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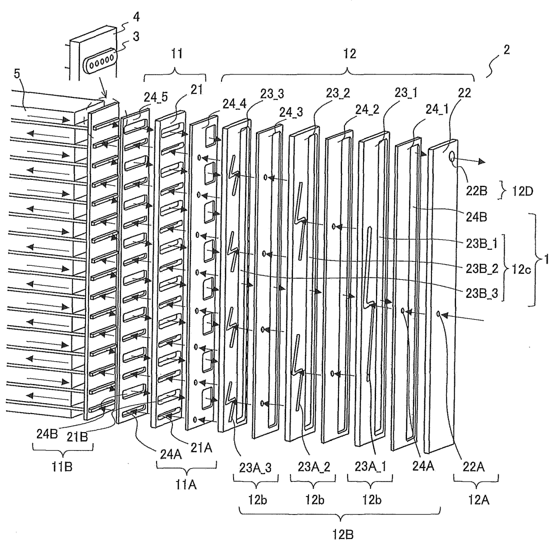
(54) LAMINATED HEADER, HEAT EXCHANGER, AND AIR CONDITIONER

(57) A stacking-type header 2 according to the present invention includes a first plate-shaped unit 11 having a plurality of first outlet flow passages 11 A and a plurality of first inlet flow passages 11 B, and a second plate-shaped unit 12 stacked on the first plate-shaped unit 11 and having at least a part of a distribution flow passage configured to distribute refrigerant flowing therein from a second inlet flow passage and to send out the refrigerant to the plurality of first outlet flow passages 11 A and at least a part of a joining flow passage configured to join refrigerant flowing therein from the plurality of first inlet flow passages 11 B and to send out the refrigerant to a second outlet flow passage. A passage area of one first inlet flow passage 11 B of the plurality of first inlet flow passages 11 B is larger than a passage area of one first outlet flow passage 11 A of the plurality of first outlet flow passages 11 A communicating with the one first inlet flow passage 11 B.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a stacking-type header, a heat exchanger, and an air-conditioning apparatus.

Background Art

[0002] There is a conventional stacking-type header including a first plate-shaped unit having a plurality of outlet flow passages and a plurality of inlet flow passages, and a second plate-shaped unit stacked on the first plate-shaped unit and having an inlet flow passage communicating with the plural outlet flow passages provided in the first plate-shaped unit and an outlet flow passage communicating with the plural inlet flow passages provided in the first plate-shaped unit (see, for example, Patent Literature 1).

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2000-161818 (paragraph [0032]-paragraph [0036], Figs. 7 and 8)

Summary of Invention

Technical Problem

[0004] In such a stacking-type header, for example, when gaseous refrigerant flows into the plural inlet flow passages in the first plate-shaped unit, the pressure loss of the refrigerant caused between the plural inlet flow passages in the first plate-shaped unit and the outlet flow passage in the second plate-shaped unit increases. When the refrigerant with the increased pressure loss flows from the outlet flow passage in the second plate-shaped unit into a compressor, the suction pressure of the compressor decreases, and the workload of the compressor increases. That is, the conventional stacking-type header has the problem in that the pressure loss of the refrigerant is high.

[0005] The present invention has been made in the context of the above-described problem, and an object of the invention is to obtain a stacking-type header in which the pressure loss of refrigerant is reduced. Another object of the invention is to obtain a heat exchanger including the stacking-type header. A further object of the invention is to obtain an air-conditioning apparatus including the heat exchanger.

Solution to Problem

[0006] A stacking-type header according to the present invention includes A stacking-type header comprising: a first plate-shaped unit having a plurality of first outlet flow passages and a plurality of first inlet flow passages; and a second plate-shaped unit stacked on the first plate-shaped unit and having at least a part of a distribution flow passage configured to distribute refrigerant, which passes through a second inlet flow passage to flow into the second plate-shaped unit, to the plurality of first outlet flow passages, the second plate-shaped unit having at least a part of a joining flow passage, the joining flow passage causing refrigerant entering from each of the first inlet flow passages to join and enter a second outlet passage, wherein a passage area of one first inlet flow passage of the plurality of first inlet flow passages is larger than a passage area of one first outlet flow passage of the plurality of first outlet flow passages communicating with the one first inlet flow passage.

Advantageous Effects of Invention

[0007] In the stacking-type header according to the present invention, the passage area of one first inlet flow passage of the plurality of first inlet flow passages is larger than the passage area of one first outlet flow passage of the plurality of first outlet flow passages communicating with the one first inlet flow passage. Hence, even during use in a situation where gaseous refrigerant flows into the plurality of first inlet flow passages in the first plate-shaped unit, it is possible to suppress the increase in pressure loss of the refrigerant caused between the plurality of first inlet flow passages in the first plate-shaped unit and the second outlet flow passage in the second plate-shaped unit.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 illustrates the structure of a heat exchanger according to Embodiment 1.
[Fig. 2] Fig. 2 is an exploded perspective view of a stacking-type header in the heat exchanger according to Embodiment 1.
[Fig. 3] Fig. 3 is a developed view of the stacking-type header in the heat exchanger according to Embodiment 1.
[Fig. 4] Fig. 4 illustrates the configuration of an air-conditioning apparatus to which the heat exchanger of Embodiment 1 is applied.
[Fig. 5] Fig. 5 is an exploded perspective view of a stacking-type header in Modification -1 of the heat exchanger of Embodiment 1.
[Fig. 6] Fig. 6 is an exploded perspective view of a stacking-type header in Modification-2 of the heat exchanger of Embodiment 1.
[Fig. 7] Fig. 7 is an exploded perspective view of a stacking-type header in Modification-3 of the heat exchanger of Embodiment 1.

[Fig. 8] Fig. 8 includes an exploded perspective view and a cross-sectional view of the principal part of a stacking-type header in Modification-4 of the heat exchanger of Embodiment 1.

[Fig. 9] Fig. 9 is an exploded perspective view of a stacking-type header in Modification-5 of the heat exchanger of Embodiment 1.

[Fig. 10] Fig. 10 is an exploded perspective view of a stacking-type header in Modification-6 of the heat exchanger of Embodiment 1.

[Fig. 11] Fig. 11 illustrates the structure of a heat exchanger according to Embodiment 2.

[Fig. 12] Fig. 12 is an exploded perspective view of a stacking-type header in the heat exchanger according to Embodiment 2.

[Fig. 13] Fig. 13 is a developed view of the stacking-type header in the heat exchanger according to Embodiment 2.

[Fig. 14] Fig. 14 illustrates the configuration of an air-conditioning apparatus to which the heat exchanger of Embodiment 2 is applied. Description of Embodiments

[0009] A stacking-type header according to the present invention will be described below with reference to the drawings.

[0010] While a case in which the stacking-type header of the present invention distributes refrigerant that flows into a heat exchanger will be described below, the stacking-type header of the present invention may distribute refrigerant that flows into other devices. The following structures, actions, and so on are just exemplary, and structures, actions, and so on are not limited thereto. In the drawings, the same or similar components are denoted by the same reference numerals, or are not denoted by any reference numeral. Illustrations of detailed structures are appropriately simplified or omitted. Overlapping or similar descriptions are appropriately simplified or omitted.

[0011] In the present invention, when one passage is provided, the term "passage area" means the cross-sectional area of the passage, and when a plurality of passages are provided, the term "passage area" means the sum of cross-sectional areas of the plural passages.

Embodiment 1

[0012] A heat exchanger according to Embodiment 1 will be described.

[Structure of Heat Exchanger]

[0013] The structure of a heat exchanger according to Embodiment 1 will be described below.

[0014] Fig. 1 illustrates the structure of the heat exchanger according to Embodiment 1.

[0015] As illustrated in Fig. 1, a heat exchanger 1 includes a stacking-type header 2, a plurality of first heat transfer tubes 3, a holding member 4, and a plurality of fins 5.

[0016] The stacking-type header 2 includes a refrigerant inflow part 2A, a plurality of refrigerant outflow parts 2B, a plurality of refrigerant inflow parts 2C, and a refrigerant outflow part 2D. Refrigerant pipes are connected to the refrigerant inflow part 2A of the stacking-type header 2 and the refrigerant outflow part 2D of the stacking-type header 2. The first heat transfer tubes 3 are flat tubes subjected to hairpin bending. The plural first heat transfer tubes 3 are connected between the plural refrigerant outflow parts 2B of the stacking-type header 2 and the plural refrigerant inflow parts 2C of the stacking-type header 2.

[0017] The first heat transfer tubes 3 are flat tubes each having a plurality of passages. For example, the first heat transfer tubes 3 are formed of aluminum. The plural first heat transfer tubes 3 are each connected at two ends to the plural refrigerant outflow parts 2B and the plural refrigerant inflow parts 2C of the stacking-type header 2 while being held by the holding member 4 shaped like a plate. For example, the holding member 4 is formed of aluminum. A plurality of fins 5 are joined to the first heat transfer tubes 3. For example, the fins 5 are formed of aluminum. The first heat transfer tubes 3 and the fins 5 are preferably joined by brazing. While the number of first heat transfer tubes 3 is eight in Fig. 1, the present invention is not limited to such a case.

[Flow of Refrigerant in Heat Exchanger]

[0018] The flow of refrigerant in the heat exchanger according to Embodiment 1 will be described below.

[0019] Refrigerant flowing through the refrigerant pipe flows into the stacking-type header 2 via the refrigerant inflow part 2A, is distributed, and flows out to the plural first heat transfer tubes 3 via the plural refrigerant outflow parts 2B. In the plural first heat transfer tubes 3, the refrigerant exchanges heat with, for example, air supplied by a fan. After passing through the plural first heat transfer tubes 3, the refrigerant flows into the stacking-type header 2 via the plural refrigerant inflow parts 2C, joins together, and flows out to the refrigerant pipe via the refrigerant outflow part 2D. The refrigerant can flow back.

[0020] [Structure of Laminated Header]

[0021] The structure of the stacking-type header in the heat exchanger of Embodiment 1 will be described below.

[0022] Fig. 2 is an exploded perspective view of the stacking-type header in the heat exchanger of Embodiment 1. Fig. 3 is a developed view of the stacking-type header in the heat exchanger of Embodiment 1. In Fig. 3, illustration of double-sided clad materials 24 is omitted.

[0023] As illustrated in Figs. 2 and 3, the stacking-type header 2 includes a first plate-shaped unit 11 and a second plate-shaped unit 12. The first plate-shaped unit 11 and the second plate-shaped unit 12 are stacked.

[0024] The first plate-shaped unit 11 is stacked on the outflow side of the refrigerant. The first plate-shaped unit

11 includes a first plate-shaped member 21. The first plate-shaped unit 11 has a plurality of first outlet flow passages 11 A and a plurality of first inlet flow passages 11 B. The plural first outlet flow passages 11 A correspond to the plural refrigerant outflow parts 2B in Fig. 1. The plural first inlet flow passages 11 B correspond to the plural refrigerant inflow parts 2C in Fig. 1.

