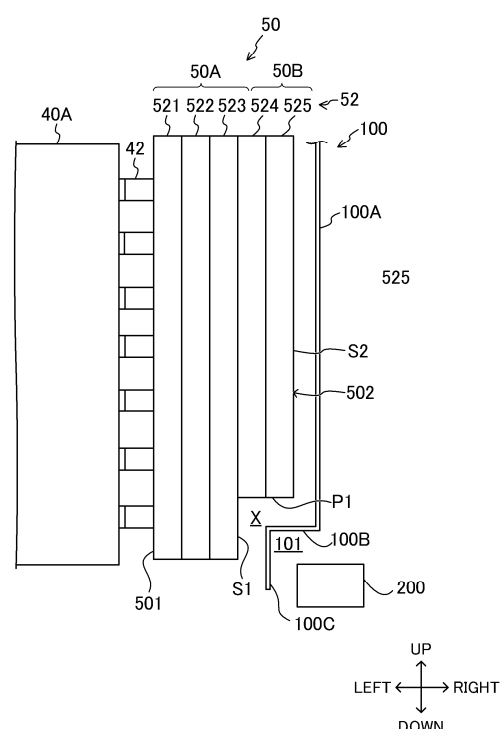




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Description

TECHNICAL FIELD

[0001] The present disclosure relates to an indoor heat exchanger and an air-conditioning indoor unit.

BACKGROUND ART

[0002] Patent Document 1 discloses a stacked header connected to a heat exchanger. Each plate of the stacked header has a groove. When the plates with such grooves are stacked, the grooves form a refrigerant flow path in the stacked header.

CITATION LIST

PATENT DOCUMENT

[0003] Patent Document 1: WO 2014/184917

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0004] The plates that form the plate stack are all formed in the same shape. The shape and position of the groove formed in the plate vary with the structure of the refrigerant flow path. Therefore, the area of the region in which the groove is not formed varies with the plate. The region in which the groove is not formed is useless, and therefore if the region is relatively large, the space in the air conditioner cannot be used effectively.

[0005] An object of the present disclosure is to provide staked plates that allow an effective use of a space in an air-conditioning indoor unit.

SOLUTION TO THE PROBLEM

[0006] A first aspect is directed to an indoor heat exchanger including:

a heat exchange portion (B) including a plurality of fins (41) and a plurality of heat transfer tubes (42) penetrating the plurality of fins (41); and
a plate stack (50, 60) in which a flow path (51, 61) communicating with the heat transfer tube (42) is provided and in which a plurality of plates (52, 62) are stacked in a first direction in which the heat transfer tube (42) extends,
wherein
the plate stack (50, 60)

is adjacent to the heat exchange portion (B) in the first direction, and
includes

a first plate portion (50A, 60A) having one or more of the plates (52, 62), and

a second plate portion (50B, 60B) which has one or more of the plates (52, 62) that is different in shape from the plates (52, 62) of the first plate portion (50A, 60A) and which is disposed on a surface of the first plate portion (50A, 60A) that is opposite to a surface facing the heat exchange portion (B),

the plate stack (50, 60) has a step portion (X) in a peripheral portion of a second surface (502, 602) opposite to a first surface (501, 601) facing the heat exchange portion (B), and
the step portion (X) is formed by the first plate portion (50A, 60A) and the second plate portion (50B, 60B).

[0007] In the first aspect, the step portion (X) is provided in the plate stack (50, 60), whereby it is possible to form a space at a position facing the step portion (X). It is possible to use this space effectively, such as disposing a predetermined component in this space.

[0008] A second aspect is directed to an air-conditioning indoor unit including:

the indoor heat exchanger of the first aspect;
a casing (31) configured to house the indoor heat exchanger; and
a first component (300) disposed in the casing (31), wherein
at least part of the first component (300) faces the step portion (X) in the first direction.

[0009] In the second aspect, the first component (300) is disposed in the space facing the step portion (X) in the first direction, whereby it is possible to shorten the total length of the indoor heat exchanger and the first component (300). Accordingly, it is possible to make the air-conditioning indoor unit compact.

[0010] A third aspect is an embodiment of the second aspect. In the third aspect,

when the plate stack (50, 60) is viewed from the first direction,
the first component (300) is disposed closer to the step portion (X) than an end portion of the second plate portion (50B, 60B) forming the step portion (X).

[0011] In the third aspect, the first component (300) is disposed in a space of the step portion (X) that is below the end surface of the second plate portion (or is close to the step portion), whereby similarly to the second aspect, it is possible to make the air-conditioning indoor unit compact.

[0012] A fourth aspect is an embodiment of the second aspect. In the fourth aspect,
at least part of the first component (300) is disposed inside the step portion (X).

[0013] In the fourth aspect, at least part of the first component (300) is disposed in the step portion (X),

whereby it is possible to make the air-conditioning indoor unit compact.

[0014] A fifth aspect is an embodiment of the second aspect. In the fifth aspect, the air-conditioning indoor unit further includes:

a second component (200) adjacent to an indoor heat exchanger (40) and facing the step portion (X) in the first direction; and
a partition plate (100) disposed between the indoor heat exchanger (40) and the second component (200),
wherein
the partition plate (100) has a recessed portion (101) formed along a shape of the step portion (X).

[0015] In the fifth aspect, the second component (200) can be disposed in the recessed portion (101). Accordingly, it is possible to shorten the total length of the indoor heat exchanger (40) and the second component (200), and therefore it is possible to make the air-conditioning indoor unit compact.

[0016] A sixth aspect is an embodiment of any one of the second to fifth aspects. In the sixth aspect,

the casing (31) has an air passage (P) through which air flows from an inlet port (33) toward an outlet port (34) in the casing (31),
the indoor heat exchanger (40) is disposed in the air passage (P), and
the step portion (X) is formed on part of the plate stack (50, 60) that is on a downstream side of air flow when viewed from the first direction.

[0017] Here, in the indoor heat exchanger, a higher load is applied to the upstream side of the air flow of the air passing through the indoor heat exchanger than the downstream side of the same. In contrast, in the sixth aspect, the step portion (X) is formed on part of the plate stack (50, 60) that is on the downstream side of the air flow, and therefore it is possible to increase the number of plates (52, 62) stacked on the upstream side of the air flow. As the number of stacked plates (52, 62) increases, the thickness of the plate stack (50, 60) increases accordingly, and therefore it is possible to sufficiently secure the number of the flow paths (51, 61) formed therein. If the number of flow paths can be secured, it is possible to increase the flow rate of a refrigerant flowing through the heat transfer tubes (42), and as a result, the heat exchange is improved. In this manner, heat exchange can be performed actively on the upstream side of the air flow of the indoor heat exchanger where the air-conditioning load is relatively high, and therefore it is possible to increase the heat exchange efficiency of the indoor heat exchanger.

[0018] A seventh aspect is an embodiment of any one of the second to sixth aspects. In the seventh aspect,

the plate stack (50, 60) has the plates (52, 62) including three or more plates (52, 62), and
in the plate stack (50, 60),

one of the plates (52, 62) of the first plate portion (50A, 60A) that is closest to the heat exchange portion (B) is defined as a first end plate (521, 621),
one of the plates (52, 62) of the second plate portion (50B, 60B) that is most distant from the heat exchange portion (B) is defined as a second end plate (525, 625), and
the plate (52, 62) disposed between the first end plate (521, 621) and the second end plate (525, 625) is defined as an intermediate plate (522 to 524, 622 to 624),

the flow path (51, 61) runs through the intermediate plate (522 to 524, 622 to 624), and
a thickness of the intermediate plate (522 to 524, 622 to 624) is greater than a thickness of the first end plate (521, 621) and the second end plate (525, 625).

[0019] In the seventh aspect, the thickness of the plate (52, 62) disposed at the center of the plate stack (50, 60) is greater than the thickness of the plate (52, 62) disposed at both the ends of the plate stack (50, 60), whereby it is possible to increase the area or the inner diameter of the cross section of the refrigerant flow path (51, 61) formed in the plate stack (50, 60). Accordingly, it is possible to reduce an increase in pressure loss of the refrigerant flowing through the refrigerant flow path (51, 61).

[0020] An eighth aspect is an embodiment of any one of the second to seventh aspects. In the eighth aspect, in the plate stack (50, 60), at least part of the first surface (501, 601) and the second surface (502, 602) is subjected to anti-corrosion treatment.

[0021] In the eighth aspect, while both the side surfaces of the plate stack (50, 60) may be electrolytically corroded by dew condensation or others, it is possible to reduce such electrolytic corrosion by the anti-corrosion treatment.

[0022] A ninth aspect is an embodiment of any one of the second to eighth aspects. In the ninth aspect, when the plate stack (50, 60) is viewed from the first direction, an area of part of the first plate portion (50A, 60A) that does not overlap with the second plate portion (50B, 60B) is smaller than an area of part of the first plate portion (50A, 60A) that overlaps with the second plate portion (50B, 60B).

[0023] In the ninth aspect, part of the plate stack (50, 60) in which the first plate portion (50A, 60A) and the second plate portion (50B, 60B) overlap with each other is thicker than part of the plate stack (50, 60) in which only the first plate portion (50A, 60A) is present, and therefore it is possible to secure a sufficient number of flow paths. As the number of the flow paths (51, 61) increases, the heat exchange increases in the heat exchange portion

(B) accordingly. Therefore, when the portion in which the first plate portion (50A, 60A) and the second plate portion (50B, 60B) overlap with each other is larger than the portion in which only the first plate portion (50A, 60A) is present, it is possible to secure a sufficient number of flow paths that can be formed in the plate stack (50, 60), and then it is possible to prevent the indoor heat exchanger from decreasing in performance.

[0024] A tenth aspect is an embodiment of any one of the second to ninth aspects. In the tenth aspect,

the flow path (51, 61) includes

a first flow path (51A) provided in the first plate portion (50A, 60A), and
a second flow path (51B) provided between the first plate portion (50A, 60A) and the second plate portion (50B, 60B), and

the second flow path (51B) is formed to intersect the first flow path (51A).

[0025] In the tenth aspect, in part of the plate stack (50, 60) in which the flow paths (51, 61) do not intersect each other, only the first plate portion (50A, 60A) may be provided with the flow paths (51, 61). Such a part does not require the second plate portion (50B, 60B) and thus can be provided with the step portion (X). In this manner, it is possible to effectively use the space formed by the step portion (X).

[0026] An eleventh aspect is an embodiment of any one of the second to tenth aspects. In the eleventh aspect,

the flow path (51, 61) has a third flow path (51C) formed in part of the first plate portion (50A, 60A) that does not overlap with the second plate portion (50B, 60B) when the plate stack (50, 60) is viewed from the first direction, and
in the third flow path (51C),

a refrigerant in a superheated region flows if the indoor heat exchanger functions as an evaporator, and
a refrigerant in a supercooled region flows if the indoor heat exchanger functions as a radiator.

[0027] In the eleventh aspect, the temperature of a refrigerant in the superheated region or the supercooled region is relatively remote from the temperature of a refrigerant flowing in the heat transfer tube (42) or the plate stack (50, 60), and thus if one of the flow paths (51, 61) through which a refrigerant in the superheated region or the supercooled region flows and another one of the flow paths (51, 61) through which another refrigerant flows are close to each other, heat exchange is performed therebetween. In the eleventh aspect, however, the third flow path (51C) is disposed away from the other flow path

(51, 61), and therefore it is possible to reduce heat exchange between a refrigerant in the superheated region or the supercooled region and another refrigerant.

[0028] A twelfth aspect is an embodiment of any one of the second to eleventh aspects. In the twelfth aspect, the air-conditioning indoor unit further includes:

a gas pipe (12a) configured to transfer compressed refrigerant gas to the indoor heat exchanger (40), wherein
the gas pipe (12a) is connected to the flow path (51, 61) formed in part of the plate stack (50, 60) in which the first plate portion (50A, 60A) and the second plate portion (50B, 60B) overlap with each other.

[0029] In the twelfth aspect, the gas refrigerant has a relatively high pressure. The thickness of the portion in which the first plate portion (50A, 60A) and the second plate portion (50B, 60B) overlap with each other is thicker than the portion in which only the first plate portion (50A, 60A) is present, and thus it is possible to increase the length of the flow path extending in the stacking direction. When such a portion is connected with the gas pipe (12a), it is possible to reduce the pressure loss of a refrigerant flowing through the flow path (51, 61) when gas flows into the plate stack (50, 60).

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

[FIG. 1] FIG. 1 is a piping system diagram of an air conditioner according to an embodiment.

[FIG. 2] FIG. 2 is a front view of an air-conditioning indoor unit.

[FIG. 3] FIG. 3 is a cross-sectional view of the air-conditioning indoor unit taken along line II-II.

[FIG. 4] FIG. 4 is a front view of an internal structure of the air-conditioning indoor unit.

[FIG. 5] FIG. 5 is an enlarged perspective view of a main part of an indoor heat exchanger.

[FIG. 6] FIG. 6 shows plate stacks as viewed from the right direction.

[FIG. 7] FIG. 7 is a cross-sectional view that illustrates refrigerant flow paths of the plate stacks.

[FIG. 8] FIG. 8 is a schematic view of a front plate stack as viewed from the front.

[FIG. 9] FIG. 9 is a cross-sectional view of the front plate stack for describing a configuration of a first flow path.

[FIG. 10] FIG. 10 is a cross-sectional view of the front plate stack for describing a configuration of a second flow path.

[FIG. 11] FIG. 11 is a schematic view showing that the first flow path and the second flow path intersect each other when the plate stack is viewed from the first direction (the right direction).

[FIG. 12] FIG. 12 is a cross-sectional view of the front

plate stack for describing a configuration of a third flow path.

[FIG. 13] FIG. 13 shows a rear plate stack according to a variation as viewed from the first direction (the right direction).

[FIG. 14] FIG. 14 is a cross-sectional view of the rear plate stack for describing a configuration of a third flow path.

[FIG. 15] FIG. 15 is a schematic view of part of an internal structure of an air-conditioning indoor unit as viewed from the front according to another embodiment.

[FIG. 16] FIG. 16 is a schematic view of part of an internal structure of an air-conditioning indoor unit as viewed from the front according to another embodiment.

[FIG. 17] FIG. 17 is a schematic view of part of an internal structure of an air-conditioning indoor unit as viewed from the front according to another embodiment.

[FIG. 18] FIG. 18 is a schematic view of part of an internal structure of an air-conditioning indoor unit as viewed from the front according to another embodiment.

DESCRIPTION OF EMBODIMENTS

[0031] An embodiment of the present disclosure will be described in detail below with reference to the drawings. The present disclosure is not limited to the embodiment shown below, and various changes can be made within the scope without departing from the technical concept of the present disclosure. Each of the drawings is intended to illustrate the present disclosure conceptually, and dimensions, ratios, or numbers may be exaggerated or simplified as necessary for the sake of ease of understanding.

