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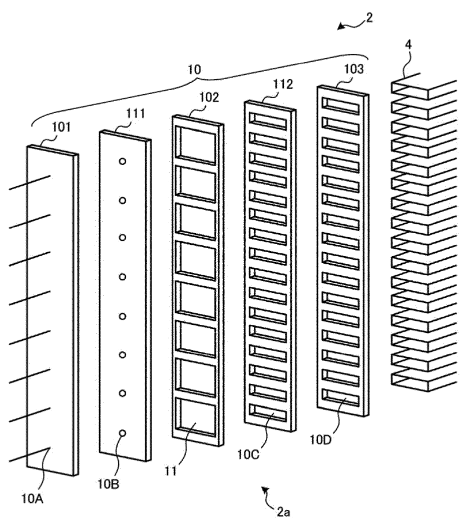
(54) REFRIGERANT DISTRIBUTOR, HEAT EXCHANGER, AND AIR-CONDITIONING DEVICE

(57) A refrigerant distributer includes a plurality of plates. The refrigerant distributer is configured to divert, into a plurality of refrigerant flows, refrigerant flowing in from one or a plurality of inlet ports thereof and allow the refrigerant flows to be let out from a plurality of outlet ports thereof spaced from one another in a first direction. The plurality of plates include: an inflow plate having one of the plurality of inlet ports; a communication plate having a communication chamber communicating with the one of the plurality of inlet ports of the inflow plate; and a heat transfer tube insertion plate into which a heat transfer tube communicating with one of the plurality of outlet ports is inserted, the heat transfer tube insertion plate having heat transfer tube insertion space through which a plurality of the heat transfer tubes communicate with the communication chamber.

FIG. 2



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Description

Technical Field

[0001] The present disclosure relates to a refrigerant distributer, a heat exchanger, and an air-conditioning apparatus. The refrigerant distributer is configured to divert, into a plurality of refrigerant flows, refrigerant flowing in and allow the refrigerant flows to be let out.

Background Art

[0002] In recent years, to reduce the amount of refrigerant and improve heat exchanger performance, there has been a tendency for heat exchangers usable in an air-conditioning apparatus to include heat transfer tubes having a smaller diameter. When the diameter of heat transfer tubes is reduced, it is necessary to inhibit an increase in pressure loss of refrigerant that passes through the heat transfer tubes. Thus, the number of paths in a heat exchanger, the number of paths being the number of branch paths along which refrigerant flows in the heat exchanger, is increased.

[0003] To increase the number of paths, heat exchangers usually include a multi-branch refrigerant distributer configured to distribute and supply, to a plurality of paths, refrigerant flowing in from one inlet passage. For example, Patent Literature 1 discloses a refrigerant distributer that is disposed to extend in a vertical direction and that is formed in a header connected to a plurality of heat transfer tubes disposed side by side in the vertical direction, the heat transfer tubes extending in a horizontal direction. When a heat exchanger functions as an evaporator, this refrigerant distributer includes an inlet pipe into which two-phase gas-liquid refrigerant flows, a mixing chamber in which gas refrigerant and liquid refrigerant forming two-phase gas-liquid refrigerant flowing in are mixed to form homogenized refrigerant, communication chambers connected to the heat transfer tubes, and distribution passages through which two-phase gas-liquid refrigerant is distributed to the communication chambers.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent No. 5376010

Summary of Invention

Technical Problem

[0005] However, the refrigerant distributer described in Patent Literature 1 has a large size, thus resulting in a reduction in the mounting area of the heat exchanger. Accordingly, this refrigerant distributer has a problem of impairing heat exchanger performance.

[0006] The present disclosure is made in view of the problem in the related art, and an object of the present disclosure is to provide a refrigerant distributer, a heat exchanger, and an air-conditioning apparatus, the refrigerant distributer inhibiting an increase in the size and thus inhibiting a reduction in the mounting area of a heat exchanger to enable an improvement in heat exchanger performance.

Solution to Problem

[0007] A refrigerant distributer in an embodiment of the present disclosure includes a plurality of plates. The refrigerant distributer is configured to divert, into a plurality of refrigerant flows, refrigerant flowing in from one or a plurality of inlet ports thereof and allow the refrigerant flows to be let out from a plurality of outlet ports thereof spaced from one another in a first direction. The plurality of plates include: an inflow plate having one of the plurality of inlet ports; a communication plate having a communication chamber communicating with the one of the plurality of inlet ports of the inflow plate; and a heat transfer tube insertion plate into which a heat transfer tube communicating with one of the plurality of outlet ports is inserted, the heat transfer tube insertion plate having heat transfer tube insertion space through which a plurality of the heat transfer tubes communicate with the communication chamber.

[0008] A heat exchanger in another embodiment of the present disclosure includes: the refrigerant distributer according to the embodiment of the present disclosure; and a plurality of heat transfer tubes connected to the plurality of respective outlet ports.

[0009] An air-conditioning apparatus in still another embodiment of the present disclosure includes the heat exchanger according to the other embodiment of the present disclosure.

Advantageous Effects of Invention

[0010] According to the embodiments of the present disclosure, formation of the communication chamber communicating with the heat transfer tubes enables a reduction in the thickness of the refrigerant distributer, thus inhibiting an increase in the size of the refrigerant distributer and thus inhibiting a reduction in the mounting area of the heat exchanger to enable an improvement in heat exchanger performance.

Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a perspective view illustrating an example of the configuration of a heat exchanger according to Embodiment 1.

[Fig. 2] Fig. 2 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 1.

[Fig. 3] Fig. 3 is a schematic diagram for describing the relationship between passages when the refrigerant distributer in Fig. 2 is viewed from above.

[Fig. 4] Fig. 4 is a schematic diagram illustrating an example of the positional relationship between the passages when the refrigerant distributer in Fig. 2 is viewed from the front.

[Fig. 5] Fig. 5 is a schematic diagram illustrating an example of the configuration of an air-conditioning apparatus to which the heat exchanger according to Embodiment 1 is applied.

[Fig. 6] Fig. 6 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 2.

[Fig. 7] Fig. 7 is a schematic diagram for describing the relationship between passages when the refrigerant distributer in Fig. 6 is viewed from above.

[Fig. 8] Fig. 8 is a schematic diagram illustrating an example of the positional relationship between the passages when the refrigerant distributer in Fig. 6 is viewed from the front.

[Fig. 9] Fig. 9 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 3.

[Fig. 10] Fig. 10 is a schematic diagram for describing the relationship between passages when the refrigerant distributer in Fig. 9 is viewed from above.

[Fig. 11] Fig. 11 is a schematic diagram illustrating an example of the positional relationship between the passages when the refrigerant distributer in Fig. 9 is viewed from the front.

[Fig. 12] Fig. 12 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 4.

[Fig. 13] Fig. 13 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 5.

[Fig. 14] Fig. 14 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 6.

Description of Embodiments

Embodiment 1

[0012] A refrigerant distributer according to Embodiment 1 will be described below with reference to the drawings, for example. The refrigerant distributer according to Embodiment 1 configured to distribute refrigerant to flow into a heat exchanger will be described below, but the configuration is not limited thereto. The refrigerant distributer may be configured to distribute refrigerant to flow into a different device. In addition, in the following description, components having the same reference signs are the same or corresponding components, and this applies to the entire embodiments described below. Furthermore, the size relationships of the components in the drawings may differ from those of actual ones. Furthermore, illustration of detailed structures is simplified or omitted as appropriate. The forms of the components in the entire description are merely examples, and the forms of the components are not limited to those in the description.

[Configuration of Heat Exchanger 1]

[0013] The configuration of a heat exchanger 1 according to Embodiment 1 will be described. Fig. 1 is a perspective view illustrating an example of the configuration of a heat exchanger according to Embodiment 1. As illustrated in Fig. 1, the heat exchanger 1 includes a refrigerant distributer 2, a gas header 3, a plurality of heat transfer tubes 4, and a plurality of fins 5. The refrigerant distributer 2 has one or a plurality of refrigerant inlet portions 2A, which are inlet ports for refrigerant, and a plurality of refrigerant outlet portions 2B, which are outlet ports for refrigerant. The refrigerant outlet portions 2B are arranged in the height direction. The gas header 3 has a plurality of refrigerant inlet portions 3A and one refrigerant outlet portion 3B. Refrigerant pipes of a refrigeration cycle apparatus such as an air-conditioning apparatus are connected to the one or the plurality of refrigerant inlet portions 2A of the refrigerant distributer 2 and the refrigerant outlet portion 3B of the gas header 3. The heat transfer tubes 4 are connected between the refrigerant outlet portions 2B of the refrigerant distributer 2 and the refrigerant inlet portions 3A of the gas header 3.

[0014] Each of the heat transfer tubes 4 is a flat tube or a circular tube having a plurality of passages. The heat transfer tube 4 is made of, for example, copper or aluminum. An end portion of each of the heat transfer tubes 4 closer to the refrigerant distributer 2 is connected to a corresponding one of the refrigerant outlet portions 2B of the refrigerant distributer 2. The fins 5 are joined to the heat transfer tubes 4. Each of the fins 5 is made of, for example, aluminum. Fig. 1 illustrates an example in which the number of the heat transfer tubes 4 is eight. However, the number of the heat transfer tubes 4 is not limited thereto and may be any number as long as the number is two or more.

[Refrigerant Flow in Heat Exchanger 1]

[0015] The refrigerant flow in the heat exchanger 1 according to Embodiment 1 will be described. For example, when the heat exchanger 1 functions as an evaporator, refrigerant flowing in refrigerant pipes flows into the refrigerant distributer 2 via the one or the plurality of refrigerant inlet portions 2A and is distributed to and flows out into the heat transfer tubes 4 via the refrigerant outlet portions 2B. The distributed refrigerants in the heat transfer tubes 4 are subjected to heat exchange with, for example, air supplied by a fan (not illustrated). The refrigerants flowing in the heat transfer tubes 4 flow into the gas header 3 via the refrigerant inlet portions 3A and join together. The joined refrigerant flows out into a refrigerant pipe via the refrigerant outlet portion 3B. When the heat exchanger 1 functions as a condenser, refrigerant flows in the direction opposite to this flow direction.

[Configuration of Refrigerant Distributer 2]

[0016] The configuration of the refrigerant distributer 2 according to Embodiment 1 will be described. Fig. 2 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 1. Fig. 3 is a schematic diagram for describing the relationship between passages when the refrigerant distributer in Fig. 2 is viewed from above. To make the relationship between the passages formed in plates easy to understand, Fig. 3 illustrates the passages with dashed lines. Fig. 4 is a schematic diagram illustrating an example of the positional relationship between the passages when the refrigerant distributer in Fig. 2 is viewed from the front.

[0017] As illustrated in Figs. 2 to 4, the refrigerant distributer 2 is formed by stacking a plurality of plates 10, which have, for example, a rectangular shape. The plates 10 are formed by alternately stacking first plates 101, 102, and 103 and second plates 111 and 112. The first plates 101, 102, and 103 and the second plates 111 and 112 have the same outside shape in plan view. The second plates 111 and 112 are partition plates for partitioning off the first plates 101, 102, and 103. For example, a soldering material is applied to both surfaces of each of the second plates 111 and 112. The first plates 101, 102, and 103 are stacked via the second plates 111 and 112 and are joined together by soldering. The plates are each made by, for example, press work or cutting work.

[0018] The first plate 101 has one or a plurality of first passages 10A, which are through holes and which are located at substantially the center of the first plate 101 in the short-side direction. A capillary tube or a refrigerant pipe of a refrigeration cycle apparatus is connected to the first passage 10A. The first passage 10A corresponds to the refrigerant inlet portion 2A in Fig. 1. The first plate 101 is an inflow plate having the one or the plurality of first passages 10A, which are the refrigerant inlet portions 2A serving as inlet ports.

[0019] Fig. 2 illustrates an example in which capillary tubes are connected to the first plate 101. In this case, the first plate 101 has the plurality of first passages 10A. When a refrigerant pipe is connected to the first plate 101, the first plate 101 can have the one first passage 10A.

