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(72) Inventors:
• **YATSUYANAGI, Akira**
Tokyo 1008310 (JP)
• **MAEDA, Tsuyoshi**
Tokyo 1008310 (JP)
• **ITO, Daisuke**
Tokyo 1008310 (JP)

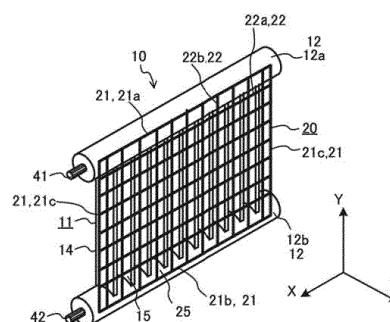
(71) Applicant: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Joachimsthaler Straße 10-12
10719 Berlin (DE)

(54) **HEAT EXCHANGER AND REFRIGERATION CYCLE APPARATUS**

(57) A heat exchanger and a refrigeration cycle apparatus are provided in each of which buckling of flat tubes in a tube-axis direction is prevented while ease of drainage and ease of air passage are maintained. The heat exchanger includes a plurality of heat transfer parts arranged in a first direction and spaced apart from each other, the plurality of heat transfer parts extending in a second direction and allowing refrigerant to flow through inside the plurality of heat transfer parts; a first header extending in the first direction and connected to one end of each of the plurality of heat transfer parts; a second header extending in the first direction and connected to an other end of each of the plurality of heat transfer parts; and a support extending along the first direction and the second direction and having an opening, the support being located at at least one face of the plurality of heat transfer parts in a third direction that is perpendicular to the first direction and the second direction, the support being fixed to the first header and the second header.

FIG. 2



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Description

Technical Field

[0001] The present disclosure relates to a heat exchanger and a refrigeration cycle apparatus including the heat exchanger, particularly to a configuration in which the buckling of heat transfer parts is prevented.

Background Art

[0002] In recent years, to provide refrigeration cycle apparatuses with higher performance and lighter weight, the introduction of aluminum flat tubes as heat transfer tubes intended for heat exchangers of refrigeration and air-conditioning apparatuses has been facilitated in place of some copper round tubes. Furthermore, in recent years, the importance of reducing the use of refrigerants having high global warming potentials has required the development of high-performance heat exchangers employing flat tubes having a much smaller inside capacity than the inside capacity of aluminum flat tubes employed in known heat exchangers.

[0003] In a proposed heat exchanger, for example, for the purpose of making the inside capacity of flat tubes much smaller than the inside capacity of aluminum flat tubes of other known heat exchangers, the minor-axis length of a plurality of flat tubes arranged parallel to each other in the axial direction of header pipes is set to, for example, smaller than 1 mm (see Patent Literature 1, for example). Herein, the minor-axis length refers to the length of the shortest diameter in a right-angled cross section of the flat tube. The heat exchanger disclosed by Patent Literature 1 includes assisting parts each provided between adjacent ones of the flat tubes. The assisting parts each extend in the direction of arrangement of refrigerant passages, thereby retaining the interval between adjacent ones of the flat tubes.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2018-162953

Summary of Invention

Technical Problem

[0005] In the heat exchanger disclosed by Patent Literature 1, however, it is difficult for only a single support to prevent the buckling of the flat tubes in the tube-axis direction. Accordingly, the heat exchanger includes a plurality of supports and is thus capable of preventing the buckling of the flat tubes in the tube-axis direction. Nevertheless, such a heat exchanger that includes a plurality of supports has a problem in that the ease of drainage

of condensed water and the ease of air passage tend to be reduced.

[0006] The present disclosure is to solve the above problem and to provide a heat exchanger and a refrigeration cycle apparatus in each of which the buckling of flat tubes in the tube-axis direction is prevented while the ease of drainage and the ease of air passage are maintained.

Solution to Problem

[0007] A heat exchanger according to an embodiment of the present disclosure includes a plurality of heat transfer parts arranged in a first direction and spaced apart from each other, the plurality of heat transfer parts extending in a second direction and allowing refrigerant to flow through inside the plurality of heat transfer parts; a first header extending in the first direction and connected to one end of each of the plurality of heat transfer parts; a second header extending in the first direction and connected to an other end of each of the plurality of heat transfer parts; and a support extending along the first direction and the second direction and having an opening, the support being located at at least one face of the plurality of heat transfer parts in a third direction that is perpendicular to the first direction and the second direction, the support being fixed to the first header and the second header.

[0008] A refrigeration cycle apparatus according to another embodiment of the present disclosure includes the heat exchanger according to an embodiment of the present disclosure.

Advantageous Effects of Invention

[0009] According to an embodiment of the present disclosure, the heat exchanger includes the support located along the first direction, in which the plurality of heat transfer parts are arranged in parallel to each other, and along the second direction, in which the plurality of heat transfer parts extend, and the support is fixed to the first header and the second header. Thus, the support retains the interval between the first header and the second header in the tube-axis direction of the plurality of heat transfer parts, that is, in the second direction. Such a configuration prevents deformation due to buckling of the plurality of heat transfer parts in the axial direction.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a refrigerant circuit diagram of a refrigeration cycle apparatus 100, including a heat exchanger 10, according to Embodiment 1.

[Fig. 2] Fig. 2 is a perspective view of the heat exchanger 10 according to Embodiment 1.

[Fig. 3] Fig. 3 is a side view of the heat exchanger

10 according to Embodiment 1.

[Fig. 4] Fig. 4 illustrates a modification of a fixing part of the heat exchanger 10 according to Embodiment 1, where a support 20 is fixed to a header 12.

[Fig. 5] Fig. 5 is a perspective view of a heat exchanger 10a, which is a modification of the heat exchanger 10 according to Embodiment 1.

[Fig. 6] Fig. 6 is a side view of the heat exchanger 10a, which is a modification of the heat exchanger 10 according to Embodiment 2.

[Fig. 7] Fig. 7 is a perspective view of a heat exchanger 10b, which is a modification of the heat exchanger 10 according to Embodiment 1.

[Fig. 8] Fig. 8 is a front view of a support 20b, which is included in the heat exchanger 10b illustrated in Fig. 7.

[Fig. 9] Fig. 9 is a perspective view of a heat exchanger 210 according to Embodiment 2.

[Fig. 10] Fig. 10 is a top view of the heat exchanger 210 according to Embodiment 2.

[Fig. 11] Fig. 11 is a perspective view of a heat exchanger 310 according to Embodiment 3.

[Fig. 12] Fig. 12 is a top view of the heat exchanger 310 according to Embodiment 3.

[Fig. 13] Fig. 13 is a perspective view of a heat exchanger 410 according to Embodiment 4.

[Fig. 14] Fig. 14 is a side view of the heat exchanger 410 according to Embodiment 4.

[Fig. 15] Fig. 15 is a perspective view of a heat exchanger 510 according to Embodiment 5.

[Fig. 16] Fig. 16 is a top view of the heat exchanger 510 according to Embodiment 5.

[Fig. 17] Fig. 17 is a side view of the heat exchanger 510 according to Embodiment 5.

Description of Embodiments

[0011] A heat exchanger and a refrigeration cycle apparatus according to Embodiment 1 will be described below with reference to the drawings and relevant materials. In the drawings, including Fig. 1, to be referred to below, factors such as relative sizes and shapes of individual elements may be different from those of actual elements. In the drawings to be referred to below, the same reference signs denote the same or equivalent elements and are consistent throughout this specification. For easy understanding, terms indicating directions (such as "upper", "lower", "right", "left", "front", and "rear") will be used according to need. Such terms, however, are only for convenience of description and do not limit the arrangements or orientations of the apparatus and individual elements. Herein, the positional relationship between relevant elements, the directions in which relevant elements extend, and the direction in which relevant elements are arranged are those in a state where the heat exchanger is installed for use.