(1) General Configuration of Air Conditioner

[0032] The present embodiment is directed to an air conditioner (10) that includes a heat exchanger unit. The air conditioner (10) adjusts the air temperature in an indoor space (I) as a target space.

[0033] As shown in FIG. 1, the air conditioner (10) is an example of a refrigeration cycle apparatus that includes a refrigerant circuit (11). The refrigerant circuit (11) is filled with a refrigerant. The refrigerant circuit (11) circulates a refrigerant to perform a refrigeration cycle.

[0034] The air conditioner (10) includes an air-conditioning outdoor unit (20), an air-conditioning indoor unit (30), a first connection pipe (12), and a second connection pipe (13). The air conditioner (10) is a pair-type air conditioner that includes one air-conditioning outdoor unit (20) and one air-conditioning indoor unit (30). The first connection pipe (12) is a gas connection pipe, and the second connection pipe (13) is a liquid connection pipe.

[0035] The air-conditioning outdoor unit (20) is placed outside. The air-conditioning outdoor unit (20) includes an outdoor casing (20a); and a compressor (21), an outdoor heat exchanger (22), an outdoor expansion valve (23), a four-way switching valve (24), and an outdoor fan (25) which are housed in the outdoor casing (20a).

[0036] The compressor (21) is a rotary compressor such as an oscillating-piston-type compressor, a rotary-type compressor, and a scroll-type compressor. The outdoor heat exchanger (22) exchanges heat between a refrigerant and outdoor air. The outdoor heat exchanger (22) is a fin-and-tube heat exchanger. The outdoor expansion valve (23) decompresses a refrigerant. The outdoor expansion valve (23) is an electronic expansion valve. The four-way switching valve (24) switches between a first state (the state indicated by the solid lines in FIG. 1) and a second state (the state indicated by the broken lines in FIG. 1). The four-way switching valve (24) in the first state allows a discharge portion of the compressor (21) and a gas end portion of the outdoor heat exchanger (22) to communicate with each other, and allows an inlet portion of the compressor (21) and the first connection pipe (12) to communicate with each other. The four-way switching valve (24) in the second state allows the discharge portion of the compressor (21) and the first connection pipe (12) to communicate with each other, and allows the inlet portion of the compressor (21) and the gas end portion of the outdoor heat exchanger (22) to communicate with each other. The outdoor fan (25) transfers air flowing through the outdoor heat exchanger (22). The outdoor fan (25) is a propeller fan.

[0037] The air-conditioning indoor unit (30) includes a casing (31); and an indoor heat exchanger (40), an indoor fan (32), and an indoor expansion valve (37) which are housed in the casing (31).

(2) Air-Conditioning Indoor Unit

[0038] The air-conditioning indoor unit (30) as an indoor air conditioner will be described in detail with reference to FIGS. 2 to 4. The air-conditioning indoor unit (30) of this embodiment is a wall-mounted unit provided on a wall of the indoor space (I). The terms "upper", "lower", "right", "left", "front", and "rear" described below correspond to the directions of the arrows shown in FIGS. 2 and 3, and the left-right direction refers to the direction in which the casing (31) is viewed from the front.

(2-1) Casing

[0039] As shown in FIG. 2 and FIG. 3, the casing (31) is formed in a box shape that extends in the left-right direction. The casing (31) includes a front panel (31a), a rear panel (31b), an upper panel (31c), a lower panel (31d), a first side panel (31e), and a second side panel (31f).

[0040] The front panel (31a) is on the front side of the casing (31) and constitutes a front surface of the casing (31). The rear panel (31b) is on the rear side of the casing (31) and constitutes a rear surface of the casing (31). The upper panel (31c) is on the upper side of the casing (31) and constitutes an upper surface of the casing (31). The lower panel (31d) is on the lower side of the casing (31) and constitutes a lower surface of the casing (31). The first side panel (31e) is on the right side of the casing (31) and constitutes a right surface of the casing (31). The second side panel (31f) is on the left side of the casing (31) and constitutes a left surface of the casing (31).

[0041] An inlet port (33) is formed in the upper panel (31c), and an outlet port (34) is formed in the lower panel (31d). In the casing (31), an air passage (P) is formed from the inlet port (33) to the outlet port (34). The inlet port (33) extends in the longitudinal direction of the casing (31). The inlet port (33) is an opening for drawing the air in the indoor space (I) into the air passage (P). The outlet port (34) is formed in the lower panel (31d). The outlet port (34) extends in the longitudinal direction of the casing (31). The outlet port (34) is an opening for discharging the air in the air passage (P) to the indoor space (I).

(2-2) Filter

[0042] The air-conditioning indoor unit (30) includes a filter (35). The filter (35) is disposed behind the inlet port (33) and upstream of the indoor heat exchanger (40). The filter (35) collects dust in the air sent from the inlet port (33) to the indoor heat exchanger (40). The air-conditioning indoor unit (30) may include a dust removal mechanism for removing the dust collected by the filter (35).

(2-3) Heat Exchanger Unit

[0043] The heat exchanger unit (U) includes one indoor heat exchanger (40) and one indoor expansion valve (37). The indoor heat exchanger (40) includes one heat exchanger body (B) and two plate stacks (50, 60). The heat exchanger body (B) of the indoor heat exchanger (40) is disposed to cross the air passage (P). The air passage (P) is divided into an upstream side and a downstream side of the heat exchanger body (B).

(2-4) Indoor Fan

[0044] The indoor fan (32) is disposed in the air passage (P). In the air passage (P), the indoor fan (32) is disposed downstream of the indoor heat exchanger (40). The indoor fan (32) is a cross-flow fan. The indoor fan (32) has a fan rotor that extends in the longitudinal direction of the casing (31).

(2-5) Flap

[0045] The air-conditioning indoor unit (30) has a flap (36) that adjusts the direction of the air discharged from

the outlet port (34). The flap (36) adjusts the airflow direction in the upper-lower direction. The air-conditioning indoor unit (30) may have a plurality of flaps (36). The flap (36) may adjust the airflow direction in the left-right direction.

(3) Heat Exchanger Unit

[0046] As described above, the heat exchanger unit (U) includes the indoor heat exchanger (40), the indoor expansion valve (37), a gas relay pipe (12a), and a liquid relay pipe (13a).

(3-1) Indoor Heat Exchanger

[0047] The indoor heat exchanger (40) shown in FIGS. 3 to 5 includes the heat exchanger body (B) and the plate stacks (50, 60) connected with the heat exchanger body (B). The indoor heat exchanger (40) is a fin-and-tube heat exchanger having fins (41) and heat transfer tubes (42). The indoor heat exchanger (40) exchanges heat between air and a refrigerant.

[0048] The heat exchanger body (B) is an example of the heat exchange portion (B). The heat exchanger body (B) includes the plurality of fins (41) and the plurality of heat transfer tubes (42) penetrating the plurality of fins (41). The plurality of fins (41) are arranged in the longitudinal direction of the casing (31). The plurality of heat transfer tubes (42) extend in the direction in which the fins (41) are arranged. The plate stack (50, 60) contains a refrigerant flow path (51, 61) that communicates with the heat transfer tubes (42). The refrigerant flow path (51, 61) is an example of the flow path (51, 61).

[0049] The fin (41) has a rectangular plate shape having long sides and short sides. The thickness direction of the fins (41) corresponds to the arrangement direction of the fins (41). The plurality of fins (41) are arranged at predetermined intervals in the thickness direction. These intervals form air flow paths. The fin (41) is made of an aluminum alloy.

[0050] The heat transfer tubes (42) are straight tubes. The heat transfer tubes (42) are made of an aluminum alloy. Refrigerant flow paths are formed inside the heat transfer tubes (42). The plurality of heat transfer tubes (42) extend parallel to each other to penetrate the fins (41). A right end portion, which is one of the end portions, of the heat transfer tubes (42) protrudes to the right of the rightmost one of the fins (41). The end portion of the heat transfer tube that protrudes to the right is connected to the plate stack (50, 60).

[0051] Among the left end portions of the plurality of heat transfer tubes (42), the end portions of the heat transfer tubes (42) adjacent to each other are connected to each other by a U-shaped pipe (48). The two heat transfer tubes (42) adjacent to each other and the U-shaped pipe (48) connecting them are integrated together seamlessly.

[0052] The indoor heat exchanger (40) of this embodi-

ment includes a front heat exchange portion (40A) and a rear heat exchange portion (40B). The front heat exchange portion (40A) is located close to the front side of the casing (31), and the rear heat exchange portion (40B) is located close to the rear side of the casing (31). The front heat exchange portion (40A) and the rear heat exchange portion (40B) are arranged to sandwich the indoor fan (32) in the direction orthogonal to both the top-bottom direction and the axial direction of the heat transfer tube (42), or in other words, in the front-rear direction.

[0053] The front heat exchange portion (40A) includes a front main heat exchange portion (43), a first auxiliary heat exchange portion (44), and a second auxiliary heat exchange portion (45).

[0054] The front main heat exchange portion (43) is disposed in part of the front heat exchange portion (40A) that is close to the indoor fan (32). The outer shape of the front main heat exchange portion (43) is formed in a V shape when viewed in the longitudinal direction of the heat transfer tube (42). The tip of the V shape is directed to the front side.

[0055] The front main heat exchange portion (43) includes a first front main heat exchange portion (43a) and a second front main heat exchange portion (43b). The first front main heat exchange portion (43a) is located in an upper part of the front main heat exchange portion (43), and the second front main heat exchange portion (43b) is located in a lower part of the front main heat exchange portion (43). The lower end of the first front main heat exchange portion (43a), or in other words, the lower short side of the fin (41), is in contact with the long side of the fin (41) of the second front main heat exchange portion (43b) (more precisely, the upper end portion of the long side of the fin (41)).

[0056] The first auxiliary heat exchange portion (44) is provided on the inlet side (the front side) of the first front main heat exchange portion (43a). The number of the heat transfer tubes (42) in the first auxiliary heat exchange portion (44) that is along the long side (hereinafter referred to as the number of rows) is smaller than the number of the heat transfer tubes (42) in the first front main heat exchange portion (43a). The number of the heat transfer tubes (42) in the first auxiliary heat exchange portion (44) that is along the short side (hereinafter referred to as the number of columns) is smaller than the number of the heat transfer tubes (42) in the first front main heat exchange portion (43a).

[0057] The second auxiliary heat exchange portion (45) is provided on the inlet side (the front side) of the second front main heat exchange portion (43b). The number of rows and the number of columns of the heat transfer tubes (42) in the second auxiliary heat exchange portion (45) are smaller than the number of rows and the number of columns of the heat transfer tubes (42) in the second front main heat exchange portion (43b).

[0058] The rear heat exchange portion (40B) includes a rear main heat exchange portion (46) and a third auxiliary heat exchange portion (47). The rear main heat

exchange portion (46) is disposed in part of the rear heat exchange portion (40B) that is close to the indoor fan (32). The third auxiliary heat exchange portion (47) is provided on the inlet side (the rear side) of the rear main heat exchange portion (46). The lengths of the long side and the short side of the fin (41) of the third auxiliary heat exchange portion (47) are shorter than the lengths of the long side and the short side of the fin (41) of the rear main heat exchange portion (46). The number of rows and the number of columns of the heat transfer tubes (42) in the third auxiliary heat exchange portion (47) are smaller than the number of rows and the number of columns of the heat transfer tubes (42) in the rear main heat exchange portion (46).

[0059] The plate stack (50, 60) is disposed to the right side of the heat exchanger body (B) and is adjacent to the heat exchanger body (B). The right side is an example of the first direction. Specifically, the plate stack (50, 60) is disposed to the right side of the rightmost one of the plurality of fins (41) as well as being parallel to the fin (41). The plate stack (50, 60) is connected to end portion of the heat transfer tube (42). As shown in FIG. 5, the plate stack (50, 60) includes a front plate stack (50) connected with the heat transfer tubes (42) of the front heat exchange portion (40A) and a rear plate stack (60) connected with the heat transfer tubes (42) of the rear heat exchange portion (40B). The front plate stack (50) is disposed to overlap with the front heat exchange portion (40A) in the axial direction of the heat transfer tube (42). The rear plate stack (60) is disposed to overlap with the rear heat exchange portion (40B) in the axial direction of the heat transfer tube (42). The front plate stack (50) and the rear plate stack (60) will be described in detail later.

(3-2) Indoor Expansion Valve, Gas Relay Pipe, and Liquid Relay Pipe

[0060] The indoor expansion valve (37) is an electronic expansion valve of which the opening degree is variable. The indoor expansion valve (37) is disposed to the right of the plate stack (50, 60). The indoor expansion valve (37) is connected to the front plate stack (50) through a first internal pipe (38), and is connected to the rear plate stack (60) through a second internal pipe (39). The first internal pipe (38) and the second internal pipe (39) are examples of the refrigerant pipes that connect the front refrigerant flow path (51) of the front plate stack (50) and the rear refrigerant flow path (61) of the rear plate stack (60) together.

(4) Plate Stack

[0061] The gas relay pipe (12a) transfers the refrigerant gas compressed by the compressor (21) to the indoor heat exchanger (40). The gas relay pipe (12a) is an example of the gas pipe (12a). One end of the gas relay pipe (12a) is connected to the rear plate stack (60). The other end of the gas relay pipe (12a) is connected to the

first connection pipe (12) via a joint. One end of the liquid relay pipe (13a) is connected to the front plate stack (50). The other end of the liquid relay pipe (13a) is connected to the second connection pipe (13) via a joint.

[0062] The plate stack (50, 60) contains the flow path (51, 61) that communicates with the heat transfer tubes (42). The plate stack (50, 60) includes a plurality of plates (52, 62) stacked in the right direction. The plate stack (50, 60) of this embodiment will be described in detail with reference to FIGS. 5 to 14.

(4-1) Front Plate Stack

[0063] The front plate stack (50) includes the front refrigerant flow path (51) formed in the front plate stack (50); a plurality of front connection pipes (53) connecting the plurality of heat transfer tubes (42) of the front heat exchange portion (40A) and the front refrigerant flow paths (51); a front relay portion (54) connected with the first internal pipe (38); and a liquid end portion (55) communicating with the second connection pipe (13) via the liquid relay pipe (13a). The front plate stack (50) will be described below as the plate stack (50, 60) of the present disclosure.

(4-1-1) First Plate Portion and Second Plate Portion

[0064] As shown in FIGS. 5, 6, and 8, the front plate stack (50) includes a front first plate portion (50A) and a front second plate portion (50B). The front first plate portion (50A) includes three front plates (52) stacked together. The front second plate portion (50B) includes two front plates (52) stacked together. The front first plate portion (50A) forms the first plate portion (50A, 60A). The front second plate portion (50B) forms the second plate portion (50B, 60B) of the present disclosure.