[0020] The second plate 111 has one or a plurality of second passages 10B, which are through holes and which are located at substantially the center of the second plate 111 in the short-side direction. The second passage 10B is formed at a position depending on the position of the corresponding first passage 10A of the first plate 101 and allows the first passage 10A and the corresponding communication chamber 11 of the first plate 102, which will be described later, to communicate with one another.

[0021] The first plate 102 has a plurality of communication chambers 11. The communication chamber 11 is formed to depend on the position of the corresponding second passage 10B of the second plate 111 and allows the second passage 10B and the corresponding third passage 10C of the second plate 112, which will be described later, to communicate with one another. The communication chambers 11 are formed to communicate with a plurality of third passages 10C. In this example, each of the communication chambers 11 is formed to communicate with corresponding two of the third passages 10C. The first plate 102 is a communication plate having the communication chambers 11, which serve as communication passages communicating with the refrigerant inlet portions 2A serving as inlet ports.

[0022] The second plate 112 has the third passages 10C, each of which has the same shape as the outside shape of the heat transfer tube 4. The third passage 10C holds the end portion of the heat transfer tube 4 inserted thereinto via the corresponding fourth passage 10D of the first plate 103, which will be described later.

[0023] The first plate 103 has a plurality of fourth passages 10D, each of which is heat transfer tube insertion space having the same shape as the outside shape of the heat transfer tube 4. The fourth passage 10D is formed to depend on the position of the corresponding third passage 10C of the second plate 112. The heat transfer tube 4 is inserted into the fourth passage 10D. The heat transfer tubes 4 are soldered to the first plate 103, and the first plate 103 and the second plate 112 are stacked. Thus, the heat transfer tubes 4 are connected to the respective third passages 10C of the second plate 112. The first plate 103 is a heat transfer tube insertion plate having the fourth passages 10D, each of which is the heat transfer tube insertion space into which the heat transfer tube 4 is inserted.

[0024] In this manner, the refrigerant distributer 2 has distribution passages 2a, which are formed by the passages of each of the first plates 101, 102, and 103 and the second plates 111 and 112. That is, the distribution passages 2a are formed by the first passages 10A, the second passages 10B, the third passages 10C, the fourth passages 10D, and the communication chambers 11.

[Refrigerant Flow in Refrigerant Distributer 2]

[0025] Next, the refrigerant flow and the distribution passages 2a in the refrigerant distributer 2 will be described with reference to Figs. 2 to 4. When the heat exchanger 1 functions as an evaporator, two-phase gas-liquid refrigerant flows into the refrigerant distributer 2 from the first passages 10A of the first plate 101. The refrigerant that has flowed into the refrigerant distributer 2 flows into each of the communication chambers 11 of the first plate 102 via the corresponding second passage 10B of the second plate 111. The refrigerant that has flowed into the communication chamber 11 flows into the third passages 10C of the second plate 112 that communicate with the communication chamber 11 and is diverted. The diverted refrigerant flows enter the respective fourth passages 10D of the second plate 112, each of which is the heat transfer tube insertion space, and are equally distributed to the heat transfer tubes 4 connected to the respective fourth passages 10D.

[0026] The example in which two third passages 10C communicate with one communication chamber 11 has been described, but the configuration is not limited thereto. Three or more third passages 10C may communicate with one communication chamber 11. In this manner, the number of distribution paths can be changed by changing the number of the third passages 10C communicating with the communication chamber 11.

[Manner in which Heat Exchanger 1 Is Used]

[0027] Next, an example of a manner in which the heat exchanger 1 according to Embodiment 1 is used will be described. An example in which the heat exchanger 1 is used in an air-conditioning apparatus 80 will be described below, but the configuration is not limited thereto. For example, the heat exchanger 1 may be used in a different refrigeration cycle apparatus including a refrigerant cycle circuit. In addition, an example in which the air-conditioning apparatus 80 is configured to switch between a cooling operation and a heating operation will be described, but the configuration is not limited thereto. The air-conditioning apparatus 80 may be configured to perform only one of the cooling operation and the heating operation.

[0028] Fig. 5 is a schematic diagram illustrating an example of the configuration of the air-conditioning apparatus 80 to which the heat exchanger 1 according to Embodiment 1 is applied. In Fig. 5, a refrigerant flow in the cooling operation is represented by dashed arrows, and a refrigerant flow in the heating operation is represented by solid arrows. As illustrated in Fig. 5, the air-conditioning apparatus 80 includes a compressor 81, a four-way valve 82, an outdoor heat exchanger 83, an expansion valve 84, an indoor heat exchanger 85, an outdoor fan 86, and an indoor fan 87. A refrigerant cycle circuit is formed by connecting, by refrigerant pipes, the compressor 81, the four-way valve 82, the outdoor heat exchanger 83, the expansion valve 84, and the indoor heat exchanger 85.

[0029] The refrigerant flow in the cooling operation will be described. High-pressure, high-temperature gas refrigerant discharged from the compressor 81 flows into the outdoor heat exchanger 83 via the four-way valve 82 and is condensed into high-pressure liquid refrigerant by being subjected to heat exchange with air supplied by the outdoor fan 86. The high-pressure liquid refrigerant flows out from the outdoor heat exchanger 83 and becomes low-pressure two-phase gas-liquid refrigerant by passing through the expansion valve 84. The low-pressure two-phase gas-liquid refrigerant flows into the indoor heat exchanger 85 and is evaporated, to cool an indoor space, into low-pressure gas refrigerant by being subjected to heat exchange with air supplied by the indoor fan 87. The low-pressure gas refrigerant flows out from the indoor heat exchanger 85 and is suctioned into the compressor 81 via the four-way valve 82.

[0030] The refrigerant flow in the heating operation will be described. High-pressure, high-temperature gas refrigerant discharged from the compressor 81 flows into the indoor heat exchanger 85 via the four-way valve 82 and is condensed, to heat an indoor space, into high-pressure liquid refrigerant by being subjected to heat exchange with air supplied by the indoor fan 87. The high-pressure liquid refrigerant flows out from the indoor heat exchanger 85 and becomes low-pressure two-phase gas-liquid refrigerant by passing through the expansion valve 84. The low-pressure two-phase gas-liquid refrigerant flows into the outdoor heat exchanger 83 and is evaporated into low-pressure gas refrigerant by being subjected to heat exchange with air supplied by the outdoor fan 86. The low-pressure gas refrigerant flows out from the outdoor heat exchanger 83 and is suctioned into the compressor 81 via the four-way valve 82.

[0031] In Embodiment 1, the heat exchanger 1 is used as at least one of the outdoor heat exchanger 83 and the indoor heat exchanger 85. When the heat exchanger 1 functions as an evaporator, the heat exchanger 1 is connected such that refrigerant flows in from the refrigerant distributer 2. That is, when the heat exchanger 1 functions as an evaporator, two-phase gas-liquid refrigerant flows into the refrigerant distributer 2 from a refrigerant pipe and is diverted to flow into each of the heat transfer tubes 4 of the heat exchanger 1. In addition, when the heat exchanger 1 functions as a condenser, liquid refrigerants flow into the refrigerant distributer 2 from the respective heat transfer tubes 4 and join together to flow out into a refrigerant pipe.

[0032] As described above, the refrigerant distributer 2 according to Embodiment 1 includes the first plate 101, which has the first passages 10A, the first plate 102, which has the communication chambers 11 communicating with the respective first passages 10A, and the first plate 103, which has the third passages 10C, through which a plurality of the heat transfer tubes 4 communicate with each of the communication chambers 11. In this manner, formation of the communication chamber 11 communicating with the heat transfer tubes 4 enables a reduction in the thickness of the refrigerant distributer 2 compared with a case in which the refrigerant distributer has a cylindrical shape. Accordingly, it is possible to reduce the size of the refrigerant distributer 2. In addition, a reduction in the size of the refrigerant distributer 2 in an air-conditioning apparatus including a casing having a consistent size results in an increase in the mounting area of the heat exchanger 1. Thus, it is possible to improve the heat exchanger performance.

Embodiment 2

[0033] Next, Embodiment 2 will be described. The refrigerant distributer 2 according to Embodiment 2 differs from that in Embodiment 1 in the positions where the first passages 10A of the first plate 101 are disposed and the positions where the second passages 10B of the second plate 111 are disposed. In the following description, parts common to Embodiment 1 and Embodiment 2 have the same reference signs, and detailed descriptions thereof are omitted.

[Configuration of Refrigerant Distributer 2]

[0034] The configuration of the refrigerant distributer 2 according to Embodiment 2 will be described. Fig. 6 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 2. Fig. 7 is a schematic diagram for describing the relationship between passages when the refrigerant distributer in Fig. 6 is viewed from above. To make the relationship between the passages formed in the plates easy to understand, Fig. 7 illustrates the passages with dashed lines. Fig. 8 is a schematic diagram illustrating an example of the positional relationship between the passages when the refrigerant distributer in Fig. 6 is viewed from the front.

[0035] As illustrated in Figs. 6 to 8, the refrigerant distributer 2 is formed by stacking a plurality of plates 20, which have, for example, a rectangular shape. The plates 20 are formed by alternately stacking the first plates 101, 102, and 103 and the second plates 111 and 112. The first plates 102 and 103 and the second plate 112 are similar to those in Embodiment 1.

[0036] The refrigerant distributer 2 has the distribution passages 2a, which are formed by the passages of each of the first plates 101, 102, and 103 and the second plates 111 and 112. That is, similarly to Embodiment 1, the distribution passages 2a are formed by the first passages 10A, the second passages 10B, the third passages 10C, the fourth passages 10D, and the communication chambers 11.

[0037] The first plate 101 has the one or the plurality of first passages 10A, to which capillary tubes or a refrigerant pipe of a refrigeration cycle apparatus is connected. Fig. 6 illustrates an example in which capillary tubes are connected to the first plate 101. The second plate 111 has the one or the plurality of second passages 10B, each of which is located at a position depending on the position of the corresponding first passage 10A of the first plate 101.

[0038] Here, when a fluid such as air mainly flows in one direction toward the heat exchanger 1, a part of the heat exchanger 1 located upstream of the fluid flow has a heat transfer performance higher than that of a part of the heat exchanger 1 located downstream of the fluid flow. For this reason, in Embodiment 2, the first passages 10A of the first plate 101 and the second passages 10B of the second plate 111 are disposed such that a larger amount of refrigerant flows in the part located upstream of the fluid flow having a high heat transfer performance.

[0039] The first passages 10A and the second passages 10B are unevenly provided to be upstream of the fluid flow relative to the central position of the plates 10 in the short-side direction. As a result, when the heat exchanger 1 including this refrigerant distributer 2 functions as an evaporator into which two-phase gas-liquid refrigerant flows, a large amount of two-phase gas-liquid refrigerant flows in the part located upstream of the fluid flow in which the amount of heat exchange is larger than that in the part located downstream of the fluid flow, thus improving the heat transfer performance of the part of the heat exchanger 1 located upstream of the fluid flow. Accordingly, it is possible to improve the heat exchanger performance.

[0040] As described above, in the refrigerant distributer 2 according to Embodiment 2, the first passages 10A are formed in the first plate 101 such that the first passages 10A are located upstream of the fluid flow outside the heat transfer tubes 4. As a result, a larger amount of refrigerant flows in the part located upstream of the fluid, thus improving the heat transfer performance of the part located upstream thereof in which the amount of heat exchange is large. Accordingly, it is possible to improve the heat exchanger performance.

Embodiment 3

[0041] Next, Embodiment 3 will be described. The refrigerant distributer 2 according to Embodiment 3 differs from that in each of Embodiments 1 and 2 in the shape of the communication chamber 11 of the first plate 102. In the following description, parts common to Embodiment 3 and Embodiment 1 or 2 have the same reference signs, and detailed descriptions thereof are omitted.

[Configuration of Refrigerant Distributer 2]

[0042] The configuration of the refrigerant distributer 2 according to Embodiment 3 will be described. Fig. 9 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 3. Fig. 10 is a schematic diagram for describing the relationship between passages when the refrigerant distributer in Fig. 9 is viewed from above. To make the relationship between the passages formed in the plates easy to understand, Fig. 10 illustrates the passages with dashed lines. Fig. 11 is a schematic diagram illustrating an example of the positional relationship between the passages when the refrigerant distributer in Fig. 9 is viewed from the front.

