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(54) **HEAT EXCHANGER SHUNT**

NEBENANSCHLUSS FÜR WÄRMETAUSCHER

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a heat exchanger which is constituted by a pair of header pipes and a plurality of flat pipes having a plurality of refrigerant flow paths to execute heat exchange between air flowing in the plurality of flat pipes and refrigerant flowing in the refrigerant flow paths of the flat pipes.

Description of the Related Art

[0002] Conventionally, a heat exchanger has been known, which is constituted by a pair of header pipes facing right and left in a horizontal direction, a plurality of flat pipes having a plurality of refrigerant flow paths and a heat-transfer fin provided between the flat pipes to execute heat exchange between air flowing in the plurality of flat pipes and refrigerant flowing in the refrigerant flow paths of the flat pipes.

[0003] In such kind of heat exchanger, it is disclosed a heat exchanger shunt in which the plurality of flat pipes are further grouped into groups of several flat pipes and each group constitutes a one-turn heat exchange section where one of the pair of header pipes flows refrigerant to the other, and an upper limit and a lower limit of the number of flat pipes constituting the one-turn heat exchange section are determined by a formula using a rated capacity of an air conditioner, a cross-sectional area of the refrigerant flow path of the flat pipes and a hydraulic diameter, so that the number of the flat pipes in the heat exchange section is optimized and uneven flow can be inhibited (for example, see Japanese Patent Laid-Open No. 2014-48028.)

[0004] FIG. 6 is a conventional heat exchanger disclosed in Japanese Patent Laid-Open No. 2014-48028.

[0005] As shown in FIG. 6, a heat exchanger 100 is constituted by a plurality of flat pipes 101 formed by a plurality of refrigerant flow paths and a pair of header pipes 102a, 102b each of which connects both ends of the flat pipes 101, and to the header pipes 102a, 102b, partition plates 104a, 104b and 104c are provided to divide the plurality of flat pipes 101 into a plurality of heat exchange sections 103a, 103b, 103c and 103d, and refrigerant piping 105a, 105b are connected to one header pipe 102a.

[0006] The heat exchange sections 103a, 103b are divided by the partition plate 104a, the heat exchange sections 103b, 103c are divided by the partition plate 104b and the heat exchange sections 103c, 103d are divided by the partition plate 104c, respectively.

[0007] When the heat exchanger 100 is used as an outdoor unit of an air conditioner, the number of flat pipes 101 constituting each of the heat exchange sections 103a, 103b, 103c and 103d are determined as within an upper limit and a lower limit obtained by a formula using a rated capacity for heating, a cross-sectional area of the refrigerant flow path of one flat pipe 101 and a hydraulic diameter.

[0008] When the heat exchanger 100 is used as an evaporator, refrigerant flows from a refrigerant piping 105b into one header pipe 102a, passes through the heat exchange section 103d, flows to the other header pipe 102b, moves upward in the other header pipe 102b, passes through the heat exchange section 103c and outflows to one header pipe 102a.

[0009] Further, the refrigerant flowing to one header pipe 102a moves upward in one header pipe 102a, passes through the heat exchange section 103b, flows to the other header pipe 102b, moves upward in the other header pipe 102b, passes through the heat exchange section 103a and flows to one header pipe 102a.

[0010] In flowing from the header pipes 102a, 102b to the plurality of flat pipes 101, setting to the number of the flat pipes 101 which does not cause uneven flow is executed, so that the refrigerant can be evenly distributed to each of the flat pipes 101.

[0011] When the heat exchanger 100 is used as the evaporator, the refrigerant is evaporated each time when it flows in each heat exchange section, and along the flowing from an inlet to an outlet of the heat exchanger, the refrigerant is changed from a liquid state (liquid rich) to a gas state (gas rich), so that a state of refrigerant which should be distributed to each heat exchange section differs. Since the state of refrigerant differs, a flowing state of the refrigerant differs. However, in a conventional configuration, shunt current improvement is insufficient since a difference of the state of refrigerant is not considered.

[0012] Especially, in the header pipe at an upstream side of evaporation where the refrigerant with a large ratio of liquid refrigerant with a high density (liquid rich) flows, since a flow distance of the refrigerant from the inlet of the heat exchanger is short, energy lost by pressure loss and a head difference is small and the refrigerant moves upward in the header pipe while kinetic energy is kept from the state where the refrigerant flows into the heat exchanger. Accordingly, such a problem has existed that, inertia of outflowing to the flat pipe is large, and uneven flow of the liquid refrigerant occurs at an upper portion of the heat exchange sections with momentum of moving upward in the header pipe, which causes the refrigerant to unevenly flow to the plurality of flat pipes.

[0013] US 2013/0126140 describes a heat exchanger according to the preamble of claim 1, that includes a plurality of refrigerant tubes extending in a horizontal direction, at least one fin coupled to the plurality of refrigerant tubes, a vertically oriented header coupled to corresponding ends of the plurality of refrigerant tubes, the header distributing refrigerant into the plurality of refrigerant tubes, and a partition device that partitions an inner space of the header, the partition device including at least two through holes that guide refrigerant into the plurality of refrigerant tubes.

[0014] US 2008/0023185 describes a heat exchanger assembly including a first single-piece manifold and a second single-piece manifold spaced from and parallel to the first single-piece manifold. Each of the first and second single-piece manifolds has a tubular wall defining a flow path. A plurality of flow tubes extend in parallel between the first and second single-piece manifolds and are in fluid communication with the flow paths. An insert having a distribution surface is slidably disposed in the flow path of the first single-piece manifold to establish a distribution chamber within the first single-piece manifold. A series of orifices defined in the distribution surface of the insert are in fluid communication with the flow path and the distribution chamber for uniformly distributing a heat exchange fluid between the flow path and the flow tubes.

[0015] The present invention resolves the conventional problem, and an object of the present invention is to evenly flow refrigerant into a plurality of flat pipes in a heat exchanger constituted by the plurality of flat pipes formed by a plurality of refrigerant flow paths and a pair of header pipes each of which connects both ends of the flat pipes.

SUMMARY OF THE INVENTION

[0016] In order to solve the conventional problem, there is provided a heat exchanger shunt as defined by appended claim 1.

[0017] Due to this, the refrigerant flowing from the plurality of flat pipes to the header pipe flows into a non-connection-side space of the flat pipe of a refrigerant outflow section to move upward. Especially, in the header pipe at a upstream side of evaporation where refrigerant with a large ratio of liquid refrigerant (liquid rich) flows, a flow distance of refrigerant from a second refrigerant piping is short and energy lost by pressure loss and a head difference is small. Accordingly, the refrigerant flows while kinetic energy is kept from the state where the refrigerant flows into the heat exchanger, so that inertia of moving upward in the header pipe is large and the refrigerant reaches an upper portion of the non-connection-side space.

[0018] A part of the refrigerant moving upward easily flows to the connection-side space of the flat pipe also from the lower communication hole having a large opening area with small flow path resistance of the plurality of communication hole.

