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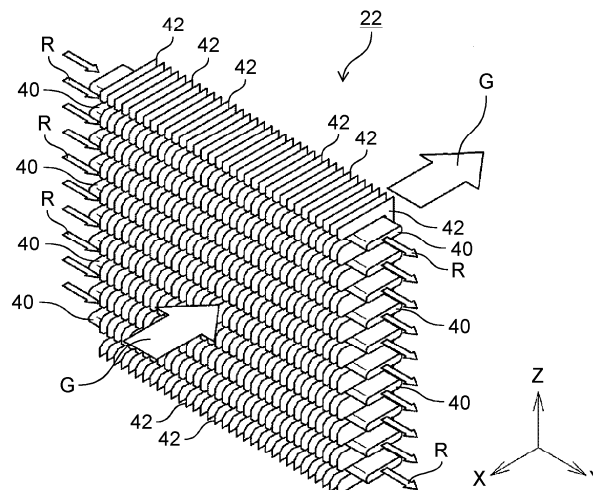
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(54) HEAT EXCHANGER AND AIR CONDITIONER INCLUDING THE SAME

(57) A heat exchanger according to a first exemplary embodiment includes multiple flat tubes (40) arranged in a first direction (Z-axis direction), and multiple fins (42) arranged in a second direction (Y-axis direction) and each including a first end edge (42a) and a second end edge (42b) in a third direction (X-axis direction). Each fin includes multiple cutout portions (42c) each of which includes an upper edge and a lower edge extending in the third direction from the first end edge and in each of which a corresponding one of the

flat tubes passes through between the upper edge and the lower edge. In addition, each fin includes multiple first spacer portions (46 to 52) provided along the upper edge of each cutout portion and protruding in the second direction to be in contact with another adjacent fin. The first spacer portion (46) closest to the first end edge extends toward the first end edge beyond a first end surface (40a) of the corresponding one of the flat tubes.

FIG. 2



Description

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a heat exchanger and an air conditioner including the heat exchanger.

2. Description of the Related Art

[0002] Conventionally, there has been known a heat exchanger which includes multiple flat tubes which are arranged in a first direction and through which a refrigerant flows, and multiple fins which are arranged in a second direction intersecting the first direction, and in which the multiple flat tubes and the multiple fins intersect in a lattice shape (see, for example, PTL 1). Since the multiple flat tubes and the multiple fins intersect in a lattice shape, multiple cutout portions through which the multiple flat tubes pass are formed at one end edge of each of the multiple fins.

Citation List

Patent Literature

[0003] PTL 1: Unexamined Japanese Patent Publication No. 2013-139931

SUMMARY

[0004] A heat exchanger such as the heat exchanger described in PTL 1 may be used in a state in which multiple flat tubes are arranged in a direction including a vertical direction component. In this case, a liquid body (water) generated by the dew condensation on the surface of the fins flows downward on the surface of the fins toward the flat tubes. The liquid body falling on the flat tubes flows on the flat tubes toward another end edge of the fins. Finally, the liquid body flows down along an end edge of the fins. That is, the flat tubes act like gutters.

[0005] As in the heat exchanger described in PTL 1, the depth of each cutout portion of the fin may be larger than the width of the flat tube, that is, one end edge of the fin in which the cutout portion is formed may be largely separated from one end surface of the flat tube. In this case, a liquid body generated by the dew condensation on the surface of the fin near one end edge cannot fall on the flat tube. The liquid body may stay at the upper edge of the cutout portion of the fin and grow large. The liquid body having continuously stayed to grow large becomes, for example, resistance of air passing between the fins, and decreases heat exchange efficiency of the heat exchanger.

[0006] Therefore, the present disclosure provides a

heat exchanger and an air conditioner capable of preventing a liquid body generated by dew condensation on surfaces of fins from continuing to stay in the heat exchanger in which cutout portions of fins each have a depth larger than a width of a flat tube.

[0007] A heat exchanger according to one aspect of the present disclosure includes multiple flat tubes arranged in a first direction including at least a vertical direction component, and multiple fins arranged in a second direction intersecting the first direction and each including a first end edge and a second end edge in a third direction intersecting the first direction and the second direction. Each of the multiple fins includes multiple cutout portions each of which includes an upper edge and a lower edge extending in a third direction from the first end edge and in each of which the flat tube passes through between the upper edge and the lower edge. In addition, each of the multiple fins includes multiple first spacer portions provided at intervals along the upper edge of each of the multiple cutout portions and protruding in the second direction to be in contact with another adjacent fin. A first spacer portion closest to the first end edge of the fin among the multiple first spacer portions extends toward the first end edge of the fin beyond the first end surface of the flat tube in the third direction on the side closer to the first end edge of the fin.

[0008] Further, an air conditioner according to another aspect of the present disclosure includes the heat exchanger described above and a fan that generates a flow of air passing through the heat exchanger in the third direction.

[0009] The present disclosure can provide a heat exchanger and an air conditioner capable of preventing the liquid body generated by dew condensation on the surfaces of the fins from continuing to stay in the heat exchanger in which cutout portions of fins each have a depth larger than the width of the flat tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a schematic view of an air conditioner according to a first exemplary embodiment of the present disclosure;

Fig. 2 is a schematic perspective view of a part of a heat exchanger;

Fig. 3 is a top view of a part of a fin;

Fig. 4 is a perspective view illustrating a cutout portion in the fin;

Fig. 5 is a sectional view of the multiple fins taken along line A-A of Fig. 3;

Fig. 6 is a sectional view of the multiple fins taken along line B-B of Fig. 3;

Fig. 7 is a sectional view of the multiple fins taken along line C-C of Fig. 3;

Fig. 8 is a perspective view illustrating movement

paths of liquid bodies generated by dew condensation on a surface of the fin in the heat exchanger according to the first exemplary embodiment; Fig. 9 is a perspective view illustrating movement paths of liquid bodies generated by dew condensation on a surface of a fin in a heat exchanger according to Comparative Example 1; Fig. 10 is a cross-sectional view of multiple fins illustrating liquid bodies remaining on an upper edge of a cutout portion of the fin in the heat exchanger according to Comparative Example 1; Fig. 11 is a perspective view illustrating a cutout portion in a fin of a heat exchanger according to Comparative Example 2; and Fig. 12 is a top view of a part of the fin illustrating liquid bodies remaining at lower edges of cutout portions of the fin in the heat exchanger according to Comparative Example 2.

DETAILED DESCRIPTIONS

[0011] A heat exchanger of one aspect of the present disclosure includes multiple flat tubes arranged in a first direction including at least a vertical direction component, and multiple fins arranged in a second direction intersecting the first direction and each including a first end edge and a second end edge in a third direction intersecting the first direction and the second direction. Each of the multiple fins includes multiple cutout portions each of which includes an upper edge and a lower edge extending in a third direction from the first end edge and in each of which the flat tube passes through between the upper edge and the lower edge. In addition, each of the multiple fins includes multiple first spacer portions provided at intervals along the upper edge of each of the multiple cutout portions and protruding in the second direction to be in contact with another adjacent fin. A first spacer portion closest to the first end edge of the fin among the multiple first spacer portions extends toward the first end edge of the fin beyond the first end surface of the flat tube in the third direction on the side closer to the first end edge of the fin.

[0012] According to such an aspect, in the heat exchanger in which the depth of each of the cutout portions of the fins is larger than the width of the flat tube, it is possible to prevent a liquid body generated by the dew condensation on the surface of the fin from staying in heat exchanger.

[0013] For example, each of the multiple fins may further include multiple second spacer portions provided at intervals along the lower edge of each of the multiple cutout portions and protruding in the second direction to be in contact with another adjacent fin. In this case, a second spacer portion closest to the first end edge of the fin in the multiple second spacer portions is entirely located on a side of the second end edge of the fin with respect to the first end surface of

the flat tube.

[0014] For example, the cutout portion may include a parallel portion in which the upper edge and the lower edge are parallel to each other and through which the flat tube passes, and a tapered portion in which the distance between the upper edge and the lower edge increases from the parallel portion toward the first end edge of the fin. In this case, the first spacer portion closest to the first end edge of the fin in the multiple first spacer portions extends to the end of the parallel portion of the cutout portion on a side of the first end edge of the fin.

