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(54) **HEAT EXCHANGER AND HEAT EXCHANGE UNIT**

(57) A heat exchanger (30) includes a plurality of heat transfer tubes (40) and a plurality of fins (45). Each of the fins (45) has a plurality of tube receiving openings (46). The tube receiving openings (46) of the fin (45) constitute an opening row (50). The lowermost one of the tube receiving openings (46) in the opening row (50) is the tube-free opening (47) in which no heat transfer tube (40) is inserted.

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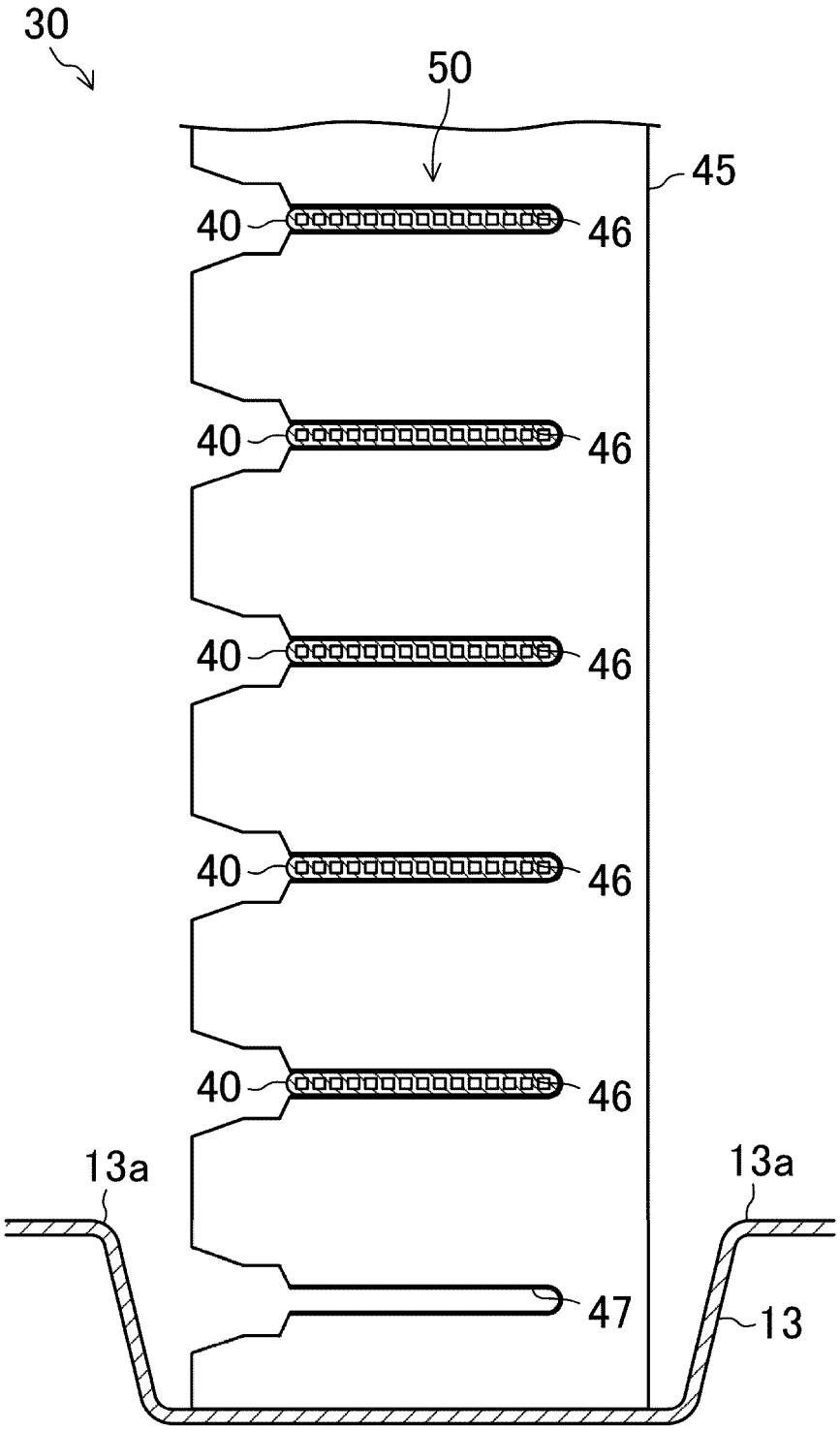
FIG.4



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat exchanger and a heat exchange unit.

BACKGROUND ART

[0002] Patent Document 1 discloses a heat exchanger. This heat exchanger is provided in an indoor unit of an air conditioner and exchanges heat between air sucked into the indoor unit and a refrigerant. During a cooling operation in which the heat exchanger functions as an evaporator, moisture in the air condenses on the surfaces of the fins of the heat exchanger, and the resulting condensed water flows down along the fins.

CITATION LIST

PATENT DOCUMENT

[0003] Patent Document 1: Japanese Unexamined Patent Publication No. 2015-127607

SUMMARY

TECHNICAL PROBLEM

[0004] As described above, condensed water flows down along the fins of the heat exchanger functioning as an evaporator. Thus, the lowermost one of heat transfer tubes in the heat exchanger remains wet for a long time, and is more likely to corrode than the other heat transfer tubes. Corrosion of the heat transfer tube may cause the refrigerant to leak from the heat transfer tube, reducing the reliability of the heat exchanger.

[0005] An object of the present disclosure is to improve the reliability of a heat exchanger and a heat exchange unit.

SOLUTION TO THE PROBLEM

[0006] A first aspect of the present disclosure is directed to a heat exchanger including: a plurality of heat transfer tubes (40) arranged in parallel to each other; and a plurality of plate-shaped fins (45) each having a plurality of tube receiving openings (46) in which the heat transfer tubes (40) are inserted. Each of the fins (45) is arranged such that its longitudinal direction corresponds to an up-and-down direction, and has a single opening row (50) constituted of the plurality of tube receiving openings (46) arranged in a row in the longitudinal direction of the fin (45). The lowermost one of the tube receiving openings (46) in the opening row (50) is a tube-free opening (47) in which no heat transfer tube (40) is inserted.

[0007] In the first aspect, each of the fins (45) has a single opening row (50). No heat transfer tube (40) is inserted in the tube-free opening (47), which is the lowermost one of the tube receiving openings (46) in the opening row (50) of the fin (45). The heat exchanger (30) of this aspect has no heat transfer tube (40) at a lower end portion where condensed water tends to remain. Thus, in this aspect, the heat transfer tubes (40) can be less likely to corrode due to the condensed water, improving the reliability of the heat exchanger (30).

[0008] A second aspect of the present disclosure is directed to a heat exchanger including: a plurality of heat transfer tubes (40) arranged in parallel to each other; and a plurality of plate-shaped fins (45) each having a plurality of tube receiving openings (46) in which the heat transfer tubes (40) are inserted. Each of the fins (45) is arranged such that its longitudinal direction corresponds to an up-and-down direction, and has a plurality of opening rows (51a, 52a, 51b, 52b) each of which is constituted of the plurality of tube receiving openings (46) arranged in a row in the longitudinal direction of the fin (45). The lowermost one of the tube receiving openings (46) in each of the opening rows (51a, 52a, 51b, 52b) is a tube-free opening (47) in which no heat transfer tube (40) is inserted.

[0009] In the second aspect, each of the fins (45) has a plurality of opening rows (51a, 52a, 51b, 52b). No heat transfer tube (40) is inserted in the tube-free opening (47), which is the lowermost one of the tube receiving openings (46) in each of the opening rows (51a, 52a, 51b, 52b) of the fin (45). The heat exchanger (30) of this aspect has no heat transfer tube (40) at a lower end portion where condensed water tends to remain. Thus, in this aspect, the heat transfer tubes (40) can be less likely to corrode due to the condensed water, improving the reliability of the heat exchanger (30).

[0010] A third aspect of the present disclosure is an embodiment of the first or second aspect. In the third aspect, the heat transfer tubes (40) are made of an aluminum alloy.

[0011] In the third aspect, the heat exchanger (30) includes the heat transfer tubes (40) made of an aluminum alloy. Aluminum has a higher ionization tendency than copper and is generally more susceptible to corrosion than copper. In this aspect, the heat exchanger (30) having the heat transfer tubes (40) made of an aluminum alloy and are more susceptible to corrosion than copper heat transfer tubes can be kept from corrosion of the heat transfer tubes (40).

[0012] A fourth aspect of the present disclosure is an embodiment of the third aspect. In the fourth aspect, each of the heat transfer tubes (40) has a flat shape with a width greater than its thickness.

[0013] In the fourth aspect, the heat exchanger is provided with flat-shaped heat transfer tubes having a width greater than its thickness. The condensed water is more likely to remain on the surfaces of the heat transfer tubes (40) having such a flat shape than on circular heat transfer tubes. In this aspect, the heat exchanger (30) having the flat-shaped heat transfer tubes (40) on which the con-

densed water is more likely to remain than on the circular heat transfer tubes can be kept from corrosion of the heat transfer tubes (40).

[0014] A fifth aspect of the present disclosure is an embodiment of any one of the first to fourth aspects. In the fifth aspect, the heat exchanger further includes: a header member (61, 62) formed in a tubular shape extending along the longitudinal direction of the fins (45), connected to the heat transfer tubes (40), and has an internal space communicating with the heat transfer tubes (40). A bottom wall surface (63) facing the internal space of the header member (61, 62) is positioned above the tube-free opening (47) in the opening row (50).

[0015] In the fifth aspect, the bottom wall surface (63) facing the internal space of the header member (61, 62) in which the refrigerant flows is positioned above the tube-free opening (47) in the opening row (50) of each fin (45). Thus, when the heat exchanger (30) functions as an evaporator, the temperature of a lower end portion of the heat exchanger (30) becomes higher than the temperatures of the other portions, keeping the condensed water from remaining in the lower end portion of the heat exchanger (30).

[0016] A sixth aspect of the present disclosure is an embodiment of any one of the first to fifth aspects. In the sixth aspect, the heat exchanger further includes: a first heat exchange section (31) and a second heat exchange section (32) each having the fins (45) and the heat transfer tubes (40) inserted in the tube receiving openings (46) of the fins (45). The second heat exchange section (32) is arranged above the first heat exchange section (31). A longitudinal direction of the fins (45) of the second heat exchange section (32) is inclined with respect to a longitudinal direction of the fins (45) of the first heat exchange section (31). The lowermost one of the tube receiving openings (46) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is the tube-free opening (47), and the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32) is the tube-free opening (47).

