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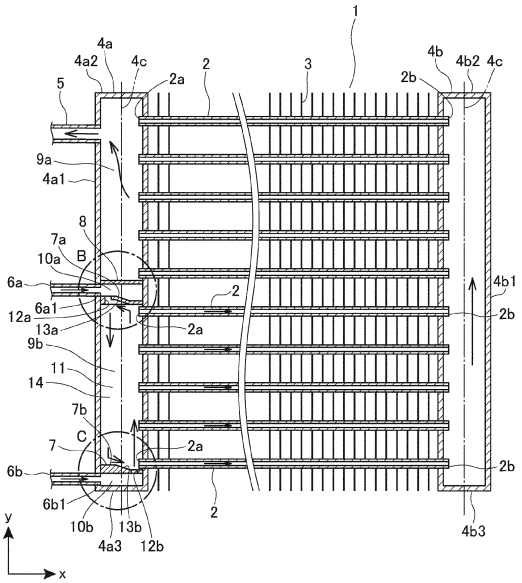
(54) HEAT EXCHANGER

(57) The present disclosure provides a heat exchanger that can allow a refrigerant to uniformly flow to a plurality of flat tubes. A heat exchanger in the present disclosure includes a pair of header pipes connected to respective end parts of each flat tube. In the case where the heat exchanger functions as an evaporator, at least one or more first refrigerant pipes from which a refrigerant flows out and a plurality of second refrigerant pipes into which the refrigerant flows are provided in a header pipe of the header pipes; a refrigerant dividing section is provided in the header pipe to which the plurality of second refrigerant pipes are connected, wherein the refrigerant dividing section is formed by a plurality of refrigerant inflow spaces into which the refrigerant flows from the plurality of second refrigerant pipes, a refrigerant outflow space provided between the plurality of refrigerant inflow spaces, and a plurality of partition plates separating the plurality of refrigerant inflow spaces and the refrigerant outflow space, and the refrigerant outflow space allows the refrigerant to flow out to the flat tube; and the partition plates are provided with communication holes, respectively, allowing the refrigerant outflow space to communicate with a refrigerant inflow space of the refrigerant inflow spaces above the refrigerant outflow space and a refrigerant inflow space of the refrigerant inflow spaces below the refrigerant outflow space.

FIG.2



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present disclosure relates to a heat exchanger including a pair of header pipes and a plurality of flat tubes forming a plurality of refrigerant flow paths to exchange heat between air flowing between the flat tubes and a refrigerant flowing through the refrigerant flow paths of the flat tubes.

Description of the Related Art

[0002] Japanese Patent Laid-Open No. 2016-53473 discloses a heat exchanger that uniformly allocates an amount of a refrigerant which flows through a plurality of flat tubes in header pipes. This heat exchanger includes a pair of header pipes facing each other on the left and right sides in the horizontal direction, flat tubes forming a plurality of refrigerant flow paths, a heat transfer fin provided between the flat tubes, a partition plate separating the inside of the header pipe into a plurality of sections, and a connection tube allowing, in the sections separated by the partition plate in the up-down direction, a lower part of the section on the upper side and an upper part of the section on the lower side to communicate with each other.

[0003] The present disclosure provides a heat exchanger that can allow a refrigerant to uniformly flow to a plurality of flat tubes.

SUMMARY OF THE INVENTION

[0004] In a heat exchanger in the present disclosure which includes a plurality of flat tubes each forming a refrigerant flow path, and a pair of header pipes connected to respective end parts of each flat tube, in the case where the heat exchanger functions as an evaporator, at least one or more first refrigerant pipes from which a refrigerant flows out and a plurality of second refrigerant pipes into which the refrigerant flows are provided in a header pipe of the header pipes; a refrigerant dividing section is provided in the header pipe to which the plurality of second refrigerant pipes are connected, wherein the refrigerant dividing section is formed by a plurality of refrigerant inflow spaces into which the refrigerant flows from the plurality of second refrigerant pipes, a refrigerant outflow space provided between the plurality of refrigerant inflow spaces, and a plurality of partition plates separating the plurality of refrigerant inflow spaces and the refrigerant outflow space, and the refrigerant outflow space allows the refrigerant to flow out to the flat tube; and the partition plates are provided with communication holes, respectively, allowing the refrigerant outflow space to communicate with a refrigerant inflow space of the refrigerant inflow spaces above the refrigerant outflow space and a refrigerant inflow space of the refrigerant inflow spaces below the refrigerant outflow space.

[0005] In the heat exchanger in the present disclosure, the refrigerant passes through the communication holes of the partition plates from the refrigerant inflow space above the refrigerant outflow space and the refrigerant inflow space below the refrigerant outflow space and then flows into the refrigerant outflow space from above and below. This prevents the refrigerant flowing from the second refrigerant pipe into the refrigerant outflow space of the header pipe from flowing straight toward the flat tube, so that the refrigerant flow can spread over a wide range in the refrigerant outflow space. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a perspective view of a heat exchanger in Embodiment 1;
Fig. 2 is a cross-sectional view of an x-y plane of the heat exchanger in Embodiment 1 (a cross-sectional view taken along A-A of Fig. 1);
Fig. 3 is an enlarged view of the x-y plane of the heat exchanger in Embodiment 1 (an enlarged view of B of Fig. 2);
Fig. 4 is an enlarged view of the x-y plane of the heat exchanger in Embodiment 1 (an enlarged view of C of Fig. 2);
Fig. 5 is an x-z plan view illustrating an internal structure of an outdoor unit using the heat exchanger of Embodiment 1;
Fig. 6 is an x-y plan view illustrating the internal structure of the outdoor unit using the heat exchanger of Embodiment 1;
Fig. 7 is a perspective view of a heat exchanger in Embodiment 2;
Fig. 8 is a cross-sectional view of an x-y plane of the heat exchanger in Embodiment 2 (a cross-sectional view taken along D-D of Fig. 7);
Fig. 9 is a cross-sectional view of the x-y plane of the heat exchanger in Embodiment 2 (a cross-sectional view taken along E-E of Fig. 7);
Fig. 10 is an x-z plan view illustrating an internal structure of an outdoor unit using the heat exchanger of Embodiment 2; and
Fig. 11 is an x-y plan view illustrating the internal structure of the outdoor unit using the heat exchanger of Embodiment 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Underlying knowledge and the like forming the basis of the present disclosure

[0007] A heat exchanger is known which includes, as

in the above conventional art, a pair of header pipes facing each other on the left and right sides in the horizontal direction, a plurality of flat tubes forming a plurality of refrigerant flow paths, and a heat transfer fin provided between the flat tubes, to exchange heat between air flowing between the plurality of flat tubes and a refrigerant flowing through the refrigerant flow paths of the flat tubes. Some of this type of heat exchangers is, in order to uniformize a ratio between an amount of the refrigerant and a gas-liquid refrigerant which flow through the plurality of flat tubes in the header pipes, provided with a partition plate separating the inside of the header pipe into a plurality of sections, and a connection tube allowing, in two separate sections, a lower part of the section on the upper side and an upper part of the section on the lower side to communicate with each other.

[0008] In the case where the above conventional heat exchanger functions as an evaporator, the refrigerant that has flowed from a refrigerant circuit into the header pipe passes through the flat tubes and then flows to the section on the lower side in the header pipe. The refrigerant that has flowed to the section on the lower side in the header pipe flows into the section on the upper side in the header pipe via the connection tube. This prevents gas-liquid separation of the refrigerant due to the influence of gravity when the refrigerant rises in the header pipe and then turns, so that the ratio between the amount of the refrigerant and the gas-liquid refrigerant which flow through the plurality of flat tubes connected to the section on the upper side of the header pipe can be made uniform.

[0009] However, in the conventional configuration, the refrigerant that has flowed from the connection tube into the header pipe flows straight toward the flat tubes; accordingly, the refrigerant is likely to flow while leaning to the flat tubes inserted in the vicinity of the connection tube. Thus, the refrigerant flowing from the header pipe to the plurality of flat pipes is likely to become nonuniform.

[0010] The present disclosure provides a heat exchanger that can allow a refrigerant to uniformly flow into a plurality of flat tubes.

[0011] Hereinafter, embodiments will be described in detail with reference to the drawings. However, unnecessarily detailed description may be omitted. For example, detailed description of already well-known matters or redundant description of substantially the same configurations may be omitted.

[0012] The attached drawings and the following description are provided to allow those skilled in the art to sufficiently understand the present disclosure and are not intended to limit the subject matter described in the claims.

Embodiment 1

[0013] Hereinafter, configurations of Embodiment 1 will be described with reference to Figs. 1 to 4.

[1-1. Configurations]

[0014] Fig. 1 is a perspective view of a heat exchanger 1 of Embodiment 1 of the present invention. In the figures, the x direction denotes the arrangement direction of fins 3; the y direction, the arrangement direction of flat tubes 2; the z direction, the flow direction of air passing through the flat tubes 2. Fig. 2 is a cross-sectional view taken along A-A of Fig. 1 (a cross-sectional view of an x-y plane of Embodiment 1 of the present disclosure). Fig. 3 is an enlarged view of B of Fig. 2 (an enlarged view of the x-y plane of the heat exchanger of Embodiment 1 of the present disclosure). Fig. 4 is an enlarged view of C of Fig. 2 (an enlarged view of the x-y plane of the heat exchanger of Embodiment 1 of the present disclosure).

[0015] In Figs. 1 to 4, the heat exchanger 1 includes a plurality of the flat tubes 2, a plurality of the fins 3, a pair of header pipes 4a and 4b, a first refrigerant pipe 5, a plurality of second refrigerant pipes 6a and 6b, a partition plate 7, and a partition wall 8. The heat exchanger 1 has a plate shape extending in the up-down direction. The plate thickness direction of the heat exchanger 1 is the flow direction of the air passing through the flat tubes 2 (z direction).

[0016] Each of the header pipes 4a and 4b is a hollow columnar part extending in the up-down direction.

[0017] One header pipe 4a includes a tubular part 4a1 having a cylindrical shape extending in the up-down direction, an upper wall part 4a2 closing an upper end of the tubular part 4a1, and a lower wall part 4a3 closing a lower end of the tubular part 4a1.

[0018] The other header pipe 4b includes a tubular part 4b1 having a cylindrical shape extending in the up-down direction, an upper wall part 4b2 closing an upper end of the tubular part 4b1, and a lower wall part 4b3 closing a lower end of the tubular part 4b1.

[0019] An axis 4c of each of the header pipes 4a and 4b extends in the up-down direction (vertical direction). The header pipes 4a and 4b are disposed so as to be spaced apart from each other in the left-right direction in the state of standing in the up-down direction.

[0020] Each of the header pipes 4a and 4b is cylindrically formed by, for example, extrusion molding of a metal material such as aluminum.

[0021] The flat tube 2 extends in the horizontal direction and connects the one header pipe 4a and the other header pipe 4b. That is, the flat tube 2 is disposed in the direction orthogonal to the header pipes 4a and 4b extending in the up-down direction.

[0022] The flat tubes 2 are arranged at substantially equal intervals in the height direction of the header pipes 4a and 4b. The flat tubes 2 are disposed in parallel to each other. Here, the height direction of the header pipes 4a and 4b is the axis direction of the header pipes 4a and 4b (y direction).

[0023] The flat tube 2 connects the tubular part 4a1 of the one header pipe 4a and the tubular part 4b1 of the other header pipe 4b.

[0024] Specifically, in the flat tube 2, one end 2a (end part) in the axis direction of the flat tube 2 is connected to the tubular part 4a1, and the other end 2b in the axis direction of the flat tube 2 is connected to the tubular part 4b1.

[0025] The one end 2a of the flat tube 2 is inserted into an outer periphery of the tubular part 4a1 of the header pipe 4a from the outside, and this inserted portion is coupled to the tubular part 4a1 by welding or the like. The one end 2a of the flat tube 2 projects into the inside of the tubular part 4a1.

[0026] The inside of the flat tube 2 is a refrigerant flow path through which a refrigerant flows. The one header pipe 4a and the other header pipe 4b communicate with each other via the flat tube 2.

[0027] The fin 3 is a plate disposed in the direction orthogonal to the flat tube 2, between the one header pipe 4a and the other header pipe 4b. The plurality of fins 3 are disposed at intervals in the axis direction of the flat tube 2. Specifically, the flat tube 2 is inserted into a hole provided in each of the fins 3 and is in contact with the flat tube 2.

[0028] The heat exchanger 1 exchanges heat between air flowing between the plurality of fins 3 and a refrigerant flowing through the plurality of flat tubes 2.

[0029] As the refrigerant, for example, R410A, R32, or a mixed refrigerant containing R32 is used.

[0030] The partition wall 8 having a disc shape is provided in the one header pipe 4a. The partition wall 8 separates a space in the one header pipe 4a into an upper space 9a on the upper side of the partition wall 8 and a lower space 9b on the lower side of the partition wall 8. The partition wall 8 is a disc-shaped plate provided at a middle part in the up-down direction of the tubular part 4a1.

