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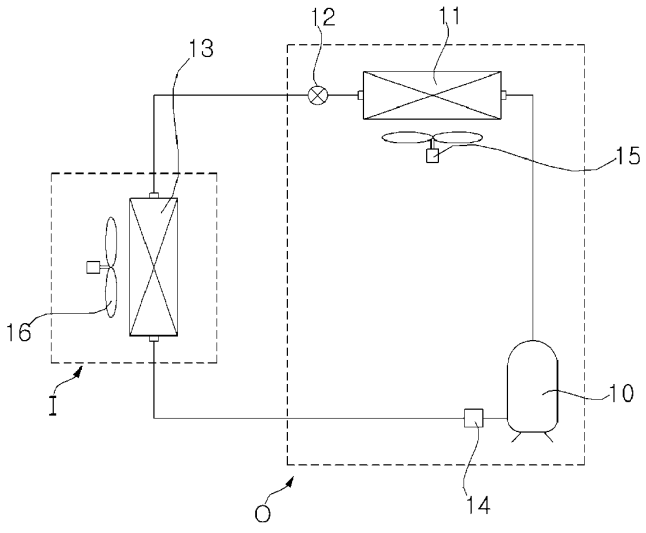
# (54) HEAT EXCHANGER

(57) A heat exchanger of the present disclosure includes a plurality of refrigerant tubes through which a refrigerant flow and a fin disposed between the refrigerant tubes adjacent to each other to transfer heat, in which the fin includes an inner portion located to overlap the refrigerant tubes in a vertical direction, and an outer portion located not to overlap the refrigerant tubes in the vertical direction, and a lower end of at least a portion of the outer portion is located higher than a lower end of the inner portion.

Fig. 1

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## Description

### CROSS REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority from Republic of Korea Patent Application No. 10-2023-0019422 filed on 2023-02-14.

### BACKGROUND

Field

**[0002]** The present disclosure relates to a heat exchanger that suppresses inflow of water from an outside and improves drainage performance.

Related Art

**[0003]** FIG. 14 is a perspective view briefly illustrating the external appearance of a heat exchanger according to the related art, FIG. 15 is an exploded view illustrating a coupling relationship of components of the heat exchanger according to the related art, and FIG. 16 is a view illustrating a cross section of a tube in FIG. 15.

**[0004]** Referring to these drawings, a conventional heat exchanger includes an upper header 2 located to correspond to an upper portion of a lower header 1, a plurality of tubes 3 located between the upper header 2 and the lower header 1, and a fin 6 located between the tubes 3. The lower header 1 is formed in a cylindrical shape and has a hollow inside, and a plurality of header holes 4 into which the tubes 3 are inserted and fixed are formed on one side of an outer periphery forming the external appearance of the lower header at equal intervals along a longitudinal direction of the lower header 1.

**[0005]** Here, the upper header 2 located at the upper portion corresponding to the lower header 1 has the same shape as the lower header 1. Both end portions of the tube 3 in the longitudinal direction are fixed to the head holes 4, and thus, the tubes 3 are arranged in parallel in longitudinal directions of the headers 1 and 2.

**[0006]** Meanwhile, the flowing air flows between each tube 3 and the two headers 1 and 2 by flowing to have a certain inclination toward the surface connecting axes of the two headers 1 and 2 in the longitudinal direction. The tube 3 has a length that is a distance between both end portions fixed to the two headers 1 and 2, a thickness that is a distance perpendicular to a direction of the flowing air, and a width that is a distance parallel to the flow direction of the flowing air. The tube 3 has a rectangular plate shape having a width and a thin thickness that can be accommodated in the two headers 1 and 2, and a plurality of hollow channels 5 are formed inside the tube 3.

**[0007]** Each fin 6 is a plate shape having a thin thickness and is bent several times zigzag and installed between each tube 4. The fin 6 may have various shapes and may be fixed, but it is generally preferable to form a space so that flow resistance of flowing air is minimized.

**[0008]** The space between the fins 6 is generally very small, and air can flow in the space, but when external water is introduced into the space, there is a problem that the water between the fins cannot be drained to the outside of the fins due to the surface tension and viscosity of water.

**[0009]** In particular, when the heat exchanger is exposed to the external environment, rain easily flows into the space between the fins 6, cannot escape from the space between the fins 6, and thus, there is a problem that the fins 6 are corroded.

**[0010]** When each fin 6 is corroded, performance of the heat exchanger deteriorates and there is a problem that the refrigerant may leak.

[Related art literature]

[Patent Literature]

**[0011]** Patent Document 1: Korean Laid-Open Patent Publication No. 20040053551

### SUMMARY

**[0012]** An object of the present disclosure is to provide a heat exchanger that prevents corrosion of fins and tubes due to water.

**[0013]** Another object of the present disclosure is to provide a heat exchanger that prevents external water from entering a space between fins.

**[0014]** Still another object of the present disclosure is to provide a heat exchanger in which water in a space between fins is easily discharged to the outside.

**[0015]** Objects of the present disclosure are not limited to the object mentioned above, and other objects not mentioned will be clearly understood by those skilled in the art from the description below.

**[0016]** The heat exchanger according to an embodiment of the present disclosure is characterized in that a lower portion of a fin exposed to an outside of a refrigerant tube is located higher than the lower portion of the fin located to overlap refrigerant tubes.

**[0017]** According to an aspect of the present disclosure, there is provided a heat exchanger including: a plurality of refrigerant tubes through which a refrigerant flow; and a fin disposed between the refrigerant tubes adjacent to each other to transfer heat, in which the fin includes an inner portion located to overlap the refrigerant tubes in a vertical direction, and an outer portion located not to overlap the refrigerant tubes in the vertical direction, and a lower end of at least a portion of the outer portion is located higher than a lower end of the inner portion.

**[0018]** The lower end of the outer portion may be formed by cutting and bending a portion of the fin.

**[0019]** The inner portion may include a plurality of first internal bodies extending in an up-down direction, a plurality of second internal bodies extending in the up-down direction and located between the plurality of first internal

bodies, an upper inner body connecting an upper end of the first inner body and an upper end of the second inner body adjacent to each other, and contacting any one of the plurality of refrigerant tubes, and a lower inner body connecting a lower end of the first inner body and a lower end of the second inner body adjacent to each other and contacting another refrigerant tube of the plurality of refrigerant tubes.

**[0020]** The outer portion may include a plurality of first outer bodies extending in an up-down direction and connected to the first internal body, a plurality of second outer bodies extending in the up-down direction, located between the plurality of first outer bodies, and connected to the second internal bodies, an upper outer body connecting an upper end of the first outer body and an upper end of the second outer body adjacent to each other, and a lower outer body connecting a lower end of the first outer body and a lower end of the second outer body adjacent to each other.

**[0021]** The lower outer body may be located higher than the lower inner body.

**[0022]** The lower end of the first outer body may be located higher than the lower end of the first inner body.

**[0023]** The lower end of the second outer body may be located higher than the lower end of the second inner body.

**[0024]** The lower outer body may be spaced apart from the lower inner body in the up-down direction.

**[0025]** At least a portion of the lower outer body may have an inclination with respect to the horizontal direction, and the lower inner body may be parallel to the horizontal direction.

**[0026]** The lower outer body may include a first folding portion located at a higher position than the lower end of the first outer body and the lower end of the second outer body, a second folding portion connecting one end of the first folding portion and a lower end of the first outer body, and a third folding portion connecting the other end of the first folding portion and the lower end of the second outer body.

**[0027]** The fin may further include a plurality of penetrating portions formed by penetrating a portion of the inner portion, and a plurality of louvers covering a portion of the penetrating portion.

**[0028]** The inner portion may further include a lower tension body connecting the lower end of the first inner body and the lower end of the second inner body adjacent to each other and spaced apart from the refrigerant tubes.

**[0029]** The lower tension body may be located higher than the lower inner body.

**[0030]** The inner portion may further include an upper tension body connecting the upper end of the first inner body and the upper end of the second inner body adjacent to each other and spaced apart from the refrigerant tubes.

**[0031]** The upper tension body may be located lower than the upper inner body.

**[0032]** The upper inner body may be located not to overlap the lower inner body in the vertical direction.

**[0033]** The upper outer body may be located not to overlap the lower outer body in the vertical direction.

**[0034]** The upper tension body may be located lower than the upper outer body.

**[0035]** A length of the inner portion may be longer than a length of the outer portion.

**[0036]** According to another aspect of the present disclosure, there is provided a heat exchanger including: a plurality of refrigerant tubes through which a refrigerant flow; and a fin disposed between the refrigerant tubes adjacent to each other to transfer heat, in which the fin includes an inner portion located to overlap the refrigerant tubes in one direction, an outer portion located not to overlap the refrigerant tubes in the one direction, a plurality of first bodies extending in an up-down direction, a plurality of second bodies extending in the up-down direction and located between the plurality of first bodies, an upper body connecting an upper end of the first body and an upper end of the second body adjacent to each other, and a lower body connecting a lower end of the first body and a lower end of the second body adjacent to each other, and a portion of the lower body located in the outer portion is located at a higher position than a portion of the lower body located in the inner portion.

**[0037]** According to still another aspect of the present disclosure, there is provided a heat exchanger including: a plurality of refrigerant tubes through which a refrigerant flow; and a fin disposed between the refrigerant tubes adjacent to each other to transfer heat, in which the fin includes an inner portion located to overlap the refrigerant tubes in one direction, and an outer portion located not to overlap the refrigerant tubes in the one direction, and a length of the inner portion in the one direction is longer than a length of at least a portion of the outer portion in the one direction.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0038]**

FIG. 1 is a diagram illustrating a refrigerating cycle device according to one embodiment of the present disclosure.

FIG. 2 is a perspective view illustrating an outside of an outdoor unit illustrated in FIG. 1.

FIG. 3 is a perspective view of a heat exchanger according to one embodiment of the present disclosure.

FIG. 4 is a longitudinal sectional view of the heat exchanger illustrated in FIG. 3.

FIG. 5 is a cross-sectional view taken along line 5-5' of FIG. 3.

FIG. 6 is an enlarged view of a partial area of FIG. 5.

FIG. 7 is a perspective view of FIG. 6.

FIG. 8 is a front elevational view of FIG. 7.

FIG. 9 is a diagram illustrating a portion of a heat exchanger according to another embodiment of the

present disclosure.

FIG. 10 is a side view of the heat exchanger of FIG. 9.

FIG. 11 is a front view of the heat exchanger of FIG. 9.

FIG. 12 is a cross-sectional view of an inner portion of the heat exchanger of FIG. 9 with a refrigerant tube removed.

FIG. 13 is a side view of a heat exchanger according to another embodiment of the present disclosure.

FIG. 14 is a perspective view illustrating the external appearance of a heat exchanger according to the related art.

FIG. 15 is an exploded view of the heat exchanger according to the related art.

FIG. 16 is a view illustrating a cross section of a tube in FIG. 15.