[0017] A seventh aspect of the present disclosure is an embodiment of any one of the first to fifth aspects. In the sixth aspect, the heat exchanger further includes: a first heat exchange section (31) and a second heat exchange section (32) each having the fins and the heat transfer tubes (40) inserted in the tube receiving openings (46) of the fins. The second heat exchange section (32) is arranged above the first heat exchange section (31). A longitudinal direction of the fins (45) of the second heat exchange section (32) is inclined with respect to a longitudinal direction of the fins (45) of the first heat exchange section (31). The lowermost one of the tube receiving openings (46) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is the tube-free opening (47). A no-flow tube (41) in which no fluid flows is inserted in the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32).

[0018] In the sixth and seventh aspects, the second heat exchange section (32) arranged above the first heat exchange section (31) is inclined with respect to the first heat exchange section (31). Thus, the condensed water may remain near the lower end of the second heat exchange section (32).

[0019] In the sixth aspect, the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32) is the tube-free opening (47). Thus, no heat transfer tube (40) is present near the lower end of the second heat exchange section (32), reducing the possibility of corrosion of the heat transfer tubes (40) of the second heat exchange section (32).

[0020] In the seventh aspect, the no-flow tube (41) is inserted in the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32). Even if the no-flow tube (41) corrodes, fluid such as the refrigerant does not leak from the no-flow tube (41). Thus, in this aspect, the heat exchanger (30) can improve in reliability.

[0021] An eighth aspect of the present disclosure is directed to a heat exchange unit including: the heat exchanger (30) of any one of the first to seventh aspects; a fan (24) that sends air to the heat exchanger (30); and a drain pan (13, 25, 26) that is provided below the heat exchanger (30) and receives condensed water generated in the heat exchanger (30). The tube-free opening (47) in the opening row (50) of each fin (45) of the heat exchanger (30) is positioned below an upper edge (13a, 25a, 26a) of the drain pan (13, 25, 26).

[0022] In the eighth aspect, the lower end portion of the heat exchanger (30) is positioned below the upper edge of the drain pan (13, 25, 26). This may cause the lower end portion of the heat exchanger (30) to be immersed in the condensed water for a long time. In this aspect, one of the tube receiving openings (46) of the fin (45) of the heat exchanger (30) positioned below the upper edge of the drain pan (13, 25, 26) is the tube-free opening (47). Thus, no heat transfer tubes (40) are provided at the lower end portion of the heat exchanger (30), reducing the possibility of corrosion of the heat transfer tubes (40) of the heat exchanger (30).

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a perspective view of an outdoor unit according to a first embodiment.

FIG. 2 is a schematic perspective view of a heat exchanger according to the first embodiment.

FIG. 3 is a partial cross-sectional view of the heat exchanger according to the first embodiment.

FIG. 4 is a cross-sectional view taken along line IV-IV in FIG. 3.

FIG. 5 is a schematic cross-sectional view of an in-

door unit according to a second embodiment.

FIG. 6 is a schematic front view of a windward bank and a leeward bank constituting first and third heat exchange sections of the heat exchanger according to the second embodiment.

FIG. 7 is a schematic front view of a windward bank and a leeward bank constituting a second heat exchange section of the heat exchanger according to the second embodiment.

FIG. 8 is a schematic cross-sectional view of an indoor unit according to a variation of the second embodiment.

FIG. 9 is a schematic cross-sectional view of an indoor unit according to a third embodiment.

DESCRIPTION OF EMBODIMENTS

«First Embodiment»

[0024] A first embodiment will be described below. The present embodiment is directed to an outdoor unit (10) of an air conditioner. The outdoor unit (10) is a heat exchange unit including a heat exchanger (30).

[0025] As illustrated in FIG. 1, the outdoor unit (10) includes a flat rectangular parallelepiped-shaped casing (11). An air outlet (12) is formed in a front surface of the casing (11). Although not shown in FIG. 1, air inlets are formed in a back surface and one of side surfaces of the casing (11). The casing (11) of the outdoor unit (10) houses the heat exchanger (30) of the present embodiment together with other components such as a compressor and a fan.

-Heat Exchanger-

[0026] As illustrated in FIG. 2, the heat exchanger (30) is a fin-and-tube heat exchanger. The heat exchanger (30) exchanges heat between a refrigerant and the air supplied by the fan. The heat exchanger (30) includes a plurality of fins (45), a plurality of heat transfer tubes (40), and a pair of header members (61, 62). The heat exchanger (30) is formed in an L-shape in plan view. The heat exchanger (30) is arranged along the air inlets of the casing (11) (i.e., the back surface and one of the side surfaces of the casing (11)).

<Fin>

[0027] As illustrated in FIG. 4, each of the fins (45) is formed in a substantially rectangular plate shape, and is arranged with long sides thereof extending in the up-and-down direction. The fins (45) are made of an aluminum alloy.

[0028] Each of the fins (45) is provided with a plurality of tube receiving openings (46). Each of the tube receiving openings (46) is a cut extending from one of the long sides of the fin (45) toward the other (from the left long side to the right long side in FIG. 4). The tube receiving opening (46) has an elongated shape along the short sides of the fin (45). The tube receiving openings (46) are arranged in a row at regular intervals in the longitudinal direction of the fin (45).

[0029] All the tube receiving openings (46) formed in each fin (45) constitute an opening row (50). The lowermost one of the tube receiving openings (46) in the opening row (50) of each fin (45) is a tube-free opening (47).

[0030] As illustrated in FIG. 3, the fins (45) of the heat exchanger (30) are arranged to face each other at regular intervals.

<Heat Transfer Tube>

[0031] As illustrated in FIGS. 3 and 4, each of the heat transfer tubes (40) has a flat shape with a width greater than its thickness. The heat transfer tubes (40) are made of an aluminum alloy. The heat transfer tubes (40) of the heat exchanger (30) are arranged to intersect with the fins (45) so that their longitudinal direction roughly corresponds to the horizontal direction. The heat transfer tubes (40) are arranged at regular intervals in the up-and-down direction.

[0032] As illustrated in FIG. 4, the heat transfer tubes (40) are inserted one by one in the tube receiving openings (46) of the fins (45), and joined to the fins (45) by, for example, brazing. Note that no heat transfer tube (40) is inserted in the tube-free openings (47) of the fins (45) of the heat exchanger (30) of the present embodiment. The heat transfer tubes (40) are inserted in the tube receiving openings (46) other than the lowermost tube-free opening (47) in the opening row (50) of each fin (45).

<Header Member>

[0033] As illustrated in FIG. 3, each header member (61, 62) is a cylindrical member with both ends closed. The header members (61, 62) are made of an aluminum alloy. The header members (61, 62) are arranged so that its axial direction corresponds to the up-and-down direction. In the heat exchanger (30), the header members (61, 62) are respectively connected to one end of each heat transfer tube (40) and the other.

[0034] Each header member (61, 62) has an internal space communicating with the heat transfer tubes (40) connected to the header member (61, 62). A bottom wall surface (63) facing the internal space of each header member (61, 62) is positioned above the tube-free openings (47) of the fins (45).

<Arrangement of Heat Exchanger>

[0035] As illustrated in FIG. 4, a lower end portion of the heat exchanger (30) is in a drain pan (13). The drain pan (13) is a recess formed in a bottom plate of the casing (11) of the outdoor unit (10). The drain pan (13) receives condensed water generated in the heat exchanger (30) functioning as an evaporator. An upper edge (13a) of the

drain pan (13) is positioned above the tube-free openings (47) of the fins (45).

<Function of Heat Exchanger>

[0036] As described above, the heat exchanger (30) exchanges heat between the refrigerant and the air. In the heating operation of the air conditioner, the heat exchanger (30) provided in the outdoor unit (10) functions as an evaporator. In the heat exchanger (30) functioning as an evaporator, the refrigerant that has entered one header member (61) is split into the plurality of heat transfer tubes (40), absorbs heat from the air passing between the fins (45), and evaporates. The flows of the refrigerant that have passed through the heat transfer tubes (40) merge together in the other header member (62), and the merged flow goes out of the heat exchanger (30).

[0037] Water vapor contained in the air is condensed on the surfaces of the fins (45) to produce condensed water. The condensed water thus produced flows downward along the fins (45), and is discharged outside the casing (11) through the drain pan (13).

- Feature (1) of First Embodiment -

[0038] The heat exchanger (30) of the present embodiment includes the plurality of heat transfer tubes (40) arranged parallel to each other and the plurality of plate-shaped fins (45). Each of the fins (45) is provided with the plurality of tube receiving openings (46) in which the heat transfer tubes (40) are inserted. The fins (45) are arranged such that their longitudinal direction corresponds to the up-and-down direction. Further, each of the fins (45) has the single opening row (50). The opening row (50) includes the plurality of tube receiving openings (46) arranged in a row in the longitudinal direction of the fin (45). The lowermost one of the tube receiving openings (46) in the opening row (50) is the tube-free opening (47) in which no heat transfer tube (40) is inserted.

[0039] Each of the fins (45) of the heat exchanger (30) of the present embodiment has the single opening row (50). No heat transfer tube (40) is inserted in the tube-free opening (47), which is the lowermost one of the tube receiving openings (46) in the opening row (50) of the fin (45). The heat exchanger (30) of the present embodiment has no heat transfer tube (40) at the lower end portion where condensed water tends to remain. Thus, in the present embodiment, the heat transfer tubes (40) can be less likely to corrode due to the condensed water, improving the reliability of the heat exchanger (30).

- Feature (2) of First Embodiment -

[0040] The heat exchanger (30) of the present embodiment includes the heat transfer tubes (40) made of an aluminum alloy.

[0041] Aluminum has a higher ionization tendency than copper and is generally more susceptible to corrosion than copper. In the present embodiment, the heat exchanger (30) having the heat transfer tubes (40) made of an aluminum alloy and are more susceptible to corrosion than copper heat transfer tubes can be kept from corrosion of the heat transfer tubes (40).

- Feature (3) of First Embodiment -

[0042] In the heat exchanger (30) of the present embodiment, each of the heat transfer tubes (40) has a flat shape with a width greater than its thickness.