Embodiment 1

(Refrigeration Cycle Apparatus 100)

[0012] Fig. 1 is a refrigerant circuit diagram of a refrigeration cycle apparatus 100, including a heat exchanger 10, according to Embodiment 1. In Fig. 1, dotted-line arrows represent the direction in which refrigerant in a refrigerant circuit 110 flows in a cooling operation, and solid-line arrows represent the direction in which the refrigerant flows in a heating operation. First, with reference to Fig. 1, the refrigeration cycle apparatus 100 including the heat exchanger 10 will be described. Embodiment 1 relates to a case where the refrigeration cycle apparatus 100 serves as an air-conditioning apparatus. The refrigeration cycle apparatus 100 is also applicable to apparatuses intended for refrigeration uses or air-conditioning uses such as a refrigerator, a freezer, a vending machine, an air-conditioning apparatus, a freezing apparatus, and a water heater. The refrigerant circuit 110 illustrated in Fig. 1 is only exemplary. The configuration and other relevant factors of circuit elements are not limited to those to be described in the following embodiments and may be changed according to need within the technical scope of the embodiments.

[0013] The refrigeration cycle apparatus 100 includes a compressor 101, a passage switcher 102, an indoor heat exchanger 103, a decompressor 104, and an outdoor heat exchanger 105, which are all connected to each other by refrigerant pipes to form a loop serving as the refrigerant circuit 110. At least one of the outdoor heat exchanger 105 and the indoor heat exchanger 103 includes the heat exchanger 10 to be described below. The refrigeration cycle apparatus 100 includes an outdoor unit 106 and an indoor unit 107. The outdoor unit 106 includes the compressor 101, the passage switcher 102, the outdoor heat exchanger 105, the decompressor 104, and an outdoor fan 108. The outdoor fan 108 supplies outdoor air to the outdoor heat exchanger 105. The indoor unit 107 includes the indoor heat exchanger 103 and an indoor fan 109. The indoor fan 109 supplies air to the indoor heat exchanger 103. The outdoor unit 106 and the indoor unit 107 are connected to each other by an extension pipe 111 and an extension pipe 112, which are two of the refrigerant pipes.

[0014] The compressor 101 is a fluid machine that compresses refrigerant sucked into the compressor 101 and discharges the compressed refrigerant. The passage switcher 102 is, for example, a four-way valve and is configured to establish a refrigerant passage that is switched between one for the cooling operation and one for the heating operation under the control of a controller (not illustrated).

[0015] The indoor heat exchanger 103 causes the refrigerant flowing inside the indoor heat exchanger 103 and the indoor air supplied by the indoor fan 109 to exchange their heat. The indoor heat exchanger 103 serves as a condenser in the heating operation and as an evap-

orator in the cooling operation.

[0016] The decompressor 104 is, for example, an expansion valve and decompresses the refrigerant. The decompressor 104 may be an electronic expansion valve whose opening degree is regulated under the control of the controller.

[0017] The outdoor heat exchanger 105 causes the refrigerant flowing inside the outdoor heat exchanger 105 and the air supplied by the outdoor fan 108 to exchange their heat. The outdoor heat exchanger 105 serves as an evaporator in the heating operation and as a condenser in the cooling operation.

(Operation of Refrigeration Cycle Apparatus 100)

[0018] An exemplary operation of the refrigeration cycle apparatus 100 will be described below with reference to Fig. 1. In the heating operation of the refrigeration cycle apparatus 100, the refrigerant is discharged from the compressor 101 in the form of gas having a high pressure and a high temperature and flows through the passage switcher 102 into the indoor heat exchanger 103, where the refrigerant exchanges heat with the air supplied by the indoor fan 109 and thus condenses. The refrigerant having condensed takes the form of liquid having a high pressure and is discharged from the indoor heat exchanger 103 into the decompressor 104, where the refrigerant turns into two-phase gas-liquid refrigerant having a low pressure. The two-phase gas-liquid refrigerant having a low pressure flows into the outdoor heat exchanger 105, where the refrigerant exchanges heat with the air supplied by the outdoor fan 108 and thus evaporates. The refrigerant having evaporated takes the form of gas having a low pressure and is sucked into the compressor 101.

[0019] In the cooling operation of the refrigeration cycle apparatus 100, the refrigerant flows through the refrigerant circuit 110 in a direction opposite to the direction in the heating operation. Specifically, in the cooling operation of the refrigeration cycle apparatus 100, the refrigerant is discharged from the compressor 101 in the form of gas having a high pressure and a high temperature and flows through the passage switcher 102 into the outdoor heat exchanger 105, where the refrigerant exchanges heat with the air supplied by the outdoor fan 108 and thus condenses. The refrigerant having condensed takes the form of liquid having a high pressure and is discharged from the outdoor heat exchanger 105 into the decompressor 104, where the refrigerant turns into two-phase gas-liquid refrigerant having a low pressure. The two-phase gas-liquid refrigerant having a low pressure flows into the indoor heat exchanger 103, where the refrigerant exchanges heat with the air supplied by the indoor fan 109 and thus evaporates. The refrigerant having evaporated takes the form of gas having a low pressure and is sucked into the compressor 101.

(Heat Exchanger 10)

[0020] Fig. 2 is a perspective view of the heat exchanger 10 according to Embodiment 1. Fig. 3 is a side view of the heat exchanger 10 according to Embodiment 1. With reference to Figs. 2 and 3, the heat exchanger 10 according to Embodiment 1 will be described below.

[0021] As illustrated in Fig. 2, the heat exchanger 10 includes a plurality of heat transfer parts 11, a first header 12a, a second header 12b, and a support 20. The first header 12a and the second header 12b are connected to respective end portions of each of the plurality of heat transfer parts 11. The support 20 is fixed to the first header 12a and the second header 12b. The plurality of heat transfer parts 11 are arranged side by side in the X-direction. The plurality of heat transfer parts 11 are each oriented such that its tube axis extends in the Y-direction. In Embodiment 1, the Y-direction is parallel to the direction of gravity. The orientation of the heat exchanger 10 is not limited to the above. The heat exchanger 10 may be oriented with the Y-direction that is made to extend diagonally to the direction of gravity. The plurality of heat transfer parts 11 are regularly spaced apart from each other at an interval w_1 in the X-direction.

[0022] The first header 12a is connected to one end portion, in a tube-axis direction, of each of the plurality of heat transfer parts 11. The second header 12b is connected to the other end portion, in the tube-axis direction, of each of the plurality of heat transfer parts 11. The first header 12a and the second header 12b are each oriented with their longitudinal direction coinciding with the direction in which the plurality of heat transfer parts 11 are arranged in parallel to each other. The longitudinal direction of the first header 12a and the longitudinal direction of the second header 12b are parallel to each other. Hereinafter, the first header 12a and the second header 12b are also collectively denoted as the headers 12.

[0023] The plurality of heat transfer parts 11 each have the opposite end portions fitted in the respective headers 12 and joined to the headers 12 by joining means such as brazing. The plurality of heat transfer parts 11 are arranged in parallel to each other in the X-direction. The plurality of heat transfer parts 11 each include a heat transfer portion 14, which is a portion excluding the opposite end portions and is located between the lower surface of the first header 12a and the upper surface of the second header 12b.

[0024] The support 20 extends parallel to the X-direction and the Y-direction and is located at the plurality of heat transfer parts 11 in the Z-direction. Air flows through the heat exchanger 10 in the Z-direction. The plurality of heat transfer parts 11 and the support 20 are arranged in series in the direction in which air flows into the heat exchanger 10. In Embodiment 1, the support 20 covers one face of the plurality of heat transfer parts 11 in the Z-direction. Herein, the X-direction in which the plurality of heat transfer parts 11 are arranged in parallel to each other is also referred to as the first direction, the Y-direction

tion coinciding with the tube-axis direction of the plurality of heat transfer parts 11 is also referred to as the second direction, and the Z-direction perpendicular to the X-direction and the Y-direction is also referred to as the third direction.