[0031] An upper end of the upper space 9a is defined by the upper wall part 4a2. A lower end of the lower space 9b is defined by the lower wall part 4a3.

[0032] The upper space 9a communicates with an upper part of the other header pipe 4b via the flat tube 2 connected to a portion defining the upper space 9a in the tubular part 4a1 of the one header pipe 4a.

[0033] In the one header pipe 4a, the lower space 9b is provided with the partition plate 7.

[0034] The partition plate 7 is formed by an upper-side partition plate 7a located at an upper part of the lower space 9b and a lower-side partition plate 7b located at a lower part of the lower space 9b. Each of the upper-side partition plate 7a and the lower-side partition plate 7b is a disc-shaped plate separating the inside of the tubular part 4a1 in the up-down direction.

[0035] The lower space 9b of the one header pipe 4a is provided with a first refrigerant inflow space 10a defined by the partition wall 8 and the upper-side partition plate 7a in the up-down direction (the axis direction of the header pipe 4a), and a second refrigerant inflow space 10b defined by the lower-side partition plate 7b and the lower wall part 4a3 in the up-down direction.

[0036] Furthermore, the lower space 9b of the one header pipe 4a is provided with a refrigerant outflow space 11 defined by the upper-side partition plate 7a and the lower-side partition plate 7b in the up-down direction.

[0037] The refrigerant outflow space 11 is provided between the first refrigerant inflow space 10a and the second refrigerant inflow space 10b in the up-down direction. Furthermore, the first refrigerant inflow space 10a is located above the refrigerant outflow space 11, and the second refrigerant inflow space 10b is located below the refrigerant outflow space 11.

[0038] The refrigerant outflow space 11 is longer in the up-down direction than the first refrigerant inflow space 10a and the second refrigerant inflow space 10b.

[0039] Each of the first refrigerant pipe 5 and the plurality of second refrigerant pipes 6a and 6b disposed in the up-down direction is connected to the one header pipe 4a. Each of the first refrigerant pipe 5 and the plurality of second refrigerant pipes 6a and 6b is configured to function as a refrigerant inflow port or outflow port.

[0040] The first refrigerant pipe 5 is connected to an upper part of the one header pipe 4a and communicates with the upper space 9a.

[0041] The second refrigerant pipe 6a on the upper side is connected to a middle part in the up-down direction of the one header pipe 4a and communicates with the first refrigerant inflow space 10a.

[0042] Specifically, an end part 6a1 of the second refrigerant pipe 6a is connected to an outer periphery of a portion defining the first refrigerant inflow space 10a in the tubular part 4a1. That is, the second refrigerant pipe 6a is connected to a portion below the partition wall 8 and above the upper-side partition plate 7a in the tubular part 4a1.

[0043] The end part 6a1 of the second refrigerant pipe 6a is disposed so as to be located on the opposite side in the tubular part 4a1 with respect to the one end 2a of the flat tube 2 inserted into the tubular part 4a1 from the outside and face the one end 2a of the flat tube 2. That is, the end part 6a1 of the second refrigerant pipe 6a is provided on the side where the flat tube 2 is not inserted in the tubular part 4a1. Here, the side where the flat tube 2 is not inserted in the tubular part 4a1 means the side far from a portion where the flat tube 2 is inserted in the tubular part 4a1.

[0044] The end part 6a1 of the second refrigerant pipe 6a extends in the horizontal direction and is parallel to the flat tube 2.

[0045] The second refrigerant pipe 6b on the lower side is connected to a lower part of the one header pipe 4a and communicates with the second refrigerant inflow space 10b.

[0046] Specifically, an end part 6b1 of the second refrigerant pipe 6b is connected to an outer periphery of a portion defining the second refrigerant inflow space 10b in the tubular part 4a1. That is, the second refrigerant pipe 6b is connected to a portion below the lower-side partition plate 7b and above the lower wall part 4a3 in

the tubular part 4a1.

[0047] The end part 6b1 of the second refrigerant pipe 6b is disposed so as to be located on the opposite side in the tubular part 4a1 with respect to the one end 2a of the flat tube 2 inserted into the tubular part 4a1 from the outside and face the one end 2a of the flat tube 2. That is, the end part 6b1 of the second refrigerant pipe 6b is provided on the side where the flat tube 2 is not inserted in the tubular part 4a1.

[0048] The end part 6b1 of the second refrigerant pipe 6b extends in the horizontal direction and is parallel to the flat tube 2.

[0049] In the lower space 9b, the flat tube 2 communicates with the refrigerant outflow space 11. The plurality of flat tubes 2 are connected to a portion defining the refrigerant outflow space 11 in the outer periphery of the tubular part 4a1. That is, the plurality of flat tubes 2 are arranged in the up-down direction at a portion between the upper-side partition plate 7a and the lower-side partition plate 7b in the tubular part 4a1.

[0050] Each of the second refrigerant pipes 6a and 6b, the upper-side partition plate 7a, and the lower-side partition plate 7b is disposed at a position different from each of the flat tubes 2 in the height direction of the header pipe 4a.

[0051] The upper-side partition plate 7a is provided with a communication hole 12a allowing the refrigerant outflow space 11 to communicate with the first refrigerant inflow space 10a above the refrigerant outflow space 11.

[0052] The communication hole 12a is a round hole penetrating the upper-side partition plate 7a in the height direction of the header pipe 4a (the axis direction of the header pipe 4a). The axis direction of the communication hole 12a is the height direction of the header pipe 4a, and the axis direction of the communication hole 12a is orthogonal to the axis direction of the flat tube 2 (horizontal direction).

[0053] The communication hole 12a is, on the upper-side partition plate 7a, disposed closer to the side where the flat tube 2 is not inserted. That is, the communication hole 12a is, in the horizontal direction, disposed closer to the end part 6a1 side of the second refrigerant pipe 6a relative to the one end 2a side of the flat tube 2.

[0054] A surface on the side of the refrigerant outflow space 11 in the upper-side partition plate 7a, that is, a lower surface of the upper-side partition plate 7a is provided with an inclined surface 13a descending from the side where the flat tube 2 is not inserted in the header pipe 4a toward the side where the flat tube 2 is inserted in the header pipe 4a.

[0055] The communication hole 12a is present ahead of the inclined surface 13a ascending from the side where the flat tube 2 is inserted in the header pipe 4a toward the side where the flat tube 2 is not inserted in the header pipe 4a.

[0056] The lower-side partition plate 7b is provided with a communication hole 12b allowing the refrigerant outflow space 11 to communicate with the second refrigerant inflow space 10b below the refrigerant outflow space 11.

[0057] The communication hole 12b is a round hole penetrating the lower-side partition plate 7b in the height direction of the header pipe 4a (the axis direction of the header pipe 4a). The axis direction of the communication hole 12b is the height direction of the header pipe 4a, and the axis direction of the communication hole 12b is orthogonal to the axis direction of the flat tube 2 (horizontal direction).

[0058] The communication hole 12b is, on the lower-side partition plate 7b, disposed closer to the side where the flat tube 2 is inserted. That is, the communication hole 12b is, in the horizontal direction, disposed closer to the one end 2a side of the flat tube 2 relative to the end part 6a1 side of the second refrigerant pipe 6a.

[0059] A surface on the side of the refrigerant outflow space 11 in the lower-side partition plate 7b, that is, an upper surface of the lower-side partition plate 7b is provided with an inclined surface 13b descending from the side where the flat tube 2 is not inserted in the header pipe 4a toward the side where the flat tube 2 is inserted in the header pipe 4a.

[0060] The communication hole 12b is present ahead of the inclined surface 13b descending from the side where the flat tube 2 is not inserted in the header pipe 4a toward the side where the flat tube 2 is inserted in the header pipe 4a.

[0061] With reference to Figs. 2 and 4, when the communication hole 12b is viewed in the axis direction of the header pipe 4a (the y direction in the figures), the communication hole 12b is spaced apart from the one end 2a of the flat tube 2 toward the side where the flat tube 2 is not inserted. That is, the communication hole 12b is provided at a position not overlapping with the one end 2a of the flat tube 2, as viewed in the axis direction of the header pipe 4a.

[0062] Furthermore, with reference to Fig. 2, the communication hole 12a of the upper-side partition plate 7a is disposed nearer the side where the flat tube 2 is not inserted in the header pipe 4a than the communication hole 12b of the lower-side partition plate 7b.

[0063] The first refrigerant inflow space 10a, the second refrigerant inflow space 10b, the refrigerant outflow space 11, the upper-side partition plate 7a, and the lower-side partition plate 7b form a refrigerant dividing section 14 that divides the refrigerant flowing into the header pipe 4a into the plurality of flat tubes 2.

[1-2. Operations]

[0064] Operations and functions of the heat exchanger 1 configured as above will be described below.

[0065] As an example, a case where the heat exchanger 1 of the present embodiment is used in an outdoor unit 20 of an air conditioning apparatus will be described with reference to Figs. 5 and 6.

[0066] Fig. 5 is an x-z plan view illustrating an internal structure of the outdoor unit 20 using the heat exchanger

1 of the present embodiment, and Fig. 6 is an x-y plan view illustrating the internal structure of the outdoor unit 20 using the heat exchanger 1 of the present embodiment.

[0067] As illustrated in Figs. 5 and 6, 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 illustrated) are connected by a liquid pipe 25 and a gas pipe 26. A direction W of an air flow caused by the blower 24 is indicated by an arrow in Fig. 5.

[0068] The header pipe 4a of the heat exchanger 1 is connected to the switching valve 22 via the first refrigerant pipe 5. Furthermore, the header pipe 4a is connected to the outdoor expansion valve 23 via the plurality of second refrigerant pipes 6a and 6b. In Figs. 5 and 6, the heat exchanger 1 is formed in a substantially L shape as viewed from the top.

[0069] In the case where a cooling operation is performed, the heat exchanger 1 functions as a condenser. In Fig. 2, a refrigerant flow at the time of a heating operation described later is indicated by arrows. A refrigerant flow at the time of the cooling operation is not illustrated.

[0070] In the cooling operation, a gas refrigerant sent from the compressor 21 of the outdoor unit 20 flows from the first refrigerant pipe 5 into the header pipe 4a via the switching valve 22. This gas refrigerant passes through the inside of the upper space 9a of the header pipe 4a, flows into a plurality of the refrigerant flow paths in the plurality of flat tubes 2, flows in the horizontal direction (+x direction, +z direction) and then flows to the upper part in the header pipe 4b.

[0071] The refrigerant in the header pipe 4b moves down in the -y direction and then flows in the horizontal direction (-z direction, -x direction) via the plurality of refrigerant flow paths in the plurality of flat tubes 2. In the flat tube 2, the refrigerant dissipates heat through heat exchange with air sent by the blower 24 and condenses.

[0072] The condensed refrigerant flows out to the refrigerant outflow space 11 defined by the upper-side partition plate 7a and the lower-side partition plate 7b and then flows into the first refrigerant inflow space 10a and the second refrigerant inflow space 10b while passing through the respective communication holes 12a and 12b provided in the upper-side partition plate 7a and the lower-side partition plate 7b.

[0073] The refrigerant that has flowed into the first refrigerant inflow space 10a and the second refrigerant inflow space 10b passes through the outdoor expansion valve 23 and the liquid pipe 25 via the second refrigerant pipes 6a and 6b and then flows out to the indoor unit.

[0074] The condensed refrigerant flowing to the indoor unit absorbs heat through heat exchange with air in an indoor heat exchanger (not illustrated) and evaporates. The evaporated refrigerant passes through the gas pipe 26 and then returns to the compressor 21 via the switching valve 22.

[0075] In the case where the heating operation is performed, the heat exchanger 1 functions as an evaporator.

[0076] In the heating operation, a gas refrigerant sent from the compressor 21 of the outdoor unit 20 passes through the gas pipe 26 via the switching valve 22 and then flows out to the indoor unit (not illustrated).

[0077] The gas refrigerant that has flowed to the indoor unit dissipates heat through heat exchange with air in the indoor heat exchanger provided in the indoor unit and condenses.

[0078] The condensed refrigerant passes through the liquid pipe 25 and the outdoor expansion valve 23 to become a gas-liquid two-phase refrigerant and then flows to the first refrigerant inflow space 10a and the second refrigerant inflow space 10b from the respective second refrigerant pipes 6a and 6b.

[0079] The refrigerant that has flowed to the first refrigerant inflow space 10a passes through the communication hole 12a of the upper-side partition plate 7a and then flows into the refrigerant outflow space 11 from the upper side. The refrigerant passing through the communication hole 12a flows downward in the refrigerant outflow space 11 along the axis direction of the communication hole 12a. That is, the refrigerant flowing from the communication hole 12a to the refrigerant outflow space 11 flows in the direction orthogonal to the axis direction of the flat tube 2.

