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(54) **Heat Exchanger with louvered transversal fins**

Wärmetauscher mit transversalen geschlitzten Rippen

Échangeur de chaleur avec des ailettes transversales à persiennes

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EP 2 447 656 B1

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Description

BACKGROUND

1. Field

[0001] Embodiments of the present disclosure relate to a heat exchanger with an improved heat exchange structure.

2. Description of the Related Art

[0002] A heat exchanger is mounted in devices operating based upon a refrigeration cycle, such as air conditioners or refrigerators. The heat exchanger includes a plurality of heat exchanger fins and a refrigerant pipe extending through the heat exchanger fins to guide a refrigerant. Contact area between the heat exchanger fins and external air introduced to the heat exchanger is increased to improve heat exchange efficiency between the refrigerant flowing in the refrigerant pipe and the external air.

[0003] When the contact area between the heat exchanger fins and external air contacting the heat exchanger fins is large or when resistance applied to air contacting the heat exchanger fins is small, heat exchange efficiency is increased. However, if the contact area between the heat exchanger fins and air is too large, large resistance is applied to air passing through the heat exchanger fins. On the other hand, if the contact area is reduced to lower resistance applied to air, heat exchange efficiency is lowered. For this reason, it may be necessary to provide fins having an optimal shape based on the heat exchanger employed.

[0004] For a heat exchanger used as an evaporator (that is, the refrigeration cycle performs a heating operation), if outdoor temperature is too low, the surface temperature of the heat exchanger is lowered to below zero Celsius, and moisture contained in outdoor air is attached to the surface of the cold heat exchanger in a frozen state, thereby reducing heat exchange efficiency of the heat exchanger.

[0005] US 4,705,105 A discloses a heat exchanger with the features of the pre-characterizing part of claim 1. It discloses a room air conditioner with a nest of tubes and numerous thin metallic fins attached thereto. Further used are an evaporator and a condenser wherein it is said that thermally conducting tubes of the evaporator and condenser are air cooled by a corresponding flow of air passing the tubes and associated fins. Such a fin may comprise a plate and a protrusion protruding from the plate. Each protrusion is provided with a louver unit to perform heat exchange with the air passing therethrough.

[0006] US 4,676,304 A discloses a heat exchanger with a flat metal tube and a plurality of corrugated fin units disposed therebetween. There seems to be no coupling of corresponding heat exchanger fins or fin units to an outer circumference of the refrigerant pipe. Fin units com-

prise a plurality of plate portions, each comprising inclined louvers and parallel louvers.

[0007] US 2002/003035 A1 discloses slits provided on both surfaces of corresponding air guide fins. However, there is no protrusion and there are no slits disposed on opposite sides of the protrusion, namely the left and right sides of such protrusion.

[0008] US 2001/004012 A1 discloses a fin and tube type heat-exchanger with a number of slit groups in each of which slits are arranged in a number of rows and are formed on each stage, namely upper stage and lower stage of each cooling fin.

[0009] US 2005/077036 A1 discloses fins for heat exchanger only with a plurality of louvers without any slits and without any protrusion.

SUMMARY

[0010] It is an object of the present disclosure to provide a heat exchanger having a structure to effectively achieve heat exchange between air and heat exchanger fins and to restrain frost formation on the surfaces of heat exchanger fins.

[0011] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the disclosure.

[0012] The object is solved by the features according to the independent claim.

[0013] Advantageous embodiments are disclosed by the subclaims.

[0014] The louver unit may include first cutouts provided at the protrusion and a plurality of guide plates provided in parallel to each other so that the guide plates are spaced apart from each other by the respective first cutouts, the first cutouts and the guide plates being alternately arranged.

[0015] Each of the guide plates may have a width of 0.5 mm to 3 mm.

[0016] The protrusion may include first inclined surfaces inclined relative to the plate, the guide plates may be provided at the first inclined surfaces, and the angle between the guide plates and the first inclined surfaces may be 10 to 60 degrees.

[0017] Each of the slits includes second inclined surfaces inclined relative to the plate, a top surface formed between the second inclined surfaces, and a second cutout provided at the rear of the top surface.

[0018] The top surface may have a width of 0.5 mm to 5 mm.