(Heat Transfer Parts 11)

[0025] The plurality of heat transfer parts 11 each allow the refrigerant to flow through inside the heat transfer part 11. The plurality of heat transfer parts 11 each extend between the first header 12a and the second header 12b. The plurality of heat transfer parts 11 are spaced apart from each other at an interval w_1 in the X-direction and are arranged in parallel to each other in the direction in which the headers 12 extend. The plurality of heat transfer parts 11 each have an oblong or elliptical sectional shape or a rectangular sectional shape, and the major axis of the section extends in the Z-direction. The plurality of heat transfer parts 11 each have lateral faces 15, each of which extends along the major axis of the section and faces a corresponding one of the lateral faces 15 of an adjacent heat transfer part 11. Between the lateral faces 15 of each adjacent two of the plurality of heat transfer parts 11 that are located face to face is provided a gap serving as a passage for air. While the heat exchanger 10 according to Embodiment 1 employs a plurality of flat tubes serving as the plurality of heat transfer parts 11, the plurality of heat transfer parts 11 are not limited to flat tubes. For example, the heat transfer parts 11 may each be a plurality of thin circular tubes that are connected to each other in the Z-direction by a plate-like part.

[0026] In the heat exchanger 10, the X-direction in which the plurality of heat transfer parts 11 are arranged coincides with the horizontal direction. Note that the direction in which the plurality of heat transfer parts 11 are arranged is not limited to the horizontal direction and may be the vertical direction or a direction extending diagonally to the vertical direction. Furthermore, in the heat exchanger 10, the direction in which each of the plurality of heat transfer parts 11 extends coincides with the vertical direction. Note that the direction in which each of the plurality of heat transfer parts 11 extends is not limited to the vertical direction and may be the horizontal direction or a direction extending diagonally to the vertical direction.

[0027] The lateral faces 15 of each adjacent two of the plurality of heat transfer parts 11 that are located face to face are not connected to each other by any heat transfer promoter. The heat transfer promoter is, for example, a plate fin or a corrugated fin. That is, the plurality of heat transfer parts 11 are connected to each other only by the headers 12.

(Headers 12)

[0028] The first header 12a and the second header 12b each extend in the X-direction and allow the refrigerant

to flow through inside the first header 12a and the second header 12b. As illustrated in Fig. 2, for example, a refrigerant passage tube 42 is connected to one end of the second header 12b and allows the refrigerant to flow into the second header 12b. Then, the refrigerant is distributed to the plurality of heat transfer parts 11. The distributed portions of refrigerant flow through the plurality of respective heat transfer parts 11 and merge together in the first header 12a. The refrigerant having merged is discharged from the first header 12a into a refrigerant passage tube 41, which is connected to one end of the first header 12a.

[0029] While the headers 12 illustrated in Figs. 2 and 3 each have a round columnar outline shape, the outline shape of the headers 12 is not limited. The outline shape of the headers 12 may be, for example, a cuboid or an elliptical column. The sectional shape of the headers 12 may also be changed according to need. Moreover, the structure of each of the headers 12 may be, for example, a cylinder with its opposite ends closed, or a stack of plate-like parts having slits. The first header 12a and the second header 12b each have a refrigerant port through which the refrigerant is allowed to flow into and out of the header 12a or 12b.

(Support 20)

[0030] As illustrated in Fig. 3, the support 20 of the heat exchanger 10 covers one face of the plurality of heat transfer parts 11 in the Z-direction. That is, the support 20 is oriented such that a face of the support 20 extending along the X-direction and the Y-direction is oriented toward the plurality of heat transfer parts 11. As illustrated in Fig. 2, the support 20 has openings 25, which allow fluid to pass through the support 20 in a direction perpendicular to the face extending along the X-direction and the Y-direction, that is, in the Z-direction.

[0031] The support 20 has a rectangular shape when seen in the Z-direction and includes a frame 21 and partitions 22. The frame 21 forms the outer periphery of the support 20. The partitions 22 divide the area enclosed by the frame 21 into a plurality of subareas. The frame 21 of the support 20 includes a first frame segment 21a, which extends along the first header 12a, a second frame segment 21b, which extends along the second header 12b, and two third frame segments 21c, which connect the ends of the first frame segment 21a and the ends of the second frame segment 21b to each other. The first frame segment 21a, the second frame segment 21b, and the two third frame segments 21c are assembled to form a rectangle. The first frame segment 21a and the second frame segment 21b form opposite sides of the rectangular frame 21. The two third frame segments 21c form the other opposite sides of the rectangular frame 21.

[0032] The partitions 22 of the support 20 according to Embodiment 1 includes first partitions 22a, which each extend in the X-direction, and second partitions 22b, which each extend in the Y-direction. The partitions 22

are arranged such that the partitions 22 divide the area enclosed by the frame 21 into a plurality of subareas. In Embodiment 1, the first partitions 22a and the second partitions 22b are orthogonal to each other, thereby forming meshes. That is, the support 20 is meshes having the openings 25. The openings 25 are each defined by the partitions 22 or by the partitions 22 and the frame 21.

[0033] The support 20 formed as a combination of the frame 21 and the partitions 22 resists deformation that may occur in the XY-plane. The support 20 is fixed to at least the first header 12a and the second header 12b. Therefore, the relative displacement between the first header 12a and the second header 12b is prevented. Consequently, the deformation of the heat exchanger 10 as a whole is prevented. Specifically, the deformation due to buckling of the plurality of heat transfer parts 11 in the Y-direction and the tilting of the plurality of heat transfer parts 11 in the X-direction are prevented. Thus, the heat exchanger 10 exhibits increased strength with the minimum addition, which is the support 20.

[0034] The size of the openings 25 may be determined according to need. In Embodiment 1, when the interval between the partitions 22 of the support 20 is set according to need, the entry of foreign matter into the heat exchanger 10 can be prevented. Furthermore, the support 20 protects the heat transfer parts 11 during the transport of the heat exchanger 10 or the refrigeration cycle apparatus 100 including the heat exchanger 10.

[0035] The support 20 is preferably made of a material having higher strength than the strength of the material of which the plurality of heat transfer parts 11 are made. In Embodiment 1, the flat tubes serving as the heat transfer parts 11 are made of, for example, aluminum. Therefore, the support 20 is preferably made of a material, such as stainless steel, having higher rigidity and strength than the rigidity and strength of aluminum.

[0036] The heat exchanger 10 includes fixing parts where the support 20 is fixed to the headers 12. In the heat exchanger 10 illustrated in Figs. 2 and 3, the support 20 and the headers 12 are joined to each other by, for example, welding. Alternatively, any fastening parts such as bolts may be employed at the fixing parts for fastening, fitting, or locking.

[0037] Fig. 4 illustrates a modification of the fixing part of the heat exchanger 10 according to Embodiment 1, where the support 20 is fixed to one of the headers 12. The fixing part, 30, according to the modification is formed by the first frame segment 21a of the support 20, and locking parts 31a and 31b. The locking parts 31a and 31b are provided on the first header 12a. The fixing part 30 is provided at each of the four corners of the rectangular support 20, and the support 20 is fixed to the headers 12 at the fixing parts 30. In the fixing part 30 illustrated in Fig. 4, the first frame segment 21a of the support 20 is fitted between the locking parts 31a and 31b. The first frame segment 21a is prevented from moving in the Y-direction and the Z-direction by the locking parts 31a and 31b. Such fixing parts 30 are located in the vicinities of

the respective opposite ends of the first frame segment 21a in the X-direction. The third frame segments 21c connected to the respective opposite ends of the first frame segment 21a are stopped by the respective locking parts 31b. Thus, displacement of the support 20 in the X-direction is prevented.

[0038] The fixing part 30 is only exemplary and may be combined with any other fastening part, such as a bolt, for fixing the support 20 to the header 12.

(Modifications)

[0039] Fig. 5 is a perspective view of a heat exchanger 10a, which is a modification of the heat exchanger 10 according to Embodiment 1. Fig. 6 is a side view of the heat exchanger 10a, which is a modification of the heat exchanger 10 according to Embodiment 2. As illustrated in Figs. 5 and 6, the heat exchanger 10a, which is a modification, includes the support 20 at each of the opposite faces of the plurality of heat transfer parts 11 in the Z-direction. That is, the opposite faces of the heat exchanger 10a in the Z-direction, which are the front face and the rear face, are formed by respective supports 20.

