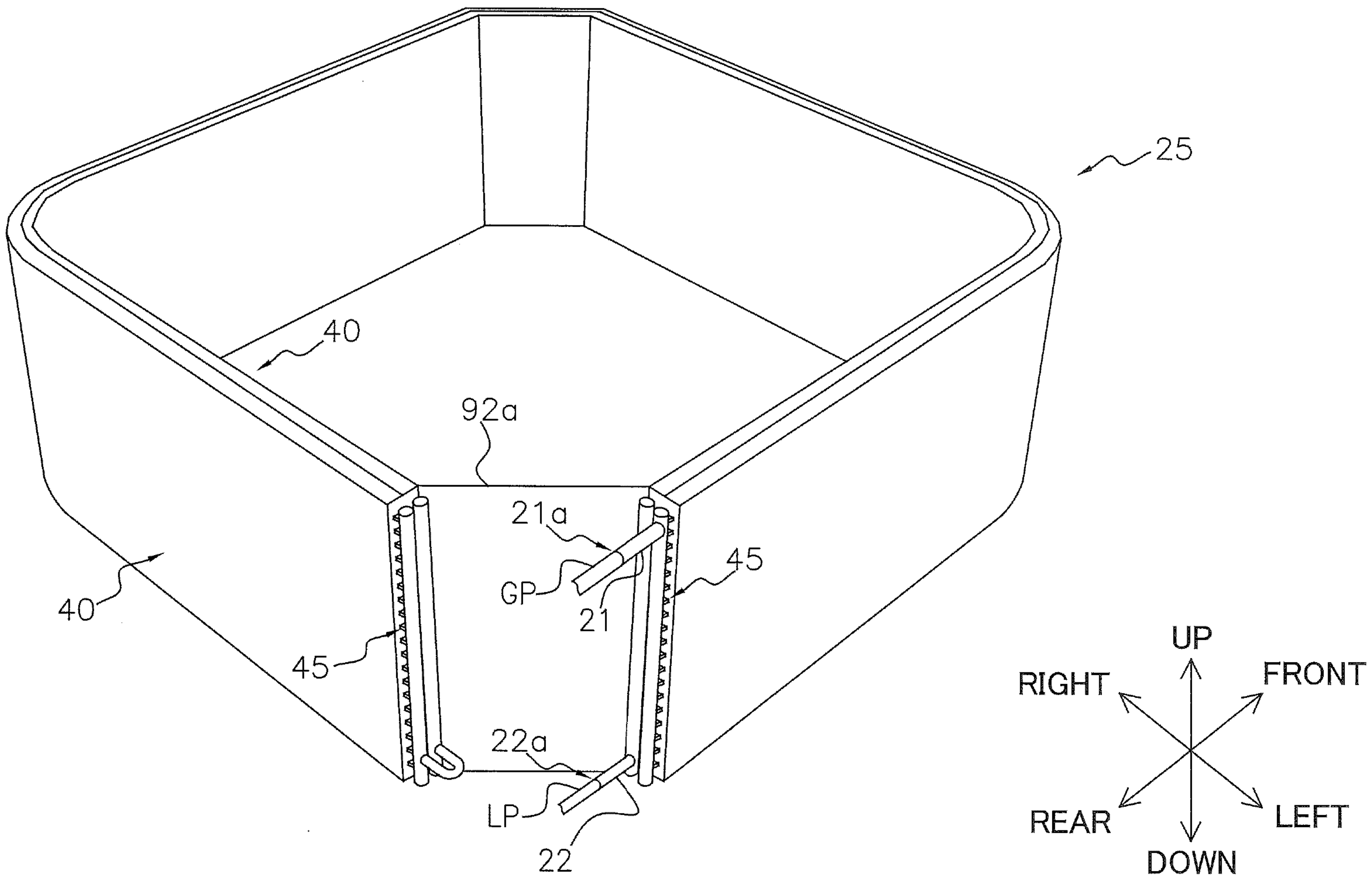
25
40
92a
21a
GP
21
45
40
45
22a
LP
22
UP
RIGHT
FRONT
REAR
LEFT
DOWN