[0025] The first plate-shaped member 21 has a plurality of passages 21 A and a plurality of passages 21 B. The plural passages 21 A and the plural passages 21 B are through holes shaped so that their inner peripheral surfaces follow outer peripheral surfaces of the first heat transfer tubes 3. The passage area (that is, the cross-sectional area) of one passage 21 B of the plural passages 21 B is larger than the passage area (that is, the cross-sectional area) of one passage 21 A of the plural passages 21 A communicating with the one passage 21 B. When the first plate-shaped member 21 is stacked, the plural passages 21 A function as the plural first outlet flow passages 11 A, and the plural passages 21 B function as the plural first inlet flow passages 11 B. For example, the first plate-shaped member 21 has a thickness of about 1 to 10 mm, and is formed of aluminum. When the plural passages 21 A and 21 B are formed by, for example, press working, working is simplified, and the production cost is reduced.

[0026] The second plate-shaped unit 12 is stacked on the inflow side of the refrigerant. The second plate-shaped unit 12 includes a second plate-shaped member 22 and a plurality of third plate-shaped members 23_1 to 23_3. The second plate-shaped unit 12 has a second inlet flow passage 12A, a distribution flow passage 12B, a joining flow passage 12C, and a second outlet flow passage 12D. The distribution flow passage 12B includes a plurality of branch passages 12b. The joining flow passage 12C includes a mixing passage 12c. The second inlet flow passage 12A corresponds to the refrigerant inflow part 2A in Fig. 1. The second outlet flow passage 12D corresponds to the refrigerant outflow part 2D in Fig. 1.

[0027] A part of the distribution flow passage 12B or a part of the joining flow passage 12C may be provided in the first plate-shaped unit 11. In such a case, it is only necessary that a passage that allows the inflow refrigerant to return and flow out should be provided in the first plate-shaped member 21, the second plate-shaped member 22, the plural third plate-shaped members 23_1 to 23_3, and so on. When the passage that allows the inflow refrigerant to return and flow out is not provided and the entire distribution flow passage 12B or the entire joining flow passage 12C is provided in the second plate-shaped unit 12, the width of the stacking-type header 2 can be made substantially equal to the width of the first heat transfer tubes 3, and this makes the heat exchanger 1 compact.

[0028] The second plate-shaped member 22 has a passage 22A and a passage 22B. The passage 22A and the passage 22B are circular through holes. The passage area (that is, the cross-sectional area) of the passage 22B is larger than the passage area (that is, the cross-sectional area) of the passage 22A. When the second plate-shaped member 22 is stacked, the passage 22A functions as the second inlet flow passage 12A, and the passage 22B functions as the second outlet flow passage 12D. For example, the second plate-shaped member 22 has a thickness of about 1 to 10 mm, and is formed of aluminum. When the passage 22A and the passage 22B are formed by, for example, press working, working is simplified, and, for example, the production cost is reduced.

[0029] For example, mouthpieces or the like are provided on a surface of the second plate-shaped member 22 on which other members are not stacked, and the refrigerant pipes are connected to the second inlet flow passage 12A and the second outlet flow passage 12D via the mouthpieces or the like. Inner peripheral surfaces of the second inlet flow passage 12A and the second outlet flow passage 12D may be shaped to be fitted on outer peripheral surfaces of the refrigerant pipes, and the refrigerant pipes may be directly connected to the second inlet flow passage 12A and the second outlet flow passage 12D without using mouthpieces or the like. In such a case, for example, the component cost is reduced.

[0030] The plural third plate-shaped members 23_1 to 23_3 have a plurality of passages 23A_1 to 23A_3. The plural passages 23A_1 to 23A_3 are through grooves each having two end portions 23a and 23b. When the plural third plate-shaped members 23_1 to 23_3 are stacked, each of the plural passages 23A_1 to 23A_3 functions as a branch passage 12b. For example, the plural third plate-shaped members 23_1 to 23_3 have a thickness of about 1 to 10 mm, and are formed of aluminum. For example, when the plural third plate-shaped members 23A_1 to 23A_3 are formed by press working, working is simplified and the production cost is reduced.

[0031] The plural third plate-shaped members 23_1 to 23_3 further have a plurality of passages 23B_1 to 23B_3. The plural passages 23B_1 to 23B_3 are rectangular through holes that penetrate almost the entire areas of the third plate-shaped members 23_1 to 23_3 in the height direction. The passage area (that is, the cross-sectional area) of the passages 23B_1 to 23B_3 is larger than the passage area (that is, the sum of cross-sectional areas) of the plural passages 21 A. When the plural third plate-shaped members 23_1 to 23_3 are stacked, each of the plural passages 23B_1 to 23B_3 functions as a part of the mixing passage 12c. The plural passages 23B_1 to 23B_3 do not always need to be rectangular.

[0032] Hereinafter, the plural third plate-shaped members 23_1 to 23_3 are sometimes generically referred to as third plate-shaped members 23. Hereinafter, the plural passages 23A_1 to 23A_3 are sometimes generically referred to as passages 23A. Hereinafter, the plural passages 23B_1 to 23B_3 are sometimes generically referred to as passages 23B. Hereinafter, the holding member 4, the first plate-shaped member 21, the second plate-shaped member 22, and the third plate-shaped members 23 are sometimes generically referred to as plate-shaped members.

[0033] The passage 23A provided in each third plate-shaped member 23 is shaped to connect two end portions 23a and 23b via a straight portion 23c perpendicular to the gravitational direction. Areas of the passage 23A other than an area 23d (hereinafter, referred to as an opening 23d) in a part between two ends of the straight portion 23c are closed by a member adjacently stacked on the inflow side of the refrigerant, and areas other than the end portions 23a and 23b are closed by a member adjacently stacked on the outflow side of the refrigerant, so that branch passage 12b is formed.

[0034] In order for the inflow refrigerant to branch and flow out to different heights, the end portion 23a and the end portion 23b are located at different heights. Particularly when one of the end portion 23a and the end portion 23b is located on the upper side of the straight portion 23c and the other is located on the lower side of the straight portion 23c, deviation of the distances from the opening 23d to the end portion 23a and the end portion 23b along the passage 23A can be reduced without complicating the shape. Since a straight line that connects the end portion 23a and the end portion 23b is parallel to the longitudinal direction of the third plate-shaped member 23, the dimension of the third plate-shaped member 23 in the shorter side direction can be reduced, and this reduces the component cost, weight, and so on. Further, since the straight line that connects the end portion 23a and the end portion 23b is parallel to the arrangement direction of the first heat transfer tubes 3, space saving of the heat exchanger 1 is achieved.

[0035] Each branch passage 12b branches the inflow refrigerant in two and sends out the refrigerant. For this reason, when eight first heat transfer tubes 3 are connected, at least three third plate-shaped members 23 are needed. When sixteen first heat transfer tubes 3 are connected, at least four third plate-shaped members 23 are needed. The number of first heat transfer tubes 3 to be connected is not limited to the power of two. In such a case, the branch passage 12b is preferably combined with a passage that does not branch. The number of first heat transfer tubes 3 to be connected may be two.

[0036] The stacking-type header 2 is not limited to the one in which the plural first outlet flow passages 11 A and the plural first inlet flow passages 11 B are arranged along the gravitational direction. For example, the stacking-type header 2 may be used when the heat exchanger 1 is disposed in an inclined manner like heat exchangers in a wall-hung indoor unit of a room air-conditioning apparatus, an outdoor unit of an air-conditioning apparatus, an outdoor unit of a chiller, and so on. In such a case, the straight portion 23c is preferably a through groove having a shape such as not to be perpendicular to the longitudinal direction of the third plate-shaped member 23.

[0037] The passage 23A may have other shapes. For example, the passage 23A may have no straight portion 23c. In such a case, a horizontal portion substantially perpendicular to the gravitational direction between the end portion 23a and the end portion 23b of the passage 23A serves as an opening 23d. When the passage 23A has the straight portion 23c, the refrigerant is unlikely to be influenced by gravity when it is branched at the opening 23d. For example, the passage 23A may be a through groove shaped so that an area that connects both ends of the straight portion 23c and an area that connects the end portion 23a and the end portion 23b are branched. When the branch passage 12b branches the inflow refrigerant in two and does not branch the branched refrigerant into a plurality of parts, uniformity of distribution of the refrigerant can be enhanced. The areas that connect both ends of the straight portion 23c to the end portion 23a and the end portion 23b may be straight or curved.

[0038] The plate-shaped members are stacked by brazing. A brazing material for joint may be supplied by using double-sided clad materials having the brazing material rolled on both surfaces for all plate-shaped members or for alternate plate-shaped members. The brazing material for joint may be supplied by using single-sided clad materials having the brazing material rolled on one surface for all the plate-shaped members. The brazing material may be supplied by stacking brazing-material sheets between the plate-shaped members. The brazing material may be supplied by applying brazing material paste between the plate-shaped members. The brazing material may be supplied by stacking double-sided clad materials having the brazing material rolled on both surfaces between the plate-shaped members.

[0039] When the plate-shaped members are stacked by brazing, they are stacked with no gap therebetween. This suppresses leakage of the refrigerant, and ensures pressure resistance. When the plate-shaped members are brazed while being pressurized, the occurrence of brazing failure is suppressed further. When a portion where the refrigerant is apt to leak is subjected to processing for promoting formation of a fillet, for example, a rib is formed, the occurrence of brazing failure is suppressed further.

[0040] Further, when all of the members to be brazed, including the first heat transfer tubes 3 and the fins 5, are formed of the same material (for example, formed of aluminum), they can be collectively brazed, and this enhances productivity. The first heat transfer tubes 3 and the fins 5 may be brazed after the stacking-type header 2 is brazed. Alternatively, only the first plate-shaped unit 11 may be first brazed to the holding member 4, and the second plate-shaped unit 12 may then be brazed.

[0041] In particular, the brazing material is preferably supplied by stacking plate-shaped members having the brazing material rolled on both surfaces, that is, double-sided clad materials between the plate-shaped members. As illustrated in Fig. 2, a plurality of double-sided clad materials 24_1 to 24_5 are stacked between the plate-shaped members. Hereinafter, the plural double-sided clad materials 24_1 to 24_5 are sometime generically referred to as double-sided clad materials 24.

[0042] The double-sided clad materials 24 have passages 24A and passages 24B penetrating therethrough. When the passages 24A and the passages 24B are formed by press working, working is simplified, and, for example, the production cost is reduced. When all of the members to be brazed, including the double-sided clad materials 24, are formed of the same material (for example, formed of aluminum), they can be collectively brazed, and this enhances productivity.

[0043] The passages 24A provided in the double-sided clad materials 24 stacked on the second plate-shaped member 22 and the third plate-shaped members 23 are circular through holes. The passages 24B provided in the double-sided clad materials 24 stacked on the third plate-shaped members 23_1 and 23_2 are rectangular through holes that penetrate almost the entire area of the double-sided clad materials 24 in the height direction. The passages 24B do not always need to be rectangular. The passage area (that is, the cross-sectional area) of the passages 24B is larger than the passage area (that is the sum of cross-sectional areas) of the plural passages 21 A. The plural passages 24B provided in the double-sided clad material 24_4 stacked between the third plate-shaped ember 23_3 and the first plate-shaped member 21 are rectangular through holes. The plural passages 24B do not always need to be rectangular. The passage area (that is, the cross-sectional area) of one passage 24B of the plural passages 24B is larger than the passage area (that is, the cross-sectional area) of one passage 21 A of the plural passages 21 A communicating with the one passage 24B.