[0019] The first inclined surfaces may be disposed at the plate in a symmetrical fashion, the distance between a line formed at the position where the first inclined surfaces join each other and the plate may constitute a height of the protrusion, and the protrusion may have a height of 0.5 mm to 4 mm.

[0020] The first inclined surfaces may be disposed at the plate in a symmetrical fashion, the distance between

a flat surface connected between the first inclined surfaces and the plate may constitute a height of the protrusion, and the protrusion may have a height of 0.5 mm to 4 mm.

[0021] The heat exchanger fin may include a plurality of plates stacked at an interval.

[0022] The protrusion may include first inclined surfaces disposed in a symmetrical fashion to form a 'V' shape, and the guide plates and the first cutouts may be provided at the first inclined surfaces.

[0023] The angle between the first inclined surfaces and the guide plates provided at the first inclined surfaces may be 10 to 60 degrees.

[0024] The protrusion may include first inclined surfaces disposed in a symmetrical fashion and a flat surface connected between the first inclined surfaces, the guide plates and the first cutouts being provided at the first inclined surfaces or the flat surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

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

FIG. 2 is a perspective view illustrating part of a heat exchanger fin of FIG. 1;

FIG. 3 is a front view of FIG. 2;

FIG. 4 is a sectional view taken along line I-I of FIG. 3;

FIG. 5 is an enlarged sectional view illustrating part of FIG. 4;

FIG. 6 is a view illustrating air flow around the heat exchanger fin of FIG. 3;

FIG. 7 is a sectional view taken along line II-II of FIG. 6;

FIG. 8 is a table illustrating heat exchange efficiency of the heat exchanger fin of FIG. 3;

FIG. 9 is a front view illustrating a conventional fin;

FIG. 10 is a sectional view taken along line A-A of FIG. 9;

FIG. 11 is a front view illustrating a heat exchanger according to another embodiment of the present disclosure;

FIG. 12 is a front view illustrating a heat exchanger according to another embodiment of the present disclosure;

FIG. 13 is a sectional view taken along line III-III of FIG. 12;

FIG. 14 is a front view illustrating a heat exchanger according to another embodiment of the present disclosure;

FIG. 15 is a sectional view taken along line IV-IV of FIG. 14;

FIG. 16 is a front view illustrating a heat exchanger

not forming part of the present invention,

FIG. 17 is a sectional view taken along line V-V of FIG. 16;

FIG. 18 is a front view illustrating a heat exchanger according to yet another embodiment of the present disclosure; and

FIG. 19 is a sectional view taken along line VI-VI of FIG. 18.

DETAILED DESCRIPTION

[0026] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0027] FIG. 1 is a perspective view illustrating a heat exchanger according to an embodiment of the present disclosure.

[0028] As shown in FIG. 1, a heat exchanger 10 includes a refrigerant pipe 20, in which a refrigerant flows, and heat exchanger fins 30 coupled to the outer circumference of the refrigerant pipe 20.

[0029] The refrigerant pipe 20 is configured in the shape of a hollow tube in which the refrigerant flows. The refrigerant pipe 20 is lengthened to increase heat exchange area between the refrigerant flowing in the refrigerant pipe 20 and external air. However, it may be difficult to extend the refrigerant pipe 20 in one direction due to spatial restrictions. Consequently, the refrigerant pipe 20 is repeatedly bent at opposite ends of the heat exchanger 10 in opposite directions to efficiently increase heat exchange area per unit volume.

[0030] The refrigerant flowing in the refrigerant pipe 20 is formed by mixing different Freon products exhibiting different properties. For example, R-134a and R410A may be used.

[0031] The refrigerant may be phase changed (compressed) from a gas state to a liquid state to perform heat exchange with external air. On the other hand, the refrigerant may be phase changed (expanded) from a liquid state to a gas state to perform heat exchange with external air. When the refrigerant is phase changed from a gas state to a liquid state, the heat exchanger 10 is used as a condenser. When the refrigerant is phase changed from a liquid state to a gas state, the heat exchanger 10 is used as an evaporator.

[0032] The refrigerant, flowing in the refrigerant pipe 20, is compressed or expanded to discharge heat to the surroundings or to absorb heat from the surroundings. The heat exchanger fins 30 are coupled to the refrigerant pipe 20 so that the refrigerant efficiently discharges or absorbs heat during compression or expansion.