## DESCRIPTION OF EXEMPLARY EMBODIMENTS

**[0039]** Advantages and features of the present disclosure and methods for achieving those of the present disclosure will become apparent upon referring to embodiments described later in detail with reference to the attached drawings. However, embodiments are not limited to the embodiments disclosed hereinafter and may be embodied in different ways. The embodiments are provided for perfection of disclosure and for informing persons skilled in this field of art of the scope of the present disclosure. The same reference numerals may refer to the same elements throughout the specification.

**[0040]** Spatially-relative terms such as "below", "beneath", "lower", "above", or "upper" may be used herein to describe one element's relationship to another element as illustrated in the FIG.s. It will be understood that spatially-relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the FIG.s. For example, if the device in one of the figures is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The exemplary terms "below" or "beneath" can, therefore, encompass both an orientation of above and below. Since the device may be oriented in another direction, the spatially-relative terms may be interpreted in accordance with the orientation of the device.

**[0041]** The terminology used in the present disclosure is for the purpose of describing particular embodiments only and is not intended to limit the disclosure. As used in the disclosure and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

**[0042]** Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

**[0043]** In the drawings, the thickness or size of each layer is exaggerated, omitted, or schematically illustrated for convenience of description and clarity. Also, the size or area of each constituent element does not entirely reflect the actual size thereof.

**[0044]** Hereinafter, exemplary embodiments of the present disclosure will be described with reference to the accompanying drawings.

**[0045]** FIG. 1 is a diagram illustrating a refrigerating cycle device according to one embodiment of the present disclosure, and FIG. 2 is a perspective view illustrating an outside of an outdoor unit illustrated in FIG. 1.

**[0046]** Referring to FIGS. 1 and 2, the refrigerating cycle device according to the present embodiment includes a compressor 10 for compressing refrigerant, an outdoor heat exchanger 11 for performing heat exchange between outdoor air and the refrigerant, an expansion mechanism 12 for expanding the refrigerant, and an indoor heat exchanger 13 for performing heat exchange between the refrigerant and indoor air.

**[0047]** The refrigerant compressed in the compressor 10 may be condensed through heat exchange with outdoor air while passing through the outdoor heat exchanger 11. The outdoor heat exchanger 11 may be used as a condenser.

**[0048]** The refrigerant condensed by the outdoor heat exchanger 11 may be expanded by flowing into the expansion mechanism 12. The refrigerant expanded by the expansion mechanism 12 may be evaporated through heat exchange with indoor air while passing through the indoor heat exchanger 13.

**[0049]** The indoor heat exchanger 12 may be used as an evaporator for evaporating the refrigerant. The refrigerant evaporated by the indoor heat exchanger 12 may be recovered to the compressor 10.

**[0050]** The heat exchanger may include the indoor heat exchanger 12 and the outdoor heat exchanger 11. The refrigerant circulates through the compressor 10, the outdoor heat exchanger 11, the expansion mechanism 12, and the indoor heat exchanger 13 and operates in a refrigeration cycle.

**[0051]** A suction channel of the compressor 10 may be connected to the compressor 10 to guide the refrigerant passing through the indoor heat exchanger 13 to the compressor 10. An accumulator 14 in which liquid refrigerant is accumulated may be installed in the suction channel of the compressor 10.

**[0052]** The indoor heat exchanger 13 may have a refrigerant passage through which refrigerant passes.

**[0053]** The refrigeration cycle device may be a separation type air conditioner in which an indoor unit I and an outdoor unit O are separated, and in this case, the compressor 10 and the outdoor heat exchanger 11 may be installed inside the outdoor unit I. In addition, the refrigerating cycle device may be a refrigerator, the indoor heat exchanger 13 may be disposed to exchange heat with air in a food storage, and the outdoor heat exchanger 11 may exchange heat with air outside the food storage. In the case of a refrigerator, the indoor unit I and the outdoor unit O may be disposed together in a main body.

**[0054]** The expansion mechanism 12 may be installed in either the indoor unit I or the outdoor unit O. The indoor heat exchanger 13 may be installed inside the indoor unit I.

**[0055]** An outdoor fan 15 for blowing outdoor air to the outdoor heat exchanger 11 may be installed in the outdoor unit O. In addition, the compressor 10 may be installed in a machine room of the outdoor unit O.

**[0056]** An indoor fan 16 for blowing indoor air to the indoor heat exchanger 13 may be installed in the indoor unit I.

**[0057]** Hereinafter, a heat exchanger of the present disclosure that suppresses inflow of water from the outside and improves discharge of internal water will be described. The heat exchanger may be used as the indoor heat exchanger 13 or/and the outdoor heat exchanger 11.

**[0058]** FIG. 3 is a perspective view of a heat exchanger according to one embodiment of the present disclosure, FIG. 4 is a longitudinal sectional view of the heat exchanger illustrated in FIG. 3, and FIG. 5 is a cross-sectional view taken along line 5-5' of FIG. 4.

**[0059]** Referring to FIGS. 3 to 5, a heat exchanger 100 is a device for exchanging heat between a refrigerant of a refrigeration cycle and external air. It is preferable that the heat exchanger 100 evenly distributes the refrigerant therein and has a wide heat transfer area.

**[0060]** The heat exchanger 100 may be arranged with a plurality of columns, and a moving direction of refrigerant may be alternately changed in one column.

**[0061]** For example, the heat exchanger 100 includes a plurality of refrigerant tubes 50 through which refrigerant flows, a fin 60 disposed between adjacent refrigerant tubes 50 to transfer heat, and a sacrificial sheet 90 having one surface which is in contact with the refrigerant tube 50 and the other surface which is in contact with the fin 60.

**[0062]** In addition, the heat exchanger 100 further includes a header 70 to which one end of each of a plurality of refrigerant tubes 50 is coupled to supply the refrigerant to the inside of the plurality of refrigerant tubes 50, and an outer pipe 110 inside the header 70 and an inner pipe 120 inside the outer pipe 110.

**[0063]** The refrigerant tube 50 has an extremely small inner diameter to maximize the contact area with air while the refrigerant flows therein. The plurality of refrigerant tubes 50 are connected to the header 70. The refrigerant tube 50 extends in a direction crossing the header 70.

**[0064]** Specifically, the refrigerant tube 50 may be disposed to be elongated in a horizontal (left-right) direction (LeRi), and a plurality of refrigerant tubes 50 may be stacked in a vertical direction (longitudinal direction) (UD). While air passes through the space between the plurality of refrigerant tubes 50 stacked in the vertical direction, heat exchange is performed between the air and the refrigerant in the refrigerant tube 50. The plurality of refrigerant tubes 50 stacked horizontally define a heat exchange surface together with fins 60 to be described later.

**[0065]** The refrigerant tube 50 may include a plurality of micro channels 50a therein. The plurality of microchannels 50a provides a space through which the refrigerant passes. The plurality of micro channels 50a may extend in a direction parallel to the refrigerant tube 50.

**[0066]** Specifically, as illustrated in FIG. 5, the cross-sectional shape of the refrigerant tube 50 may be a rectangular shape with left and right sides longer than the top and bottom, and the cross-sectional shape of the microchannel 50a may be a rectangular shape.

**[0067]** It is common that the microchannels 50a are stacked in one row in a direction (front-rear direction) (FR) crossing the longitudinal direction of the refrigerant tube 50.

**[0068]** The fin 60 transfers the heat of the refrigerant tube 50. The fin 60 increases the contact area with air to improve heat dissipation performance.

**[0069]** The fin 60 is disposed between the refrigerant tubes 50 adjacent to each other. The fin 60 may have various shapes, but may be formed by bending a plate having the same width as the refrigerant tube 50. The fin 60 may be coated with clad 601.

**[0070]** The fin 60 may transfer heat by connecting two refrigerant tubes 50 stacked in the up-down direction. The fin 60 may directly contact the refrigerant tube 50 or may be connected to the refrigerant tube 50 by a sacrificial sheet 90.

**[0071]** When viewed from the front-rear direction, a contact portion between the fin 60 and the sacrificial sheet 90 becomes a U-shape or V-shape. The fin 60 and the refrigerant tube 50 are alternately stacked in the up-down direction, and have a layout in which the refrigerant tube 50 is located at the uppermost end and the lowermost end.

**[0072]** When a refrigerant tube 50 located at the uppermost end is defined as first refrigerant tubes 50 and 51 and a refrigerant tube 50 located below the first refrigerant tubes 50 and 51 is defined as the second refrigerant tubes 50 and 52, a fin 60 between the first refrigerant tubes 50 and 51 and the second refrigerant tubes 50 and 52 may be defined as first fins 60 and 61. In this way, the nth refrigerant tube and the nth fin may be defined.

**[0073]** The header 70 is coupled to one end of each of the plurality of refrigerant tubes 50 to supply refrigerant into the plurality of refrigerant tubes 50. In addition, the header 70 may be coupled to one end of the refrigerant

tube 50 to collect the refrigerant discharged from the refrigerant tube 50 and supply the collected refrigerant to another device.

**[0074]** The header 70 has a larger diameter, inner diameter or size than the refrigerant tube 50 and extends in the up-down direction. The header 70 may include a left header 71 connected to one end of the refrigerant tube 50 and lower headers 70 and 81 connected to the other end of the refrigerant tube 50.

**[0075]** The right header 81 communicates with the right side of the plurality of refrigerant tubes 50. The right header 81 extends in the up-down direction and is connected to an inlet pipe 22. The inside of the right header 81 is formed as one space, and the refrigerant introduced through the inlet pipe 22 is distributed and supplied to the plurality of refrigerant tubes 50. The inlet pipe 22 is an example of a refrigerant supply unit.

**[0076]** The inlet pipe 22 is connected to a region adjacent to the lower end of the right header 81.

**[0077]** The left header 71 communicates with the left side of the plurality of refrigerant tubes 50. The left header 71 extends in the up-down direction and is connected to an outflow pipe 24. The inside of the left header 71 is formed as one space, and guides the refrigerant discharged to the upper side of the plurality of refrigerant tubes 50 to the outlet pipe 24.

**[0078]** Of course, the refrigerant discharged from the left header 71 may be supplied to the header 70 of another heat exchanger 100.

**[0079]** In the heat exchanger 100, the outer pipe 110 and the inner pipe 120 may be located to prevent the refrigerant from being biased inside the header 70. The refrigerant is uniformly distributed through holes of the outer pipe 110 and the inner pipe 120.

**[0080]** The sacrificial sheet 90 has one surface in contact with the refrigerant tube 50 and the other surface in contact with the fin 60, and the sacrificial sheet 90 is corroded instead of the fin 60 and the refrigerant tube 50 to suppress corrosion of the fin 60 and the refrigerant tube 50 and peeling of the fin 60 and the refrigerant tube 50.

**[0081]** For example, a corrosion potential of the sacrificial sheet 90 may be lower than that of the refrigerant tube 50. When corrosion occurs in a state where the two metals are in contact, since the metal with the lowest corrosion potential is corroded, the sacrificial sheet 90 instead of the refrigerant tube 50 is corroded to prevent the refrigerant tube 50 from being corroded and the refrigerant from leaking.