[0019] In the heat exchanger according to the present invention, especially in a case where the refrigerant with a large ratio of liquid refrigerant (liquid rich) flows, when the refrigerant flowing from the plurality of flat pipes into the header pipe moves upward in the header pipe, the refrigerant flows from the lower communication hole to the connection-side space of the flat pipe while preventing uneven flow of the refrigerant to the upper portion of the header pipe due to inertia, so that the refrigerant can be evenly flowed to the plurality of flat pipes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 is a perspective view of a heat exchanger according to a first embodiment of the present invention;

FIG. 2 is a cross-sectional view of an x-y plane of a header pipe according to the first embodiment of the present invention;

FIG. 3 is a front view of an x-z plane showing an internal structure of an outdoor unit applying the heat exchanger;

FIG. 4 is a front view of the x-y plane showing the internal structure of the outdoor unit applying the heat exchanger;

FIG. 5 is a cross-sectional view of the x-y plane of a header pipe according to a second embodiment of the present invention; and

FIG. 6 is a cross-sectional view of the x-y plane of a conventional heat exchanger.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] According to the invention, there is provided a heat exchanger shunt including among others: a plurality of flat pipes having a plurality of refrigerant flow paths; and a pair of header pipes each of which connects both ends of the flat pipes, wherein the header pipes each include a partition plate which divides the plurality of flat pipes into a plurality of heat exchange sections, when the heat exchanger functions as an evaporator, a first refrigerant piping from which refrigerant outflows is provided to an upper portion of one header pipe of the header pipes, while a second refrigerant piping into which the refrigerant flows is provided to a lower portion of the one header pipe, the header pipe of the header pipes includes a partition wall which divides a connection-side space of the flat pipes and a non-connection-side space of the flat pipes in a refrigerant outflow section from which the refrigerant outflows to the plurality of flat pipes, the partition wall includes a plurality of communication holes arranged in a vertical direction, and one communication hole of the communication holes has a smaller opening area than an opening area of another communication hole of the communication holes immediately below the one communication hole.

[0022] Due to this, the refrigerant flowing from the plurality of flat pipes into the header pipe flows in a non-connection-side space of the flat pipe of a refrigerant outflow section to move upward. Especially, in the header pipe at a upstream side of evaporation where refrigerant with a large ratio of liquid refrigerant (liquid rich) flows, a flow distance of refrigerant from a second refrigerant piping is short and energy lost by pressure loss and a head difference is small. Accordingly, the refrigerant flows while kinetic energy is kept from the state where the refrigerant flows into the heat exchanger, so that inertia of moving upward in the header pipe is large and the refrigerant reaches an upper portion of the non-connection-side space.

[0023] A part of the refrigerant moving upward easily flows to the connection-side space of the flat pipe also from the lower communication hole having a large opening area with small flow path resistance of the plurality of communication holes.

[0024] Accordingly, especially in a case where the refrigerant with a large ratio of liquid refrigerant (liquid rich) flows, when the refrigerant flowing from the plurality of flat pipes to the header pipe moves upward into the header pipe, the refrigerant flows from the lower communication hole to the connection-side space of the flat pipe while preventing uneven flow of the refrigerant to the upper portion of the header pipe due to inertia, so that the refrigerant can be evenly flowed to the plurality of flat pipes.

[0025] Moreover, the other header is provided with a damming plate, which has an updraft hole and which is provided between the plurality of communication holes, so that the heat exchange section in the other header pipe is divided into a plurality of heat exchange sections and the updraft hole is located at the non-connection-side space of the flat pipe.

[0026] Due to this, one part of the refrigerant moving upward in the non-connection-side space of the flat pipe passes through the updraft hole of the damming plate, moves upward and flows in the connection-side space of the flat pipe from an upper communication hole of the plurality of communication holes, while another part of the refrigerant collides with a lower surface of the damming plate to reduce kinetic energy, does not move upward and flows in the connection-side space of the flat pipe from a lower communication hole of the plurality of communication holes.

[0027] Consequently, in a rated operation in which an amount of refrigerant circulation is particularly large and a flow rate of the refrigerant is faster, such a matter is inhibited that liquid refrigerant moves upward swiftly in the non-connection-side space of the flat pipe and flows in the connection-side space only from the upper communication hole of the plurality of communication holes without flowing from the lower communication hole, so that the refrigerant flows only to the flat pipe at an upper stage. As a result, the refrigerant is allowed to flow evenly to the plurality of flat pipes.

[0028] According to an embodiment of the invention, an opening area of the updraft hole is smaller than an opening area of the lower communication hole of the plurality of communication holes.

[0029] Due to this, flow path resistance is smaller in the updraft hole than in the lower communication hole.

[0030] Accordingly, particularly in an overload operation in which an amount of refrigerant circulation is the largest and a flow rate of the refrigerant is the fastest, while inhibiting that liquid refrigerant moves upward swiftly and a large amount of liquid refrigerant flows to an upper side of the header pipe from the updraft hole, the liquid refrigerant flows in the connection-side space of the flat pipe from the lower communication hole. As a result, the refrigerant is allowed to flow evenly to the plurality of flat pipes.

[0031] Hereinafter, embodiments of the present invention will be explained with reference to the drawings. Additionally, the present invention is not limited by these embodiments.

(First embodiment)

[0032] FIG. 1 is a perspective view of a heat exchanger of a first embodiment of the present invention, in which an x direction is a flowing direction of refrigerant which flows in a flow path of a flat pipe, a y direction is an axial direction of a header pipe and a z direction is a flowing direction of air. FIG. 2 is a cross-sectional view taken along the line A-A of FIG. 1 (a cross-sectional view of an x-y plane of the heat exchanger according to the first embodiment of the present invention.)

[0033] In FIGS. 1 and 2, a heat exchanger 1 includes a plurality of flat pipes 2 and a pair of header pipes 3a, 3b.

[0034] The plurality of flat pipes 2 is arranged in a horizontal direction (the x direction) to be parallel with each other along the axial direction of the header pipes 3a, 3b (the y direction.)

[0035] Between two of the plurality of flat pipes 2, a plurality of fins 4 formed as undulant continuing in the up-down direction is provided, and heat exchange is executed between air flowing in the plurality of fins 4 and refrigerant flowing in the plurality of flat pipes 2.

[0036] Additionally, as refrigerant, for example, R410A, R32 and mixed refrigerants including R32 are used.

[0037] A plurality of refrigerant flow paths 5 provided in the flat pipes 2 communicates with an inner portion of the header pipes 3a, 3b.

[0038] The header pipes 3a, 3b are cylindrically formed by extrusion molding of a metal material such as aluminum.

[0039] To one header pipe 3a, a first refrigerant piping 6 and a second refrigerant piping 7 are connected. The first refrigerant piping 6 is connected to an upper portion of the one header pipe 3a and the second refrigerant piping 7 is connected to a lower portion of one header pipe 3a so that the first refrigerant piping 6 and the second refrigerant piping 7 are configured to function as a flow inlet or a flow outlet of refrigerant.

[0040] In the header pipes 3a, 3b, at positions in a height direction (the y direction) between the first refrigerant piping 6 and the second refrigerant piping 7, partition plates 9a, 9b and 9c which divide the plurality of flat pipes 2 into a plurality of heat exchange sections 8a, 8b, 8c and 8d are provided.

[0041] The heat exchange sections 8a, 8b are divided by the partition plate 9a, the heat exchange sections 8b, 8c are divided by the partition plate 9b and the heat exchange sections 8c, 8d are divided by the partition plate 9c, respectively.

[0042] In a lower space divided by the partition plate 9b of the other header pipe 3b, in a case of functioning as an evaporator, a dividing plate 12 which makes a division into a refrigerant inflow section 10 into which refrigerant flows from the heat exchange section 8d and a refrigerant outflow section 11 from which refrigerant outflows to the heat exchange section 8c and a partition wall 15 which makes a division into a connection-side space 13 of the flat pipe 2 of the refrigerant outflow section 11 and a non-connection-side space 14 of the flat pipe 2 and which extends in the axial direction of the other header pipe 3b (the y direction) are provided.

[0043] The dividing plate 12 is installed at a position with the same height in the y direction as the partition plate 9c provided in one header pipe 3a.

[0044] The partition wall 15 includes a plurality of communication holes 16a, 16b arranged in a vertical direction (the y direction), and the communication hole 16a is configured to have a smaller opening area than an opening area of the communication hole 16b immediately below the communication hole 16a.