[0044] The plural passages 24A and the plural passages 24B provided in the double-sided clad material 24_5 stacked between the first plate-shaped member 21 and the holding member 4 are through holes shaped so that their inner peripheral surfaces extend along the outer peripheral surfaces of the first heat transfer tubes 3. The passage area (that is, the cross-sectional area) of one passage 24B of the plural passages 24B is larger than the passage area (that is, the cross-sectional area) of one passage 21 A of the plural passages 21 A communicating with the one passage 24B.

[0045] When the double-sided clad materials 24 are stacked, the passages 24A function as refrigerant separation passages for the first outlet flow passages 11 A, the distribution flow passage 12B, and the second inlet flow passage 12A, and the passages 24B function as refrigerant separation passages for the first inlet flow passages 11 B, the joining flow passage 12C, and the second outlet flow passage 12D. Since the refrigerant separation passages are formed by the double-sided clad materials 24, separation of the refrigerant is performed reliably. Further, since separation of the refrigerant is reliably performed, the flexibility in designing the passages is improved. The double-sided clad materials 24 may be stacked between some of the plate-shaped members, and the brazing material may be supplied between the other plate-shaped members by other methods.

[0046] End portions of the first heat transfer tubes 3 protrude from the surface of the holding member 4, the double-sided clad material 24_5 is stacked on the holding member 4, and the inner peripheral surfaces of the passages 24A and 24B of the double-sided clad material 24_5 are fitted on the outer peripheral surfaces of the end portions. Hence, the first heat transfer tubes 3 are connected to the first outlet flow passages 11 A and the first inlet flow passages 11 B. The first outlet flow passages 11 A and the first inlet flow passages 11 B, and the first heat transfer tubes 3 may be positioned, for example, by fitting projections provided on the holding member 4 in recessed portions provided in the first plate-shaped unit 11. In such a case, the end portions of the first heat transfer tubes 3 do not have to protrude from the surface of the holding member 4. The first heat transfer tubes 3 may be directly connected to the first outlet flow passages 11 A and the first inlet flow passages 11 B without providing the holding member 4. In such a case, for example, the component cost is reduced.

[Flow of Refrigerant in Laminated Header]

[0047] A description will be given below of the flow of refrigerant in the stacking-type header in the heat exchanger of Embodiment 1.

[0048] As illustrated in Figs. 2 and 3, refrigerant that has passed through the passage 22A of the second plate-shaped member 22 flows into the opening 23d of the passage 23A provided in the third plate-shaped member 23_1. The refrigerant that has flowed in the opening 23d strikes the surface of the adjacently stacked member, and is branched in two toward both ends of the straight portion 23c. The branched refrigerant reaches the end portions 23a and 23b of the passage 23A, and flows into the openings 23d of the passages 23A provided in the third plate-shaped member 23_2.

[0049] Similarly, the refrigerant that has flowed in the opening 23d of each passage 23A provided in the third plate-shaped member 23_2 strikes the surface of the adjacently stacked member, and is branched in two toward both ends of the straight portion 23c. The branched refrigerant reaches the end portions 23a and 23b of the passage 23A, and flows into the openings 23d of the passages 23A provided in the third plate-shaped member 23_3.

[0050] Similarly, the refrigerant that has flowed in the opening 23d of each passage 23A provided in the third plate-shaped member 23_3 strikes the surface of the adjacently stacked member, and is branched in two toward both ends of the straight portion 23c. The branched refrigerant reaches the end portions 23a and 23b of the passage 23A, passes through the passages 21 A of the first plate-shaped member 21, and flows into the first heat transfer tubes 3.

[0051] The refrigerant, which has flowed out from the passages 21 A of the first plate-shaped member 21 and has passed through the first heat transfer tubes 3, flows into the passages 21 B of the first plate-shaped member 21. The refrigerant that has flowed in the passages 21 B of the first plate-shaped member 21 flows into the passages 23B provided in the third plate-shaped members 23 so as to be mixed. The mixed refrigerant passes through the passage 22B of the second plate-shaped member 22, and flows out to the refrigerant pipe.

[Use Mode of Heat Exchanger]

[0052] An example of a use mode of the heat exchanger according to Embodiment 1 will be described below.

[0053] While a case in which the heat exchanger according to Embodiment 1 is used in an air-conditioning apparatus will be described below, the present invention is not limited to such a case. For example, the heat exchanger of Embodiment 1 may be used in other refrigeration cycle apparatuses including a refrigerant circuit. Further, while a case in which cooling operation and heating operation are switched in the air-conditioning apparatus, the present invention is not limited to such a case, and only cooling operation or heating operation may be performed.

[0054] Fig. 4 illustrates the configuration of an air-conditioning apparatus to which the heat exchanger of Embodiment 1 is applied. In Fig. 4, the flow of refrigerant in cooling operation is shown by solid arrows, and the flow of the refrigerant in heating operation is shown by dotted arrows.

[0055] As illustrated in Fig. 4, an air-conditioning apparatus 51 includes a compressor 52, a four-way valve 53, a heat-source-side heat exchanger 54, an expansion device 55, a load-side heat exchanger 56, a heat-source-side fan 57, a load-side fan 58, and a controller 59. The compressor 52, the four-way valve 53, the heat-source -heat exchanger 54, the expansion device 55, and the load-side heat exchanger 56 are connected by refrigerant pipes to form a refrigerant circuit.

[0056] To the controller 59, for example, the compressor 52, the four-way valve 53, the expansion device 55, the heat-source-side fan 57, the load-side fan 58, and various sensors are connected. The controller 59 switches the passage of the four-way valve 53 to switch between cooling operation and heating operation. The heat-source-side heat exchanger 54 functions as a condenser in the cooling operation and functions as an evaporator in the heating operation. The load-side heat exchanger 56 functions as an evaporator in the cooling operation and functions as a condenser in the heating operation.

[0057] The flow of refrigerant during the cooling operation will be described.

[0058] A high-pressure and high-temperature gaseous refrigerant discharged from the compressor 52 flows into the heat-source-side heat exchanger 54 via the four-way valve 53, is condensed into a high-pressure liquid refrigerant by heat exchange with outdoor air supplied by the heat-source-side fan 57, and flows out from the heat-source-side heat exchanger 54. The high-pressure liquid refrigerant that has flowed out from the heat-source-side heat exchanger 54 flows into the expansion device 55, and is turned into a low-pressure two-phase gas-liquid refrigerant. The low-pressure two-phase gas-liquid refrigerant flowing out from the expansion device 55 flows into the load-side heat exchanger 56, is evaporated into a low-pressure gaseous refrigerant by heat exchange with indoor air supplied by the load-side fan 58, and flows out from the load-side heat exchanger 56. The low-pressure gaseous refrigerant flowing out from the load-side heat exchanger 56 is sucked by the compressor 52 via the four-way valve 53.

[0059] The flow of the refrigerant during heating operation will be described.

[0060] A high-pressure and high-temperature gaseous refrigerant discharged from the compressor 52 flows into the load-side heat exchanger 56 via the four-way valve 53, is condensed into a high-pressure liquid refrigerant by heat exchange with indoor air supplied by the load-side fan 58, and flows out from the load-side heat exchanger 56. The high-pressure liquid refrigerant that has flowed out from the load-side heat exchanger 56 flows into the expansion device 55, where it is turned into a low-pressure two-phase gas-liquid refrigerant. The low-pressure two-phase gas-liquid refrigerant flowing out from the expansion device 55 flows into the heat-source-side heat exchanger 54, is evaporated into a low-pressure gaseous refrigerant by heat exchange with outdoor air supplied by the heat-source-side fan 57, and flows out from the heat-source-side heat exchanger 54. The low-pressure gaseous refrigerant flowing out from the heat-source-side heat exchanger 54 is sucked by the compressor 52 via the four-way valve 53.

[0061] The heat exchanger 1 is used in at least one of the heat-source-side heat exchanger 54 and the load-side heat exchanger 56. The heat exchanger 1 is connected so that the refrigerant flows from the distribution flow passage 12B of the stacking-type header 2 into the first heat transfer tubes 3 and the refrigerant flows from the first heat transfer tubes 3 into the joining flow passage 12C of the stacking-type header 2 when the heat exchanger 1 operates as an evaporator. That is, when the heat exchanger 1 operates as the evaporator, a two-phase gas-liquid refrigerant flows from the refrigerant pipe into the distribution flow passage 12B of the stacking-type header 2, and a gaseous refrigerant flows from the first heat transfer tubes 3 into the joining flow passage 12C of the stacking-type header 2. When the heat exchanger 1 operates as a condenser, a gaseous refrigerant flows from the refrigerant pipe into the joining flow passage 12C of the stacking-type header 2, and a liquid refrigerant flows from the first heat transfer tubes 3 into the distribution flow passage 12B of the stacking-type header 2.

[Operation of Heat Exchanger]

[0062] The operation of the heat exchanger according to Embodiment 1 will be described below.

[0063] In the stacking-type header 2, the passage area of one first inlet flow passage 11 B of the plural first inlet flow passages 11 B is larger than the passage area of one first outlet flow passage 11 A of the plural first outlet flow passages 11 A that communicates with the first inlet flow passage 11 B. For this reason, even during use in a situation where the gaseous refrigerant flows into the plural first inlet flow passages 11 B in the first plate-shaped unit 11, it is possible to suppress the increase in pressure loss of the refrigerant caused between the plural first inlet flow passages 11 B of the first plate-shaped unit 11 and the second outlet flow passage 12D of the second plate-shaped unit 12.

[0064] Further, in the stacking-type header 2, the passage area of the joining flow passage 12c is larger than the passage area of the plural first outlet flow passages 11 A. For this reason, even during use in a situation where the gaseous refrigerant flows into the plural first inlet flow passages 11 B of the first plate-shaped unit 11, it is possible to suppress the increase in pressure loss of the refrigerant caused between the plural first inlet flow passages 11 B of the first plate-shaped unit 11 and the second outlet flow passage 12D of the second plate-shaped unit 12.

[0065] In the stacking-type header, the passage area of the second outlet flow passage 12D is larger than the passage area of the second inlet flow passage 12A. For this reason, even during use in a situation where the gaseous refrigerant flows into the plural first inlet flow passages 11 B of the first plate-shaped unit 11, it is possible to suppress the increase in pressure loss of the refrigerant caused in the second outlet flow passage 12D of the second plate-shaped unit 12.

[0066] In particular, even during use in a situation where the refrigerant flowing from the stacking-type header 2 into the first heat transfer tubes 3 is in a two-phase gas-liquid state and the refrigerant flowing from the first heat transfer tubes 3 into the stacking-type header 2 is in the gas state, it is possible to suppress the increase in pressure loss of the refrigerant caused between the plural first inlet flow passages 11 B of the first plate-shaped unit 11 and the second outlet flow passage 12D of the second plate-shaped unit 12. When the heat exchanger 1 operates as an evaporator and the gaseous refrigerant flowing out from the stacking-type header 2 is sucked by the compressor 52, the refrigerant whose increase in pressure loss is suppressed is sucked by the compressor 52. This suppresses the increase in workload of the compressor 52 due to the decrease in suction pressure of the compressor 52, and, for example, performance of the air-conditioning apparatus 51 is enhanced.