[0043] As illustrated in Figs. 9 to 11, the refrigerant distributer 2 is formed by stacking a plurality of plates 30, which have, for example, a rectangular shape. The plates 30 are formed by alternately stacking the first plates 101, 102, and 103 and the second plates 111 and 112. The first plates 101 and 103 and the second plates 111 and

112 are similar to those in Embodiment 1.

[0044] The refrigerant distributer 2 has the distribution passages 2a, which are formed by the passages of each of the first plates 101, 102, and 103 and the second plates 111 and 112. That is, similarly to Embodiments 1 and 2, the distribution passages 2a are formed by the first passages 10A, the second passages 10B, the third passages 10C, the fourth passages 10D, and the communication chambers 11.

[0045] The first plate 102 has the plurality of communication chambers 11, each of which is formed to depend on the position of the corresponding second passage 10B of the second plate 111. In Embodiment 3, the communication chamber 11 has a descent inhibiting portion 11a.

[0046] As illustrated in Fig. 10, the descent inhibiting portion 11a is provided such that the descent inhibiting portion 11a is unevenly located to be downstream of a fluid flow. As illustrated in Fig. 11, the descent inhibiting portion 11a is provided to be located lower than the position of the corresponding second passage 10B.

[0047] In the communication chamber 11, a passage flow resistance applied downward in the direction of gravity against refrigerant flowing in is usually large. Provision of the descent inhibiting portion 11a lower than the position where refrigerant flows in causes the flow resistance in a lower part of the communication chamber 11 to be larger than that in an upper part of the communication chamber 11. Accordingly, liquid refrigerant forming two-phase gas-liquid refrigerant is inhibited from being unevenly distributed to flow in the lower part due to gravity. As a result, the liquid refrigerant flows evenly in the communication chamber 11. Thus, it is possible to evenly distribute the liquid refrigerant to the heat transfer tubes 4 communicating with the communication chamber 11 when the liquid refrigerant flows out from the communication chamber 11 and to improve the performance of the heat exchanger 1.

[0048] In addition, the descent inhibiting portion 11a is provided such that the descent inhibiting portion 11a is unevenly located to be downstream of the fluid flow. This causes two-phase gas-liquid refrigerant flowing in from the corresponding second passage 10B of the second plate 111 to flow in the part located upstream of the fluid flow more than in the part located downstream of the fluid flow, thus improving the heat transfer performance of the part of the heat exchanger 1 located upstream of the fluid flow. Accordingly, it is possible to improve the heat exchanger performance.

[0049] As described above, in the refrigerant distributer 2 according to Embodiment 3, the communication chamber 11 has the descent inhibiting portion 11a, which is located lower than the top of the corresponding first passage 10A. This inhibits liquid refrigerant forming two-phase gas-liquid refrigerant flowing into the communication chamber 11 from being unevenly distributed to flow in the lower part due to gravity. Thus, the liquid refrigerant is distributed evenly to the heat transfer tubes 4. Accordingly, it is possible to improve the heat exchanger performance.

[0050] In the refrigerant distributer 2, the descent inhibiting portion 11a is formed to be located downstream of the fluid flow. As a result, a larger amount of refrigerant flows in the part located upstream of the fluid, thus improving the heat transfer performance of the part located upstream thereof in which the amount of heat exchange is large. Accordingly, it is possible to improve the heat exchanger performance.

Embodiment 4

[0051] Next, Embodiment 4 will be described. Embodiment 4 differs from Embodiments 1 to 3 in provision of a plate having branch passages in which refrigerant is diverted into a plurality of refrigerant flows, the plate being located between the first plate 101 and the first plate 102. In the following description, parts common to Embodiment 4 and Embodiment 1, 2, or 3 have the same reference signs, and detailed descriptions thereof are omitted.

[Configuration of Refrigerant Distributer 2]

[0052] The configuration of the refrigerant distributer 2 according to Embodiment 4 will be described. Fig. 12 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 4.

[0053] As illustrated in Fig. 12, the refrigerant distributer 2 is formed by stacking a plurality of plates 40, which have, for example, a rectangular shape. The plates 40 are formed by stacking the first plates 101, 102, and 103, second plates 112, 113, and 114, and third plates 121 and 122. The first plates 101, 102, and 103, the second plates 112, 113, and 114, and the third plates 121 and 122 have the same outside shape in plan view.

[0054] The refrigerant distributer 2 has the distribution passages 2a, which are formed by the passages of the first plates 101, 102, and 103, the second plates 112, 113, and 114, and the third plates 121 and 122. The distribution passages 2a are formed by the first passage 10A, a fifth passage 10E, a sixth passage 10F, seventh passages 10G, eighth passages 10H, ninth passages 101, tenth passages 10J, and eleventh passages 10K, the communication chambers 11, a first branch passage 12A, second branch passages 12B, and third branch passages 12C, and first interlevel cross passages 13A and second interlevel cross passages 13B.

[0055] The first plate 101 has the one or the plurality of first passages 10A, which are through holes and which are located at substantially the center of the first plate 101 in the short-side direction. Fig. 12 illustrates an example in which a refrigerant pipe is connected to the first plate 101. In this case, the one first passage 10A is provided at substantially the center of the first plate 101.

[0056] The third plate 121 has the fifth passage 10E, which is a through hole and which is located at substantially the center of the third plate 121. The fifth passage

10E is formed at a position depending on the position of the corresponding first passage 10A of the first plate 101 and allows the first passage 10A and the sixth passage 10F, which will be described later, to communicate with one another.

[0057] A pair of the seventh passages 10G, which are circular through holes and which are located at respective positions horizontal to the sixth passage 10F, and a pair of the eighth passages 10H, which are circular through holes and which are located at respective positions symmetrical relative to the sixth passage 10F in the height direction, are open in the second plate 113. In addition, a pair of the ninth passages 101, which are circular through holes and which are located at respective positions horizontal to each of the eighth passages 10H, and a pair of the tenth passages 10J, which are circular through holes and which are located at respective positions point-symmetrical relative to the eighth passage 10H, are open in the second plate 113. The second plate 113 is a through passage plate having the sixth passage 10F to the tenth passages 10J, which serve as through passages.

[0058] The third plate 122 has the first branch passage 12A, which is a straight through groove extending in a horizontal direction, such that the first branch passage 12A communicates with the sixth passage 10F and the seventh passages 10G of the second plate 113 in a state in which the third plate 122 and the second plate 113 are stacked. In addition, the third plate 122 has the second branch passages 12B, which are straight through grooves extending in the horizontal direction, such that the second branch passages 12B are located at respective positions symmetrical relative to the first branch passage 12A in the height direction and each communicate with the corresponding eighth passage 10H and the corresponding ninth passages 101.

[0059] Furthermore, the third plate 122 has the third branch passages 12C, which are through grooves. The third branch passages 12C are formed such that part of each of the third branch passages 12C extends straight in the horizontal direction and such that respective end portions of the straight part extend toward the opposite sides in the height direction. Both end portions of each of the third branch passages 12C are formed to be connected to the corresponding eleventh passages 10K of the second plate 114, which will be described later. The third plate 122 is a branch passage plate having the first branch passage 12A to the third branch passages 12C, which serve as branch passages.

[0060] The third plate 121 has the first interlevel cross passages 13A, which are a pair of through grooves extending in a height direction, such that the first interlevel cross passages 13A each communicate with the corresponding seventh passage 10G and the corresponding eighth passage 10H of the second plate 113 in a state in which the third plate 121 and the second plate 113 are stacked. In addition, the third plate 121 has the second interlevel cross passages 13B, which are a pair of through grooves extending in the height direction, such that the second interlevel cross passages 13B each communicate with the corresponding ninth passage 101 and the corresponding tenth passage 10J of the second plate 113 in a state in which the third plate 121 and the second plate 113 are stacked. The first interlevel cross passages 13A and the second interlevel cross passages 13B are each formed to cross the heat transfer tubes 4 connected to the corresponding refrigerant outlet portions 2B, which are outlet ports, and to allow two passages to communicate with one another. The third plate 121 is an interlevel cross passage plate having the first interlevel cross passages 13A and the second interlevel cross passages 13B, which serve as interlevel cross passages.

[0061] The second plate 114 has the eleventh passages 10K, which are through holes. The eleventh passage 10K is formed at a position depending on the position of an end portion of the corresponding third branch passage 12C of the third plate 122 and allows the third branch passage 12C and the corresponding communication chamber 11 of the first plate 102 to communicate with one another.

[0062] When the plates are stacked, the sixth passage 10F and the seventh passages 10G are connected to the first branch passage 12A. In addition, the seventh passage 10G and the eighth passage 10H are connected to respective end portions of the corresponding first interlevel cross passage 13A. The eighth passage 10H and the ninth passages 101 are connected to the corresponding second branch passage 12B. The ninth passage 101 and the tenth passage 10J are connected to respective end portions of the corresponding second interlevel cross passage 13B. The eleventh passages 10K are connected to respective end portions of the corresponding third branch passage 12C.

[Refrigerant Flow in Refrigerant Distributer 2]

[0063] Next, the refrigerant flow and the distribution passages 2a in the refrigerant distributer 2 will be described with reference to Fig. 12. When the heat exchanger 1 functions as an evaporator, two-phase gas-liquid refrigerant flows into the refrigerant distributer 2 from the first passage 10A of the first plate 101.

[0064] The refrigerant that has flowed into the refrigerant distributer 2 moves straight in the fifth passage 10E of the third plate 121 and the sixth passage 10F of the second plate 113, comes into contact with a surface of the second plate 114 in the first branch passage 12A of the third plate 122, and is diverted in the horizontal direction. The diverted refrigerant flows move to respective end portions of the first branch passage 12A and enter the pair of the respective seventh passages 10G.

[0065] The refrigerant flows that have entered the respective seventh passages 10G move straight in the respective seventh passages 10G in the direction opposite to the direction in which refrigerant moves in the fifth passage 10E and the sixth passage 10F. Each of the refrigerant flows enters one end of the corresponding first interlevel cross passage 13A of the third plate 121, comes into contact with a surface of the first plate 101 in the first interlevel cross passage 13A, and moves toward the other end of the first interlevel cross passage 13A. Each of the refrigerant flows that has reached the other end of the corresponding first interlevel cross passage 13A enters the corresponding eighth passage 10H of the second plate 113.

[0066] The refrigerant flows that have entered the respective eighth passages 10H move straight in the respective eighth passages 10H in the direction opposite to the direction in which refrigerant moves in the seventh passage 10G. Each of the refrigerant flows comes into contact with the surface of the second plate 114 in the corresponding second branch passage 12B of the third plate 122 and is diverted in the horizontal direction. The diverted refrigerant flows move to respective end portions of the corresponding second branch passage 12B and enter the pair of the respective ninth passages 101.

[0067] The refrigerant flows that have entered the respective ninth passages 101 move straight in the respective ninth passages 101 in the direction opposite to the direction in which refrigerant moves in the eighth passage 10H. Each of the refrigerant flows enters one end of the corresponding second interlevel cross passage 13B of the third plate 121, comes into contact with the surface of the first plate 101 in the second interlevel cross passage 13B, and moves toward the other end of the second interlevel cross passage 13B. Each of the refrigerant flows that has reached the other end of the corresponding second interlevel cross passage 13B enters the corresponding tenth passage 10J.

[0068] The refrigerant flows that have entered the respective tenth passages 10J move straight in the respective tenth passages 10J in the direction opposite to the direction in which refrigerant moves in the ninth passage 101. Each of the refrigerant flows comes into contact with the surface of the second plate 114 in the corresponding third branch passage 12C of the third plate 122 and is diverted in the horizontal direction. The diverted refrigerant flows move to respective end portions of the corresponding third branch passage 12C and enter the respective eleventh passages 10K of the second plate 114. Then, the refrigerant flows move out from the respective eleventh passages 10K and enter the respective communication chambers 11 of the first plate 102.

[0069] Each of the refrigerant flows that has entered the corresponding communication chamber 11 enters the third passages 10C of the second plate 112 that communicate with the communication chamber 11 and is diverted. The diverted refrigerant flows enter the respective fourth passages 10D of the second plate 112 and are equally distributed to the heat transfer tubes 4 connected to the respective fourth passages 10D.