[0045] Regarding the heat exchanger thus configured, in a case of functioning as an evaporator, refrigerant flowing from the second refrigerant piping 7 into one header pipe 3a passes through the heat exchange section 8d in +x direction, and flows to the refrigerant inflow section 10 of the other header pipe 3b. The refrigerant in the refrigerant inflow section 10 moves toward the refrigerant outflow section 11, and moves upward in the non-connection-side space 14 in +y direction. The raised refrigerant passes through a plurality of communication holes 16a, 16b provided to the partition wall 15, flows in the connection-side space 13, passes through the heat exchange section 8c in -x direction and outflows to one header pipe 3a.

[0046] Further, the refrigerant flowing to one header pipe 3a passes through the heat exchange section 8b in the +x direction, and flows to the other header pipe 3b, moves upward in the other header pipe 3b in the +y direction, passes through the heat exchange section 8a in the -x direction and flows to one header pipe 3a.

[0047] Next, regarding use of the present embodiment, an explanation will be made using an example where the heat exchanger 1 of the present embodiment is used to an outdoor unit 20 of an air conditioner.

[0048] FIG. 3 is a plan view of an x-z plane showing an internal structure of the outdoor unit 20 applying the heat exchanger 1 of the present embodiment. FIG. 4 is a plan view of the x-y plane showing the internal structure of the outdoor unit 20 applying the heat exchanger 1 of the present embodiment.

[0049] As shown in FIGS. 3 and 4, the outdoor unit 20 includes a compressor 21, a switching valve 22, an outdoor expansion valve 23, a blower 24 and the heat exchanger 1. The outdoor unit 20 and an indoor unit (not shown) are connected by a liquid pipe 25 and a gas pipe 26.

[0050] The header pipes 3a, 3b of the heat exchanger 1 are connected to the switching valve 22 via the first refrigerant piping 6 and connected to the outdoor expansion valve 23 via the second refrigerant piping 7, respectively.

[0051] First, when cooling operation is executed, the heat exchanger 1 functions as a condenser.

[0052] Gas refrigerant sent from the compressor 21 of the outdoor unit 20 is allowed to flow from the first refrigerant piping 6 into one header pipe 3a via the switching valve 22. The gas refrigerant passes through an inner portion of one header pipe 3a on a connecting side of the first refrigerant piping 6 divided by the partition plate 9a, is allowed to flow into the plurality of refrigerant flow paths 5 in the plurality of flat pipes 2, flows in the heat exchange section 8a in a horizontal direction (the +x direction and +z direction) and outflows to the other header pipe 3b. The outflowed refrigerant moves downward in the other header pipe 3b in the vertical direction (-y direction), flows into the heat exchange section 8b, flows in the horizontal direction (-z direction and the -x direction) and outflows to one header pipe 3a.

[0053] Also, the refrigerant outflowed to one header pipe 3a moves downward in one header pipe 3a in the vertical direction (-y direction), flows into the heat exchange section 8c, flows in the horizontal direction (the +z direction, the +x direction) and outflows to the other header pipe 3b. The outflowed refrigerant passes through the plurality of communication holes 16a, 16b provided to the partition wall 15 from the connection-side space 13, flows in the non-connection-side space 14, moves downward in the other header pipe 3b in the vertical direction (the -y direction), flows into the heat exchange section 8d, and flows in the horizontal direction (the -z direction, the -x direction.)

[0054] The refrigerant dissipates heat to be condensed in the flat pipe 2 by executing heat exchange with air sent from the blower 24.

[0055] The condensed refrigerant outflows to a space of the header pipe 3a on a connecting side of the second refrigerant piping 7 divided by the partition plate 9c, passes from the second refrigerant piping 7 through the outdoor expansion valve 23 and the liquid pipe 25 and is outflowed to the indoor unit.

[0056] The condensed refrigerant flowed into the indoor unit absorbs heat to be evaporated by executing heat exchange with air in an indoor heat exchanger (not shown.) The evaporated refrigerant passes through the gas pipe 26, and via the switching valve 22, circulates to the compressor 21.

[0057] When heating operation is executed, the heat exchanger 1 functions as the evaporator.

[0058] Gas refrigerant sent from the compressor 21 of the outdoor unit 20 passes through the gas pipe 26 via the switching valve 22 and is outflowed to the indoor unit.

[0059] The gas refrigerant sent to the indoor unit dissipates heat to be condensed by executing heat exchange with air in the indoor heat exchanger provided in the indoor unit.

[0060] The condensed refrigerant passes through the liquid pipe 25 and the outdoor expansion valve 23 to become gas-liquid two-phase refrigerant, passes through an inner portion of one header pipe 3a on the connecting side of the second refrigerant piping 7 divided by the partition plate 9c from the second refrigerant piping 7 to be flowed into the plurality of refrigerant flow paths 5 in the plurality of flat pipes 2, flows in the heat exchange section 8d in the horizontal direction (the +x direction, the +z direction) and flows to the refrigerant inflow section 10 of the other header pipe 3b.

[0061] In the refrigerant with a large ratio of the flowed liquid refrigerant (liquid rich), a flow distance of refrigerant from the second refrigerant piping 7 is short and energy lost by pressure loss and a head difference is small. Accordingly, the refrigerant flows while kinetic energy is kept from the state where the refrigerant flows into the heat exchanger 1, so that inertia of moving upward in the other header pipe 3b is large. Moreover, due to the partition wall 15, the refrigerant surely moves upward in the non-connection-side space 14 of the refrigerant outflow section 11 having a smaller flow path cross-sectional area than that of the other header pipe 3b.

[0062] One part of the refrigerant moving upward flows in the connection-side space 13 from the lower communication hole 16b provided at the partition wall 15 with a large opening area and a small flow path resistance while moving upward in the vertical direction (the +y direction), while another part of the refrigerant reaches an upper portion of the non-connection-side space 14 and flows in the connection-side space 13 from the upper communication hole 16a provided at the partition wall 15.

[0063] The refrigerant flowed in the connection-side space 13 flows into the heat exchange section 8c, flows in the horizontal direction (the -z direction, the -x direction) and outflows to one header pipe 3a.

[0064] Also, the refrigerant outflowed to one header pipe 3a moves upward in one header pipe 3a in the vertical direction (the +y direction), flows into the heat exchange section 8b, flows in the horizontal direction (the +x direction, the +z direction) and flows to the other header pipe 3b. The outflowed refrigerant moves upward in the other header pipe 3b in the vertical direction (the +y direction), flows into the heat exchange section 8a and flows in the horizontal direction (the -z direction, the -x direction.)

[0065] The refrigerant absorbs heat to be evaporated in the flat pipe 2 by executing heat exchange with air sent from the blower 24.

[0066] The evaporated refrigerant outflows to a space of the header pipe 3a on a connecting side of the first refrigerant piping 6 divided by the partition plate 9a, and circulates to the compressor 21 from the first refrigerant piping 6 via the switching valve 22.

[0067] As described above, in the present embodiment, the heat exchanger 1 has the flat pipe 2 including the plurality of refrigerant flow paths 5 and the pair of header pipes 3a, 3b which arranges the plurality of flat pipe 2 in the horizontal direction and each of which connects both ends of the flat pipes 2, and the plurality of flat pipes 2 are connected to be parallel with each other along the axial direction of the header pipes 3a, 3b.