[0015] For example, the first distance between the first end edge of the fin and the first end surface of the flat tube may be larger than a second distance between the second end edge of the fin and the second end surface of the flat tube in the third direction on a side closer to the second end edge.

[0016] An air conditioner of another aspect of the present disclosure includes the heat exchanger described above and a fan that generates a flow of air passing through the heat exchanger in the third direction.

[0017] According to such another aspect, in the air conditioner including the heat exchanger in which the depth of each of the cutout portions of the fins is larger than the width of the flat tube, it is possible to prevent a liquid body generated by the dew condensation on the surface of the fin from staying in heat exchanger.

[0018] For example, the fan may generate a flow of air such that air flows between the fins from the side of the first end edge of each fin.

(Exemplary embodiment 1)

[0019] Hereinafter, a first exemplary embodiment of the present disclosure will be described with reference to the drawings.

[0020] Fig. 1 is a schematic view of air conditioner 10 according to a first exemplary embodiment of the present disclosure.

[0021] As illustrated in Fig. 1, air conditioner 10 according to the present exemplary embodiment includes indoor unit 12 disposed indoors and outdoor unit 14 disposed outdoors.

[0022] As illustrated in Fig. 1, indoor unit 12 includes housing 16 disposed indoors, heat exchanger 18 that is disposed inside housing 16 and exchanges heat with indoor air, and cross flow fan 20 that generates an indoor air flow to cause indoor air to pass through heat exchanger 18. When cross flow fan 20 rotates, indoor air flows into housing 16 and passes through heat exchanger 18. Air that has passed through heat exchanger 18 is blown from housing 16 into an indoor space.

[0023] As illustrated in Fig. 1, the outdoor unit 14 includes heat exchanger 22 that exchanges heat with outdoor air, axial fan 24 that generates a flow of outdoor air so that the outdoor air passes through heat

exchanger 22, and compressor 26 that sends out a refrigerant (first fluid) passing through heat exchangers 18 and 22. Heat exchanger 18, heat exchanger 22, and compressor 26 are connected via refrigerant pipe 28. Expansion valve 30 that decompresses the refrigerant and four-way valve 32 that changes a flow direction of the refrigerant are disposed on refrigerant pipe 28.

[0024] During a cooling operation, the refrigerant is sent out from compressor 26, passes through four-way valve 32, heat exchanger 22 of outdoor unit 14, expansion valve 30, and heat exchanger 18 of indoor unit 12 in this order, and returns to compressor 26. During a heating operation, the refrigerant is sent out from compressor 26, passes through four-way valve 32, heat exchanger 18 of indoor unit 12, expansion valve 30, and heat exchanger 22 of outdoor unit 14 in this order, and returns to compressor 26. Four-way valve 32 switches flow of the refrigerant between flow during the cooling operation and flow during the heating operation.

[0025] Fig. 2 is a perspective view schematically illustrating a part of heat exchanger 22. Note that X-Y-Z orthogonal coordinate system illustrated in the drawing is for facilitating understanding of the exemplary embodiment, and does not limit the exemplary embodiment. The Z-axis direction indicates a vertical direction.

[0026] As illustrated in Fig. 2, heat exchanger 22 includes multiple flat tubes 40 that are arranged at intervals in the first direction (Z-axis direction) and through which the refrigerant R flows, and multiple fins 42 arranged at intervals in the second direction (Y-axis direction) intersecting the first direction and thermally connected to the multiple flat tubes 40. That is, the multiple flat tubes 40 and the multiple fins 42 intersect in a lattice shape as viewed in the third direction (X-axis direction) intersecting both the first and second directions. Axial fan 24 generates a flow of air G so that air G passes through heat exchanger 22 in the third direction. Therefore, the flow direction (X-axis direction) of air G flowing between fins 42 intersects the flow direction (Y-axis direction) of the refrigerant R flowing in flat tubes 40. Note that axial fan 24 corresponds to an example of "fan" of the present disclosure. As described above, air conditioner 10 includes heat exchanger 22 and axial fan 24 that generates a flow of air G so that air passes through heat exchanger 22 in the third direction (X-axis direction). In the exemplary embodiment, the first direction (Z-axis direction) is the vertical direction, but the "first direction" in the present disclosure only needs to include at least the vertical direction component.

[0027] Each of the multiple flat tubes 40 is a tubular member that has a flat cross-sectional shape elongated in a flow direction (X-axis direction) of air G passing through heat exchanger 22 and through which the refrigerant R flows. The multiple flat tubes 40 extend in parallel to each other in the arranging direction (Y-axis direction) of the multiple fins 42.

[0028] Each of the multiple fins 42 has a thin plate

shape and has a substantially rectangular shape as viewed in the arranging direction (the second direction (Y-axis direction)). The thickness (size in the Y-axis direction) of fin 42 is, for example, about 0.08 mm to 0.13 mm. Specifically, each of fins 42 has a shape that is relatively long in the arranging direction (first direction (Z-axis direction)) of the multiple flat tubes 40 and relatively short in the flow direction (third direction (X-axis direction)) of air G passing through heat exchanger 22.

[0029] Further, in the case of the present exemplary embodiment, each of the multiple fins 42 is produced by processing, for example, pressing a metal thin plate having a brazing material layer on each surface, that is, a brazing plate. The brazing plate is produced by forming an aluminum-silicon alloy layer as a brazing material on each surface of a thin plate produced from an aluminum alloy, for example.

[0030] Hereinafter, details of fins 42 will be described with reference to Figs. 3 to 7. Fig. 3 is a top view of a part of fin 42. Further, Fig. 4 is a perspective view illustrating cutout portion 42c in fin 42. Furthermore, Figs. 5 to 7 are sectional views of the multiple fins 42 taken along lines A-A, B-B, and C-C illustrated in Fig. 3, respectively.

[0031] As illustrated in Fig. 3, fin 42 includes first end edge 42a and second end edge 42b in a lateral direction (third direction (X-axis direction)) thereof. In the present exemplary embodiment, first end edge 42a is located on the upstream side in the flow direction of air G passing through heat exchanger 22, and second end edge 42b is located on the downstream side.

[0032] In addition, fin 42 includes multiple cutout portions 42c extending in the lateral direction (third direction (X-axis direction)) from first end edge 42a. The multiple cutout portions 42c extend in the lateral direction in parallel at intervals. In other words, in the case of the present exemplary embodiment, the multiple cutout portions 42c extend from the upstream side toward the downstream side in the flow direction of air G passing through heat exchanger 22.

[0033] Each of the multiple cutout portions 42c includes an upper edge 42d and a lower edge 42e facing each other in the longitudinal direction (first direction (Z-axis direction)) of fin 42. Upper edge 42d and lower edge 42e extend in the lateral direction (third direction (X-axis direction)) from first end edge 42a. Flat tube 40 passes between upper edge 42d and lower edge 42e. The depth (size in the X-axis direction) of cutout portion 42c is larger than the width (the size in the X-axis direction) of flat tube 40.

[0034] In the case of the present exemplary embodiment, cutout portion 42c includes parallel portion 42f in which upper edge 42d and lower edge 42e extend in parallel to each other and through which flat tube 40 passes, and tapered portion 42g in which the distance between upper edge 42d and lower edge 42e increases from parallel portion 42f toward first end edge 42a. Tapered portion 42g allows flat tube 40 to be ea-

sily inserted into cutout portion 42c in the lateral direction (third direction (X-axis direction)) of fin 42.

[0035] As illustrated in Fig. 4, collar portion 44 for holding flat tube 40 is integrally provided in each of the multiple cutout portions 42c of fin 42. Collar portion 44 is produced by press molding, for example. Further, collar portion 44 is a wall-shaped portion having a "U" shape provided along an edge of cutout portion 42c and standing in the arranging direction (the second direction (Y-axis direction)) of the multiple fins 42. An outer peripheral surface of flat tube 40 is in contact with inner peripheral surface 44a of collar portion 44. As a result, each of fins 42 is thermally connected to flat tubes 40 while holding the multiple flat tubes 40 passing through each of cutout portions 42c via the multiple collar portions 44.