[0065] The shape of the outer edge of each front plate (52) of the front first plate portion (50A) is the same. The three front plates (52) of the front first plate portion (50A) are defined as a first plate (521), a second plate (522), and a third plate (523) in order from the left. The first plate (521) is connected with the front connection pipes (53) extending toward the right end portion of the heat transfer tubes (42). The inside of the front connection pipes (53) forms the front refrigerant flow path (51) described later.

[0066] The shape of the outer edge of each front plate (52) of the front second plate portion (50B) is the same. The two front plates (52) of the front second plate portion (50B) are defined as a fourth plate (524) and a fifth plate (525) in order from the left.

[0067] The shape of each front plate (521, 522, 523) of the front first plate portion (50A) is different from the shape of each front plate (524, 525) of the front second plate portion (50B). Specifically, the shape of the outer edge of the front first plate portion (50A) is different from the shape of the outer edge of the front second plate portion (50B).

[0068] The front second plate portion (50B) is disposed

on the surface of the front first plate portion (50A) that is opposite to the surface facing the heat exchanger body (B). Specifically, the front second plate portion (50B) is disposed on the right surface of the front first plate portion (50A).

[0069] The front plates (521 to 525) of the front first plate portion (50A) and the front second plate portion (50B) are made of the same material as those of the heat transfer tube (42) and the front connection pipe (53). In this embodiment, the front plates (521 to 525) of the front first plate portion (50A) and the front second plate portion (50B) are made of an aluminum alloy.

[0070] When the front plate stack (50) is viewed from the right direction, the area of the right surface of the front first plate portion (50A) is larger than the area of right surface of the front second plate portion (50B). Accordingly, when the front plate stack (50) is viewed from the right direction, a first region (S1) in which the front first plate portion (50A) and the front second plate portion (50B) do not overlap with each other and a second region (S2) in which the front first plate portion (50A) and the front second plate portion (50B) overlap with each other are formed.

[0071] When the front plate stack (50) is viewed from the right direction, the area of part of the front first plate portion (50A) that does not overlap with the front second plate portion (50B) is smaller than the area of part of the front first plate portion (50A) that overlaps with the front second plate portion (50B). In other words, the area of the first region (S1) is smaller than the area of the second region (S2).

[0072] As shown in FIG. 8, the front plate stack (50) has a step portion (X). The step portion (X) is formed by the front first plate portion (50A) and the front second plate portion (50B). The step portion (X) is formed in a peripheral portion of the second surface (502) of the front plate stack (50) that is opposite to the first surface (501) that faces the heat exchanger body (B). The first surface (501) is the left surface (501) of the front plate stack (50). The second surface (502) is the right surface (502) of the front plate stack (50). In other words, the step portion (X) is formed in the peripheral portion of the right surface (502) of the front plate stack (50).

[0073] The step portion (X) is a portion in which the first region (S1) is formed when the front plate stack (50) is viewed from the right direction. Specifically, the step portion (X) is formed by the first region (S1) and a first circumferential surface (P1) of the front second plate portion (50B). The first circumferential surface (P1) is part of a circumferential surface between the right surface and the left surface of the front second plate portion (50B) that is in contact with the first region (S1).

[0074] The step portion (X) is formed in a lower portion of the front plate stack (50) when the front plate stack (50) is viewed from the right. Specifically, the step portion (X) is formed in part of the front plate stack (50) that is below the central height of the front plate stack (50). In other words, in the air-conditioning indoor unit (30) of this

embodiment, the inlet port (33), the front heat exchange portion (40A), and the outlet port (34) are disposed in order from the top (see FIG. 3), and therefore the step portion (X) is located close to the outlet port (34) in the front plate stack (50).

[0075] In this manner, the first region (S1) is formed in a lower portion of the front first plate portion (50A). Part of the circumferential surface of the front plate stack (50) in which the front first plate portion (50A) and the front second plate portion (50B) overlap with each other is a flush surface. In other words, when the front plate stack (50) is viewed from the left direction, there is no region in which the front first plate portion (50A) and the front second plate portion (50B) do not overlap with each other.

[0076] The first region (S1) only needs to be formed in a lower portion of the front first plate portion (50A) when the front plate stack (50) is viewed from the right direction, and the shape of the first region (S1) is not limited.

[0077] The front plate stack (50) is subjected to anti-corrosion treatment. Specifically, in the front plate stack (50), the entire surface of the left surface (501) and the second region (S2) of the right surface (502) are subjected to anti-corrosion treatment. For the anti-corrosion treatment of this embodiment, alloy plates with a sacrificial anti-corrosion effect are provided on the entire surface of the left surface (501) and the second region (S2) of the right surface (502) of the front plate stack (50). The alloy plates are made of, for example, a clad material with a relatively high amount of metal in which a core material is aluminum and a skin material is zinc. The first region (S1) and the first circumferential surface (P1) do not require the anti-corrosion treatment. This is because the third plate (523) forming the first region (S1) is one of intermediate plates (522 to 524) each having a large thickness. Similarly, this is because the fourth plate (524) forming part of the first circumferential surface (P1) is also one of the intermediate plates (522 to 524) each having a large thickness.

[0078] Next, the thicknesses of each front plate (521 to 525) of the front plate stack (50) will be described. In the front plate stack (50), the front plate of the front first plate portion (50A) that is closest to the heat exchanger body (B) is defined as a first end plate (521), and the front plate of the front second plate portion (50B) that is most distant from the heat exchanger body (B) is defined as a second end plate (525). In this embodiment, the first end plate (521) is the first plate (521) located at the left end of the front first plate portion (50A), and the second end plate (525) is the fifth plate (525) located at the right end of the front second plate portion (50B).

[0079] In the front plate stack (50), the plates between the first end plate (521) and the second end plate (525) are defined as the intermediate plates (522 to 524). In this embodiment, the intermediate plates (522 to 524) include the second plate (522), the third plate (523), and the fourth plate (524).

[0080] The thickness of each of the intermediate plates (522 to 524) is greater than the thickness of each of the

first end plate (521) and the second end plate (525). In this embodiment, the thickness of each of the intermediate plates (522 to 524) is 3.0 mm, and the thickness of each of the first end plate (521) and the second end plate (525) is 1.5 mm.

(4-1-2) Configuration of Refrigerant Flow Path

[0081] A configuration of the front refrigerant flow path (51) of the plate stack (50) of this embodiment will be described. The front refrigerant flow path (51) forms the refrigerant flow path (51, 61) of the present disclosure. An example of the front refrigerant flow path (51) will be described below.

[0082] As shown in FIGS. 9 and 10, the front refrigerant flow path (51) has first flow paths (51A) provided in the front first plate portion (50A), and second flow paths (51B) provided between the front first plate portion (50A) and the front second plate portion (50B). The first flow paths (51A) and the second flow paths (51B) are provided in portions that overlap with the front first plate portion (50A) and the front second plate portion (50B).

[0083] The first flow path (51A) is formed by two first through holes (71) penetrating the first plate (521) in the thickness direction located at the left end of the front first plate portion (50A); a first groove portion (81) formed in the second plate (522) located in the middle; and the third plate (523) located at the right end. One end of the first through hole (71) communicates with one end of the heat transfer tube (42). The other end of the first through hole (71) is connected to the first groove portion (81).

[0084] The first groove portion (81) is a long hole formed along the surface of the first plate (521). One end of the first groove portion (81) is connected to one of the first through holes (71), and the other end of the first groove portion (81) is connected to the other one of the first through holes (71). The first groove portion (81) is closed in the left-right direction by the first plate (521) located at the left end and the third plate (523) located at the right end.

[0085] The second flow path (51B) is formed by second through holes (72) penetrating the front first plate portion (50A) in the thickness direction; a second groove portion (82) formed in the fourth plate (524) located at the left end of the front second plate portion (50B); and the fifth plate (525) located at the right end of the front second plate portion (50B). One end of the second through hole (72) communicates with one end of the heat transfer tube (42). The other end of the second through hole (72) is connected to the second groove portion (82). The second groove portion (82) is a long hole formed along the surface of the second plate (522). One end of the second groove portion (82) is connected to one of the second through holes (72), and the other end of the second groove portion (82) is connected to the other one of the second through holes (72). The second groove portion (82) is closed in the left-right direction by the third plate (523) and the fifth plate (525).

[0086] As shown in FIG. 11, the first groove portion (81) and the second groove portion (82) are disposed to intersect each other when the front plate stack (50) is viewed from the right. Accordingly, the second flow path (51B) intersects the first flow path (51A). Specifically, the second flow path (51B) is formed to cross the first flow path (51A) in the right direction.

[0087] As shown in FIG. 12, the front refrigerant flow path (51) has a third flow path (51C) formed in part of the front first plate portion (50A) that does not overlap with the front second plate portion (50B). Specifically, the third flow path (51C) is formed in the first region (S1) when the front plate stack (50) is viewed from the right direction. The third flow path (51C) is formed two third through holes (73) penetrating the first plate (521) of the front first plate portion (50A) in the thickness direction; a third groove portion (83) formed in the second plate (522); and the third plate (523). One end of the third through hole (73) communicates with one end of the heat transfer tube (42). The other end of the third through hole (73) is connected to the third groove portion (83). The third groove portion (83) is a long hole formed along the surface of the second plate (522). One end of the third groove portion (83) is connected to one of the third through holes (73), and the other end of the third groove portion (83) is connected to the other one of the third through holes (73). The third groove portion (83) is closed in the left-right direction by the first plate (521) and the third plate (523).

(4-2) Rear Plate Stack

[0088] As shown in FIG. 6, the rear plate stack (60) includes the rear refrigerant flow path (61) formed inside the rear plate stack (60); a plurality of rear connection pipes (not shown) connecting the plurality of heat transfer tubes (42) of the rear heat exchange portion (40B) and the rear refrigerant flow path (61); a rear relay portion (64) connected with the second internal pipe (39); and a gas end portion (65) communicating with the first connection pipe (12) via the gas relay pipe (12a). The rear refrigerant flow path (61) forms the refrigerant flow path (51, 61) of the present disclosure.

[0089] The rear plate stack (60) is different from the front plate stack (50) in terms of the shape of the outer edge of the plate when viewed from the right direction and in terms of the rear refrigerant flow path (61) in the rear plate stack (60). The rear plate stack (60) is a thick plate member that includes five rear plates (62) each formed in the same shape and stacked together. The rear plates (62) are stacked in the right direction.

[0090] The five rear plates (62) forming the rear plate stack (60) include a sixth plate (621), a seventh plate (622), an eighth plate (623), a ninth plate (624), and a tenth plate (625) arranged in order from the left (see FIG. 5).

[0091] As in the front plate stack (50), the sixth plate (621) closest to the heat exchange portion (B) is defined

as a first end plate (621), the tenth plate (625) most distant from the heat exchange portion (B) is defined as a second end plate (625), and the seventh to ninth plates (622 to 624) disposed between the sixth plate (621) and the tenth plate (625) are defined as intermediate plates (622 to 624). In this case, the thickness of each of the intermediate plates (622 to 624) is greater than the thickness of each of the sixth plate (621) and the tenth plate (625).

[0092] The rear plate stack (60) is subjected to anti-corrosion treatment in the same way as the front plate stack (50) is. Specifically, the alloy plates are attached to the left surface (601) and the right surface (602) of the rear plate stack (60). The left surface (601) and the right surface (602) of the rear plate stack (60) correspond to the first surface (601) and the second surface (602) of the present disclosure, respectively.

[0093] The rear relay portion (64) is a circular pipe. As shown in FIG. 6, the rear relay portion (64) is disposed on the right surface of the rear plate stack (60). In other words, in the rear plate stack (60), the second internal pipe (39) that connects the front refrigerant flow path (51) of the front plate stack (50) and the rear refrigerant flow path (61) of the rear plate stack (60) are connected to the right surface of the rear plate stack (60). The gas end portion (65) is a circular pipe. The gas end portion (65) is located on the right surface of the rear plate stack (60).

(5) Arrangement of Partition Plate and Electric Component Box

[0094] As shown in FIG. 8, the air-conditioning indoor unit (30) of this embodiment is provided with partition plate (100) in the casing (31). The partition plate (100) is a plate member that separates the indoor heat exchanger (40) and an electric component box (200).

[0095] The electric component box (200) is disposed to the right side of the indoor heat exchanger (40). The electric component box (200) faces the step portion (X) in the right direction. The partition plate (100) is disposed between the indoor heat exchanger (40) and the electric component box (200). The electric component box (200) is an example of the second component (200). The electric component box (200) houses electric components including a predetermined substrate.

[0096] The partition plate (100) extends in the top-bottom direction between the indoor heat exchanger (40) and the electric component box (200). The partition plate (100) has a first plate portion (100A), a second plate portion (100B), and a third plate portion (100C). The lower end of the first plate portion (100A) is connected with the second plate portion (100B), and the lower end of the second plate portion (100B) is connected with the third plate portion (100C). The partition plate (100) has a recessed portion (101).

[0097] The first plate portion (100A) extends substantially in the vertical direction. The height of the lower end of the first plate portion (100A) is at the height of the upper

end of the step portion (X). In other words, the height of the lower end of the first plate portion (100A) is at the height of the lower end of the front second plate portion (50B). The second plate portion (100B) extends to the left from the lower end of the first plate portion (100A). In other words, the second plate portion (100B) extends to the left from the lower end of the first plate portion (100A) to approach the space formed by the step portion (X). Here, the space formed by the step portion (X) refers to a space that is not formed in the front plate stack (50) if the front first plate portion (50A) and the front second plate portion (50B) have the same shape and then the step portion (X) is not formed, compared with the front plate stack (50) of this embodiment. The lower end of the second plate portion (100B) extends to the lower end of the front plate stack (50). The third plate portion (100C) extends downward substantially in the vertical direction from the lower end of the second plate portion (100B). The recessed portion (101) is a space formed by the second plate portion (100B) and the third plate portion (100C).

[0098] The electric component box (200) is disposed near the partition plate (100). The electric component box (200) is disposed to the right side of the second plate portion (100B). The electric component box (200) is disposed as close to the second plate portion (100B) as possible. In this state, the upper end of the electric component box (200) is located immediately below the lower end of the first plate portion (100A). In this manner, the electric component box can be disposed more leftward than if the partition plate (100) does not have the second plate portion (100B) but has only the first plate portion (100A).

(6) Features

(6-1) First Feature

[0099] Among the plate stacks (50, 60) of the indoor heat exchanger (40) of this embodiment, the front plate stack (50) has the front first plate portion (50A) adjacent to the heat exchanger body (B) in the right direction (the first direction) and having three plates (52), and the front second plate portion (50B) having two plates (52) and disposed on the surface of the front first plate portion (50A) that is opposite to the surface facing the indoor heat exchanger (40). The front plate stack (50) has the step portion (X) in the peripheral portion of the second surface (502) opposite to the first surface (501) facing the heat exchange portion (B). The step portion (X) is formed by the front first plate portion (50A) and the front second plate portion (50B).