[0068] The header pipes 3a, 3b include the partition plates 9a, 9c and 9c which divide the plurality of flat pipes 2 into the plurality of heat exchange sections 8a, 8b, 8c and 8d, and when the heat exchanger 1 functions as an evaporator, the first refrigerant piping 6 from which the refrigerant outflows is provided at the upper portion of one header pipe 3a, while the second refrigerant piping 7 into which the refrigerant flows is provided at the lower portion of the one header pipe 3a. Moreover, in the refrigerant outflow section 11 in the other header pipe 3b, the partition wall 15 which divides the connection-side space 13 of the flat pipe 2 and the non-connection-side space 14 of the flat pipe 2 is included, the partition wall 15 includes the plurality of communication holes 16a, 16b arranged in the vertical direction (the y direction), and the communication hole 16a is configured to have a smaller opening area than the opening area of the communication hole 16b immediately below the communication hole 16a.

[0069] Due to this, the refrigerant flowing from the plurality of flat pipes 2 into the other header pipe 3b flows in the non-connection-side space 14 of the flat pipe 2 of the refrigerant outflow section 11 to move upward. Especially, in the other header pipe 3b at the upstream side of evaporation where refrigerant with a large ratio of liquid refrigerant (liquid rich) flows, a flow distance of refrigerant from the second refrigerant piping 7 is short and energy lost by pressure loss and a head difference is small. Accordingly, the refrigerant flows while kinetic energy is kept from the state where the refrigerant flows into the heat exchanger 1, so that inertia of moving upward in the other header pipe 3b is large and the refrigerant reaches an upper portion of the non-connection-side space 14.

[0070] A part of the refrigerant moving upward easily flows to the connection-side space 13 of the flat pipe 2 also from the lower communication hole 16b having a large opening area with small flow path resistance of the plurality of communication holes 16a, 16b.

[0071] Accordingly, especially in a case where the refrigerant with a large ratio of liquid refrigerant (liquid rich) flows, when the refrigerant flowing from the plurality of flat pipes 2 into the other header pipe 3b moves upward in the other header pipe 3b, the refrigerant flows from the lower communication hole 16b to the connection-side space 13 of the flat pipe 2 while preventing uneven flow of the refrigerant to an upper portion of the other header pipe 3b due to a centrifugal force, so that the refrigerant can be evenly flowed to the plurality of flat pipes 2.

[0072] Also, when the refrigerant is allowed to flow from the heat exchange section 8d to the heat exchange section 8c, the liquid refrigerant can be preferentially flowed in the other header pipe 3b without the need of connecting a connection pipe as a separate member to the other header pipe 3b, so that an increase of an inner volume of the other header pipe 3b can be inhibited and a necessary amount of the refrigerant can be reduced.

(Second embodiment)

[0073] FIG. 5 is a cross-sectional view of the x-y plane of a second embodiment of the present invention.

[0074] As shown in FIG. 5, a damming plate 18 having an updraft hole 17 is provided between the plurality of communication holes 16a, 16b, so that the heat exchange section 8c is divided into a plurality of heat exchange sections and the updraft hole 17 is located at the non-connection-side space 14 of the flat pipe 2.

[0075] Due to this, one part of the refrigerant moving upward in the non-connection-side space 14 of the flat pipe 2 passes through the updraft hole 17 of the damming plate 18, moves upward and flows in the connection-side space 13 of the flat pipe 2 from an upper communication hole 16a of the plurality of communication holes 16a, 16b, while another part of the refrigerant collides with a lower surface of the damming plate 18 to reduce kinetic energy, does not move upward and flows in the connection-side space 13 of the flat pipe 2 from a lower communication hole 16b of the plurality of communication holes 16a, 16b.

[0076] Consequently, in a rated operation in which an amount of refrigerant circulation is particularly large and a flow rate of the refrigerant is faster, such a matter is inhibited that liquid refrigerant moves upward swiftly in the non-connection-side space 14 of the flat pipe 2 and flows in the connection-side space 13 only from the upper communication hole 16a of the plurality of communication holes 16a, 16b without flowing from the lower communication hole 16b, so that the refrigerant flows only to the flat pipe 2 at an upper stage. As a result, the refrigerant is allowed to flow evenly to the plurality of flat pipes 2.

[0077] Also, an opening area of the updraft hole 17 of the damming plate 18 is preferably less than an opening area of the lower communication hole 16b of the plurality of communication holes 16a, 16b.

[0078] Due to this, flow path resistance is smaller in the updraft hole 17 than in the lower communication hole 16b.

[0079] Accordingly, particularly in an overload operation in which an amount of refrigerant circulation is the largest and a flow rate of the refrigerant is the fastest, while inhibiting that liquid refrigerant moves upward swiftly in the non-connection-side space 14 and a large amount of liquid refrigerant flows to an upper side from the updraft hole 17, the liquid refrigerant flows in the connection-side space 13 of the flat pipe 2 from the lower communication hole 16b. As a result, the refrigerant is allowed to flow evenly to the plurality of flat pipes 2.

[0080] Also, the plurality of communication holes 16a, 16b is preferably provided such that the number of flat pipes 2 connected to the refrigerant outflow section 11 is evenly divided by the number of communication holes 16a, 16b with inclusion of at least a height position in the y direction of the flat pipe 2 existing at the uppermost stage of the plurality of divided flat pipes 2. For example, in a case where eight flat pipes 2 are connected to the refrigerant outflow section 11 and two communication holes 16a and 16b are provided, the upper communication hole 16a includes a height position in the y direction of the flat pipe 2 at the uppermost stage of the eight flat pipes 2, while the lower communication hole 16b includes a height position in the y direction of the fifth flat pipe 2 from the top of the eight flat pipes 2.

[0081] Due to this, in the plurality of flat pipes 2 corresponding to each of the communication holes 16a, 16b, a flow path in which the refrigerant flows to the flat pipe 2 existing at the highest position in the y direction can be respectively secured. Accordingly, the refrigerant easily flows evenly from an upper side to a lower side of the refrigerant outflow section 11, so that the refrigerant is allowed to flow evenly to the plurality of flat pipes 2.

[0082] Additionally, while one array of the heat exchanger 1 is installed in the example, for example two or more of the heat exchangers may be provided in an air flowing direction (the z direction), and needless to say, the similar effect can be obtained even when the configuration in which two or more heat exchangers 1 are arranged in a direction of gravitational force (the y direction) is used.

[0083] Also, while the configuration that the plurality of fins 4 is formed as undulant continuing in the up-down direction between the plurality of flat pipes 2 is used in the example, needless to say, the similar effect can be obtained even when the configuration that the fins are formed plate-like such that they are orthogonally inserted into the plurality of flat pipes 2 to be parallel with each other.

[0084] Also, while two communication holes 16a, 16b arranged in the vertical direction (the y direction) are provided at the partition wall 15 in the example, needless to say, the similar effect can be obtained even when two or more communication holes are provided.

[0085] The present invention relates to a heat exchanger shunt which inhibits, when refrigerant with a large ratio of the liquid refrigerant with a high density (liquid rich) flows into a header pipe in a heat exchanger using flat pipes, uneven flow of liquid refrigerant to an upper portion due to momentum of moving upward in the header pipe since the refrigerant flows in the header pipe from the flat pipe. Moreover, this heat exchanger shunt can be applied to usage for a refrigerator, an air conditioner and a composite device for hot-water supply and air conditioning etc.