[0043] The heat exchanger (30) of the present embodiment is provided with the flat-shaped heat transfer tubes having a width larger than its thickness. The condensed water is more likely to remain on the surfaces of the heat transfer tubes (40) having such a flat shape than on circular heat transfer tubes. In the present embodiment, the heat exchanger (30) having the flat-shaped heat transfer tubes (40) on which the condensed water is more likely to remain than on the circular heat transfer tubes can be kept from corrosion of the heat transfer tubes (40).

- Feature (4) of First Embodiment -

[0044] The heat exchanger (30) of the present embodiment includes the header members (61, 62). Each header member (61, 62) is formed in a tubular shape extending along the longitudinal direction of the fins (45), connected to the heat transfer tubes (40), and has the internal space communicating with the heat transfer tubes (40). The bottom wall surface (63) facing the internal space of the header member (61, 62) is positioned above the tube-free opening (47) in the opening row (50).

[0045] In the heat exchanger (30) of the present embodiment, the bottom wall surface (63) facing the internal space of the header member (61, 62) in which the refrigerant flows is positioned above the tube-free opening (47) in the opening row (50) of each fin (45). Thus, when the heat exchanger (30) functions as an evaporator, the temperature of a lower end portion of the heat exchanger (30) becomes higher than the temperatures of the other portions, keeping the condensed water from remaining in the lower end portion of the heat exchanger (30).

- Feature (5) of First Embodiment -

[0046] The outdoor unit (10) of the present embodiment includes the heat exchanger (30), the fan that sends the air to the heat exchanger (30), and the drain pan (13). The drain pan (13) is provided below the heat exchanger (30) and receives the condensed water generated in the heat exchanger (30). In the heat exchanger (30), the tube-free opening (47) in the opening row (50) of each fin (45) is positioned below the upper edge (13a) of the drain pan (13).

[0047] In the outdoor unit (10) of the present embodiment, the lower end portion of the heat exchanger (30) is positioned below the upper edge (13a) of the drain pan

(13). This may cause the lower end portion of the heat exchanger (30) to be immersed in the condensed water for a long time. In the heat exchanger (30) of the present embodiment, one of the tube receiving openings (46) in the fin (45) positioned below the upper edge (13a) of the drain pan (13) is the tube-free opening (47). Thus, no heat transfer tubes (40) are provided at the lower end portion of the heat exchanger (30), reducing the possibility of corrosion of the heat transfer tubes (40) of the heat exchanger (30).

«Second Embodiment»

[0048] A second embodiment will be described below. The present embodiment is directed to an indoor unit (20) of an air conditioner. The indoor unit (20) is a heat exchange unit including a heat exchanger (30).

[0049] As illustrated in FIG. 5, the indoor unit (20) includes a box-shaped casing (21). The casing (21) is formed in a horizontally oriented rectangular parallelepiped shape. An air inlet (22) is formed in an upper surface of the casing (21). An air outlet (23) is formed in a lower surface of the casing (21). The casing (21) houses a heat exchanger (30) and a fan (24). The fan (24) is a so-called cross-flow fan, and is arranged such that its rotation axis extends along the longitudinal direction of the casing (21) (the direction perpendicular to the plane of FIG. 5). The casing (21) has a front drain pan (25) in front of the fan (24) (on the left side in FIG. 5) and a rear drain pan (26) behind the fan (24) (on the right side in FIG. 5).

-Heat Exchanger-

[0050] The heat exchanger (30) is arranged to cover the front and top of the fan (24). The heat exchanger (30) includes a first heat exchange section (31), a second heat exchange section (32), and a third heat exchange section (33). Each of the first heat exchange section (31), the second heat exchange section (32), and the third heat exchange section (33) has a two row structure.

<First Heat Exchange Section>

[0051] The first heat exchange section (31) is arranged in front of the fan (24) (on the left in FIG. 5). A lower end portion of the first heat exchange section (31) is in the front drain pan (25). The first heat exchange section (31) is inclined such that its upper portion is closer to the front surface of the casing (21) than its lower portion (inclined to the left side in FIG. 5).

[0052] The first heat exchange section (31) includes a first windward bank (31a) and a first leeward bank (31b). The first windward bank (31a) and the first leeward bank (31b) are arranged to overlap each other. The first leeward bank (31b) is placed closer to the fan (24) than the first windward bank (31a).

[0053] As illustrated in FIG. 6, each of the first windward bank (31a) and the first leeward bank (31b) includes a plurality of rectangular plate-shaped fins (45), a plurality of flat-shaped heat transfer tubes (40), and a pair of tubular header members (61, 62), and is configured similarly to the heat exchanger (30) of the first embodiment.

[0054] Specifically, each of the fins (45) of the first windward bank (31a) and the first leeward bank (31b) has a single opening row (50a). In each of the fins (45) of the first windward bank (31a) and the first leeward bank (31b), the lowermost one of the tube receiving openings (46) in the opening row (50a) is a tube-free opening (47). In each of the first windward bank (31a) and the first leeward bank (31b), a bottom wall surface (63) facing an internal space of each header member (61, 62) is positioned above the tube-free opening (47). The fins (45), the heat transfer tubes (40), and the header members (61, 62) are all made of an aluminum alloy.

[0055] Note that the first windward bank (31a) and the first leeward bank (31b) differ from the heat exchanger (30) of the first embodiment formed in an L-shape in plan view in that the heat transfer tubes (40) are formed into a linearly extending flat shape. Further, each of the first windward bank (31a) and the first leeward bank (31b) differs from the heat exchanger (30) of the first embodiment in the number and size of the fins (45), the number and length of the heat transfer tubes (40), and the shape of the header members (61, 62). The positions of the tube receiving openings (46) constituting the opening row (50a) of the first windward bank (31a) are shifted from the positions of the tube receiving openings (46) constituting the opening row (50a) of the first leeward bank (31b) by one-half pitch in the longitudinal direction of the fins (45).

<Second Heat Exchange Section>

[0056] The second heat exchange section (32) is arranged above the first heat exchange section (31). A lower end of the second heat exchange section (32) is in contact with an upper end of the first heat exchange section (31). The second heat exchange section (32) is inclined such that its upper portion is closer to the rear surface of the casing (21) than its lower portion (inclined to the right side in FIG. 5).

[0057] The second heat exchange section (32) includes a second windward bank (32a) and a second leeward bank (32b). The second windward bank (32a) and the second leeward bank (32b) are arranged to overlap each other. The second leeward bank (32b) is placed closer to the fan (24) than the second windward bank (32a).

[0058] As illustrated in FIG. 7, each of the second windward bank (32a) and the second leeward bank (32b) includes a plurality of rectangular plate-shaped fins (45), a plurality of flat-shaped heat transfer tubes (40), and a pair of tubular header members (61, 62), and is configured similarly to the heat exchanger (30) of the first embodiment. The fins (45), the heat transfer tubes (40), and the header members (61, 62) are all made of an alumi-

num alloy.

[0059] The longitudinal direction of the fins (45) constituting the second windward bank (32a) and the second leeward bank (32b) is inclined toward the rear surface of the casing (21) with respect to the longitudinal direction of the fins (45) constituting the first windward bank (31a) and the first leeward bank (31b).

[0060] As in the heat exchanger (30) of the first embodiment, each of the fins (45) of the second windward bank (32a) and the second leeward bank (32b) has a single opening row (50b). In each of the second windward bank (32a) and the second leeward bank (32b), a no-flow tube (41) is inserted in the lowermost one of the tube receiving openings (46) in the opening row (50b) formed in the fin (45). In each of the second windward bank (32a) and the second leeward bank (32b), a bottom wall surface (63) facing an internal space of each header member (61, 62) is positioned above the no-flow tube (41). Thus, the no-flow tube (41) does not communicate with the internal space of each header member (61, 62). No refrigerant flows through the no-flow tube (41).

[0061] Note that the second windward bank (32a) and the second leeward bank (32b) differ from the heat exchanger (30) of the first embodiment formed in an L-shape in plan view in that the heat transfer tubes (40) are formed into a linearly extending flat shape. Each of the second windward bank (32a) and the second leeward bank (32b) differs from the heat exchanger (30) of the first embodiment in the number and size of the fins (45), the number and length of the heat transfer tubes (40), and the shape of the header members (61, 62). The positions of the tube receiving openings (46) constituting the opening row (50b) of the second windward bank (32a) are shifted from the positions of the tube receiving openings (46) constituting the opening row (50b) of the second leeward bank (32b) by one-half pitch in the longitudinal direction of the fins (45).

<Third Heat Exchange Section>

[0062] The third heat exchange section (33) is arranged behind (on the right side in FIG. 5) the second heat exchange section (32). An upper end of the third heat exchange section (33) is in contact with an upper end of the second heat exchange section (32). A lower end portion of the third heat exchange section (33) is in the rear drain pan (26). The third heat exchange section (33) is inclined such that its upper portion is closer to the front surface of the casing (21) than its lower portion (inclined to the left side in FIG. 5).

[0063] The third heat exchange section (33) includes a third windward bank (33a) and a third leeward bank (33b). The third windward bank (33a) and the third leeward bank (33b) are arranged to overlap each other. The third leeward bank (33b) is placed closer to the fan (24) than the third windward bank (33a).

[0064] As illustrated in FIG. 6, each of the third windward bank (33a) and the third leeward bank (33b) includes a plurality of rectangular plate-shaped fins (45), a plurality of flat-shaped heat transfer tubes (40), and a pair of tubular header members (61, 62), and is configured similarly to the heat exchanger (30) of the first embodiment.

[0065] Specifically, each of the fins (45) of the third windward bank (33a) and the third leeward bank (33b) has a single opening row (50c). In each of the fins (45) of the third windward bank (33a) and the third leeward bank (33b), the lowermost one of the tube receiving openings (46) in the opening row (50) is a tube-free opening (47). In each of the third windward bank (33a) and the third leeward bank (33b), a bottom wall surface (63) facing an internal space of each header member (61, 62) is positioned above the tube-free opening (47). The fins (45), the heat transfer tubes (40), and the header members (61, 62) are all made of an aluminum alloy.

