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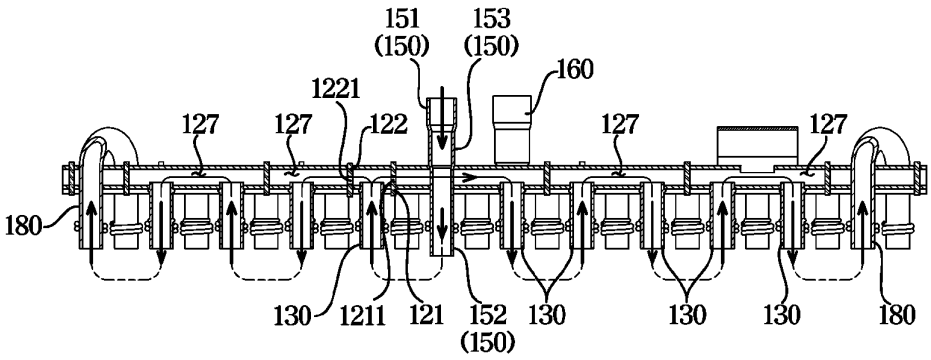
(54) **HEAT EXCHANGER**

(57) A heat exchanger may comprise: a plurality of refrigerant tubes provided to allow refrigerant to flow; and headers coupled to ends of the plurality of refrigerant tubes. The header may comprise: a header housing disposed on one side of the plurality of refrigerant tubes; an inlet pipe that penetrates the header housing to be connected to one of the plurality of refrigerant tubes, and forms a flow path through which refrigerant is introduced into the refrigerant tube; and a plurality of distribution baffles that are disposed inside the header housing, so that the refrigerant introduced into the refrigerant tube from the inlet pipe flows out from the refrigerant tube and is distributed in both directions inside the header housing.

FIG. 7



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Description

[TECHNICAL FIELD]

[0001] The disclosure relates to a heat exchanger with an improved structural header.

[BACKGROUND ART]

[0002] In general, a heat exchanger is a device used in a refrigeration cycle that acts as a condenser or evaporator.

[0003] A heat exchanger is a device for exchanging heat between refrigerant and outside air, including a refrigerant tube in which a refrigerant flows and exchanges heat with the outside air, and heat exchange fins that contact the refrigerant tube to increase the heat dissipation area.

[0004] Such a refrigerant tube includes a bend portion to allow the refrigerant to flow back and forth, and may have an open end facing one side of the heat exchanger.

[0005] In this case, a separate structure for transferring refrigerant between adjacent refrigerant tubes becomes necessary.

[DISCLOSURE]

[TECHNICAL PROBLEM]

[0006] An aspect of the present disclosure provides a heat exchanger in which refrigerant transfer between a plurality of refrigerant tubes may be facilitated via an improved structural header.

[TECHNICAL SOLUTION]

[0007] According to an embodiment of the present disclosure, a heat exchanger may include a plurality of refrigerant tubes configured to allow refrigerant to flow. The heat exchanger may include a header coupled to ends of the plurality of refrigerant tubes.

[0008] The header may include a header housing arranged on one side of the plurality of refrigerant tubes. The header may include an inlet pipe configured to penetrate the header housing to be connected to one of the plurality of refrigerant tubes, and forming a flow path through which refrigerant is introduced into the refrigerant tube. The header may include a plurality of distribution baffles arranged inside the header housing to allow the refrigerant introduced into the refrigerant tube from the inlet pipe to flow out of the refrigerant tube and be distributed in both directions inside the header housing.

[0009] The inlet pipe may include a refrigerant inlet positioned on an outer side of the header housing, and a refrigerant outlet positioned on an inner side of the header housing and connected to the refrigerant tube.

[0010] The header may further include a connecting pipe configured to be connected to the refrigerant tube coupled to the refrigerant outlet of the inlet pipe so as to return the refrigerant introduced into the refrigerant tube to the header, and extending from the header housing to the inner side of the header housing.

[0011] The plurality of distribution baffles may include a first distribution baffle arranged on one side of the inlet pipe and having a first baffle hole formed therein and a second distribution baffle arranged to be spaced apart from the first distribution baffle and having a second baffle hole formed therein.

[0012] The refrigerant introduced into the refrigerant tube through the inlet pipe may be returned to the header and flow in a first direction through the first baffle hole of the first distribution baffle and in a second direction opposite to the first direction through the second baffle hole of the second distribution baffle.

[0013] The refrigerant passing through the first baffle hole of the first distribution baffle may pass through a connection space formed between the inlet pipe and the header housing and flow into another refrigerant tube.

[0014] The header housing may include a first header housing, and a second header housing that is covered by the first header housing and is coupled to the first header housing at an inner side of the first header housing.

[0015] The second header housing may include an inlet through hole through which the inlet pipe penetrates into an inner side of the second header housing.

[0016] The second header housing may further include a plurality of compartment baffles, and a plurality of refrigerant flow spaces formed by the plurality of compartment baffles and configured to connect two refrigerant tubes arranged adjacent to each other.

[0017] The header housing may include a connecting hole formed in a base of the header housing to allow the plurality of refrigerant tubes to be inserted into the inner side of the header housing.

[0018] The header may further include a connection space formed between the inlet pipe and the refrigerant tubes connected to the inlet pipe and the header housing.

[0019] The header may include a first row and a second row arranged side by side, and a portion of the refrigerant tubes of the plurality of refrigerant tubes coupled to the first row and a portion of the refrigerant tubes of the plurality of refrigerant tubes coupled to the second row may be arranged to communicate with each other inside the header housing.

[0020] The header may include a first row and a second row arranged side by side to which the inlet pipe is coupled, and further include an outlet pipe coupled to the second row and configured to discharge the heat exchanged refrigerant.

[0021] The header may further include a bend pipe coupled to the header housing to connect a portion of the plurality of refrigerant tubes arranged along the first row with a portion of the plurality of refrigerant tubes arranged along the second row.

[0022] The header may further include a sensor holder brazed to the header housing to receive a sensor for

detecting a temperature of the refrigerant.

[0023] According to an embodiment of the present disclosure, a heat exchanger may include a plurality of refrigerant tubes configured to allow refrigerant to flow, and a header coupled to an end of each of the plurality of refrigerant tubes.

[0024] The header may include a header housing. The header may include an inlet pipe configured to penetrate the header housing to be connected to one of the plurality of refrigerant tubes and forming a flow path through which refrigerant is introduced into the refrigerant tube. The header may include a first distribution baffle arranged inside the header housing to allow the refrigerant introduced into the refrigerant tube to flow out of the refrigerant tube and be distributed in a first direction inside the header housing. The header may include a second distribution baffle arranged to be spaced apart from the first distribution baffle inside the header housing to allow the refrigerant discharged from the refrigerant tube to flow in a second direction opposite to the first direction. The header may include a connection space formed between the inlet pipe and the header housing such that refrigerant passing through the first distribution baffle is compartmentalized with refrigerant flowing through the interior of the inlet pipe and into another refrigerant tube adjacent to the inlet pipe.

[0025] The connection space may be formed on an outer side of the inlet pipe.

[0026] The inlet pipe may include a refrigerant inlet positioned on an outer side of the header housing, a refrigerant outlet positioned on an inner side of the header housing, and an inlet body arranged between the refrigerant inlet and the refrigerant outlet and positioned inside the header housing.

[0027] The header may further include a connecting pipe configured to be connected to the refrigerant tube coupled to the inlet pipe so as to return the refrigerant introduced into the refrigerant tube to the header, and extending from the header housing to the inner side of the header housing.

[0028] The refrigerant passing through the first distribution baffle may flow through the connection space to pass through the outer side of the inlet body.

[ADVANTAGEOUS EFFECTS]

[0029] The structure of the heat exchanger may be simplified by implementing a refrigerant deliver structure between the plurality of refrigerant tubes as a header type.

[0030] The inlet pipe may be directly connected to the refrigerant tube and the refrigerant returned from the refrigerant tube may be distributed inside the header, thereby eliminating the need for a separate distribution structure on the outside of the header.

[0031] By applying the refrigerant delivery structure using the header, space utilization on the side of the heat exchanger may be increased.

[DESCRIPTION OF DRAWINGS]

[0032]

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

FIG. 2 is a perspective view of a header of the heat exchanger shown in FIG. 1;

FIG. 3 is a front view of the header of the heat exchanger shown in FIG. 2 from the inside;

FIG. 4 is a side view of the header of the heat exchanger shown in FIG. 2 from the side;

FIG. 5 is a front view of the header of the heat exchanger shown in FIG. 2 from the outside;

FIG. 6 is an exploded perspective view showing the header of the heat exchanger shown in FIG. 2;

FIG. 7 is a cross-sectional view of the header taken along line A-A' of FIG. 5;

FIG. 8 is a cross-sectional view of the header taken along line B-B' of FIG. 5;

FIG. 9 is a cross-sectional view of the header taken along line C-C' of FIG. 5;

FIG. 10 is a partial perspective view of a heat exchanger according to an embodiment of the present disclosure;

FIG. 11 is an exploded view of refrigerant tubes and a header of the heat exchanger shown in FIG. 10; and

FIG. 12 is an exploded perspective view of a partially disassembled configuration of the header of the heat exchanger shown in FIG. 10.

[MODES OF THE INVENTION]

[0033] Embodiments described in the disclosure and configurations shown in the drawings are merely examples of the embodiments of the disclosure and may be modified in various different ways at the time of filing of the present application to replace the embodiments and drawings of the disclosure.

[0034] In addition, the same reference numerals or signs shown in the drawings of the disclosure indicate elements or components performing substantially the same function.