[0070] In this example, the refrigerant distributer 2 in which refrigerant passes through three kinds of branch passages, that is, along eight branch paths has been described, but the configuration is not limited thereto. The number of branch paths can be set to any number other than eight by changing the number of branch passages.

[0071] As described above, in the refrigerant distributer 2 according to Embodiment 4, the third plate 122 is disposed between the first plate 101 and the first plate 102, the third plate 122 having the branch passages through which refrigerant flowing in from the first passage 10A is diverted into a plurality of refrigerant flows. This realizes the multi-branch refrigerant distributer 2 without increasing in size. Accordingly, it is possible to increase the total length of the heat transfer tubes 4 of the heat exchanger 1 and to thus improve the heat exchanger performance.

Embodiment 5

[0072] Next, Embodiment 5 will be described. The refrigerant distributer 2 according to Embodiment 5 differs from that in Embodiment 4 in the shape of the communication chamber 11 of the first plate 102. In the following description, parts common to Embodiment 5 and Embodiment 1, 2, 3, or 4 have the same reference signs, and detailed descriptions thereof are omitted.

[Configuration of Refrigerant Distributer 2]

[0073] The configuration of the refrigerant distributer 2 according to Embodiment 5 will be described. Fig. 13 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 5.

[0074] As illustrated in Fig. 13, the refrigerant distributer 2 is formed by stacking a plurality of plates 50, which have, for example, a rectangular shape. The plates 40 are formed by stacking the first plates 101, 102, and 103, the second plates 112, 113, and 114, and the third plates 121 and 122. The first plates 101 and 103, the second plates 112, 113, and 114, and the third plate 121 are similar to those in Embodiment 4.

[0075] The refrigerant distributer 2 has the distribution passages 2a, which are formed by the passages of the first plates 101, 102, and 103, the second plates 112, 113, and 114, and the third plates 121 and 122. The distribution passages 2a are formed by the first passage 10A, the fifth passage 10E, the sixth passage 10F, the seventh passages 10G, the eighth passages 10H, the ninth passages 101, the tenth passages 10J, and the eleventh passages 10K, the communication chambers 11, the first branch passage 12A, the second branch passages 12B, and the third branch passages 12C, and the first interlevel cross passages 13A and the second interlevel cross passages 13B.

[0076] The first plate 102 has the plurality of communication chambers 11, each of which is formed to depend on the position of the corresponding second passage 10B of the second plate 111. In Embodiment 5, similarly to Embodiment 3, the communication chamber 11 has the descent inhibiting portion 11a.

[0077] In this manner, similarly to Embodiment 3, provision of the descent inhibiting portion 11a in the communication chamber 11 causes the flow resistance in a lower part of the communication chamber 11 to be larger than that in an upper part of the communication chamber 11. Accordingly, liquid refrigerant forming two-phase gas-liquid refrigerant is inhibited from being unevenly distributed to flow in the lower part due to gravity. As a result, the liquid refrigerant flows evenly in the communication chamber 11. Thus, it is possible to evenly distribute the liquid refrigerant to the heat transfer tubes 4 communicating with the communication chamber 11 when the liquid refrigerant flows out from the communication chamber 11 and to improve the performance of the heat exchanger 1.

[0078] In addition, the descent inhibiting portion 11a is provided such that the descent inhibiting portion 11a is unevenly located to be downstream of the fluid flow. This causes two-phase gas-liquid refrigerant flowing in from the corresponding second passage 10B of the second plate 111 to flow in the part located upstream of the fluid flow more than in the part located downstream of the fluid flow, thus improving the heat transfer performance of the part of the heat exchanger 1 located upstream of the fluid flow. Accordingly, it is possible to improve the heat exchanger performance.

[0079] As described above, in the refrigerant distributer 2 according to Embodiment 5, the communication chamber 11 has the descent inhibiting portion 11a, which is located lower than the top of the corresponding first passage 10A. This inhibits liquid refrigerant forming two-phase gas-liquid refrigerant flowing into the communication chamber 11 from being unevenly distributed to flow in the lower part due to gravity. Thus, the liquid refrigerant is distributed evenly to the heat transfer tubes 4. Accordingly, it is possible to improve the heat exchanger performance.

[0080] In the refrigerant distributer 2, the descent inhibiting portion 11a is formed to be located downstream of the fluid flow. As a result, a larger amount of refrigerant flows in the part located upstream of the fluid, thus improving the heat transfer performance of the part located upstream thereof in which the amount of heat exchange is large. Accordingly, it is possible to improve the heat exchanger performance.

Embodiment 6

[0081] Next, Embodiment 6 will be described. The refrigerant distributer 2 according to Embodiment 6 differs from that in Embodiment 5 in the shape of branch passages of a third plate. In the following description, parts common to Embodiment 6 and Embodiment 1, 2, 3, 4, or 5 have the same reference signs, and detailed descriptions thereof are omitted.

[Configuration of Refrigerant Distributer 2]

[0082] The configuration of the refrigerant distributer 2 according to Embodiment 6 will be described. Fig. 14 is an exploded perspective view illustrating an example of the configuration of a refrigerant distributer according to Embodiment 6.

[0083] As illustrated in Fig. 14, the refrigerant distributer 2 is formed by stacking a plurality of plates 60, which have, for example, a rectangular shape. The plates 60 are formed by stacking the first plates 101, 102, and 103, the second plates 112 and 113, and third plates 121 and 123. The first plates 101, 102, and 103, the second plates 112, 113, and 114, and the third plates 121 and 122 have the same outside shape in plan view.

[0084] The refrigerant distributer 2 has the distribution passages 2a, which are formed by the passages of the first plates 101, 102, and 103, the second plates 112 and 113, and the third plates 121 and 123. The distribution passages 2a are formed by the first passage 10A, the fifth passage 10E, the sixth passage 10F, the seventh passages 10G, the eighth passages 10H, the ninth passages 101, and the tenth passages 10J, the communication chambers 11, the first branch passage 12A, the second branch passages 12B, and fourth branch passages 12D, and the first interlevel cross passages 13A and the second interlevel cross passages 13B.

[0085] The first plate 101 has the one or the plurality of first passages 10A, which are through holes and which are located at substantially the center of the first plate 101 in the short-side direction. Fig. 14 illustrates an example in which a refrigerant pipe is connected to the first plate 101. In this case, the one first passage 10A is provided at substantially the center of the first plate 101.

[0086] The third plate 121 has the fifth passage 10E, which is a through hole and which is located at substantially the center of the third plate 121. The fifth passage 10E is formed at a position depending on the position of the corresponding first passage 10A of the first plate 101 and allows the first passage 10A and the sixth passage 10F, which will be described later, to communicate with one another.

[0087] The pair of the seventh passages 10G, which are circular through holes and which are located at respective positions horizontal to the sixth passage 10F, and the pair of the eighth passages 10H, which are circular through holes and which are located at respective positions symmetrical relative to the sixth passage 10F in the height direction, are open in the second plate 113. In addition, the pair of the ninth passages 101, which are circular through holes and which are located at respective positions horizontal to each of the eighth passages 10H, and the pair of the tenth passages 10J, which are circular through holes and which are located at respective positions point-symmetrical relative to the eighth passage 10H, are open in the second plate 113. The second plate 113 is a through passage plate having the sixth passage 10F to the tenth passages 10J, which serve as through passages.

[0088] The third plate 123 has the first branch passage 12A, which is a straight through groove extending in a horizontal direction, such that the first branch passage 12A communicates with the sixth passage 10F and the seventh passages 10G of the second plate 113 in a state in which the third plate 123 and the second plate 113 are stacked. In addition, the third plate 122 has the second branch passages 12B, which are straight through grooves extending in the horizontal direction, such that the second branch passages 12B are located at respective positions symmetrical relative to the first branch passage 12A in the height direction and each communicate with the corresponding eighth passage 10H and the corresponding ninth passages 101.

[0089] Furthermore, the third plate 123 has the fourth branch passages 12D, which are through grooves. The fourth branch passages 12D are formed such that part of each of the fourth branch passages 12D extends straight in the horizontal direction and such that an upstream end portion of the straight part, the upstream end portion being one of end portions of the straight part located upstream of the fluid flow, extends upward and downward on a straight line. That is, the fourth branch passage 12D is formed such that the upstream end portion extends in two different directions parallel to the height direction. In other words, the fourth branch passage 12D has a shape in which a T shape is turned over sideways. The upstream end portion of the fourth branch passage 12D is formed to be connected to the corresponding communication chambers 11 of the first plate 102. The third plate 123 is a branch passage plate having the first branch passage 12A, the second branch passages 12B, and the fourth branch passages 12D, which serve as branch passages.

[0090] The third plate 121 has the first interlevel cross passages 13A, which are a pair of through grooves extending in a height direction, such that the first interlevel cross passages 13A each communicate with the corresponding seventh passage 10G and the corresponding eighth passage 10H of the second plate 113 in a state in which the third plate 121 and the second plate 113 are stacked. In addition, the third plate 121 has the second interlevel cross passages 13B, which are a pair of through grooves extending in the height direction, such that the second interlevel cross passages 13B each communicate with the corresponding ninth passage 101 and the corresponding tenth passage 10J of the second plate 113 in a state in which the third plate 121 and the second plate 113 are stacked. The first interlevel cross passages 13A and the second interlevel cross passages 13B are each formed to cross the heat transfer tubes 4 connected to the corresponding refrigerant outlet portions 2B, which are outlet ports, and to allow two passages to communicate with one another. The third plate 121 is an interlevel cross passage plate having the first interlevel cross passages 13A and the second interlevel cross passages 13B, which serve as interlevel cross passages.

[0091] When the plates are stacked, the sixth passage 10F and the seventh passages 10G are connected to the first branch passage 12A. In addition, the seventh passage 10G and the eighth passage 10H are connected to respective end portions of the corresponding first interlevel cross passage 13A. The eighth passage 10H and the ninth passages 101 are connected to the corresponding second branch passage 12B. The ninth passage 101 and the tenth passage 10J are connected to respective end portions of the corresponding second interlevel cross passage 13B. Different ones of the communication chambers 11 are connected to respective end portions of the corresponding fourth branch passage 12D that extend upward and downward on a straight line.

[Refrigerant Flow in Refrigerant Distributer 2]

[0092] Next, the refrigerant flow and the distribution passages 2a in the refrigerant distributer 2 will be described with reference to Fig. 14. When the heat exchanger 1 functions as an evaporator, two-phase gas-liquid refrigerant flows into the refrigerant distributer 2 from the first passage 10A of the first plate 101.

[0093] The refrigerant that has flowed into the refrigerant distributer 2 moves straight in the fifth passage 10E of the third plate 121 and the sixth passage 10F of the second plate 113, comes into contact with a surface of the first plate 102 in the first branch passage 12A of the third plate 123, and is diverted in the horizontal direction. The diverted refrigerant flows move to respective end portions of the first branch passage 12A and enter the pair of the respective seventh passages 10G.

[0094] The refrigerant flows that have entered the respective seventh passages 10G move straight in the respective seventh passages 10G in the direction opposite to the direction in which refrigerant moves in the fifth passage 10E and the sixth passage 10F. Each of the refrigerant flows enters one end of the corresponding first interlevel cross passage 13A of the third plate 121, comes into contact with a surface of the first plate 101 in the first interlevel cross passage 13A, and moves toward the other end of the first interlevel cross passage 13A. Each of the refrigerant flows that has reached the other end of the corresponding first interlevel cross passage 13A enters the corresponding eighth passage 10H of the second plate 113.

[0095] The refrigerant flows that have entered the respective eighth passages 10H move straight in the respective eighth passages 10H in the direction opposite to the direction in which refrigerant moves in the seventh passage 10G. Each of the refrigerant flows comes into contact with the surface of the first plate 102 in the corresponding second branch passage 12B of the third plate 123 and is diverted in the horizontal direction. The diverted refrigerant flows move to respective end portions of the corresponding second branch passage 12B and enter the pair of the respective ninth passages 101.