[0066] Note that the third windward bank (33a) and the third leeward bank (33b) differ from the heat exchanger (30) of the first embodiment formed in an L-shape in plan view in that the heat transfer tubes (40) are formed into a linearly extending flat shape. Each of the third windward bank (33a) and the third leeward bank (33b) differs from the heat exchanger (30) of the first embodiment in the number and size of the fins (45), the number and length of the heat transfer tubes (40), and the shape of the header members (61, 62). The positions of the tube receiving openings (46) constituting the opening row (50c) of the third windward bank (33a) are shifted from the positions of the tube receiving openings (46) constituting the opening row (50c) of the third leeward bank (33b) by one-half pitch in the longitudinal direction of the fins (45).

<Function of Heat Exchanger>

[0067] The heat exchanger (30) exchanges heat between the refrigerant and the air. In the cooling operation of the air conditioner, the heat exchanger (30) provided in the indoor unit (20) functions as an evaporator. In the heat exchanger (30) functioning as an evaporator, the refrigerant flowing through the heat transfer tubes (40) absorbs heat from the air passing between the fins (45) and evaporates.

[0068] When the heat exchanger (30) functions as an evaporator, water vapor contained in the air is condensed on the surfaces of the fins (45) to produce condensed water. The condensed water thus produced flows down along the fins (45). The condensed water generated in the first heat exchange section (31) flows down to the front drain pan (25) along the fins (45) of the first heat exchange section (31). The condensed water generated in the second heat exchange section (32) flows down along the fins (45) of the second heat exchange section (32), and then flows down to the front drain pan (25) along the fins (45) of the first heat exchange section (31). The condensed water generated in the third heat exchange section (33) flows down to the rear drain pan (26) along the fins (45) of the third heat exchange section (33).

- Feature (1) of Second Embodiment -

[0069] The indoor unit (20) of the present embodiment includes the heat exchanger (30), the fan (24) that sends the air to the heat exchanger (30), and the drain pans (25, 26). The drain pans (25, 26) are provided below the heat exchanger (30) and receive the condensed water generated in the heat exchanger (30). In the heat exchanger (30) of the present embodiment, the tube-free opening (47) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is positioned below an upper edge (25a) of the front drain pan (25). In the heat exchanger (30) of the present embodiment, the tube-free opening (47) in the opening row (50b) of each fin (45) of the third heat exchange section (33) is positioned below an upper edge (26a) of the rear drain pan (26).

[0070] In the indoor unit (20) of the present embodiment, the lower end portion of the first heat exchange section (31) is positioned below the upper edge (25a) of the front drain pan (25), and the lower end portion of the third heat exchange section (33) is positioned below the upper edge (26a) of the rear drain pan (26). Thus, the lower end portions of the first heat exchange section (31) and the third heat exchange section (33) may be immersed in the condensed water for a long time.

[0071] In the heat exchanger (30) of the present embodiment, one of the tube receiving openings (46) in the fin (45) of the first heat exchange section (31) positioned below the upper edge (25a) of the front drain pan (25) is the tube-free opening (47). In this heat exchanger (30), one of the tube receiving openings (46) in the fin (45) of the third heat exchange section (33) positioned below the upper edge (26a) of the rear drain pan (26) is the tube-free opening (47). Thus, no heat transfer tubes (40) are provided at the lower end portions of the first heat exchange section (31) and the third heat exchange section (33), reducing the possibility of corrosion of the heat transfer tubes (40) of the heat exchanger (30).

- Feature (2) of Second Embodiment -

[0072] The heat exchanger (30) of the present embodiment includes the first heat exchange section (31) and the second heat exchange section (32). Each of the first heat exchange section (31) and the second heat exchange section (32) includes the fins (45) and the heat transfer tubes (40) inserted in the tube receiving openings (46) of the fins (45). The second heat exchange section (32) is arranged above the first heat exchange section (31). The longitudinal direction of the fins (45) of the second heat exchange section (32) is inclined with respect to the longitudinal direction of the fins (45) of the first heat exchange section (31). The lowermost one of the tube receiving openings (46) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is the tube-free opening (47). The no-flow tube (41) in which no fluid flows is inserted in the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32).

[0073] In the heat exchanger (30) of the present embodiment, the no-flow tube (41) is inserted in the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32). Even if the no-flow tube (41) corrodes, no refrigerant leaks from the no-flow tube (41). Thus, in this aspect, leakage of the refrigerant due to the corrosion of the heat transfer tubes (40) can be less likely to occur, improving the reliability of the heat exchanger (30).

[0074] If the second heat exchange section (32) has no no-flow tube (41), the amount of air passing near the lower end of the second heat exchange section (32) without exchanging heat with the refrigerant increases. This may lead to a decrease in heat exchange performance of the heat exchanger (30). In the present embodiment, however, the no-flow tube (41) is provided near the lower end of the second heat exchange section (32), and the flow rate of the air passing near the lower end of the second heat exchange section (32) can be made substantially equal to the flow rate of the air passing through the other portion of the second heat exchange section (32). Thus, in the present embodiment, the decrease in heat exchange performance of the heat exchanger (30) can be avoided.

-Variation of Second Embodiment-

[0075] As illustrated in FIG. 8, in each of the second windward bank (32a) and the second leeward bank (32b) constituting the second heat exchange section (32) of the heat exchanger (30) of the present embodiment, the lowermost one of the tube receiving openings (46) in the opening row (50) formed in the fin (45) may be the tube-free opening (47). The second windward bank (32a) and the second leeward bank (32b) of this variation have no no-flow tube (41).

<Features of Variation>

[0076] The heat exchanger (30) of this variation includes the first heat exchange section (31) and the second heat exchange section (32). Each of the first heat exchange section (31) and the second heat exchange section (32) includes the fins (45) and the heat transfer tubes (40) inserted in the tube receiving openings (46) of the fins (45). The second heat exchange section (32) is arranged above the first heat exchange section (31). The longitudinal direction of the fins (45) of the second heat exchange section (32) is inclined with respect to the longitudinal direction of the fins (45) of the first heat exchange section (31). In the heat exchanger (30) of this variation, the lowermost one of the tube receiving openings (46) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is the tube-free opening (47), and the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the

second heat exchange section (32) is the tube-free opening (47).

[0077] In the heat exchanger (30) of this variation, the second heat exchange section (32) arranged above the first heat exchange section (31) is inclined with respect to the first heat exchange section (31). When the heat exchanger (30) functions as an evaporator, condensed water generated in the second heat exchange section (32) flows down to the first heat exchange section (31) positioned below the second heat exchange section (32). Thus, the condensed water may remain near the lower end of the second heat exchange section (32).

[0078] However, in the heat exchanger (30) of this variation, the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32) is the tube-free opening (47). Thus, no heat transfer tube (40) is present near the lower end of the second heat exchange section (32), reducing the possibility of corrosion of the heat transfer tubes (40) of the second heat exchange section (32).

«Third Embodiment»

[0079] A third embodiment will be described below. The present embodiment has been made by modifying the structure of the heat exchanger (30) of the indoor unit (20) of the second embodiment. The following description will be focused on the differences between an indoor unit (20) of the present embodiment and the indoor unit (20) of the second embodiment.

-Heat Exchanger-

[0080] As illustrated in FIG. 9, a heat exchanger (30) of the present embodiment is a so-called cross-fin-type fin-and-tube heat exchanger. The heat exchanger (30) includes a plurality of plate-shaped fins (45) and a plurality of circular heat transfer tubes (40). The fins (45) are made of an aluminum alloy. The heat transfer tubes (40) are made of a copper alloy.

[0081] The heat exchanger (30) is arranged to cover the front and top of the fan (24). The heat exchanger (30) includes a front heat exchange section (35) and a rear heat exchange section (36). Each of the front heat exchange section (35) and the rear heat exchange section (36) has a two row structure.

<Front Heat Exchange Section>

[0082] The front heat exchange section (35) is curved to the rear side of the casing (21) (to the right side in FIG. 5). The front heat exchange section (35) is arranged to extend from the front (the left side in FIG. 9) to top of the fan (24). A lower end portion of the front heat exchange section (35) is in a front drain pan (25).

[0083] The front heat exchange section (35) includes a plurality of plate-shaped fins (45) and a plurality of circular heat transfer tubes (40). The fins (45) are formed in an elongated plate shape. Each fin (45) has a pair of curved long sides extending along the longitudinal direction, and the long sides are substantially parallel to each other. The fins (45) of the front heat exchange section (35) are arranged such that their longitudinal direction corresponds to the up-and-down direction.

[0084] Each of the fins (45) is provided with a plurality of tube receiving openings (46). Each of the tube receiving openings (46) is a circular hole penetrating the fin (45) in the thickness direction. The tube receiving openings (46) are arranged in a row along each of the two long sides extending in the longitudinal direction of the fins (45). The tube receiving openings (46) arranged along the outer long side of the curved fin (45) constitute a first opening row (51a). The tube receiving openings (46) arranged along the inner long side of the curved fin (45) constitute a second opening row (52a).

[0085] In each of the first opening row (51a) and the second opening row (52a), the tube receiving openings (46) are arranged in a row in the longitudinal direction of the fin (45). In each of the first opening row (51a) and the second opening row (52a), the tube receiving openings (46) are arranged at predetermined intervals in the longitudinal direction of the fin (45). The positions of the tube receiving openings (46) constituting the first opening row (51a) are shifted from the positions of the tube receiving openings (46) constituting the second opening row (52a) by one-half pitch in the longitudinal direction of the fins (45). The lowermost one of the tube receiving openings (46) in each of the first opening row (51a) and the second opening row (52a) is a tube-free opening (47).

[0086] The heat transfer tubes (40) are inserted one by one in the tube receiving openings (46) of the fins (45). Note that no heat transfer tube (40) is inserted in the tube-free openings (47) of the fins (45) of the front heat exchange section (35). In the first opening row (51a) and the second opening row (52a) of each fin (45), the heat transfer tubes (40) are inserted in the tube receiving openings (46) other than the lowermost tube-free opening (47).

<Rear Heat Exchange Section>

[0087] The rear heat exchange section (36) is formed in a flat shape. The rear heat exchange section (36) is arranged above the fan (24). A lower end portion of the rear heat exchange section (36) is in a rear drain pan (26). The rear heat exchange section (36) is inclined such that its upper portion is closer to the front surface of the casing (21) than its lower portion (inclined to the left side in FIG. 9).