[0035] Also, the terms used herein are used to describe the embodiments and are not intended to limit and/or restrict the disclosure. The singular forms "a," "an" and

"the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. In this disclosure, the terms "including", "having", and the like are used to specify features, figures, steps, operations, elements, components, or combinations thereof, but do not preclude the presence or addition of one or more of the features, figures, steps, operations, elements, components, or combinations thereof.

[0036] It will be understood that, although the terms "first", "second", "primary", "secondary", etc., may be used herein to describe various elements, but elements are not limited by these terms. These terms are only used to distinguish one element from another element. For example, without departing from the scope of the disclosure, a first element may be termed as a second element, and a second element may be termed as a first element. The term of "and/or" includes a plurality of combinations of relevant items or any one item among a plurality of relevant items.

[0037] Hereinafter, various embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0038] FIG. 1 is a perspective view of a heat exchanger according to an embodiment of the present disclosure.

[0039] Referring to FIG. 1, a heat exchanger 1 may include a plurality of refrigerant tubes 30 through which refrigerant flows, and heat exchange fins 10 arranged on an outer side of the plurality of refrigerant tubes 30.

[0040] The plurality of refrigerant tubes 30 may be hollow to allow refrigerant, which is a fluid, to flow therein, thereby forming a flow path through which the refrigerant flows.

[0041] The plurality of refrigerant tubes 30 may utilize microchannel refrigerant tubes. The microchannel refrigerant tubes may be defined as tubes having a hydraulic diameter of 3 mm or less. The hydraulic diameter is a value obtained by dividing the cross-sectional area of the tube by the circumference of the tube.

[0042] The refrigerant may compress or expand as it flows along the flow path formed in the refrigerant tubes 30, thereby releasing heat to the surroundings or absorbing heat from the surroundings. To efficiently release or absorb heat as the refrigerant compresses or expands, the refrigerant tubes 30 may be coupled with heat exchange fins 10.

[0043] The heat exchange fins 10 shown in FIG. 1 are schematically shown in the plurality of heat exchange fins 10, rather than in a single configuration. Accordingly, the heat exchanger 1 according to the disclosure may be provided with the plurality of heat exchange fins 10.

[0044] The heat exchange fins 10 may be arranged in a plurality spaced apart from each other at regular intervals in a direction perpendicular to a direction in which the refrigerant tube 30 extends. The heat exchange fins 10 may include an aluminum alloy material having a high thermal conductivity.

[0045] The heat exchange fins 10 may be bonded to an outer surface of the refrigerant tube 30 to substantially serve to increase the heat exchange area between the outside air and the refrigerant tube 30.

[0046] The narrower a spacing at which the heat exchange fins 10 are stacked, the greater the number of heat exchange fins 10 may be arranged. However, if the spacing between the heat exchange fins 10 becomes too narrow, the heat exchange fins 10 may act as a resistance to a flow of the outside air flowing into the heat exchanger 1.

[0047] Accordingly, the spacing between the heat exchange fins 10 may be adjusted appropriately to minimize pressure losses.

[0048] The heat exchanger 1 may include a support plate 20.

[0049] The support plate 20 may be arranged such that connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, connected to the refrigerant tube 30 are mounted thereon. The support plate 20 may be arranged on one side of the refrigerant tube 30 to support an open end of the refrigerant tube 30.

[0050] The refrigerant tubes 30 may be arranged in a plurality of rows.

[0051] For example, the refrigerant tube 30 may be a portion into which the refrigerant is introduced, and may be arranged side by side along one side of the support plate 20.

[0052] The ends of the plurality of refrigerant tubes 30 may be coupled with a header 100 to allow for refrigerant exchange between adjacent refrigerant tubes 30.

[0053] FIG. 2 is a perspective view showing the header of the heat exchanger shown in FIG. 1. FIG. 3 is a front view showing the header of the heat exchanger shown in FIG. 2 from the inside. FIG. 4 is a side view showing the header of the heat exchanger shown in FIG. 2 from the side. FIG. 5 is a front view showing the header of the heat exchanger shown in FIG. 2 from the outside.

[0054] Referring to FIG. 2, FIG. 3, FIG. 4, and FIG. 5, the header 100 may include header housings, such as first header housing 110 and second header housing 120.

[0055] The header housings, such as first header housing 110 and second header housing 120 may be arranged on one side of the plurality of refrigerant tubes 30. The header housings may form the exterior of the header 100.

[0056] The header housings, such as first header housing 110 and second header housing 120 may include the first header housing 110 and the second header housing 120.

[0057] The first header housing 110 and the second header housing 120 may be coupled together. The first header housing 110 may be arranged on an outer side of the second header housing 120. The second header housing 120 may be arranged on an inner side of the first header housing 110.

[0058] The first header housing 110 may cover an open surface of the second header housing 120. An inlet pipe 150, an outlet pipe 160, a bend pipe 180, and a sensor holder 170 may be coupled to the first header housing

110.

[0059] The second header housing 120 may be covered by the first header housing 110. The second header housing 120 may be connected to the connecting pipes, such as first connecting pipe 130 and second connecting pipe 140.

[0060] Further details regarding the first header housing 110 and the second header housing 120 will be described later.

[0061] The header 100 may include the connecting pipes, such as first connecting pipe 130 and second connecting pipe 140.

[0062] The connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, may extend from the header housing to an inner side of the header housing.

[0063] For example, the connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, may extend from the second header housing 120 to the inner side of the second header housing 120.

[0064] The connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, and the second header housing 120 may be joined by welding. However, the method of joining the connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, and the second header housing 120 is not limited thereto.

[0065] The first connecting pipe 130 may be connected to the refrigerant tube 30 that is coupled to a refrigerant outlet 152 of the inlet pipe 150 so as to return the refrigerant flowing into the refrigerant tube 30 from the inlet pipe 150 to the header 100.

[0066] Such a first connecting pipe 130 may be aligned with the inlet pipe 150. In FIG. 2, the refrigerant tube 30 connected to the first connecting pipe 130 is omitted.

[0067] Alternatively, other connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, may be configured to connect the header 100 and the refrigerant tubes 30 to deliver the refrigerant from the header 100 to the refrigerant tubes 30.

[0068] The connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, may be provided in a plurality and may be connected to the plurality of the refrigerant tubes 30, respectively.

[0069] The connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, may include the first connecting pipe 130 and the second connecting pipe 140.

[0070] The header 100 of the heat exchanger 1 according to an embodiment of the present disclosure may include a first row L1 and a second row L2.

[0071] The first row L1 and the second row L2 may be arranged side by side to each other. The first row L1 and the second row L2 may be arranged along a longitudinal direction of the header 100.

[0072] The inlet pipe 150 may be coupled to the first row L1 of the header 100, and the outlet pipe 160 may be coupled to the second row L2 of the header 100.

[0073] The refrigerant tubes 30 may be arranged along the first row L1 of the header 100. In addition, the refrigerant tubes 30 may be arranged along the second row L2 of the header 100.

[0074] The first row L1 and the second row L2 may correspond to the front and rear of the heat exchanger 1 based on the direction shown in FIG. 1. However, the orientation based on which the first row L1 and the second row L2 are referenced may vary depending on the direction of arrangement of the heat exchanger 1.

[0075] The first connecting pipe 130 may be arranged in the first row L1 of the header 100. The second connecting pipe 140 may be arranged in the second row L2 of the header 100.

[0076] The header 100 may include the inlet pipe 150 and the outlet pipe 160.

[0077] The inlet pipe 150 may penetrate the header housings, such as first header housing 110 and second header housing 120 and may be connected to any one of the plurality of refrigerant tubes 30. The inlet pipe 150 may form a flow path for introducing refrigerant into the refrigerant tubes 30. The inlet pipe 150 may be coupled to the first row L1 of the header 100.

[0078] The inlet pipe 150 may include a refrigerant inlet 151, the refrigerant outlet 152, and an inlet body 153.

[0079] The refrigerant inlet 151 may be positioned on the outer side of the header housings, such as first header housing 110 and second header housing 120. The refrigerant outlet 152 may be positioned on the inner side of the header housings, such as first header housing 110 and second header housing 120 and may be connected to the refrigerant tubes 30.

[0080] The inlet body 153 may be arranged between the refrigerant inlet 151 and the refrigerant outlet 152 and may be configured to penetrate the interior of the header housings, such as first header housing 110 and second header housing 120. A portion of the inlet body 153 may be positioned on the interior of the header housings, such as first header housing 110 and second header housing 120.

[0081] The outlet pipe 160 may be arranged to be connected to the second row L2 of the header 100 and may be configured to discharge the heat exchanged refrigerant to an outside of the heat exchanger.

[0082] The header 100 may include the sensor holder 170.

[0083] The sensor holder 170 may be coupled to the first header housing 110. The sensor holder 170 may be configured to receive a sensor that detects a temperature of the refrigerant. Alternatively, the sensor holder 170 may be configured to support the sensor.

[0084] The sensor holder 170 may be brazed to the first header housing 110. However, the method of coupling the sensor holder 170 and the header housing is not limited thereto.

[0085] For example, the sensor holder 170 may be coupled to the first header housing 110. The sensor holder 170 may be coupled to the outer side of the first

header housing 110 and configured to support or receive a sensor.

[0086] The header 100 may include the bend pipe 180.

[0087] The bend pipe 180 may be coupled to the header housings, such as first header housing 110 and second header housing 120 to connect a portion of the plurality of refrigerant tubes 30 arranged along the first row L1 with a portion of the plurality of refrigerant tubes 30 arranged along the second row L2.

[0088] For example, the bend pipe 180 may be arranged at two ends of the header 100.

[0089] The bend pipe 180 may be arranged to connect the refrigerant tube 30 positioned at the outermost side of the header 100 among the refrigerant tubes 30 of the first row L1 and the refrigerant tube 30 positioned at the outermost side of the header 100 among the refrigerant tubes 30 of the second row L2.