[0036] As illustrated in Fig. 4, in the case of the present exemplary embodiment, each collar portion 44 of fin 42 includes multiple first spacer portions 46, 48, 50, and 52, and multiple second spacer portions 54, 56, and 58 for forming a gap through which air G flows with another adjacent fin 42. As described above, each of the multiple fins 42 includes the multiple first spacer portions 46, 48, 50, and 52 and the multiple second spacer portions 54, 56, and 58.

[0037] As illustrated in Fig. 3, the multiple first spacer portions 46 to 52 are provided at intervals along upper edge 42d of cutout portion 42c. The multiple second spacer portions 54 to 58 are provided at intervals along lower edge 42e of cutout portion 42c.

[0038] Further, each of the multiple first spacer portions 46 to 52 and the multiple second spacer portions 54 to 58 protrudes in the arranging direction (second direction (Y-axis direction)) of fin 42 to be in contact with another adjacent fin 42. Specifically, first spacer portions 46, 48, 50, 52 respectively include rising portions 46a, 48a, 50a, 52a extending toward another adjacent fin 42, and include flare portions 46b, 48b, 50b, 52b provided at the tips of the respective rising portions 46a, 48a, 50a, 52a to be in contact with another adjacent fin 42. Flare portions 46b, 48b, 50b, 52b respectively include contact surfaces 46c, 48c, 50c, 52c in contact with another adjacent fin 42.

[0039] Similarly, second spacer portions 54, 56, 58 respectively include rising portions 54a, 56a, 58a extending toward another adjacent fin 42, and include flare portions 54b, 56b, 58b provided at the tips of the respective rising portions 54a, 56a, 58a to be in contact with another adjacent fin 42. Flare portions 54b, 56b, 58b respectively include contact surfaces 54c, 56c, 58c in contact with another adjacent fin 42.

[0040] Here, a method for producing heat exchanger 22 will be described.

[0041] First, multiple fins 42 are stacked. Specifically, the multiple fins 42 are stacked such that the stacking direction (the second direction (Y-axis direction)) is the vertical direction.

[0042] When multiple fins 42 are stacked, multiple

flat tubes 40 are inserted into the respective multiple cutout portions 42c of each of the multiple fins 42. That is, one flat tube 40 is simultaneously inserted into cutout portion 42c of each of the multiple fins 42. As a result, multiple flat tubes 40 and multiple fins 42 intersect in a lattice shape. By heating multiple fins 42 into which multiple flat tubes 40 are inserted, brazing material layers on surfaces of each of fins 42 are melted. After that, when cooled, the multiple flat tubes 40 and the multiple fins 42 are fixed to each other by the solidified brazing material.

[0043] Hereinafter, further features of the present exemplary embodiment will be described.

[0044] As illustrated in Figs. 3 and 4, in the multiple first spacer portions 46 to 52, first spacer portion 46 closest to first end edge 42a of fin 42 extends toward first end edge 42a. Specifically, first spacer portion 46 extends toward first end edge 42a of fin 42 beyond first end surface 40a of flat tube 40 in the third direction (X-axis direction) on the side closer to first end edge 42a of fin 42. In the case of the present exemplary embodiment, first spacer portion 46 extends to the end of parallel portion 42f of cutout portion 42c on the side of first end edge 42a of fin 42. That is, in the arranging direction (first direction (Z-axis direction)) of flat tubes 40, first spacer portion 46 has a part that does not overlap flat tube 40 on the side of first end edge 42a of fin 42 and the remaining part that overlaps flat tube 40.

[0045] The role of first spacer portion 46 will be described. For that, a description is made with reference to Comparative Example 1.

[0046] Fig. 8 is a perspective view illustrating movement paths of liquid bodies W1 and W2 generated by dew condensation on a surface of fin 42 in heat exchanger 18 according to the present exemplary embodiment. Fig. 9 is a perspective view illustrating movement paths of liquid bodies W1 and W2 generated by dew condensation on a surface of fin 142 in the heat exchanger according to Comparative Example 1. Fig. 10 is a cross-sectional view of multiple fins 142 illustrating liquid bodies W1 remaining on upper edges 142d of cutout portions 142c of fins 142 in the heat exchanger according to Comparative Example 1.

[0047] As illustrated in Fig. 8, in the case of the present exemplary embodiment, liquid bodies W1 and W2 condensed on the surface of fin 42 flow downward along the surface of fin 42 and reach onto flat tube 40. Specifically, liquid bodies W2 far from first end edge 42a of fin 42 directly reach onto flat tube 40. Liquid bodies W2 on flat tube 40 are attracted to liquid body W3 flowing down at a high speed along second end edge 42b of fin 42 and flow toward second end edge 42b. Note that liquid body W3 is constituted by liquid bodies W1 and W2 generated above liquid W3. Then, liquid bodies W2 finally flow down along second end edge 42b.

[0048] Liquid body W1 close to first end edge 42a of fin 42 first reaches onto the rising portion 46a of first

spacer portion 46 closest to first end edge 42a. Then, liquid body W1 on the rising portion 46a of first spacer portion 46 is attracted to liquid bodies W2 moving toward the second end edge 42b on the flat tube 40, and moves toward flat tube 40. Then, similarly to liquid bodies W2, liquid body W1 is attracted to liquid body W3 and finally flows down along second end edge 42b of fin 42.

[0049] Note that such movement of liquid bodies W1 to W3 occurs even when air G is not flowing in heat exchanger 22 (that is, even in a state in which the rotation of axial fan 24 is stopped).

[0050] In contrast, in the case of Comparative Example 1 illustrated in Fig. 9, first spacer portion 146 closest to first end edge 142a of fin 142 does not extend beyond first end surface 40a of flat tube 40 on the side closer to first end edge 142a of fin 142. That is, in the case of Comparative Example 1, the first spacer portions 146, 148, 150, and 152 entirely overlap flat tube 40 in the arranging direction (first direction (Z-axis direction)) of flat tubes 40.

[0051] Therefore, in the case of Comparative Example 1, liquid bodies W2 condensed at the surface position of fin 142 far from first end edge 142a of fin 142 flow downward along the surface of fin 142 and reach onto flat tube 40. In contrast, liquid body W1 condensed at the surface position close to first end edge 142a of fin 142 cannot reach onto flat tube 40 because first spacer portion 146 closest to first end edge 142a does not extend beyond first end surface 40a of the flat tube 40 toward the first end edge 142a. As a result, as illustrated in Fig. 10, in the case of Comparative Example 1, liquid body W1 is not guided onto flat tube 40 by first spacer portion 146, and continues to stay at upper edge 142d of cutout portion 142c. Liquid body W1 that continues to stay at upper edge 142d of cutout portion 142c becomes a resistance of air G passing between fins 142 when largely growing. As a result, the heat exchange efficiency of the heat exchanger according to Comparative Example 1 decreases.

[0052] Therefore, unlike Comparative Example 1, in the case of the present exemplary embodiment, first spacer portion 46 closest to first end edge 42a of fin 42 extends beyond first end surface 40a of flat tube 40 toward first end edge 42a. This allows liquid body W1 close to first end edge 42a of fin 42 to move on first spacer portion 46 and reach onto flat tube 40. As a result, liquid body W1 is prevented from staying at upper edge 42d of cutout portion 42c.

[0053] Note that, as illustrated in Figs. 3 and 4, second spacer portion 54, which is provided at lower edge 42e of cutout portion 42c and closest to first end edge 42a of fin 42, does not extend beyond first end surface 40a of flat tube 40 unlike first spacer portion 46. That is, second spacer portion 54 is entirely positioned on the side of second end edge 42b of fin 42 with respect to first end surface 40a of flat tube 40. The reason will be described with reference to Comparative Example 2.

[0054] Fig. 11 is a perspective view illustrating cutout portion 242c in fin 242 of the heat exchanger according to Comparative Example 2. Fig. 12 is a top view of a part of fin 242 illustrating liquid bodies W4 remaining at the lower edges of cutout portions 242c of fin 242 in the heat exchanger according to Comparative Example 2.