**[0082]** In addition, the corrosion potential of the sacrificial sheet 90 may be lower than that of the fin 60. Even when only the refrigerant tube 50 is not corroded, there is no problem because the refrigerant is prevented from leaking. However, when the fin 60 is corroded, the flow of air is hindered and the efficiency of the refrigerant is lowered, and thus, it is preferable that the corrosion potential of the sacrificial sheet 90 is lower than that of the fin 60.

**[0083]** When the corrosion potential of the sacrificial sheet 90 is lower than that of the fins 60, the sacrificial sheet 90 is corroded first instead of the fins 60, thereby preventing corrosion of the fins 60.

**[0084]** Preferably, the corrosion potential of the fin 60 may be lower than that of the refrigerant tube 50. In a case where both the fin 60 and the refrigerant tube 50 are corroded, it is more dangerous when the refrigerant tube 50 is corroded. When the fin 60 is corroded, there is a problem in that efficiency is slightly lowered, but when the refrigerant tube 50 is corroded, the refrigerant leaks out and the air conditioner does not operate, which causes a major problem.

**[0085]** Therefore, in the present disclosure, the corrosion potential of the fin 60 lower than that of the refrigerant tube 50, and thus, the fin 60 corrodes first than the refrigerant tube 50, and the corrosion of the refrigerant tube 50 is prevented.

**[0086]** In conclusion, the corrosion potential of the sacrificial sheet 90 may be lower than that of the refrigerant tube 50, the corrosion potential of the sacrificial sheet 90 may be lower than that of the fin 60, the corrosion potential of the fin 60 may be lower than that of the refrigerant tube 50.

**[0087]** FIG. 6 is an enlarged view of a partial area of FIG. 5, FIG. 7 is a perspective view of FIG. 6, and FIG. 8 is a front elevational view of FIG. 7.

**[0088]** Referring to FIG. 6, a portion of the fin 60 protrudes to the outside of the tube to prevent water flowing in from the outside, and to allow water condensed in the space between the fins 60 to be easily discharged to the outside.

**[0089]** Each fin 60 includes an inner portion 610 that is located to overlap the refrigerant tubes 50 in the first direction (up-down direction), and an outer portion 620 that is located so as not to overlap the refrigerant tubes 50 in the first direction.

**[0090]** Specifically, the outer portion 620 is connected to the rear end of the inner portion 610 and is located rearward than the inner portion 610. The refrigerant tube 50 is not disposed below and above the outer portion 620.

**[0091]** The outer portion 620 may include a first outer portion 620a connected to the rear end of the inner portion 610 and a second outer portion 620b connected to the first outer portion 620a.

**[0092]** A length of the inner portion 610 in a front-rear direction may be longer than a length of the outer portion 620 in the front-rear direction. This is because when the length of the inner portion 610 is shorter than the outer portion 620, the area for heat exchange with the refrigerant tube 50 is reduced. The heat of the refrigerant tube 50 is transferred to the fin 60 in the inner portion 610, and even when external water is introduced from the outer portion 620, the lower part of the outer portion 620 is not blocked by the tub, and thus, the surface tension becomes weaker than gravity, causing the water to fall.

**[0093]** The water located in the space between the fins 60 in the inner portion 610 spreads long in the horizontal

direction due to surface tension, and a portion of the water that spreads long falls downward from the outer portion 620, the water in the inner portion 610 is moved to the outer portion 620 by surface tension and viscosity, and the water moved to the outer portion 620 falls again by gravity, and thus, there is an advantage that it is easy to discharge water condensed in the space between the fins 60 to the outside.

**[0094]** A width of the outer portion 620 in the front-rear direction may be smaller than a separation distance between the refrigerant tubes 50 adjacent to each other. This is because when the width of the outer portion 620 in the front-rear direction is larger than the separation distance between the tubes adjacent to each other, the heat exchange area is reduced, heat exchange efficiency is reduced, and the ability to suppress water inflow is not improved.

**[0095]** At least a portion of the lower end of the outer portion 620 may be located higher than the lower end of the inner portion 610. Accordingly, when viewed from the side, an opening portion 629 may be defined in which a portion of the lower end of the outer portion 620 is open.

**[0096]** Specifically, the lower end of the second outer portion 620b is located higher than the lower end of the inner portion 610.

**[0097]** Additionally, the length of the inner portion 610 in one direction (vertical direction) is longer than the length of at least a portion of the outer portion 620 in the vertical direction.

**[0098]** Specifically, the length of the inner portion 610 in the vertical direction is longer than the length of the second outer portion 620b in the vertical direction.

**[0099]** The lower end of the second outer portion 620b can be formed in various ways. For example, the lower end of the outer portion 620 may be formed by cutting and bending a portion of the fin. Specifically, a boundary between the first outer portion 620a and the second outer portion 620b is cut in the vertical direction, and the second outer portion 620b is bent upward so that the lower end of the second outer portion 620b is formed.

**[0100]** Referring to FIGS. 6 to 8, the fin 60 may be formed by bending a plurality of bodies. For example, the fin 60 may include a plurality of first bodies 611 and 621 extending in the up-down direction, a plurality of second bodies 613 and 623 extending in the up-down direction and located between the plurality of first bodies 611 and 621, upper bodies 615 and 625 connecting upper ends of the first bodies 611 and 621 and upper ends of the second bodies 613 and 623 adjacent to each other, and lower bodies 617 and 627 connecting lower ends of the first bodies 611 and 621 and lower ends of the second bodies 613 and 623 adjacent to each other.

**[0101]** Of course, depending on the embodiment, the first bodies 611 and 621 and the second bodies 613 and 623 may have an inclination in the up-down direction.

**[0102]** The upper bodies 615 and 625 are connected to the lower end of the refrigerant tube 50 located at the upper portion of the refrigerant tubes 50 adjacent to each other, and the lower bodies 617 and 627 are connected to the upper end of the refrigerant tube 50 located at the upper portion of the refrigerant tubes 50 adjacent to each other.

**[0103]** A portion 615 of the upper body of the first fin 60 is connected to the lower end of the first refrigerant tube 51, and a portion 617 of the lower body of the first fin 60 is connected to the upper end of the second refrigerant tube 52.

**[0104]** The upper bodies 615 and 625 are located so as not to overlap the lower bodies 617 and 627 in the vertical direction. The upper bodies 615 and 625 and lower bodies 617 and 627 are located alternately in the left-right direction.

**[0105]** The first bodies 611 and 621, the second bodies 613 and 623, the upper bodies 615 and 625, and the lower bodies 617 and 627 extend in a direction intersecting the longitudinal direction of the refrigerant tube 50. Specifically, the first bodies 611 and 621, the second bodies 613 and 623, the upper bodies 615 and 625, and the lower bodies 617 and 627 extend in the front-rear direction.

**[0106]** The first bodies 611 and 621 may include a first inner body 611 located in the inner portion 610 and a first outer body 621 located in the outer portion 620, the second bodies 613 and 623 may include a second inner body 613 located in the inner portion 610 and a second outer body 623 located in the outer portion 620, the upper bodies 615 and 625 may include an upper inner body 615 located in the inner portion 610 and an upper outer body 625 located in the outer portion 620, and the lower bodies 617 and 627 may include a lower inner body 617 located in the inner portion 610 and a lower outer body 627 located in the outer portion 620.

**[0107]** That is, the inner portion 610 may include the first inner body 611, the second inner body 613, the upper inner body 615, and the lower inner body 617, and the outer portion 620 may include the first outer body 621, the second outer body 623, the upper outer body 625, and the lower outer body 627.

**[0108]** The first inner body 611 extends in the up-down direction, and the second inner body 613 extends in the up-down direction and is located between the plurality of first inner bodies 611. The fin may include a plurality of penetrating portions formed by penetrating a portion of the inner portion 610 and a plurality of louvers covering some of the penetrating portions. The penetrating portion and louver may be formed in the first inner body 611 or/and the second inner body 613.

**[0109]** The upper inner body 615 connects the upper end of the first inner body 611 and the upper end of the second inner body 613 adjacent to each other, and contacts any one of the plurality of refrigerant tubes.

**[0110]** The lower inner body 617 connects the lower end of the first inner body 611 and the lower end of the second inner body 613 adjacent to each other, and contacts another refrigerant tube of the plurality of refrigerant tubes.

**[0111]** The upper inner body 615 is located so as not to overlap the lower inner body 617 in the vertical direction. The upper inner body 615 and the lower inner body 617 are arranged alternately along the left-right direction.

**[0112]** Of course, in other embodiments where the first inner body 611 and the second inner body 613 have an inclination with respect to the vertical direction, the center of the upper inner body 615 is located so as not to overlap the center of the lower inner body 617 in the vertical direction.

**[0113]** The first outer body 621 extends in the up-down direction and is connected to the first inner body 611. The first outer body 621 is connected to the rear end of the first inner body 611.

**[0114]** The second outer body 623 extends in the up-down direction, is located between the plurality of first outer bodies 621, and is connected to the second inner body 613. The second outer body 623 is connected to the rear end of the second inner body 613.

**[0115]** The upper outer body 625 connects the upper end of the first outer body 621 and the upper end of the second outer body 623 adjacent to each other. The upper outer body 625 does not contact the refrigerant tube. The upper outer body 625 is connected to the upper inner body 615.

**[0116]** The lower outer body 627 connects the lower end of the first outer body 621 and the lower end of the second outer body 623 adjacent to each other. The lower outer body 627 does not contact the refrigerant tube.

**[0117]** The upper outer body 625 is located so as not to overlap the lower outer body 627 in the vertical direction. The upper outer body 625 and the lower outer body 627 are arranged alternately along the left-right direction.

**[0118]** Of course, in other embodiments where the first outer body 621 and the second outer body 623 have an inclination with respect to the vertical direction, both ends of the upper outer body 625 are located to overlap both ends of the lower outer body 627 in the vertical direction, and the center of the upper outer body 625 is located so as not to overlap the center of the lower outer body 627 in the vertical direction.

**[0119]** The lower outer body 627 is located higher than the lower inner body 617. Accordingly, the opening portion 629 is located at the rear of the lower inner body 617. The lower outer body 627 may be manufactured in various ways to be located higher than the lower inner body 617, but considering the convenience and cost of manufacturing, the lower outer body 627 may be locate higher than the lower inner body 617 by cutting a portion of each of the lower bodies 617 and 627, a portion of each of the first bodies 611 and 621, and a portion of each of the second bodies 613 and 623 and bending the lower outer body 627 so as to move in an upward direction.

**[0120]** The water located in the space between the fins 60 spreads long in the horizontal direction due to surface tension and is collected to the lower side of the fin 60 due to gravity. Then, the opening portion 629 of the outer portion 620 increases the falling force of water collected downward from the inner portion 610 so that the water is easily discharged, the water introduced into the inner portion 610 from the outer portion 620 falls, and thus, it is possible to prevent the external water from being easily introduced.

**[0121]** The lower end of the first outer body 621 may be located higher than the lower end of the first inner body 611, and the lower end of the second outer body 623 may be located higher than the lower end of the second inner body 613.

**[0122]** The boundary between the first outer body 621 and the second inner body 613 is cut, and the boundary between the second outer body 623 and the second inner body 613 is cut and rolled up together with the lower inner body 617.