Reference Signs List

[0086]

1 heat exchanger
2 flat pipe
3a, 3b header pipe
4 fin
5 refrigerant flow path
6 first refrigerant piping
7 second refrigerant piping
8a, 8b, 8c, 8d heat exchange section
9a, 9b, 9c partition plate
10 refrigerant inflow section
11 refrigerant outflow section
12 dividing plate
13 connection-side space
14 non-connection-side space
15 partition wall
16a, 16b communication hole
17 updraft hole
18 damming plate
20 outdoor unit
21 compressor
22 switching valve
23 outdoor expansion valve
24 blower
25 liquid pipe
26 gas pipe
100 heat exchanger
101 flat pipe
102a, 102b header pipe
103a, 103b, 103c, 103d heat exchange section
104a, 104b, 104c partition plate
105a, 105b refrigerant piping

Claims

1. A heat exchanger shunt comprising:

a plurality of flat pipes (2) having a plurality of refrigerant flow paths (5); and
a pair of header pipes (3a, 3b) each of which connects both ends of the flat pipes,
wherein the header pipes each include a partition plate (9a, 9b, 9c) which divides the plurality of flat pipes into a plurality of heat exchange sections (8a, 8b, 8c, 8d),
a first refrigerant piping (6) is provided to an upper portion of one header pipe of the header pipes, while a second refrigerant piping (7) is provided to a lower portion of the one header pipe so that refrigerant outflows from the first refrigerant piping (6) into the second refrigerant piping (7) when the heat exchanger functions as an evaporator,
the other header pipe of the header pipes includes a partition wall (15) which divides a connection-side space (13) of the flat pipes and a non-connection-side space (14) of the flat pipes in a refrigerant outflow section (11) from which the refrigerant outflows to the plurality of flat pipes,
the partition wall includes a plurality of communication holes (16a, 16b) arranged in a vertical direction, and
one communication hole of the communication holes has a smaller opening area than an opening area of another communication hole of the communication holes, which is in use immediately below the one communication hole
characterized in that
the other header pipe is provided with a damming plate (18), which has an updraft hole (17) and which is provided between the plurality of communication holes, so that the heat exchange section in the other header pipe is divided into a plurality of heat exchange sections and the updraft hole is located at the non-connection-side space.

2. The heat exchanger shunt according to claim 1, wherein, an opening area of the updraft hole is smaller than an opening area of a lower communication hole of the plurality of communication holes in use.

3. An outdoor unit comprising the heat exchanger shunt according to claim 1 or 2.

Patentansprüche

1. Wärmetauscher-Nebenanschluss, umfassend:

eine Mehrzahl von Flachrohren (2) mit einer Mehrzahl von Kältemittelströmungswegen (5); und
ein Paar Verteilerrohre (3a, 3b), von denen jedes die beiden Enden der Flachrohre verbindet,
wobei die Verteilerrohre jeweils eine Trennplatte (9a, 9b, 9c) enthalten, die die Mehrzahl von Flachrohren in eine Mehrzahl von Wärmeaustauschabschnitten (8a, 8b, 8c, 8d) unterteilt,
eine erste Kältemittelleitung (6) an einem oberen Abschnitt eines Verteilerrohrs der Verteilerrohre vorgesehen ist, während eine zweite Kältemittelleitung (7) an einem unteren Abschnitt des einen Verteilerrohrs vorgesehen ist, so dass Kältemittel aus der ersten Kältemittelleitung (6) in die zweite Kältemittelleitung (7) ausströmt, wenn der Wärmetauscher als ein Verdampfer arbeitet,
das andere Verteilerrohr der Verteilerrohre eine Trennwand (15) aufweist, die einen anschlussseitigen Raum (13) der Flachrohre und einen

nicht-anschlussseitigen Raum (14) der Flachrohre in einen Kältemittelabflussabschnitt (11) unterteilt, von dem das Kältemittel zu der Vielzahl von Flachrohren abfließt,
die Trennwand eine Vielzahl von Verbindungslöchern (16a, 16b) aufweist, die in einer vertikalen Richtung angeordnet sind, und
ein Verbindungsloch der Verbindungslöcher eine kleinere Öffnungsfläche als eine Öffnungsfläche eines anderen Verbindungslochs der Verbindungslöcher aufweist, das sich im Gebrauch unmittelbar unter dem einen Verbindungsloch befindet
dadurch gekennzeichnet, dass
das andere Verteilerrohr mit einer Dämmplatte (18) versehen ist, die ein Aufwindloch (17) aufweist und die zwischen der Vielzahl von Verbindungslöchern vorgesehen ist, so dass der Wärmetauschabschnitt in dem anderen Verteilerrohr in eine Vielzahl von Wärmeaustauschabschnitten unterteilt ist und das Aufwindloch an dem nicht-anschlussseitigen Raum angeordnet ist.

2. Wärmetauscher-Nebenanschluss nach Anspruch 1, wobei im Gebrauch eine Öffnungsfläche des Aufwindlochs kleiner ist als eine Öffnungsfläche eines unteren Verbindungslochs der Vielzahl von Verbindungslöchern.

3. Außeneinheit umfassend den Wärmetauscher-Nebenanschluss nach Anspruch 1 oder 2.

Revendications

1. Dérivation d'échangeur de chaleur comprenant :

une pluralité de tuyaux plats (2) présentant une pluralité de trajets d'écoulement de fluide frigorigène (5) ; et
une paire de tuyaux collecteurs (3a, 3b) dont chacun relie les deux extrémités des tuyaux plats,
les tuyaux collecteurs comprenant chacun une plaque de séparation (9a, 9b, 9c) qui sépare la pluralité de tuyaux plats en une pluralité de sections d'échange de chaleur (8a, 8b, 8c, 8d),
une première tuyauterie de fluide frigorigène (6) étant disposée sur une partie supérieure d'un tuyau collecteur parmi les tuyaux collecteurs, tandis qu'une deuxième tuyauterie de fluide frigorigène (7) est disposée sur une partie inférieure dudit un tuyau collecteur de telle sorte que le fluide frigorigène s'écoule à partir de la première tuyauterie de fluide frigorigène (6) dans la deuxième tuyauterie de fluide frigorigène (7) lorsque l'échangeur de chaleur fonctionne comme un évaporateur,
l'autre tuyau collecteur parmi les tuyaux collecteurs comprenant une paroi de séparation (15) qui sépare un espace côté raccordement (13) des tuyaux plats et un espace côté non-raccordement (14) des tuyaux plats dans une section de sortie de fluide frigorigène (11) à partir de laquelle le fluide frigorigène s'écoule vers la pluralité de tuyaux plats,
la paroi de séparation comprenant une pluralité de trous de communication (16a, 16b) agencés dans une direction verticale et
un trou de communication parmi les trous de communication présentant une zone d'ouverture plus petite qu'une zone d'ouverture d'un autre trou de communication parmi les trous de communication, qui est en utilisation immédiatement au-dessous dudit un trou de communication
caractérisée en ce que
l'autre tuyau collecteur est pourvu d'une plaque de retenue (18), qui présente un trou à courant ascendant (17) et qui est disposée entre la pluralité de trous de communication, de telle sorte que la section d'échange de chaleur dans l'autre tuyau collecteur est séparée en une pluralité de sections d'échange de chaleur et le trou à courant ascendant est situé au niveau de l'espace côté non-raccordement.

2. Dérivation d'échangeur de chaleur selon la revendication 1, une zone d'ouverture du trou à courant ascendant étant plus petite qu'une zone d'ouverture d'un trou de communication inférieur de la pluralité de trous de communication pendant l'utilisation.