[0055] As illustrated in Figs. 11 and 12, in the case of Comparative Example 2, each second spacer portion 254 closest to first end edge 242a of fin 242 extends beyond first end surface 40a of flat tube 40 toward first end edge 242a. Therefore, each liquid body W4 generated by the dew condensation on first end surface 40a of flat tube 40 is accumulated between first end surface 40a and second spacer portion 254. Space S in front of first end surface 40a of flat tube 40 is made into a dead end space by first spacer portion 246, second spacer portion 254, and flat tube 40. Therefore, liquid body W4 accumulated in the dead end space S cannot move anywhere even if air G flows in heat exchanger 22. Air G that has flowed into the dead end space S cannot also move. As a result, liquid body W4 and air G continue to stay on first end surface 40a of flat tube 40, and the heat exchange efficiency at first end surface 40a significantly decreases.

[0056] Therefore, unlike Comparative Example 2, in the case of the present exemplary embodiment, second spacer portion 54 closest to first end edge 42a of fin 42 does not extend beyond first end surface 40a of flat tube 40 toward first end edge 42a. As a result, space S in front of first end surface 40a of flat tube 40 does not become a dead end space. This causes air G subjected to the heat exchange at first end surface 40a of flat tube 40 and liquid bodies W4 generated by the dew condensation at first end surface 40a to move without staying on first end surface 40a. As a result, first end surface 40a of flat tube 40 can continue to exchange heat with air G with high heat exchange efficiency without being hindered by liquid bodies W4 generated by condensation.

[0057] In the case of the present exemplary embodiment, as illustrated in Fig. 3, distance L1 between first end edge 42a of fin 42 and first end surface 40a of flat tube 40 is made as follows. That is, distance L1 is larger than distance L2 between second end edge 42b of fin 42 and second end surface 40b of flat tube 40 in the third direction (X-axis direction) on the side closer to second end edge 42b. That is, the center of flat tube 40 in the width direction (X-axis direction) is shifted toward second end edge 42b from the center of fin 42 in the lateral direction (X-axis direction). In addition, in the case of the present exemplary embodiment, axial fan 24 generates a flow of air G so that air G flows between fins 42 from first end edge 42a side. As a result, heat exchange efficiency between air G and heat exchanger 22 can be improved (compared with the case where distances L1, L2 are equal). Note that distance L1 corresponds to an example of a "first distance" of the present disclosure, and distance L2 corresponds to an ex-

ample of a "second distance" of the present disclosure.

[0058] Specifically, the surface area of the upstream portion of fin 42 between first end edge 42a and first end surface 40a of flat tube 40 is larger than the surface area of the downstream portion of fin 42 between second end surface 40b of flat tube 40 and second end edge 42b. The upstream portion of fin 42 exchanges heat with the fresh air G before exchanging heat with flat tube 40, thereby improving the heat exchange efficiency between air G and heat exchanger 22. In contrast, in a case where the surface area of the downstream portion of fin 42 is made larger than the surface area of the upstream portion, the downstream portion exchanges heat with air G that has undergone heat exchange with flat tube 40, so that the heat exchange efficiency between fin 42 and air G is not substantially improved.

[0059] According to the present exemplary embodiment as described above, in heat exchanger 22 in which the depth of cutout portion 42c of fin 42 is larger than the width of flat tube 40, it is possible to prevent liquid bodies W1 and W2 generated by the dew condensation on the surface of fin 42 from staying in heat exchanger 22.

(Other exemplary embodiments)

[0060] Although the present disclosure is described above with reference to the first exemplary embodiment described above, the present disclosure is not limited to the first exemplary embodiment described above.

[0061] For example, in the case of the above-described first exemplary embodiment, as illustrated in Fig. 3, air G flows between fins 42 from first end edge 42a side of fin 42 in which cutout portion 42c is formed. As a result, as illustrated in Fig. 8, when axial fan 24 is rotating, the air blow promotes the movement of liquid bodies W1 and W2 generated by the dew condensation in each fin 42 toward second end edge 42b. However, the exemplary embodiment of the present disclosure is not limited to this.

[0062] Air G may flow between fins 42 from the side of second end edge 42b of fins 42. In this case, in a case where air G does not flow between fins 42, as illustrated in Fig. 8, liquid bodies W1 and W2 generated by the dew condensation in each fin 42 flow toward second end edge 42b. In addition, also in a case where the flow velocity of air G flowing between fins 42 from second end edge 42b toward first end edge 42a is small, similarly, as illustrated in Fig. 8, liquid bodies W1 and W2 generated by the dew condensation in each fin 42 flow toward second end edge 42b. That is, liquid bodies W1 and W2 generated by the dew condensation in each fin 42 are attracted to liquid body W3 flowing down at a high speed along second end edge 42b, and thereby move toward second end edge 42b regardless of the direction of air G flowing between fins 42.

[0063] For example, the heat exchanger 22 according to the first exemplary embodiment of the present disclosure is mounted in the outdoor unit 14 of the air conditioner 10, but may be mounted in the indoor unit 12. Further, the heat exchanger according to the exemplary embodiment of the present disclosure can also be used for applications other than an air conditioner.

[0064] That is, in a broad sense, the heat exchanger according to the exemplary embodiment of the present disclosure includes multiple flat tubes arranged in a first direction including at least a vertical direction component, and multiple fins arranged in a second direction intersecting the first direction and each including a first end edge and a second end edge in a third direction intersecting the first direction and the second direction. Each of the multiple fins includes multiple cutout portions each of which includes an upper edge and a lower edge extending in a third direction from the first end edge and in each of which the flat tube passes through between the upper edge and the lower edge. In addition, each of the multiple fins includes multiple first spacer portions provided at intervals along the upper edge of each of the multiple cutout portions and protruding in the second direction to be in contact with another adjacent fin. A first spacer portion closest to the first end edge of the fin among the multiple first spacer portions extends toward the first end edge of the fin beyond the first end surface of the flat tube in the third direction on the side closer to the first end edge of the fin.

[0065] The present disclosure is applicable to a heat exchanger in which multiple spacer portions provided in each of the fins are in contact with another adjacent fin to form a gap between the fins.

Claims

1. A heat exchanger comprising:

multiple flat tubes arranged in a first direction including at least a vertical direction component; and
multiple fins arranged in a second direction intersecting the first direction and each including a first end edge and a second end edge in a third direction intersecting the first direction and the second direction,
wherein each of the multiple fins includes multiple cutout portions each including an upper edge and a lower edge extending from the first end edge in the third direction, each of the multiple cutout portions allowing a corresponding one of the multiple flat tubes to pass between the upper edge and the lower edge, and
multiple first spacer portions provided at intervals along the upper edge of each of the multi-

ple cutout portions and protruding in the second direction to be in contact with an adjacent fin of the multiple fins, and
 a first spacer portion closest to the first end edge of a corresponding one of the multiple fins among the multiple first spacer portions extends toward the first end edge of the corresponding one of the multiple fins beyond a first end surface of a corresponding one of the multiple flat tubes in the third direction on a side closer to the first end edge of the corresponding one of the multiple fins.

2. The heat exchanger according to Claim 1,

wherein each of the multiple fins further includes multiple second spacer portions provided at intervals along the lower edge of each of the multiple cutout portions and protruding in the second direction to be in contact with an adjacent fin of the multiple fins, and
 a second spacer portion closest to the first end edge of a corresponding one of the multiple fins among the multiple second spacer portions is entirely located on a side of the second end edge of the corresponding one of the multiple fins with respect to the first end surface of a corresponding one of the multiple flat tubes.

3. The heat exchanger according to Claim 2,

wherein the multiple cutout portions each include a parallel portion in which the upper edge and the lower edge are parallel to each other and through which a corresponding one of the multiple flat tubes passes, and a tapered portion in which distance between the upper edge and the lower edge increases from the parallel portion toward the first end edge of a corresponding one of the multiple fins, and
 a first spacer portion closest to the first end edge of the corresponding one of the multiple fins among the multiple first spacer portions extends to an end of the parallel portion of each of the multiple cutout portions on a side of the first end edge of the corresponding one of the multiple fins.

4. The heat exchanger according to Claim 1, wherein a first distance between the first end edge of each of the multiple fins and the first end surface of a corresponding one of the multiple flat tubes is larger than a second distance between the second end edge of the corresponding one of the multiple fins and a second end surface of the corresponding one of the multiple flat tubes in the third direction on a side closer to the second end edge.