[0067] In particular, when the heat transfer tubes are changed from circular tubes to flat tubes, for example, in order to reduce the refrigerant amount and to achieve space saving of the heat exchanger, the conventional stacking-type header must be increased in size in the circumferential direction perpendicular to the inflow direction of the refrigerant. However, the stacking-type header 2 does not have to be increased in size in the circumferential direction perpendicular to the inflow direction of the refrigerant, and this leads to space saving of the heat exchanger 1. That is, when the heat transfer tubes are changed from circular tubes to flat tubes in the conventional stacking-type header, the passage cross-sectional area in the heat transfer tubes decreases, and the pressure loss occurring in the heat transfer tubes increases. Hence, the necessity of increasing the number of paths (that is, the number of heat transfer tubes) by further decreasing the angular interval of the plural grooves that form the branch passage occurs, and the stacking-type header is increased in size in the circumferential direction perpendicular to the inflow direction of the refrigerant. In contrast, in the stacking-type header 2, even when the necessary of increasing the number of paths occurs, it is only necessary to increase the number of third plate-shaped members 23. Hence, the increase in size of the stacking-type header 2 in the circumferential direction perpendicular to the inflow direction of the refrigerant is suppressed. The stacking-type header 2 is not limited to the one in which the first heat transfer tubes 3 are flat tubes.

[Modification-1]

[0068] Fig. 5 is an exploded perspective view of a stacking-type header in Modification-1 of the heat exchanger according to Embodiment 1.

[0069] As illustrated in Fig. 5, in third plate-shaped members 23, peripheral edges of passages 23B may be enlarged to be closer to peripheral edges of passages 23A. When the passages 23B in all the third plate-shaped members 23 have the same shape, the pressure loss is reduced. For this reason, the passages 23B penetrate areas that do not overlap with any of the passages 23A. Passages 24B of double-sided clad materials 24 stacked between a second plate-shaped member 22 and a third plate-shaped member 23_3 also have the same shape.

[Modification-2]

[0070] Fig. 6 is an exploded perspective view of a stacking-type header in Modification-2 of the heat exchanger according to Embodiment 1.

[0071] As illustrated in Fig. 6, the number of third plate-shaped members 23 may be reduced by forming a plurality of passages 22A in a second plate-shaped member 22, that is, by forming a plurality of second inlet flow passages 12A in a second plate-shaped unit 12. This structure reduces, for example, the component cost and weight. The passage area (that is, the cross-sectional area) of a passage 22B is larger than the passage area (that is, the sum of cross-sectional areas) of the plural passages 22A.

[Modification-3]

[0072] Fig. 7 is an exploded perspective view of a stacking-type header in Modification-3 of the heat exchanger according to Embodiment 1.

[0073] As illustrated in Fig. 7, a second plate-shaped member 22 and third plate-shaped members 23 may have a plurality of passages 22B and a plurality of passages 23B. That is, a joining flow passage 12C may have a plurality of mixing passages 12c. A plurality of passages 24B of double-sided clad materials 24 stacked between the second plate-shaped member 22 and a third plate-shaped member 23_3 have the same shape as that of the plural passages 23B. The passage area (the sum of cross-sectional areas) of the plural passages 22B is larger than the passage area (that is, the cross-sectional area) of a passage 22A. The passage area (that is, the sum of cross-sectional areas) of the plural passages 23B is larger than the passage area (that is, the sum of cross-sectional areas) of a plurality of passages 21 A. The passage area (that is, the sum of cross-sectional areas) of the plural passages 24B is larger than the passage area (that is, the sum of cross-sectional areas) of the plural passages 21 A.

[Modification-4]

[0074] Fig. 8 includes a perspective view of the principal part and a cross-sectional view of the principal part in an exploded state of a stacking-type header in Modification-4 of the heat exchanger according to Embodiment 1. Fig. 8(a) is a perspective view of the principal part of the stacking-type header in the exploded state, and Fig. 8(b) is a cross-sectional view of a third plate-shaped member 23, taken along line A-A of Fig. 8(a).

[0075] As illustrated in Fig. 8, any of passages 23A provided in third plate-shaped members 23 is a bottomed groove. In such a case, a circular through hole 23e is provided in each of an end portion 23a and an end portion 23b of a bottom surface of the groove of the passage 23A. In this structure, double-sided clad materials 24 do not have to be stacked between the plate-shaped members so that passages 24A functioning as refrigerant separation passages are provided between branch passages 12b. This enhances production efficiency. While the refrigerant outflow side of the passage 23A is the bottom surface in Fig. 8, the refrigerant inflow side of the passage 23A may be the bottom surface. In such a case, it is only necessary that a through hole should be provided in an area corresponding to an opening 23d.

[Modification-5]

[0076] Fig. 9 is an exploded perspective view of a stacking-type header in Modification-5 of the heat exchanger according to Embodiment 1.

[0077] As illustrated in Fig. 9, a passage 22A serving as a second inlet flow passage 12A may be provided in a stacked member other than a second plate-shaped member 22, that is, for example, in another plate-shaped member or a double-sided clad material 24. In such a case, for example, the passage 22A is formed by a through hole that extends through the plate-shaped member from a side surface to a surface on the side of the second plate-shaped member 22.

[Modification-6]

[0078] Fig. 10 is an exploded perspective view of a stacking-type header in Modification-6 of the heat exchanger according to Embodiment 1.

[0079] As illustrated in Fig. 10, a passage 22B serving as a second outlet flow passage 12D may be provided in, for example, a plate-shaped member other than a second plate-shaped member 22 of a second plate-shaped unit 12 or a double-sided clad material 24. In such a case, for example, it is only necessary that a cutout should be provided to communicate between a part of a passage 23B or a passage 24B and a side surface of a third plate-shaped member 23 or a double-sided clad material 24. The passage 22B serving as the second outlet flow passage 12D may be provided in a first plate-shaped member 21 by bending back a mixing passage 12c.

Embodiment 2

[0080] A heat exchanger according to Embodiment 2 will be described.

[0081] Descriptions overlapping with or similar to those of Embodiment 1 are appropriately simplified or omitted.

[Structure of Heat Exchanger]

[0082] The structure of the heat exchanger according to Embodiment 2 will be described below.

[0083] Fig. 11 illustrates the structure of the heat exchanger according to Embodiment 2.

[0084] As illustrated in Fig. 11, a heat exchanger 1 includes a stacking-type header 2, a plurality of first heat transfer tubes 3, a plurality of second heat transfer tubes 6, a holding member 4, and a plurality of fins 5.

[0085] The stacking-type header 2 includes a plurality of refrigerant return parts 2E. The second heat transfer tubes 6 are flat tubes subjected to hairpin bending, similarly to the first heat transfer tubes 3. The plural first heat transfer tubes 3 are connected between a plurality of refrigerant outflow parts 2B and the plural refrigerant return parts 2E in the stacking-type header 2, and the plural second heat transfer tubes 6 are connected between the plural refrigerant return parts 2E and a plurality of refrigerant inflow parts 2C in the stacking-type header 2.

[Flow of Refrigerant in Heat Exchanger]

[0086] A description will be given below of the flow of refrigerant in the heat exchanger according to Embodiment 2.

[0087] Refrigerant flowing through a refrigerant pipe flows into the stacking-type header 2 via a refrigerant inflow part 2A, is distributed, and flows out to the plural first heat transfer tubes 3 via the plural refrigerant outflow parts 2B. In the plural first heat transfer tubes 3, the refrigerant exchanges heat with, for example, air supplied by a fan. The refrigerant that has passed through the plural first heat transfer tubes 3 flows into the plural refrigerant return parts 2E of the stacking-type header 2, is returned, and flows out to the plural second heat transfer tubes 6. In the plural second heat transfer tubes 6, the refrigerant exchanges heat with, for example, air supplied by a fan. The refrigerant that has passed through the plural second heat transfer tubes 6 flows into the stacking-type header 2 via the plural refrigerant inflow parts 2C, joins, and flows out to a refrigerant pipe via a refrigerant outflow part 2D. The refrigerant can flow back.

[Structure of Laminated Header]

[0088] A description will be given below of the structure of the stacking-type header in the heat exchanger according to Embodiment 2.

[0089] Fig. 12 is an exploded perspective view of the stacking-type header in the heat exchanger according to Embodiment 2. Fig. 13 is a developed view of the stacking-type header in the heat exchanger according to Embodiment 2. In Fig. 13, illustration of double-sided clad materials 24 is omitted.

[0090] As illustrated in Figs. 12 and 13, the stacking-type header 2 includes a first plate-shaped unit 11 and a second plate-shaped unit 12. The first plate-shaped unit 11 and the second plate-shaped unit 12 are stacked.

[0091] The first plate-shaped unit 11 has a plurality of first outlet flow passages 11 A, a plurality of first inlet flow passages 11 B, and a plurality of return passages 11 C. The plural return passages 11 C correspond to the plural refrigerant return parts 2E in Fig. 11.

[0092] A first plate-shaped member 21 has a plurality of passages 21 C. The plural passages 21 C are through holes shaped so that inner peripheral surfaces thereof surround outer peripheral surfaces of refrigerant outflow-side end portions of the first heat transfer tubes 3 and outer peripheral surfaces of refrigerant inflow-side end portions of the second heat transfer tubes 6. When the first plate-shaped member 21 is stacked, the plural passages 21C function as the plural return passages 11C.

[0093] In particular, brazing material is preferably supplied by stacking double-sided clad materials 24 having the brazing material rolled on both surfaces between the plate-shaped members. Passages 24C provided in a double-sided clad material 24_5 stacked between the holding member 4 and the first plate-shaped member 21 are through holes shaped so that inner peripheral surfaces thereof surround the outer peripheral surfaces of the refrigerant outflow-side end portions of the first heat transfer tubes 3 and the outer peripheral surfaces of the refrigerant inflow-side end portions of the second heat transfer tubes 6. When the double-sided clad materials 24 are stacked, the passages 24C function as refrigerant separation passages of the return passages 11C.

[Flow of Refrigerant in Laminated Header]

[0094] A description will be given below of the flow of refrigerant in the stacking-type header in the heat exchanger according to Embodiment 2.

[0095] As illustrated in Figs. 12 and 13, the refrigerant that has flowed out from the passages 21 A of the first plate-shaped member 21 and has passed through the first heat transfer tubes 3 flows into the passages 21C of the first plate-shaped member 21, is returned, and flows into the second heat transfer tubes 6. The refrigerant that has passed through the second heat transfer tubes 6 flows into the passages 21 B of the first plate-shaped member 21. The refrigerant that has flowed in the passages 21 B of the first plate-shaped member 21 flows into passages 23B provided in third plate-shaped members 23 so as to be mixed. The mixed refrigerant passes through the passage 22B of the second plate-shaped member 22, and flows out to the refrigerant pipe.

[Use Mode of Heat Exchanger]

[0096] An example of a use mode of the heat exchanger according to Embodiment 2 will be described below.

[0097] Fig. 14 illustrates the configuration of an air-conditioning apparatus to which the heat exchanger of Embodiment 2 is applied.