**[0123]** The lower outer body 627 may be separated from the lower inner body 617 without being connected to the lower inner body 617. Specifically, the lower outer body 627 may be spaced apart from the lower inner body 617 in the up-down direction. The front end of the lower outer body 627 and the rear end of the lower inner body 617 may overlap each other in the vertical direction.

**[0124]** Of course, depending on the embodiment, the fin structure of the first outer portion 620a may be the same as the inner portion 610, and only the second outer portion 620b may include the first outer body 621, the second outer body 623, the upper outer body 625, and lower outer body627.

**[0125]** At least a portion of the lower outer body 627 may have an inclination to the horizontal direction, and the lower inner body 617 may be parallel to the horizontal direction.

**[0126]** Specifically, the lower outer body 627 may include a first folding portion 6271 located at a position higher than the lower end of the first outer body 621 and the lower end of the second outer body 623, a second folding portion 6272 connecting one end of the first folding portion 6271 and a lower end of the first outer body 621, and a third folding portion 6273 connecting the other end of the first folding portion 6271 and the lower end of the second outer body 623.

**[0127]** The first folding portion 6271 is located higher than the second folding portion 6272 and the third folding portion 6273. The second folding portion 6272 and the third folding portion 6273 may be inclined in a vertical direction. The second folding portion 6272 and the third folding portion 6273 may include a portion parallel to and a portion inclined in the vertical direction.

**[0128]** The first folding portion 6271 may be parallel to the horizontal direction. Of course, depending on the embodiment, the first folding portion 6271 may have an inclination in the horizontal direction.

**[0129]** When the lower outer body 627 is deformed when pressed upward by a press, the lower outer body 627 has the above-described structure.

**[0130]** FIG. 9 is a diagram illustrating a portion of a heat exchanger according to another embodiment of the present disclosure, FIG. 10 is a side view of the heat

exchanger of FIG. 9, FIG. 11 is a front view of the heat exchanger of FIG. 9, and FIG. 12 is a cross-sectional view of an inner portion 610 of the heat exchanger with the refrigerant tube removed.

**[0131]** Compared to the embodiment of FIG. 7, a heat exchanger 100-1 according to another embodiment of the present disclosure has a difference in the structure of a lower outer body 627-1 and further includes tension bodies 614 and 616. Hereinafter, the description will focus on the differences from FIG. 7, and parts without special explanation will be considered the same as the embodiment of FIG. 7.

**[0132]** Referring to FIGS. 9 to 12, the lower outer body 627-1 of another embodiment of the present disclosure includes a round portion 6274, a first inclined portion 6275 connecting the round portion 6274 and the first outer body 621, and a second inclined portion 6276 connecting the round portion 6274 and the second outer body 623.

**[0133]** The round portion 6274 has a shape protruding upward and is located higher than the first inclined portion 6275 and the second inclined portion 6276. The first slope 6275 is inclined upward from left to right, and the second slope 6276 is inclined downward from left to right.

**[0134]** The tension bodies 614 and 616 relieve the elastic restoring force generated by the reverse folding of the lower outer body 627, thereby limiting the return of the fin to its original shape and stably maintaining the folded structure.

**[0135]** The tension bodies 614 and 616 may include a lower tension body 616 and/or an upper tension body 614. The lower tension body 616 or the upper tension body 614 may be located in the inner portion 610. Specifically, the lower tension body 616 or the upper tension body 614 may be located at the center of the inner portion 610 in the front-rear direction.

**[0136]** The lower tension body 616 connects the lower end of the first inner body 611 and the lower end of the second inner body 613 adjacent to each other and is spaced apart from the refrigerant tubes.

**[0137]** The lower tension body 616 is located higher than the lower inner body 617. The lower tension body 616 may be located lower than the upper outer body 625. The lower tension body 616 may be formed by cutting and bending the first inner body 611, the second inner body 613, and the lower inner body 617.

**[0138]** The upper tension body 614 connects the upper end of the first inner body 611 and the upper end of the second inner body 613 and is spaced apart from the refrigerant tubes 50.

**[0139]** The upper tension body 614 is located lower than the upper inner body 615. The upper tension body 614 may be located higher than the lower outer body 627. The upper tension body 614 may be formed by cutting and bending the first outer body 621, the second outer body 623, and the lower outer body 627.

**[0140]** FIG. 13 is a side view of a heat exchanger according to another embodiment of the present disclosure.

**[0141]** Compared to the embodiment of FIG. 6, a heat exchanger 100-2 according to another embodiment of the present disclosure has a difference in that it further includes an inflow prevention hole 640. Hereinafter, the description will focus on the differences from FIG. 6, and parts without special explanation will be considered the same as the embodiment of FIG. 6.

**[0142]** Referring to FIG. 13, inflow prevention holes 640 are formed in the first outer bodies 621 and the second outer bodies 623. The inflow prevention holes 640 formed in the first outer body 621 and the second outer body 623 may be located to overlap in the left-right direction.

**[0143]** The inflow prevention hole 640 may be located to overlap the lower outer body 627 in the up-down direction. A diameter of the inflow prevention hole 640 is preferably smaller than the length of the lower outer body 627 in the front-rear direction.

**[0144]** Water introduced from the outside is located in the space between the fins 60 of the outer portion 620, a portion of the water falls downward due to gravity and the action of the lower outer body 627, but a portion thereof may flow from the upper portion of the outer portion 620 into the inner portion 610, and the inflow prevention hole 640 suppresses the inflow of water.

**[0145]** The heat exchanger of the present disclosure has one or more of the following effects.

**[0146]** First, in the present disclosure, the fins have the inner region that overlaps in one direction with the plurality of tubes adjacent to each other, the outer region that does not overlap, and heat from the tube is transferred to the fin from the inner region. Therefore, even when external water is introduced from the outer region, the lower part of the outer region is not blocked by the tub, and thus, the surface tension becomes weaker than gravity, causing the water to fall.

**[0147]** Second, in the present disclosure, the water located in the space between the fins in the inner region spreads long in the horizontal direction due to surface tension, a portion of the water spreading long falls downward from the outer region, the water in the inner region is moved to the outer region due to surface tension and viscosity, the water moved to the outer region falls again due to gravity, and thus, it is possible to easily discharge the water condensed in the space between the fins to the outside.

**[0148]** Third, when manufacturing a fin, the basic body is manufactured, and the base body is bent to manufacture the fin. It is very difficult to cut out a part of the outer region when manufacturing the fin. However, according to the present disclosure, by creating a cutting line in the outer region and banding the outer region, it is possible to easily manufacture the opening portion at the lower end of the outer region.

**[0149]** Fourth, according to the present disclosure, the tension body is formed in the body of the fin in the inner region, the tension generated when bending the lower body of the outer region can be relieved, and thus, it is possible to prevent the bent fin from bending due to the

force of returning to its original shape.

**[0150]** The above-described features, configurations, effects, and the like are included in at least one of the embodiments of the present disclosure, and should not be limited to only one embodiment. In addition, the features, configurations, effects, and the like as illustrated in each embodiment may be implemented with regard to other embodiments as they are combined with one another or modified by those skilled in the art. Thus, content related to these combinations and modifications should be construed as including in the scope of the disclosure as disclosed in the accompanying claims.

## Claims

**1.** A heat exchanger comprising:

a plurality of refrigerant tubes (50) through which a refrigerant flow; and
a fin (60) disposed between adjacent refrigerant tubes (50) adjacent and configured to transfer heat,
wherein the fin (60) includes:

an inner portion (610) configured to overlap the refrigerant tubes (50) in a vertical direction, and
an outer portion (620) configured to not overlap the refrigerant tubes (50) in the vertical direction, and
wherein a lower end of at least a portion of the outer portion (620) is located higher than a lower end of the inner portion (610).

**2.** The heat exchanger of claim 1, wherein the lower end of the outer portion (620) is formed by cutting and bending a portion of the fin (60).

**3.** The heat exchanger of claims 1 or 2, wherein the inner portion (610) includes

a plurality of first inner bodies (611) extending in an up-down direction,
a plurality of second inner bodies (613) extending in the up-down direction and located between the plurality of first inner bodies (611),
an upper inner body (615) connecting an upper end of a respective first inner body (611) and an upper end of a respective second inner body (613) adjacent to each other, and contacting any one of the plurality of refrigerant tubes (50), and
a lower inner body (617) connecting a lower end of a respective first inner body (611) and a lower end of a second inner body adjacent to each other and contacting another refrigerant tube of the plurality of refrigerant tubes (50).

**4.** The heat exchanger of claims 2 or 3, wherein the outer portion includes

a plurality of first outer bodies (621) extending in an up-down direction and connected to the first inner bodies (611),
a plurality of second outer bodies (623) extending in the up-down direction, located between the plurality of first outer bodies (621), and connected to the second inner bodies (613),
an upper outer body (625) connecting an upper end of a respective first outer body (621) and an upper end of a respective second outer body (623) adjacent to each other, and
a lower outer body (627) connecting a lower end of a respective first outer body (621) and a lower end of a respective second outer body (623) adjacent to each other.

**5.** The heat exchanger of claim 4, wherein the lower outer body (627) is located higher than the lower inner body (617).

**6.** The heat exchanger of claims 4 or 5, wherein the lower end of the first outer body (621) is located higher than the lower end of the first inner body (611).

**7.** The heat exchanger of any one of the claims 4 to 6, wherein the lower end of the second outer body (623) is located higher than the lower end of the second inner body (613).

**8.** The heat exchanger of any one of the claims 4 to 7, wherein the lower outer body (627) is spaced apart from the lower inner body (617) in the up-down direction.

**9.** The heat exchanger of any one of the claims 4 to 8, wherein at least a portion of the lower outer body (627) has an inclination with respect to the horizontal direction, and
the lower inner body (617) is parallel to the horizontal direction.

**10.** The heat exchanger of any one of the claims 4 to 9, wherein the lower outer body (627) includes,

a first folding portion (6271) located at a higher position than the lower end of the first outer body (621) and the lower end of the second outer body (623),
a second folding portion (6272) connecting one end of the first folding portion (6271) and a lower end of the first outer body (621), and
a third folding portion (6273) connecting the other end of the first folding portion (6271) and the lower end of the second outer body (623).

**11.** The heat exchanger of any one of the claims 1 to 10, wherein the fin (60) further includes

a plurality of penetrating portions formed by penetrating a portion of the inner portion, and
a plurality of louvers covering a portion of the penetrating portion.

**12.** The heat exchanger of claim 3, wherein the inner portion further includes a lower tension body (616) connecting the lower end of the first inner body (611) and the lower end of the second inner body (613) adjacent to each other and spaced apart from the refrigerant tubes (50), and
wherein the lower tension body (616) is located higher than the lower inner body (617).

**13.** The heat exchanger of claim 3, wherein the inner portion further includes an upper tension body (614) connecting the upper end of the first inner body (611) and the upper end of the second inner body (613) adjacent to each other and spaced apart from the refrigerant tubes (50), and
wherein the upper tension body (614) is located lower than the upper inner body (615).

**14.** The heat exchanger of claim 3, wherein the upper inner body (615) is configured not to overlap the lower inner body (611) in the vertical direction.