[0090] For example, the bend pipe 180 on the upper side may be arranged to connect the refrigerant tube 30 positioned on the upper outer side of the header 100 among the refrigerant tubes 30 of the first row L1 and the refrigerant tube 30 positioned on the upper outer side of the header 100 among the refrigerant tubes 30 of the second row L2. The bend pipe 180 on the lower side may be arranged to connect the refrigerant tube 30 arranged on the lower outer side of the header 100 among the refrigerant tubes 30 of the first row L1 and the refrigerant tube 30 arranged on the lower outer side of the header 100 among the refrigerant tubes 30 of the second row L2.

[0091] As a result, the refrigerant introduced into the refrigerant tube 30 through the inlet pipe 150 coupled to the first row L1 may move to the second row L2 and be discharged to the outside of the heat exchanger 1 through the outlet pipe 160 coupled to the second row L2.

[0092] FIG. 6 is an exploded perspective view showing the header of the heat exchanger shown in FIG. 2.

[0093] The detailed configuration of the header 100 will be described with reference to FIG. 6.

[0094] As shown in FIG. 6, the first header housing 110 may include an inlet connection 111, an outlet connection 112, a bend pipe insertion portion 113, and a sensor mounting portion 114.

[0095] The inlet connection 111 may be formed by cutting a portion of the first header housing 110 to allow the inlet pipe 150 to pass through the first header housing 110. The inlet pipe 150 passing through the inlet connection 111 may extend through the first header housing 110 and into the inner side of the second header housing 120, and may be connected to the refrigerant tube 30.

[0096] The outlet connection 112 may be formed by cutting a portion of the first header housing 110 to allow the outlet pipe 160 to pass through the first header housing 110. The outlet pipe 160 passing through the outlet connection 112 may extend through the first header housing 110 and into the inner side of the second header housing 120, and may have an end received in the inner side of the second header housing 120.

[0097] The bend pipe insertion portion 113 may be formed by cutting a portion of the first header housing 110 to allow the bend pipe 180 to be inserted. For example, the bend pipe insertion portion 113 may each be arranged so that one of the both ends of the bend pipe 180 may be inserted.

[0098] In addition, since the heat exchanger 1 according to an embodiment of the present disclosure includes two bend pipes 180 as shown in FIG. 6, the bend pipe insertion portions may be provided in pairs on each side of the header 100.

[0099] The sensor mounting portion 114 may be formed by cutting a portion of the first header housing 110 to allow the sensor holder 170 to be attached.

[0100] The second header housing 120 may include a base 124, an inlet through hole 125, and a bend pipe through hole 126.

[0101] The base 124 may form one side of the second header housing 120. For example, the base 124 may be configured to connect the connecting pipes 130 and 140. The base 124 may be arranged in the shape of an elongated plate through which the connecting pipes, such as first connecting pipe 130 and second connecting pipe 140, pass.

[0102] The inlet through hole 125 may be formed by cutting a portion of the base 124 to allow the inlet pipe 150 to pass through. The bend pipe through hole 126 may be formed by cutting a portion of the base 124 to allow the bend pipe 180 to pass through.

[0103] The inlet through hole 125 may be formed at a position corresponding to the coupling position of the inlet pipe 150. The bend pipe through hole 126 may be formed at a position corresponding to the coupling position of the bend pipe 180.

[0104] The inlet through hole 125 and the bend pipe through hole 126 may allow the inlet pipe 150 and the bend pipe 180, respectively, to pass through the header housing and be directly connected to the refrigerant tube 30.

[0105] The second header housing 120 may include a plurality of distribution baffles, such as first distribution baffle 121 and second distribution baffle 122.

[0106] The plurality of distribution baffles, such as first distribution baffle 121 and second distribution baffle 122 may be arranged in the interior of the header housing such that the refrigerant flowing into the refrigerant tube 30 from the inlet pipe 150 may flow out of the refrigerant tube 30 and be distributed in both directions in the interior of the header housing.

[0107] For example, the plurality of distribution baffles, such as first distribution baffle 121 and second distribution baffle 122 may be arranged in the base 124 so as to be spaced apart from each other with the first connecting pipe 130 interposed therebetween.

[0108] The plurality of distribution baffles may include the first distribution baffle 121 and the second distribution baffle 122.

[0109] The first distribution baffle 121 may be arranged on one side of the inlet pipe 150 and may include a first

baffle hole 1211. The first distribution baffle 121 may be arranged in the interior of the header housing such that the refrigerant introduced into the refrigerant tube 30 connected to the inlet pipe 150 may flow out of the refrigerant tube 30 and flow in a first direction in the interior of the header housing.

[0110] The second distribution baffle 122 may be arranged to be spaced apart from the first distribution baffle 121 and may include a second baffle hole 1221. The second distribution baffle 122 may be arranged in the interior of the header housing such that the refrigerant introduced into the refrigerant tube 30 connected to the inlet pipe 150 may flow out of the refrigerant tube 30 and flow in a second direction in the interior of the header housing.

[0111] The refrigerant returned to the header 100 through the first connecting pipe 130 arranged between the first distribution baffle 121 and the second distribution baffle 122 may flow in the first direction through the first distribution baffle 121 and in the second direction opposite to the first direction through the second distribution baffle 122.

[0112] The second header housing 120 may include a plurality of compartment baffles 123 and refrigerant flow spaces 127.

[0113] The plurality of compartment baffles 123 may be arranged in the base 124 of the second header housing 120. The plurality of compartment baffles 123 may define a plurality of refrigerant flow spaces 127. The plurality of refrigerant flow spaces 127 may be arranged to connect adjacent refrigerant tubes 30 of the plurality of refrigerant tubes 30 to each other.

[0114] FIG. 7 is a cross-sectional view of the header taken along line A-A' of FIG. 5. FIG. 8 is a cross-sectional view of the header taken along line B-B' of FIG. 5. FIG. 9 is a cross-sectional view of the header taken along line C-C' of FIG. 5.

[0115] Referring to FIG. 7, FIG. 8, and FIG. 9, the flow of refrigerant inside the header 100 of the heat exchanger 1 according to an embodiment of the present disclosure will be described. In FIG. 7, FIG. 8, and FIG. 9, the refrigerant tubes 30 are omitted. The part indicated by the dotted lines in FIG. 7 and FIG. 8 may refer to the refrigerant flow in the interior of the refrigerant tubes 30.

[0116] FIG. 7 shows the refrigerant flow in the first row L1 of the header 100, and FIG. 8 shows the refrigerant flow in the second row L2 of the header 100.

[0117] As shown in FIG. 7, the refrigerant may be introduced into the heat exchanger 1 via the inlet pipe 150.

[0118] The refrigerant inlet 151 of the inlet pipe 150 may be arranged on the outer side of the header 100, and the refrigerant outlet 152 of the inlet pipe 150 may be arranged on the inner side of the header 100. In addition, a portion of the inlet body 153 of the inlet pipe 150 may be arranged in the interior of the header 100. In other words, the inlet pipe 150 may be arranged to penetrate the header housings, such as first header housing 110 and second header housing 120.

[0119] The refrigerant introduced into the refrigerant tube 30 through the inlet pipe 150 may flow into the first connecting pipe 130. In this case, the refrigerant flowing into the first connecting pipe 130 arranged between the first distribution baffle 121 and the second distribution baffle 122 may flow in the first direction through the first baffle hole 1211 of the first distribution baffle 121 and in the second direction through the second baffle hole 1221 of the second distribution baffle 122.

[0120] In this case, the first direction may refer to the right with respect to FIG. 7, and the second direction may refer to the left with respect to FIG. 7.

[0121] The refrigerant passing through the first baffle hole 1211 of the first distribution baffle 121 may flow through a connection space S1 formed between the inlet pipe 150 and the header housings, such as first header housing 110 and second header housing 120 into the first connecting pipe 130 arranged on one side of the inlet pipe 150 and be introduced into the refrigerant tube 30 connected to the first connecting pipe 130.

[0122] Referring to FIG. 7, FIG. 8, and FIG. 9, the connection space S1 may be formed by the inlet pipe 150, the first header housing 110, and the second header housing 120. The connection space S1 may be configured such that the refrigerant passing through the first distribution baffle 121 is compartmentalized from the refrigerant flowing through the interior of the inlet pipe 150 to be introduced into another refrigerant tube 30 adjacent to the refrigerant tube 30 connected to the inlet pipe 150.

[0123] The connection space S1 may be formed on the outer side of the inlet pipe 150. The refrigerant passing through the first distribution baffle 121 may flow through the connection space S1 to the outer side of the inlet body 153.

[0124] Accordingly, the refrigerant flowing into the refrigerant tube 30 through the inlet pipe 150 may be distributed in both directions by the plurality of distribution baffles, such as first distribution baffle 121 and second distribution baffle 122 within the interior of the header 100.

[0125] Thereafter, the refrigerant may sequentially flow through the different refrigerant tubes 30 arranged adjacent to each other through respective refrigerant flow spaces 127 formed by the compartment baffles 123 of the header 100.

[0126] Referring to FIG. 7 and FIG. 8, the refrigerant flowing in both directions through the plurality of distribution baffles, such as first distribution baffle 121 and second distribution baffle 122 may flow through the bend pipe 180 to flow along the first row L1 of the header 100 and then flow along the second row L2 of the header 100.

[0127] The refrigerant introduced into the second row L2 of the header 100 by the bend pipe 180 may flow from the outer side of the header 100 toward the outlet pipe 160. The refrigerant may sequentially flow through the different refrigerant tubes 30 arranged adjacent to each

other through respective refrigerant flow spaces 127 formed by the compartment baffles 123 of the header 100.