[0098] As illustrated in Fig. 14, the heat exchanger 1 is used in at least one of a heat-source-side heat exchanger 54 and a load-side heat exchanger 56. The heat exchanger 1 is connected so that refrigerant flows from a distribution flow passage 12B of the stacking-type header 2 into the first heat transfer tubes 3 and the refrigerant flows from the second heat transfer tubes 6 into a joining flow passage 12C of the stacking-type header 2 when the heat exchanger 1 operates as an evaporator. That is, when the heat exchanger 1 operates as the evaporator, a two-phase gas-liquid refrigerant flows from the refrigerant pipe into the distribution flow passage 12B of the stacking-type header 2 and a gaseous refrigerant flows from the second heat transfer tubes 6 into the joining flow passage 12C of the stacking-type header 2. Further, when the robot system 1 operates as a condenser, a gaseous refrigerant flows from the refrigerant pipe into the joining flow passage 12C of the stacking-type header 2 and a liquid refrigerant flows from the first heat transfer tubes 3 into the distribution flow passage 12B of the stacking-type header 2.

[0099] Further, the heat exchanger 1 is disposed so that the first heat transfer tubes 3 are located on the upstream side (windward side) of the second heat transfer tubes 6 in an airflow produced by a heat-source-side fan 57 or a load-side fan 58. That is, the flow of the refrigerant from the second heat transfer tubes 6 to the first heat transfer tubes 3 is opposed to the airflow. The temperature of the refrigerant in the first heat transfer tubes 3 is lower than the temperature of the refrigerant in the second heat transfer tubes 6. The temperature of the airflow produced by the heat-source-side fan 57 or the load-side fan 58 is lower on the upstream side of the heat exchanger 1 than on the downstream side of the heat exchanger 1. As a result, in particular, the refrigerant can be subcooled (subjected to so-called SC) by the low-temperature airflow flowing on the upstream side of the heat exchanger 1, and this enhances condenser performance. The heat-source-side fan 57 and the load-side fan 58 may be provided on the windward side or the leeward side.

[Operation of Heat Exchanger]

[0100] The operation of the heat exchanger according to Embodiment 2 will be described below.

[0101] In the heat exchanger 1, the plural return passages 11C are provided in the first plate-shaped unit 11, and the plural second heat transfer tubes 6 are connected in addition to the plural first heat transfer tubes 3. For example, while the heat exchange amount can be increased by increasing the area of the heat exchanger 1 when viewed from the front side, a housing that contains the heat exchanger 1 is increased in size in this case. Further, while the heat exchange amount can be increased by reducing the interval of the fins 5 to increase the number of fins 5, it is difficult to set the interval of the fins 5 less than about 1 mm from the viewpoints of drainage performance, frosting performance, and dust resistance, and the increase in heat exchange amount sometimes becomes insufficient. In contrast, when the number of rows of the heat transfer tubes is increased as in the heat exchanger 1, the heat exchange amount can be increased without changing, for example, the area of the heat exchanger 1 when viewed from the front side and the interval of the fins 5. When the number of rows of the heat transfer tubes becomes two, the heat exchange amount increases by a factor of about 1.5 or more. The number of rows of the heat transfer tubes may be three or more. Further, for example, the area of the heat exchanger 1 when viewed from the front side, and the interval of the fins 5 may be changed.

[0102] The header (stacking-type header 2) is provided on only one side of the heat exchanger 1. For example, when the heat exchanger 1 is disposed while being bent along a plurality of side surfaces of the housing containing the heat exchanger 1 in order to increase the mount volume of the heat exchange section, the end portions are not aligned among the rows of heat transfer tubes owing to the differences in curvature radius of the bent portions among the rows of heat transfer tubes. When the header (stacking-type header 2) is provided on only one side of the heat exchanger 1, as in the stacking-type header 2, even if the end portions are not aligned among the rows of heat transfer tubes, it is only necessary that the end portions should be aligned on only one side. This improves the flexibility in design and production efficiency. In particular, the heat exchanger 1 can be bent after the members of the heat exchanger 1 are joined, and this further enhances the production efficiency.

[0103] When the heat exchanger 1 operates as the condenser, the first heat transfer tubes 3 are located on the windward side of the second heat transfer tubes 6. When a header is provided on each side of the heat exchanger, it is difficult to enhance the condenser performance by making differences in refrigerant temperature among the rows of heat transfer tubes. Particularly when the first heat transfer tubes 3 and the second heat transfer tubes 6 are flat tubes, the flexibility in bending is low, unlike circular tubes. Hence, it is difficult to make the differences in temperature of the refrigerant among the rows of heat transfer tubes by deforming the passages of the refrigerant. In contrast, when the first heat transfer tubes 3 and the second heat transfer tubes 6 are connected to the stacking-type header 2 as in the heat exchanger 1, the differences in temperature of the refrigerant are necessarily made among the rows of heat transfer tubes. Thus, the opposed relationship between the flow of the refrigerant and the airflow can be easily achieved without deforming the passages of the refrigerant.

[0104] While Embodiment 1 and Embodiment 2 have been described above, the present invention is not limited to the descriptions of Embodiments. For example, the entirety or a part of each Embodiment, Modifications, and so on can be combined.

Reference Signs List

[0105] 1: heat exchanger, 2: stacking-type header, 2A: refrigerant inflow part, 2B: refrigerant outflow part, 2C: refrigerant inflow part, 2D: refrigerant outflow part, 2E: refrigerant return part, 3: first heat transfer tube, 4: holding member, 5: fin, 6: second heat transfer tube, 11: first plate-shaped unit, 11 A: first outlet flow passage, 11 B: first inlet flow passage, 11C: return passage, 12: second plate-shaped unit, 12A: second inlet flow passage, 12B: distribution flow passage, 12C: joining flow passage, 12D: second outlet flow passage, 12b: branch passage, 12c: mixing passage, 21: first plate-shaped member, 21A to 21C: passage, 22: second plate-shaped member, 22A, 22B: passage, 23, 23_1 to 23_3: third plate-shaped member, 23A, 23B, 23A_1 to 23A_3, 23B_1 to 23B_3: passage, 23a, 23b: end portion, 23c: straight portion, 23d: opening, 23e: through hole, 24, 24_1 to 24_5: double-sided clad material, 24A to 24C: passage, 51: air-conditioning apparatus, 52: compressor, 53: four-way valve, 54: heat-source-side heat exchanger, 55: expansion device, 56: load-side heat exchanger, 57: heat-source-side fan, 58: load-side fan, 59: controller.

Claims

1. A stacking-type header comprising:

a first plate-shaped unit having a plurality of first outlet flow passages and a plurality of first inlet flow passages; and
a second plate-shaped unit stacked on the first plate-shaped unit and having at least a part of a distribution flow passage configured to distribute refrigerant, which passes through a second inlet flow passage to flow into the second plate-shaped unit, to the plurality of first outlet flow passages, the second plate-shaped unit having at least a part of a joining flow passage, the joining flow passage causing refrigerant entering from each of the first inlet flow passages to join and enter a second outlet passage,
wherein a passage area of one first inlet flow passage of the plurality of first inlet flow passages is larger than a passage area of one first outlet flow passage of the plurality of first outlet flow passages communicating with the one first inlet flow passage.

2. The stacking-type header of claim 1, wherein a passage area of a flow passage of the joining flow passage through which the refrigerant passes after joining is larger than a passage area of the plurality of first outlet flow passages.

3. The stacking-type header of claim 1 or 2, wherein a passage area of the second outlet flow passage is larger than a passage area of the second inlet flow passage.

4. The stacking-type header of any one of claims 1 to 3, wherein the first plate-shaped unit has a plurality of turn-back flow passages formed therein, the plurality of turn-back flow passages being configured to turn back the refrigerant flowing into the first plate-shaped unit to cause the refrigerant to flow out from the first plate-shaped unit.

5. A heat exchanger comprising:

the stacking-type header of any one of claims 1 to 3; and
a plurality of first heat transfer tubes each being connected to the plurality of first outlet flow passages and the plurality of first inlet flow passages.

6. A heat exchanger comprising:

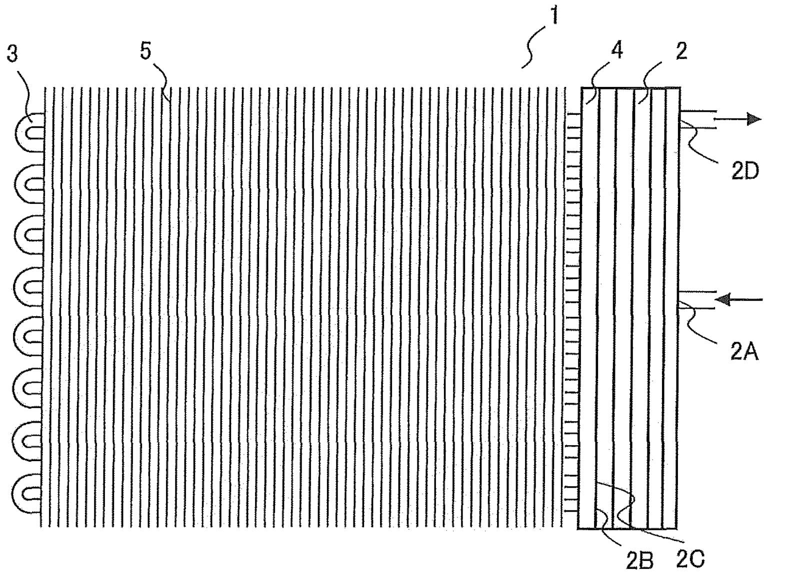
the stacking-type header of claim 4;
a plurality of first heat transfer tubes each connected to the plurality of first outlet flow passages and an inlet side of the plurality of turn-back flow passages; and
a plurality of second heat transfer tubes each connected to an outlet side of a corresponding one of the turn-back flow passages and a corresponding one of the first inlet flow passages.

7. The heat exchanger of claim 5 or 6, wherein the plurality of heat transfer tubes each comprise a flat tube.

8. An air-conditioning apparatus comprising the heat exchanger of any one of claims 5 to 7,
wherein the distribution flow passage is configured to cause the refrigerant to flow out from the distribution flow passage toward the plurality of first outlet flow passages when the heat exchanger acts as an evaporator.

9. An air-conditioning apparatus comprising the heat exchanger of claim 6,
wherein the distribution flow passage is configured to cause the refrigerant to flow out from the distribution flow passage toward the plurality of first outlet flow passages when the heat exchanger acts as an evaporator, and
wherein the plurality of first heat transfer tubes are positioned on a windward side with respect to the plurality of second heat transfer tubes when the heat exchanger acts as a condenser.