**15.** The heat exchanger of any one of the claims 4 to 10, wherein the upper outer body (625) is configured not to overlap the lower outer body (627) in the vertical direction.

Fig. 1

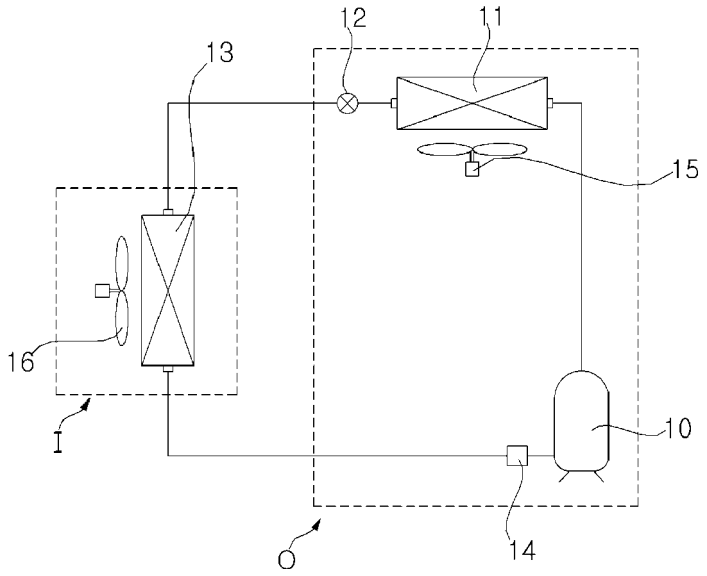


Fig. 2

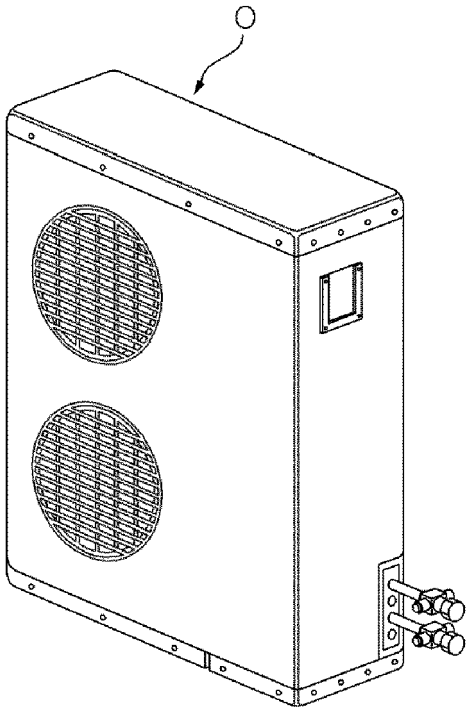

Fig. 3

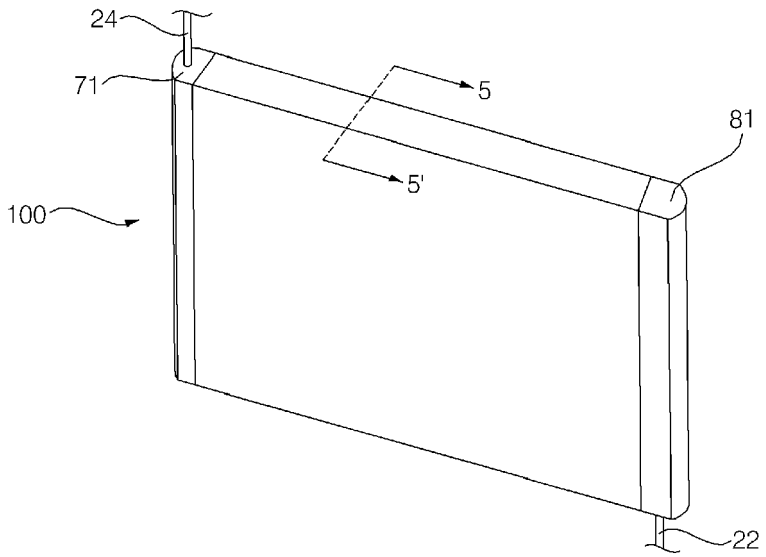

Fig. 4

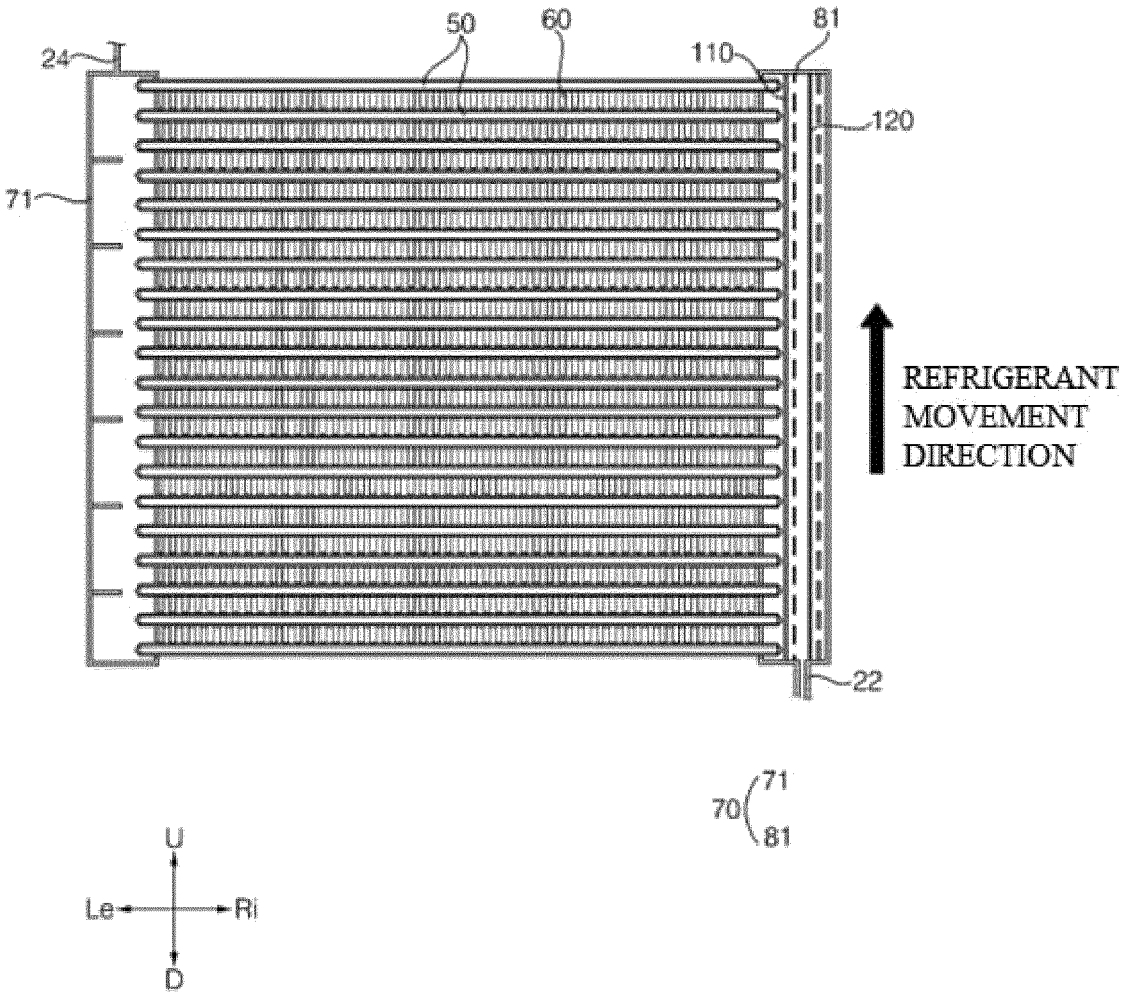
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Fig. 5

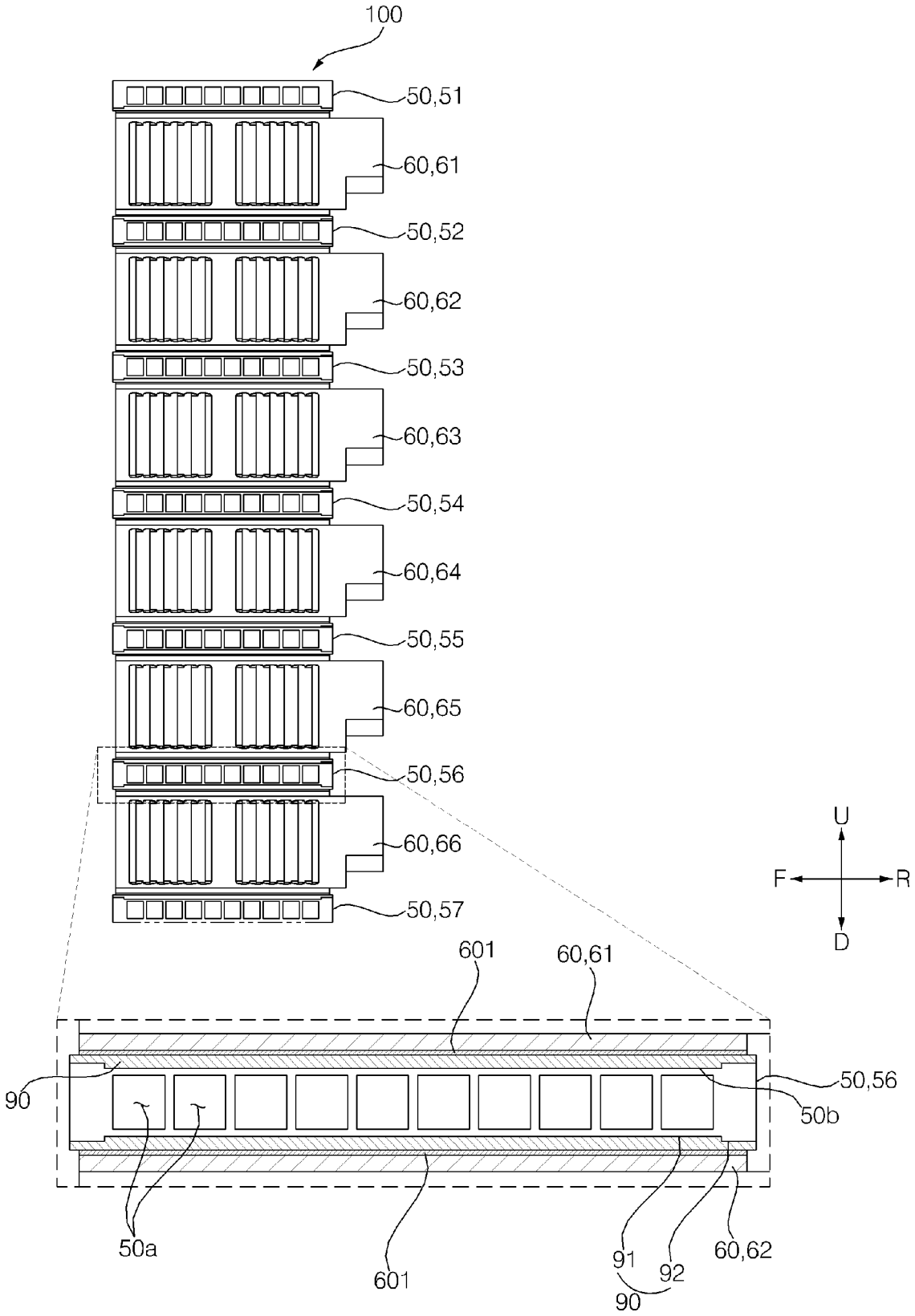
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Fig. 6