[0040] The two supports 20 are fixed to the respective faces of each of the first header 12a and the second header 12b in the Z-direction. The two headers 12 are connected to each other by the two supports 20. Such a configuration provides higher strength than the strength of the heat exchanger 10 according to Embodiment 1.

[0041] The supports 20 cover the respective opposite faces of the plurality of heat transfer parts 11 in the Z-direction. Therefore, the supports 20 not only prevent the entry of foreign matter from both respective faces in the Z-direction but also protect the plurality of heat transfer parts 11 in situations such as during the transport of the heat exchanger 210.

[0042] Fig. 7 is a perspective view of a heat exchanger 10b, which is a modification of the heat exchanger 10 according to Embodiment 1. Fig. 8 is a front view of a support 20b, which is included in the heat exchanger 10b illustrated in Fig. 7. The support 20b included in the heat exchanger 10b, which is a modification, includes partitions 27a and 27b, which extend diagonally to the X-direction and the Y-direction. As illustrated in Fig. 8, the partitions 27a and the partitions 27b are orthogonal to each other. Openings 25 are each defined by the inclined partitions 27a and 27b or by the partitions 27a and 27b and the frame 21.

[0043] The support 20b including the inclined partitions 27a and 27b exhibits great ease of drainage of any dew water that may be generated on the support 20b. Specifically, when the heat exchanger 10b is installed with the Y-direction coinciding with the direction of gravity, any waterdrops adhering to the partitions 27a and 27b flow downward under the influence of gravity. Hence, in the heat exchanger 10b, dew water does not keep staying on the partitions 27a and 27b. Accordingly, retention of dew water and frosting with frozen dew water are pre-

vented. Consequently, the reduction in the ease of air passage through the heat exchanger 10b is prevented.

[0044] The support 20b is a combination of the frame 21, which extends in the X-direction and the Y-direction, and the partitions 27a and 27b, which are inclined. Therefore, the support 20b exhibits high strength to deformation in the XY-plane. Accordingly, the heat exchanger 10b including the support 20b exhibits increased strength to a deformation that may tilt the plurality of heat transfer parts 11 in the X-direction. Furthermore, a load that may act in such a direction as to buckle the plurality of heat transfer parts 11 is borne not only by the third frame segments 21c but also by the partitions 27a and 27b, which extend diagonally to the Y-direction. Accordingly, the heat exchanger 10b also exhibits increased strength to a load acting in the Y-direction.

Embodiment 2

[0045] A heat exchanger 210 according to Embodiment 2 will be described below. The heat exchanger 210 is obtained by changing the shape of the support 20 or 20b according to Embodiment 1. Elements having the same functions and effects as those described in Embodiment 1 are denoted by corresponding ones of the reference signs used in Embodiment 1, and description of such elements is omitted.

[0046] Fig. 9 is a perspective view of the heat exchanger 210 according to Embodiment 2. Fig. 10 is a top view of the heat exchanger 210 according to Embodiment 2. The heat exchanger 210 according to Embodiment 2 includes a support 220, which is located at the plurality of heat transfer parts 11 in the Z-direction. The support 220 is different from the support 20 or 20b according to Embodiment 1 in the shape at its opposite ends in the X-direction. The support 220 is folded and extends in the backward Z-direction at its opposite ends in the X-direction. Specifically, the support 220 includes first folded portions 24, which are located at the respective opposite ends of the support 220 in the X-direction and each extend in the backward Z-direction.

[0047] As with the case of the support 20b according to Embodiment 1, the support 220 according to Embodiment 2 includes the partitions 27a and 27b, which extend diagonally to the X-direction and the Y-direction. The partitions 27a and 27b are located at the face of the support 220 that is oriented toward the Z-direction and are extended into the first folded portions 24. Alternatively, the partitions 27a and 27b may be absent in the first folded portions 24.

[0048] When the heat exchanger 210 is seen from above as illustrated in Fig. 10, the first folded portions 24 of the support 220 hold the headers 12 between the first folded portions 24 in the X-direction. The support 220 has a rectangular U-shape in top view and therefore exhibits high strength to deformation in the XZ-plane. Furthermore, the support 220 is joined to the headers 12. Accordingly, deformation of the heat exchanger 210 in

the XZ-plane is prevented.

[0049] The first frame segment 21a and the second frame segment 21b at the Y-direction opposite ends of the support 220 are each folded at corresponding ones of the X-direction opposite ends and extend in the backward Z-direction, thereby forming the respective first folded portions 24. The support 220 further includes fourth frame segments 21d, each of which forms the end of a corresponding one of the first folded portions 24 in the backward Z-direction. The third frame segments 21c are located at the respective ends of the first folded portions 24 in the Z-direction. The third frame segments 21c may be omitted. However, providing the third frame segments 21c enhances the effect of strengthening the heat exchanger 210.

[0050] The support 220 exhibits high rigidity by employing the first folded portions 24 that are located at the respective X-direction ends and extend in the Z-direction. Consequently, the effect of strengthening the heat exchanger 210 is enhanced. The first folded portions 24 are located at the respective X-direction ends and therefore do not hinder the passage of air through the heat exchanger 210.

[0051] According to Embodiment 2, the partitions 27a and 27b of the support 220 are inclined as with the case of the support 20b according to Embodiment 1. Such a configuration exhibits great ease of drainage and increased strength. The partitions 27a and the partitions 27b of the support 220 do not necessarily need to be inclined and may extend in the X-direction and the Y-direction, respectively, as with the case of the first partitions 22a and the second partitions 22b according to Embodiment 1.

Embodiment 3

[0052] A heat exchanger 310 according to Embodiment 3 will be described below. The heat exchanger 310 is obtained by changing the shape of the support 20 or 20b according to Embodiment 1. Elements having the same functions and effects as those described in Embodiment 1 are denoted by corresponding ones of the reference signs used in Embodiment 1, and description of such elements is omitted.

[0053] Fig. 11 is a perspective view of the heat exchanger 310 according to Embodiment 3. Fig. 12 is a top view of the heat exchanger 310 according to Embodiment 3. The heat exchanger 310 includes a support 320. As illustrated in Fig. 12, the support 320 is folded and extends in the Z-direction at a portion in the X-direction. As with the case of the heat exchanger 10a according to Embodiment 1, the support 320 covers the opposite faces of the heat exchanger 310 in the Z-direction. The support 320 has faces 320a and 320b, which are located at respective opposite sides of the plurality of heat transfer parts 11 and are connected to each other by a first folded portion 324. In other words, the faces 320a and 320b connected to each other by the first folded portion 324

hold the heat exchanger 310 between the faces 320a and 320b from both sides in the Z-direction. The face 320a is also referred to as the first portion, and the face 320b is also referred to as the second portion.

[0054] The support 320 is a single continuous unit. That is, the support 320 includes a small number of components. Accordingly, the cost of the heat exchanger 310 is reduced, and the ease of manufacturing of the heat exchanger 310 is increased.

[0055] The support 320 according to Embodiment 3 includes the partitions 27a that are inclined in one direction but includes no partitions 27b that intersect the partitions 27a. The partitions 27a extend continuously over the support 320 from the face 320a to the face 320b. Therefore, when the heat exchanger 310 is seen in the Z-direction, portions of the partitions 27a forming the face 320a and portions of the partitions 27a forming the face 320b appear to intersect each other. When the support 320 is unfolded, the partitions 27a are inclined in one direction over the entirety of the support 320. When the support 320 is assembled into the heat exchanger 310, the direction in which the partitions 27a are inclined is symmetrical between that in the front face of the heat exchanger 310 and that in the rear face of the heat exchanger 310. Accordingly, the support 320 uniformly resists a force that may act on the heat exchanger 310 in such a manner as to tilt the plurality of heat transfer parts 11 in the X-direction and a force that may act on the heat exchanger 310 in such a manner as to tilt the plurality of heat transfer parts 11 in the backward X-direction.