FIG. 1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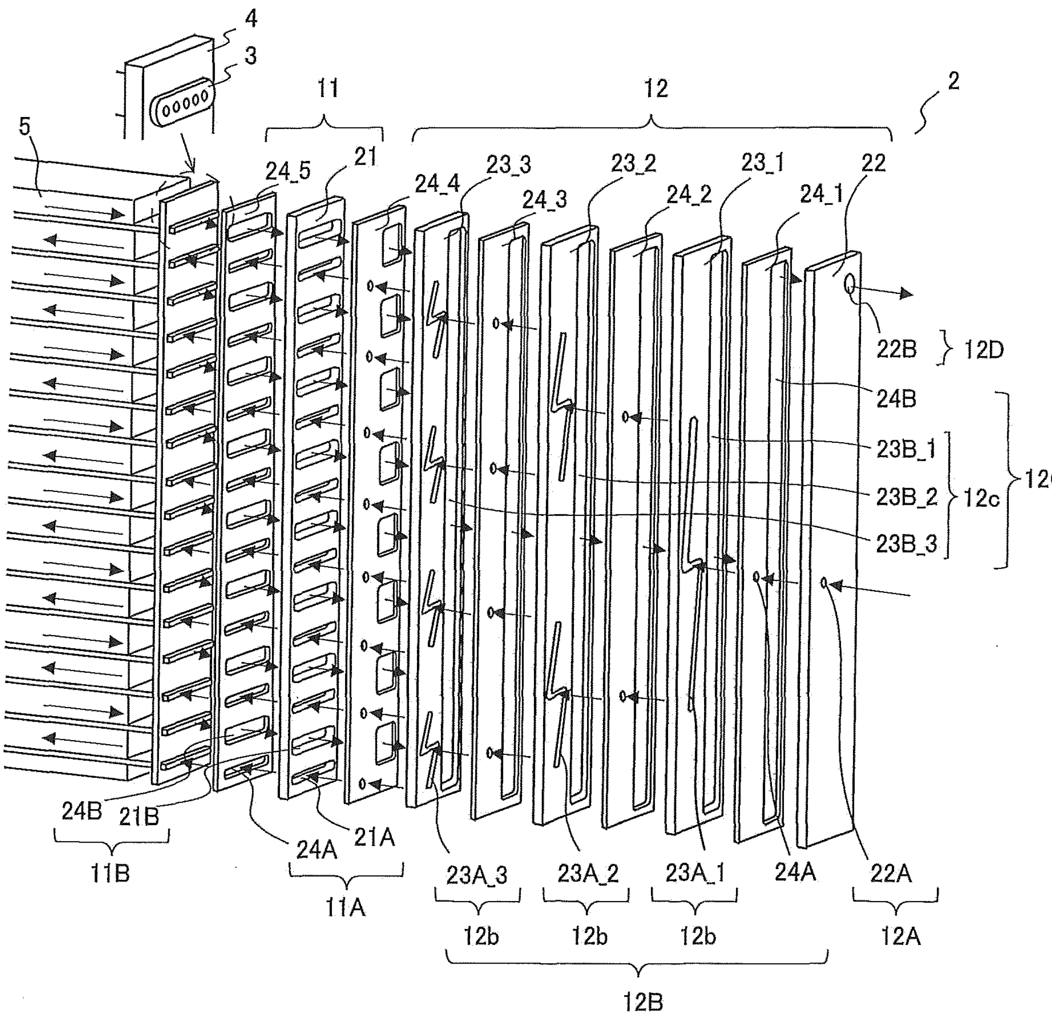
2B
2C

FIG. 2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21A
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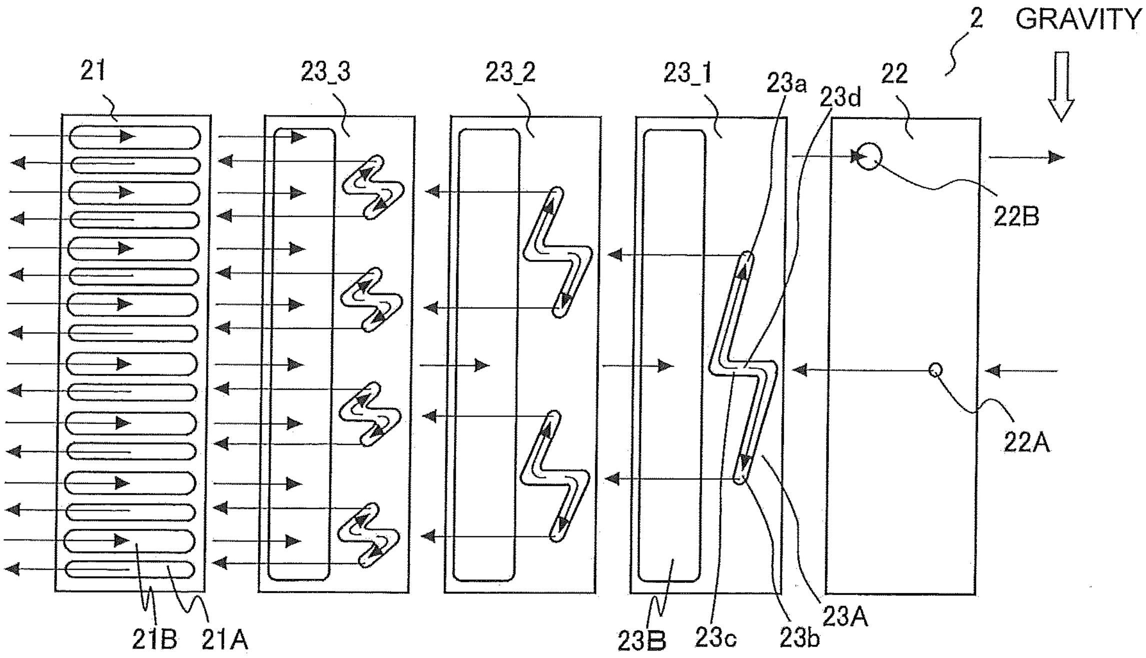
12B

F I G. 3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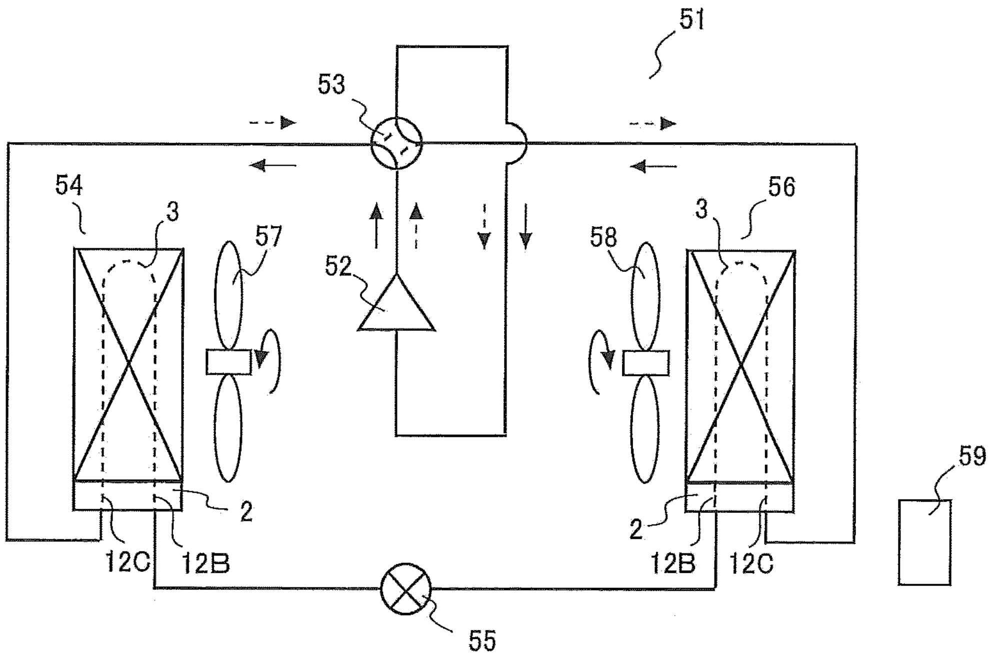
23b