[0096] The refrigerant flows that have entered the respective ninth passages 101 move straight in the respective ninth passages 101 in the direction opposite to the direction in which refrigerant moves in the eighth passage 10H. Each of the refrigerant flows enters one end of the corresponding second interlevel cross passage 13B of the third plate 121, comes into contact with the surface of the first plate 101 in the second interlevel cross passage 13B, and moves toward the other end of the second interlevel cross passage 13B. Each of the refrigerant flows that has reached the other end of the corresponding second interlevel cross passage 13B enters the corresponding tenth passage 10J.

[0097] The refrigerant flows that have entered the respective tenth passages 10J move straight in the respective tenth passages 10J in the direction opposite to the direction in which refrigerant moves in the ninth passage 101. Each of the refrigerant flows comes into contact with the surface of the first plate 102 in the corresponding fourth branch passage 12D of the third plate 123 and moves to the corresponding end portion thereof located upstream of the fluid flow. Each of the refrigerant flows that has moved to the corresponding upstream end portion moves to respective end portions of the upstream end portion in an up-down direction and enters the corresponding communication chambers 11 of the first plate 102.

[0098] Each of the refrigerant flows that has entered the corresponding communication chamber 11 enters the third passages 10C of the second plate 112 that communicate with the communication chamber 11 and is diverted. The diverted refrigerant flows enter the respective fourth passages 10D of the second plate 112 and are equally distributed to the heat transfer tubes 4 connected to the respective fourth passages 10D.

[0099] As described above, in the refrigerant distributer 2 according to Embodiment 6, the fourth branch passage 12D is formed such that the upstream end portion of the end portions of the straight part of the fourth branch passage 12D, the straight part extending in the horizontal direction, the upstream end portion being located upstream of the fluid flow, extends in the two different directions parallel to the height direction. As a result, a larger amount of refrigerant flows in the part located upstream of the fluid, thus improving the heat transfer performance of the part located upstream thereof in which the amount of heat exchange is large. Accordingly, it is possible to improve the heat exchanger performance.

[0100] Although Embodiments 1 to 6 have been described above, the present disclosure is not limited to Embodiments 1 to 6 described above. Various modifications and applications can be made without departing from the gist of the present disclosure. For example, in Embodiments 1 to 6, the branch passages and the interlevel cross passages have each been described as the entire passage being formed by a through groove passing through both sides of a plate, but the configuration is not limited to this example. It is sufficient that the branch passages and the interlevel cross passages partially communicate with the respective passages 10A to 10K. Thus, for example, the branch passages and the interlevel cross passages may be shaped like a groove having a depth less than the thickness of a plate such that part of each of the passages does not pass through a plate in the thickness direction.

Reference Signs List

[0101] 1: heat exchanger, 2: refrigerant distributer, 2A: refrigerant inlet portion, 2B: refrigerant outlet portion, 3: gas header, 3A: refrigerant inlet portion, 3B: refrigerant outlet portion, 4: heat transfer tube, 5: fin, 10, 20, 30, 40, 50, 60: plate, 10A: first passage, 10B: second passage, 10C: third passage, 10D: fourth passage, 10E: fifth passage, 10F: sixth passage, 10G: seventh passage, 10H: eighth passage, 10I: ninth passage, 10J: tenth passage, 10K: eleventh passage, 11: communication chamber, 11a: descent inhibiting portion, 12A: first branch passage, 12B: second branch passage, 12C: third branch passage, 12D: fourth branch passage, 13A: first interlevel cross passage, 13B: second interlevel cross passage, 80: air-conditioning apparatus, 81: compressor, 82: four-way valve, 83: outdoor heat exchanger, 84: expansion valve, 85: indoor heat exchanger, 86: outdoor fan, 87: indoor fan, 101, 102, 103: first plate, 111, 112, 113, 114: second plate, 121, 122, 123: third plate

Claims

1. A refrigerant distributer including a plurality of plates, the refrigerant distributer being configured to divert, into a plurality of refrigerant flows, refrigerant flowing in from one or a plurality of inlet ports thereof and allow the refrigerant flows to be let out from a plurality of outlet ports thereof spaced from one another in a first direction,
the plurality of plates comprising:

    an inflow plate having one of the plurality of inlet ports;
    a communication plate having a communication chamber communicating with the one of the plurality of inlet ports of the inflow plate; and
    a heat transfer tube insertion plate into which a heat transfer tube communicating with one of the plurality of outlet ports is inserted, the heat transfer tube insertion plate having heat transfer tube insertion space through which a plurality of the heat transfer tubes communicate with the communication chamber.

2. The refrigerant distributer of claim 1, wherein one or the plurality of inlet ports are formed in the inflow plate such that the one or the plurality of inlet ports are located upstream of a flow of the fluid, when a fluid flows in one direction outside the heat transfer

tube.

3. The refrigerant distributer of claim 1 or 2, wherein the plurality of plates further comprises a branch passage plate disposed between the inflow plate and the communication plate, the branch passage plate having a branch passage through which the refrigerant flowing in from the one or the plurality of inlet ports is diverted into a plurality of refrigerant flows in a second direction different from the first direction.

4. The refrigerant distributer of claim 3, wherein the branch passage is formed such that respective end portions of a straight part of the branch passage, the straight part extending straight in the second direction, extend toward opposite sides in the first direction.

5. The refrigerant distributer of claim 3, wherein the branch passage is formed such that an upstream end portion of end portions of a straight part of the branch passage, the straight part extending straight in the second direction, the upstream end portion being located upstream of a flow of the fluid, extends in two different directions parallel to the first direction, when a fluid flows in one direction outside the heat transfer tube.

6. The refrigerant distributer of any one of claims 1 to 5, wherein the communication chamber has a descent inhibiting portion located lower than a top of the one or the plurality of inlet ports, the descent inhibiting portion being configured to inhibit liquid refrigerant from descending, when the refrigerant in a two-phase gas-liquid state flows in from the one or the plurality of inlet ports.

7. The refrigerant distributer of claim 6, wherein, the descent inhibiting portion is unevenly located to be downstream of a flow of the fluid when a fluid flows in one direction outside the heat transfer tube.

8. A heat exchanger comprising:

   the refrigerant distributer of any one of claims 1 to 7; and
   a plurality of heat transfer tubes connected to the plurality of respective outlet ports.