[0088] The rear heat exchange section (36) includes a plurality of plate-shaped fins (45) and a plurality of circular heat transfer tubes (40). The fins (45) are formed in an elongated rectangular plate shape. The fins (45) of the rear heat exchange section (36) are arranged such that their longitudinal direction corresponds to the up-and-down direction.

[0089] Each of the fins (45) is provided with a plurality of tube receiving openings (46). Each of the tube receiving openings (46) is a circular hole penetrating the fin (45) in the thickness direction. The tube receiving openings (46) are arranged in a row along each of the two long sides extending in the longitudinal direction of the fins (45). The tube receiving openings (46) arranged along the upper long side of the inclined fin (45) constitute a first opening row (51b). The tube receiving openings (46) arranged along the lower long side of the inclined fin (45) constitute a second opening row (52b).

[0090] In each of the first opening row (51b) and the second opening row (52b), the tube receiving openings (46) are arranged in a row in the longitudinal direction of the fin (45). In each of the first opening row (51b) and the second opening row (52b), the tube receiving openings (46) are arranged at predetermined intervals in the longitudinal direction of the fin (45). The positions of the tube receiving openings (46) constituting the first opening row (51b) are shifted from the positions of the tube receiving openings (46) constituting the second opening row (52b) by one-half pitch in the longitudinal direction of the fins (45). The lowermost one of the tube receiving openings (46) in each of the first opening row (51b) and the second opening row (52b) is a tube-free opening (47).

[0091] The heat transfer tubes (40) are inserted one by one in the tube receiving openings (46) of the fins (45). Note that no heat transfer tube (40) is inserted in the tube-free openings (47) of the fins (45) of the rear heat exchange section (36). In the first opening row (51b) and the second opening row (52b) of each fin (45), the heat transfer tubes (40) are inserted in the tube receiving openings (46) other than the lowermost tube-free opening (47).

- Feature (1) of Third Embodiment -

[0092] The heat exchanger (30) of the present embodiment includes the plurality of heat transfer tubes (40) arranged parallel to each other and the plurality of plate-shaped fins (45). Each of the fins (45) is provided with the plurality of tube receiving openings (46) in which the heat transfer tubes (40) are inserted. The fins (45) are arranged such that their longitudinal direction corresponds to the up-and-down direction. The fin (45) has a plurality of opening rows (51a, 52a, 51b, 52b). Each opening row (51a, 52a, 51b, 52b) is constituted of a plurality of tube receiving openings (46) arranged in a row in the longitudinal direction of the fin (45). The lowermost one of the tube receiving openings (46) in each of the opening rows (51a, 52a, 51b, 52b) is the tube-free opening (47) through which no heat transfer tube (40) is inserted.

[0093] In the heat exchanger (30) of the present embodiment, each fin (45) has a plurality of opening rows (51a, 52a, 51b, 52b). No heat transfer tube (40) is inserted in the tube-free opening (47), which is the lowermost one of the tube receiving openings (46) in each of the opening rows (51a, 52a, 51b, 52b) of the fin (45). The heat exchanger (30) of the present embodiment has no heat transfer tube (40) at the lower end portion where condensed water tends to remain. Thus, in the present embodiment, the heat transfer tubes (40) can be less likely to corrode due to the condensed water, improving the reliability of the heat exchanger (30).

[0094] While the embodiment and variations 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 embodiments and variations thereof may be combined and replaced with each other without deteriorating the intended functions of the present disclosure.

INDUSTRIAL APPLICABILITY

[0095] As can be seen from the foregoing description, the present disclosure is useful for a heat exchanger and a heat exchange unit.

DESCRIPTION OF REFERENCE CHARACTERS

[0096]

10	Outdoor Unit (Heat Exchange Unit)
13	Drain Pan
13a	Upper Edge
20	Indoor Unit (Heat Exchange Unit)
24	Fan
25	Front Drain Pan
25a	Upper Edge
26	Rear Drain Pan
26a	Upper Edge
30	Heat Exchanger
31	First Heat Exchange Section
32	Second Heat Exchange Section
40	Heat Transfer Tube
41	Circulation-free Tube
45	Fin
46	Tube Receiving Opening
47	Tube-Free Opening
50, 50a, 50b	Opening Row
51a, 51b	First Opening Row
52a, 52b	Second Opening Row
61, 62	Header Member
63	Bottom Wall Surface

Claims

1. A heat exchanger comprising: a plurality of heat transfer tubes (40) arranged in parallel to each other; and a plurality of plate-shaped fins (45) each having a plurality of tube receiving openings (46) in which the heat transfer tubes (40) are inserted, wherein

each of the fins (45)

is arranged such that its longitudinal direction corresponds to an up-and-down direction, and
has a single opening row (50) constituted of the plurality of tube receiving openings (46) arranged in a row in the longitudinal direction of the fin (45), and

the lowermost one of the tube receiving openings (46) in the opening row (50) is a tube-free opening (47) in which no heat transfer tube (40) is inserted.

2. A heat exchanger comprising: a plurality of heat transfer tubes (40) arranged in parallel to each other; and a plurality of plate-shaped fins (45) each having a plurality of tube receiving openings (46) in which the heat transfer tubes (40) are inserted, wherein

each of the fins (45)

is arranged such that its longitudinal direction corresponds to an up-and-down direction, and
has a plurality of opening rows (51a, 52a, 51b, 52b) each of which is constituted of the plurality of tube receiving openings (46) arranged in a row in the longitudinal direction of the fin (45), and

the lowermost one of the tube receiving openings (46) in each of the opening rows (51a, 52a, 51b, 52b) is a tube-free opening (47) in which no heat transfer tube (40) is inserted.

3. The heat exchanger of claim 1 or 2, wherein
the heat transfer tubes (40) are made of an aluminum alloy.

4. The heat exchanger of claim 3, wherein
each of the heat transfer tubes (40) has a flat shape with a width greater than its thickness.

5. The heat exchanger of any one of claims 1 to 4, further comprising:

a header member (61, 62) formed in a tubular shape extending along the longitudinal direction of the fins (45), connected to the heat transfer tubes (40), and has an internal space communicating with the heat transfer tubes (40), and
a bottom wall surface (63) facing the internal space of the header member (61, 62) is positioned above the tube-free opening (47) in the opening row (50).

6. The heat exchanger of any one of claims 1 to 5, further comprising:

a first heat exchange section (31) and a second heat exchange section (32) each having the fins (45) and the heat transfer tubes (40) inserted in the tube receiving openings (46) of the fins (45), wherein
the second heat exchange section (32) is arranged above or on the first heat exchange section (31),
a longitudinal direction of the fins (45) of the second heat exchange section (32) is inclined with respect to a longitudinal direction of the fins (45) of the first heat exchange section (31), and
the lowermost one of the tube receiving openings (46) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is the tube-free opening (47), and the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32) is the tube-free opening (47).

7. The heat exchanger of any one of claims 1 to 5, further comprising:

a first heat exchange section (31) and a second heat exchange section (32) each having the fins and the heat transfer tubes (40) inserted in the tube receiving openings (46) of the fins, wherein
the second heat exchange section (32) is arranged above or on the first heat exchange section (31),
a longitudinal direction of the fins (45) of the second heat exchange section (32) is inclined with respect to a longitudinal direction of the fins (45) of the first heat exchange section (31), and
the lowermost one of the tube receiving openings (46) in the opening row (50a) of each fin (45) of the first heat exchange section (31) is the tube-free opening (47), and
a no-flow tube (41) in which no fluid flows is inserted in the lowermost one of the tube receiving openings (46) in the opening row (50b) of each fin (45) of the second heat exchange section (32).

8. A heat exchange unit comprising: the heat exchanger (30) of any one of claims 1 to 7;

a fan (24) that sends air to the heat exchanger (30); and
a drain pan (13, 25, 26) that is provided below the heat exchanger (30) and receives condensed water generated in the heat exchanger (30), wherein
the tube-free opening (47) in the opening row (50) of each fin (45) of the heat exchanger (30) is positioned below an upper edge (13a, 25a, 26a) of the drain pan (13, 25, 26).