Embodiment 4

[0056] A heat exchanger 410 according to Embodiment 4 will be described below. The heat exchanger 410 is obtained by changing the shape of the support 20 or 20b according to Embodiment 1. Elements having the same functions and effects as those described in Embodiment 1 are denoted by corresponding ones of the reference signs used in Embodiment 1, and description of such elements is omitted.

[0057] Fig. 13 is a perspective view of the heat exchanger 410 according to Embodiment 4. Fig. 14 is a side view of the heat exchanger 410 according to Embodiment 4. The heat exchanger 410 according to Embodiment 4 includes a support 420. As illustrated in Fig. 14, the support 420 is folded and extends in the Z-direction at a portion in the Y-direction. In the heat exchanger 410, as with the case of the heat exchanger 10a according to Embodiment 1, the support 420 covers the opposite faces of the plurality of heat transfer parts 11 in the Z-direction. The support 420 has faces 420a and 420b, which are located at the plurality of heat transfer parts 11 in the Z-direction and are connected to each other by a second folded portion 28. In other words, the support 420 holds the heat exchanger 410 from the Z-direction opposite sides, specifically, the face 420a and the face 420b connected to each other by the second folded por-

tion 28 hold the heat exchanger 410 between the face 420a and the face 420b from both sides in the Z-direction. The second folded portion 28 extends in the Z-direction along the upper surface of the first header 12a.

[0058] The support 420 according to Embodiment 4 includes the partitions 27a that are inclined in one direction but includes no partitions 27b that intersect the partitions 27a. The partitions 27a extend continuously over the support 420 from the face 420a to the face 420b. Therefore, when the heat exchanger 410 is seen in the Z-direction, portions of the partitions 27a forming the face 420a and portions of the partitions 27a forming the face 420b appear to intersect each other. When the support 420 is unfolded, the partitions 27a are inclined in one direction over the entirety of the support 420. When the support 420 is assembled into the heat exchanger 410, the direction in which the partitions 27a are inclined is symmetrical between that in the front face of the heat exchanger 410 and that in the rear face of the heat exchanger 410. Accordingly, the support 420 uniformly resists a force that may act on the heat exchanger 410 in such a manner as to tilt the plurality of heat transfer parts 11 in the X-direction and a force that may act on the heat exchanger 410 in such a manner as to tilt the plurality of heat transfer parts 11 in the backward X-direction.

Embodiment 5

[0059] A heat exchanger 510 according to Embodiment 5 will be described below. The heat exchanger 510 is obtained by changing the shape of the support 20 or 20b according to Embodiment 1. Elements having the same functions and effects as those described in Embodiment 1 are denoted by corresponding ones of the reference signs used in Embodiment 1, and description of such elements is omitted.

[0060] Fig. 15 is a perspective view of the heat exchanger 510 according to Embodiment 5. Fig. 16 is a top view of the heat exchanger 510 according to Embodiment 5. Fig. 17 is a side view of the heat exchanger 510 according to Embodiment 5. The heat exchanger 510 according to Embodiment 5 includes a support 520. As with the case of the support 320 of the heat exchanger 310 according to Embodiment 3, the support 520 included in the heat exchanger 510 according to Embodiment 5 covers the front face and the rear face of the heat exchanger 510. The support 520 includes partitions 527a, which are inclined in one direction. The partitions 527a extend uniformly over the entirety of the support 520. When the heat exchanger 510 is seen in the Z-direction, portions of the partitions 527a on the front face of the heat exchanger 510 and portions of the partitions 527a on the rear face of the heat exchanger 510 intersect each other.

[0061] Portions of the partitions 527a on a face 520a of the support 520 are provided with projection parts 529. The projection parts 529 are plate-like parts extending along and joined to the respective portions of the partitions 527a that form the face 520a. The projection parts

529 are preferably provided on the face 520a, which receives incoming air. In Embodiment 5, air flows in the backward Z-direction. The projection parts 529 also serve as heat transfer surfaces. In such a case, the projection parts 529 compensate for the insufficiency in the heat transfer area of the heat exchanger 510, which is referred to as a finless heat exchanger.

[0062] As illustrated in Fig. 17, the heat exchanger 510 includes a plurality of heat transfer parts 511. The plurality of heat transfer parts 511 each include heat transfer plates 16, which are each shaped in a plate form and extend from the respective Z-direction ends of the heat transfer part 511. The support 520 may be in contact with or joined to the Z-direction ends of the heat transfer plates 16. In such a configuration, the support 520 and the heat transfer plates 16 are thermally connected to each other. Therefore, the support 520 serves as a heat transfer surface of the heat exchanger 510 while enhancing the strength of the heat exchanger 510.

[0063] The support 520 includes the partitions 527a, which extend diagonally to the X-direction and the Y-direction, dew water thus does not stay on the projection parts 529. Therefore, the ease of air passage through the heat exchanger 510 is secured. Furthermore, for example, when the heat exchanger 510 is installed in a refrigeration cycle apparatus 100, the projection parts 529 of the support 520 are positioned in the vicinity of the outside of the refrigeration cycle apparatus 100. Therefore, the projection parts 529 start to corrode earlier than the heat transfer parts 11 and the headers 12. In particular, when the support 520 is made of a metal material that is more likely to be ionized than the materials of which the heat transfer parts 11 and the headers 12 are made, the support 520 is given priority to corrode. Thus, in the heat exchanger 510, the corrosion of the heat transfer parts 11 is prevented. Consequently, refrigerant leakage due to corrosion is prevented. Furthermore, a cost reduction is possible by reducing the thicknesses of the materials of which the heat transfer parts 11 and the headers 12 are made.

[0064] The present disclosure is not limited to the above configurations. For example, the heat exchangers 10, 10a, 10b, 210, 310, 410, and 510 according to Embodiments 1 to 5 may each employ any combination of the above features. As a specific example, the configuration of the support 20 of the heat exchanger 10b that includes the partitions 27a and 27b may be applied to the heat exchanger 310 or any of the other heat exchangers.

Reference Signs List

[0065] 10: heat exchanger, 10a: heat exchanger, 10b: heat exchanger, 11: heat transfer part, 12: header, 12a: first header, 12b: second header, 14: heat transfer portion, 15: lateral face, 16: heat transfer plate, 20: support, 20b: support, 21: frame, 21a: first frame segment, 21b: second frame segment, 21c: third frame segment, 21d:

fourth frame segment, 22: partition, 22a: first partition, 22b: second partition, 24: first folded portion, 25: opening, 27a: partition, 27b: partition, 28: second folded portion, 30: fixing part, 30a: fixing part, 31a: locking part, 31b: locking part, 41: refrigerant passage tube, 42: refrigerant passage tube, 100: refrigeration cycle apparatus, 101: compressor, 102: passage switcher, 103: indoor heat exchanger, 104: decompressor, 105: outdoor heat exchanger, 106: outdoor unit, 107: indoor unit, 108: outdoor fan, 109: indoor fan, 110: refrigerant circuit, 111: extension pipe, 112: extension pipe, 210: heat exchanger, 220: support, 310: heat exchanger, 320: support, 320a: face, 320b: face, 324: first folded portion, 410: heat exchanger, 420: support, 420a: face, 420b: face, 510: heat exchanger, 511: heat transfer part, 520: support, 520a: face, 527a: partition, 529: projection part

Claims

1. A heat exchanger, comprising:

a plurality of heat transfer parts arranged in a first direction and spaced apart from each other, the plurality of heat transfer parts extending in a second direction and allowing refrigerant to flow through inside the plurality of heat transfer parts;
a first header extending in the first direction and connected to one end of each of the plurality of heat transfer parts;
a second header extending in the first direction and connected to an other end of each of the plurality of heat transfer parts; and
a support extending along the first direction and the second direction and having an opening, the support being located at at least one face of the plurality of heat transfer parts in a third direction that is perpendicular to the first direction and the second direction, the support being fixed to the first header and the second header.