9. An air-conditioning apparatus comprising the heat exchanger of claim 8.

FIG. 1

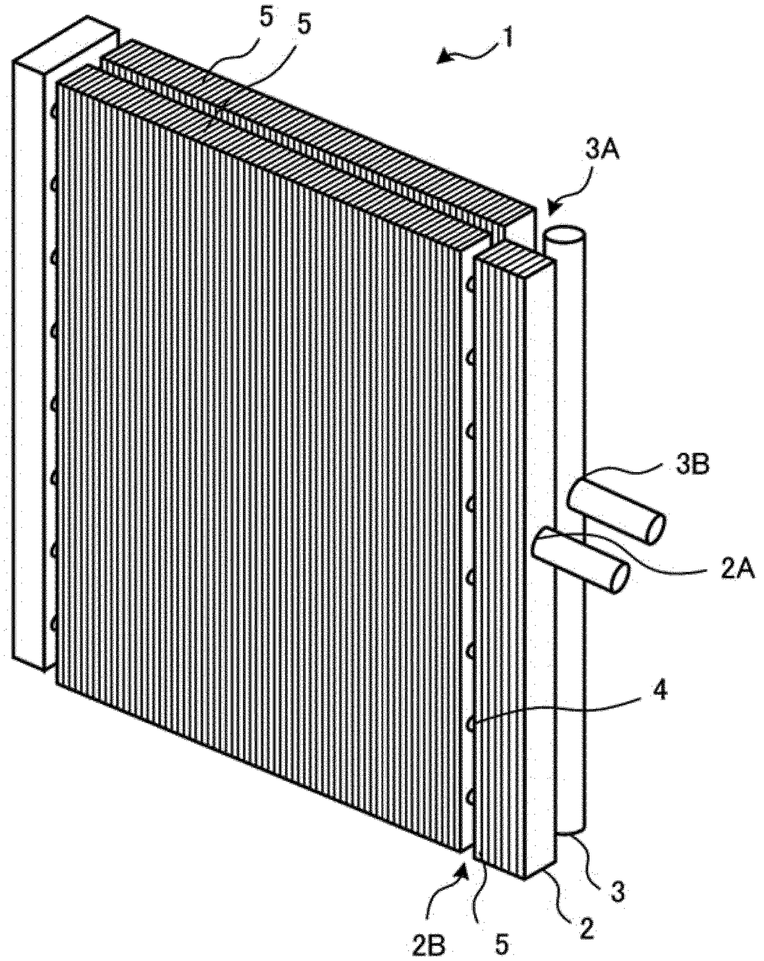


FIG. 2

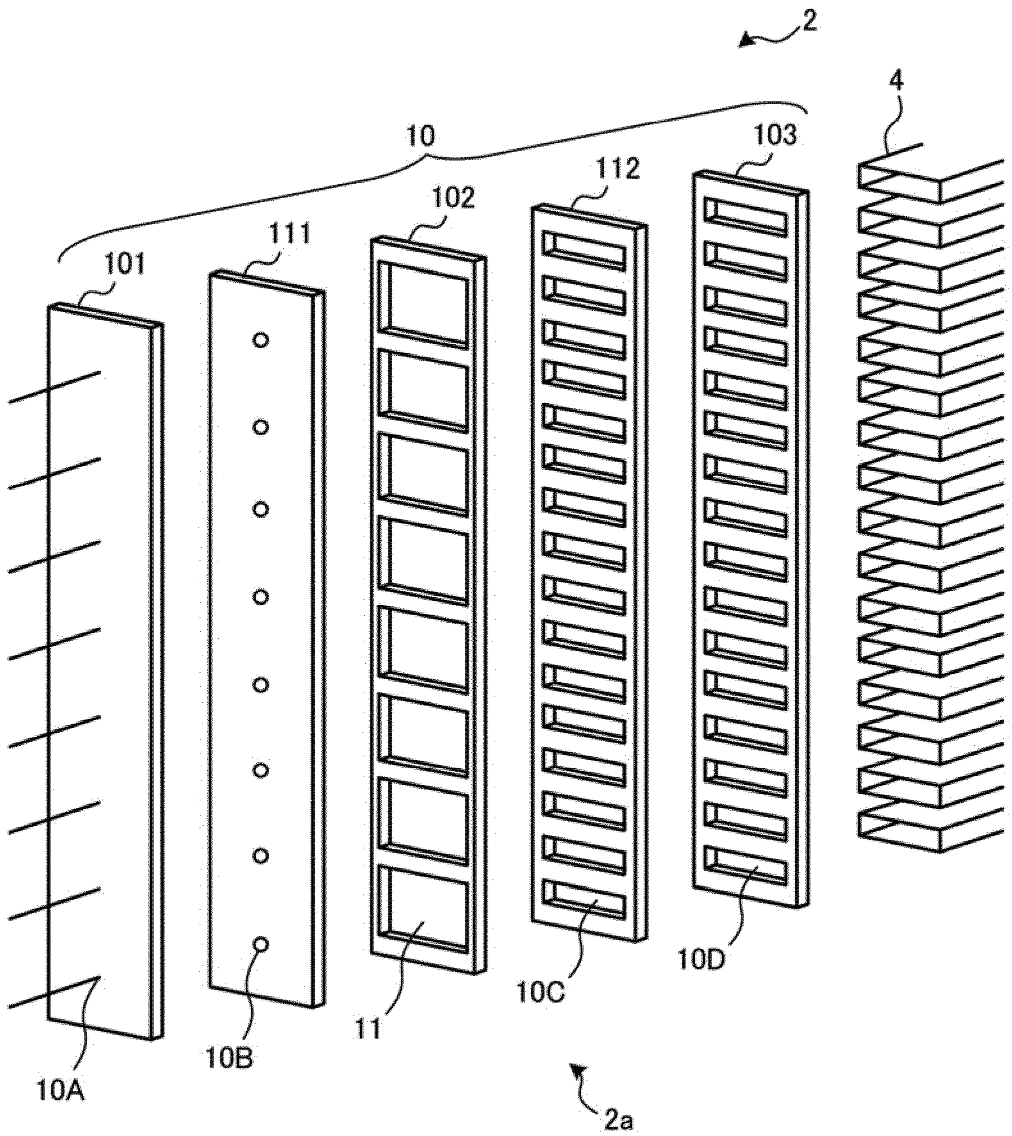


FIG. 3

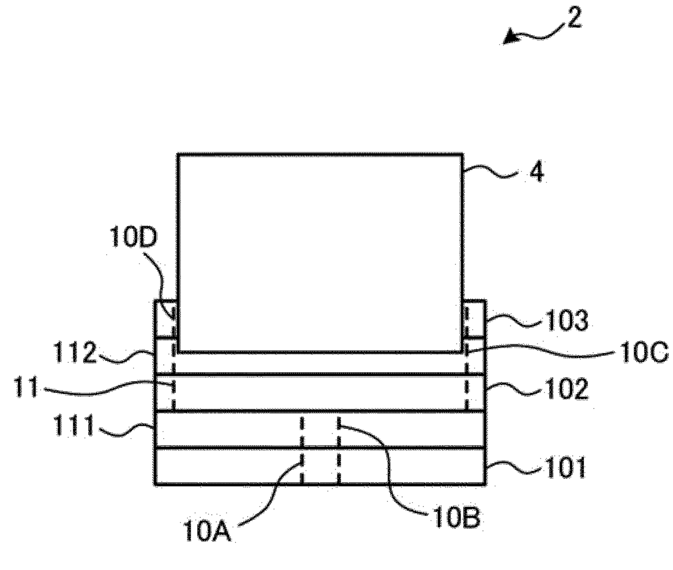


FIG. 4

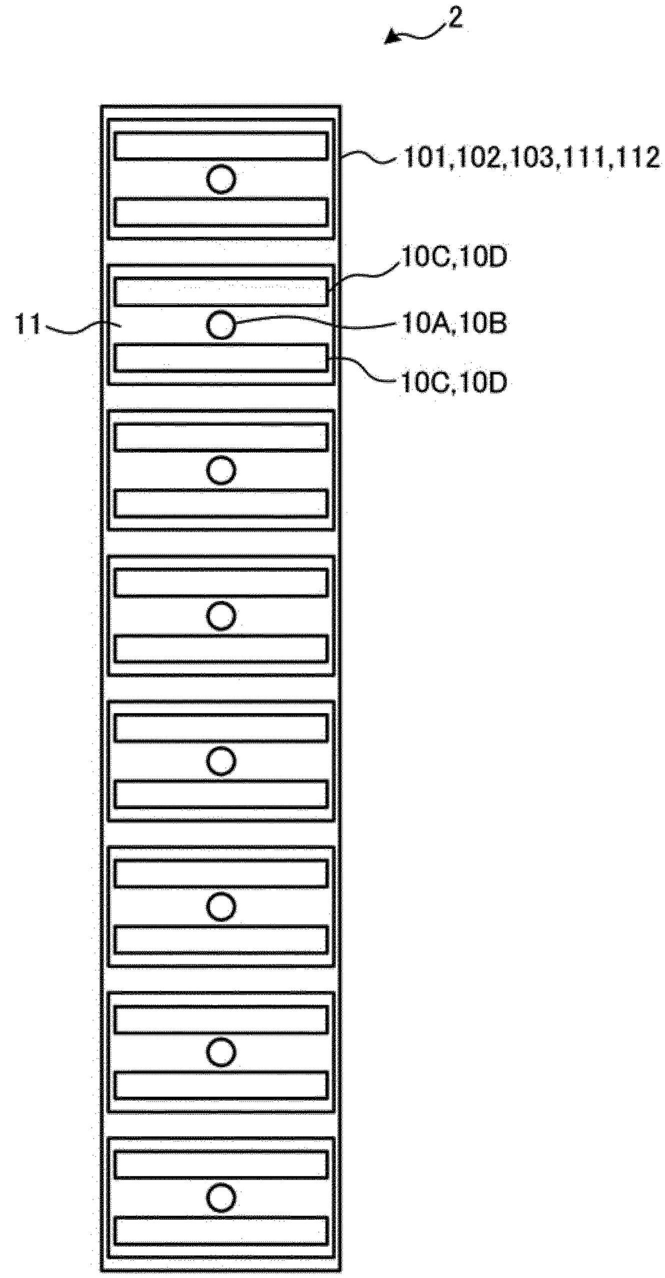


FIG. 5

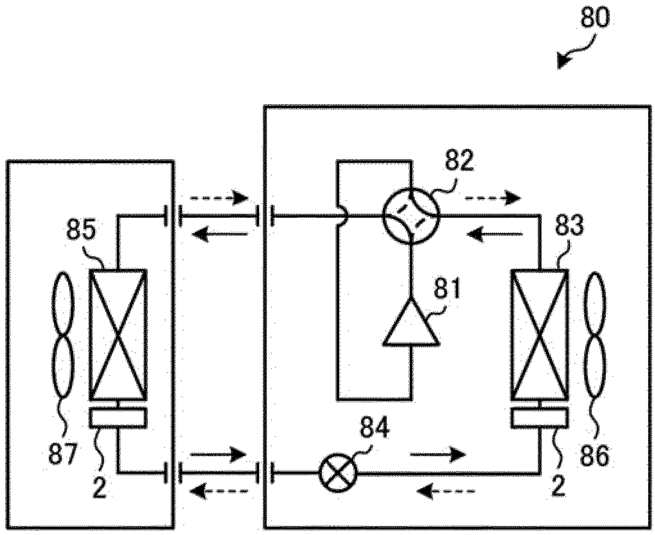


FIG. 6