[0080] Specifically, the communication hole 12a is provided on the side where the flat tube 2 is not inserted in the tubular part 4a1; accordingly, the refrigerant flowing downward from the communication hole 12a, in the refrigerant outflow space 11, flows downward at the position on the side where the flat tube 2 is not inserted.

[0081] The refrigerant that has flowed to the second refrigerant inflow space 10b passes through the communication hole 12b of the lower-side partition plate 7b and then flows into the refrigerant outflow space 11 from the lower side. The refrigerant passing through the communication hole 12b flows upward in the refrigerant outflow space 11 along the axis direction of the communication hole 12b. That is, the refrigerant flowing from the communication hole 12b to the refrigerant outflow space 11 flows in the direction orthogonal to the axis direction of the flat tube 2.

[0082] Specifically, the communication hole 12b is provided on the side where the flat tube 2 is inserted in the tubular part 4a1; accordingly, the refrigerant flowing upward from the communication hole 12b, in the refrigerant outflow space 11, flows upward at the position on the side where the flat tube 2 is inserted.

[0083] The refrigerant flowing while moving down from the communication hole 12a to the refrigerant outflow space 11 is accelerated by gravity and accordingly is likely to flow more strongly than the refrigerant flowing while moving up from the communication hole 12b to the refrigerant outflow space 11.

[0084] The communication hole 12b is offset to the side where the flat tube 2 is not inserted in the tubular part 4a1, relative to the one end 2a of the flat tube 2, and does

not overlap with the one end 2a, as viewed in the axis direction of the header pipe 4a. Thus, the refrigerant flowing from the communication hole 12b into the refrigerant outflow space 11 flows upward in the refrigerant outflow space 11 so as to avoid the one end 2a.

[0085] A part of the refrigerant flowing from the communication hole 12b into the refrigerant outflow space 11 moves up and then reaches the vicinity of the lower surface of the upper-side partition plate 7a. This refrigerant, along the inclined surface 13a of the lower surface of the upper-side partition plate 7a, flows from the side where the flat tube 2 is inserted to the side where the flat tube 2 is not inserted, reaches the communication hole 12a side and then joins the flow flowing from the communication hole 12a into the refrigerant outflow space 11.

[0086] A part of the refrigerant flowing from the communication hole 12a into the refrigerant outflow space 11 reaches the vicinity of the upper surface of the lower-side partition plate 7b. This refrigerant, along the inclined surface 13b of the upper surface of the lower-side partition plate 7b, flows from the side where the flat tube 2 is not inserted to the side where the flat tube 2 is inserted, reaches the communication hole 12b side and then joins the flow flowing from the communication hole 12b into the refrigerant outflow space 11.

[0087] The refrigerant that has flowed into the refrigerant outflow space 11 flows from the one end 2a into the flat tube 2, flows in the horizontal direction (+x direction, +z direction) via the refrigerant flow paths in the plurality of flat tubes 2 and then flows to a lower part in the other header pipe 4b.

[0088] The refrigerant that has flowed into the header pipe 4b moves up in the +y direction in the header pipe 4b and then flows in the horizontal direction (-z direction, -x direction) via the refrigerant flow paths in the plurality of flat tubes 2 connected to the upper part of the header pipe 4b. In the flat tube 2, the refrigerant absorbs heat through heat exchange with air sent by the blower 24 and evaporates.

[0089] The refrigerant that has evaporated in the flat tube 2 flows into the upper space 9a of the header pipe 4a and then returns from the first refrigerant pipe 5 to the compressor 21 via the switching valve 22.

[1-3. Effects and the like]

[0090] As above, in the present embodiment, the heat exchanger 1 includes the plurality of flat tubes 2 each forming the refrigerant flow path and the pair of header pipes 4a and 4b connected to respective end parts of each flat tube 2; in the case where the heat exchanger 1 functions as an evaporator, at least one or more first refrigerant pipes 5 from which a refrigerant flows out and the plurality of second refrigerant pipes 6a and 6b into which the refrigerant flows are provided in the header pipe 4a; the refrigerant dividing section 14 is provided in the header pipe 4a to which the plurality of second refrigerant pipes 6a and 6b are connected, wherein the refrigerant dividing section 14 is formed by the first refrigerant inflow space 10a and the second refrigerant inflow space 10b into which the refrigerant flows from the plurality of second refrigerant pipes 6a and 6b, the refrigerant outflow space 11 provided between the first refrigerant inflow space 10a and the second refrigerant inflow space 10b, and the partition plates 7 separating the first refrigerant inflow space 10a and the second refrigerant inflow space 10b, and the refrigerant outflow space 11, and the refrigerant outflow space 11 allows the refrigerant to flow out to the flat tube 2; and the partition plates 7 are provided with the communication holes 12a and 12b allowing the refrigerant outflow space 11 to communicate with the first refrigerant inflow space 10a above the refrigerant outflow space 11 and the second refrigerant inflow space 10b below the refrigerant outflow space 11.

[0091] Accordingly, the refrigerant passes through the communication holes 12a and 12b of the partition plates 7 from the first refrigerant inflow space 10a above the refrigerant outflow space 11 and the second refrigerant inflow space 10b below the refrigerant outflow space 11 and then flows into the refrigerant outflow space 11 from above and below. This prevents the refrigerant flowing from the second refrigerant pipes 6a and 6b into the refrigerant outflow space 11 of the header pipe 4a from flowing straight toward the flat tube 2, so that the refrigerant flow can spread over a wide range in the refrigerant outflow space 11. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0092] Furthermore, as in the present embodiment, the flat tube 2 may be connected to the header pipe 4a such that the one end 2a of the flat tube 2 is inserted into the header pipe 4a, and the communication hole 12a provided in the upper-side partition plate 7a located above the refrigerant outflow space 11 may be provided nearer the side where the flat tube 2 is not inserted in the header pipe 4a than the communication hole 12b provided in the lower-side partition plate 7b located below the refrigerant outflow space 11.

[0093] Accordingly, the refrigerant flowing from the communication hole 12a of the upper-side partition plate 7a to the refrigerant outflow space 11, in the header pipe 4a, flows downward on the side where the flat tube 2 is not inserted and flows at a position far from the flat tube 2. Furthermore, the refrigerant flowing from the communication hole 12b of the lower-side partition plate 7b to the refrigerant outflow space 11, in the header pipe 4a, flows upward on the side where the flat tube 2 is inserted, relative to the communication hole 12a, and flows at a position near the flat tube 2. Therefore, nonuniformity of the refrigerant flow in the refrigerant outflow space 11 can be reduced, and the refrigerant can uniformly flow to the plurality of flat tubes 2. For example, when the air conditioning apparatus is operated in a partial load operation and thereby the amount of the refrigerant circulation becomes small and the refrigerant flow rate becomes slow, the refrigerant which is likely to move down due to the influence of gravity moves down at the position

far from the flat tube 2, and the refrigerant which is less likely to move up due to the influence of gravity moves up at the position near the flat tube 2. As a result, the flow of the refrigerant flowing to the flat tube 2 is prevented from leaning to an upper part of the refrigerant outflow space 11, so that the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0094] Furthermore, as in the present embodiment, the communication hole 12b provided in the lower-side partition plate 7b located below the refrigerant outflow space 11 may be provided at the position not overlapping with the flat tube 2 in the header pipe 4a, when viewed from the axis direction of the header pipe 4a.

[0095] This prevents the refrigerant flowing from the communication hole 12b of the lower-side partition plate 7b into the refrigerant outflow space 11 from colliding with the flat tube 2 in the header pipe 4a. Therefore, the refrigerant flowing from the communication hole 12b into the refrigerant outflow space 11 can effectively move up, and the refrigerant can uniformly flow to the plurality of flat tubes 2. For example, even when the air conditioning apparatus is operated in a minimum load operation and thereby the amount of the refrigerant circulation becomes smallest and the refrigerant flow rate becomes slow, the refrigerant moving up from below the refrigerant outflow space 11 is prevented from colliding with the flat tube 2 inserted into the header pipe 4a. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0096] Furthermore, as in the present embodiment, the surfaces on the sides of the refrigerant outflow space 11 in the upper-side partition plate 7a and the lower-side partition plate 7b may be provided with the inclined surfaces 13a and 13b descending from the side where the flat tube 2 is not inserted in the header pipe 4a toward the side where the flat tube 2 is inserted in the header pipe 4a.

[0097] Accordingly, the refrigerant that has flowed from the communication hole 12b of the lower-side partition plate 7b into the refrigerant outflow space 11 and then has moved up to the position of the upper-side partition plate 7a, along the inclined surface 13a, flows from the side where the flat tube 2 is inserted to the side where the flat tube 2 is not inserted, reaches the communication hole 12a side and then joins the flow flowing from the communication hole 12a into the refrigerant outflow space 11. Furthermore, the refrigerant that has flowed from the communication hole 12a of the upper-side partition plate 7a into the refrigerant outflow space 11 and then has moved down to the position of the lower-side partition plate 7b, along the inclined surface 13b, flows from the side where the flat tube 2 is not inserted to the side where the flat tube 2 is inserted, reaches the communication hole 12b side and then joins the flow flowing from the communication hole 12b into the refrigerant outflow space 11. Therefore, the refrigerant flow can spread over a wide range in the refrigerant outflow space 11, and the refrigerant can uniformly flow to the plurality of flat tubes 2. For example, even when the air conditioning apparatus is operated in an overload operation and thereby the amount of the refrigerant circulation becomes large and the refrigerant flow rate becomes fast, the refrigerant blowing up from below the refrigerant outflow space 11 is likely to reach above the refrigerant outflow space 11, and the refrigerant that has reached above the refrigerant outflow space 11 flows to the communication hole 12a along the inclined surface 13a of the upper-side partition plate 7a, flows to below the refrigerant outflow space 11 due to the refrigerant flowing from above the refrigerant outflow space 11 and then flows to the flat tube 2 side along the inclined surface 13b of the lower-side partition plate 7b, so that the refrigerant is prevented from flowing while leaning to the flat tube 2 of the upper part of the refrigerant outflow space 11. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0098] Furthermore, as in the present embodiment, the axis direction of the communication holes 12a and 12b may be orthogonal to the axis direction of the flat tube 2.

[0099] Accordingly, the flow flowing from the communication holes 12a and 12b into the refrigerant outflow space 11 is orthogonal to the axis direction of the flat tube 2, so that the refrigerant flowing from the communication holes 12a and 12b into the refrigerant outflow space 11 and proceeding straight in the axis direction of the communication holes 12a and 12b is prevented from directly flowing to the flat tube 2. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes 2. It is sufficient that the axis direction of the communication holes 12a and 12b is substantially orthogonal to the axis direction of the flat tube 2.

Embodiment 2

[0100] Hereinafter, Embodiment 2 will be described with reference to Figs. 7 to 11. In this Embodiment 2, parts configured in the same manner as those in Embodiment 1 above are denoted by the same reference signs, and description thereof will be omitted.

[2-1. Configurations]

[0101] Fig. 7 is a perspective view of a heat exchanger 100 of Embodiment 2 of the present invention. Fig. 8 is a cross-sectional view taken along D-D of Fig. 7 (a cross-sectional view of an x-y plane of a heat exchanger 101 disposed upstream of an air flow in Embodiment 2 of the present disclosure). Fig. 9 is a cross-sectional view taken along E-E of Fig. 7 (a cross-sectional view of an x-y plane of a heat exchanger 201 disposed downstream of the air flow in Embodiment 2 of the present disclosure).

[0102] The heat exchanger 100 is configured such that a plurality of the heat exchangers 101 and 201 are disposed so as to overlap with each other in the plate thickness direction of the heat exchangers 101 and 201. The heat exchanger 101 is disposed upstream of the heat exchanger 201 in the air flow passing through the heat

exchanger 100 for heat exchange.

[0103] The heat exchanger 101 includes a plurality of flat tubes 2, a plurality of fins 3, a pair of header pipes 4a and 4b, a plurality of second refrigerant pipes 6a and 6b, an upper-side partition plate 7a and a lower-side partition plate 7b, and a partition wall 8.

[0104] The partition wall 8 separates the inside of the header pipe 4a of the heat exchanger 101 into an upper space 9a and a lower space 9b.

[0105] A first refrigerant inflow space 10a, a second refrigerant inflow space 10b, and a refrigerant outflow space 11 are provided in the lower space 9b of the heat exchanger 101.

[0106] In the heat exchanger 101, the upper-side partition plate 7a is provided with a communication hole 12a, and the lower-side partition plate 7b is provided with a communication hole 12b.

[0107] Furthermore, the heat exchanger 201 includes a plurality of flat tubes 2, a plurality of fins 3, a pair of header pipes 4a and 4b, a first refrigerant pipe 5, an upper-side partition plate 7a and a lower-side partition plate 7b, and a partition wall 8.

[0108] The partition wall 8 separates the inside of the header pipe 4a of the heat exchanger 201 into an upper space 9a and a lower space 9b.

[0109] A first refrigerant inflow space 10a, a second refrigerant inflow space 10b, and a refrigerant outflow space 11 are provided in the lower space 9b of the heat exchanger 201.