FIG.1

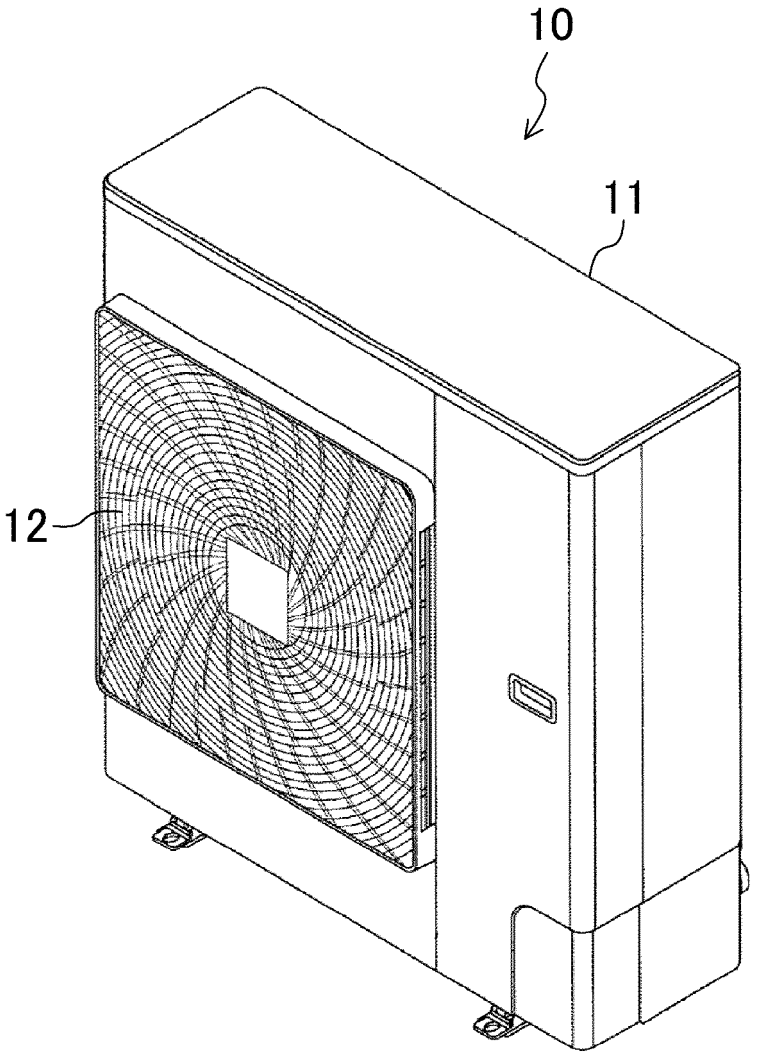


FIG.2

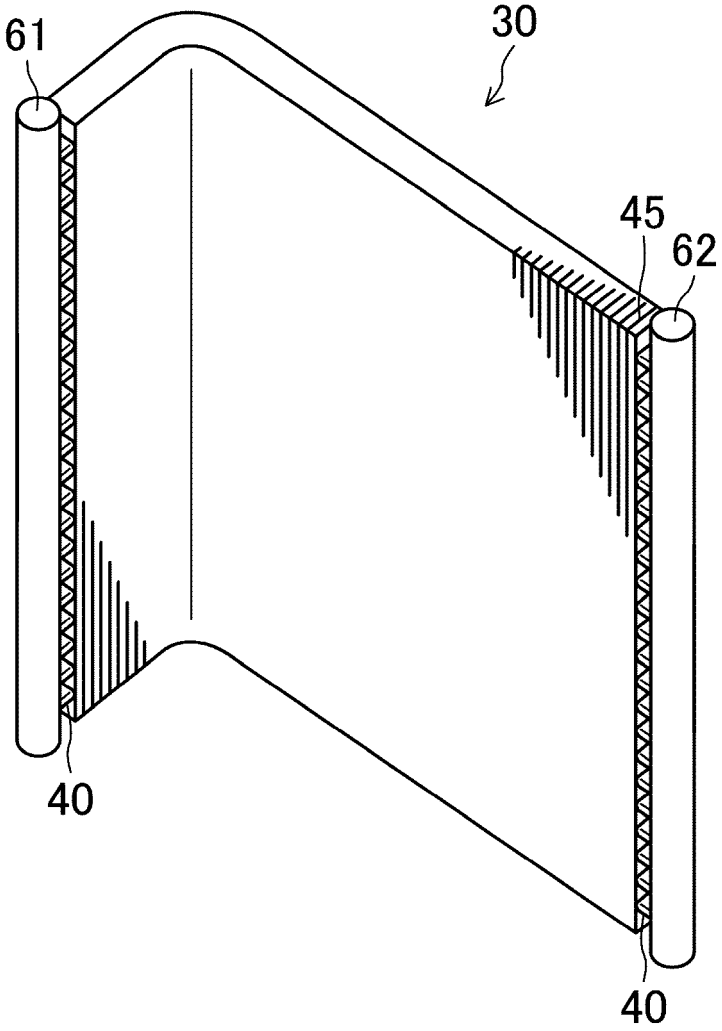


FIG.3

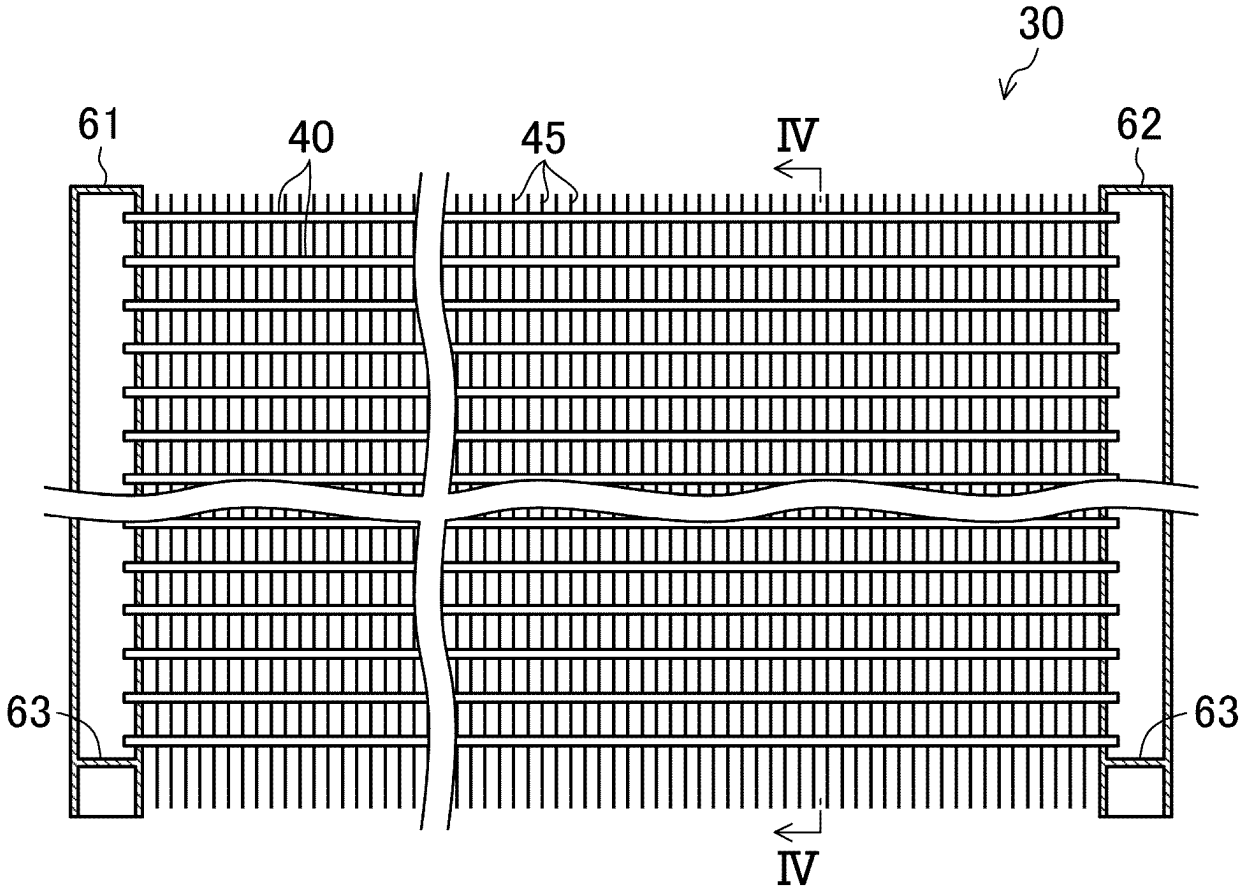


FIG.4

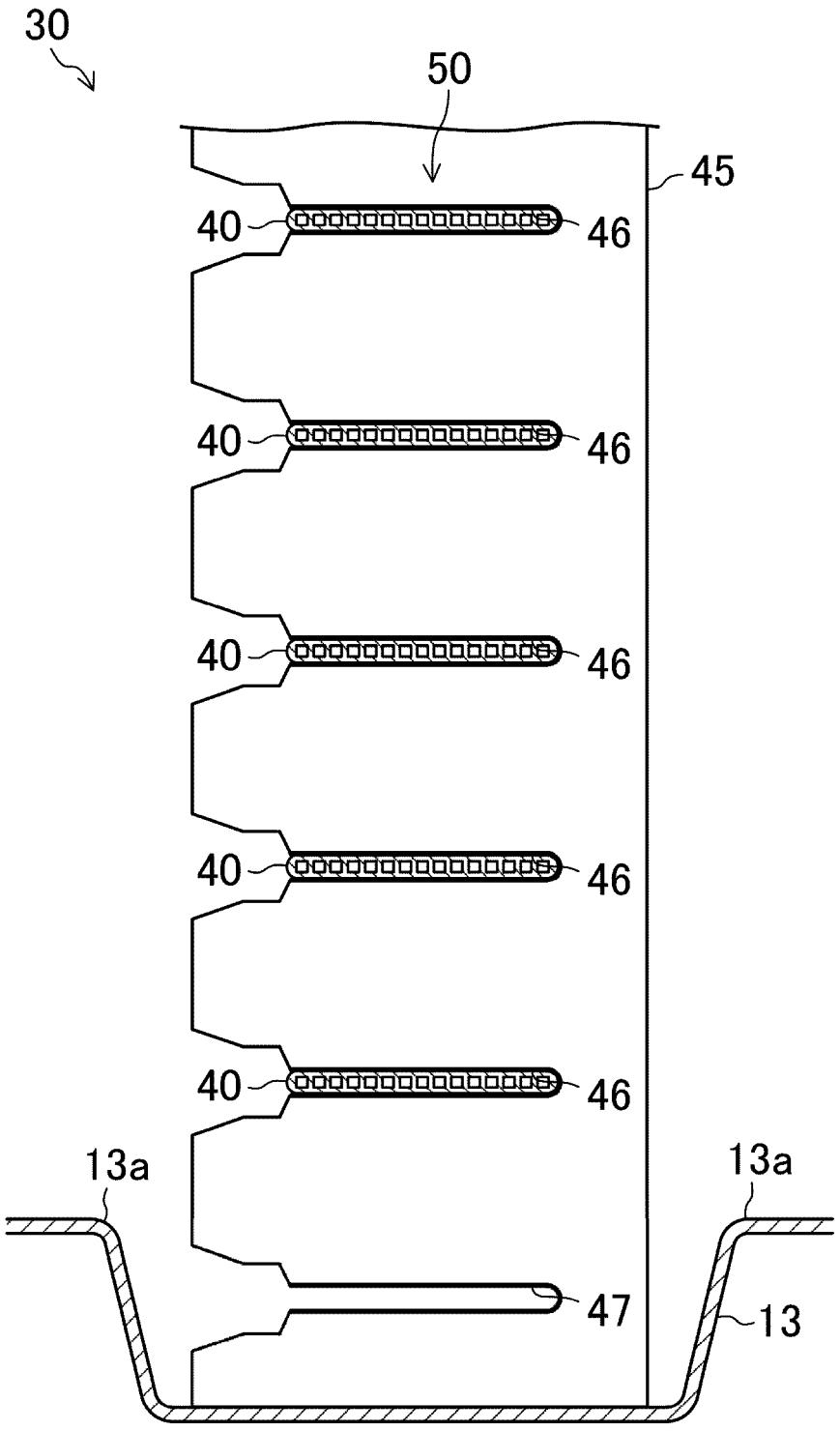


FIG.5

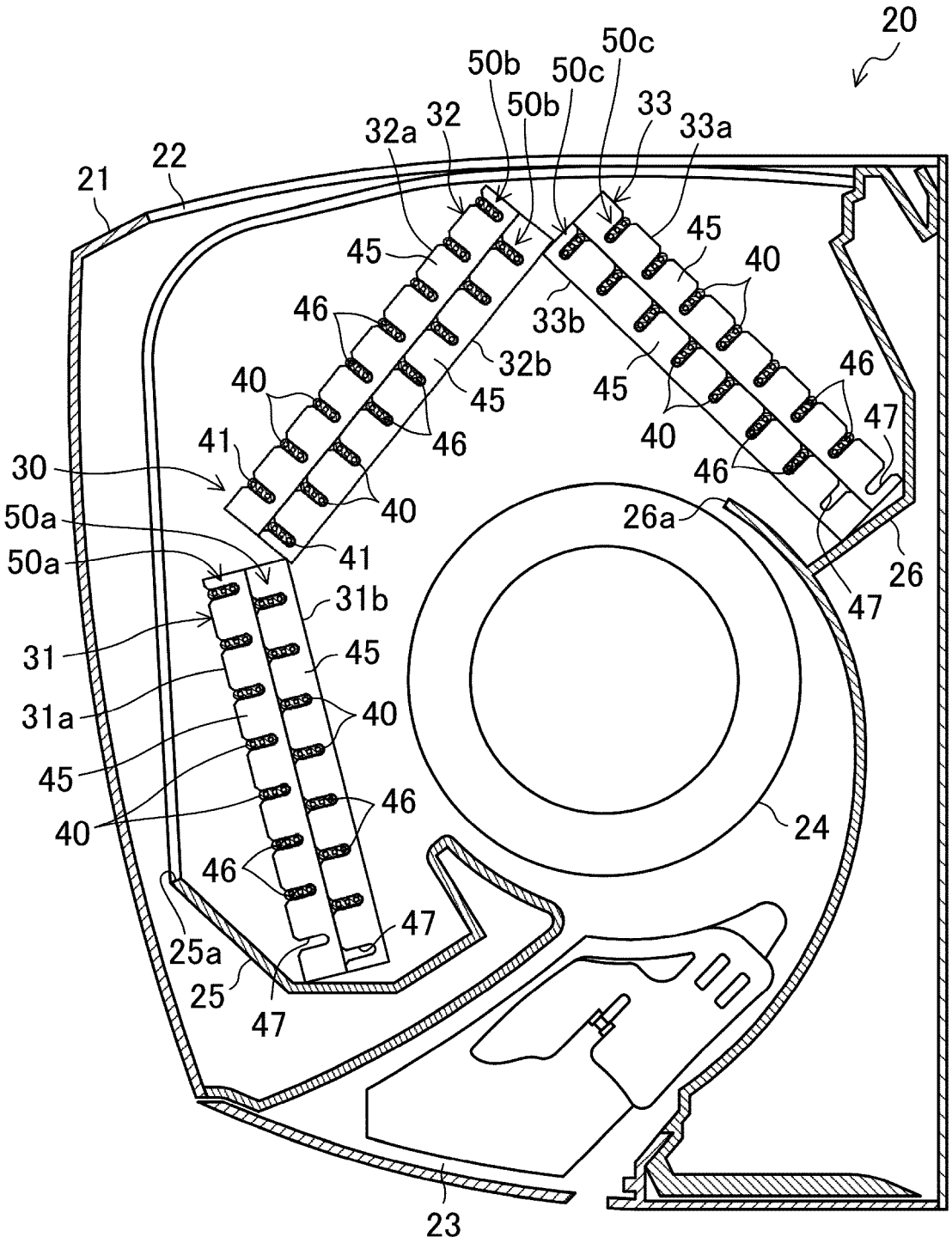

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FIG.6

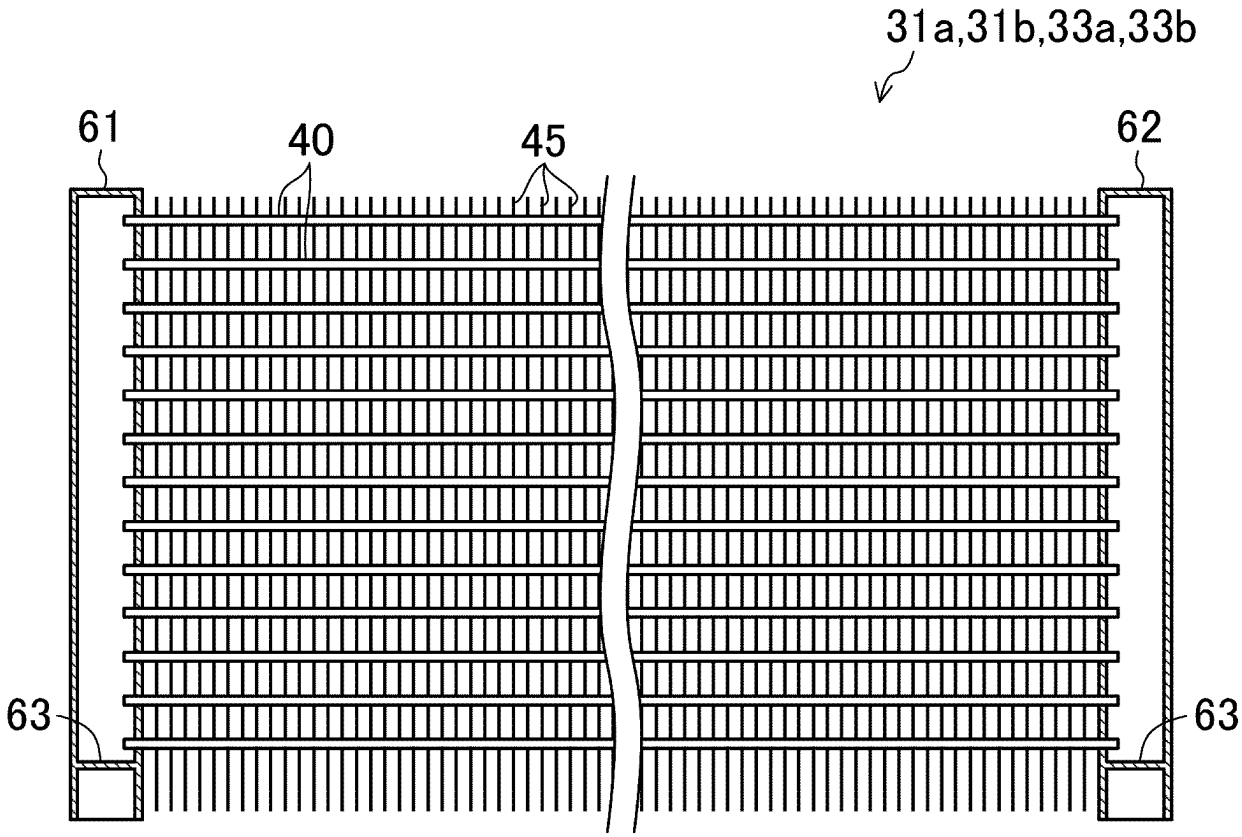

FIG.7

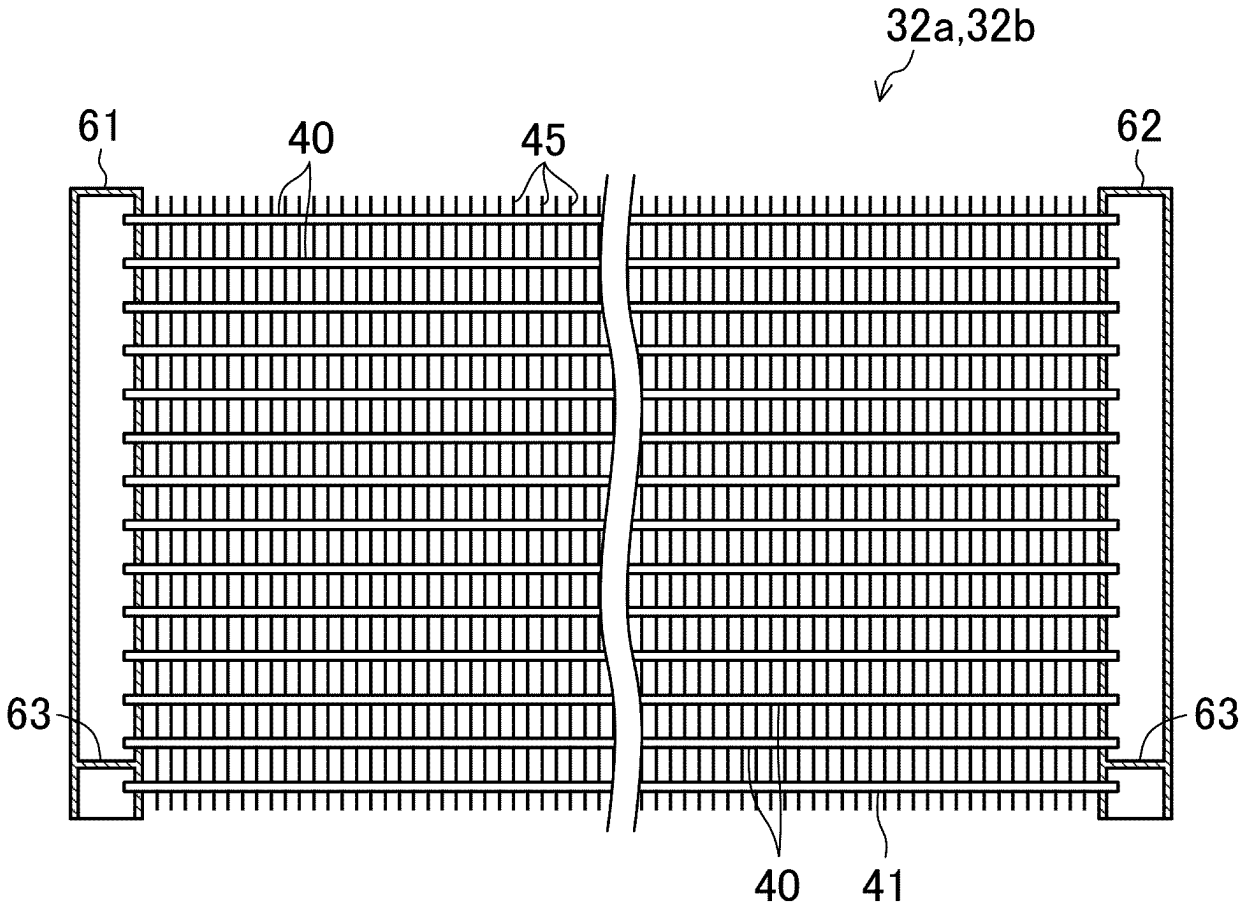

FIG.8

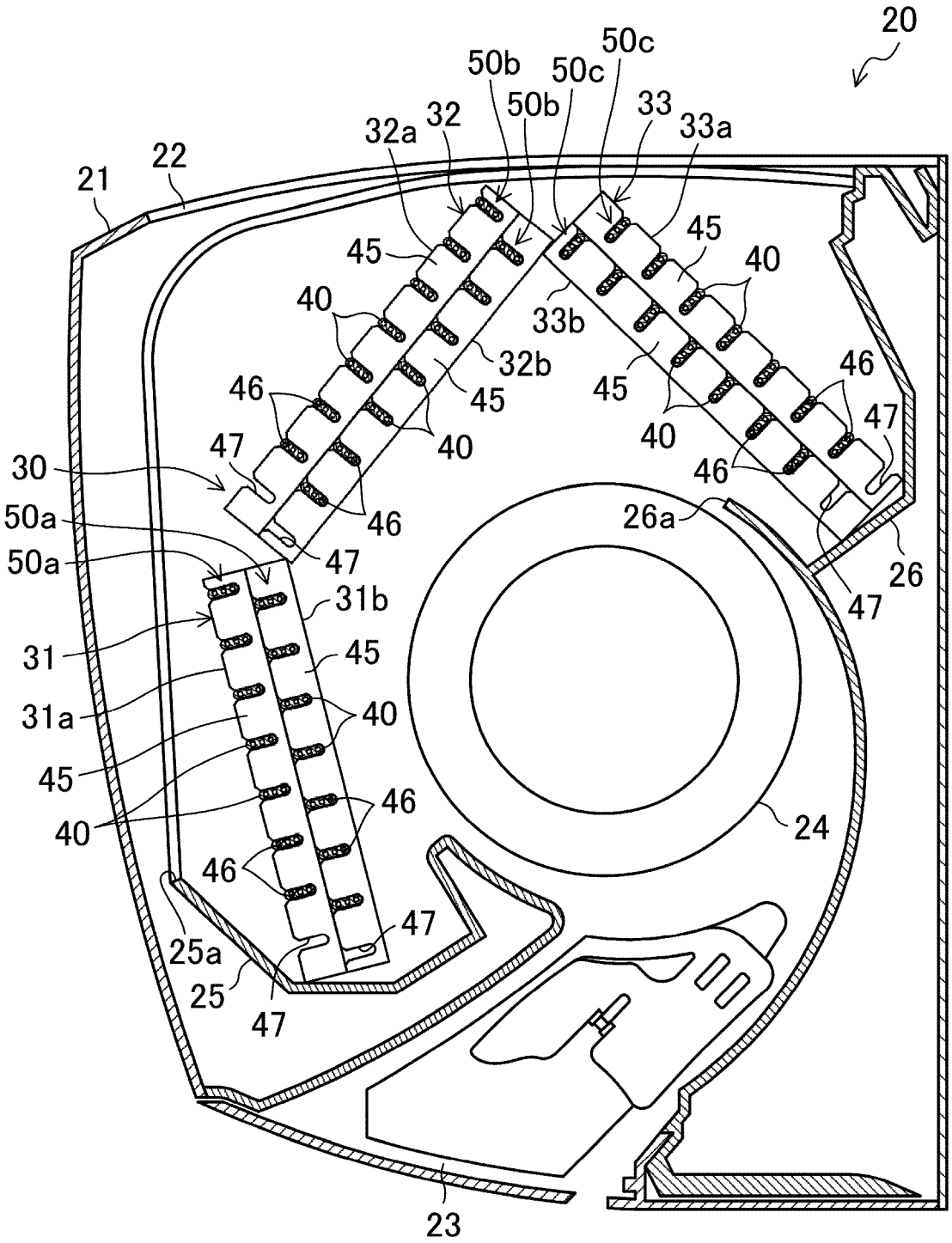
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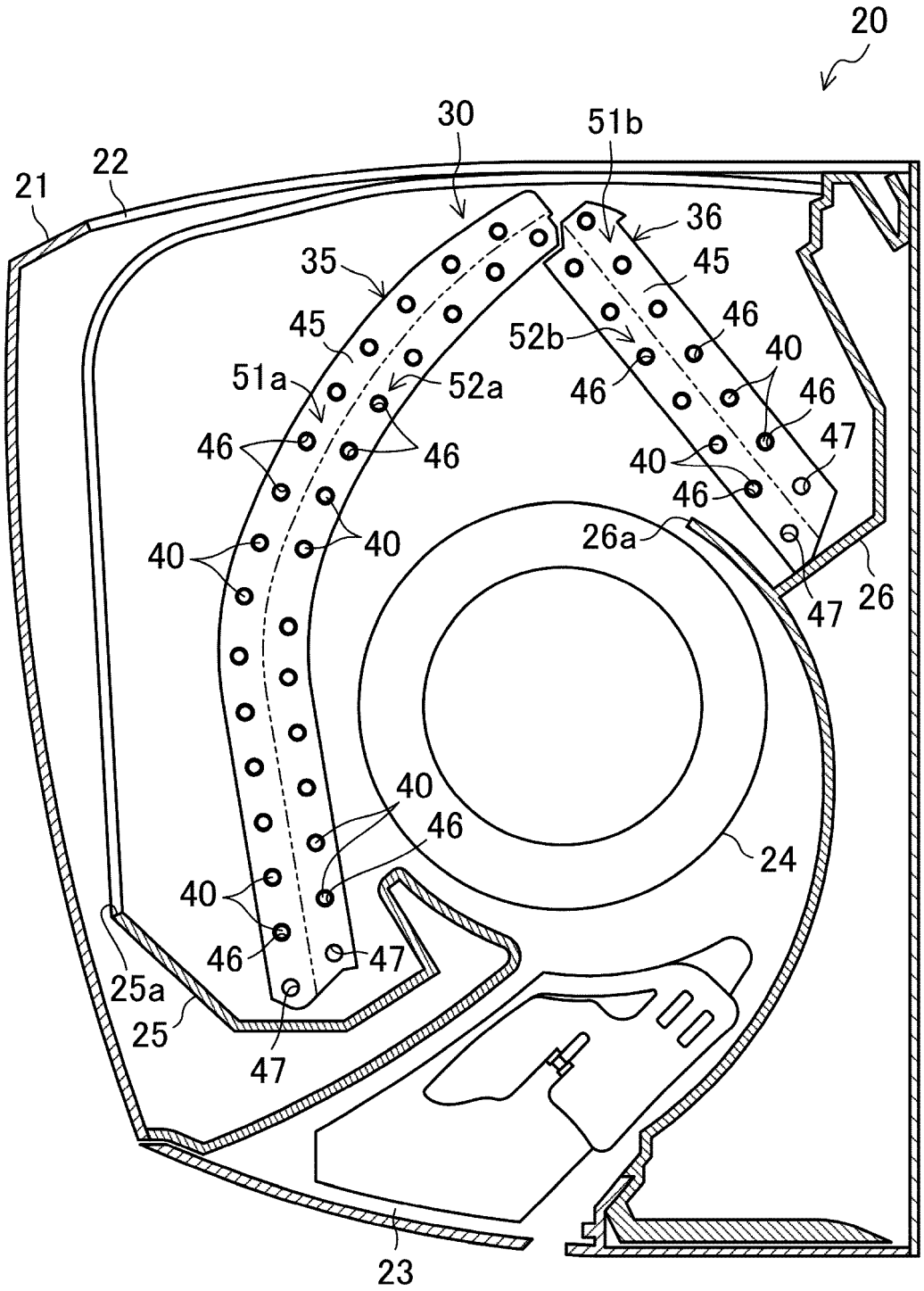
FIG.9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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/027038

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F28D1/053(2006.01)i, F28F1/02(2006.01)i, F28F1/32(2006.01)i, F28F21/08(2006.01)i, F28F27/02(2006.01)i, F28F9/02(2006.01)i, F24F13/22(2006.01)i, F24F13/30(2006.01)i, F24F1/0067(2019.01)i