[0100] By providing the step portion (X) in the front plate stack (50) in this manner, it is possible to form a space at a position facing the step portion (X). By using this space effectively, such as disposing a predetermined component in this space, it is possible to downsize the air-conditioning indoor unit (30).

(6-2) Second Feature

[0101] The air-conditioning indoor unit (30) of this embodiment further includes the electric component box (200) (the second component) adjacent to the indoor heat exchanger (40) and facing the step portion (X) in the right direction (the first direction); and the partition plate (100) disposed between the indoor heat exchanger (40) and the electric component box (200). The partition plate (100) has the recessed portion (101) formed along the shape of the step portion (X).

[0102] Since the partition plate (100) has the recessed portion (101) that is recessed toward the step portion (X), it is possible to effectively use the space formed by the recessed portion (101). By disposing the electric component box (200) in the space formed by the recessed portion (101), it is possible to shorten the length of the casing (31) in the left-right direction and then it is possible to downsize the air-conditioning indoor unit (30).

(6-3) Third Feature

[0103] In this embodiment, the second to fourth plates (522 to 524) of the front plate stack (50) are thicker than the first plate (521) and the fifth plate (525), and the seventh to ninth plates (622 to 624) of the rear plate stack (60) are thicker than the sixth plate (621) and the tenth plate (625).

[0104] By increasing the thickness of each of the intermediate plates (522 to 524, 622 to 624) in this manner, it is possible to increase the area or the inner diameter of the cross section of the refrigerant flow path (51, 61) formed in the plate stack (50, 60). Accordingly, it is possible to reduce an increase in pressure loss of the refrigerant flowing through the refrigerant flow path (51, 61).

(6-4) Fourth Feature

[0105] In this embodiment, the left surface (501) and the second region (S2) of the right surface (502) of the front plate stack (50) as well as the left surface (601) and the right surface (602) of the rear plate stack (60) are subjected to the anti-corrosion treatment. Accordingly, it is possible to reduce electrolytic corrosion of the side surface of the plate stack (50, 60) caused by dew condensation or others, and then it is possible to increase the durability of the indoor heat exchanger (40).

(6-5) Fifth Feature

[0106] In the front plate stack (50) of this embodiment, when the front plate stack (50) is viewed from the right direction, the area of part of the front first plate portion (50A) that does not overlap with the front second plate portion (50B) is smaller than the area of part of the front first plate portion (50A) that overlaps with the front second plate portion (50B).

[0107] In the front plate stack (50), the portion in which

the front first plate portion (50A) and the front second plate portion (50B) are stacked together is thicker than the portion in which only the front first plate portion (50A) is disposed, and therefore it is possible to secure the number of the front refrigerant flow paths (51) accordingly. In other words, since the area of the first region (S1) is smaller than the area of the second region (S2), it is possible to secure the number of the front refrigerant flow paths (51) in the front plate stack (50), and then it is possible to promote the indoor heat exchanger (40) exchanging heat between air and a refrigerant.

(6-6) Sixth Feature

[0108] In this embodiment, the front refrigerant flow path (51) formed in the front plate stack (50) has the first flow paths (51A) formed only in the front first plate portion (50A), and the second flow path (51B) provided between the front first plate portion (50A) and the front second plate portion (50B). The first flow path (51A) and the second flow path (51B) are formed to intersect each other.

[0109] By designing the front refrigerant flow path (51) so that the first flow path (51A) and the second flow path (51B) intersect each other, it is possible to create more patterns of the front refrigerant flow path (51) in the front plate stack (50). On the other hand, by designing the front plate stack (50) where the portion in which only the first flow path (51A) is provided and the first flow path (51A) and the second flow path (51B) do not intersect with each other is formed as the step portion (X), it is possible to form a space that can be used effectively, and also it is possible to reduce an unnecessary part of the plate in which the front refrigerant flow path (51) is not provided.

(7) Variation

[0110] An air-conditioning indoor unit (30) of a variation will be described. The configurations different from those of the air-conditioning indoor unit (30) of the embodiment will be described below.

[0111] A rear plate stack (60) of this variation has the same configuration as that of the front plate stack (50) of the embodiment. In other words, the rear plate stack (60) has a rear first plate portion (60A) and a rear second plate portion (60B). The rear first plate portion (60A) and the rear second plate portion (60B) are included in the first plate portion (50A, 60A) and the second plate portion (50B, 60B) of the present disclosure. The rear plate stack (60) forms the plate stack (50, 60) of the present disclosure. The rear first plate portion (60A) and the rear second plate portion (60B) have the same configurations as those of the front first plate portion (50A) and the front second plate portion (50B) of the front plate stack (50) of the embodiment, respectively, and thus the description thereof will be omitted.

[0112] As shown in FIGS. 13 and 14, the gas end portion (65) formed in the rear plate stack (60) is con-

nected to the rear refrigerant flow path (61) formed in part of the rear plate stack (60) in which the rear first plate portion (60A) and the rear second plate portion (60B) overlap with each other. Specifically, the gas end portion (65) is disposed in the second region (S2). More specifically, the gas end portion (65) is provided at one end of the rear refrigerant flow path (61) formed between the rear first plate portion (60A) and the rear second plate portion (60B).

[0113] Accordingly, the gas refrigerant flowing from the gas relay pipe (12a) through the gas end portion (65) flows from the rear second plate portion (60B) to the rear first plate portion (60A) of the rear plate stack (60). Here, in the rear plate stack (60), among the rear refrigerant flow paths (61) extending in the stack direction, one formed between the rear first plate portion (60A) and the rear second plate portion (60B) is longer in length than one formed only in the rear first plate portion (60A). In this manner, in this variation, the gas end portion (65) is disposed in the second region (S2), and therefore it is possible to reduce more pressure loss of the refrigerant gas passing through the rear refrigerant flow paths (61) in the rear plate stack (60) than if the gas end portion (65) is disposed in the first region (S1).

(8) Other Embodiments

[0114] The following configurations may be applied to the air-conditioning indoor units (30) of the above-described embodiment and variation.

[0115] As shown in FIG. 15, at least part of the functional component (300) disposed in the casing (31) only needs to face the step portion (X) in the right direction. In this case, the partition plate (100) does not need to be provided. Further, the functional component (300) only needs to be a component necessary for the air-conditioning indoor unit (30) and may be an electric component box. The functional component (300) is an example of the first component (300). While in this manner a certain distance is formed between the functional component (300) and the front plate stack (50) adjacent to each other, the functional component (300) can be disposed closer to the front plate stack (50) by effectively using the space formed by the step portion (X). In other words, the functional component (300) can be disposed more leftward, and therefore it is possible to make the casing (31) compact in the left-right direction.

[0116] As shown in FIG. 16, when the plate stack (50, 60) is viewed from the right direction, the functional component (300) disposed in the casing (31) is closer to the step portion (X) than the end portion of the front second plate portion (50B) forming the step portion (X). Specifically, since the step portion (X) is formed in the lower portion of the front plate stack (50), the height of the end portion of the front second plate portion (50B) forming the step portion (X) is located at the lower end of the front second plate portion (50B). Therefore, the functional component (300) adjacent to the right side of the

front plate stack (50) is disposed below the lower end of the front second plate portion (50B). More precisely, the functional component (300) is located to face the step portion (X) in the right direction and is disposed below the lower end of the front second plate portion (50B). The functional component (300) is an example of the first component (300).

[0117] In this manner, the height of the upper end of the functional component (300) is lower than the lower end of the front second plate portion (50B), and therefore part of the functional component (300) can be disposed in the space formed by the step portion (X). In other words, at least part of the functional component (300) can be disposed inside the step portion (X). In other words, while the functional component (300) is disposed at a predetermined distance from the front plate stack (50), the functional component (300) can be disposed closer to the front plate stack (50) when being disposed below the lower end of the front second plate portion (50B) than when being disposed above the same. Accordingly, it is possible to shorten the casing (31) in the left-right direction, and then it is possible to make the air-conditioning indoor unit (30) compact. Also in this case, the partition plate (100) does not need to be provided. Further, the functional component (300) only needs to be a component necessary for the air-conditioning indoor unit (30) and may be an electric component box.

[0118] As shown in FIG. 17, at least part of the functional component (300) disposed in the casing (31) is disposed in the step portion (X). Specifically, at least part of the functional component (300) is disposed in the space formed by the step portion (X). In other words, when the air-conditioning indoor unit (30) is viewed from above, at least part of the functional component (300) is disposed in the space and close to the plate stack (50, 60), and therefore the casing (31) can be further shortened in the left-right direction than if the functional component (300) is disposed outside the step portion (X). Also in this case, the partition plate (100) does not need to be provided. The functional component (300) only needs to be a component necessary for the air-conditioning indoor unit (30) and may be an electric component box.

[0119] As shown in FIG. 18, a U-shaped connection pipe (400) may be provided in the step portion (X) of the front plate stack (50). The U-shaped connection pipe (400) communicates with the front refrigerant flow path (51) in the front plate stack (50). Specifically, the U-shaped connection pipe (400) is disposed in the first region (S1), and both ends of the U-shaped connection pipe are connected to the first region (S1). The U-shaped connection pipe (400) is provided with, for example, a temperature sensor (not shown) for measuring the temperature of a refrigerant flowing through the front refrigerant flow path (51). By disposing the U-shaped connection pipe (400) in the step portion (X) in this manner, the length of the indoor heat exchanger (40) can be more reduced in the left-right direction than if the U-shaped connection pipe (400) is disposed in the second region

(S2).

[0120] In the embodiment, the indoor heat exchanger (40) may be configured so that if the indoor heat exchanger (40) functions as a radiator, a refrigerant in a supercooled region flows in the third flow path (51C) formed in the front plate stack (50). In this case, the liquid end portion (55) may be disposed in the first region (S1) so as to communicate with the third flow path (51C). The third flow path (51C), unlike the first flow path (51A) and the second flow path (51B), is not configured to intersect the other front refrigerant flow path (51), and therefore can be disposed away from the other front refrigerant flow path (51). In other words, the third flow path (51C) is not disposed near the other front refrigerant flow path (51), and therefore it is possible to reduce heat exchange between the refrigerant in the supercooled region flowing through the third flow path (51C) and the refrigerant flowing through the other front refrigerant flow path (51).

[0121] The indoor heat exchanger (40) may be disposed in the air passage (P) communicating with the inlet port (33) and the outlet port (34) each provided in the casing (31), and the step portion (X) may be formed on part of the plate stack (50, 60) that is on a downstream side of the air flow when viewed from the right direction.

[0122] For example, in summer, if the indoor heat exchanger (40) functions as an evaporator, the air passage (P) has a temperature gradient in which the temperature decreases from the inlet port (33) to the outlet port (34). In this air passage (P), the air temperature is higher on the upstream side, and therefore the load of heat exchange is greater in part of the indoor heat exchanger (40) that is located on an upstream side of the air flow than on a downstream side of the same. Therefore, by providing the step portion (X) on a downstream part of the plate stack (50, 60) and increasing the thickness of an upstream part of the plate stack (50, 60), it is possible to secure a sufficient number of refrigerant flow paths (51, 61) on the upstream part of the plate stack (50, 60). Accordingly, it is possible to increase the flow rate of the refrigerant flowing through the upper part of the heat exchanger body (B), and then it is possible to promote heat exchange between the refrigerant and the air in the upper part of the indoor heat exchanger (40). As a result, it is possible to reduce the load of heat exchange in the upper part of the indoor heat exchanger (40), and also it is possible to increase the efficiency of heat exchange with the air flowing through the air passage (P), and therefore, it is possible to adjust the air temperature in the indoor space to the target temperature immediately.

[0123] In the embodiment, a liquid end portion (55) may be formed in the step portion (X) of the front plate stack (50). Specifically, the liquid end portion (55) may be disposed in the first region (S1) of the front plate stack (50). Accordingly, it is possible to reduce rightward protrusion of the liquid relay pipe (13a) that extends from the liquid end portion (55) in the right direction, and then it is possible to reduce the length of the indoor heat exchanger (40) in the left-right direction. Accordingly, it is pos-

sible to make the air-conditioning indoor unit (30) compact.

[0124] In the embodiment, a front relay portion (54) may be formed in the step portion (X) of the front plate stack (50). Specifically, the front relay portion (54) may be disposed in the first region (S1) of the front plate stack (50). Accordingly, it is possible to reduce rightward protrusion of the first internal pipe (38) that extends from the front relay portion (54) in the right direction, and then it is possible to reduce the length of the indoor heat exchanger (40) in the left-right direction. Accordingly, it is possible to make the air-conditioning indoor unit (30) compact.

[0125] In the variation, a rear relay portion (64) may be formed in the step portion (X) of the rear plate stack (60). Specifically, the rear relay portion (64) may be disposed in the first region (S1) of the rear plate stack (60). Accordingly, it is possible to reduce rightward protrusion of the second internal pipe (39) that extends from the rear relay portion (64) in the right direction, and then it is possible to reduce the length of the indoor heat exchanger (40) in the left-right direction. Accordingly, it is possible to make the air-conditioning indoor unit (30) compact.

[0126] In the variation, the rear plate stack (60) may include rear refrigerant flow paths (61) that correspond to the first flow path (51A) and the second flow path (51B) of the front plate stack (50) of the embodiment. In other words, the rear plate stack (60) may have the plurality of rear refrigerant flow paths (61) that intersect each other.

[0127] In the variation, the rear plate stack (60) may include a rear refrigerant flow path (61) that corresponds to the third flow path (51C) of the embodiment. In other words, the rear refrigerant flow path (61) may be formed in part of the rear first plate portion (60A) in which the rear first plate portion (60A) and the rear second plate portion (60B) do not overlap with each other. This rear refrigerant flow path (61) is referred to as a rear third flow path. The indoor heat exchanger (40) is configured so that a refrigerant in a superheated region flows in the rear third flow path if the indoor heat exchanger (40) functions as an evaporator. In this case, the gas end portion (65) may be provided in the first region (S1) so that the gas end portion (65) and the rear third flow path communicate with each other. The rear third flow path can be disposed away from the other rear refrigerant flow path (61), and therefore it is possible to prevent a refrigerant in a superheated region from exchanging heat with a refrigerant in the other rear refrigerant flow path (61).

[0128] In the embodiment and variation, the first plate portion (50A, 60A) or the second plate portion (50B, 60B) may have one or more plates. In other words, the first plate portion (50A, 60A) may have three or more plates, and the second plate portion (50B, 60B) may have two or more plates.