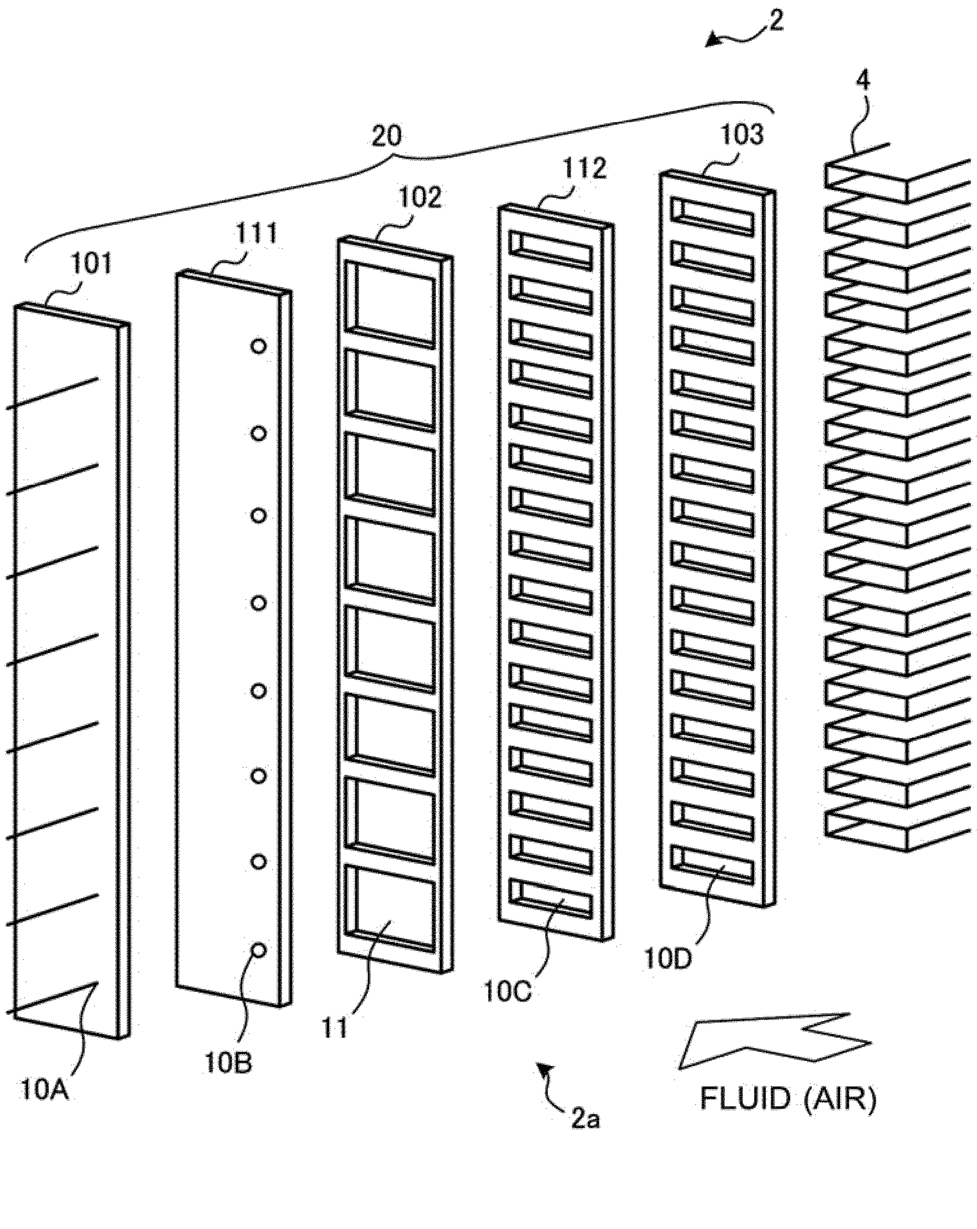


FIG. 7

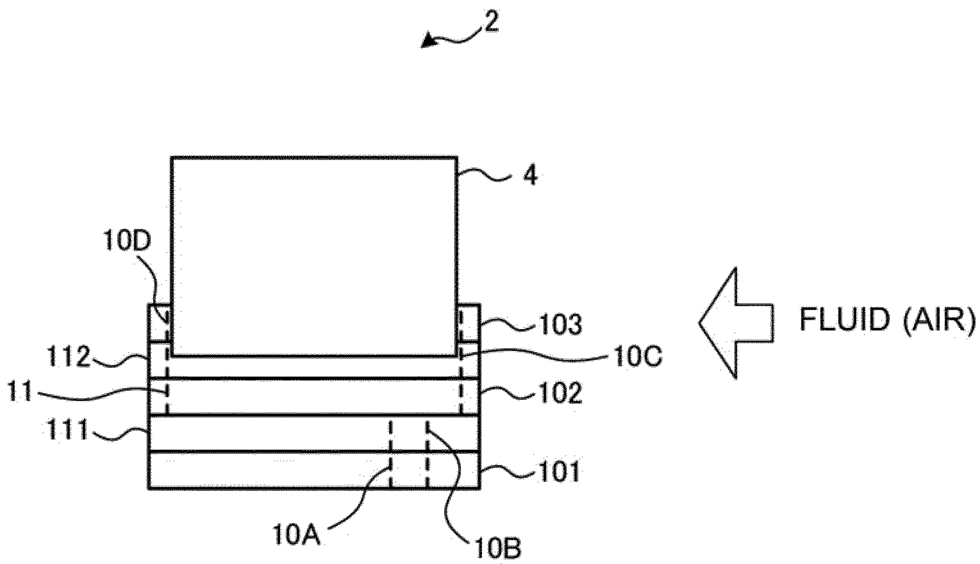


FIG. 8

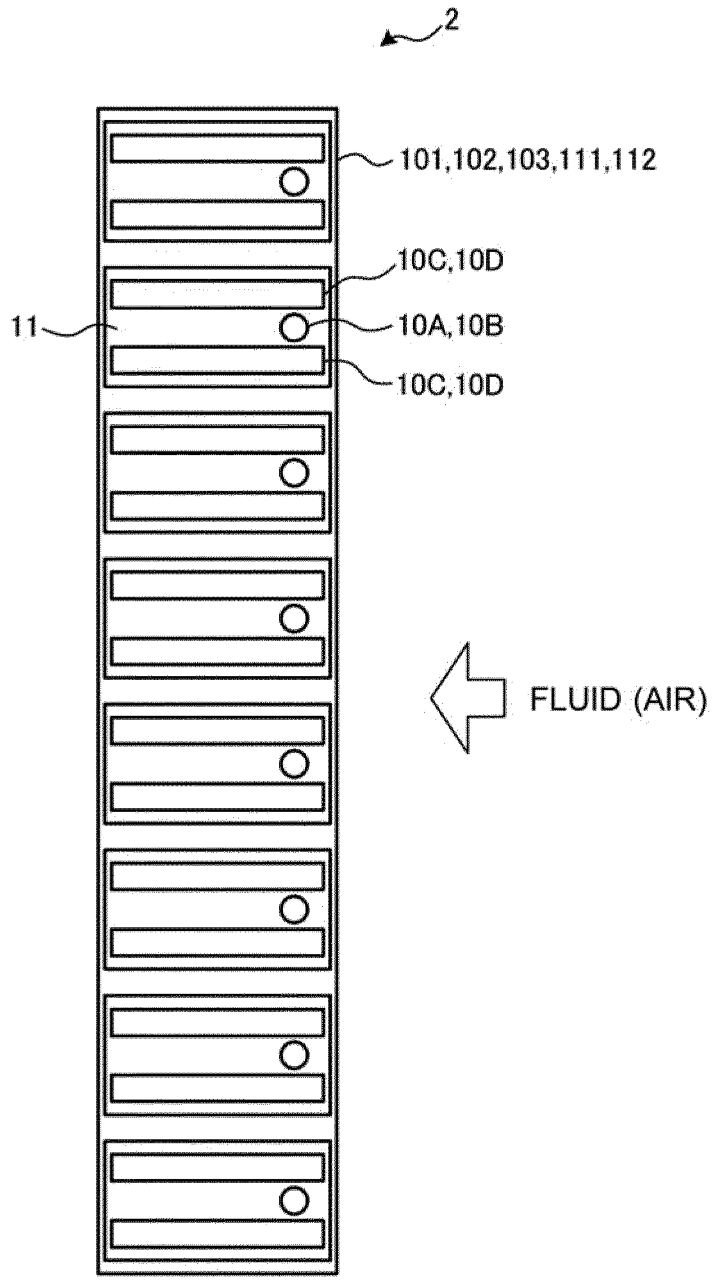


FIG. 9

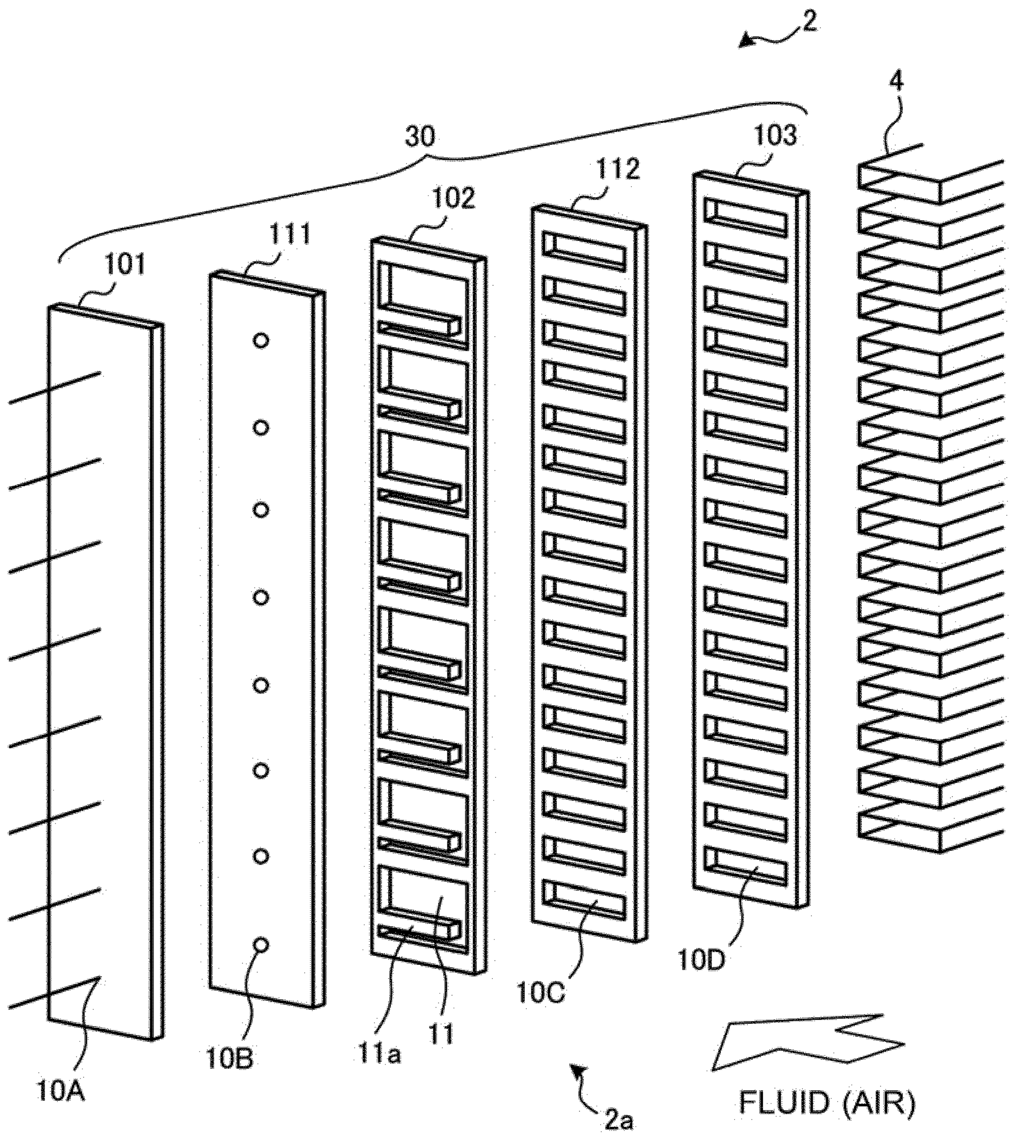


FIG. 10

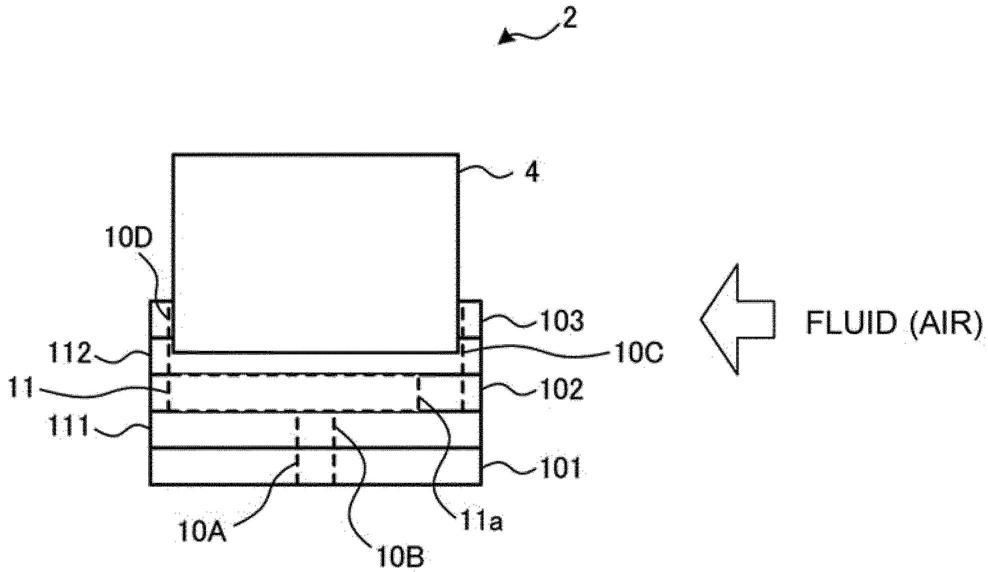


FIG. 11

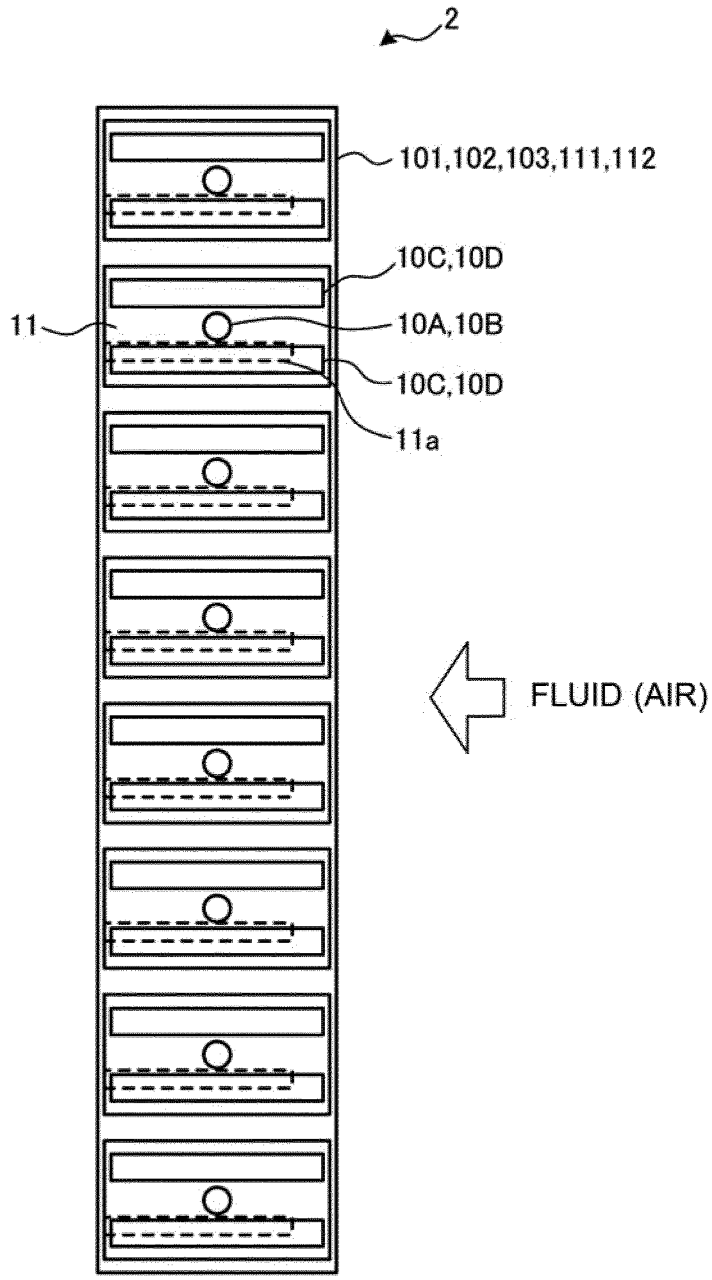
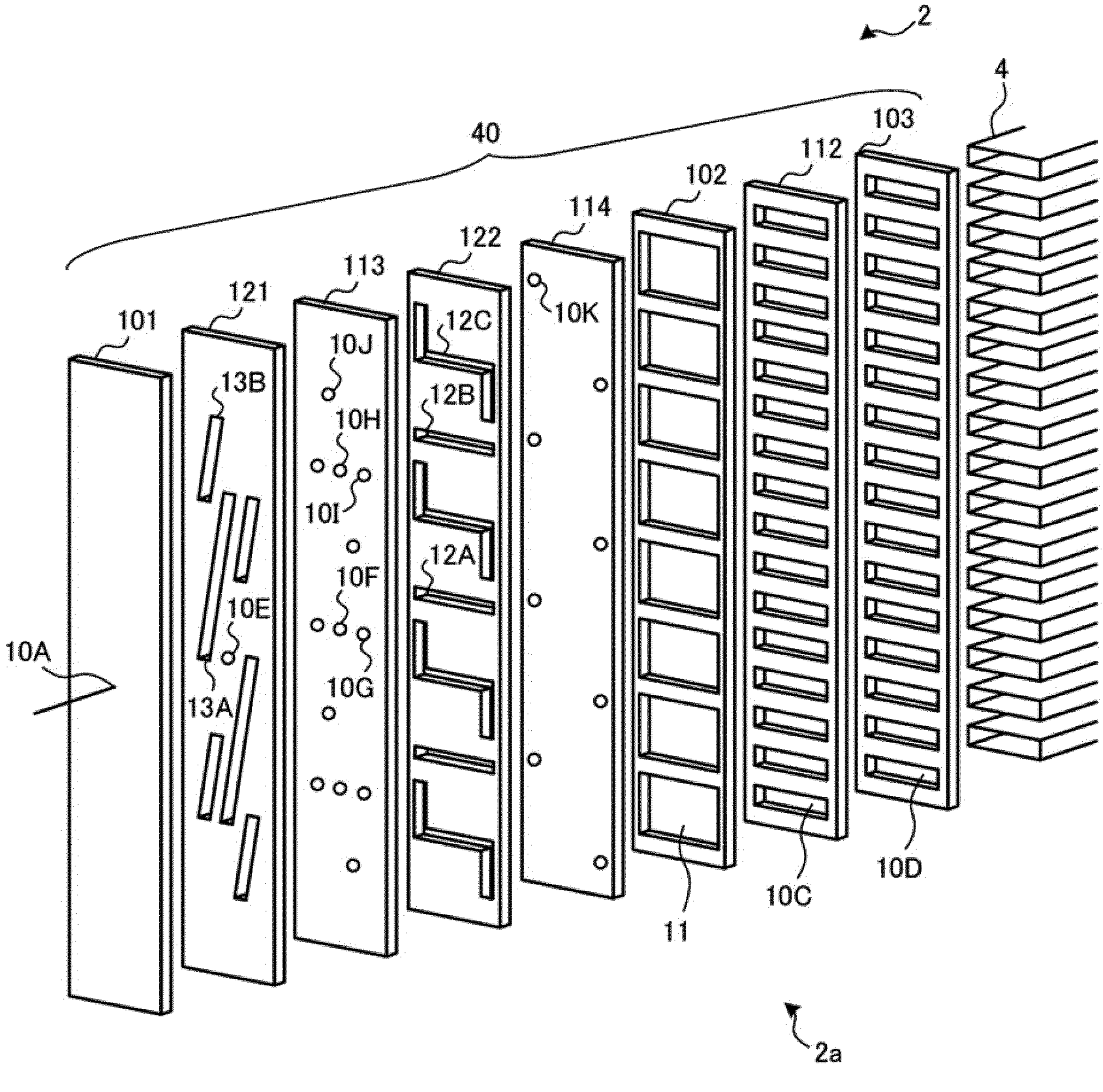