3. Unité extérieure comprenant la dérivation d'échangeur de chaleur selon la revendication 1 ou 2.

FIG.1

1: HEAT EXCHANGER
2: FLAT PIPE
3a, 3b: HEADER PIPE
4: FIN
6: FIRST REFRIGERANT PIPING
7: SECOND REFRIGERANT PIPING
9a, 9b, 9c: PARTITION PLATE

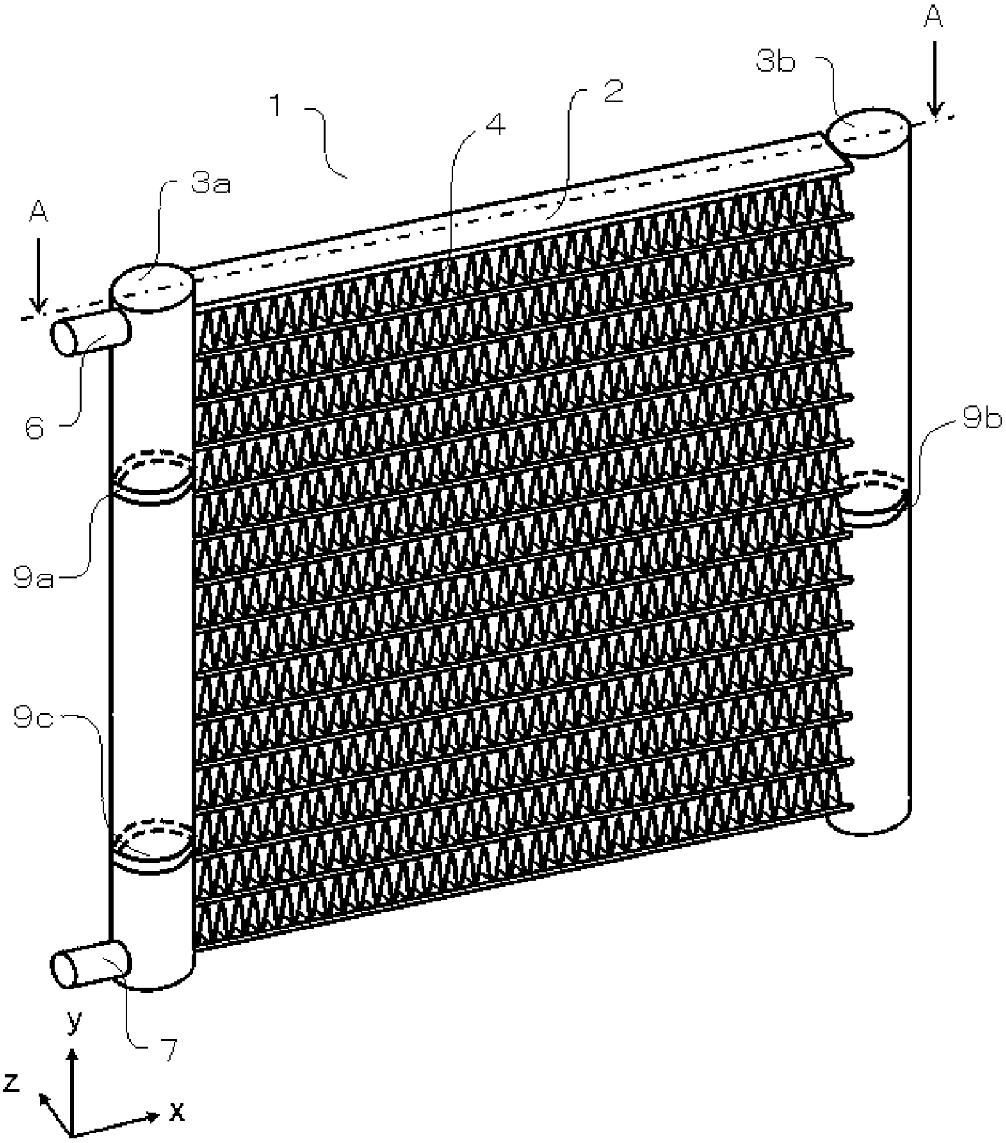


FIG.2

1: HEAT EXCHANGER
2: FLAT PIPE
3a, 3b: HEADER PIPE
4: FIN
5: REFRIGERANT FLOW PATH
6: FIRST REFRIGERANT PIPING
7: SECOND REFRIGERANT PIPING
8a, 8b, 8c, 8d: HEAT EXCHANGE SECTION
9a, 9b, 9c: PARTITION PLATE
10: REFRIGERANT INFLOW SECTION
11: REFRIGERANT OUTFLOW SECTION
12: DIVIDING PLATE
13: CONNECTION-SIDE SPACE
14: NON-CONNECTION-SIDE SPACE
15: PARTITION WALL
16a, 16b: COMMUNICATION HOLE