[0129] Similarly to the third flow path (51C), the front refrigerant flow path (51) formed only in the front first plate portion (50A) may be formed to extend to the right end of the front first plate portion (50A). Specifically, the third

groove portion (83) only needs to be formed in a plate adjacent to the plate disposed at the right end of the front first plate portion (50A) (the end in the first direction).

[0130] In addition to the first plate portion (50A, 60A) and the second plate portion (50B, 60B), the plate stack (50, 60) may include a third plate portion different from the first plate portion (50A, 60A) and the second plate portion (60B, 50B). The third plate portion may be stacked at the right end of the second plate portion (50B, 60B), and another step portion may be newly formed by the second plate portion (50B, 60B) and the third plate portion when viewed from the right direction.

[0131] In the embodiment and variation, instead of the alloy plates with the sacrificial anti-corrosion effect, an anti-corrosion or anti-rust coating material may be applied to the plate stack (50, 60). In this case, the coating material is an epoxy resin coating material. The coating material only needs to be applied to form a coating film on a front surface including the right surface (502) and the left surface (501) of the plate stack (50, 60).

[0132] The heat transfer tube (42), the plate stack (50, 60), or the refrigerant pipe (the connection pipe (53), the U-shaped connection pipe (400), or others) may be made of a copper alloy or stainless steel. If the heat transfer tube (42) is made of a copper alloy, the plate stack (50, 60) and the refrigerant pipe is also made of a copper alloy in one preferred embodiment.

[0133] While the embodiment and variation thereof have been described above, it will be understood that various changes in form and details may be made without departing from the spirit and scope of the claims. The foregoing embodiment and variation thereof may be combined and replaced with each other without deteriorating the intended functions of the present disclosure. The expressions of "first," "second," ... described above are used to distinguish the terms to which these expressions are given, and do not limit the number and order of the terms.

INDUSTRIAL APPLICABILITY

[0134] As described above, the present disclosure is useful for an indoor heat exchanger and an air-conditioning indoor unit.

DESCRIPTION OF REFERENCE CHARACTERS

[0135]

12a	Gas Relay Pipe (Gas Pipe)
30	Air-Conditioning Indoor Unit
31	Casing
33	Inlet Port
40	Indoor Heat Exchanger
41	Fin
42	Heat Transfer Tube
50, 60	Plate Stack
50A	First Plate Portion

50B	Second Plate Portion	
51, 61	Flow Path (Refrigerant Flow Path)	
51A	First Flow Path	
51B	Second Flow Path	
51C	Third Flow Path	5
52, 62	Plate	
100	Partition Plate	
101	Recessed Portion	
200	Second Component (Electric Component Box)	10
300	Functional Component (First Component)	
521	First End Plate	
522	Second Plate	
522 to 524	Intermediate Plate	15
525	Fifth Plate (Second End Plate)	
B	Heat Exchanger Body (Heat Exchange Portion)	
P	Air Passage	
X	Step Portion	20

Claims

1. An indoor heat exchanger comprising:

a heat exchange portion (B) including a plurality of fins (41) and a plurality of heat transfer tubes (42) penetrating the plurality of fins (41); and a plate stack (50, 60) in which a flow path (51, 61) communicating with the heat transfer tube (42) is provided and in which a plurality of plates (52, 62) are stacked in a first direction in which the heat transfer tube (42) extends, wherein the plate stack (50, 60)

is adjacent to the heat exchange portion (B) in the first direction, and includes

a first plate portion (50A, 60A) having one or more of the plates (52, 62), and a second plate portion (50B, 60B) which has one or more of the plates (52, 62) that is different in shape from the plates (52, 62) of the first plate portion (50A, 60A) and which is disposed on a surface of the first plate portion (50A, 60A) that is opposite to a surface facing the heat exchange portion (B),

the plate stack (50, 60) has a step portion (X) in a peripheral portion of a second surface (502, 602) opposite to a first surface (501, 601) facing the heat exchange portion (B), and the step portion (X) is formed by the first plate portion (50A, 60A) and the second plate portion (50B, 60B).

2. An air-conditioning indoor unit comprising:

the indoor heat exchanger of claim 1; a casing (31) configured to house the indoor heat exchanger; and a first component (300) disposed in the casing (31), wherein at least part of the first component (300) faces the step portion (X) in the first direction.

3. The air-conditioning indoor unit of claim 2, wherein

when the plate stack (50, 60) is viewed from the first direction, the first component (300) is disposed closer to the step portion (X) than an end portion of the second plate portion (50B, 60B) forming the step portion (X).

4. The air-conditioning indoor unit of claim 2, wherein at least part of the first component (300) is disposed inside the step portion (X).

5. The air-conditioning indoor unit of claim 2, further comprising:

a second component (200) adjacent to an indoor heat exchanger (40) and facing the step portion (X) in the first direction; and a partition plate (100) disposed between the indoor heat exchanger (40) and the second component (200), wherein the partition plate (100) has a recessed portion (101) formed along a shape of the step portion (X).

6. The air-conditioning indoor unit of any one of claims 2 to 5, wherein

the casing (31) has an air passage (P) through which air flows from an inlet port (33) toward an outlet port (34) in the casing (31), the indoor heat exchanger (40) is disposed in the air passage (P), and the step portion (X) is formed on part of the plate stack (50, 60) that is on a downstream side of air flow when viewed from the first direction.

7. The air-conditioning indoor unit of any one of claims 2 to 6, wherein

the plate stack (50, 60) has the plates (52, 62) including three or more plates (52, 62), and in the plate stack (50, 60),

one of the plates (52, 62) of the first plate portion (50A, 60A) that is closest to the heat exchange portion (B) is defined as a first

- end plate (521, 621),
 one of the plates (52, 62) of the second plate
 portion (50B, 60B) that is most distant from
 the heat exchange portion (B) is defined as
 a second end plate (525, 625), and
 the plate (52, 62) disposed between the first
 end plate (521, 621) and the second end
 plate (525, 625) is defined as an intermedi-
 ate plate (522 to 524, 622 to 624),
- the flow path (51, 61) runs through the inter-
 mediate plate (522 to 524, 622 to 624), and
 a thickness of the intermediate plate (522 to 524,
 622 to 624) is greater than a thickness of the first
 end plate (521, 621) and the second end plate
 (525, 625).
8. The air-conditioning indoor unit of any one of claims 2
 to 7, wherein
 in the plate stack (50, 60), at least part of the first
 surface (501, 601) and the second surface (502,
 602) is subjected to anti-corrosion treatment.
9. The air-conditioning indoor unit of any one of claims 2
 to 8, wherein
 when the plate stack (50, 60) is viewed from the first
 direction, an area of part of the first plate portion
 (50A, 60A) that does not overlap with the second
 plate portion (50B, 60B) is smaller than an area of
 part of the first plate portion (50A, 60A) that overlaps
 with the second plate portion (50B, 60B).
10. The air-conditioning indoor unit of any one of claims 2
 to 9, wherein
 the flow path (51, 61) includes
 a first flow path (51A) provided in the first
 plate portion (50A, 60A), and
 a second flow path (51B) provided between
 the first plate portion (50A, 60A) and the
 second plate portion (50B, 60B), and
 the second flow path (51B) is formed to intersect
 the first flow path (51A).
11. The air-conditioning indoor unit of any one of claims 2
 to 10, wherein
 the flow path (51, 61) has a third flow path (51C)
 formed in part of the first plate portion (50A, 60A)
 that does not overlap with the second plate
 portion (50B, 60B) when the plate stack (50,
 60) is viewed from the first direction, and
 in the third flow path (51C),
 a refrigerant in a superheated region flows if
 the indoor heat exchanger functions as an
- evaporator, and
 a refrigerant in a supercooled region flows if
 the indoor heat exchanger functions as a
 radiator.
12. The air-conditioning indoor unit of any one of claims 2
 to 11, further comprising:
 a gas pipe (12a) configured to transfer com-
 pressed refrigerant gas to the indoor heat ex-
 changer (40),
 wherein
 the gas pipe (12a) is connected to the flow path
 (51, 61) formed in part of the plate stack (50, 60)
 in which the first plate portion (50A, 60A) and the
 second plate portion (50B, 60B) overlap with
 each other.