F I G. 4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12C
12B
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12C
59
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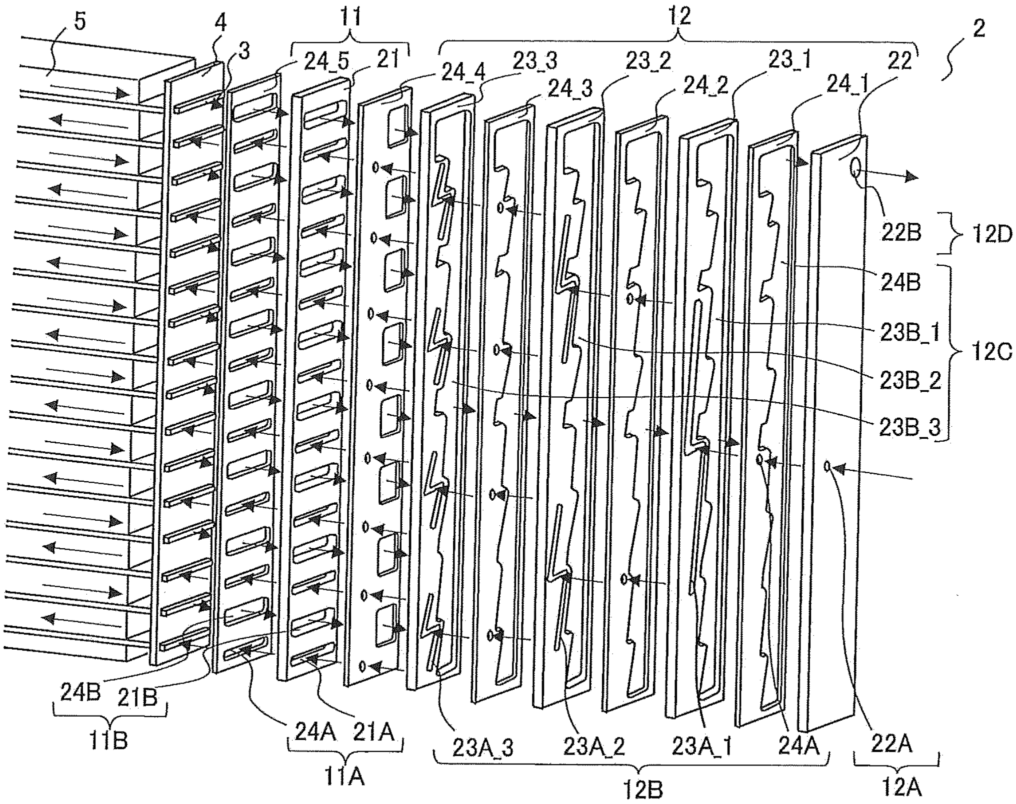
FIG. 5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23B_2
23B_3
12C
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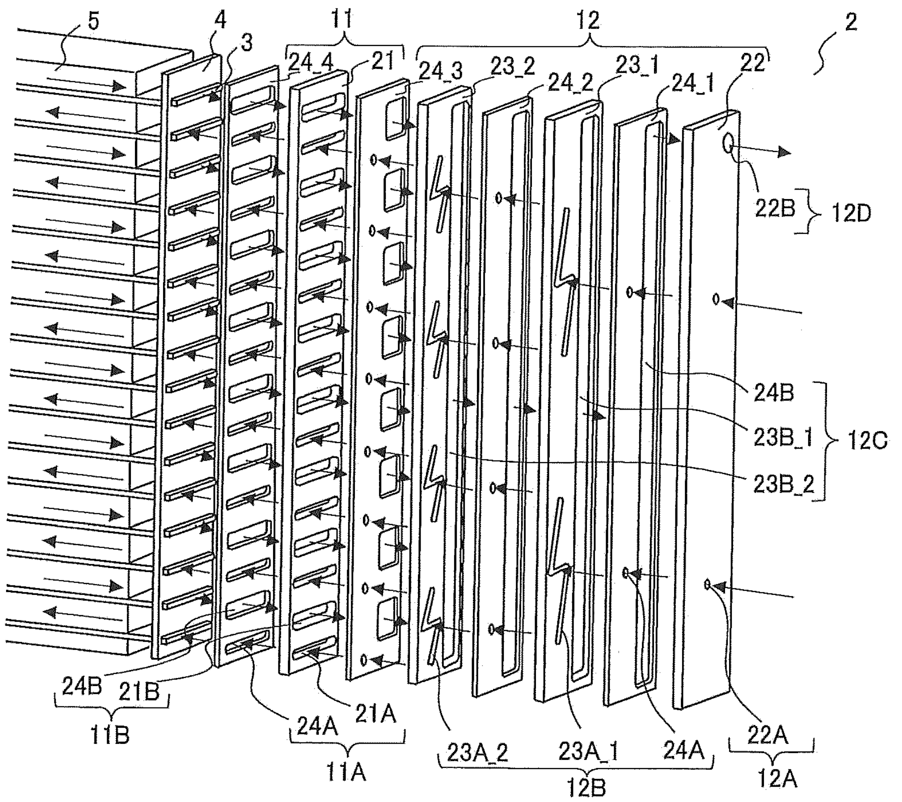
FIG. 6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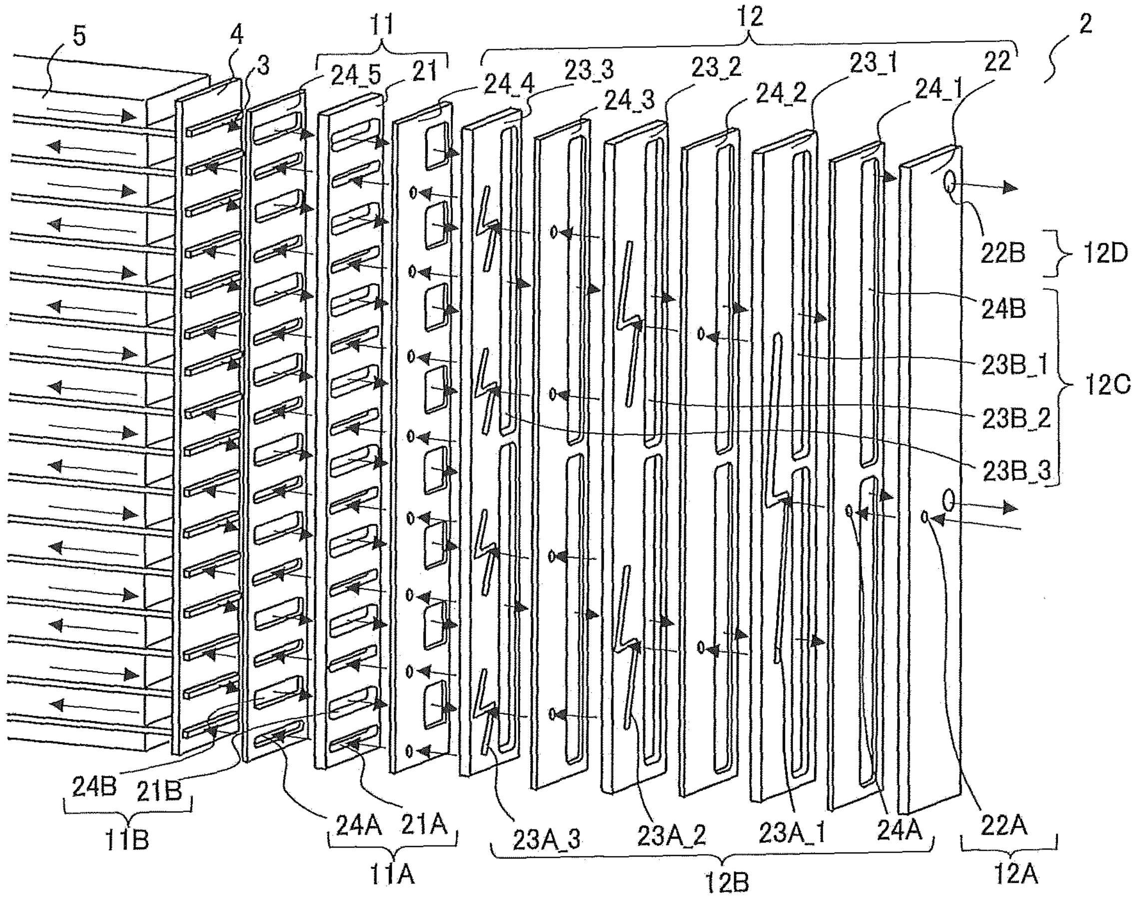
22A
12B
12A

FIG. 7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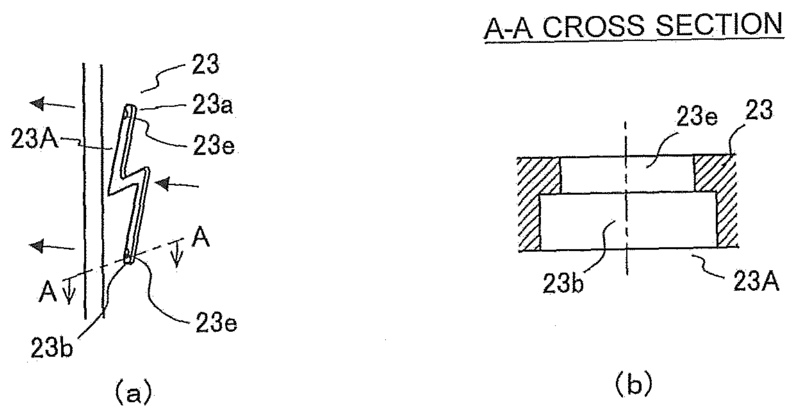
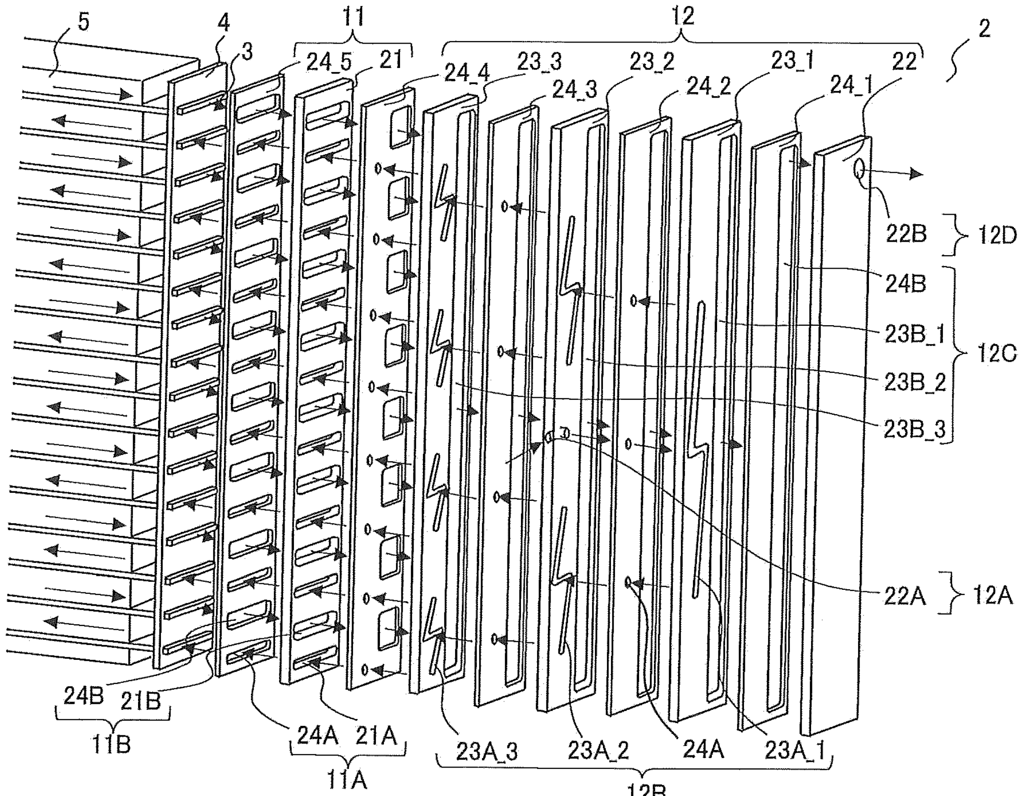
22B
12D
24B
23B_1
12C
23B_2
23B_3
24B
21B
11B
24A
21A
11A
23A_3
23A_2
23A_1
24A
22A
12B
12A

FIG. 8


23
23a
23A
23e
A
A
23e
23b
(a)
A-A CROSS SECTION
23e
23
23b
23A
(b)

F I G. 9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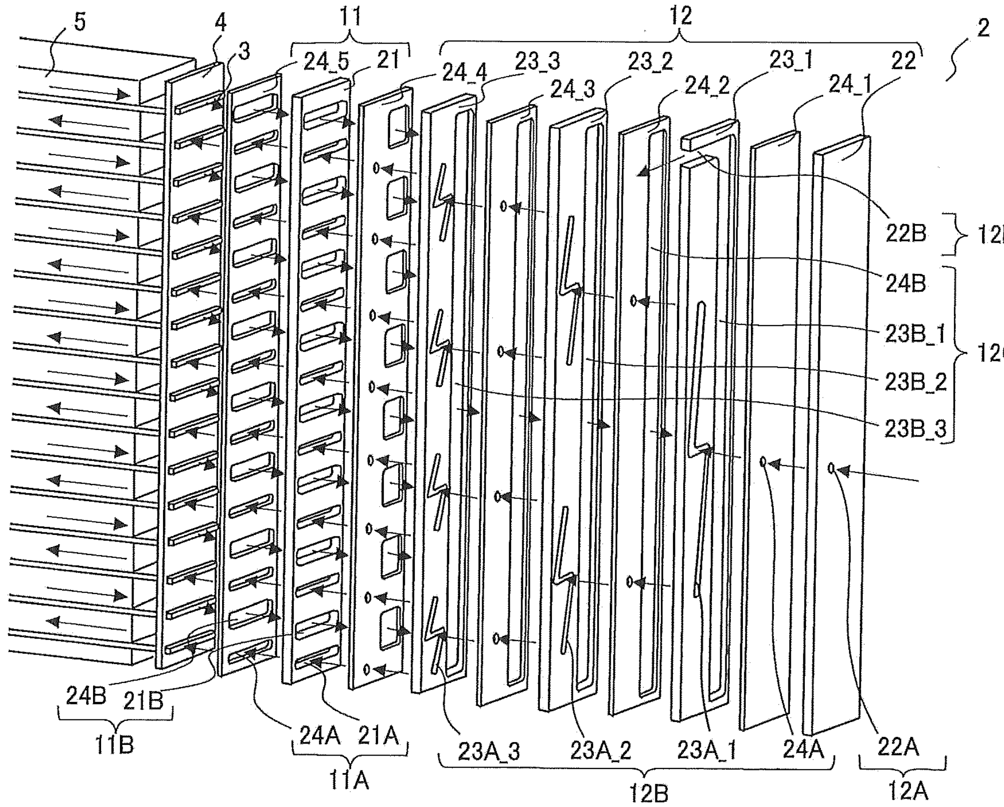
24_5
21
12
24_4
23_3
24_3
23_2
24_2
23_1
24_1
22
2
22B
12D
24B
23B_1
23B_2
23B_3
12C
22A
12A
24B
21B
11B
24A
21A
11A
23A_3
23A_2
24A
23A_1
12B