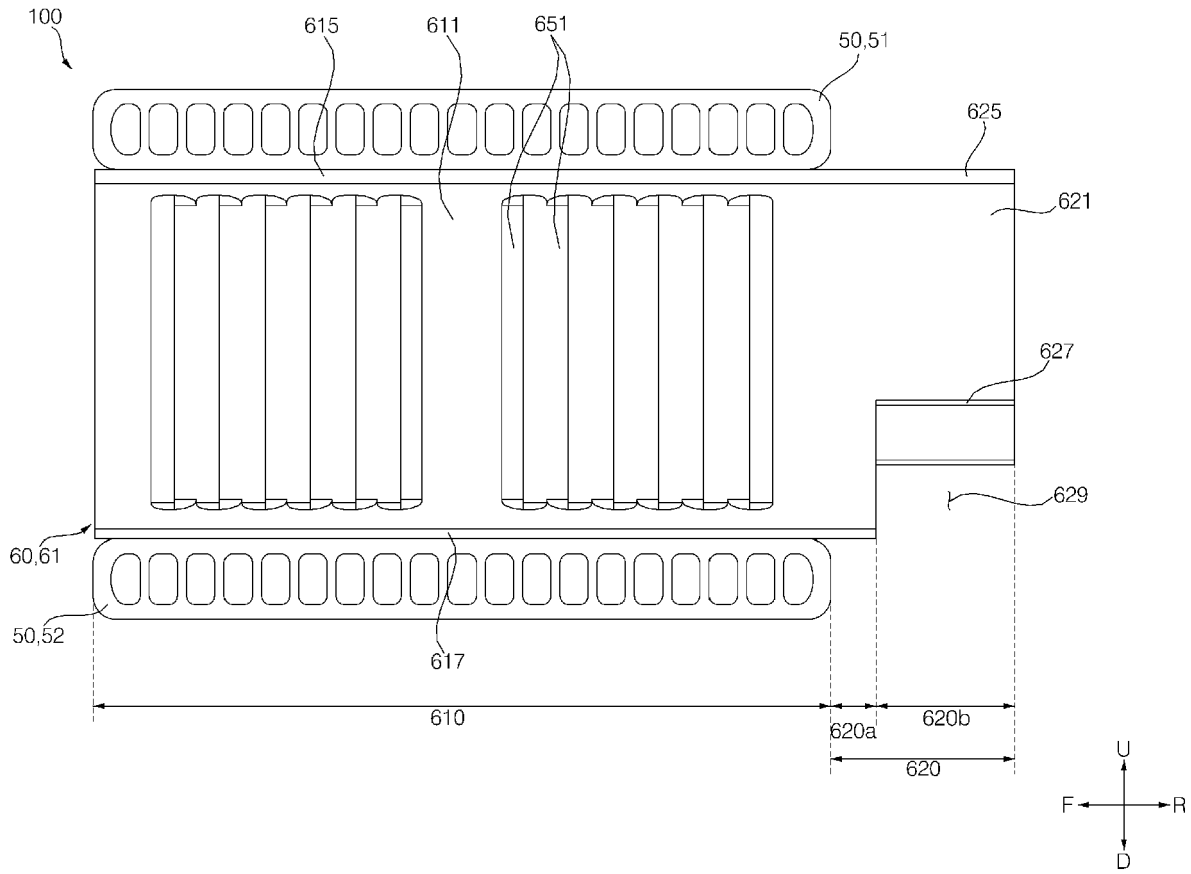
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Fig. 7

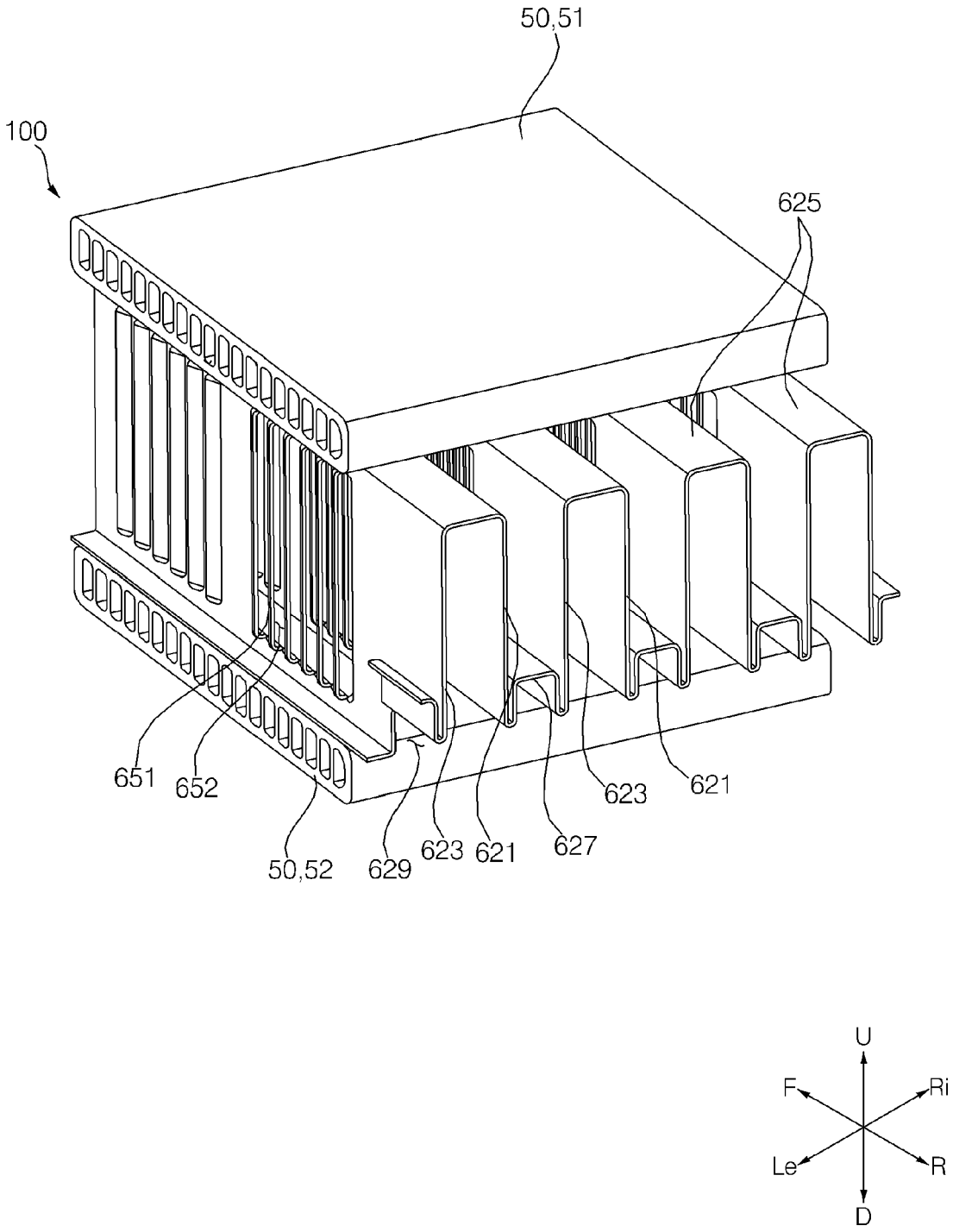

Fig. 8

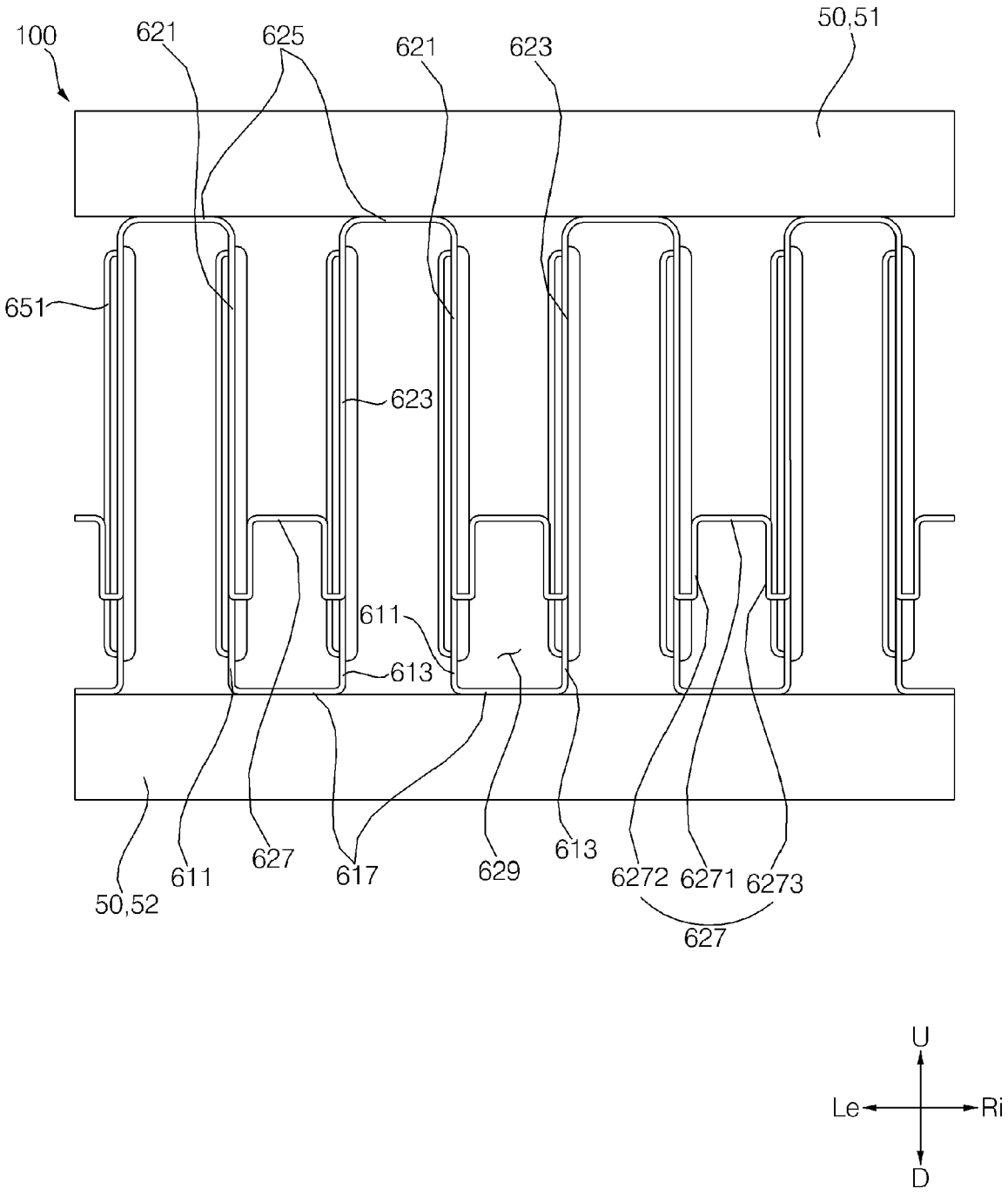
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Fig. 9