FIG. 7

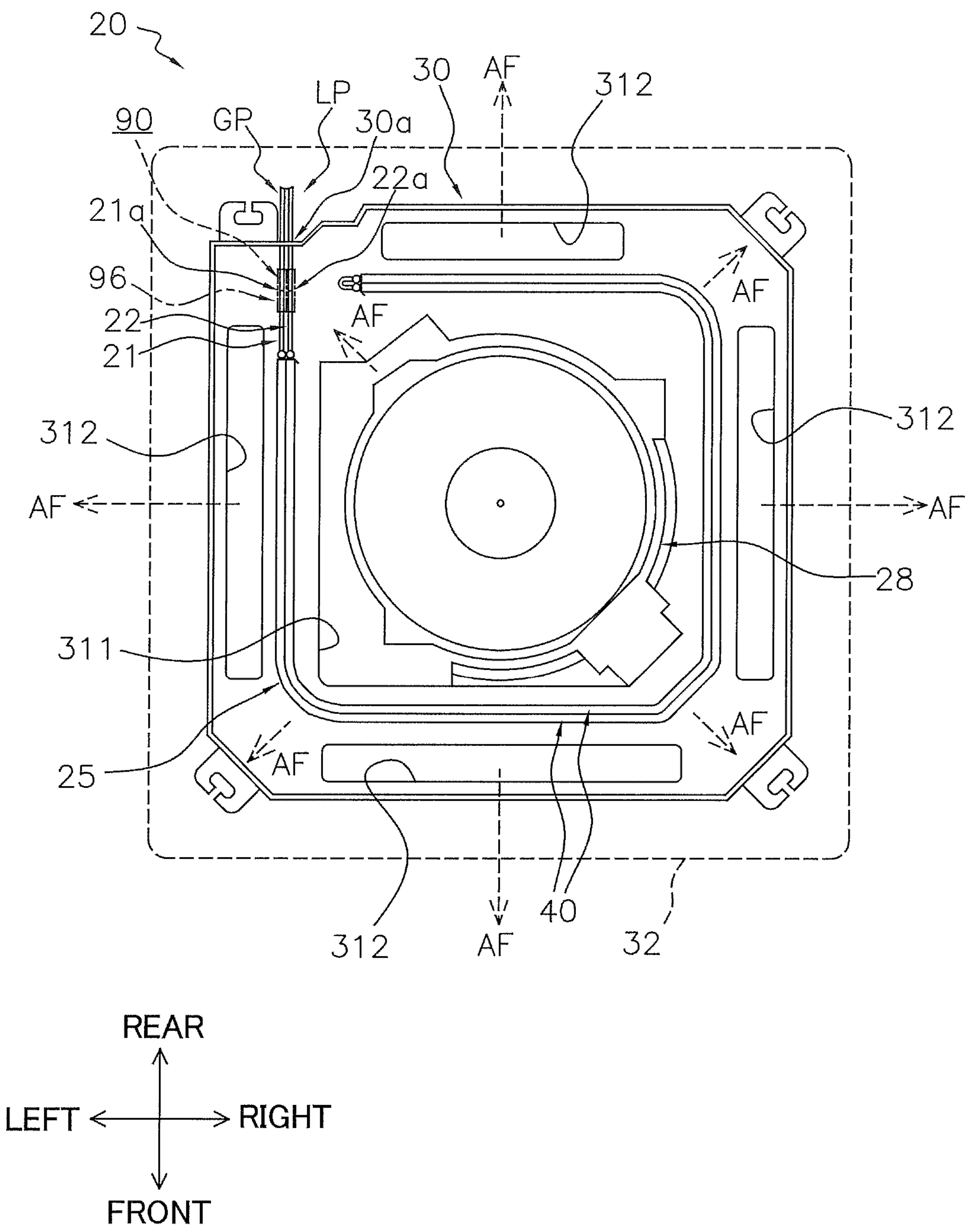
20
90
GP
LP
30a
30
AF
312
22a
21a
96
22
21
AF
AF
312
312
AF
AF
28
311
25
AF
AF
312
AF
40
32
REAR
LEFT
RIGHT
FRONT