[0128] Finally, the refrigerant that has completed the heat exchange may be collected in the refrigerant flow space 127 connected to the outlet pipe 160 and may be discharged to the outside of the heat exchanger 1 via the outlet pipe 160.

[0129] The heat exchanger 1 according to an embodiment of the present disclosure may simplify the structure of the heat exchanger by implementing the refrigerant deliver structure between the plurality of refrigerant tubes 30 as a header 100 type.

[0130] Furthermore, the heat exchanger 1 according to an embodiment of the present disclosure may eliminate the need for a separate distribution structure outside the header 100 because the inlet pipe may be directly connected to the refrigerant tube and the refrigerant returned from the refrigerant tube may be distributed inside the header 100.

[0131] Furthermore, the heat exchanger 1 according to an embodiment of the present disclosure may increase the space utilization on the side of the heat exchanger by applying a refrigerant deliver structure using the header 100.

[0132] FIG. 10 is a partial perspective view of a heat exchanger according to an embodiment of the present disclosure. FIG. 11 is an exploded view of the refrigerant tube and the header of the heat exchanger shown in FIG. 10. FIG. 12 is an exploded perspective view of a partially disassembled configuration of the header of the heat exchanger shown in FIG. 10.

[0133] With reference to FIG. 10, FIG. 11, and FIG. 12, a heat exchanger 1a according to an embodiment of the present disclosure will be described.

[0134] As shown in FIG. 10, FIG. 11, and FIG. 12, the heat exchanger 1a may include a plurality of refrigerant tubes 30a through which refrigerant flows, and heat exchange fins 10a arranged on an outer side of the plurality of refrigerant tubes 30a.

[0135] The heat exchange fins 10a may be arranged in a plurality of regularly spaced apart from each other at predetermined intervals in a direction perpendicular to a direction in which the refrigerant tube 30a extends. The heat exchange fins 10a may include an aluminum alloy material having a high thermal conductivity.

[0136] The heat exchange fin 10a may be bonded to an outer surface of the refrigerant tube 30a to substantially serve to increase the heat exchange area between the outside air and the refrigerant tube 30a.

[0137] The narrower a gap between the heat exchange fins 10a stacked, the greater the number of heat exchange fins 10a may be arranged. However, if the gap between the heat exchange fins 10a becomes too narrow, the heat exchange fins 10a may act as a resistance to the flow of the outside air flowing into the heat exchanger 1a.

[0138] Accordingly, the gap between the heat exchange fins 10a may be appropriately adjusted to minimize pressure losses.

[0139] The heat exchanger 1a may include a support plate 20a.

[0140] The support plate 20a may be arranged on one side of the refrigerant tube 30a so as to support an end of the refrigerant tube 30a.

[0141] The refrigerant tubes 30a may be arranged in a plurality of rows.

[0142] For example, the refrigerant tubes 30a may be arranged side by side along one side of the support plate 20a as a portion into which the refrigerant is introduced.

[0143] The ends of the plurality of refrigerant tubes 30a may be coupled with a header 100a to allow for refrigerant exchange between adjacent refrigerant tubes 30a.

[0144] According to an embodiment of the present disclosure shown in FIG. 10,

[0145] FIG. 11, and FIG. 12, the header 100a of the heat exchanger 1a may not include separate connecting pipes 130 and 140, unlike the header 100 shown in FIG. 1, FIG. 2, FIG. 3, FIG. 4, FIG. 5, FIG. 6, FIG. 7, FIG. 8, and FIG. 9. The header 100a of the heat exchanger 1a according to an embodiment of the present disclosure shown in FIG. 10, FIG. 11, and FIG. 12 may be implemented in such a way that the plurality of refrigerant tubes 30a are directly inserted into an interior of the header 100a.

[0146] The header 100a may include header housings, such as first header housing 110a and second header housing 120a.

[0147] The header housings, such as first header housing 110a and second header housing 120a may be arranged on one side of the plurality of refrigerant tubes 30a. The header housings, such as first header housing 110a and second header housing 120a may form the exterior of the header 100a.

[0148] The header housings, such as first header housing 110a and second header housing 120a may include the first header housing 110a and the second header housing 120a.

[0149] The first header housing 110a and the second header housing 120a may be coupled together. The first header housing 110a may be arranged on an outer side of the second header housing 120a. The second header housing 120a may be arranged on an inner side of the first header housing 110a.

[0150] The first header housing 110a may cover an open surface of the second header housing 120a. An inlet pipe 150a, an outlet pipe 160a, and a sensor holder 170a may be coupled to the first header housing 110a.

[0151] The second header housing 120a may be covered by the first header housing 110a.

[0152] The header 100a of the heat exchanger 1a according to an embodiment of the present disclosure may include the first row L1 and the second row L2.

[0153] The first row L1 and the second row L2 may be arranged side by side to each other. The first row L1 and the second row L2 may be arranged along a longitudinal

direction of the header 100a.

[0154] The inlet pipe 150a may be coupled to the first row L1 of the header 100a, and the outlet pipe 160a may be coupled to the second row L2 of the header 100a.

[0155] The refrigerant tubes 30a may be arranged along the first row L1 of the header 100a. In addition, the refrigerant tubes 30a may be arranged along the second row L2 of the header 100a.

[0156] The first row L1 and the second row L2 may correspond to the front and rear of the heat exchanger 1a based on the direction shown in FIG. 12. However, the orientation based on which the first row L1 and the second row L2 are referenced may vary depending on the direction of arrangement of the heat exchanger 1a.

[0157] The header housings, such as first header housing 110a and second header housing 120a may include connecting holes formed in a base 124a of the header housings, such as first header housing 110a and second header housing 120a to allow the plurality of refrigerant tubes 30a to be inserted into an inner side of the header housings, such as first header housing 110a and second header housing 120a. The connecting holes may be provided in a plurality.

[0158] The connecting holes may include a first connecting hole 130a and a second connecting hole 140a. The first connecting hole 130a may be arranged along the first row L1 of the header 100a. The second connecting hole 140a may be arranged along the second row L2 of the header 100a.

[0159] The header 100a may include the inlet pipe 150a and the outlet pipe 160a.

[0160] The inlet pipe 150a may pass through the header housings, such as first header housing 110a and second header housing 120a and be connected to any one of the plurality of refrigerant tubes 30a. The inlet pipe 150a may form a flow path for introducing refrigerant into the refrigerant tubes 30a. The inlet pipe 150a may be coupled to the first row L1 of the header 100a.

[0161] The inlet pipe 150a may include a refrigerant inlet 151a, a refrigerant outlet 152a, and an inlet body 153a.

[0162] The refrigerant inlet 151a may be positioned on the outer side of the header housings, such as first header housing 110a and second header housing 120a. The refrigerant outlet 152a may be positioned on the inner side of the header housings, such as first header housing 110a and second header housing 120a and may be connected to the refrigerant tubes 30a.

[0163] The inlet body 153a may be arranged between the refrigerant inlet 151a and the refrigerant outlet 152a and may be arranged in the interior of the header housings, such as first header housing 110a and second header housing 120a.

[0164] The outlet pipe 160a may be arranged to be connected to the second row L2 of the header 100a and may be configured to discharge the heater exchanged refrigerant to an outside of the heat exchanger 1a.

[0165] The header 100a may include the sensor holder 170a.

[0166] The sensor holder 170a may be coupled to the header housings, such as first header housing 110a and second header housing 120a. The sensor holder 170a may be configured to receive a sensor that detects a temperature of the refrigerant. Alternatively, the sensor holder 170a may be configured to support the sensor.

[0167] The sensor holder 170a may be brazed to the header housings, such as first header housing 110a and second header housing 120a. However, the method of coupling the sensor holder 170a and the header housings, such as first header housing 110a and second header housing 120a is not limited thereto.

[0168] For example, the sensor holder 170a may be coupled to the first header housing 110a. The sensor holder 170a may be coupled to the outer side of the first header housing 110a and configured to support or receive the sensor.

[0169] The heat exchanger 1a according to an embodiment of the present disclosure shown in FIG. 10, FIG. 11, and FIG. 12 may be configured not to include separate bend pipes, unlike the heat exchanger 1 shown in FIG. 1, FIG. 2, FIG. 3, FIG. 4, FIG. 5, FIG. 6, FIG. 7, FIG. 8, and FIG. 9.

[0170] Accordingly, the heat exchanger 1a according to an embodiment of the present disclosure shown in FIG. 10, FIG. 11, FIG. 12 may be configured such that a portion of the refrigerant tubes 30a of the plurality of refrigerant tubes 30a coupled to the first row L1 and a portion of the refrigerant tubes 30a among the plurality of refrigerant tubes 30a coupled to the second row L2 are in communication with each other inside the header housing.

[0171] For example, the header housings, such as first header housing 110a and second header housing 120a may be configured such that the refrigerant tube 30a positioned at the outermost side of the header 100a among the refrigerant tubes 30a of the first row L1 and the refrigerant tube 30a positioned at the outermost side of the header 100a among the refrigerant tubes 30a of the second row L2 are connected to each other.

[0172] For example, the header housings, such as first header housing 110a and second header housing 120a may be arranged to connect the refrigerant tube 30a positioned on the upper outer side of the header 100a among the refrigerant tubes 30a of the first row L1 with the refrigerant tube 30a positioned on the upper outer side of the header 100a among the refrigerant tubes 30a of the second row L2. The header housings, such as first header housing 110a and second header housing 120a may be arranged to connect the refrigerant tube 30a positioned on the lower outer side of the header 100a among the refrigerant tubes 30a of the first row L1 with the refrigerant tube 30a positioned on the lower outer side of the header 100a among the refrigerant tubes 30a of the second row L2.

[0173] As a result, the refrigerant introduced into the refrigerant tube 30a through the inlet pipe 150a coupled to the first row L1 may move to the second row L2 and be

discharged to the outside of the heat exchanger 1a through the outlet pipe 160a coupled to the second row L2.