5. An air conditioner comprising:

the heat exchanger according to any one of Claims 1 to 4; and
 a fan that generates a flow of air to pass through the heat exchanger in the third direction.

6. The air conditioner according to Claim 5, wherein the fan generates a flow of the air, the air flowing between the multiple fins from a side of the first end edge of each of the multiple fins.

FIG. 1

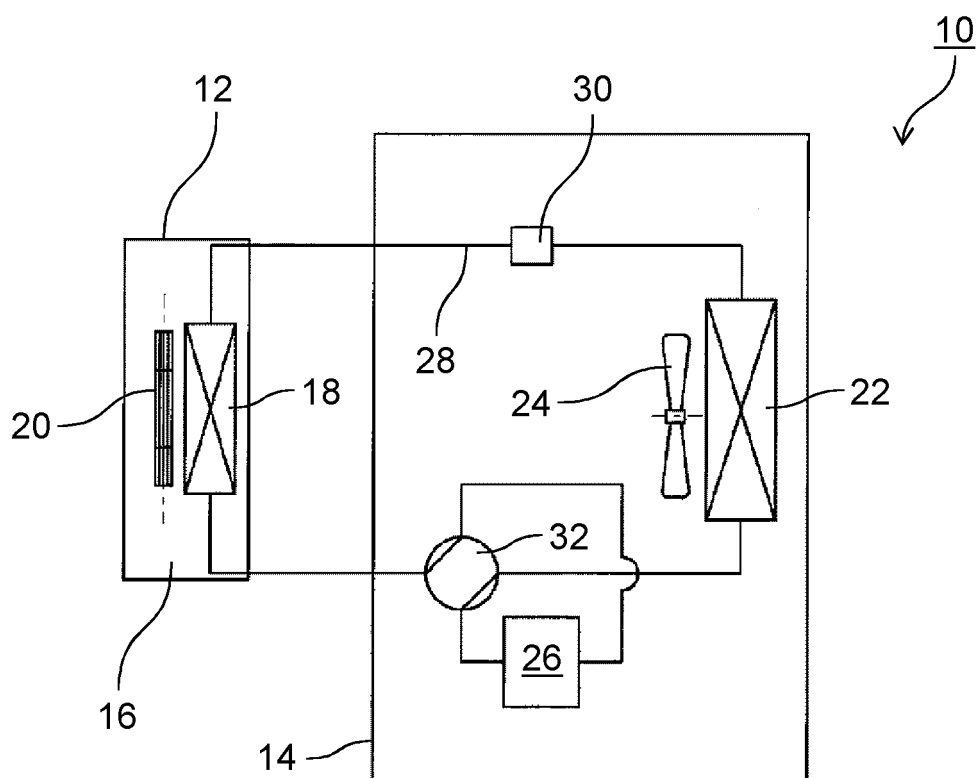


FIG. 2

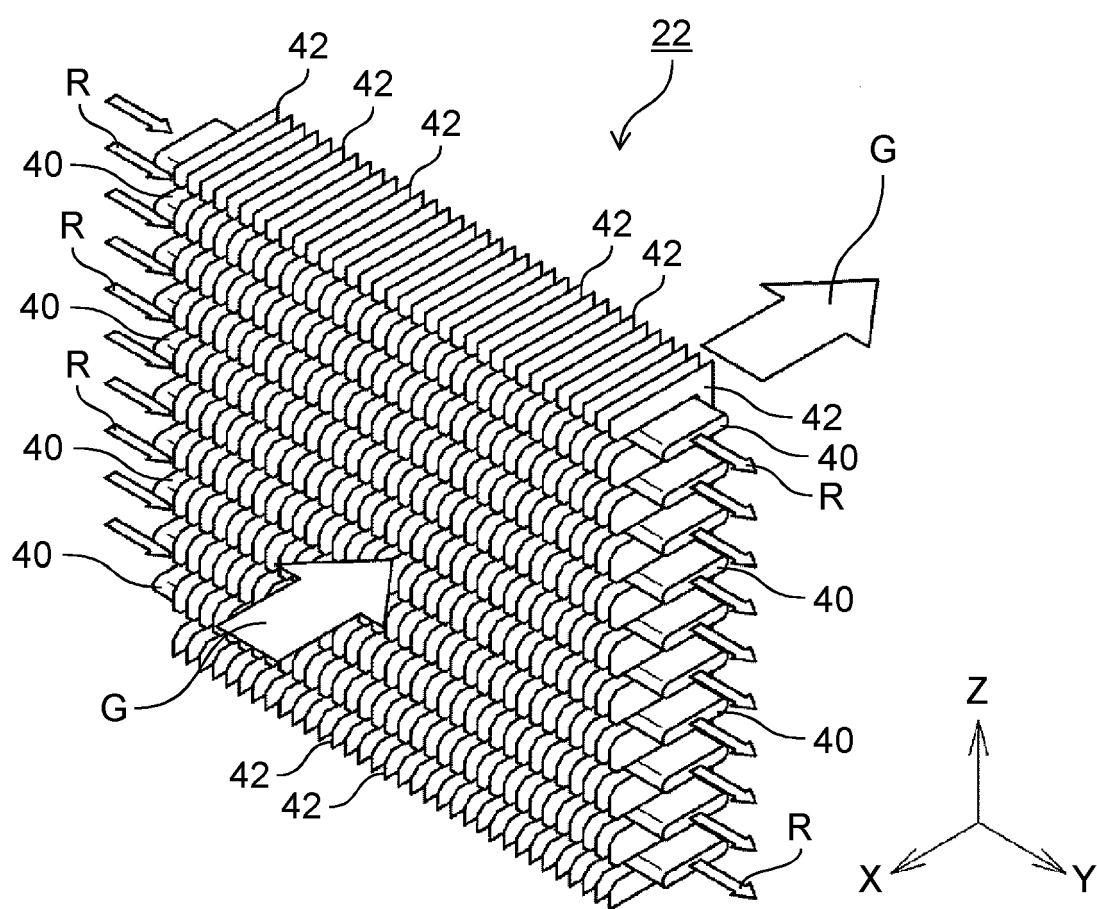


FIG. 3

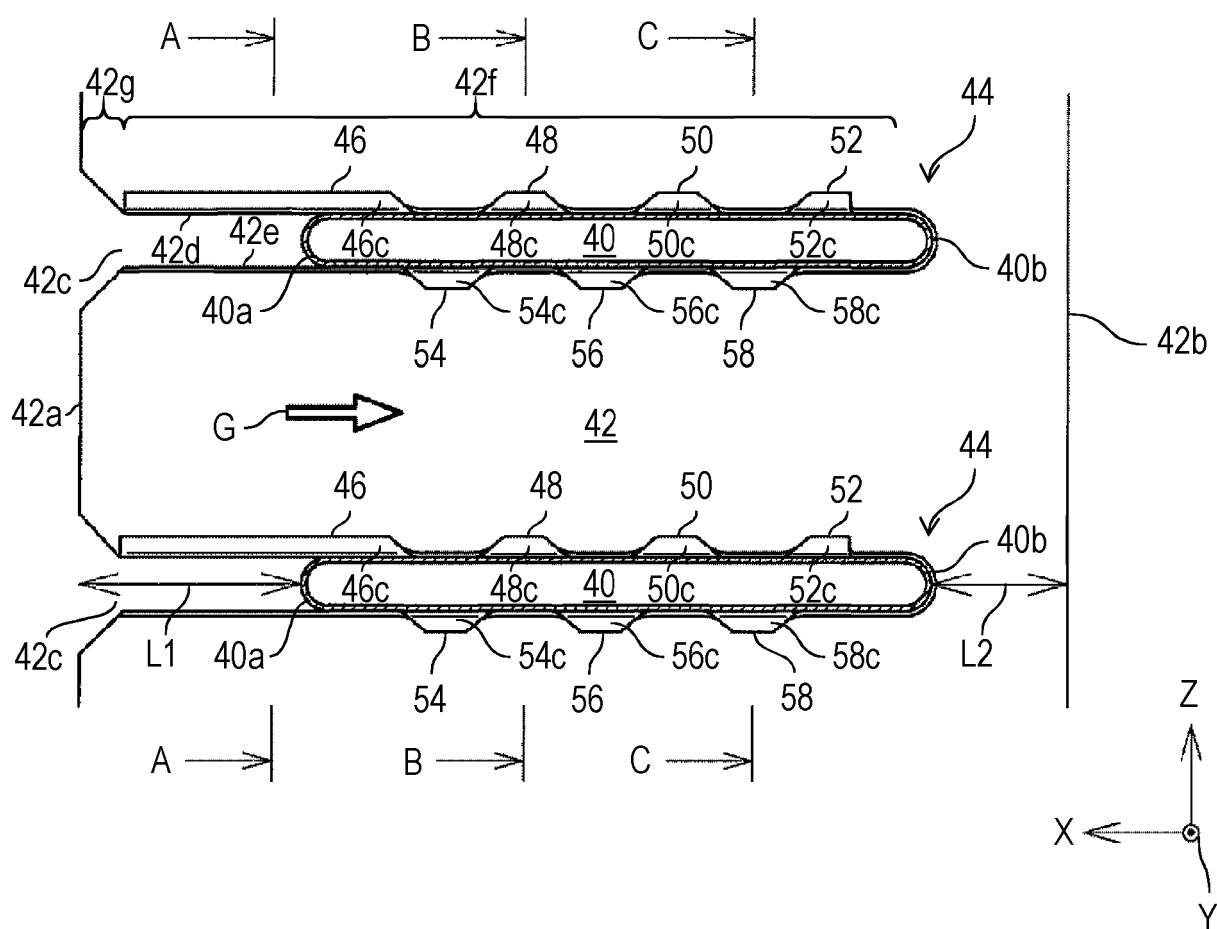