FIG. 8

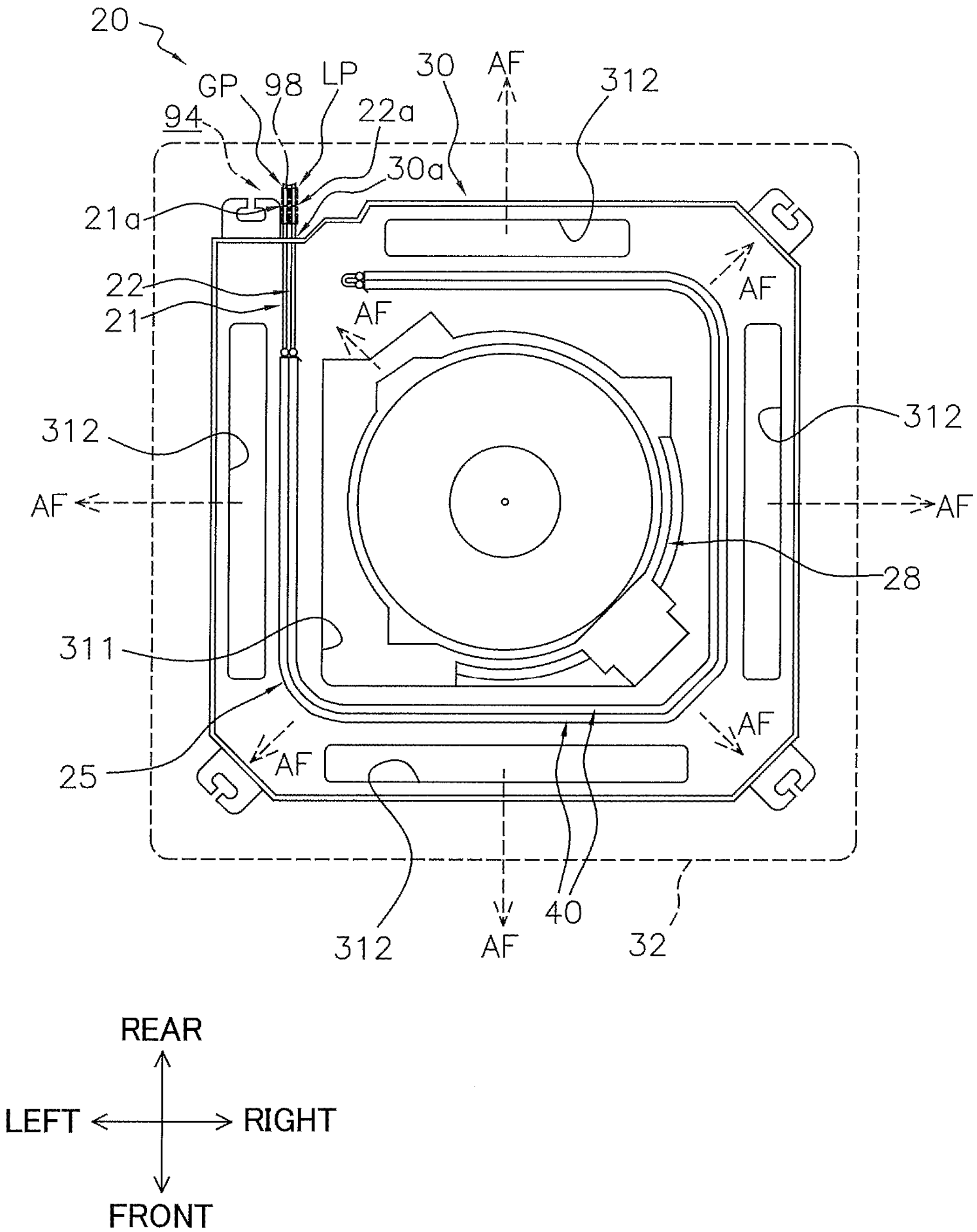
20
GP
98
LP
30
AF
312
94
22a
30a
21a
22
21
AF
AF
312
312
AF
AF
28
311
25
AF
AF
312
AF
40
32
REAR
LEFT
RIGHT
FRONT

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/043793

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F1/0326(2019.01)i, F24F13/20(2006.01)i, F25B41/00(2006.01)i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. F24F1/0326, F24F13/20, F25B41/00

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

Published examined utility model applications of Japan	1922–1996
Published unexamined utility model applications of Japan	1971–2019
Registered utility model specifications of Japan	1996–2019
Published registered utility model applications of Japan	1994–2019

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.
X A	JP 2005-90761 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 07 April 2005, paragraphs [0008], [0013]-[0031], fig. 1-3 (Family: none)	1, 5, 7-10 2-4, 6
X A	JP 2013-155892 A (MITSUBISHI ELECTRIC CORP.) 15 August 2013, paragraphs [0012]-[0052], fig. 1-7 & EP 2620736 A2, paragraphs [0012]-[0052], fig. 1-7 & CN 103225847 A & SG 192323 A & RU2509969 C	1, 6-10 2-5

☒ 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
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"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	Date of mailing of the international search report
30 January 2019 (30.01.2019)	12 February 2019 (12.02.2019)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/043793

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 2016-84946 A (HITACHI APPLIANCES, INC.) 19 May 2016, paragraphs [0020]-[0021], fig. 2-3, 5 (Family: none)	1-10
A	WO 2015/155826 A1 (MITSUBISHI ELECTRIC CORP.) 15 October 2015 (Family: none)	1-10
A	WO 2013/084433 A1 (PANASONIC CORP.) 13 June 2013 & CN 103782126 A	1-10
A	JP 2009-92274 A (HITACHI APPLIANCES, INC.) 30 April 2009, paragraphs [0110]-[0111] (Family: none)	1-10
A	JP 2013-2683 A (PANASONIC CORP.) 07 January 2013 (Family: none)	1-10
A	JP 2013-130345 A (DAIKIN INDUSTRIES, LTD.) 04 July 2013 & US 2015/0068709 A1 & WO 2013/094386 A1 & EP 2796799 A1 & AU 2012355058 A & CN 104011471 A & KR 10-2014-0105586 A & ES 2574507 T & BR 112014015074 A	1-10
A	WO 2016/038865 A1 (PANASONIC IP MANAGEMENT CO., LTD.) 17 March 2016 & CN 105765308 A	
A	WO 2013/122451 A1 (PANASONIC APPLIANCES AIR-CONDITIONING R&D MALAYSIA SDN. BHD.) 22 August 2013 & CN 104254739 A	1-10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012184870 A **[0003] [0004] [0122]**