[0174] The first header housing 110a may include an inlet connection 111a, an outlet connection 112a, a bend pipe insertion portion, and a sensor mounting portion 114a.

[0175] The inlet connection 111a may be formed by cutting a portion of the first header housing 110a to allow the inlet pipe 150a to pass through the first header housing 110a. The inlet pipe 150a passing through the inlet connection 111a may extend through the first header housing 110a and into the inner side of the second header housing 120a, and may be connected to the refrigerant tube 30a.

[0176] The outlet connection 112a may be formed by cutting a portion of the first header housing 110a to allow the outlet pipe 160a to pass through the first header housing 110a. The outlet pipe 160a passing through the outlet connection 112a may extend through the first header housing 110a and into the inner side of the second header housing 120a, and may have an end received in the inner side of the second header housing 120a.

[0177] The sensor mounting portion 114a may be formed by cutting a portion of the first header housing 110a to allow the sensor holder 170a to be attached.

[0178] The second header housing 120a may include the base 124a.

[0179] The base 124a may form one side of the second header housing 120a. For example, the connecting holes 130a and 140a may be arranged in the base 124a.

[0180] The second header housing 120a may include a plurality of distribution baffles, such as first distribution baffle 121a and second distribution baffle 122a.

[0181] The plurality of distribution baffles, such as first distribution baffle 121a and second distribution baffle 122a may be arranged in the interior of the header housings, such as first header housing 110a and second header housing 120a such that the refrigerant flowing into the refrigerant tube 30a from the inlet pipe 150a may flow out of the refrigerant tube 30a and be distributed in both directions in the interior of the header housings, such as first header housing 110a and second header housing 120a.

[0182] For example, the plurality of distribution baffles, such as first distribution baffle 121a and second distribution baffle 122a may be arranged in the base 124a so as to be spaced apart from each other with the first connecting hole 130a therebetween.

[0183] The plurality of distribution baffles, such as first distribution baffle 121a and second distribution baffle 122a may include the first distribution baffle 121a and the second distribution baffle 122a.

[0184] The first distribution baffle 121a may be arranged on one side of the inlet pipe 150a and may include a first baffle hole 1211a. The first distribution baffle 121a may be arranged in the interior of the header housings, such as first header housing 110a and second header housing 120a such that the refrigerant introduced into the refrigerant tube 30a connected to the inlet pipe 150a may flow out of the refrigerant tube 30a and flow in a first direction in the interior of the header housings, such as first header housing 110a and second header housing 120a.

[0185] The second distribution baffle 122a may be arranged to be spaced apart from the first distribution baffle 121a and may include a second baffle hole 1221a. The second distribution baffle 122a may be arranged in the interior of the header housings, such as first header housing 110a and second header housing 120a such that the refrigerant introduced into the refrigerant tube 30a connected to the inlet pipe 150a may flow out of the refrigerant tube 30a and flow in a second direction in the interior of the header housings, such as first header housing 110a and second header housing 120a.

[0186] The refrigerant returned to the header 100a through the first connecting hole 130a arranged between the first distribution baffle 121a and the second distribution baffle 122a may flow in the first direction through the first distribution baffle 121a and in the second direction opposite to the first direction through the second distribution baffle 122a.

[0187] The heat exchanger 1a according to an embodiment of the present disclosure shown in FIG. 10, FIG. 11, and FIG. 12 may include a connection space S2 as the heat exchanger 1 shown in FIG. 1, FIG. 2, FIG. 3, FIG. 4, FIG. 5, FIG. 6, FIG. 7, FIG. 8, and FIG. 9.

[0188] The refrigerant passing through the first baffle hole 1211a of the first distribution baffle 121a may flow through the connection space S2 formed between the inlet pipe 150a and the header housing into the first connecting hole 130a arranged on one side of the inlet pipe 150a and be introduced into the refrigerant tube 30a connected to the first connecting hole 130a.

[0189] The connection space S2 may be configured such that the refrigerant passing through the first distribution baffle 121a is compartmentalized from the refrigerant flowing through the interior of the inlet pipe 150a to be introduced into another refrigerant tube 30a adjacent to the refrigerant tube 30a connected to the inlet pipe 150a.

[0190] The connection space S2 may be formed on the outer side of the inlet pipe 150a. The refrigerant passing through the first distribution baffle 121a may flow through the connection space S2 to the outer side of the inlet body 153a.

[0191] The second header housing 120a may include a plurality of compartment baffles 123a and refrigerant flow spaces 127a.

[0192] The plurality of compartment baffles 123a may be arranged in the base 124a of the second header housing 120a. The plurality of compartment baffles 123a may define a plurality of refrigerant flow spaces 127a. The plurality of refrigerant flow spaces 127a may be arranged to connect adjacent refrigerant tubes 30a of the plurality of refrigerant tubes 30a to each other.

[0193] Accordingly, the heat exchanger 1a according to an embodiment of the present disclosure shown in FIG. 10, FIG. 11, and FIG. 12 may implement a refrigerant deliver structure through the connecting holes without forming a separate connecting pipe in the header 100a, in contrast to the heat exchanger 1 according to an embodiment of the present disclosure shown in FIG. 1, FIG. 2, FIG. 3, FIG. 4, FIG. 5, FIG. 6, FIG. 7, FIG. 8, and FIG. 9.

[0194] In addition, the refrigerant deliver structure from the first row L1 to the second row L2 may be implemented through the header housings, such as first header housing 110a and second header housing 120a without forming a separate bend pipe in the header 100a.

[0195] Although certain exemplary embodiments are illustrated and described above, the present disclosure is not limited to the certain embodiments, various applications may of course be performed by those skilled in the art without deviating from what is claimed in the scope of claims, and such applications should not be understood separately from the technical idea or prospects herein.

Claims

1. A heat exchanger comprising:

a plurality of refrigerant tubes configured to allow refrigerant to flow therethrough; and
a header coupled to ends of the plurality of refrigerant tubes,
wherein the header comprises:

a header housing on one side of the plurality of refrigerant tubes;
an inlet pipe penetrating the header housing and connected to a refrigerant tube of the plurality of refrigerant tubes to provide a flow path through which the refrigerant is introduced into the refrigerant tube; and
a plurality of distribution baffles inside the header housing to allow the refrigerant introduced into the refrigerant tube from the inlet pipe to flow out of the refrigerant tube and be distributed in both directions inside the header housing.

2. The heat exchanger of claim 1, wherein the inlet pipe comprises:

a refrigerant inlet on an outer side of the header housing; and
a refrigerant outlet on an inner side of the header housing and connected to the refrigerant tube.

3. The heat exchanger of claim 2, wherein the header further comprises a connecting pipe connected to the refrigerant tube coupled to the refrigerant outlet of the inlet pipe to return the refrigerant introduced into the refrigerant tube to the header, and extending from the header housing to the inner side of the header housing.

4. The heat exchanger of claim 1, wherein the plurality of distribution baffles comprises:

a first distribution baffle on one side of the inlet pipe and comprising a first baffle hole therein; and
a second distribution baffle spaced apart from the first distribution baffle and having a second baffle hole therein.

5. The heat exchanger of claim 4, wherein the refrigerant introduced into the refrigerant tube through the inlet pipe is returned to the header and flows in a first direction through the first baffle hole of the first distribution baffle and in a second direction opposite to the first direction through the second baffle hole of the second distribution baffle.

6. The heat exchanger of claim 5, wherein the refrigerant passing through the first baffle hole of the first distribution baffle passes through a connection space formed between the inlet pipe and the header housing and flows into another refrigerant tube.

7. The heat exchanger of claim 1, wherein the header housing comprises:

a first header housing; and
a second header housing that is covered by the first header housing and is coupled to the first header housing at an inner side of the first header housing.

8. The heat exchanger of claim 7, wherein the second header housing comprises an inlet through hole through which the inlet pipe is penetrated into an inner side of the second header housing.

9. The heat exchanger of claim 7, the second header housing further comprises:

a plurality of compartment baffles; and
a plurality of refrigerant flow spaces provided by the plurality of compartment baffles and configured to connect two refrigerant tubes, of the plurality of refrigerant tubes, arranged adjacent to each other.

10. The heat exchanger of claim 1, wherein the header housing comprises a connecting hole in a base of the header housing to allow the plurality of refrigerant tubes to be inserted into the inner side of the header housing.

11. The heat exchanger of claim 10, wherein the header further comprises a connection space between the inlet pipe and the refrigerant tube connected to the inlet pipe and the header housing.

12. The heat exchanger of claim 10, wherein the header comprises

a first row and a second row arranged side by side, and
a portion of the refrigerant tubes of the plurality of refrigerant tubes coupled to the first row and a portion of the refrigerant tubes of the plurality of refrigerant tubes coupled to the second row are in communication with each other inside the header housing.

13. The heat exchanger of claim 1, wherein the header comprises a first row and a second row arranged side by side to which the inlet pipe is coupled, and further comprises an outlet pipe coupled to the second row and configured to discharge the heat exchanged refrigerant.

14. The heat exchanger of claim 13, wherein the header further comprises a bend pipe coupled to the header housing to connect a portion of the plurality of refrigerant tubes arranged along the first row with a portion of the plurality of refrigerant tubes arranged along the second row.

15. The heat exchanger of claim 1, wherein the header further comprises a sensor holder brazed to the header housing to receive a sensor configured to detect a temperature of the refrigerant.