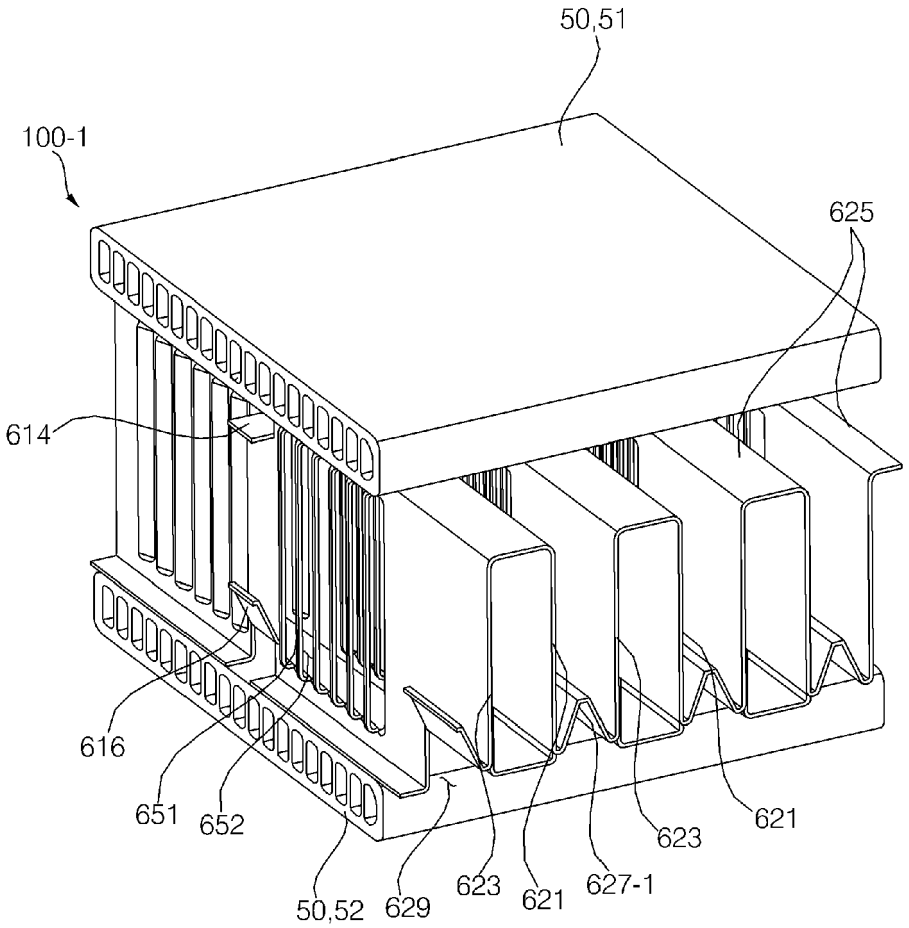
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Fig. 10

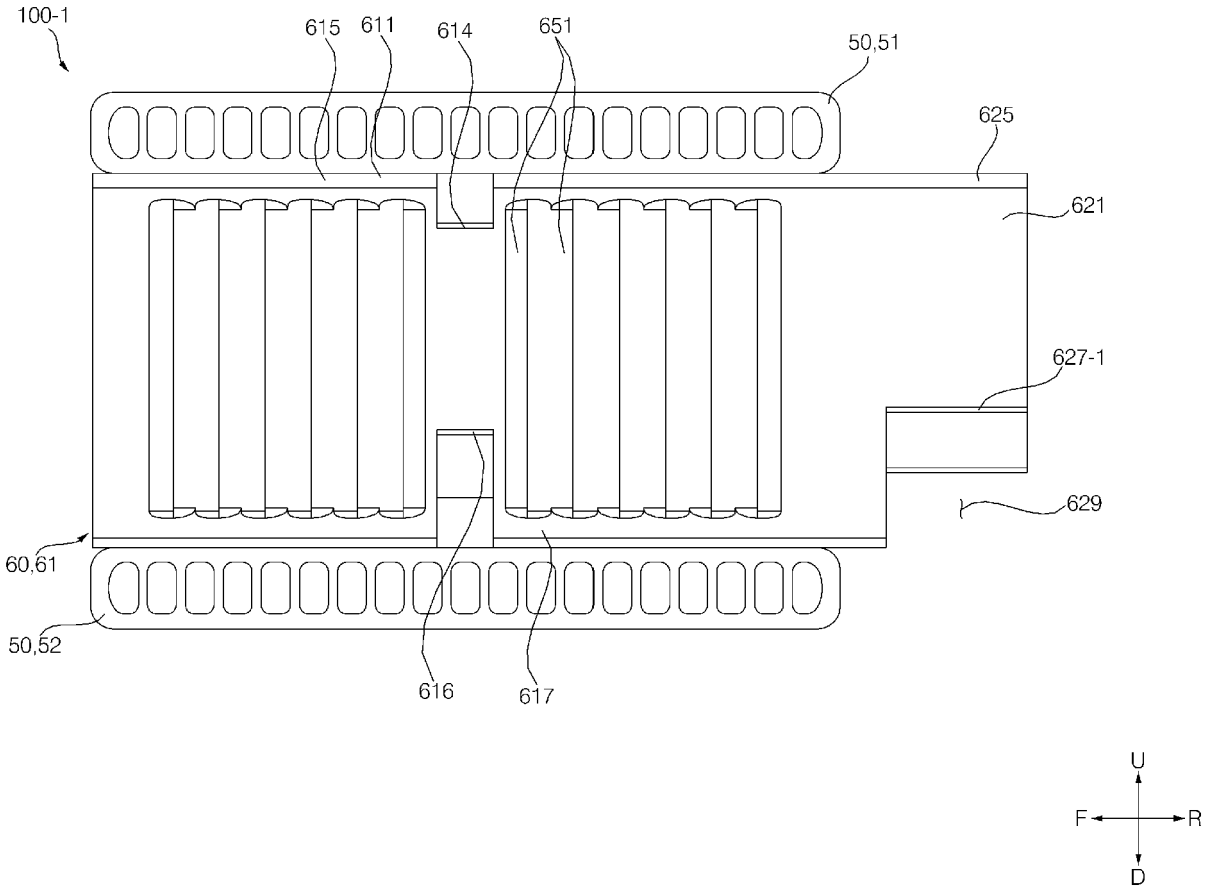
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Fig. 11

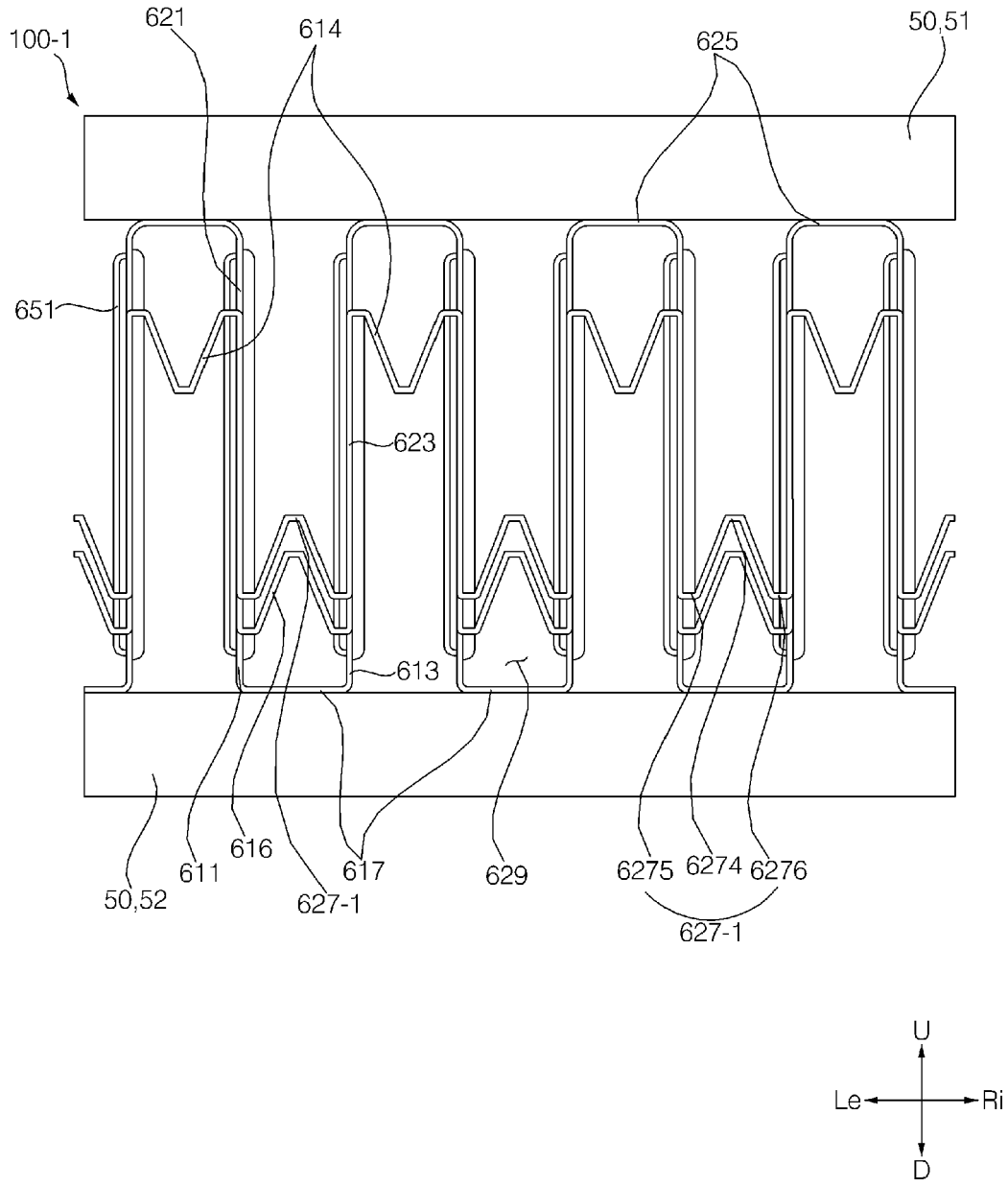
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Fig. 12