FI: F28F1/32W, F24F1/0067, F24F13/30, F28F1/02A, F28F21/08A, F28F9/02301E, F28F27/02C, F28D1/053A, F24F1/0007361Z, F24F13/22
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. F28D1/053, F28F1/02, F28F1/32, F28F21/08, F28F27/02, F28F9/02, F24F13/22, F24F13/30, F24F1/0067

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	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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 Y	JP 2018-35992 A (FUJITSU GENERAL LIMITED) 08.03.2018 (2018-03-08), paragraphs [0013]-[0027], fig. 1-5	1 3-8
X Y	JP 2013-242104 A (MITSUBISHI ELECTRIC CORPORATION) 05.12.2013 (2013-12-05), paragraphs [0015]-[0039], fig. 1-6	2 3
Y	WO 2013/160959 A1 (MITSUBISHI ELECTRIC CORPORATION) 31.10.2013 (2013-10-31), paragraphs [0009]-[0014], fig. 1-3	3-8
A	JP 2012-211735 A (DAIKIN INDUSTRIES, LTD.) 01.11.2012 (2012-11-01), paragraphs [0024]-[0082], fig. 1-7	1-8

☒ 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
04.09.2020	24.09.2020

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/JP2020/027038

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 16334/1984 (Laid-open No. 128168/1985) (DAIKIN INDUSTRIES, LTD.) 28.08.1985 (1985-08-28), specification, page 5, line 12 to page 12, line 7, 1-8	1-8

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/027038

JP 2018-35992 A	08.03.2018	(Family: none)	
JP 2013-242104 A	05.12.2013	(Family: none)	
WO 2013/160959 A1	31.10.2013	US 2015/0101362 A1 paragraphs [0017]-[0022], fig. 1-3 EP 2863159 A1 CN 104246410 A	
JP 2012-211735 A	01.11.2012	(Family: none)	
JP 60-128168 U1	28.08.1985	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015127607 A **[0003]**