[0110] In the heat exchanger 201, the upper-side partition plate 7a is provided with a communication hole 12a, and the lower-side partition plate 7b is provided with a communication hole 12b.

[0111] The heat exchanger 101 and the heat exchanger 201 are connected by a plurality of connection pipes 115a and 115b.

[0112] Specifically, the connection pipe 115a connects the upper space 9a of the heat exchanger 101 and the first refrigerant inflow space 10a of the heat exchanger 201. The upper space 9a of the heat exchanger 101 and the first refrigerant inflow space 10a of the heat exchanger 201 communicate with each other through the connection pipe 115a.

[0113] One end part 115a1 of the connection pipe 115a (Fig. 8) is connected to an upper part of the header pipe 4a of the heat exchanger 101. The other end part 115a2 of the connection pipe 115a (Fig. 9) is connected to a middle part in the up-down direction of the header pipe 4a of the heat exchanger 201.

[0114] The other end part 115a2 of the connection pipe 115a is connected to an outer periphery of a portion defining the first refrigerant inflow space 10a in a tubular part 4a1 of the heat exchanger 201. That is, the other end part 115a2 of the connection pipe 115a is connected to a portion below the partition wall 8 and above the upper-side partition plate 7a in the tubular part 4a1.

[0115] The other end part 115a2 of the connection pipe 115a is provided on the side where the flat tube 2 is not inserted in the tubular part 4a1. The other end part 115a2 extends in the horizontal direction and is parallel to the flat tube 2.

[0116] The connection pipe 115b disposed below the connection pipe 115a connects the upper space 9a of the heat exchanger 101 and the second refrigerant inflow space 10b of the heat exchanger 201. The upper space 9a of the heat exchanger 101 and the second refrigerant inflow space 10b of the heat exchanger 201 communicate with each other through the connection pipe 115b.

[0117] One end part 115b1 of the connection pipe 115b (Fig. 8) is connected to a position below the one end part 115a1 in the upper part of the header pipe 4a of the heat exchanger 101. The other end part 115b2 of the connection pipe 115b (Fig. 9) is connected to a lower part of the header pipe 4a of the heat exchanger 201.

[0118] The other end part 115b2 of the connection pipe 115b is connected to an outer periphery of a portion defining the second refrigerant inflow space 10b in the tubular part 4a1 of the heat exchanger 201. That is, the other end part 115b2 of the connection pipe 115b is connected to a portion below the lower-side partition plate 7b and above a lower wall part 4a3 in the tubular part 4a1.

[0119] The other end part 115b2 of the connection pipe 115b is provided on the side where the flat tube 2 is not inserted in the tubular part 4a1. The other end part 115b2 extends in the horizontal direction and is parallel to the flat tube 2.

[2-2. Operations]

[0120] Operations and functions of the heat exchangers 101 and 201 configured as above will be described below.

[0121] As an example, a case where the heat exchangers 101 and 201 of Embodiment 2 are used in an outdoor unit 120 of an air conditioning apparatus will be described with reference to Figs. 10 and 11.

[0122] Fig. 10 is an x-z plan view illustrating an internal structure of the outdoor unit 120 using the heat exchangers 101 and 201 of the present embodiment. Fig. 11 is an x-y plan view illustrating the internal structure of the outdoor unit 120 using the heat exchangers 101 and 201 of the present embodiment.

[0123] As illustrated in Figs. 10 and 11, the outdoor unit 120 includes a compressor 121, a switching valve 122, an outdoor expansion valve 123, a blower 124, and the heat exchanger 100. The outdoor unit 120 and an indoor unit (not illustrated) are connected by a liquid pipe 125 and a gas pipe 126. A direction W of an air flow caused by the blower 124 is indicated by an arrow in Fig. 10.

[0124] The header pipe 4a of the heat exchanger 201 is connected to the switching valve 122 via the first refrigerant pipe 5.

[0125] The header pipe 4a of the heat exchanger 101 is connected to the outdoor expansion valve 123 via the second refrigerant pipes 6a and 6b. In Figs. 10 and 11,

each of the heat exchangers 101 and 201 is formed in a substantially L shape as viewed from the top.

[0126] In the case where a cooling operation is performed, each of the heat exchangers 101 and 201 functions as a condenser. In Figs. 8 and 9, a refrigerant flow at the time of a heating operation described later is indicated by arrows. A refrigerant flow at the time of the cooling operation is not illustrated.

[0127] In the cooling operation, a gas refrigerant sent from the compressor 121 of the outdoor unit 120 flows into the header pipe 4a of the heat exchanger 201 from the first refrigerant pipe 5 via the switching valve 122. This gas refrigerant passes through the upper space 9a of the header pipe 4a in the heat exchanger 201, flows into refrigerant flow paths of the plurality of flat tubes 2, flows in the horizontal direction (+x direction, +z direction) and then flows out to the upper side of the header pipe 4b of the heat exchanger 201.

[0128] The refrigerant that has flowed out to the header pipe 4b of the heat exchanger 201 moves down in the -y direction in the header pipe 4b, flows in the horizontal direction (-z direction, -x direction) via the refrigerant flow paths of the plurality of flat tubes 2 and then flows to the refrigerant outflow space 11 of the header pipe 4a of the heat exchanger 201. The refrigerant dissipates heat in the flat tube 2. The refrigerant in the refrigerant outflow space 11 passes through the communication holes 12a and 12b of the upper-side partition plate 7a and the lower-side partition plate 7b and then flows into the first refrigerant inflow space 10a and second refrigerant inflow space 10b of the heat exchanger 201.

[0129] The refrigerant that has flowed to the first refrigerant inflow space 10a passes through the connection pipe 115a and then flows into the upper space 9a of the header pipe 4a of the heat exchanger 101.

[0130] The refrigerant that has flowed to the second refrigerant inflow space 10b passes through the connection pipe 115b and then flows into the upper space 9a of the header pipe 4a of the heat exchanger 101.

[0131] The refrigerant that has flowed into the upper space 9a flows into refrigerant flow paths of the plurality of flat tubes 2, flows in the horizontal direction (+x direction, +z direction) and then flows into an upper part in the header pipe 4b of the heat exchanger 101. This refrigerant moves down in the header pipe 4b in the -y direction and then flows in the horizontal direction (-z direction, -x direction) via the refrigerant flow paths of the plurality of flat tubes 2. In the flat tube 2, the refrigerant dissipates heat through heat exchange with air sent by the blower 124 and condenses.

[0132] The refrigerant condensed in the flat tube 2 flows into the refrigerant outflow space 11 of the header pipe 4a of the heat exchanger 101, passes through the communication holes 12a and 12b of the upper-side partition plate 7a and the lower-side partition plate 7b and then flows into the first refrigerant inflow space 10a and second refrigerant inflow space 10b of the heat exchanger 101. This refrigerant passes through the outdoor expansion valve 123 and the liquid pipe 125 via the second refrigerant pipes 6a and 6b and then flows to the indoor unit.

[0133] The condensed refrigerant flowing to the indoor unit absorbs heat through heat exchange with air in an indoor heat exchanger (not illustrated) and evaporates. The evaporated refrigerant passes through the gas pipe 126 and then returns to the compressor 121 via the switching valve 122.

[0134] In the case where the heating operation is performed, the heat exchanger 101 functions as an evaporator.

[0135] In the heating operation, a gas refrigerant sent from the compressor 121 of the outdoor unit 120 passes through the gas pipe 126 via the switching valve 122 and then flows to the indoor unit.

[0136] The gas refrigerant that has flowed to the indoor unit dissipates heat through heat exchange with air in the indoor heat exchanger provided in the indoor unit and condenses.

[0137] The refrigerant condensed in the indoor heat exchanger passes through the liquid pipe 125 and the outdoor expansion valve 123 to become a gas-liquid two-phase refrigerant and then flows from the second refrigerant pipes 6a and 6b to the first refrigerant inflow space 10a and second refrigerant inflow space 10b of the heat exchanger 101.

[0138] The refrigerant that has flowed into the first refrigerant inflow space 10a of the heat exchanger 101 passes through the communication hole 12a provided in the upper-side partition plate 7a and then flows to the refrigerant outflow space 11.

[0139] The refrigerant that has flowed into the second refrigerant inflow space 10b of the heat exchanger 101 passes through the communication hole 12b provided in the lower-side partition plate 7b and then flows to the refrigerant outflow space 11.

[0140] The refrigerant that has flowed into the refrigerant outflow space 11 of the heat exchanger 101 flows in the horizontal direction (+x direction, +z direction) via the refrigerant flow paths of the plurality of flat tubes 2 and then flows to a lower part in the header pipe 4b of the heat exchanger 101. This refrigerant moves up in the +y direction in the header pipe 4b, flows in the horizontal direction (-z direction, -x direction) via the refrigerant flow paths of the plurality of flat tubes 2 and then flows to the upper space 9a of the header pipe 4a of the heat exchanger 101. At this time, the refrigerant absorbs heat in the flat tube 2.

[0141] The refrigerant that has flowed to the upper space 9a of the heat exchanger 101 passes through the connection pipes 115a and 115b and then flows into the header pipe 4a of the heat exchanger 201.

[0142] Specifically, the refrigerant in the upper space 9a of the heat exchanger 101 flows out to the outside of the heat exchanger 101 via the connection pipe 115a and then flows into the first refrigerant inflow space 10a of the heat exchanger 201 via the connection pipe 115a.

[0143] Furthermore, the refrigerant in the upper space 9a of the heat exchanger 101 flows out to the outside of the heat exchanger 101 via the connection pipe 115b and then flows into the second refrigerant inflow space 10b of the heat exchanger 201 via the connection pipe 115b.

[0144] That is, in the heating operation in which each of the heat exchangers 101 and 201 functions as an evaporator, for the heat exchanger 101, the connection pipe 115a functions as a first refrigerant pipe allowing the refrigerant to flow out to the outside of the heat exchanger 101.

[0145] Furthermore, in the heating operation, for the heat exchanger 201, the connection pipe 115a functions as a second refrigerant pipe through which the refrigerant flows into the heat exchanger 201 from the outside.

[0146] In the heating operation, for the heat exchanger 101, the connection pipe 115b functions as a first refrigerant pipe allowing the refrigerant to flow out to the outside of the heat exchanger 101. That is, two first refrigerant pipes (connection pipes 115a and 115b) are connected to the heat exchanger 101.

[0147] Furthermore, in the heating operation, for the heat exchanger 201, the connection pipe 115b functions as a second refrigerant pipe through which the refrigerant flows into the heat exchanger 201 from the outside. That is, two second refrigerant pipes (connection pipes 115a and 115b) are connected to the heat exchanger 201.

[0148] The refrigerant that has flowed into the first refrigerant inflow space 10a of the heat exchanger 201 passes through the communication hole 12a provided in the upper-side partition plate 7a and then flows to the refrigerant outflow space 11.

[0149] The refrigerant that has flowed into the second refrigerant inflow space 10b of the heat exchanger 201 passes through the communication hole 12b provided in the lower-side partition plate 7b and then flows to the refrigerant outflow space 11.

[0150] The refrigerant that has flowed to the refrigerant outflow space 11 of the heat exchanger 201 flows in the horizontal direction (+x direction, +z direction) via the refrigerant flow paths of the plurality of flat tubes 2 and then flows to a lower part in the header pipe 4b of the heat exchanger 201.

[0151] The refrigerant that has flowed to the header pipe 4b moves up in the +y direction in the header pipe 4b and then flows in the horizontal direction (-z direction, -x direction) via the refrigerant flow paths of the plurality of flat tubes 2. In the flat tube 2, the refrigerant absorbs heat through heat exchange with air sent by the blower 124 and evaporates.

[0152] The evaporated refrigerant flows into the upper space 9a of the header pipe 4a of the heat exchanger 201 and then returns from the first refrigerant pipe 5 to the compressor 121 via the switching valve 122.

[2-3. Effects and the like]

[0153] As above, in Embodiment 2, the heat exchanger 101 includes the plurality of flat tubes 2 each forming the refrigerant flow path, and the pair of header pipes 4a and 4b connected to respective end parts of each flat tube 2; in the case where the heat exchanger 101 functions as an evaporator, the connection pipes 115a and 115b as the two first refrigerant pipes from which the refrigerant flows out and the plurality of second refrigerant pipes 6a and 6b into which the refrigerant flows are provided in the header pipe 4a; a refrigerant dividing section 14 is provided in the header pipe 4a to which the plurality of second refrigerant pipes 6a and 6b are connected, wherein the refrigerant dividing section 14 is formed by the first refrigerant inflow space 10a and the second refrigerant inflow space 10b into which the refrigerant flows from the plurality of second refrigerant pipes 6a and 6b, the refrigerant outflow space 11 provided between the first refrigerant inflow space 10a and the second refrigerant inflow space 10b, and the partition plates 7 separating the first refrigerant inflow space 10a and the second refrigerant inflow space 10b, and the refrigerant outflow space 11, and the refrigerant outflow space 11 allows the refrigerant to flow out to the flat tube 2; and the partition plates 7 are provided with the communication holes 12a and 12b allowing the refrigerant outflow space 11 to communicate with the first refrigerant inflow space 10a above the refrigerant outflow space 11 and the second refrigerant inflow space 10b below the refrigerant outflow space 11.