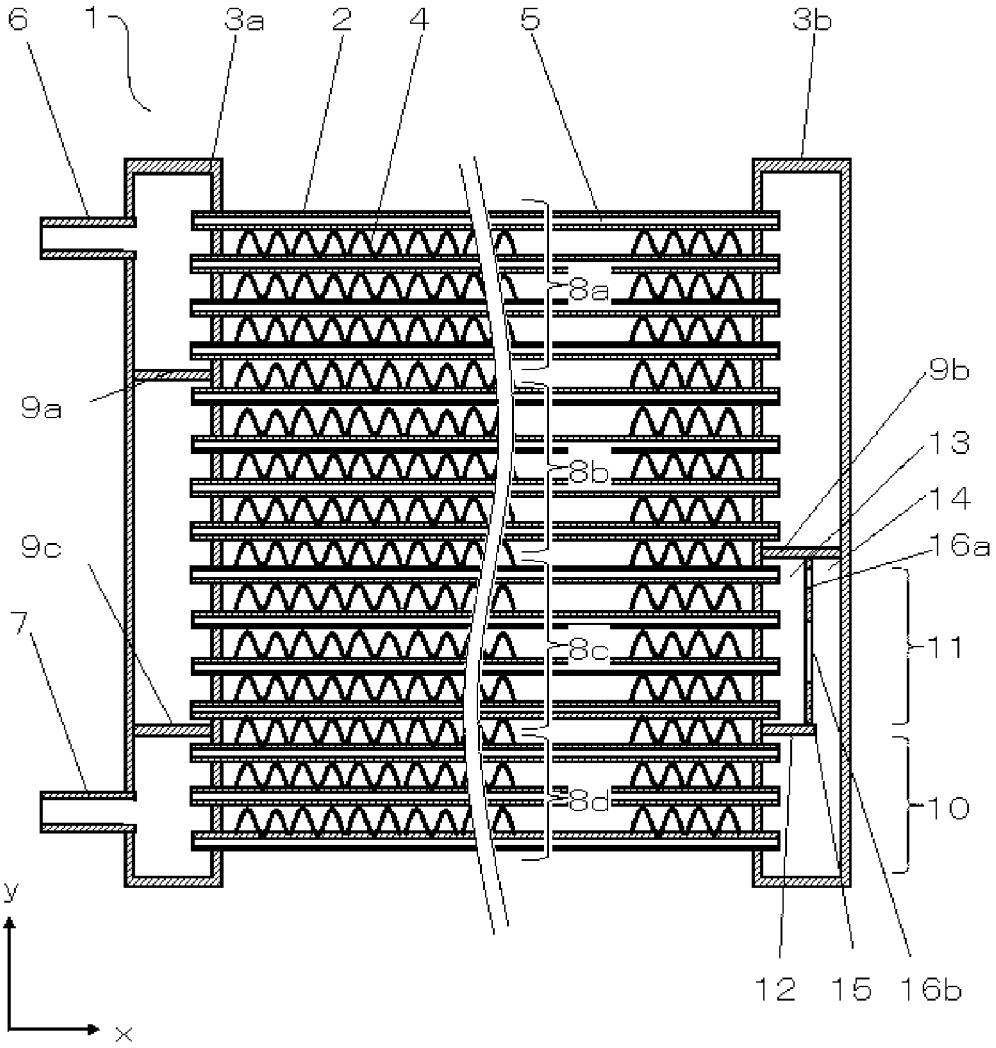


FIG.3

1: HEAT EXCHANGER
2: FLAT PIPE
3a, 3b: HEADER PIPE
6: FIRST REFRIGERANT PIPING
7: SECOND REFRIGERANT PIPING

20: OUTDOOR UNIT
21: COMPRESSOR
22: SWITCHING VALVE
23: OUTDOOR EXPANSION VALVE
24: BLOWER
25: LIQUID PIPE
26: GAS PIPE

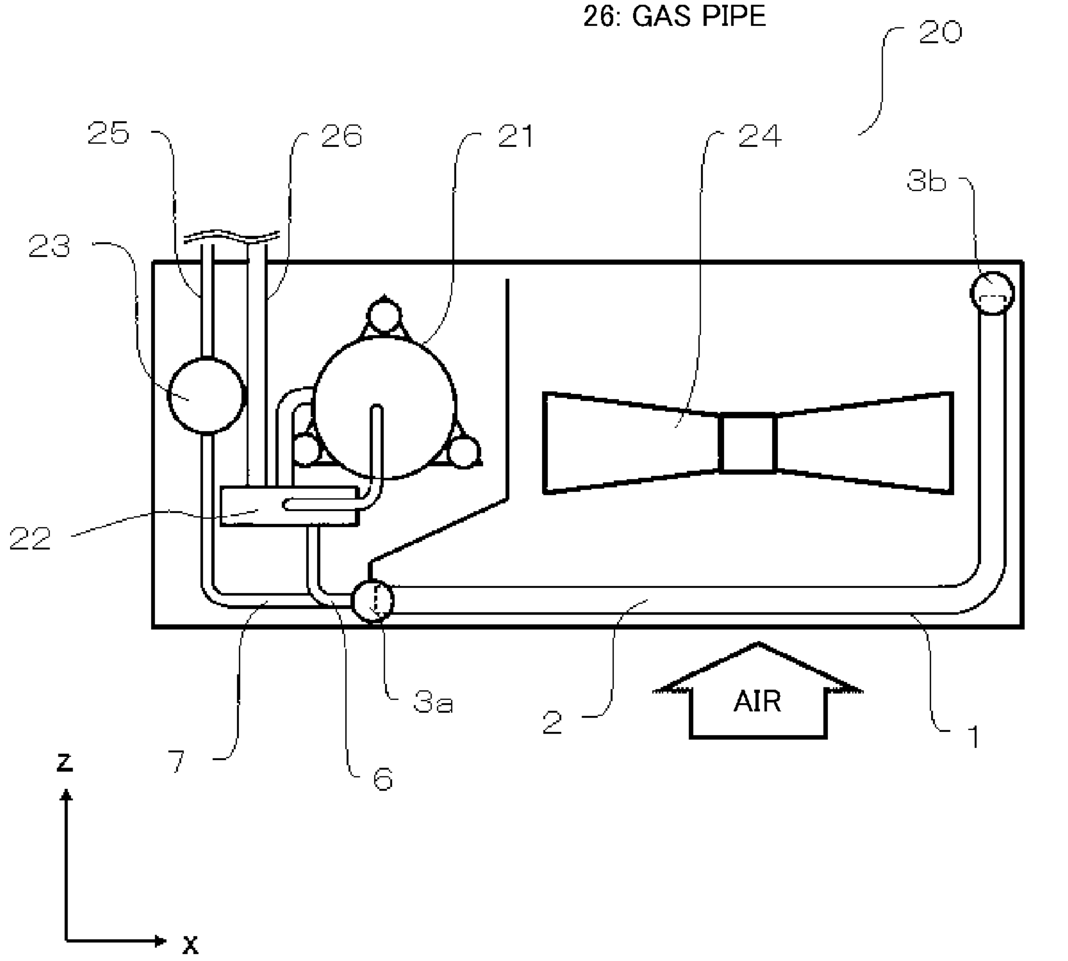


FIG.4

1: HEAT EXCHANGER
2: FLAT PIPE
3a, 3b: HEADER PIPE
4: FIN
6: FIRST REFRIGERANT PIPING
7: SECOND REFRIGERANT PIPING
20: OUTDOOR UNIT
21: COMPRESSOR
22: SWITCHING VALVE
23: OUTDOOR EXPANSION VALVE

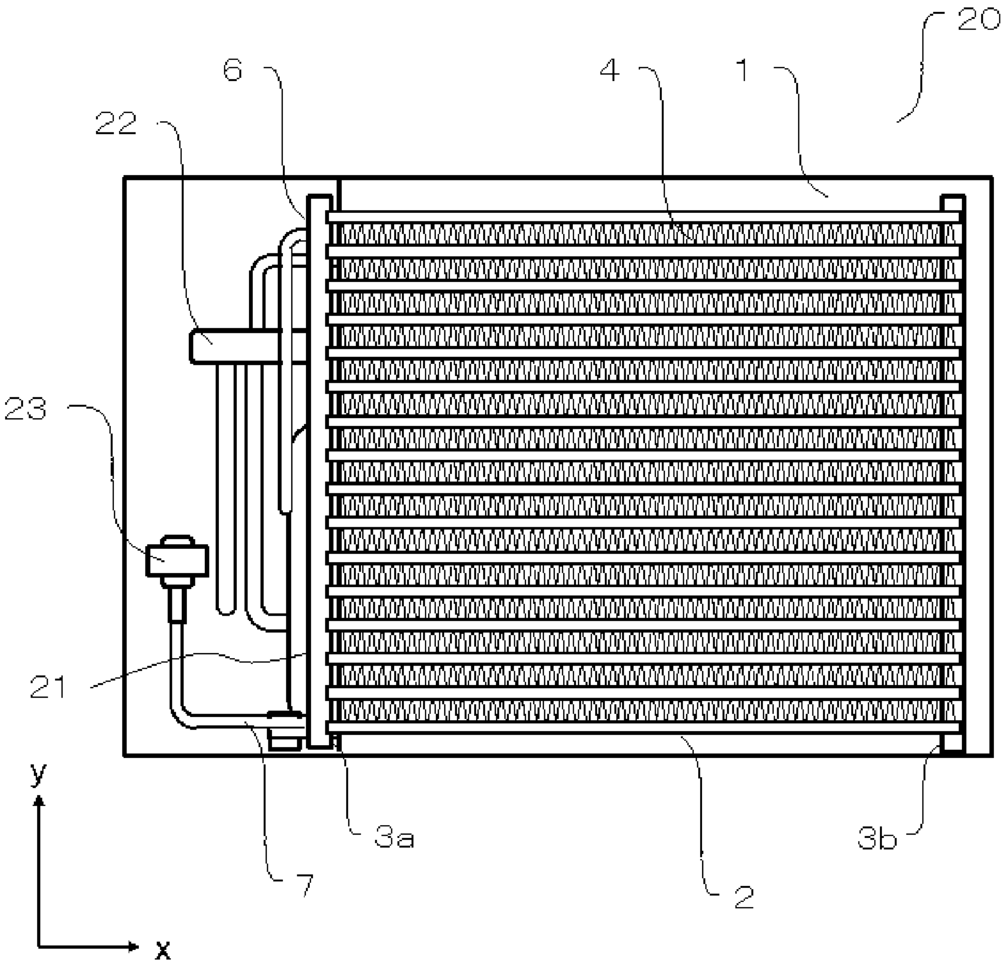


FIG.5

1: HEAT EXCHANGER
2: FLAT PIPE
3a, 3b: HEADER PIPE
4: FIN
5: REFRIGERANT FLOW PATH
6: FIRST REFRIGERANT PIPING
7: SECOND REFRIGERANT PIPING
8a, 8b, 8c, 8d: HEAT EXCHANGE SECTION
9a, 9b, 9c: PARTITION PLATE
12: DIVIDING PLATE
13: CONNECTION-SIDE SPACE
14: NON-CONNECTION-SIDE SPACE
15: PARTITION WALL
16a, 16b: COMMUNICATION HOLE
17: UPDRAFT HOLE
18: DAMMING PLATE