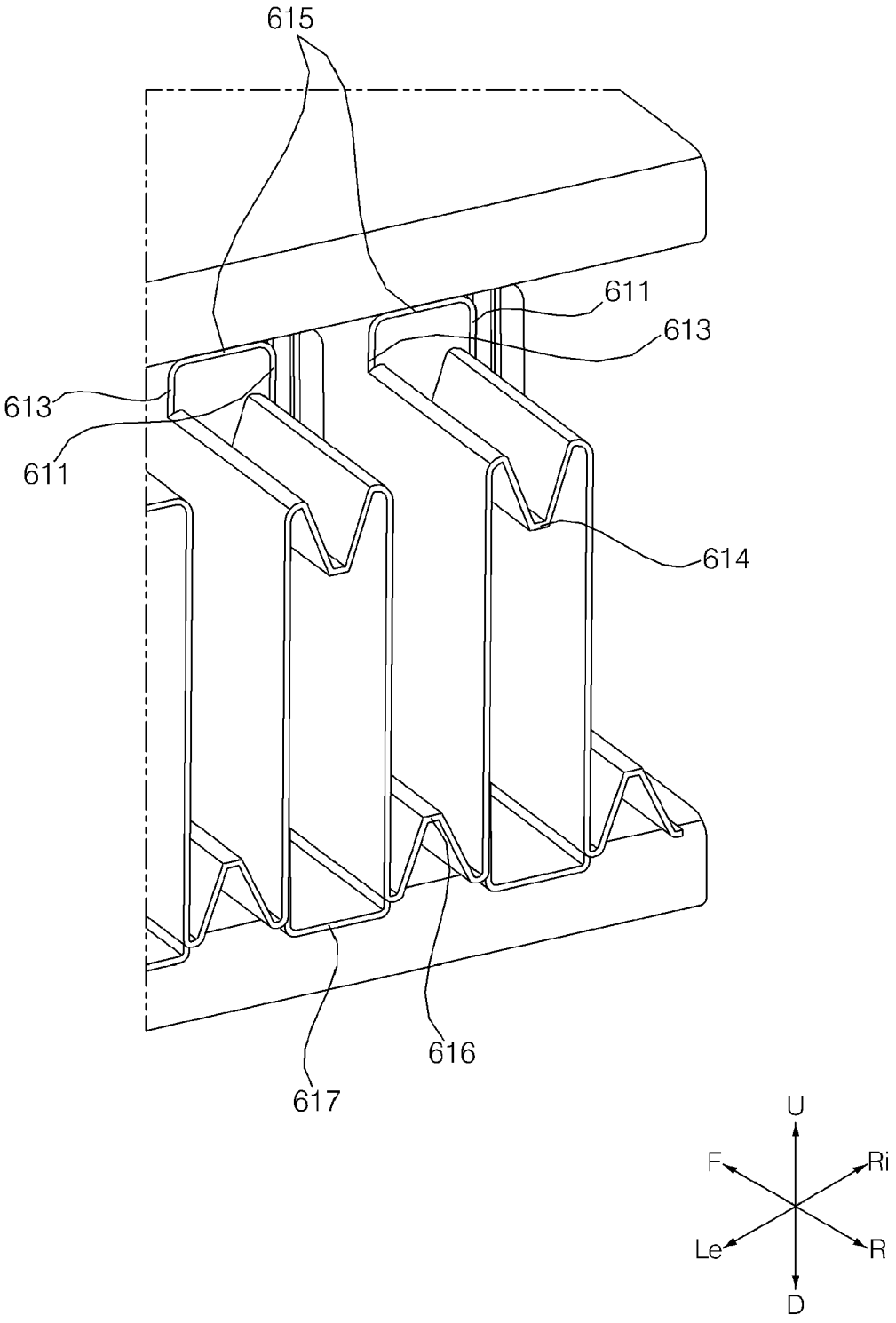


Fig. 13

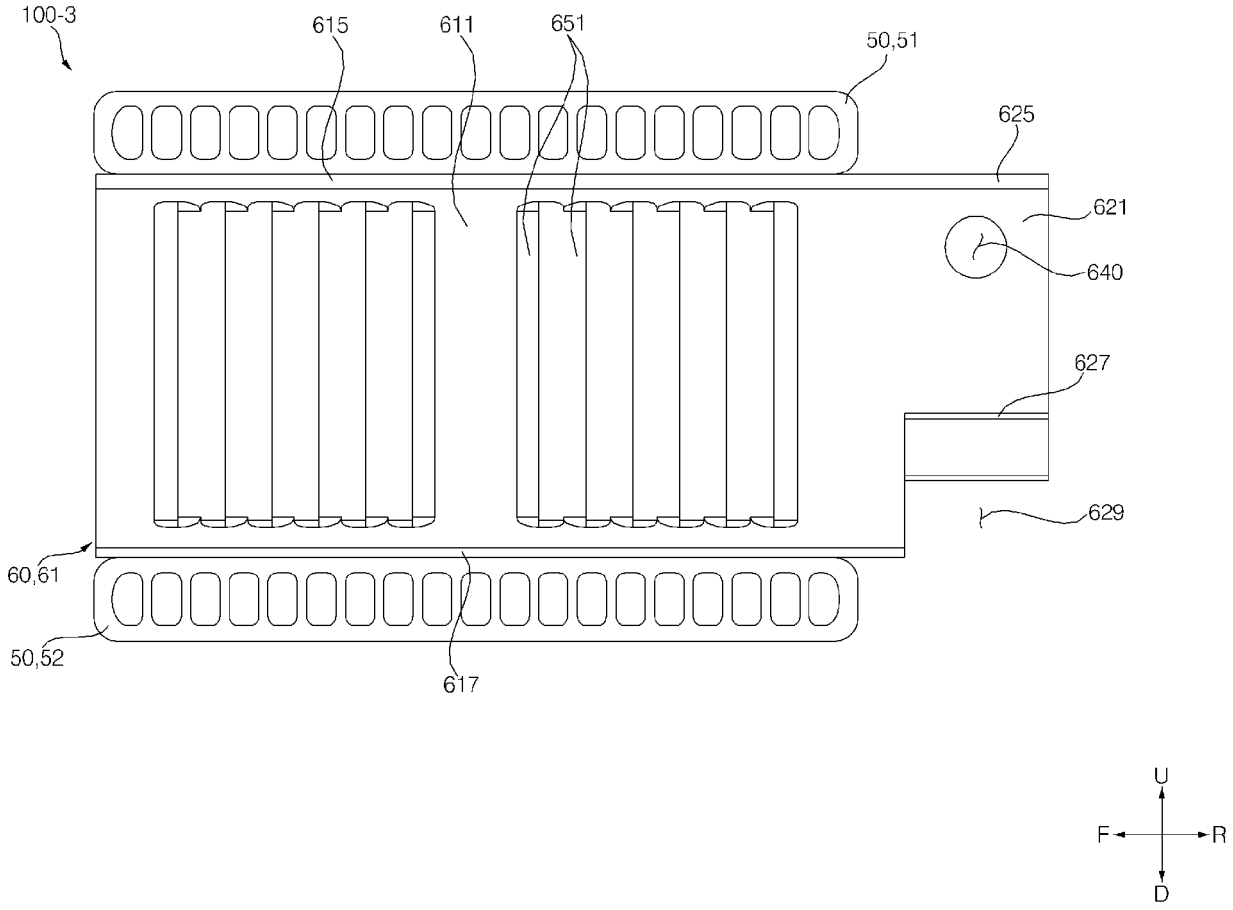


Fig. 14

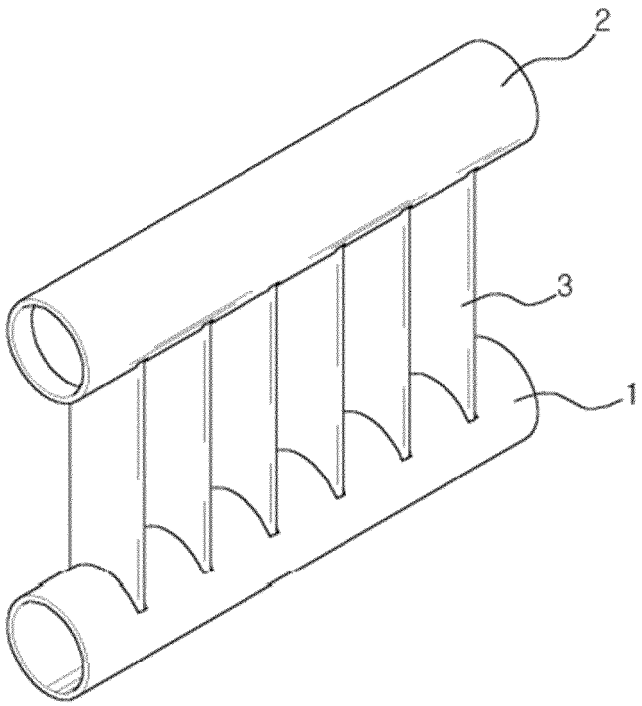



Fig. 15

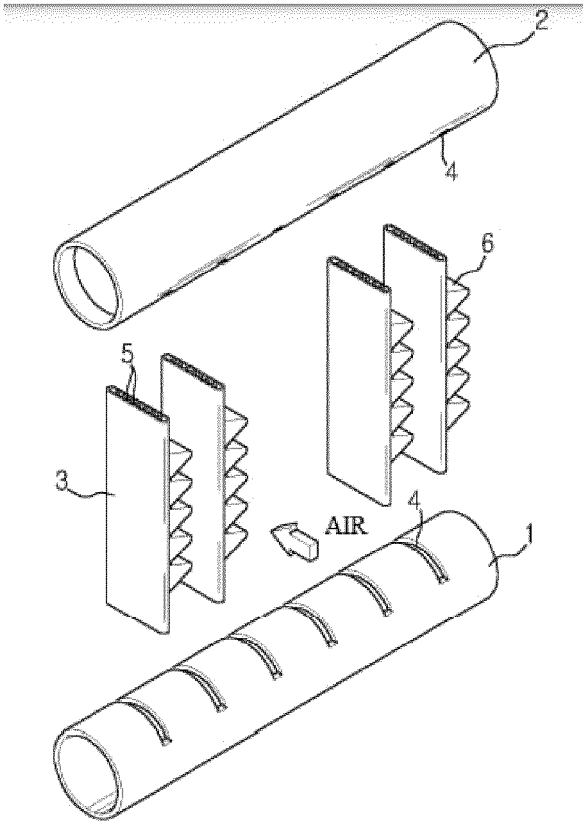
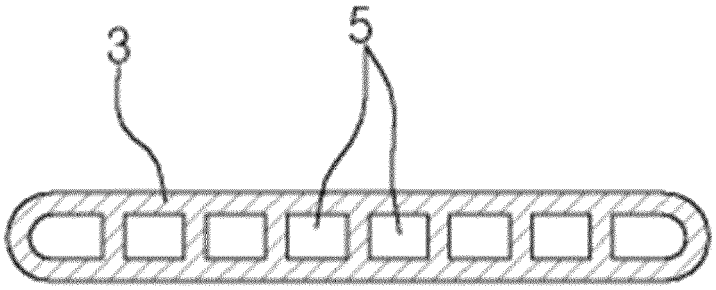


Fig. 16



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Application Number
EP 24 15 7542

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| X | US 2012/227945 A1 (TARAS MICHAEL F [US] ET AL) 13 September 2012 (2012-09-13) * column 0031 - column 0032; figures 5-5A * | 1-4,6,11 | |
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| | | | F28D<br>F28F |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 20 June 2024 | Jessen, Flemming |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 15 7542

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