[0154] Accordingly, in the heat exchanger 101, the refrigerant passes through the communication holes 12a and 12b of the partition plates 7 from the first refrigerant inflow space 10a above the refrigerant outflow space 11 and the second refrigerant inflow space 10b below the refrigerant outflow space 11 and then flows into the refrigerant outflow space 11 from above and below. This prevents the refrigerant flowing from the second refrigerant pipes 6a and 6b into the refrigerant outflow space 11 of the header pipe 4a from flowing straight toward the flat tube 2, so that the refrigerant flow can spread over a wide range in the refrigerant outflow space 11. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0155] Furthermore, the heat exchanger 201 includes the plurality of flat tubes 2 each forming the refrigerant flow path, and the pair of header pipes 4a and 4b connected to respective end parts of each flat tube 2; in the case where the heat exchanger 201 functions as an evaporator, the first refrigerant pipe 5 from which the refrigerant flows out and the connection pipes 115a and 115b as a plurality of the second refrigerant pipes into which the refrigerant flows are provided in the header pipe 4a; a refrigerant dividing section 14 is provided in the header pipe 4a to which the plurality of connection pipes 115a and 115b are connected, wherein the refrigerant dividing section 14 is formed by the first refrigerant inflow space

10a and the second refrigerant inflow space 10b into which the refrigerant flows from the plurality of connection pipes 115a and 115b, the refrigerant outflow space 11 provided between the first refrigerant inflow space 10a and the second refrigerant inflow space 10b, and the partition plates 7 separating the first refrigerant inflow space 10a and the second refrigerant inflow space 10b, and the refrigerant outflow space 11, and the refrigerant outflow space 11 allows the refrigerant to flow out to the flat tube 2; and the partition plates 7 are provided with the communication holes 12a and 12b allowing the refrigerant outflow space 11 to communicate with the first refrigerant inflow space 10a above the refrigerant outflow space 11 and the second refrigerant inflow space 10b below the refrigerant outflow space 11.

[0156] Accordingly, in the heat exchanger 201, the refrigerant passes through the communication holes 12a and 12b of the partition plates 7 from the first refrigerant inflow space 10a above the refrigerant outflow space 11 and the second refrigerant inflow space 10b below the refrigerant outflow space 11 and then flows into the refrigerant outflow space 11 from above and below. This prevents the refrigerant flowing from the connection pipes 115a and 115b into the refrigerant outflow space 11 of the header pipe 4a from flowing straight toward the flat tube 2, so that the refrigerant flow can spread over a wide range in the refrigerant outflow space 11. Therefore, the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0157] The heat exchanger 100 formed by arranging the heat exchanger 101 and the heat exchanger 201 in the direction of the air flow (z direction) can be used for large-scale air conditioning which requires a large capacity. As in the heat exchanger 100, even in the configuration in which the heat exchanger 101 and the heat exchanger 201 are connected by the connection pipes 115a and 115b, separation between a liquid refrigerant and a gas refrigerant due to a difference in density caused by an increase in gas ratio is prevented. This can prevent the liquid refrigerant from leaning to the flat tubes 2 on the lower side and can prevent the gas refrigerant from leaning to the flat tubes 2 on the upper side, so that the refrigerant can uniformly flow to the plurality of flat tubes 2.

[0158] The present disclosure is a heat exchanger including a plurality of flat tubes each forming a refrigerant flow path, and a pair of header pipes connected to respective end parts of each flat tube; in the case where the heat exchanger functions as an evaporator, a first refrigerant pipe from which a refrigerant flows out and a plurality of second refrigerant pipes into which the refrigerant flows are provided in a header pipe of the header pipes; a refrigerant dividing section is provided in the header pipe to which the plurality of second refrigerant pipes are connected, wherein the refrigerant dividing section is formed by a plurality of refrigerant inflow spaces into which the refrigerant flows from the plurality of second refrigerant pipes, a refrigerant outflow space provided between the plurality of refrigerant inflow spaces, and a plurality of partition plates separating the plurality of refrigerant inflow spaces and the refrigerant outflow space, and the refrigerant outflow space allows the refrigerant to flow out to the flat tube; and the partition plates are provided with communication holes, respectively, allowing the refrigerant outflow space to communicate with a refrigerant inflow space of the refrigerant inflow spaces above the refrigerant outflow space and a refrigerant inflow space of the refrigerant inflow spaces below the refrigerant outflow space, so that the refrigerant can uniformly flow to the plurality of flat tubes. The present disclosure is applicable to a refrigerator, an air conditioning apparatus, a combined hot water supply and air conditioning apparatus, or the like.

Reference Signs List

[0159]

1	heat exchanger
2	flat tube
2a	one end (end part)
2b	other end
3	fin
4a, 4b	header pipe
4a1, 4b1	tubular part
4a2, 4b2	upper wall part
4a3, 4b3	lower wall part
4c	axis
5	first refrigerant pipe
6a, 6b	second refrigerant pipe
6a1, 6b1	end part
7	partition plate
7a	upper-side partition plate (partition plate)
7b	lower-side partition plate (partition plate)
8	partition wall
9a	upper space
9b	lower space
10a	first refrigerant inflow space (refrigerant inflow space)
10b	second refrigerant inflow space (refrigerant inflow space)
11	refrigerant outflow space
12a, 12b	communication hole
13a, 13b	inclined surface
14	refrigerant dividing section
20, 120	outdoor unit
21, 121	compressor
22, 122	switching valve
23, 123	outdoor expansion valve
24, 124	blower
25, 125	liquid pipe
26, 126	gas pipe
100	heat exchanger
101	heat exchanger

115a, 115b	connection pipe (first refrigerant pipe, second refrigerant pipe)
115a1, 115b1	one end part
115a2, 115b2	other end part
201	heat exchanger

Claims

1. A heat exchanger (1) comprising:

a plurality of flat tubes (2) each forming a refrigerant flow path; and
a pair of header pipes (4a, 4b) connected to respective end parts (2a, 2b) of each flat tube,
characterized in that in a case where the heat exchanger functions as an evaporator, at least one or more first refrigerant pipes (5) from which a refrigerant flows out and a plurality of second refrigerant pipes (6a, 6b) into which the refrigerant flows are provided in a header pipe (4a) of the header pipes,
a refrigerant dividing section (14) is provided in the header pipe to which the plurality of second refrigerant pipes are connected, the refrigerant dividing section being formed by a plurality of refrigerant inflow spaces (10a, 10b) into which the refrigerant flows from the plurality of second refrigerant pipes, a refrigerant outflow space (11) provided between the plurality of refrigerant inflow spaces, and a plurality of partition plates (7) separating the plurality of refrigerant inflow spaces and the refrigerant outflow space, the refrigerant outflow space allowing the refrigerant to flow out to the flat tube, and
the partition plates are provided with communication holes (12a, 12b), respectively, allowing the refrigerant outflow space to communicate with a refrigerant inflow space (10a) of the refrigerant inflow spaces above the refrigerant outflow space and a refrigerant inflow space (10b) of the refrigerant inflow spaces below the refrigerant outflow space.

2. The heat exchanger according to claim 1,
wherein the flat tube is connected to the header pipe such that an end part (2a) of the flat tube is inserted into the header pipe, and
the communication hole provided in the partition plate (7a) located above the refrigerant outflow space is provided nearer a side where the flat tube is not inserted in the header pipe than the communication hole provided in the partition plate (7b) located below the refrigerant outflow space.

3. The heat exchanger according to claim 2, wherein the communication hole provided in the partition plate (7b) located below the refrigerant outflow space is provided at a position not overlapping with the flat tube in the header pipe, when viewed from an axis direction of the header pipe.

4. The heat exchanger according to claim 2 or 3, wherein a surface on a side of the refrigerant outflow space in the partition plate is provided with an inclined surface (13a, 13b) descending from the side where the flat tube is not inserted in the header pipe toward a side where the flat tube is inserted in the header pipe.

5. The heat exchanger according to any of claims 1 to 4, wherein an axis direction of each communication hole is orthogonal to an axis direction of the flat tube.

FIG.1

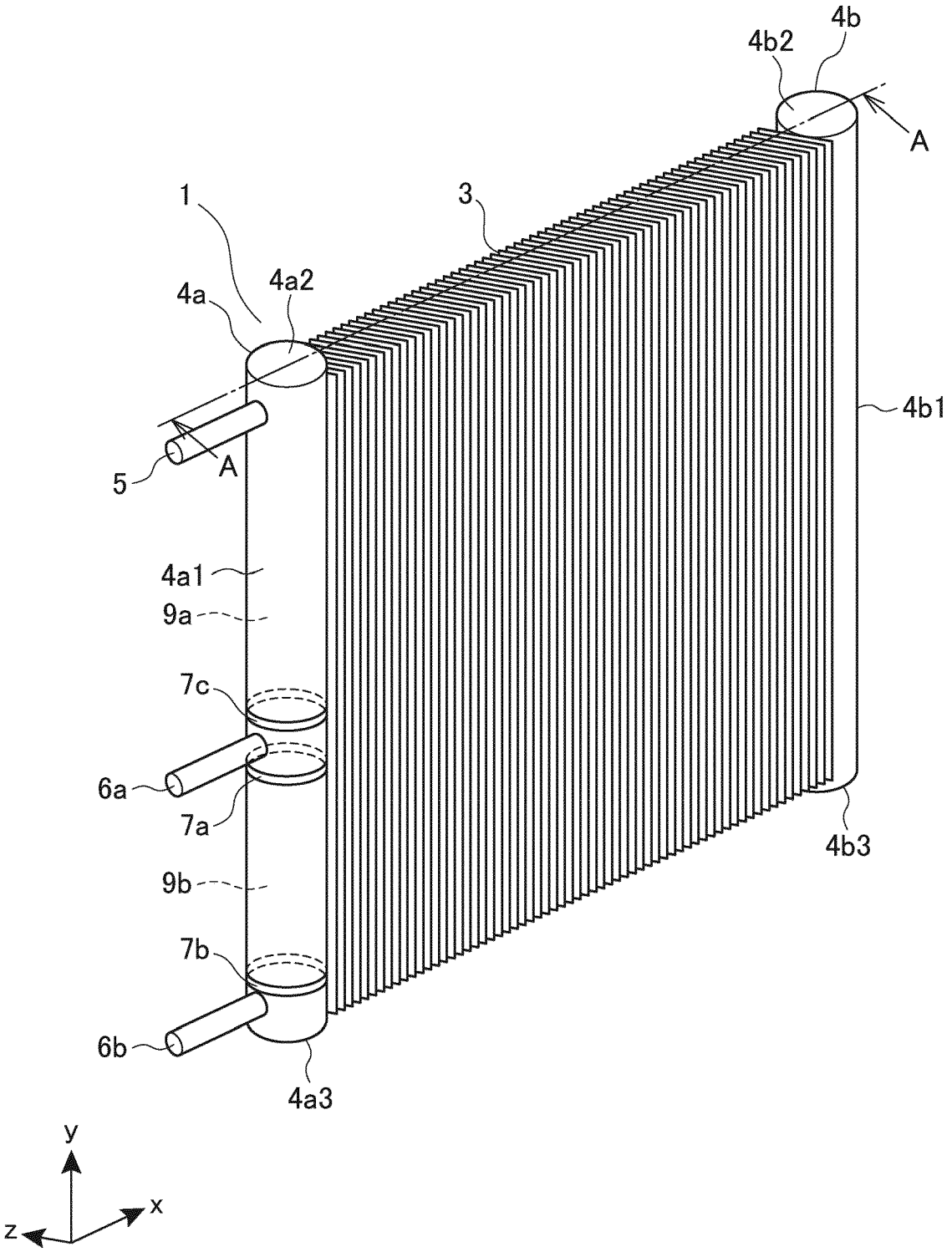
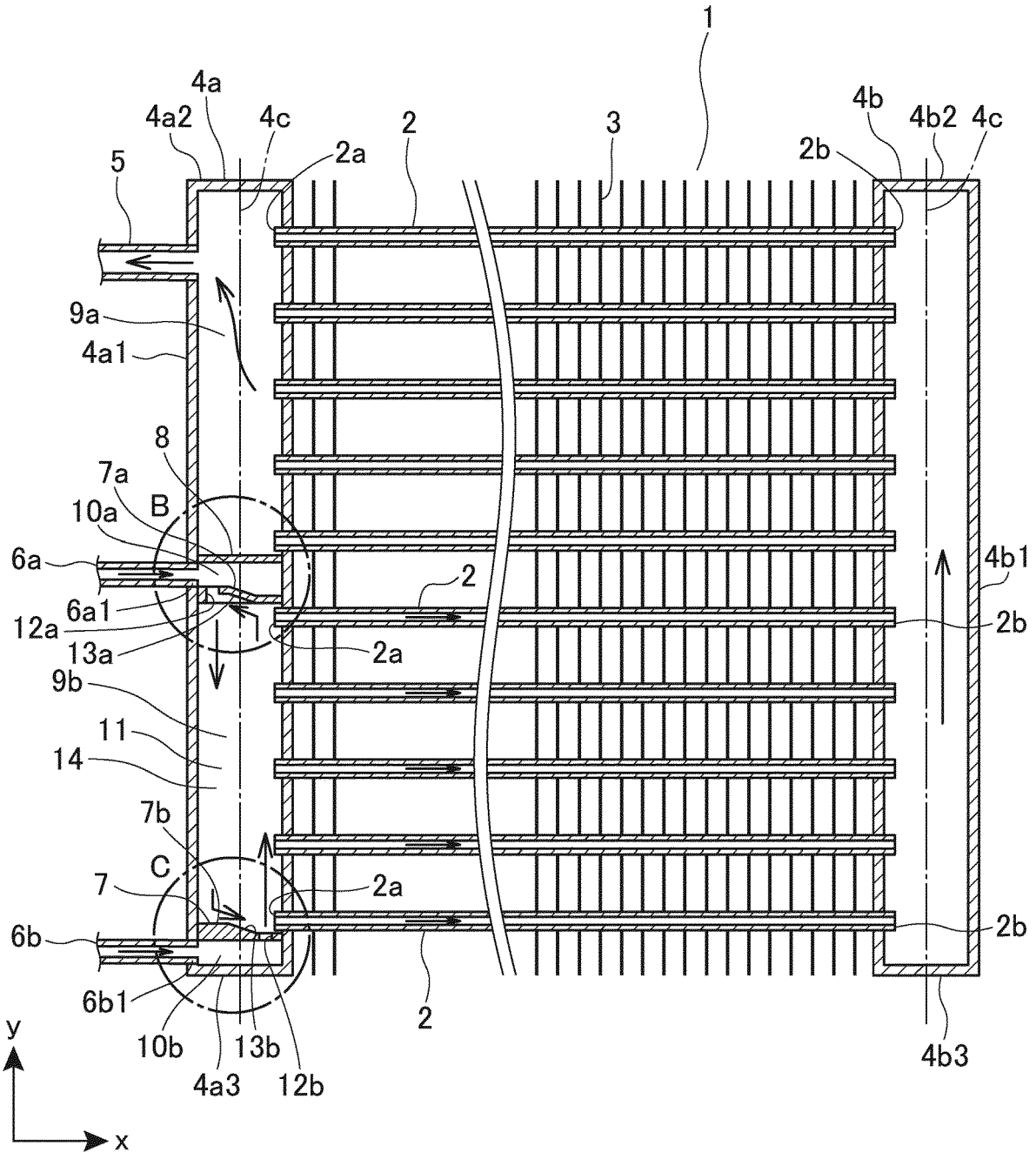