FIG. 12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11
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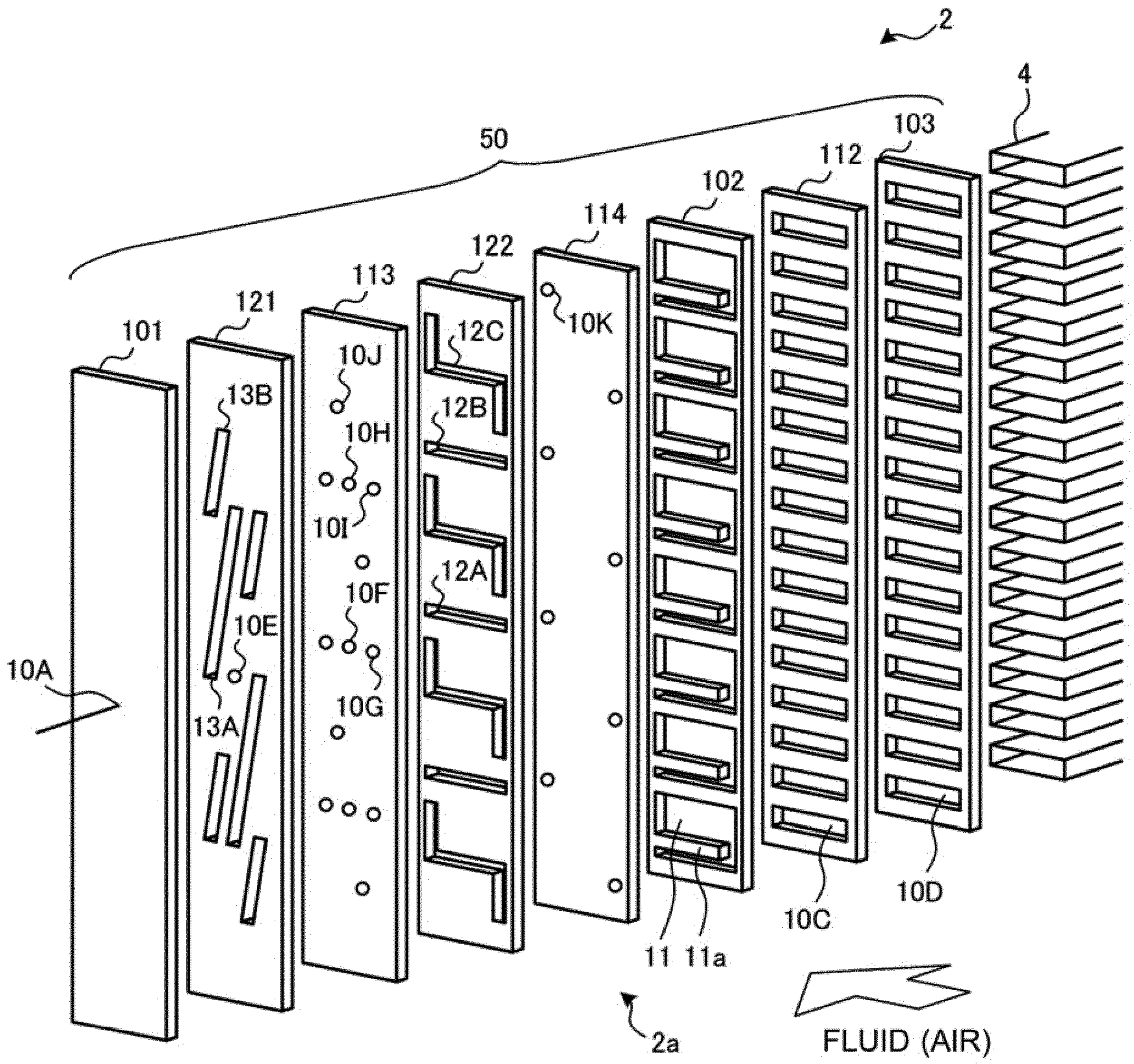
2a

FIG. 13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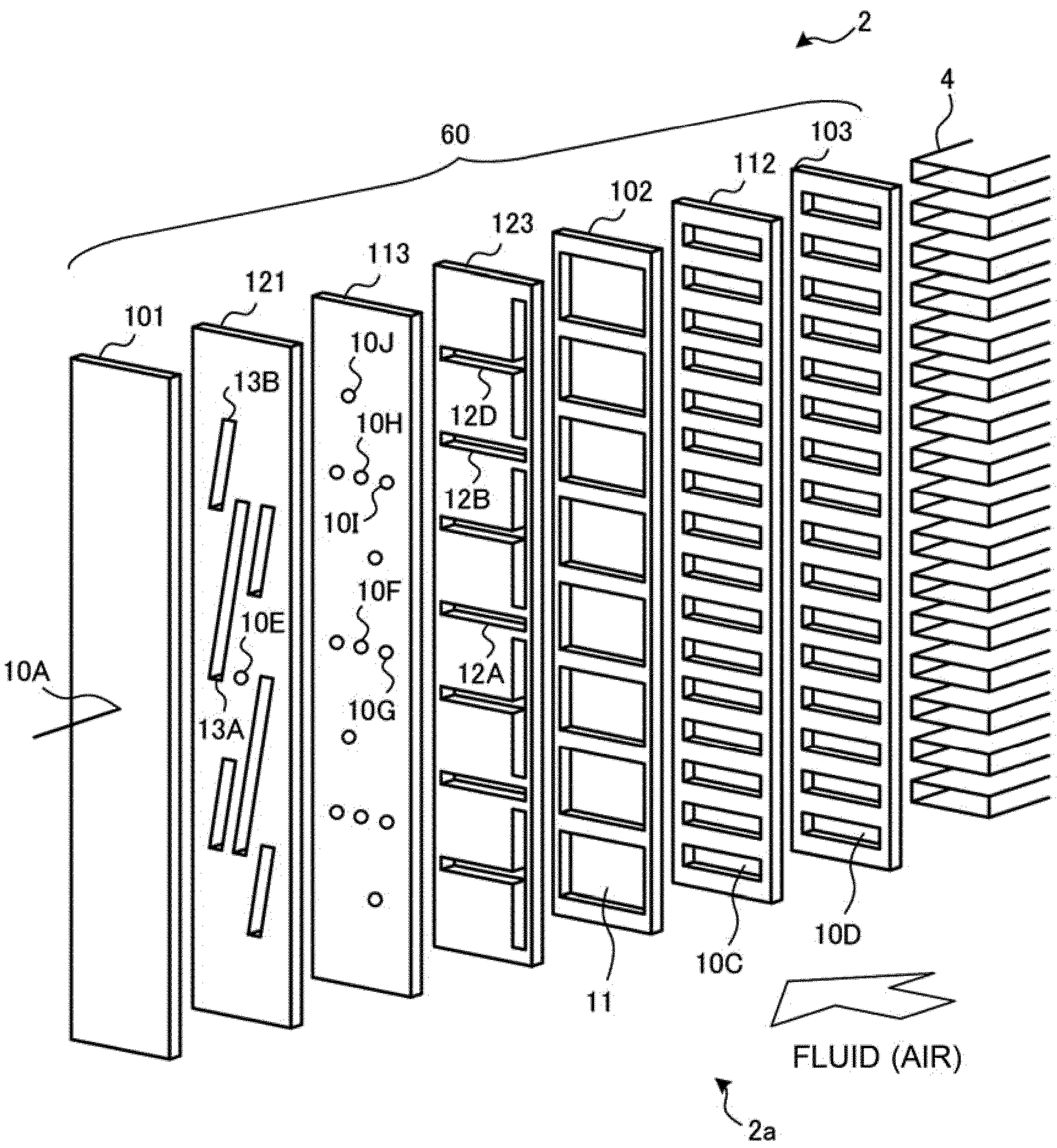
10C
10D
2a
FLUID (AIR)

FIG. 14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FLUID (AIR)
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/022246

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F25B39/02(2006.01)i, F25B41/00(2006.01)i, F28F9/22(2006.01)i
FI: F25B41/00 C, F25B39/02 G, F28F9/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. F25B39/00-39/04, F25B41/00, F28F9/00-9/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2020
Registered utility model specifications of Japan 1996-2020
Published registered utility model applications of Japan 1994-2020

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	WO 2014/184918 A1 (MITSUBISHI ELECTRIC CORP.) 20 November 2014, paragraphs [0001], [0011]-[0042], [0060]-[0069], fig. 1-3, 11-14	1, 3-4, 8-9 2, 6-7 5
X Y A	WO 2014/184914 A1 (MITSUBISHI ELECTRIC CORP.) 20 November 2014, paragraphs [0001], [0011]-[0057], [0109], [0110], fig. 1-3, 11, 33	1, 3-4, 8-9 2, 6-7 5
X Y A	JP 9-189463 A (MITSUBISHI ELECTRIC CORP.) 22 July 1997, paragraphs [0001], [0034], [0035], fig. 6	1, 8-9 2 3-7
Y	WO 2019/186674 A1 (TOSHIBA CARRIER CORP.) 03 October 2019, paragraphs [0076]-[0078], [0100], fig. 9	2

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21.07.2020	11.08.2020

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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/022246

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-66502 A (DAIKIN INDUSTRIES, LTD.) 17 April 2014, paragraph [0072], fig. 5-7	2

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/022246

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
WO 2014/184918 A1	20.11.2014	EP 2998680 A1 paragraphs [0001], [0012]-[0051], [0080]-[0099], fig. 1-3, 11-14	
WO 2014/184914 A1	20.11.2014	US 2016/0116231 A1 paragraphs [0001], [0046]-[0103], [0192]-[0195], fig. 1-3, 11, 33 EP 3018441 A1 CN 105229405 A	
JP 9-189463 A	22.07.1997	(Family: none)	
WO 2019/186674 A1	03.10.2019	(Family: none)	
JP 2014-66502 A	17.04.2014	(Family: none)	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 5376010 B **[0004]**