FIG.1

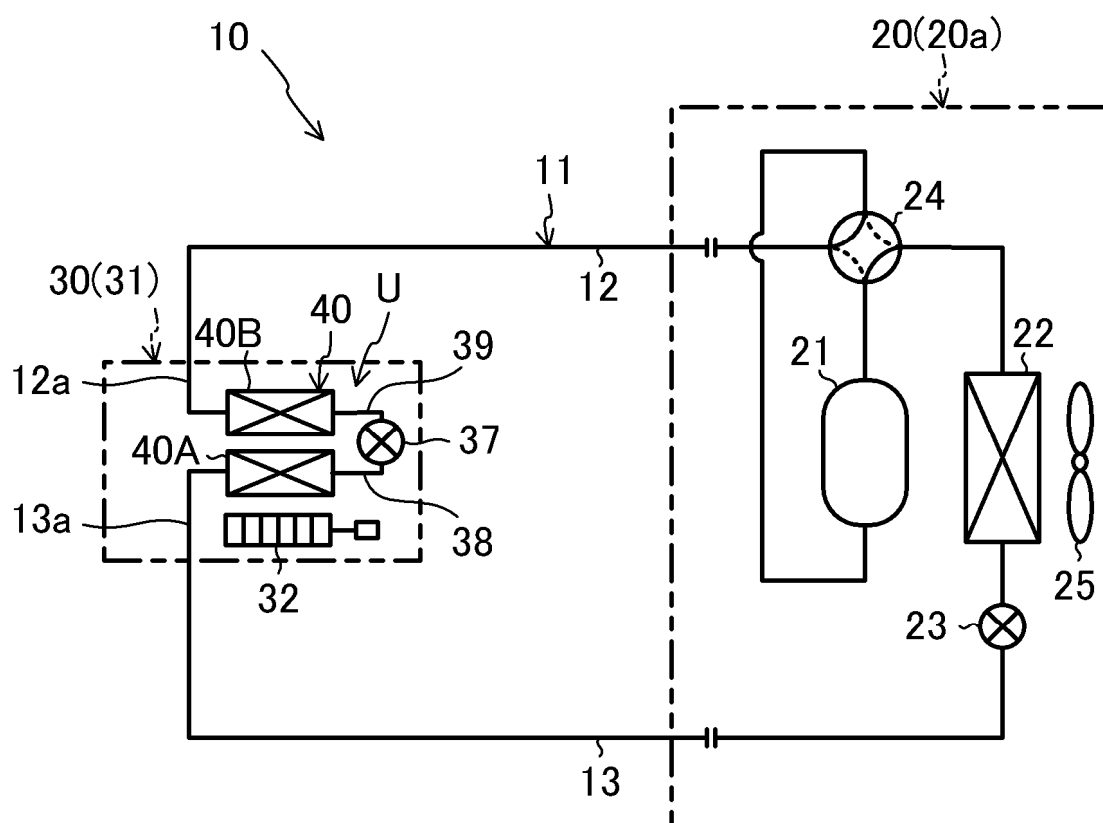


FIG.2

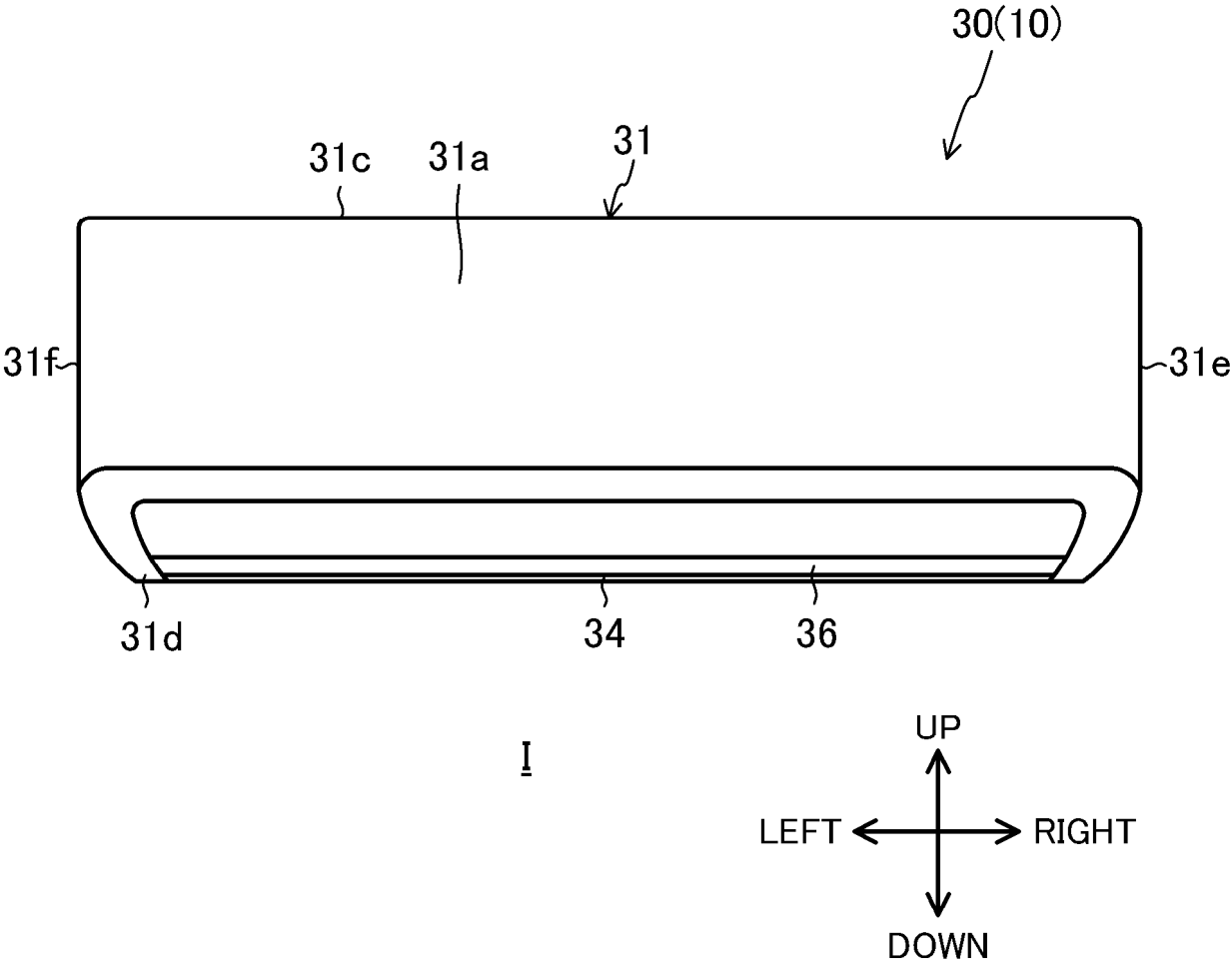


FIG.3

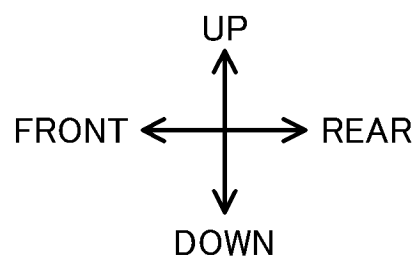
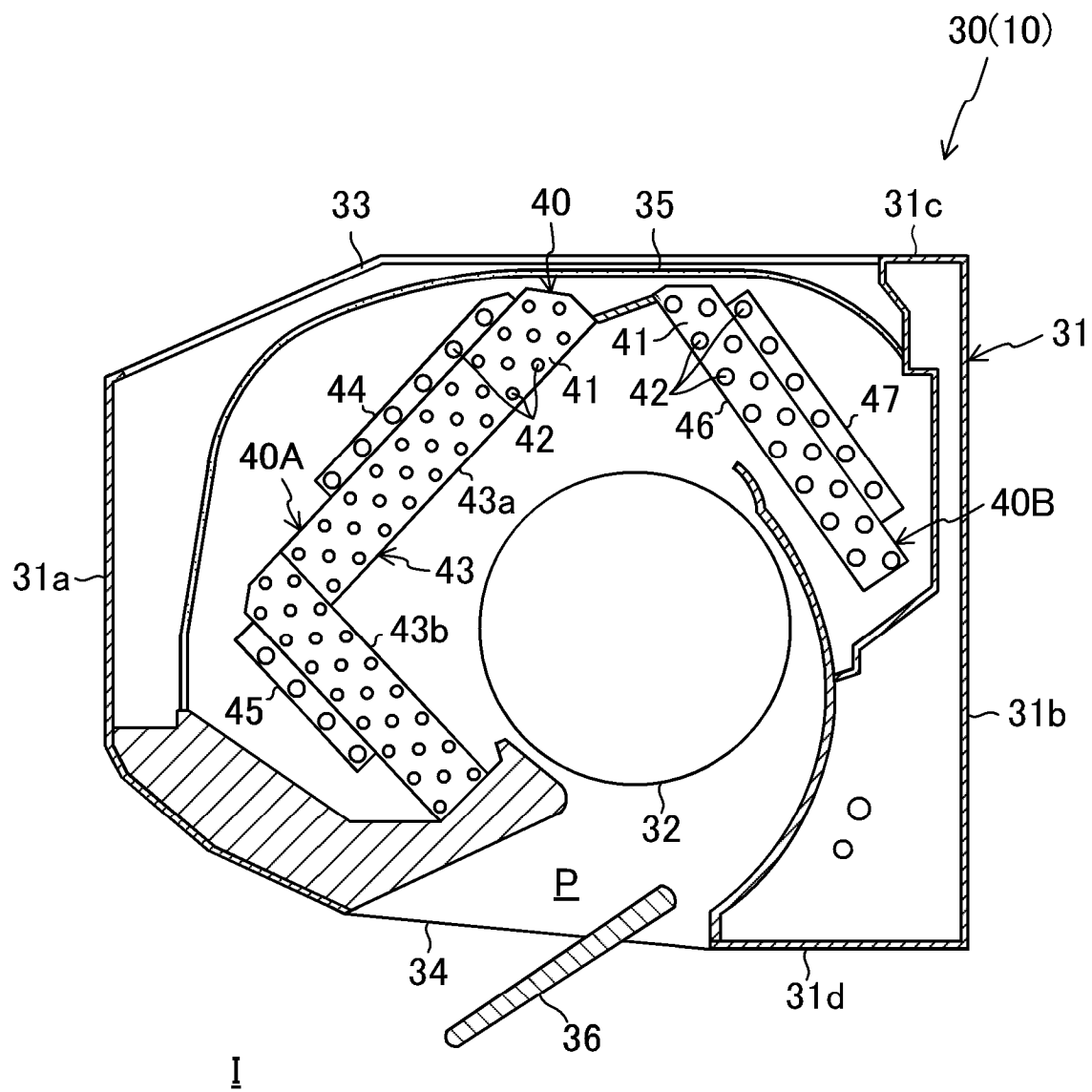