FIG. 1

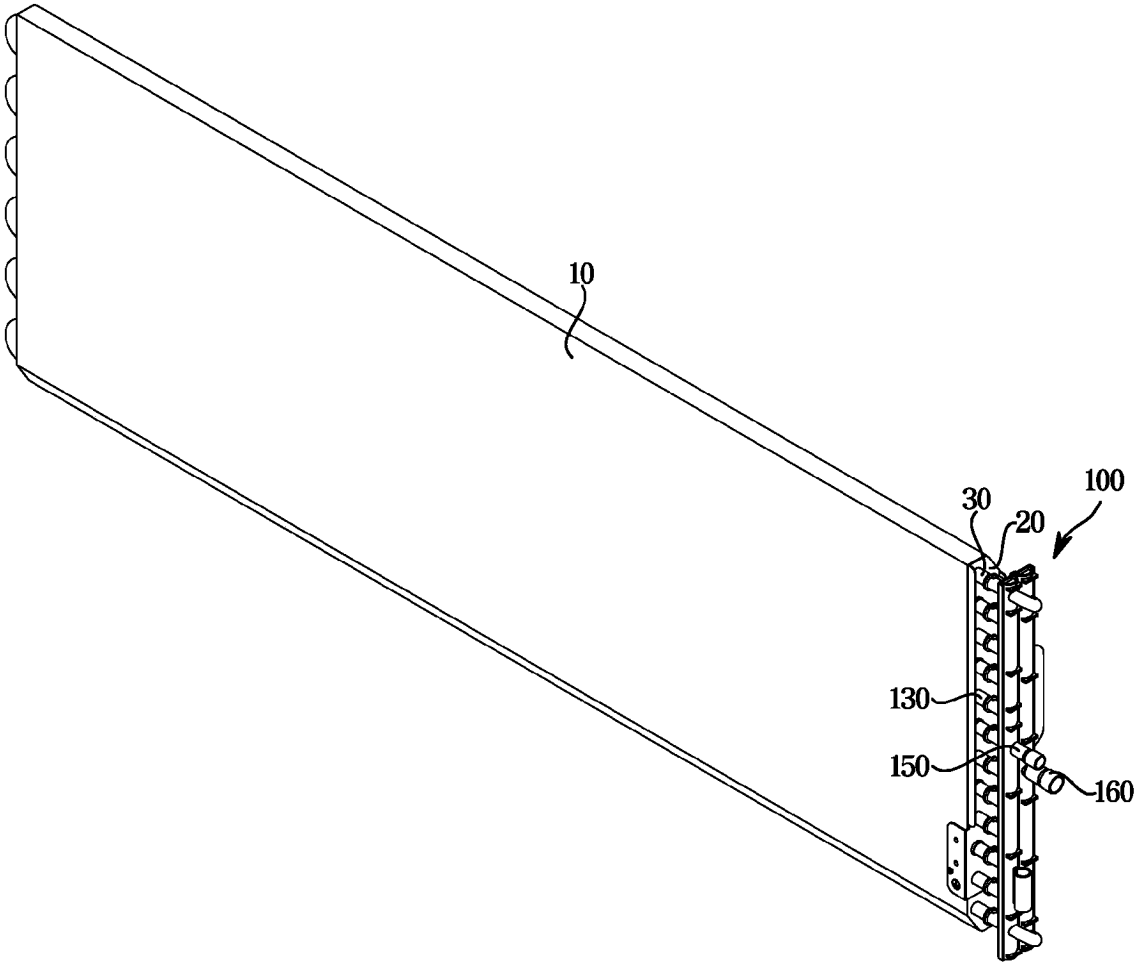
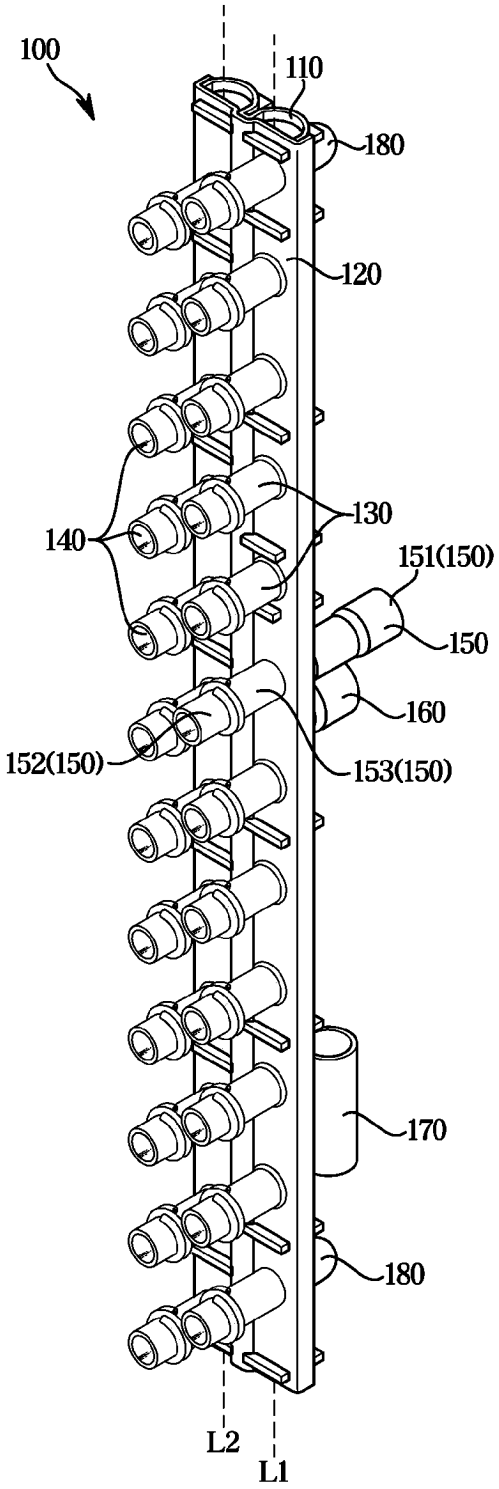


FIG. 2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150
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153(150)
170
180
L2
L1