FIG. 4

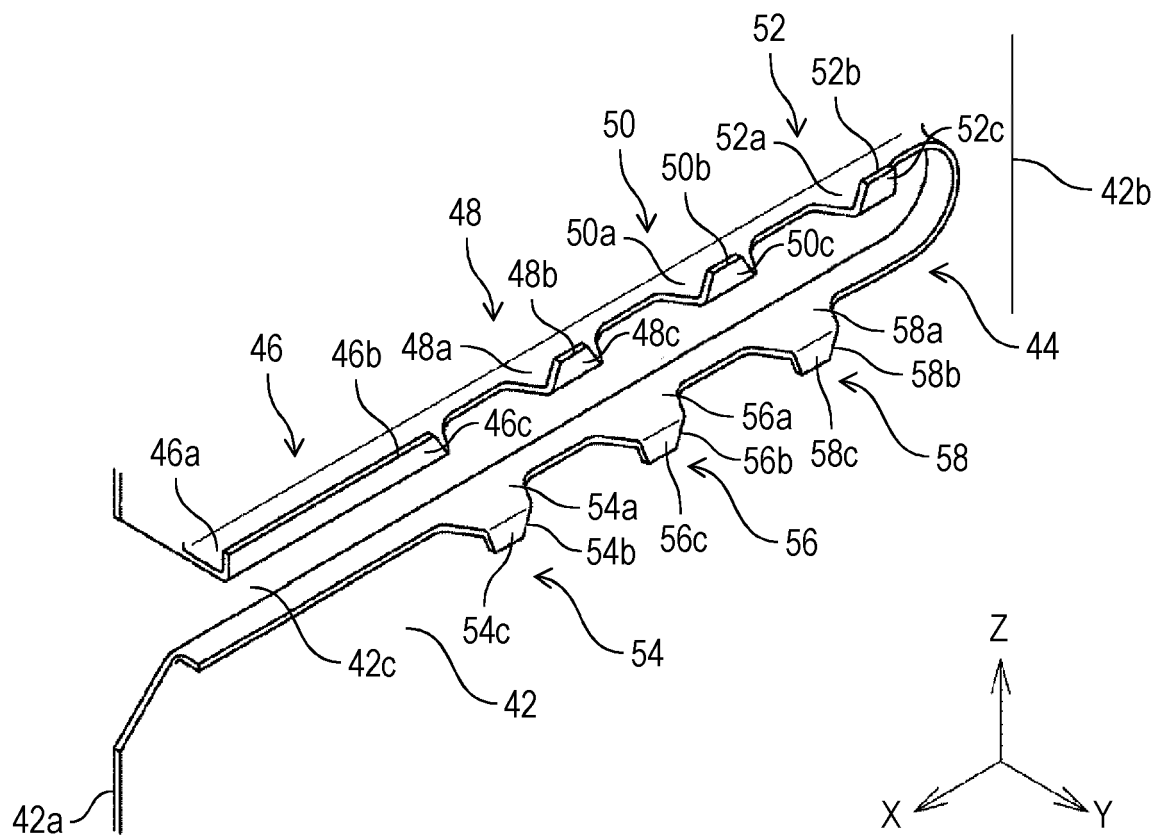


FIG. 5

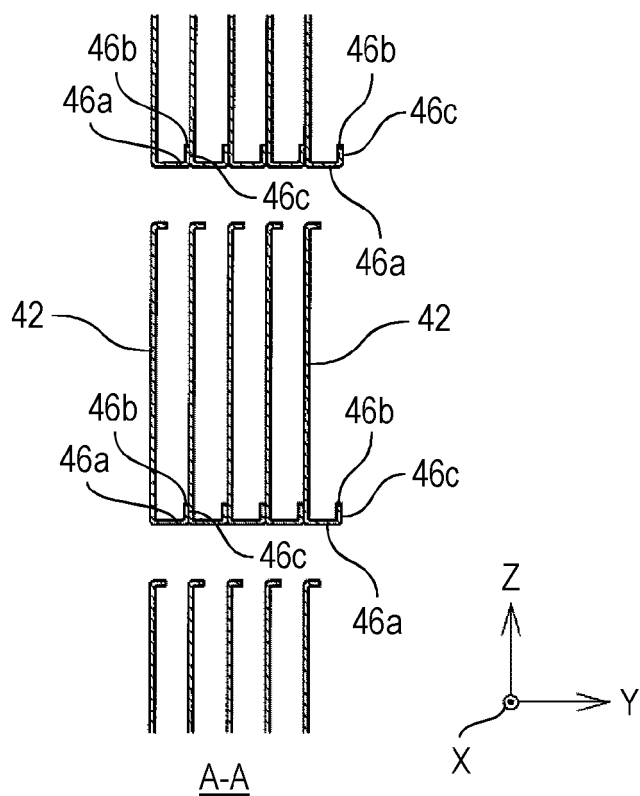


FIG. 6

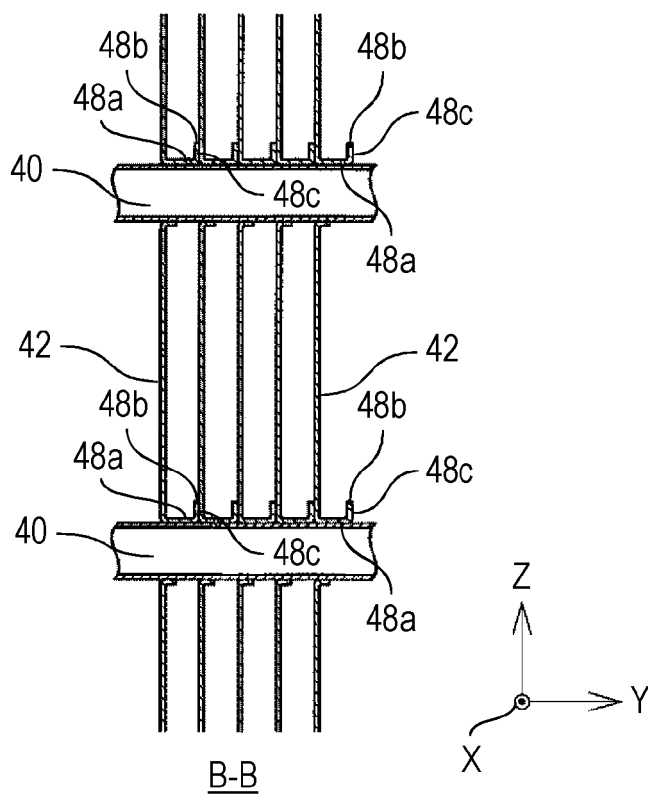


FIG. 7

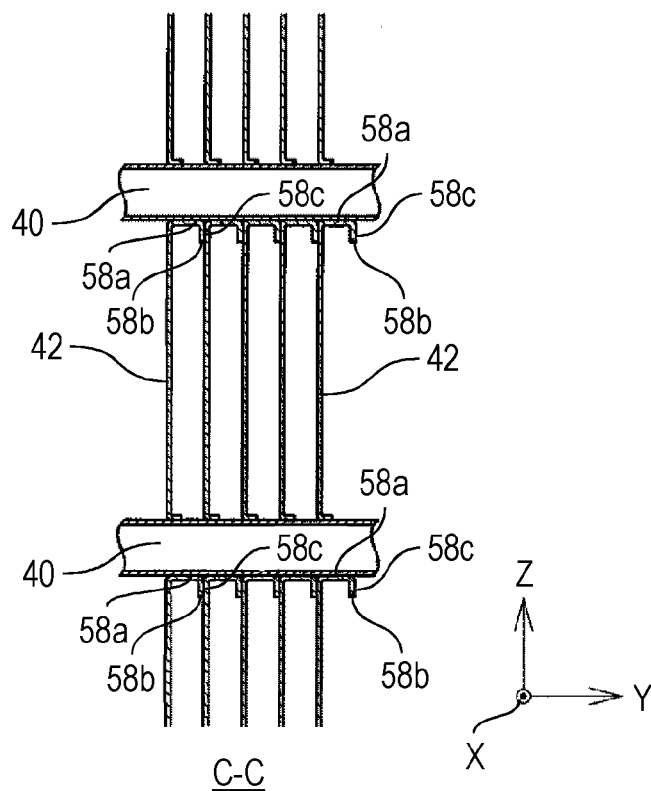


FIG. 8

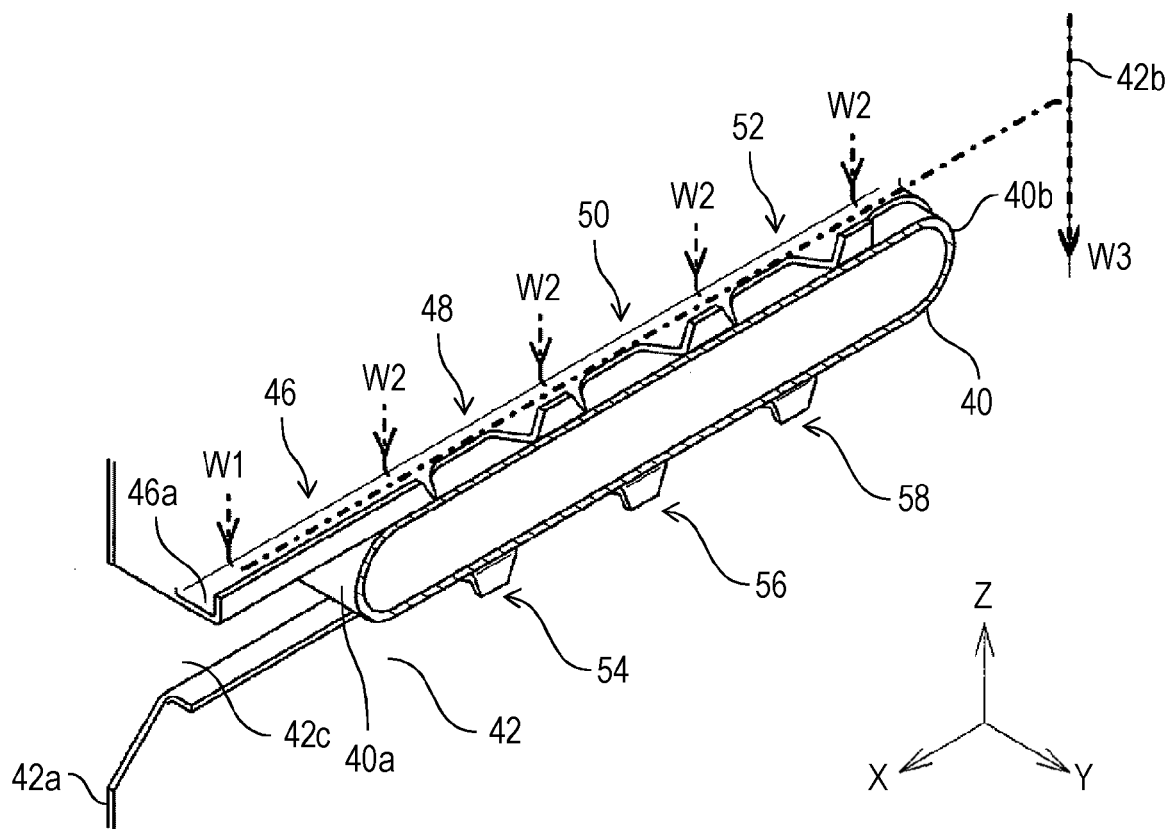


FIG. 9