FIG.4

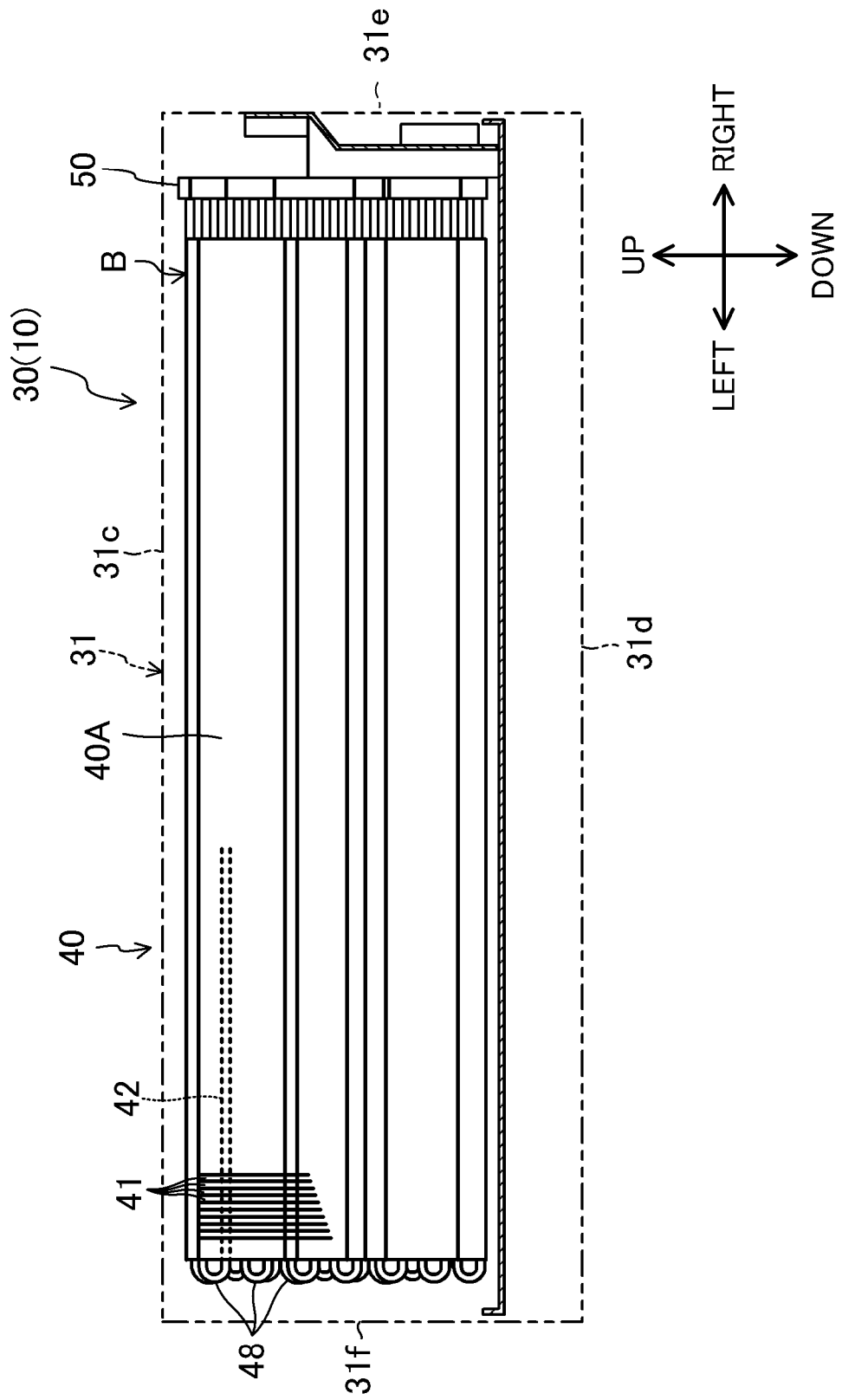


FIG.5

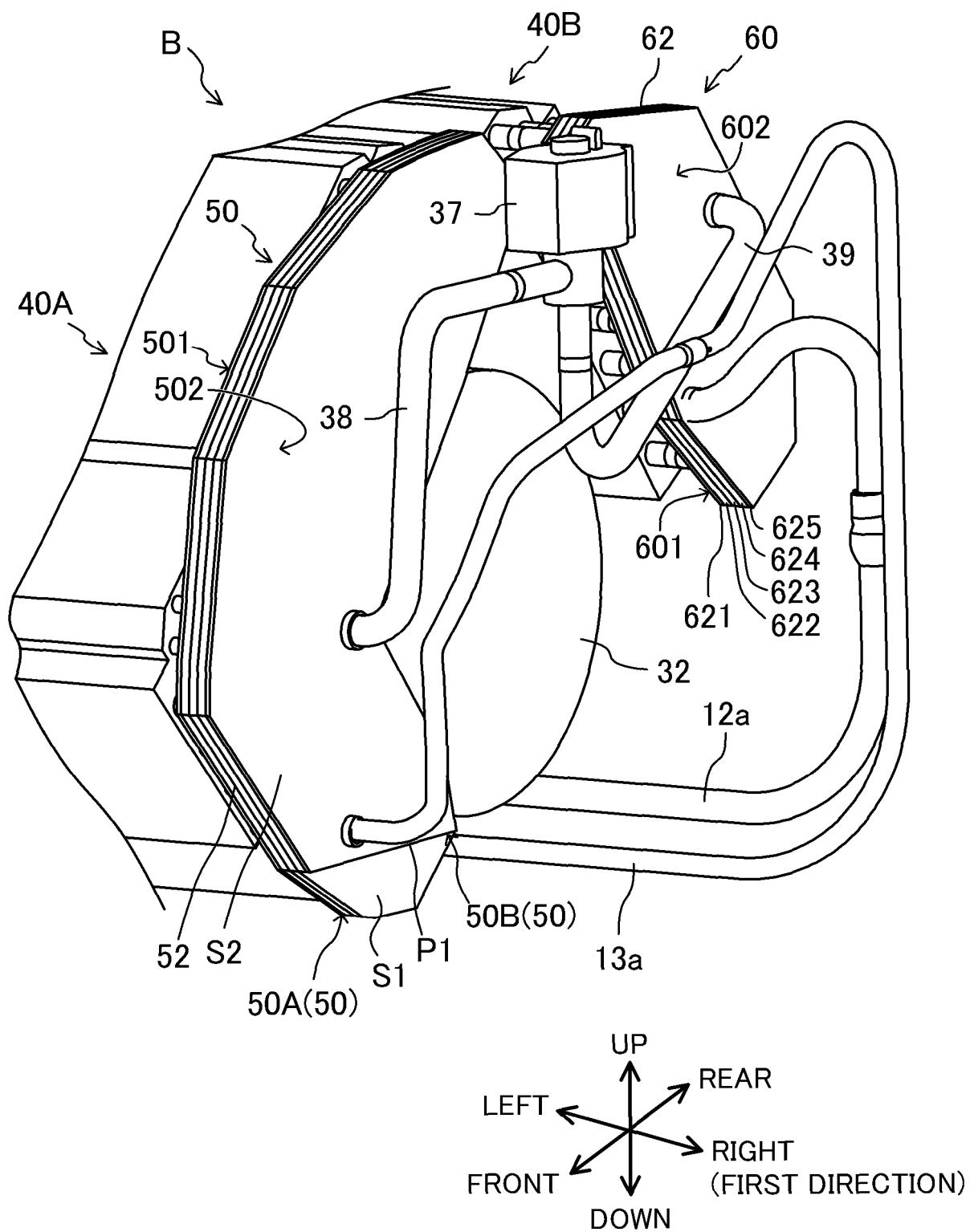


FIG.6

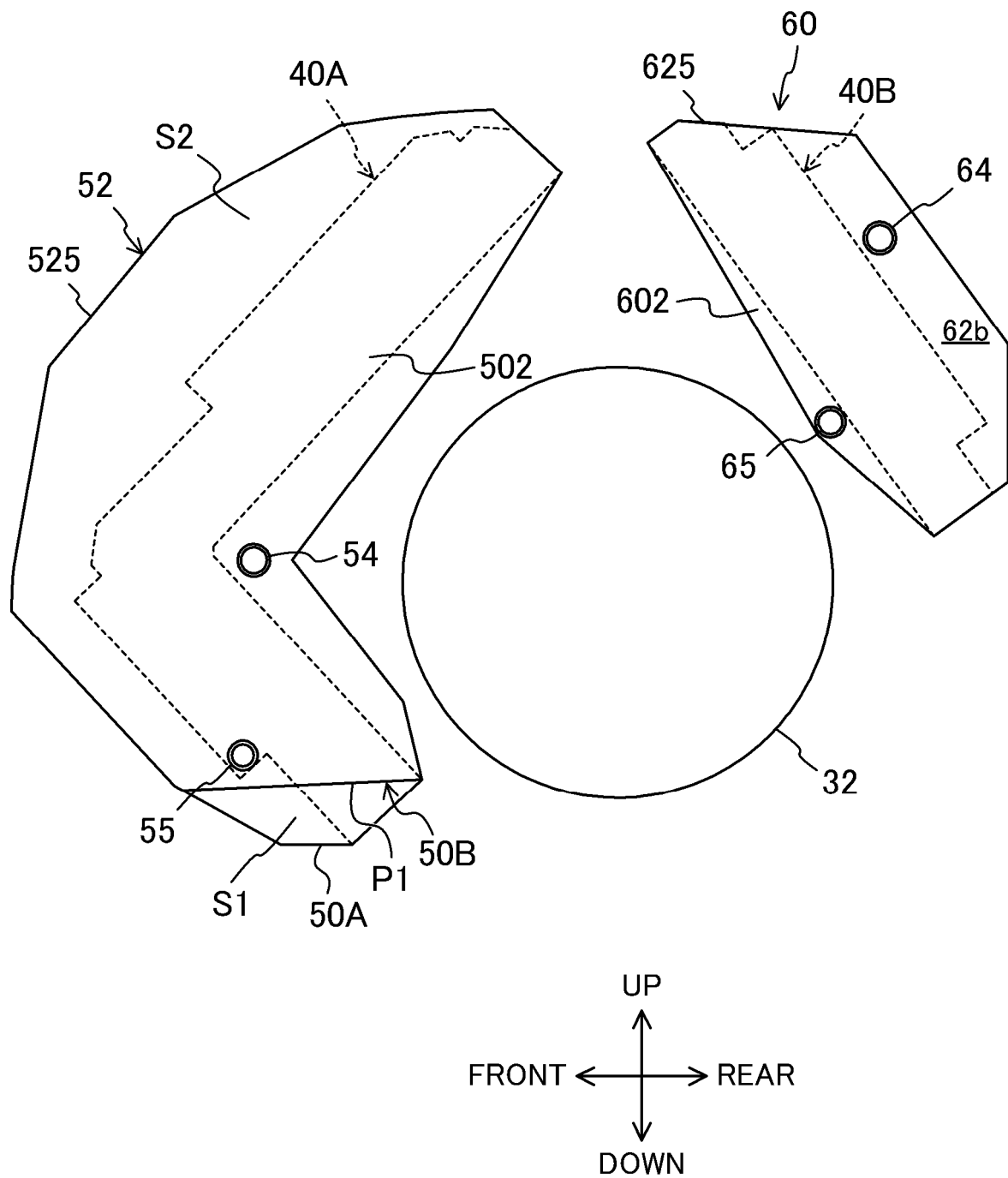


FIG.7

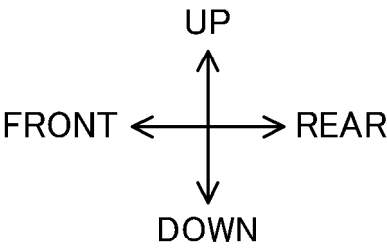
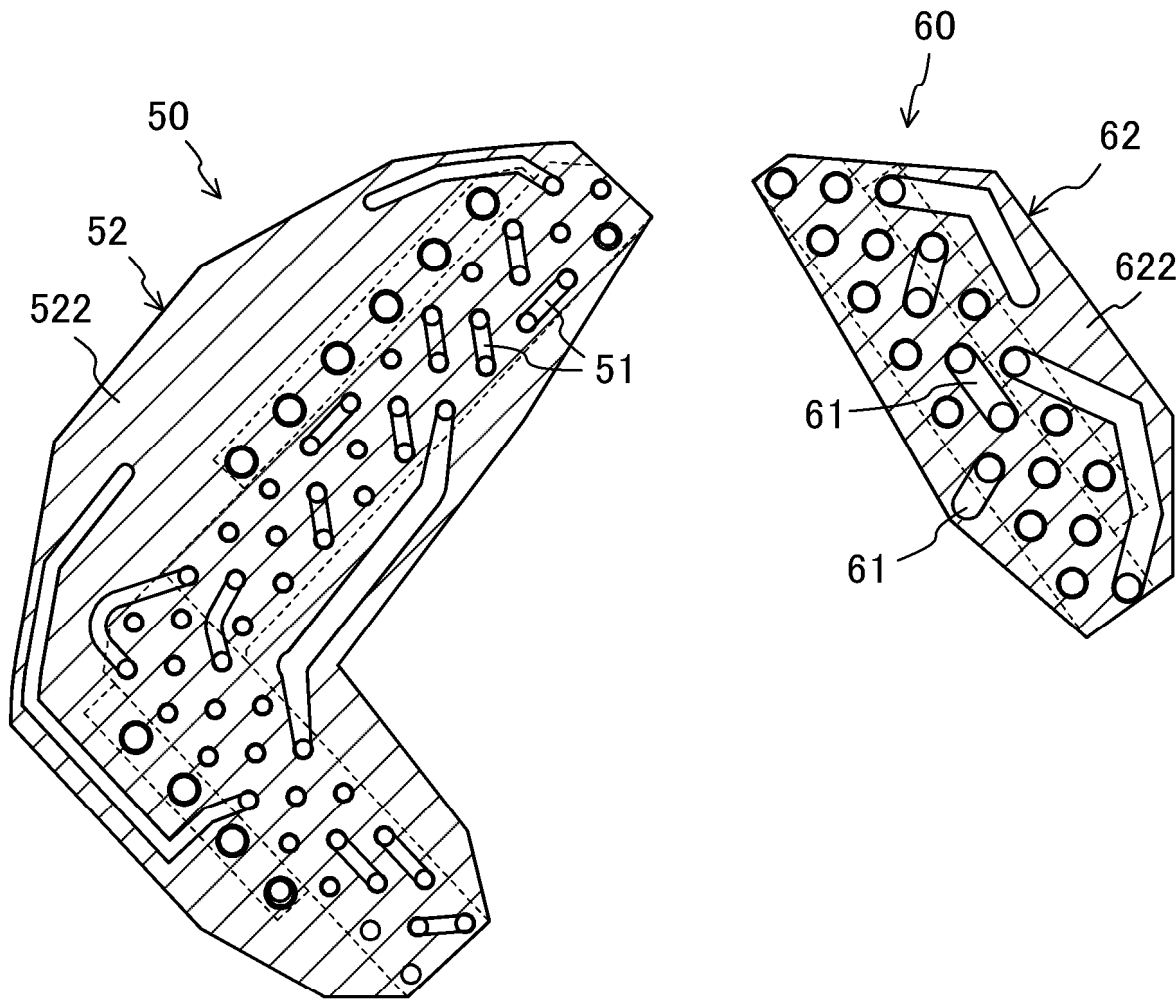