2. The heat exchanger of claim 1,

wherein the support includes
a frame that forms an outer periphery of the support, and
a partition that divides an area enclosed by the frame,
wherein the opening is defined by at least one of the frame and the partition, and
wherein the partition extends diagonally to the first direction.

3. The heat exchanger of claim 2,

wherein the support is joined to the plurality of heat transfer parts, and

wherein the partition projects in the third direction.

4. The heat exchanger of any one of claims 1 to 3,

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wherein the support includes a first folded portion obtained by folding the support at an end of the support in the first direction, the first folded portion extending in the third direction, and wherein the first folded portion is fixed to the first header and the second header.

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

wherein the support includes a second folded portion obtained by folding the support at an end of the support in the second direction, the second folded portion extending in the third direction, and

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wherein the second folded portion is fixed to at least one of the first header and the second header.

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6. The heat exchanger of claim 5,

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wherein the support includes a first portion that covers one face of the plurality of heat transfer parts in the third direction, and a second portion that covers an other face of the plurality of heat transfer parts in the third direction, and wherein the second folded portion connects the first portion and the second portion to each other.

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7. The heat exchanger of any one of claims 1 to 6, wherein the support is made of a material that is more likely to be ionized than materials of which the plurality of heat transfer parts, the first header, and the second header are made.

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8. The heat exchanger of any one of claims 1 to 7,

wherein the first header and the second header each include a fixing part where the support is fixed to a corresponding one of the first header and the second header, and wherein the support is locked at the fixing part.

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9. A refrigeration cycle apparatus, comprising: the heat exchanger of any one of claims 1 to 8.