FIG. 3

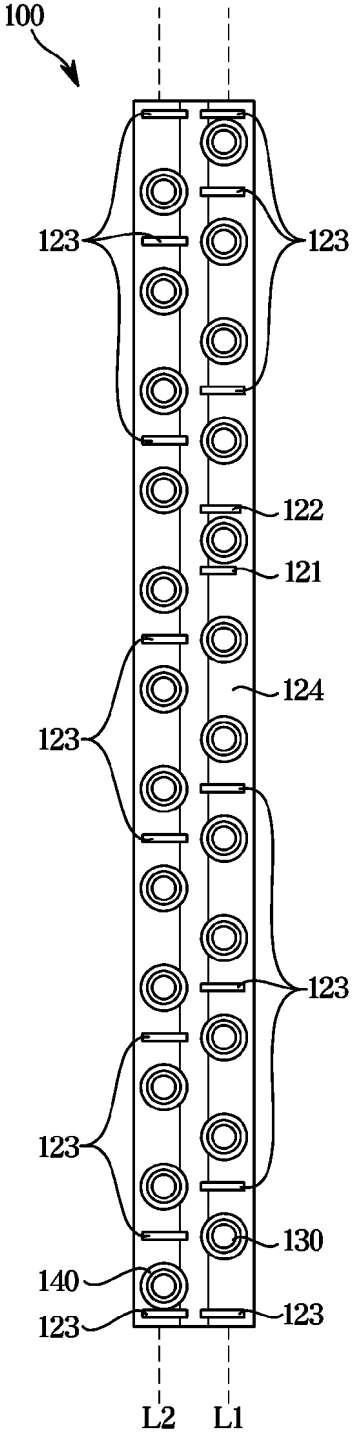


FIG. 4

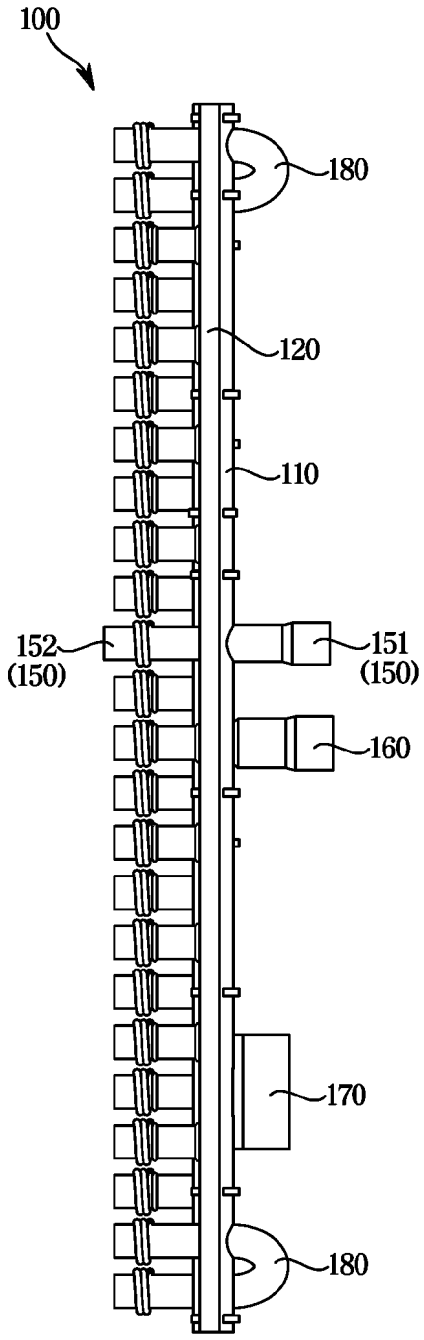


FIG. 5

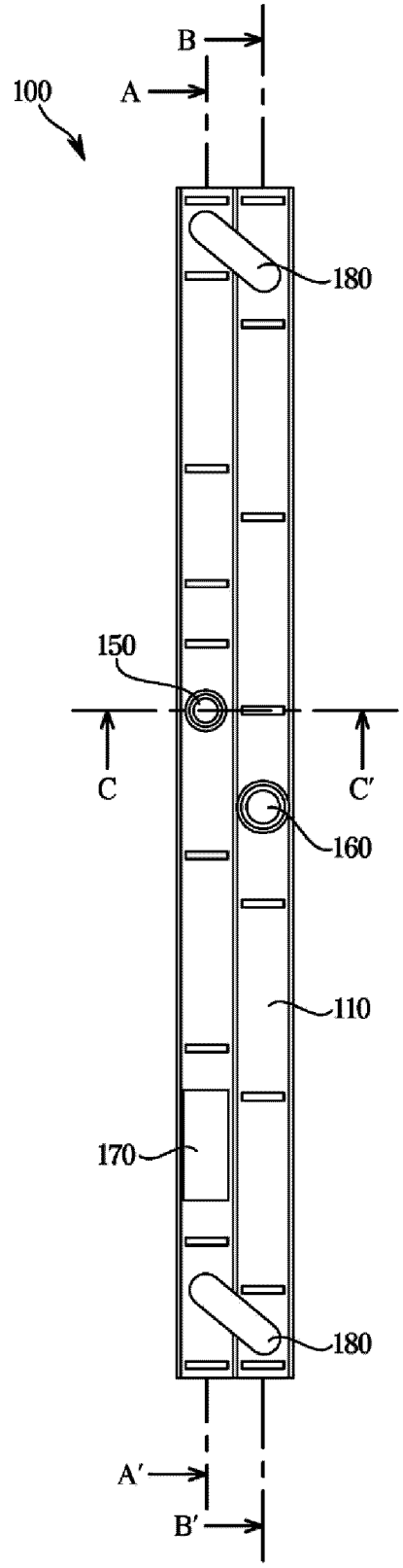
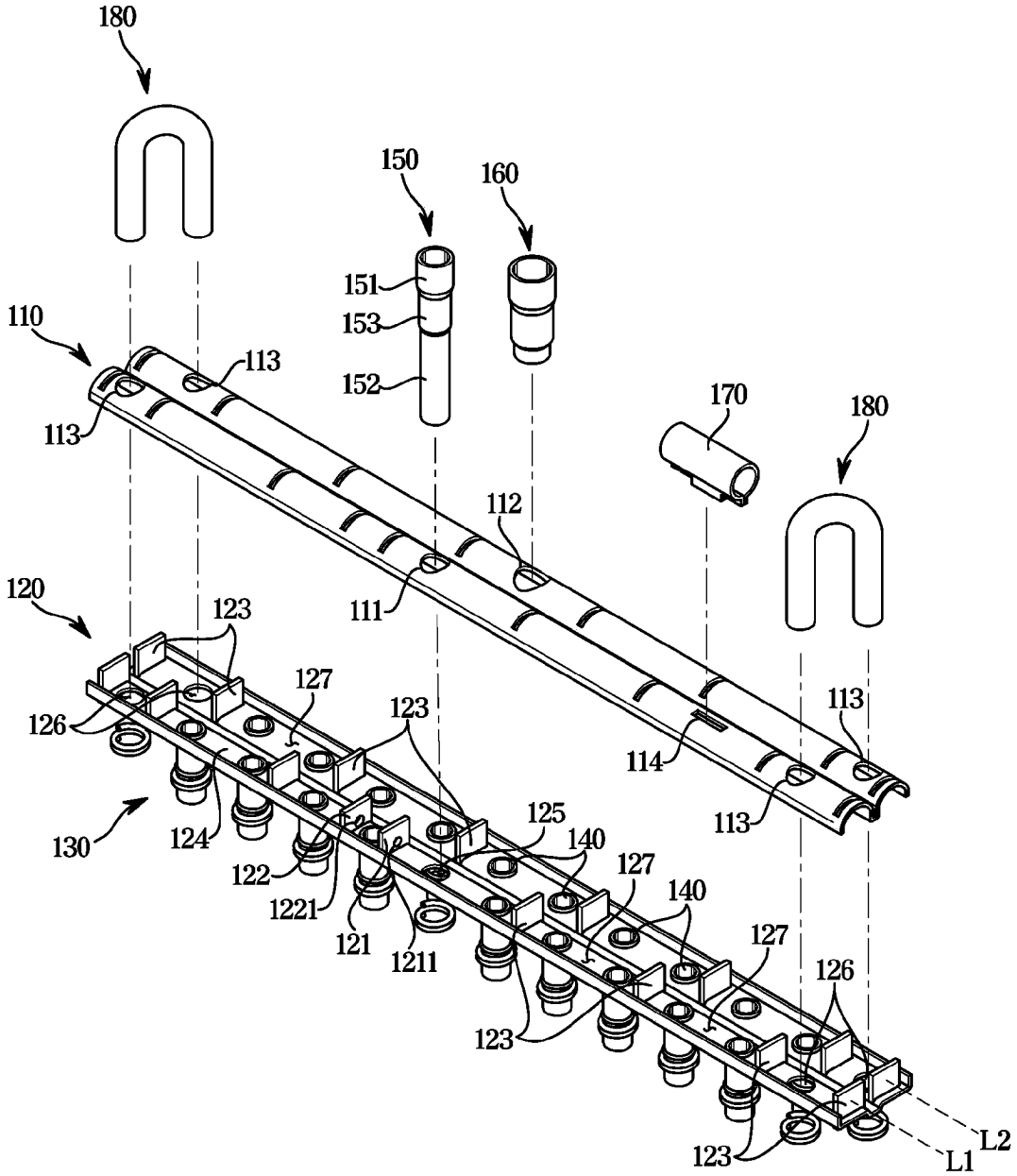


FIG. 6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124
122
127
1221
140
121
1211
127
126
123
123
L2
L1

FIG. 7

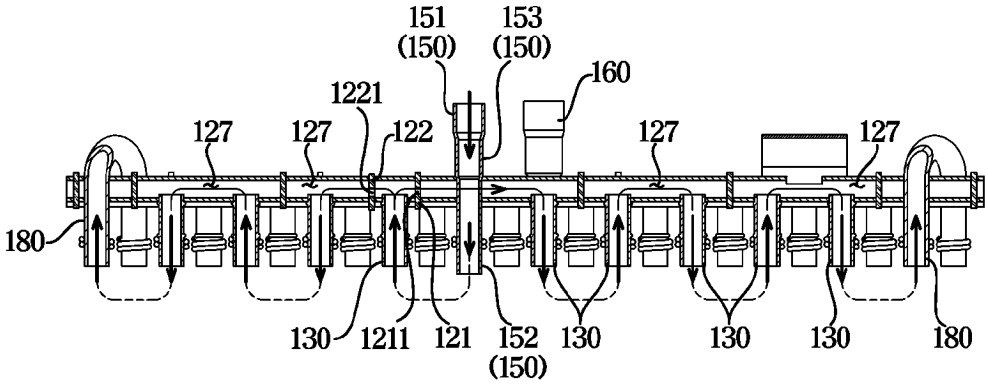
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FIG. 8