FIG.8

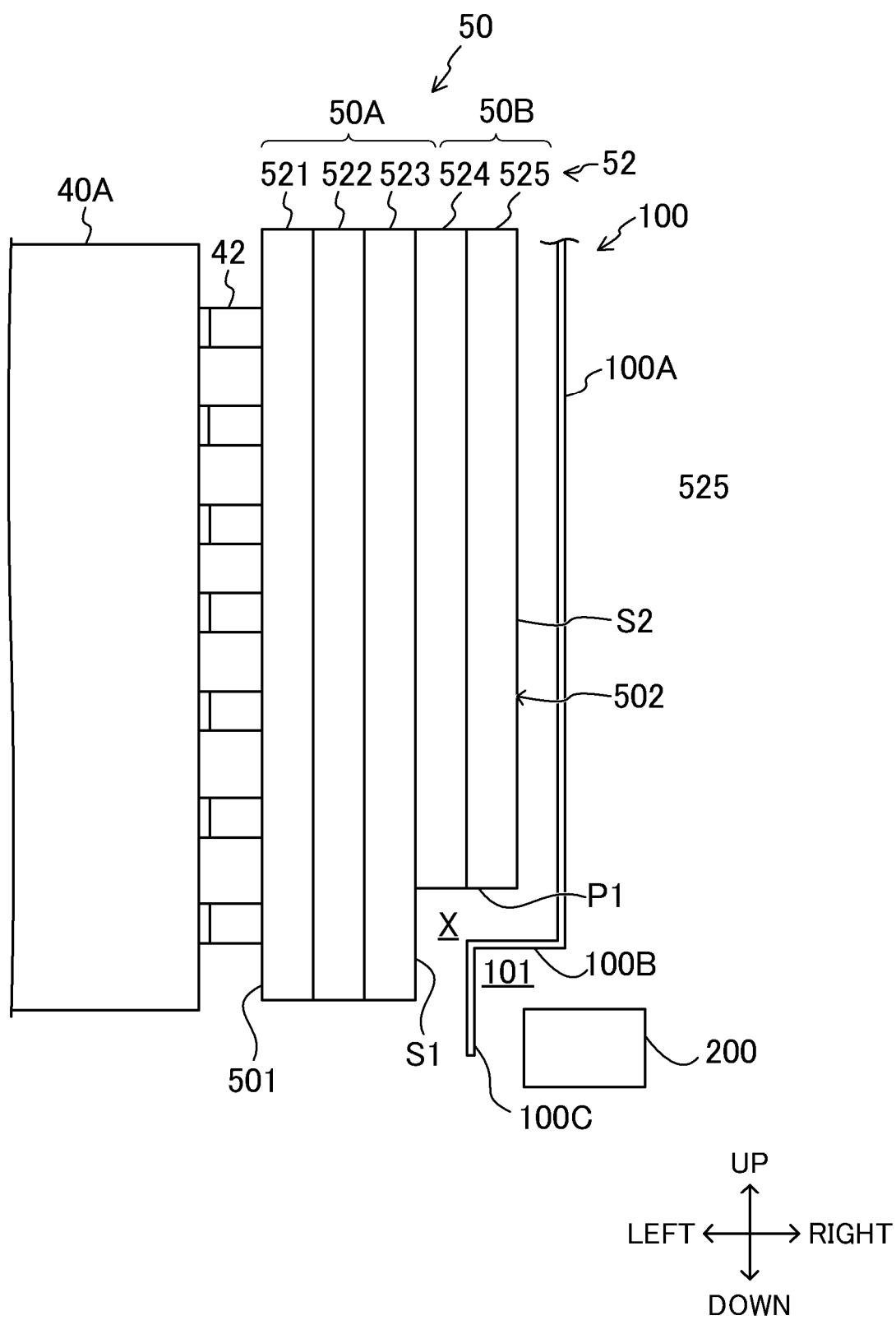


FIG.9

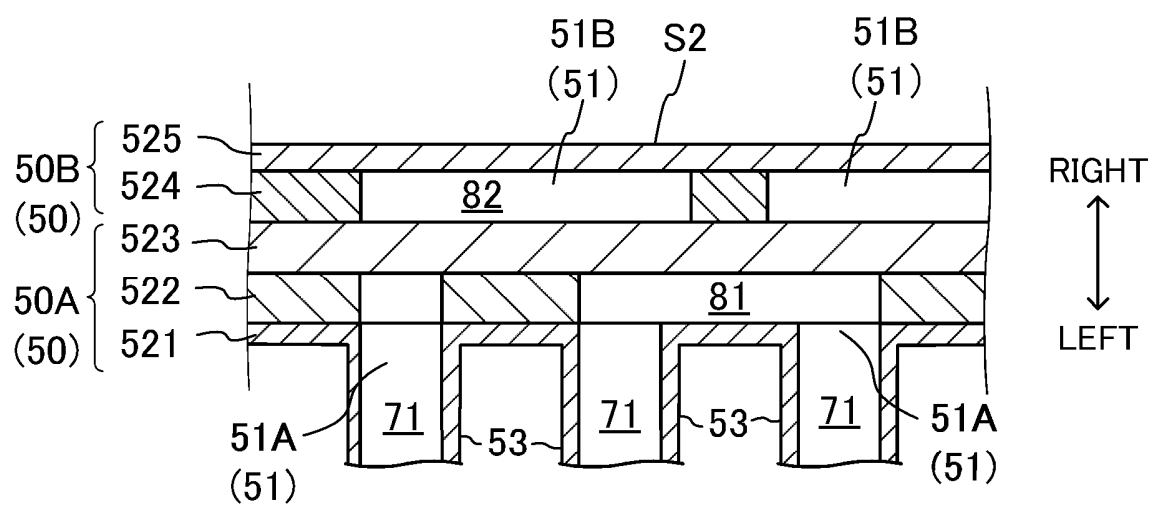


FIG.10

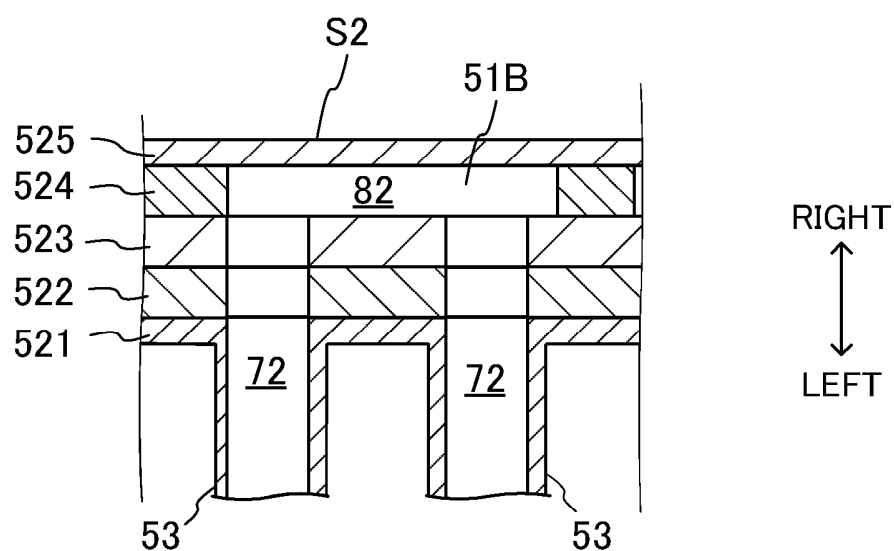


FIG.11

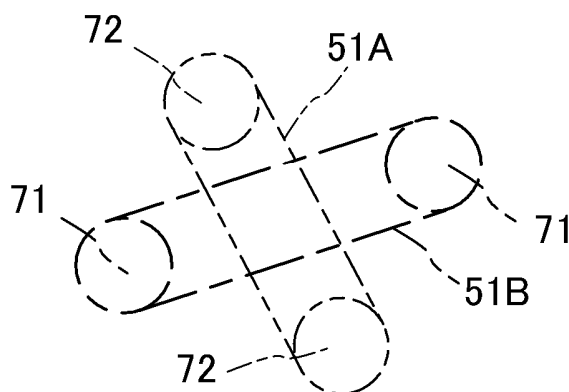


FIG.12

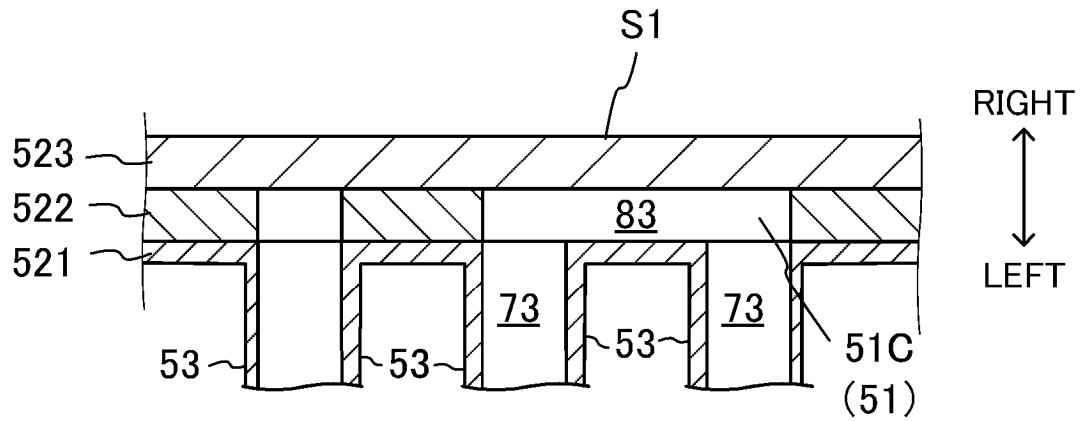


FIG.13

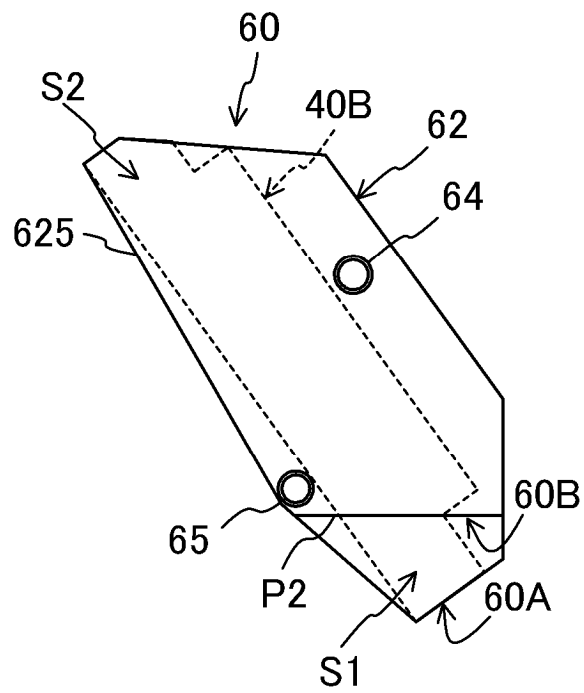


FIG.14

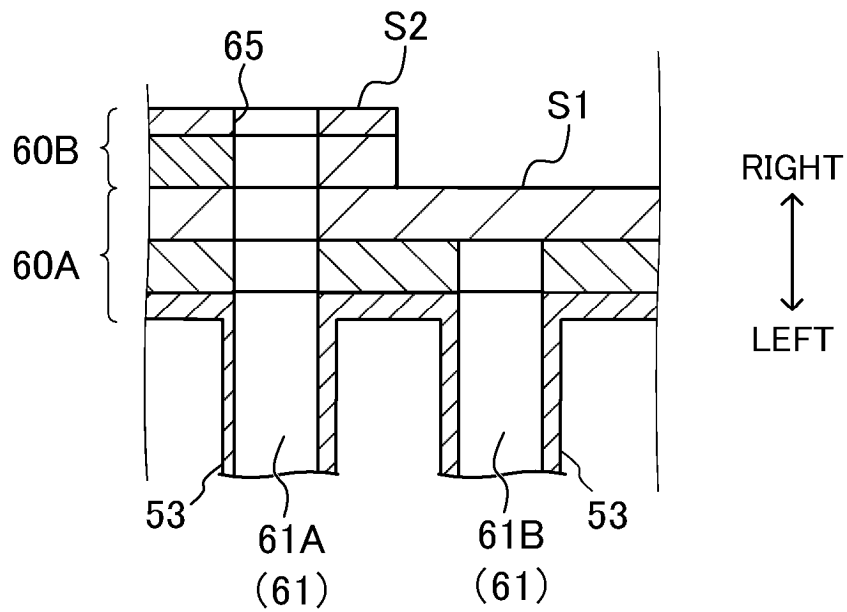


FIG.15

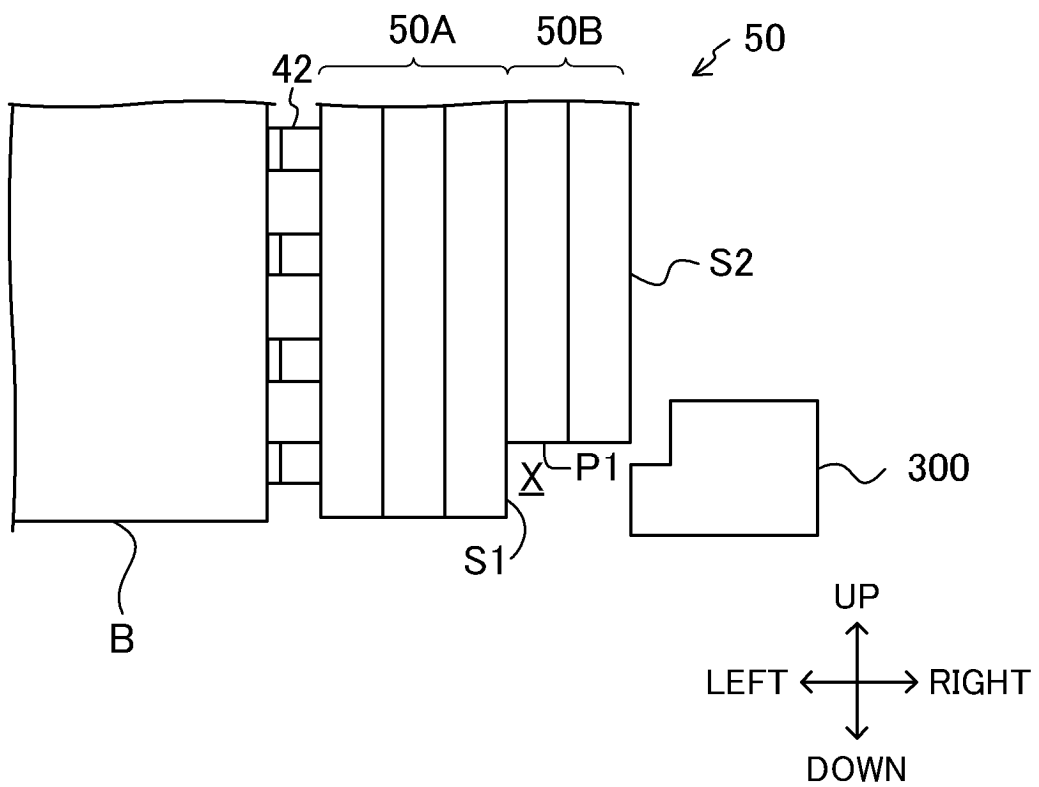


FIG.16

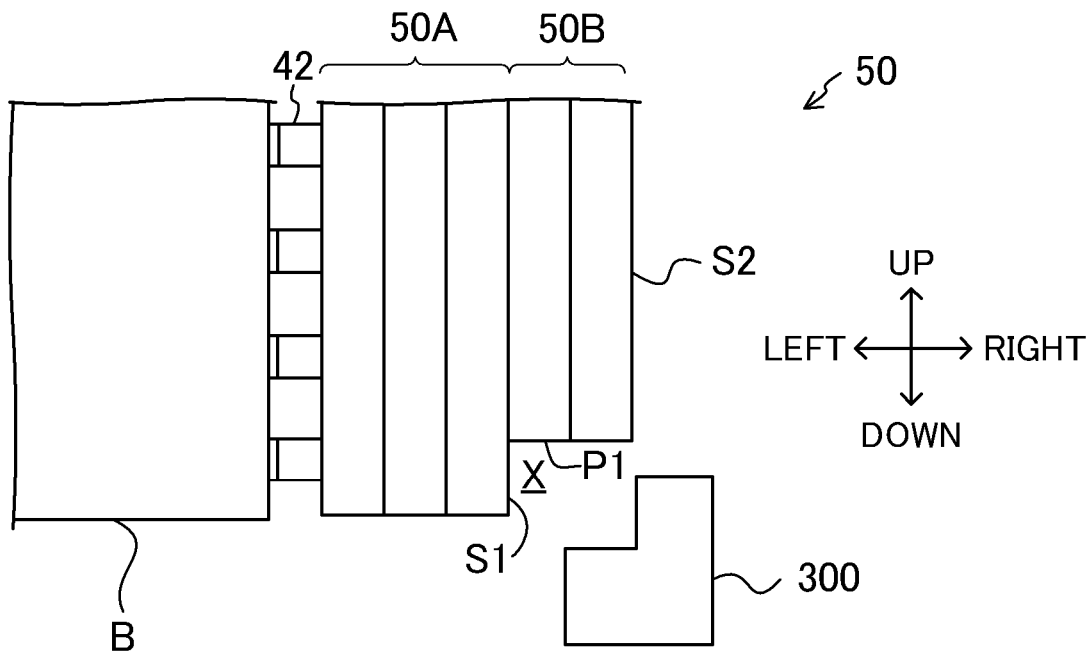


FIG.17

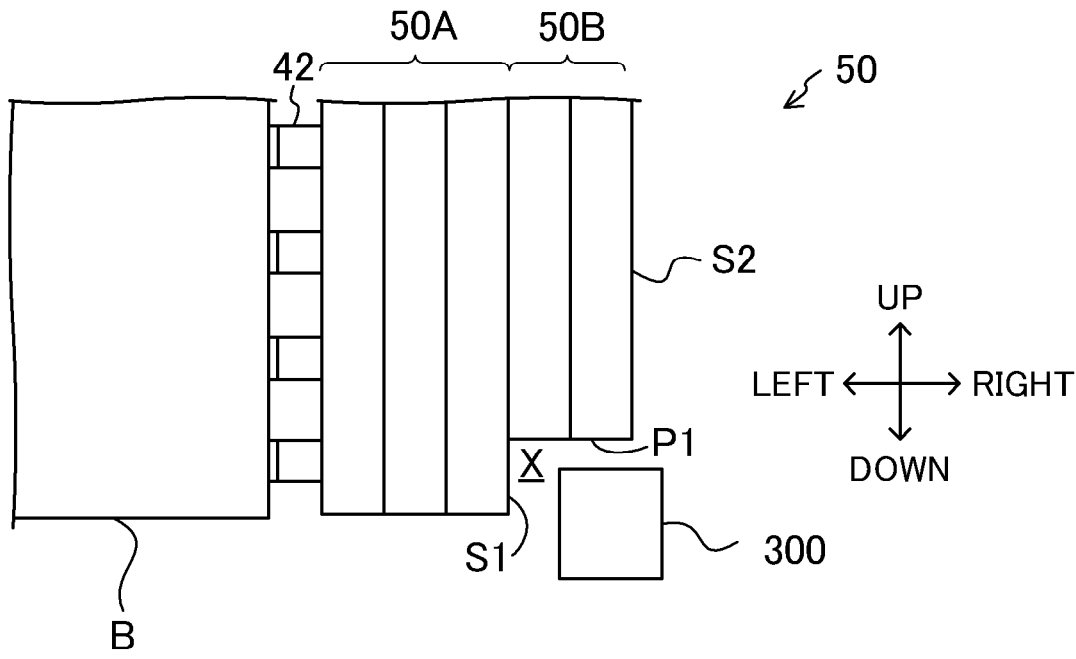
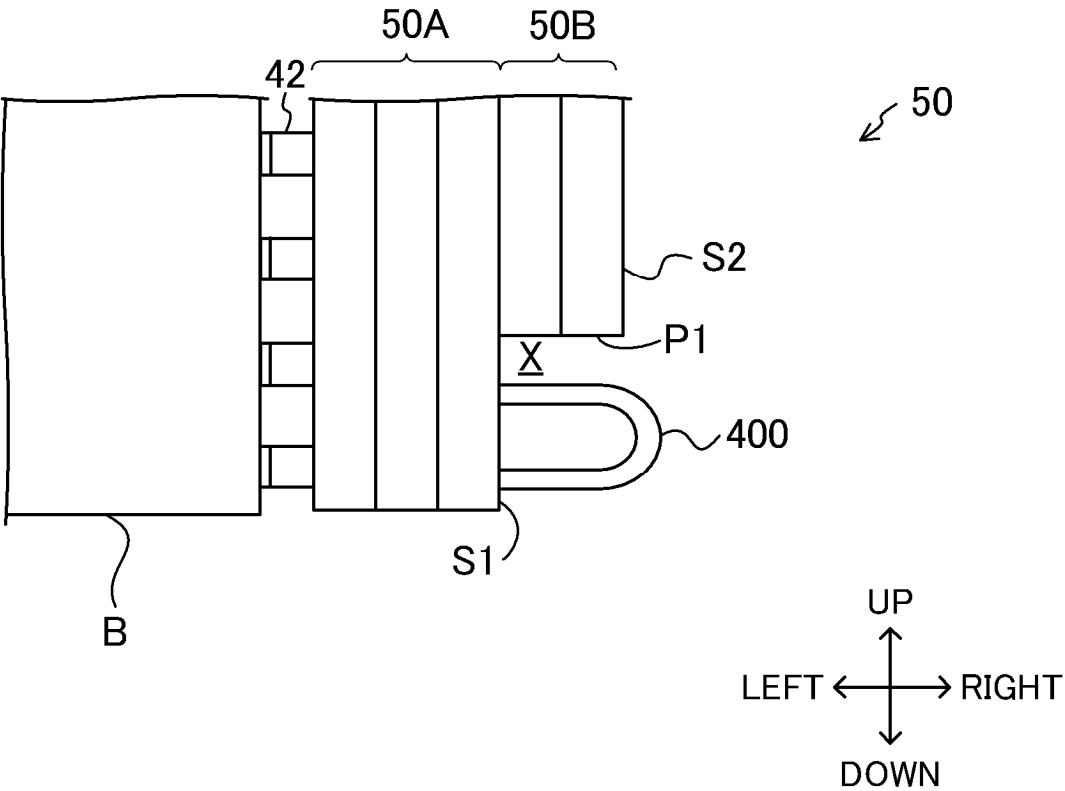


FIG.18



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/021700

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/02(2006.01)i; **F25B 39/00**(2006.01)i; **F28D 1/04**(2006.01)i; **F28F 19/06**(2006.01)i
 FI: F28F9/02 301Z; F28F19/06 A; F28D1/04 Z; F25B39/00 E; F25B39/00 P

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)

F28F1/00-99/00; F28D1/00-21/00; F25B39/00-39/04; F25B 41/42; F24F1/0059-1/0067; F24F1/14-1/18; F24F13/30

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 1971-2024
 Registered utility model specifications of Japan 1996-2024
 Published registered utility model applications of Japan 1994-2024

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	WO 2016/178398 A1 (MITSUBISHI ELECTRIC CORPORATION) 10 November 2016 (2016-11-10) particularly, paragraphs [0061]-[0065], fig. 10-11	1
A		2-12
A	JP 2006-125652 A (MITSUBISHI ELECTRIC CORPORATION) 18 May 2006 (2006-05-18) paragraphs [0010]-[0071], fig. 1-13	1-12
A	WO 2022/102040 A1 (MITSUBISHI ELECTRIC CORPORATION) 19 May 2022 (2022-05-19) paragraphs [0009]-[0051], fig. 1-10	1-12
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 39435/1981 (Laid-open No. 152521/1982) (SHARP KK) 25 September 1982 (1982-09-25), description, p. 2, line 10 to p. 5, line 5, fig. 1-3	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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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

11 July 2024

Date of mailing of the international search report

23 July 2024

Name and mailing address of the ISA/JP

**Japan Patent Office (ISA/JP)
 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
 Japan**

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/021700

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Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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JP	2006-125652	A	18 May 2006	(Family: none)	
WO	2022/102040	A1	19 May 2022	US 2023/0332776 A1 paragraphs [0018]-[0061], fig. 1-10 AU 2020476620 A1	
JP	57-152521	U1	25 September 1982	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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