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FIG. 1

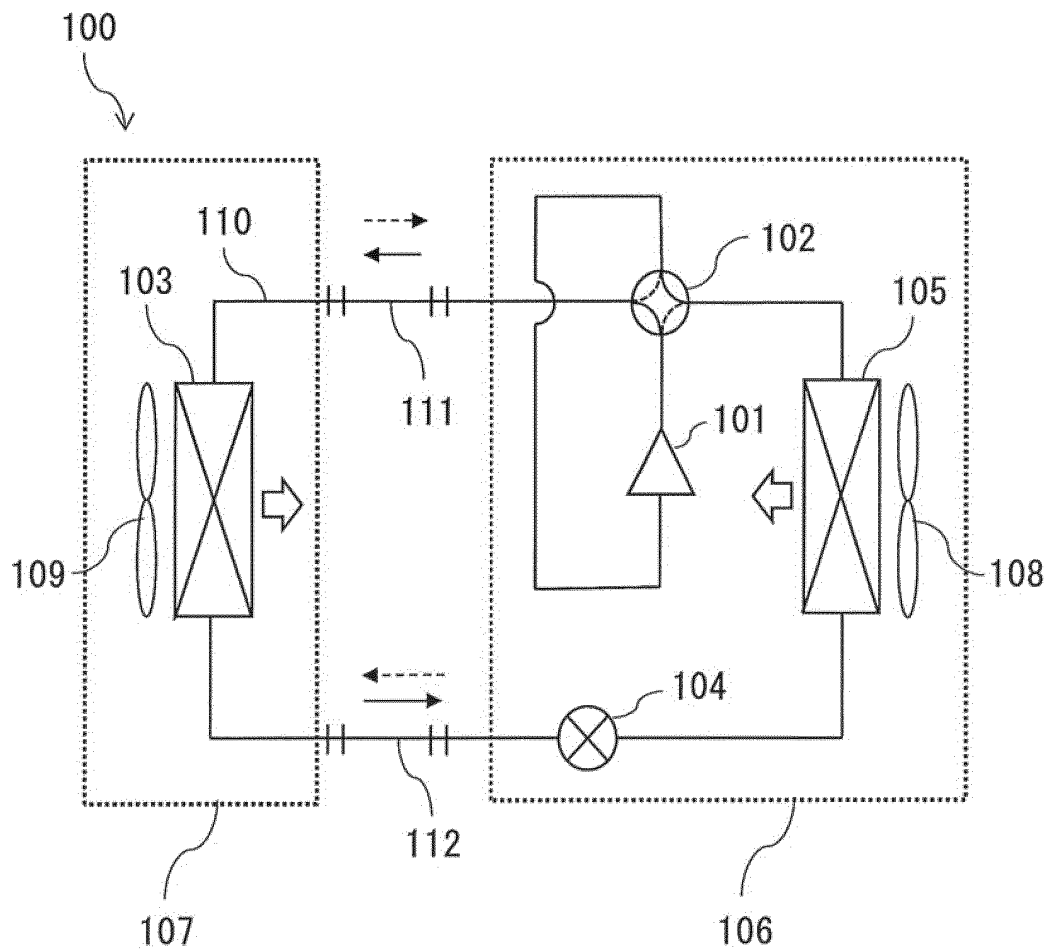


FIG. 2

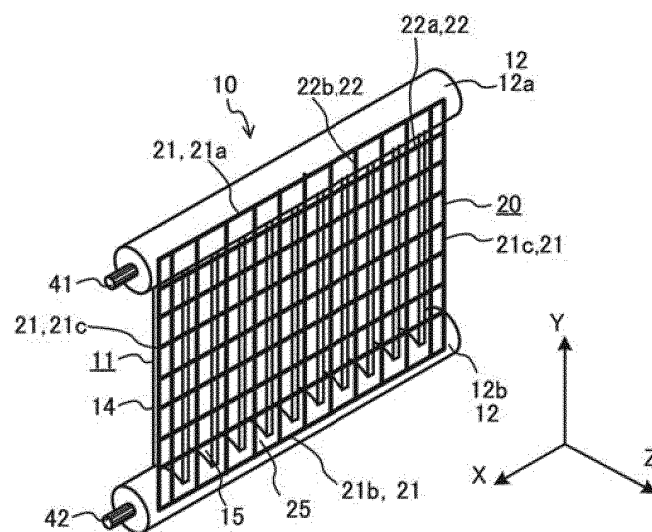


FIG. 3

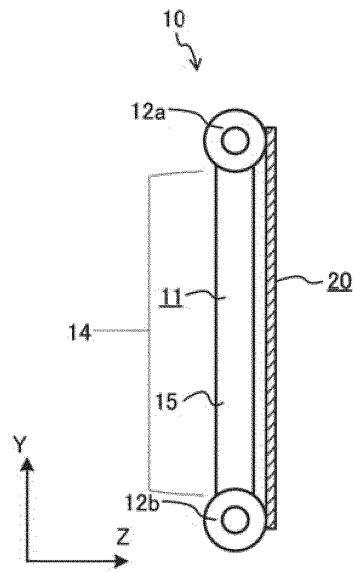


FIG. 4

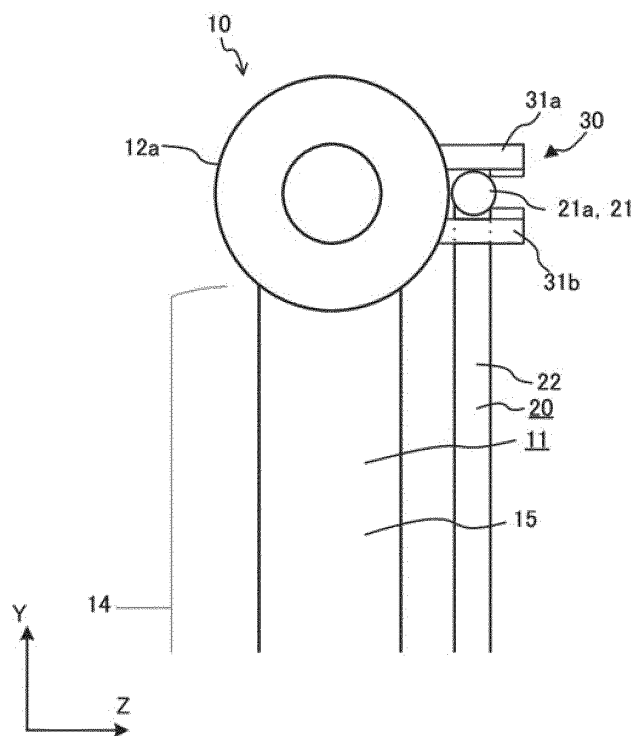


FIG. 5

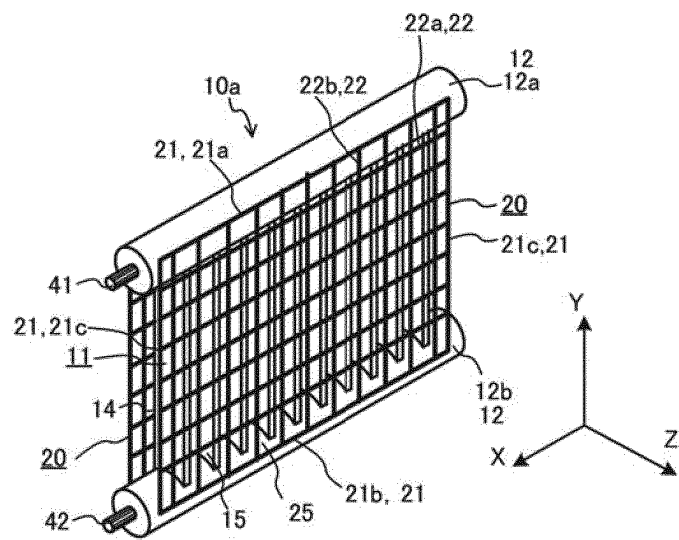


FIG. 6

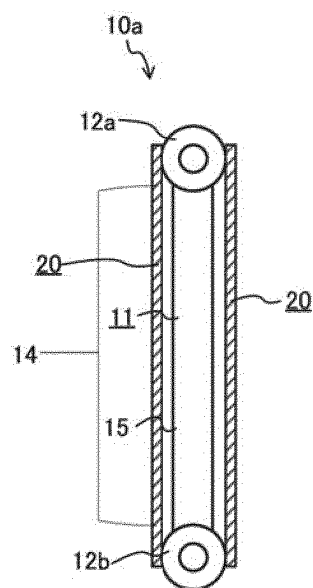


FIG. 7

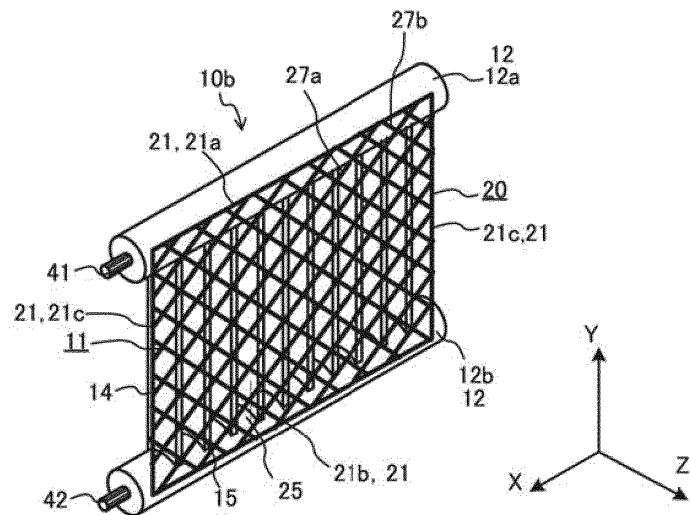


FIG. 8

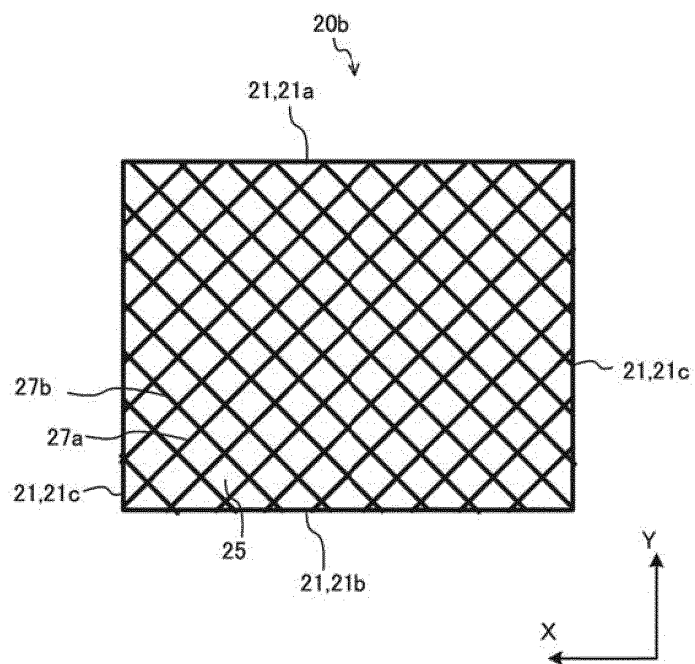


FIG. 9

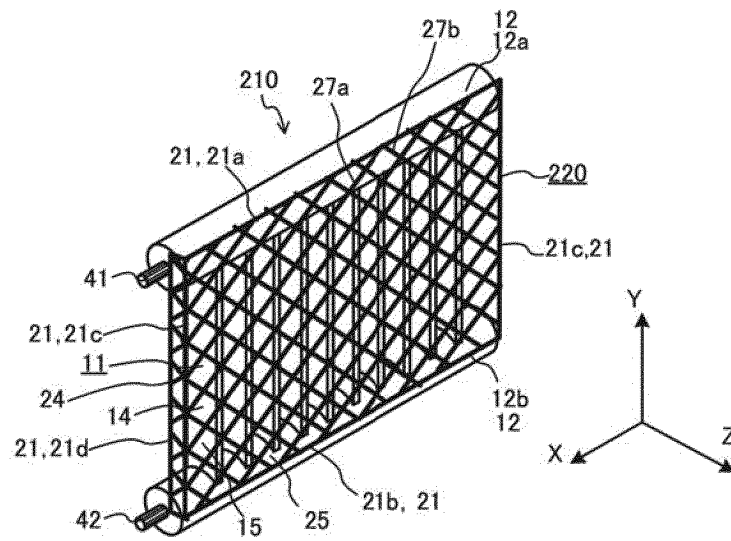


FIG. 10

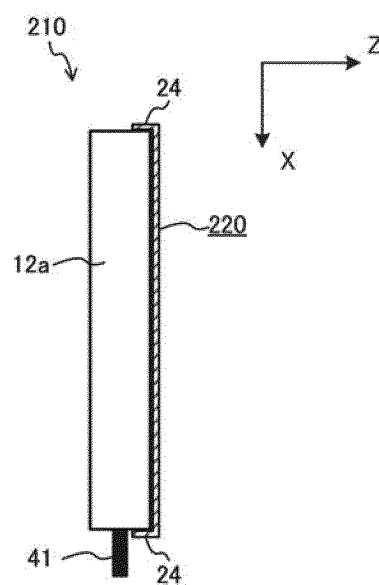


FIG. 11

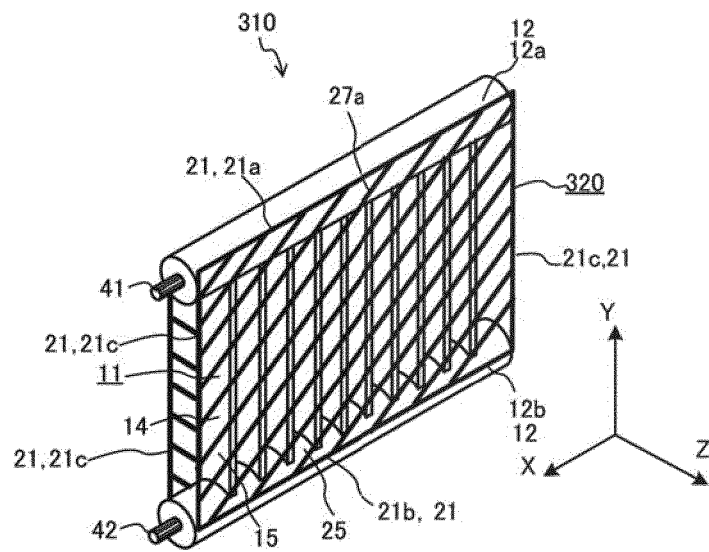


FIG. 12

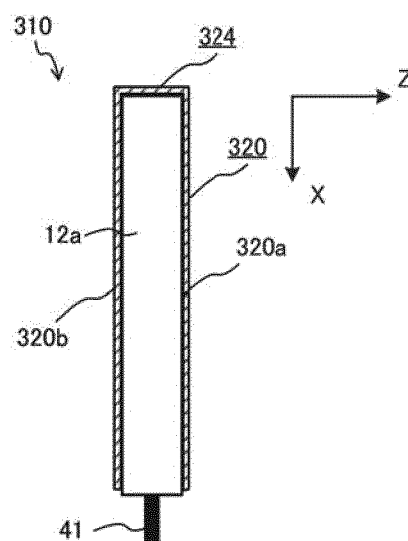


FIG. 13

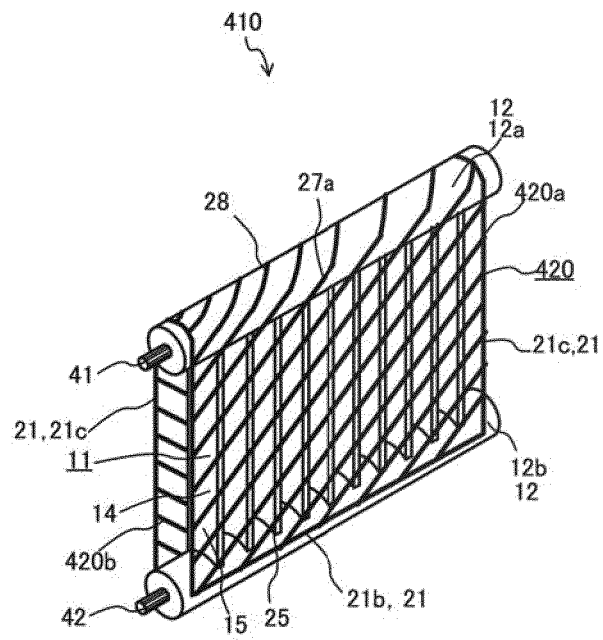


FIG. 14

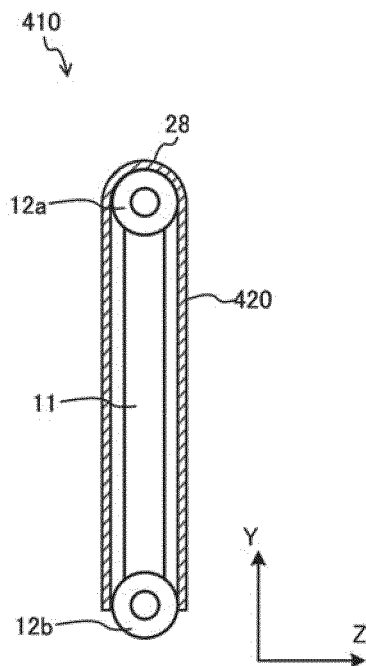


FIG. 15

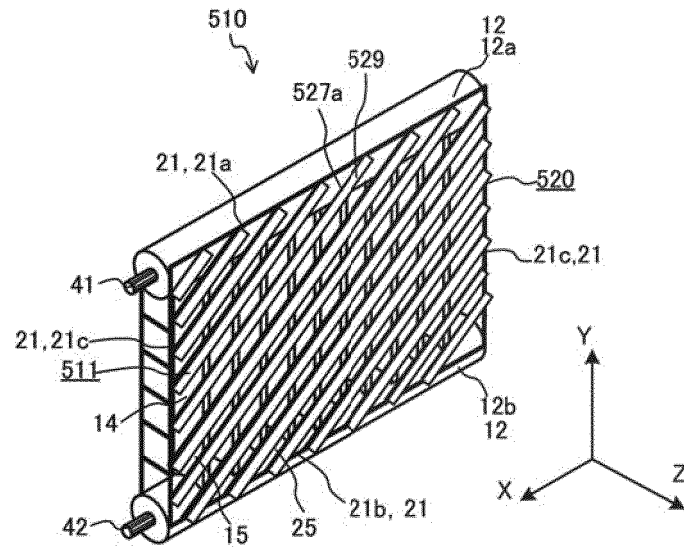


FIG. 16

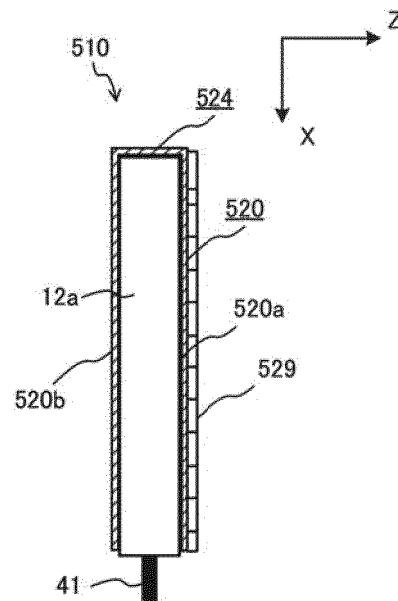
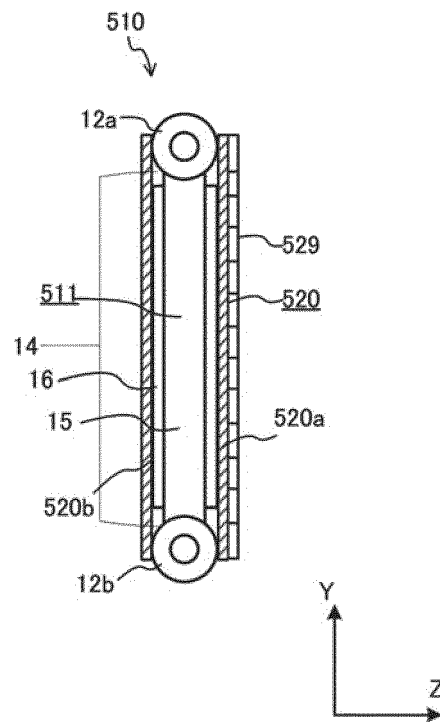


FIG. 17



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/023377

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/013 (2006.01) i; F28F 1/02 (2006.01) i

FI: F28F9/013 A; F28F1/02 A

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)

F28F9/013; F28F1/02