FIG.2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4c
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4b
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4c
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2b
9a
4a1
8
7a
10a
B
6a
2
4b1
6a1
12a
13a
2a
2b
9b
11
14
7b
C
7
2a
6b
2b
6b1
2
10b
13b
4a3
12b
4b3
y
x

FIG.3

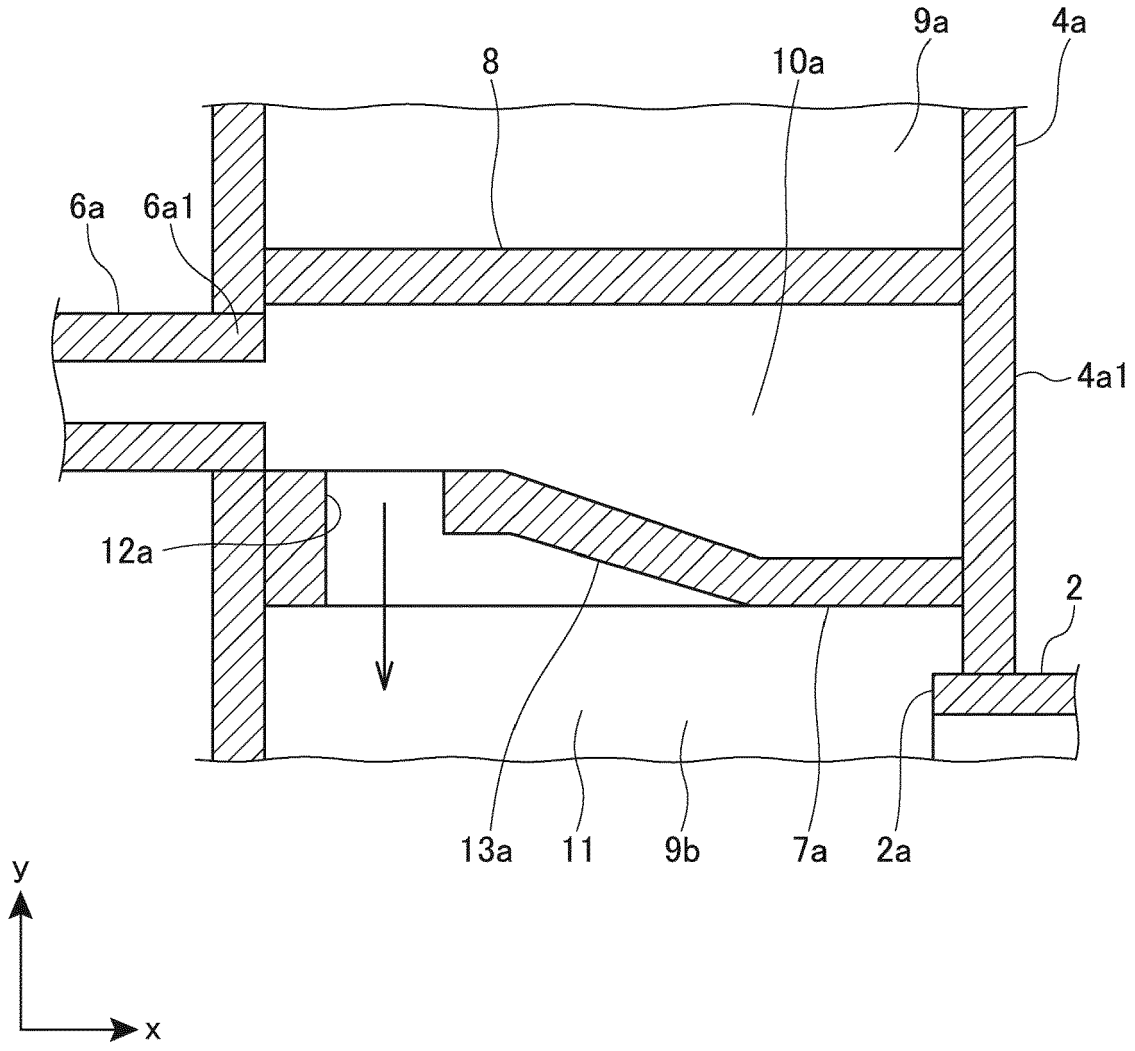


FIG.4