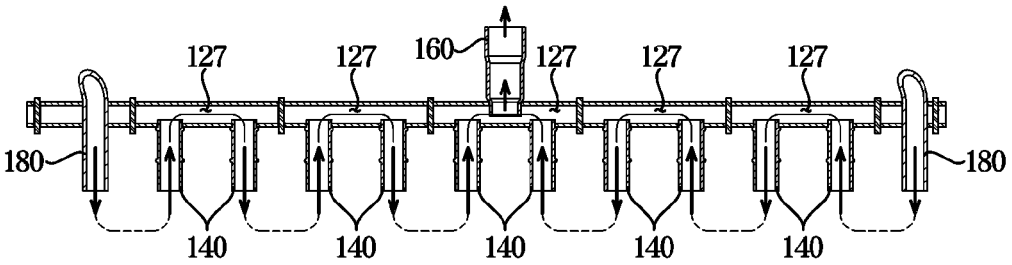

FIG. 9

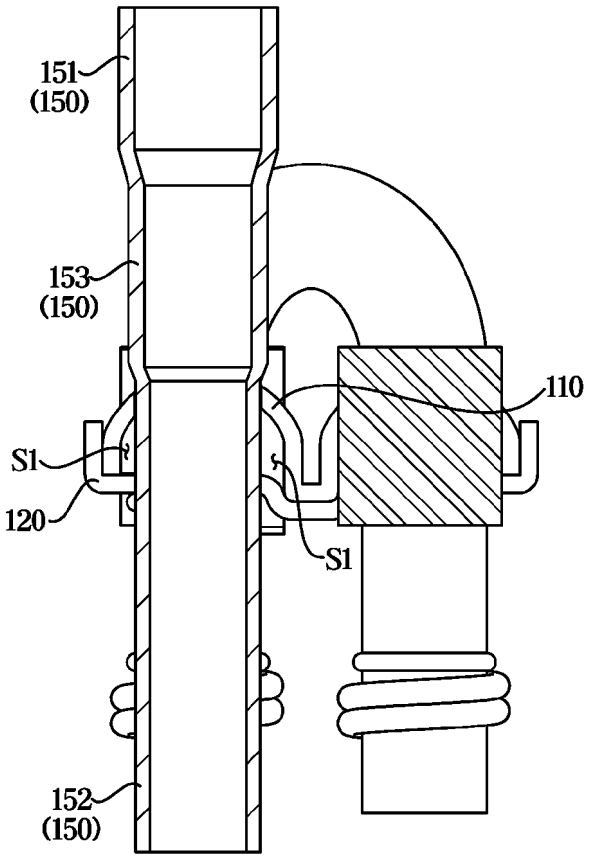

FIG. 10

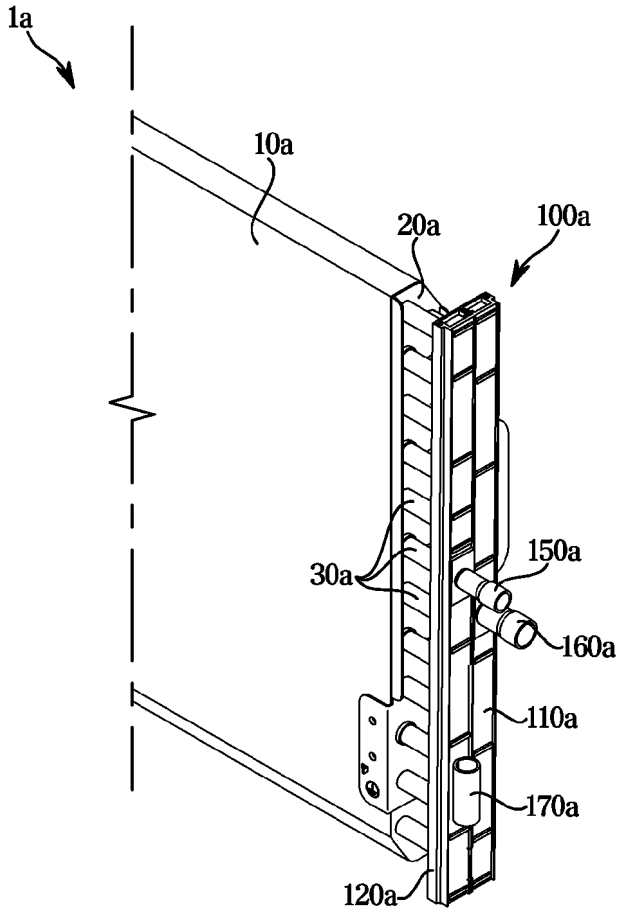

FIG. 11

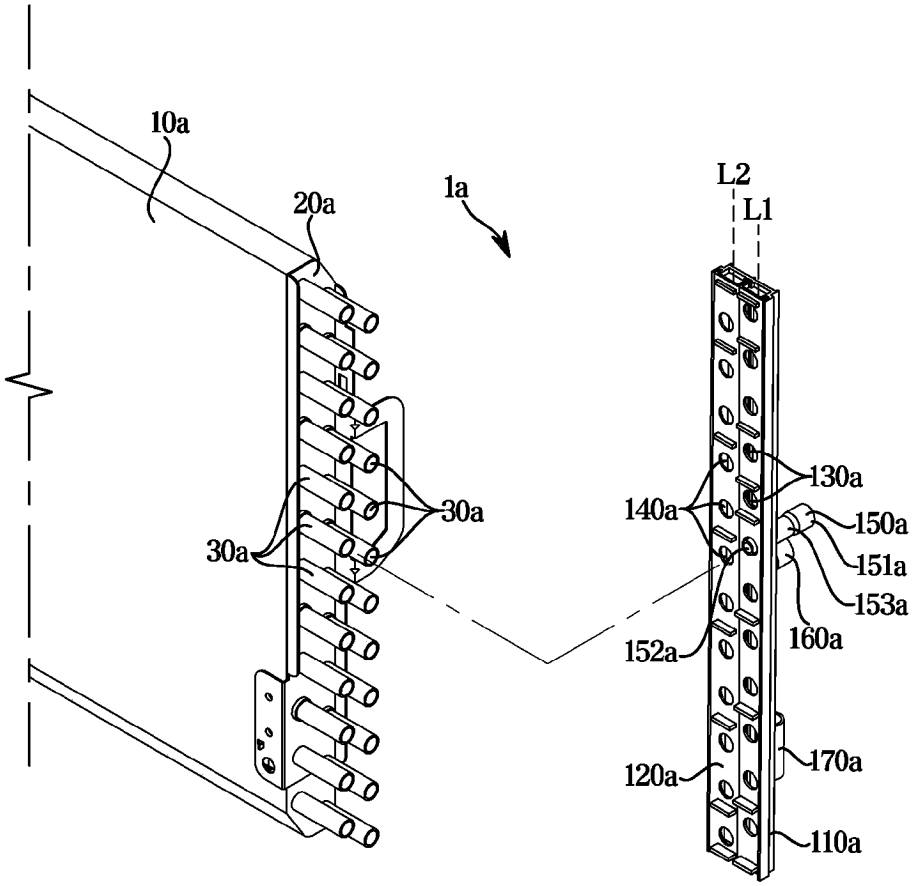
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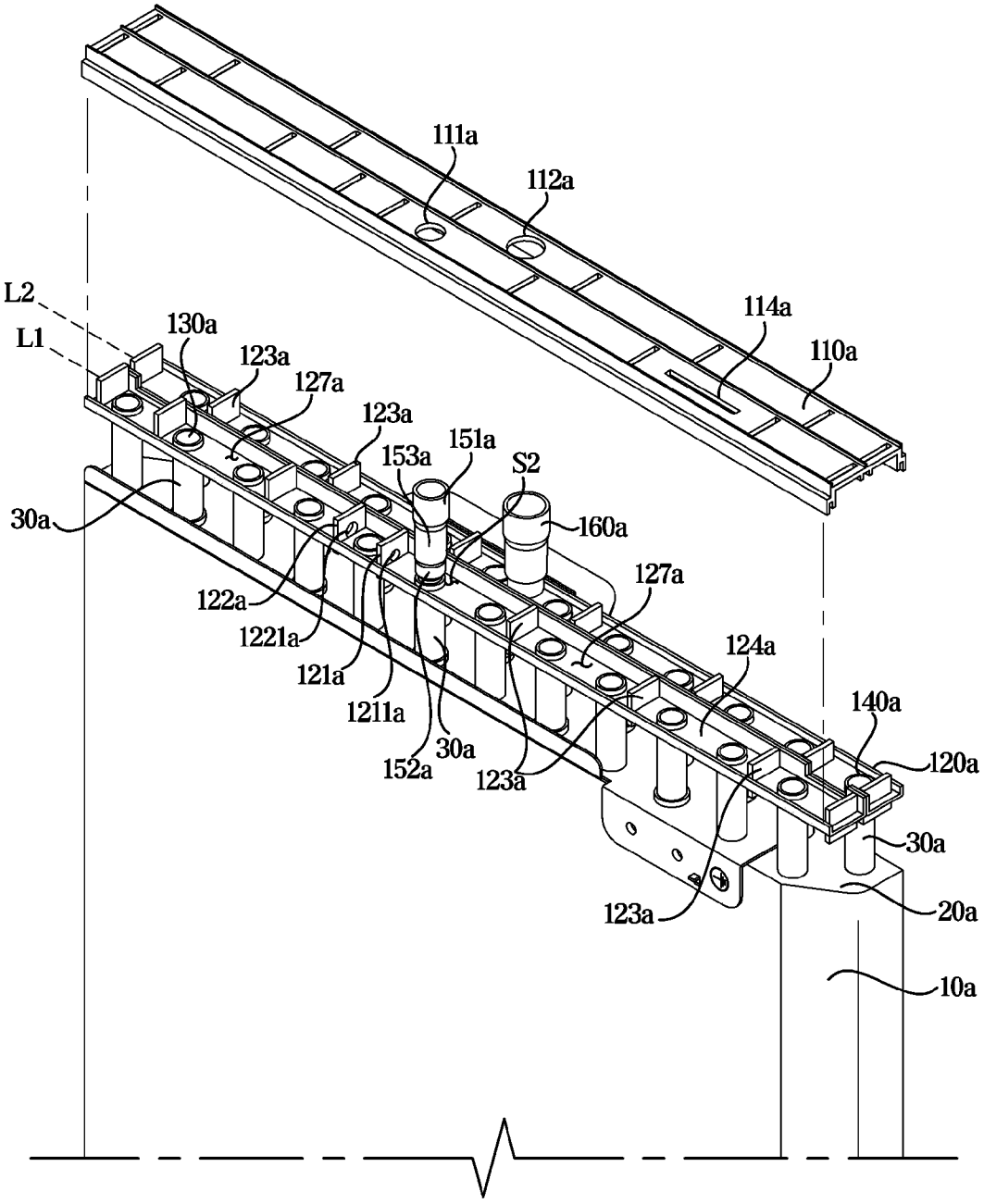
FIG. 12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1221a
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123a
30a
123a
20a
10a

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2023/012371

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/02(2006.01)i; **F28D 1/053**(2006.01)i; **F28F 27/00**(2006.01)i; **F28D 21/00**(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)

F28F 9/02(2006.01); F24D 19/00(2006.01); F28D 1/053(2006.01); F28D 7/00(2006.01); F28F 9/00(2006.01)

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

Korean utility models and applications for utility models: IPC as above
Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords:

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2013-137193 A (DAIKIN INDUSTRIES LTD.) 11 July 2013 (2013-07-11) See paragraphs [0013]-[0016], [0020], [0041]-[0042] and [0134] and figures 3, 5-6 and 9.	1-15
Y	JP 2015-094500 A (TESUKU SHIZAI HANBAI CO., LTD. et al.) 18 May 2015 (2015-05-18) See paragraph [0090] and figures 6 and 8.	1-15
Y	KR 10-2018-0029730 A (SAMSUNG ELECTRONICS CO., LTD.) 21 March 2018 (2018-03-21) See paragraphs [0041], [0046] and [0049] and figures 2-3.	12-14
A	US 5653282 A (HACKEMESSER et al.) 05 August 1997 (1997-08-05) See column 4, line 50 - column 7, line 30 and figures 1-2.	1-15
A	KR 10-2017-0064836 A (ERAE AUTOMOTIVE SYSTEMS CO., LTD.) 12 June 2017 (2017-06-12) See paragraphs [0021]-[0034] and figure 3.	1-15

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
06 December 2023	**06 December 2023**
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Information on patent family members

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