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 A	JP 2002-147986 A (SANDEN CORP.) 22 May 2002 (2002-05-22) paragraphs [0009]-[0016], fig. 4, 9-10, 27	1, 4-5, 9 2-3, 6-8
X A	JP 4-251171 A (GENERAL MOTORS CORPORATION) 07 September 1992 (1992-09-07) paragraphs [0014]-[0019], fig. 1	1, 4, 8-9 2-3, 5-7
A	JP 2001-527634 A (VOLKSWAGEN AKTIENGESELLSCHAFT) 25 December 2001 (2001-12-25) page 9, line 24 to page 10, line 9, fig. 3	1-9
A	DE 102017221083 A1 (MAHLE INTERNATIONAL GMBH) 29 May 2019 (2019-05-29) paragraphs [0024]-[0028], fig. 1	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

03 August 2020 (03.08.2020)

Date of mailing of the international search report

18 August 2020 (18.08.2020)

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/JP2020/023377

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
JP 2002-147986 A	22 May 2002	(Family: none)	
JP 4-251171 A	07 Sep. 1992	US 5042575 A	
		column 3, lines 4-51, fig. 1	
JP 2001-527634 A	25 Dec. 2001	EP 473218 A2	
DE 102017221083 A1	29 May 2019	WO 1998/050751 A1	
		(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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- JP 2018162953 A [0004]