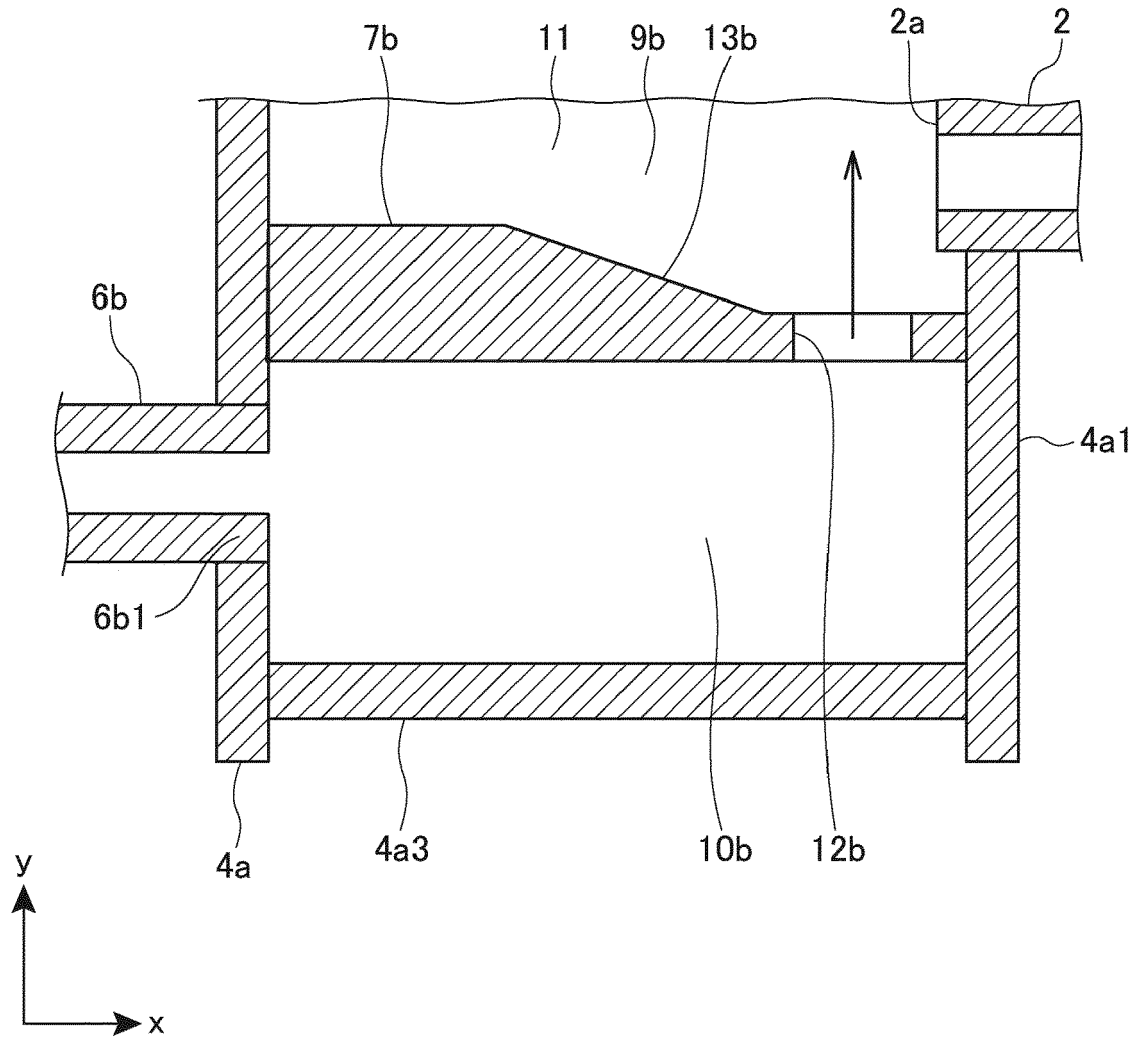


FIG.5

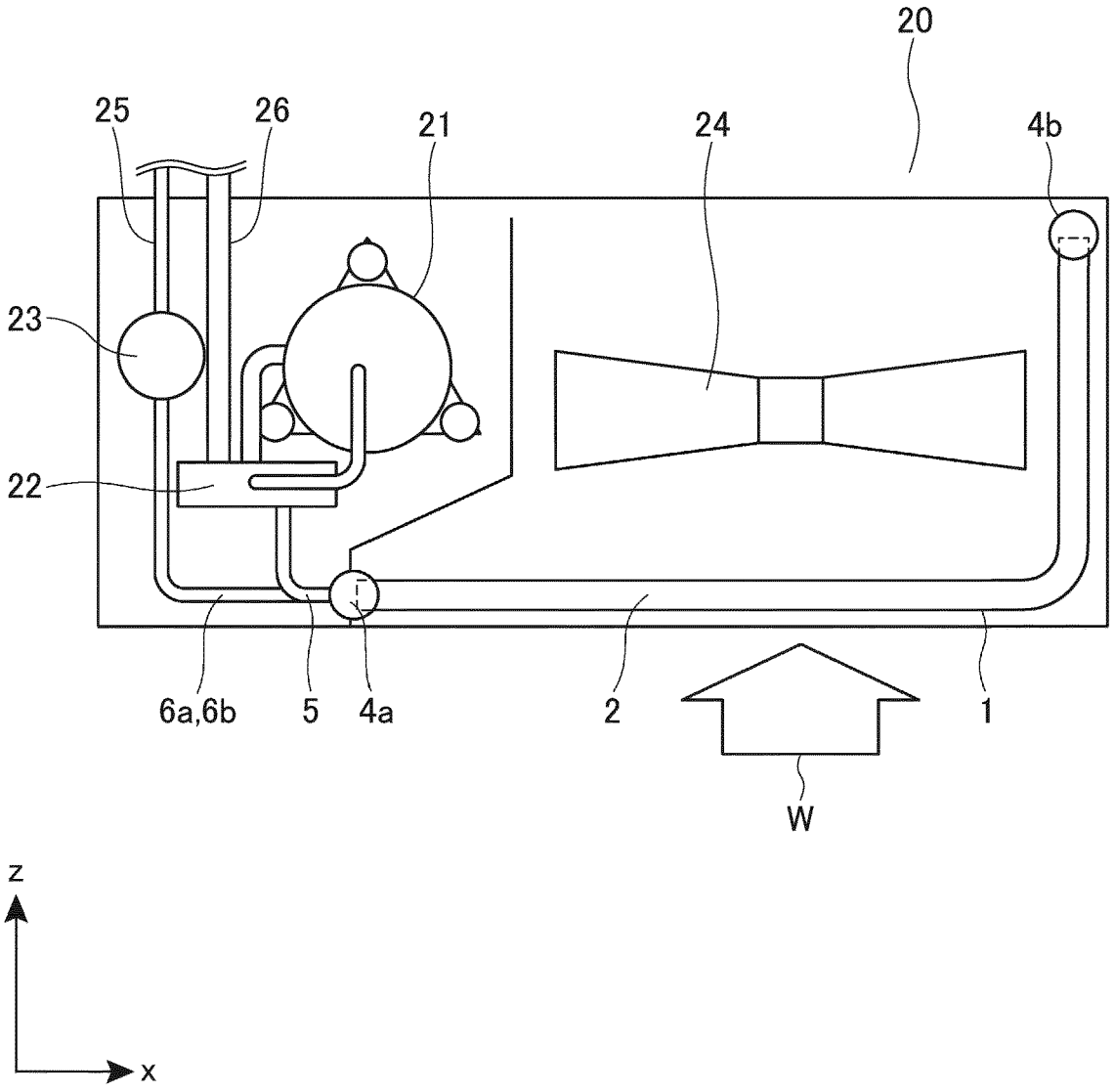


FIG.6

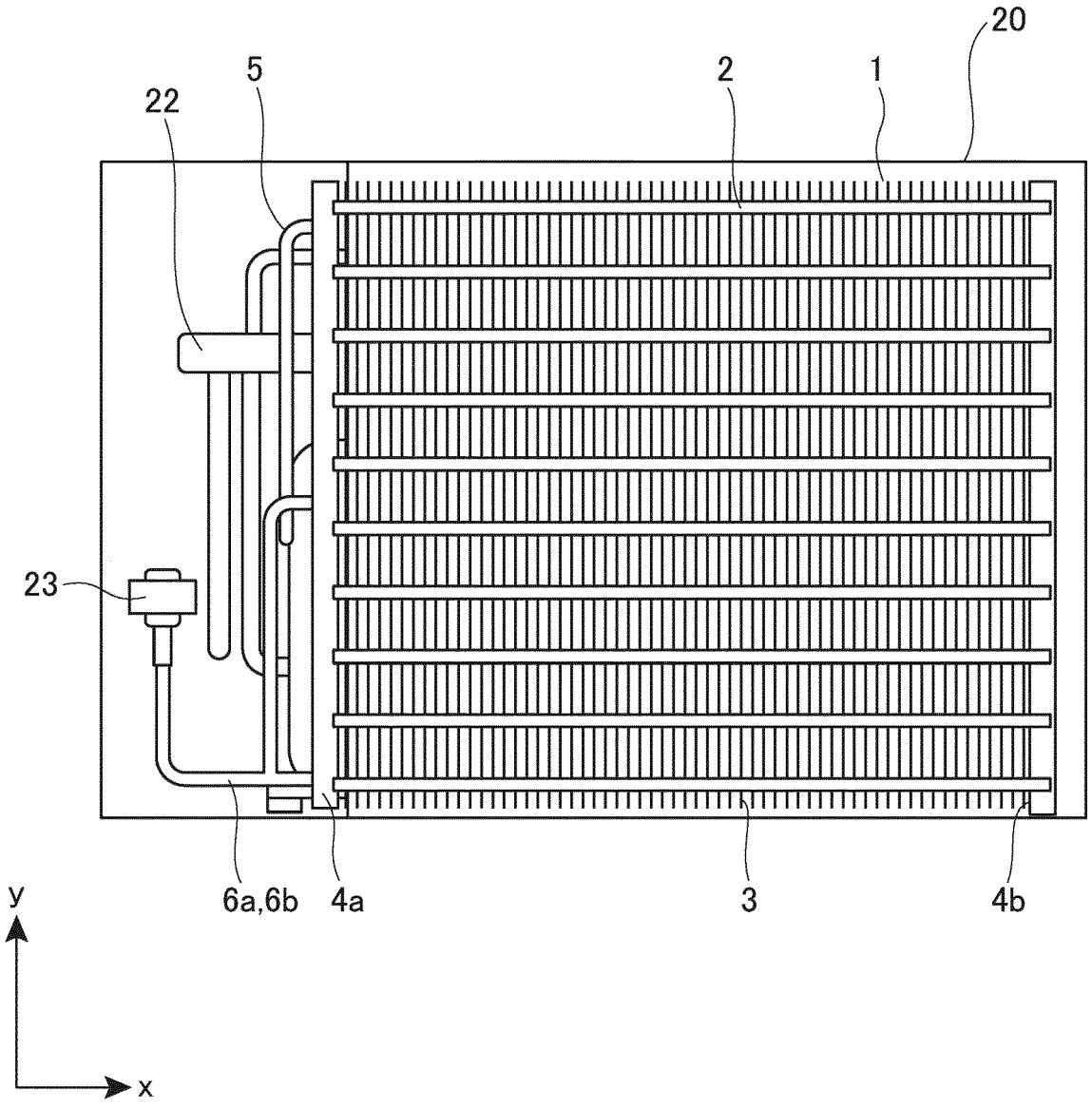
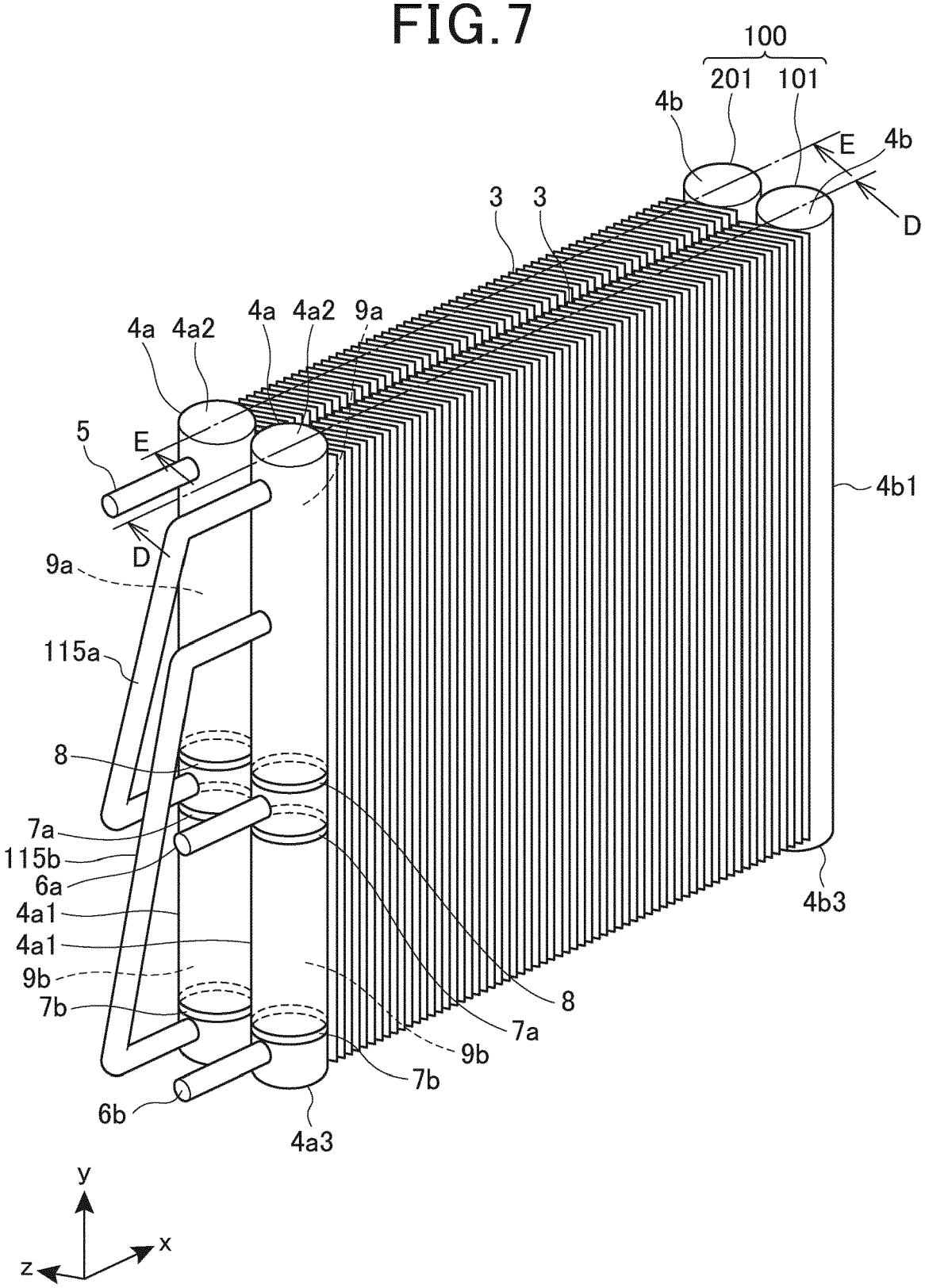


FIG.7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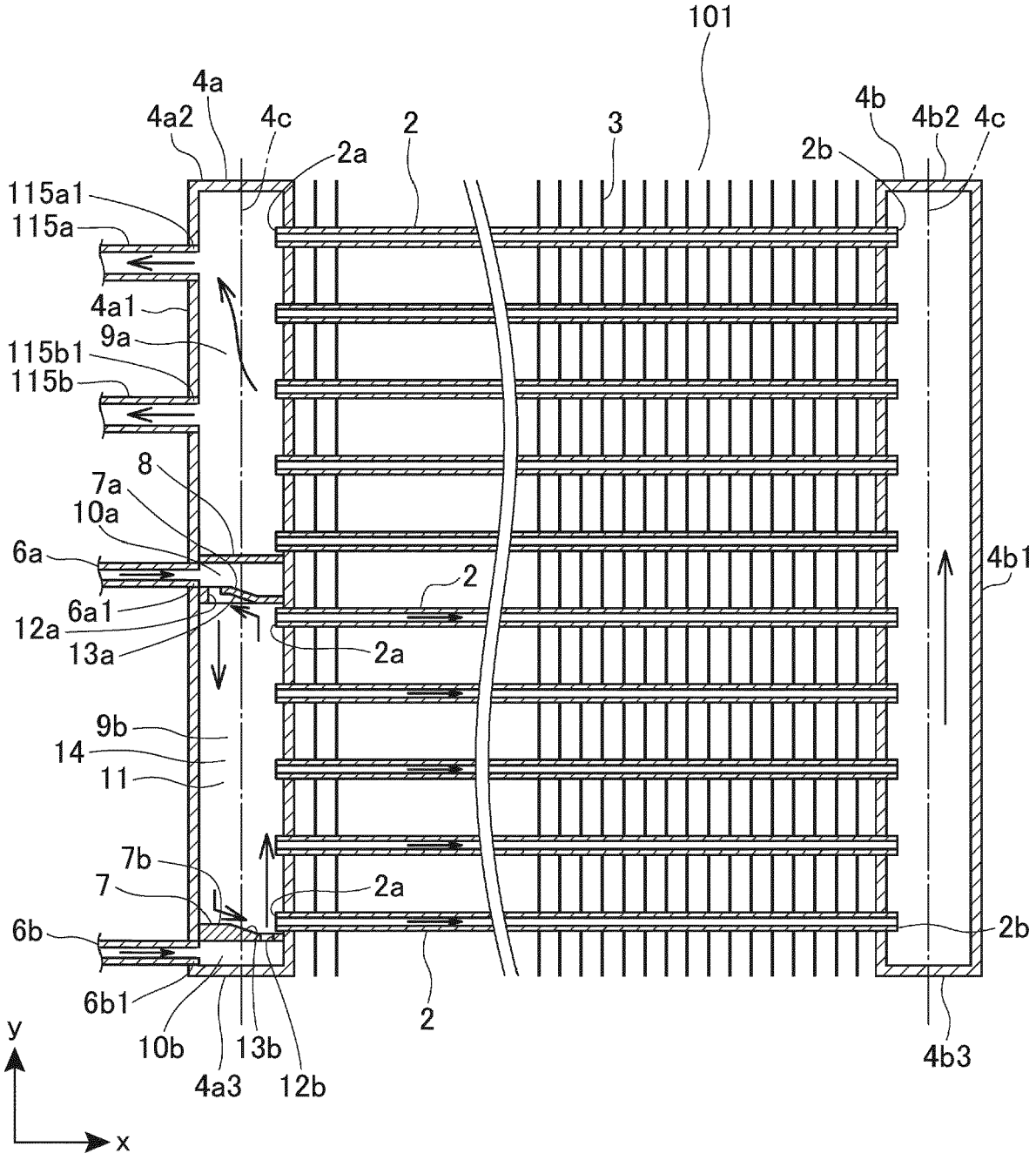
201
101
4b
E
4b
D
3
3
4a
4a2
4a
4a2
9a
5
E
D
4b1
9a
115a
8
7a
115b
6a
4a1
4a1
9b
7b
6b
4a3
8
7a
9b
7b
4b3
y
x
z