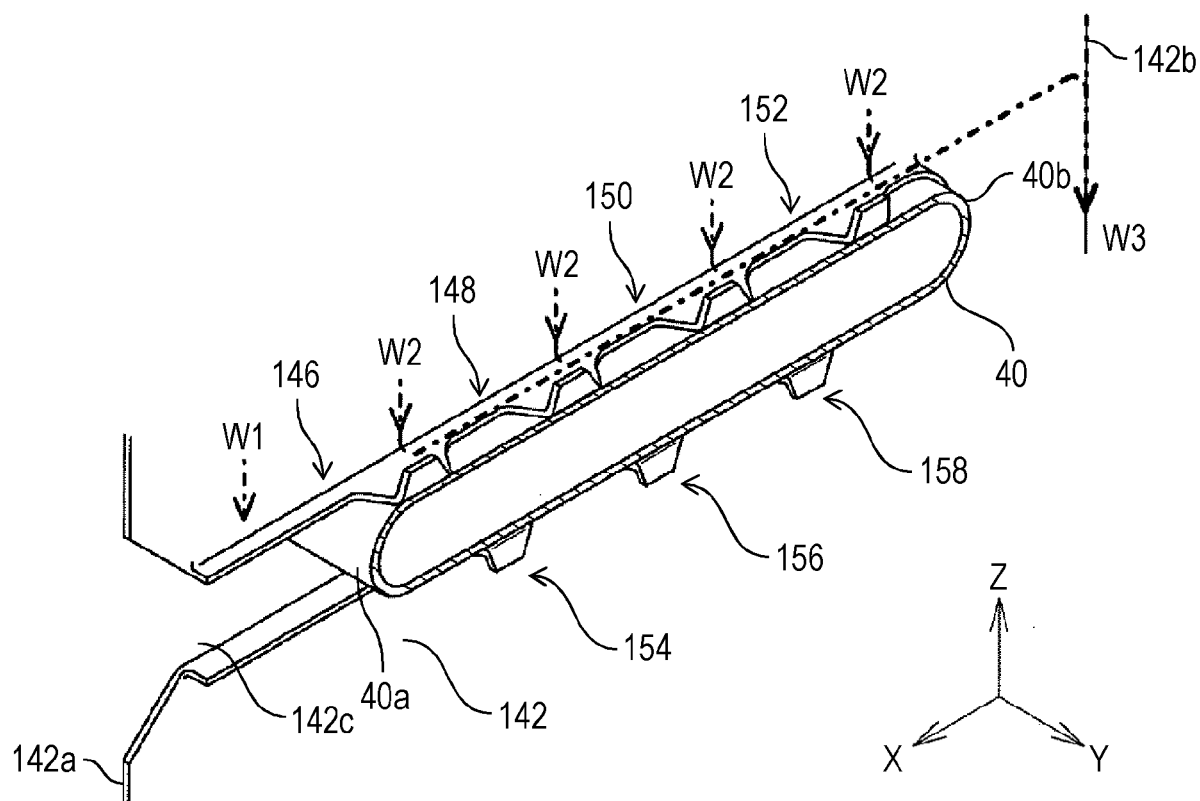


FIG. 10

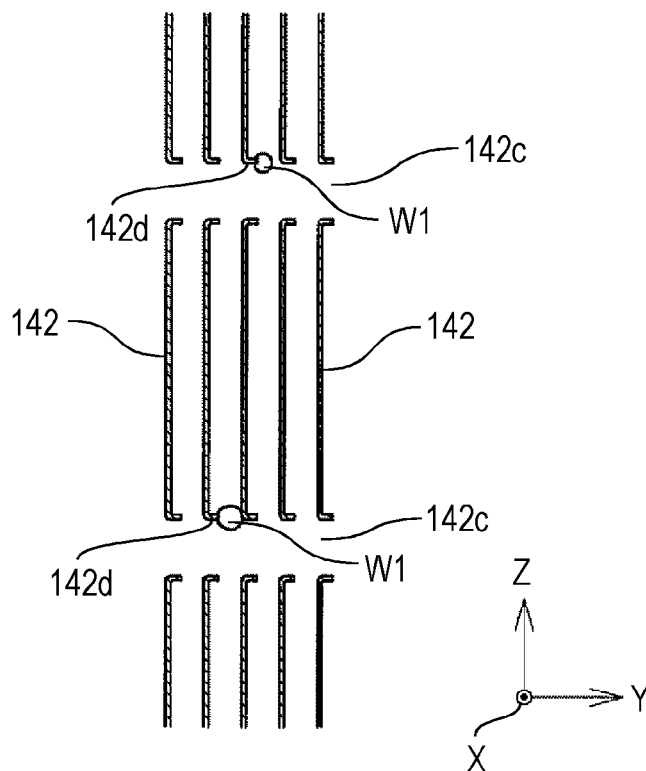


FIG. 11

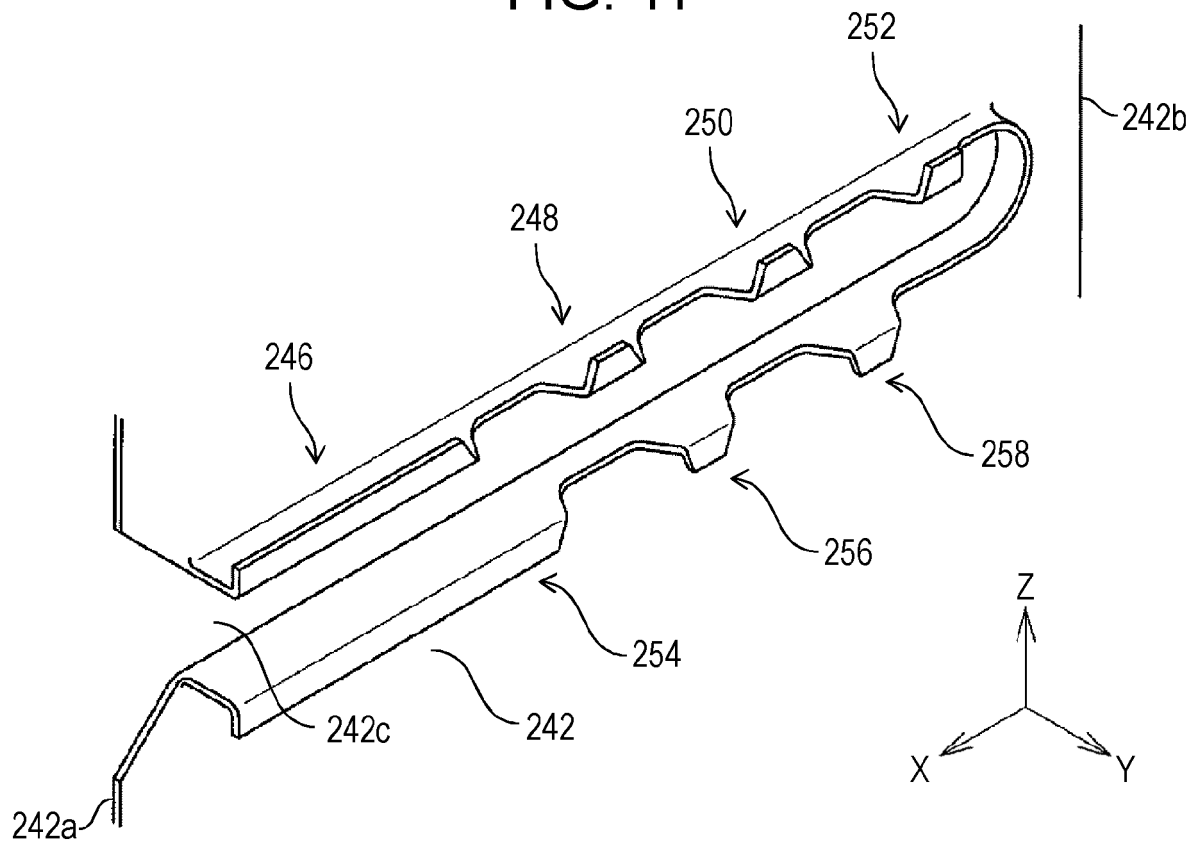
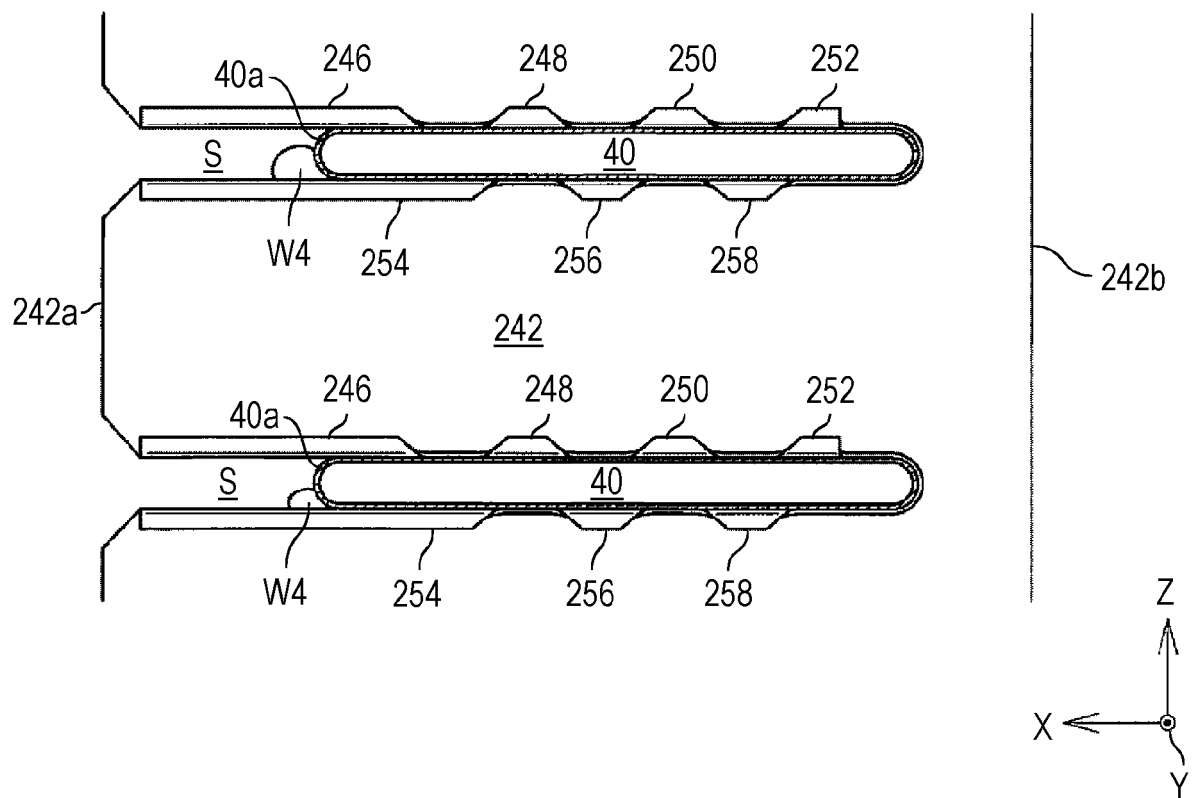


FIG. 12





EUROPEAN SEARCH REPORT

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