F I G. 1 0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11
24_5
21
12
24_4
23_3
24_3
23_2
24_2
23_1
24_1
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22B
12D
24B
23B_1
23B_2
23B_3
12C
24B
21B
11B
24A
21A
11A
23A_3
23A_2
23A_1
24A
12B
22A
12A

FIG. 11

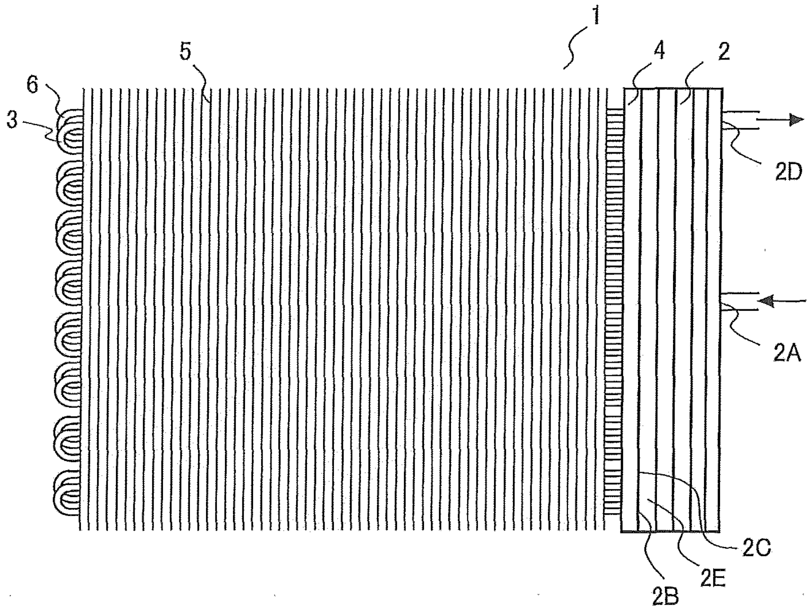
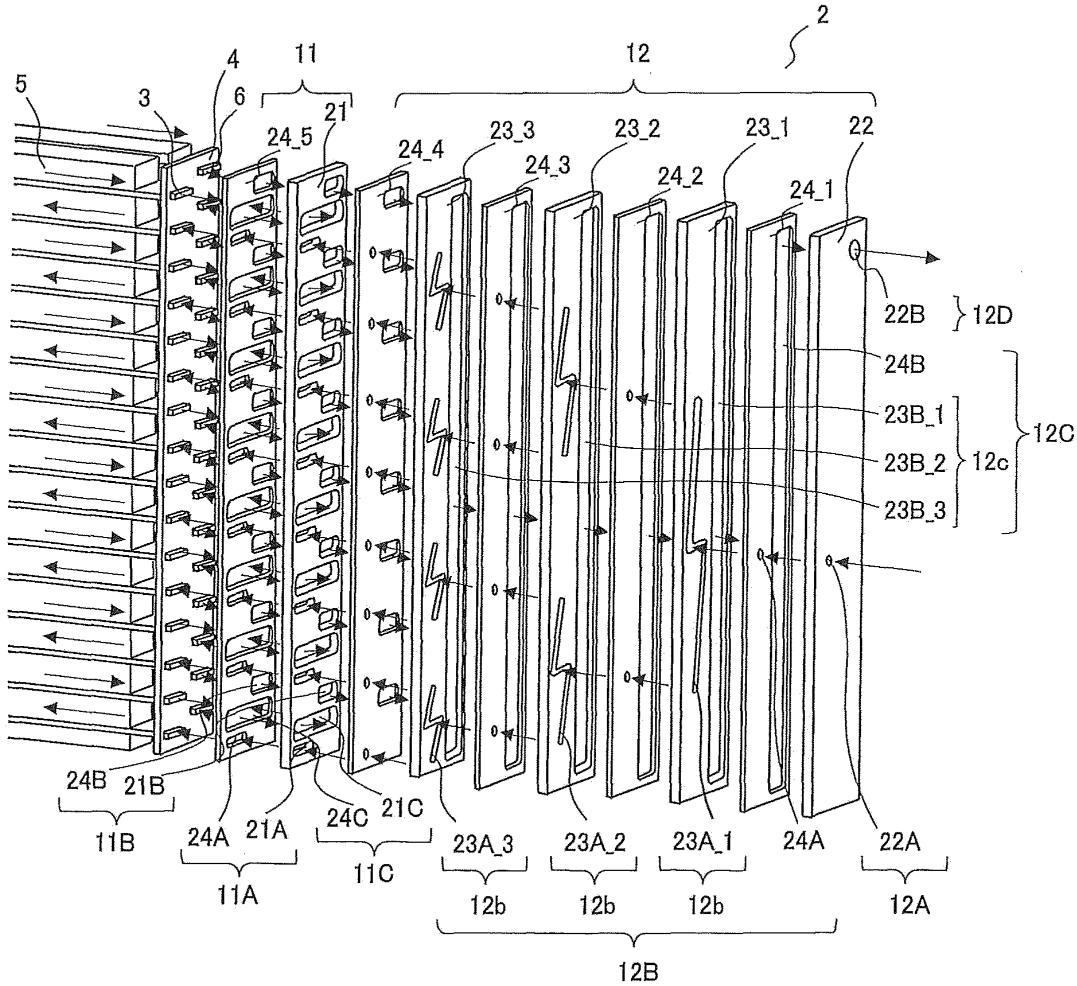

1
5
4
2
6
3
2D
2A
2C
2E
2B

FIG. 12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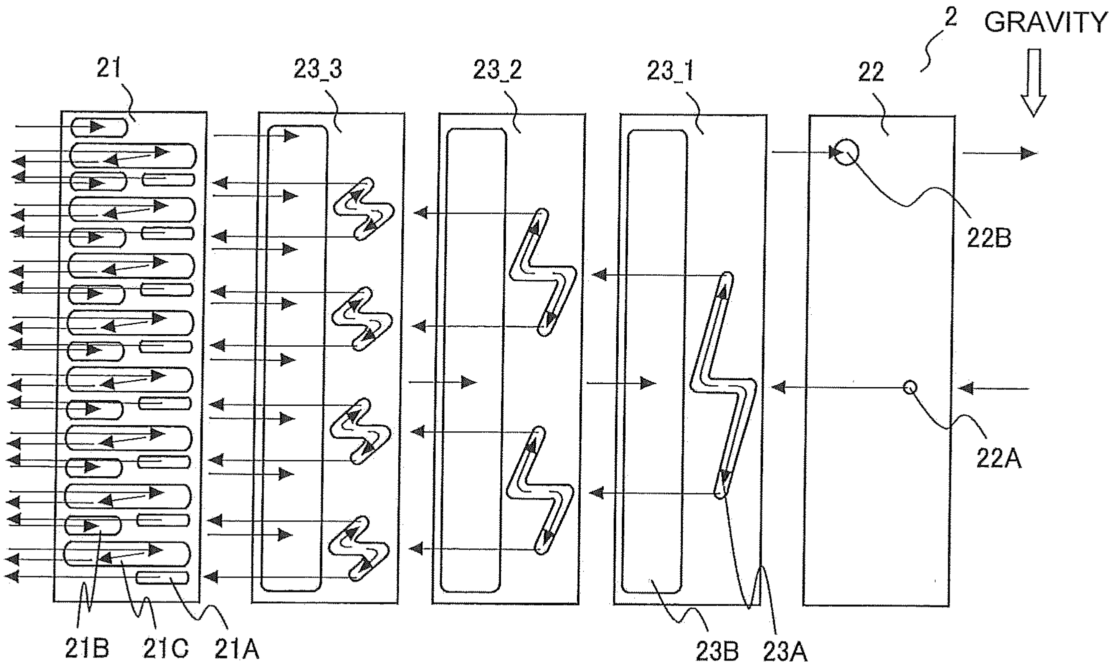
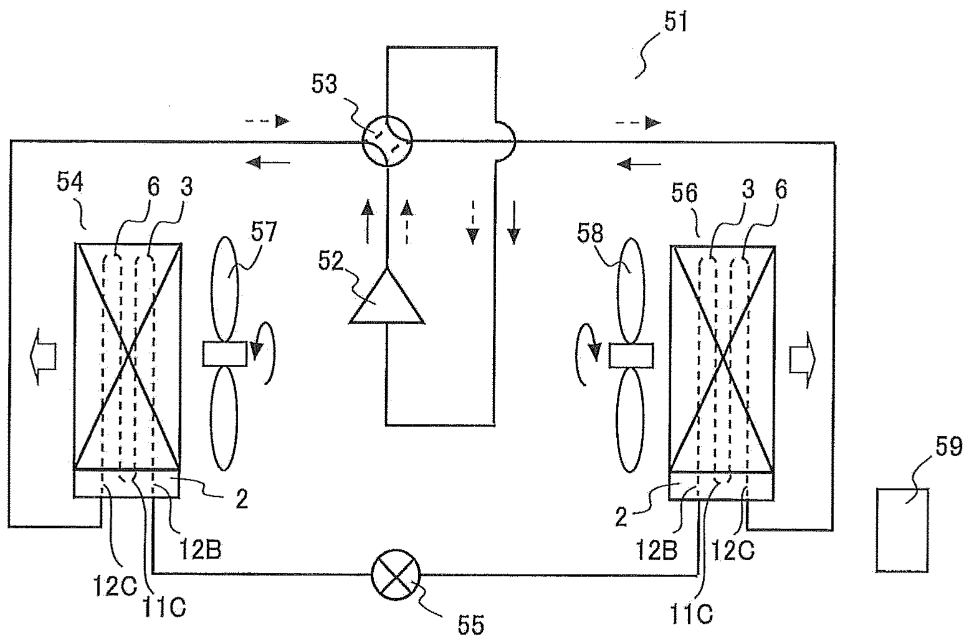
12
11
4
5
3
6
21
24_5
24_4
23_3
23_2
23_1
22
24_3
24_2
24_1
22B
12D
24B
23B_1
23B_2
23B_3
12c
12C
24B
21B
24A
21A
24C
21C
23A_3
23A_2
23A_1
24A
22A
11B
11A
11C
12b
12b
12b
12A
12B

F I G. 1 3


2
GRAVITY
21
23_3
23_2
23_1
22
22B
22A
21B
21C
21A
23B
23A

F I G. 1 4


51
53
54
6
3
57
52
56
3
6
58
2
12B
12C
11C
55
2
12B
12C
11C
59

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/063611

A. CLASSIFICATION OF SUBJECT MATTER
F28F9/02(2006.01)i

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)
F28F9/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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.
A	JP 6-11291 A (Nartron Corp.), 21 January 1994 (21.01.1994), fig. 1 to 9 & US 5242016 A	1-9
A	JP 2007-298197 A (Showa Denko Kabushiki Kaisha), 15 November 2007 (15.11.2007), fig. 1 to 7 & US 2007/0251682 A1	1-9

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 July, 2013 (11.07.13)	23 July, 2013 (23.07.13)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

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Patent documents cited in the description

- JP 2000161818 A **[0003]**