FIG.8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4c
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4b
4b2
4c
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2b
115a1
115a
4a1
9a
115b1
115b
8
7a
10a
6a
6a1
12a
13a
2
2a
4b1
9b
14
11
7b
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6b
2b
6b1
10b
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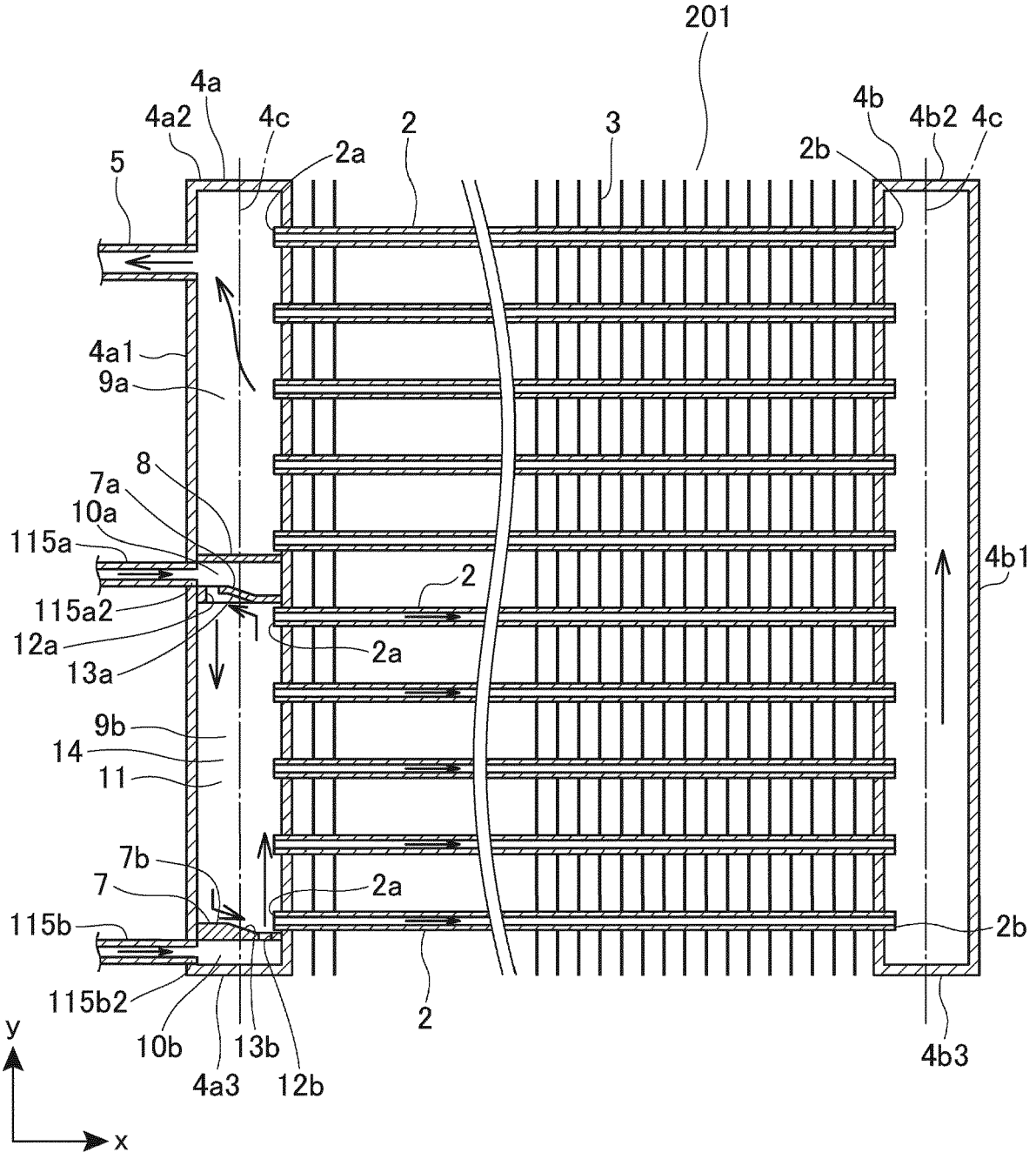
4a3
12b
2
4b3
y
x

FIG.9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4c
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4c
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4a1
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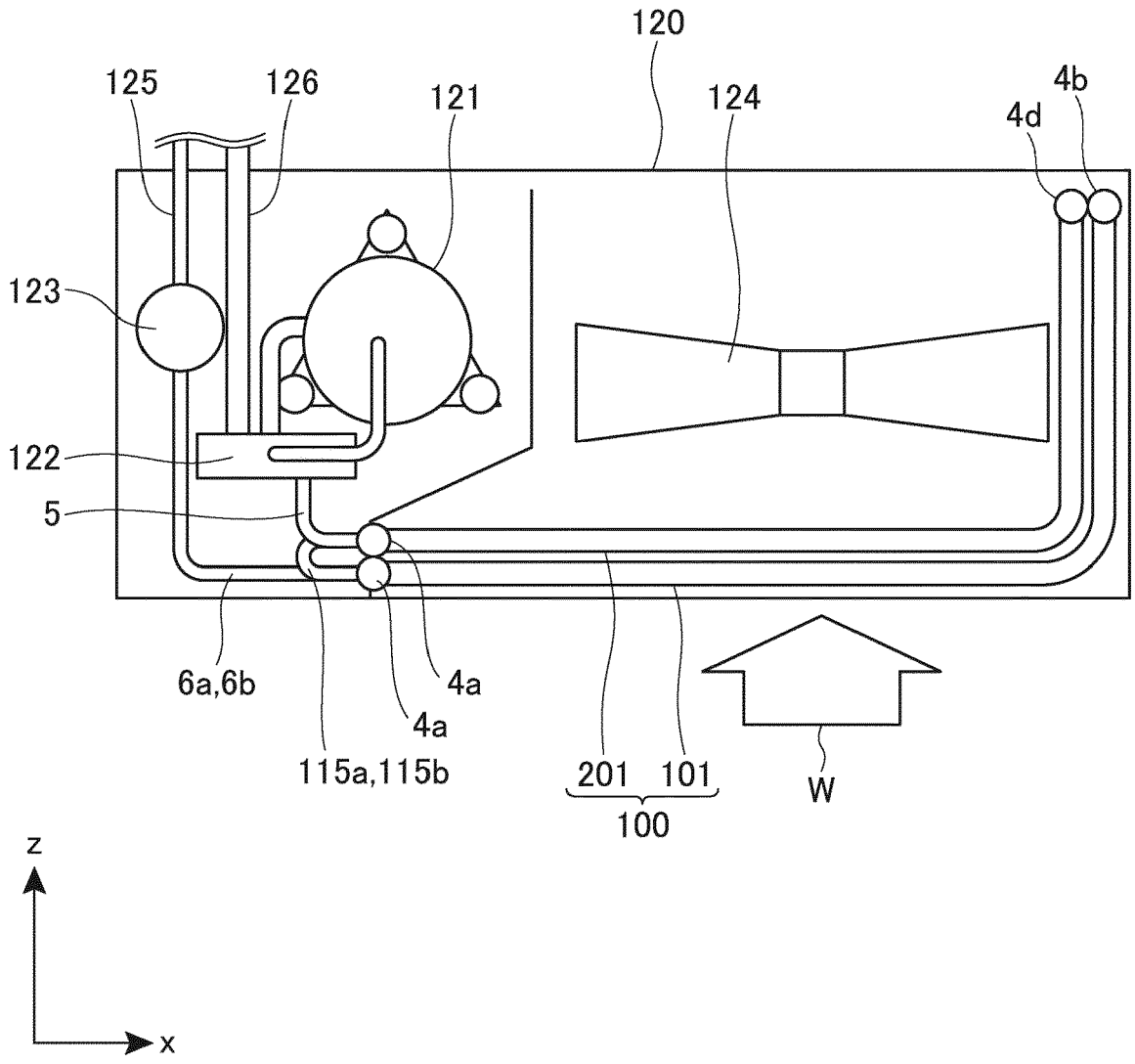
115a
115a2
12a
13a
2
2a
4b1
9b
14
11
7b
7
2a
115b
2b
115b2
2
10b
13b
4a3
12b
4b3
y
x

FIG.10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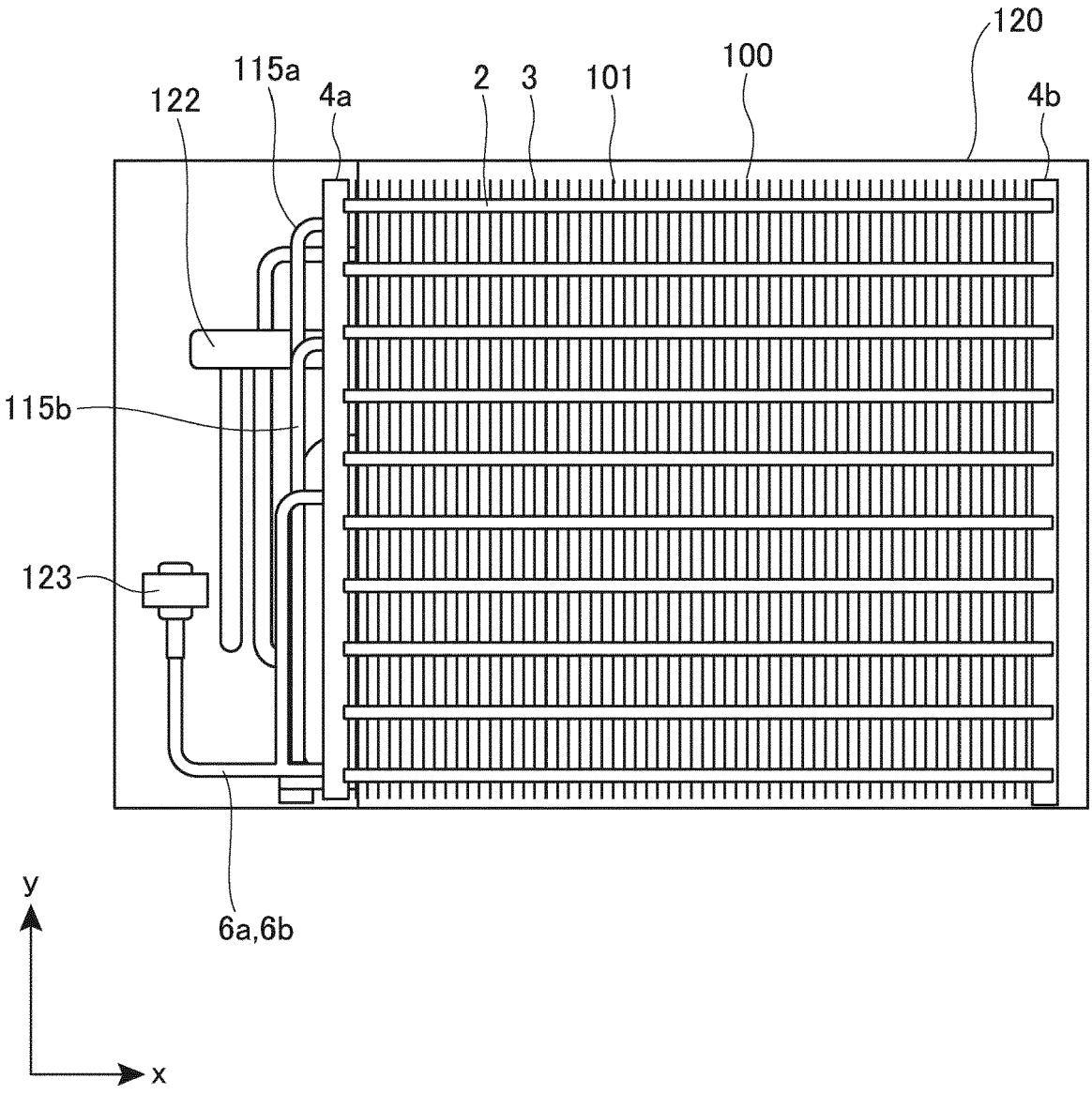
126
121
124
4b
4d
123
122
5
6a,6b
4a
4a
115a,115b
201
101
100
W
z
x

FIG.11



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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 October 2021	Bloch, Gregor

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