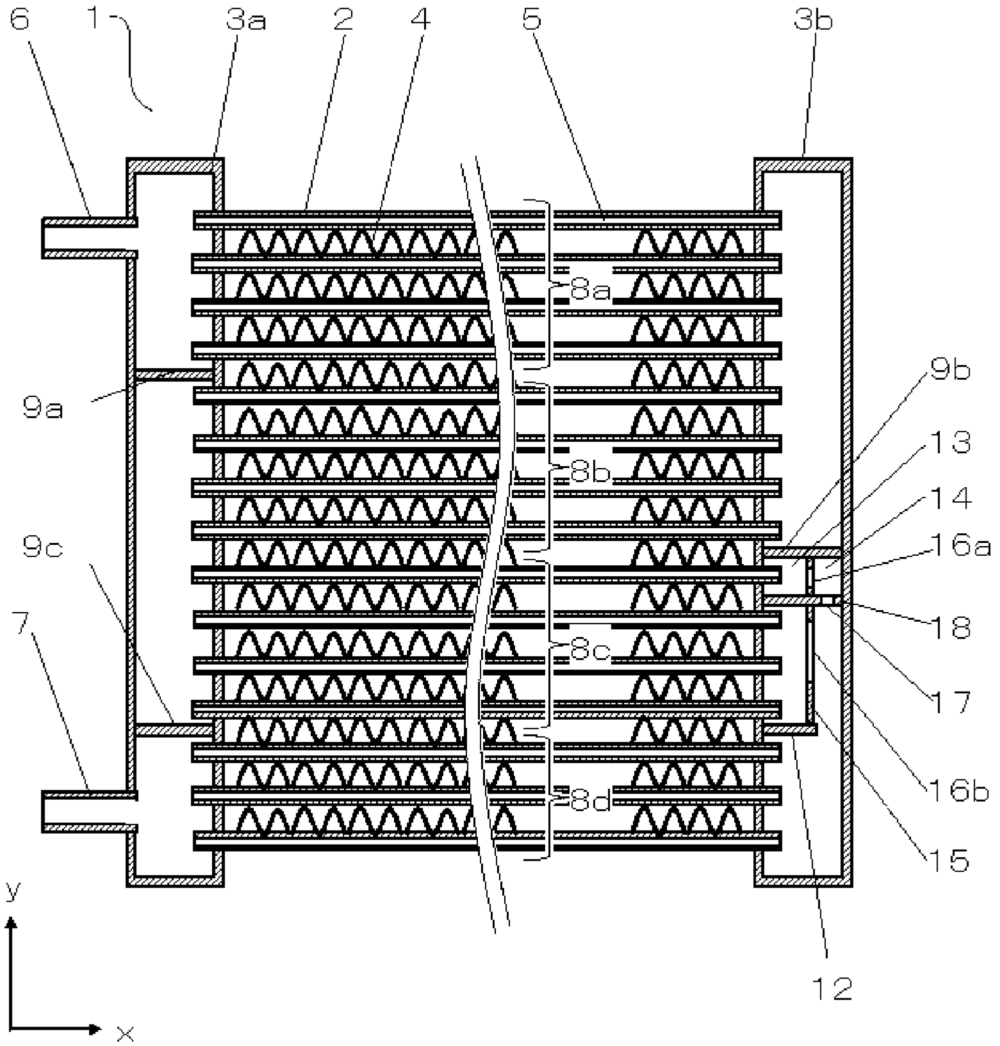
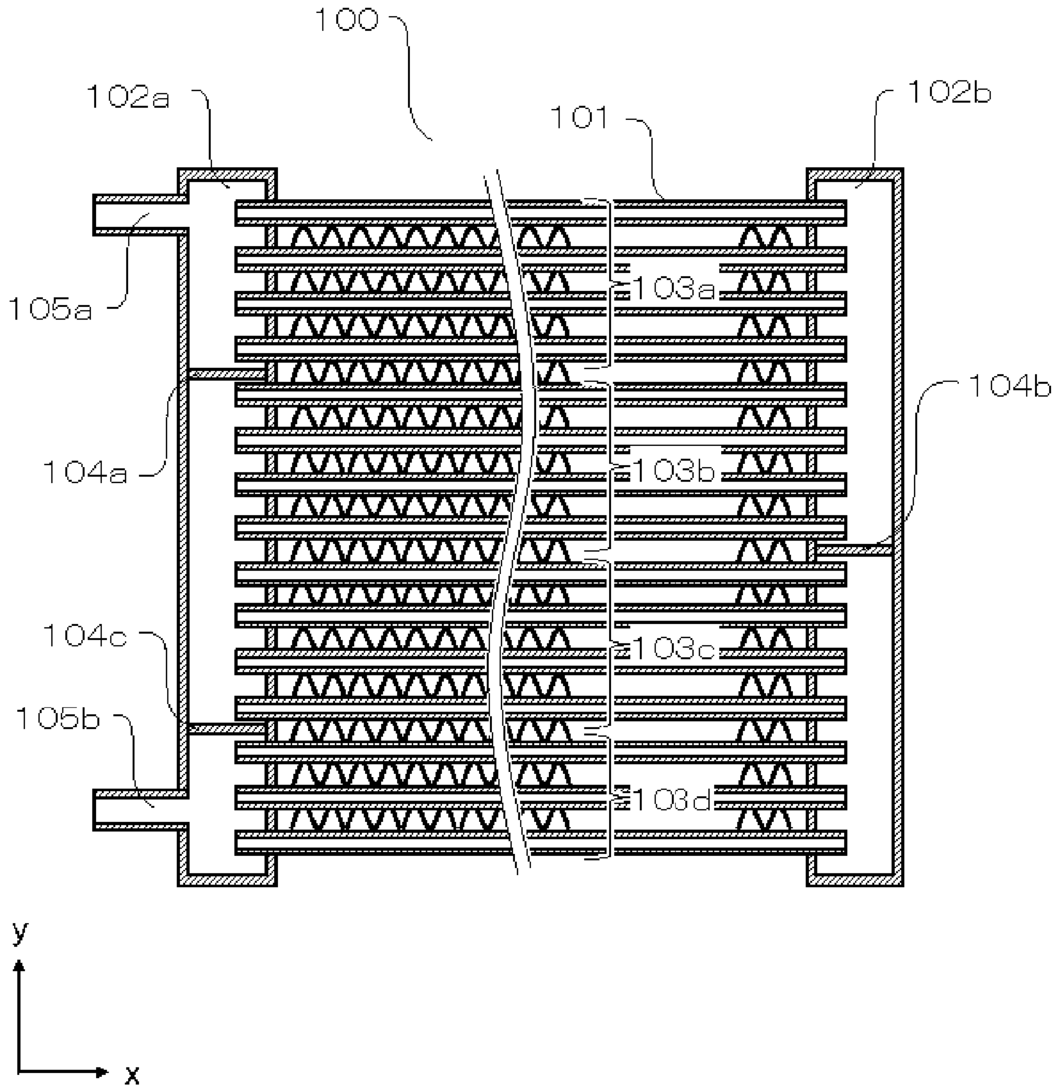


FIG.6

100: HEAT EXCHANGER
101: FLAT PIPE
102a, 102b: HEADER PIPE
103a, 103b, 103c, 103d: HEAT EXCHANGE SECTION
104a, 104b, 104c: PARTITION PLATE
105a, 105b: REFRIGERANT PIPING



REFERENCES CITED IN THE DESCRIPTION

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