[0033] The heat exchanger fins 30 are disposed at a predetermined interval in the direction in which the refrigerant pipe 20 extends.

[0034] The heat exchanger fins 30 may be made of various metal materials, such as aluminum, exhibiting high thermal conductivity. The heat exchanger fins 30

are coupled to the outer circumference of the refrigerant pipe 20 in a contact state to increase contact area between the refrigerant pipe 20 and external air.

[0035] The interval between the heat exchanger fins 30 may be reduced to increase the number of the heat exchanger fins 30. If the interval between the heat exchanger fins 30 is too small, however, the heat exchanger fins 30 may act as resistance to air F introduced to the heat exchanger 10, as shown in FIG. 1, resulting in pressure loss. For this reason, the interval between the heat exchanger fins 30 may be properly adjusted.

[0036] FIG. 2 is a perspective view illustrating part of one of the heat exchanger fins of FIG. 1, FIG. 3 is a front view of FIG. 2, FIG. 4 is a sectional view taken along line I-I of FIG. 3, and FIG. 5 is an enlarged sectional view illustrating part of FIG. 4.

[0037] As shown in FIGS. 2 to 5, the heat exchanger fin 30 includes a plate 40, a protrusion 70 protruding from the plate 40, slits 50 provided at opposite sides of the protrusion 70, and a louver unit 60 provided at the protrusion 70.

[0038] The plate 40 is made of an aluminum alloy. The plate 40 is thin. The plate 40 includes location holes 32, through which the refrigerant pipe 20 extends in a contact state.

[0039] Each of the location holes 32 contacts the outer circumference of the refrigerant pipe 20 to support the refrigerant pipe 20. Each of the location holes 32 is formed in a shape corresponding to the outer circumference of the refrigerant pipe 20 to surround the refrigerant pipe 20.

[0040] As shown in FIG. 2, each of the location holes 32 protrudes frontward and rearward from the plate 40 to stably support the refrigerant pipe 20 and to increase contact area between the refrigerant pipe 20 and the heat exchanger fin 30 so that heat exchange is smoothly achieved.

[0041] The protrusion 70 protrudes frontward from the plate 40.

[0042] The protrusion 70 includes first inclined surfaces 72 disposed at a predetermined angle relative to the plate 40. The first inclined surfaces 72 are disposed on the plate 40 in a symmetrical fashion to form a 'V' shape.

[0043] The first inclined surfaces 72 guide air, passing through the slits 50, to the louver unit 60. That is, air, accelerated while passing through the slits 50, naturally flows along the first inclined surfaces 72 so that speed of the air is not reduced. The air flowing along the first inclined surfaces 72 contacts the louver unit 60 to perform heat exchange with the refrigerant flowing in the refrigerant pipe 20, thereby increasing heat transfer efficiency.

[0044] As previously described, the first inclined surfaces 72 are disposed on the plate 40 in a symmetrical fashion to form a 'V' shape. A contact line 74 is formed vertically at a position where the first inclined surfaces 72 join each other. The distance between the contact line 74 and the plate 40 constitutes a height H of the protrusion 70.

[0045] If the height H of the protrusion 70 is increased, the area of the first inclined surfaces 72 increases, thereby increasing the contact area between the first inclined surfaces 72 and external air. If the height H of the protrusion 70 is excessively increased, however, the first inclined surfaces 72 act as resistance to external air. As a result, the speed of air is reduced and pressure of the air is reduced (pressure loss), thereby reducing heat transfer efficiency. The height H of the protrusion 70 is 0.5 mm to 4.0 mm.

[0046] Meanwhile, the first inclined surfaces 72 may be disposed on the plate in a non-symmetrical fashion, which will be described in detail below in connection with a heat exchanger fin 300 according to another embodiment of the present disclosure.

[0047] The slits 50 are disposed at opposite sides of the protrusion 70.

[0048] The slits 50 prevent moisture contained in external air from being attached to the surface of the heat exchanger fin 30. Also, the slits accelerate external air introduced to the heat exchanger 10 and guide the external air to the protrusion 70 and the louver unit 60. Each of the slits 50 includes second inclined surfaces 52 inclined relative to the plate 40, a top surface 54 provided between the second inclined surfaces 52, and a second cutout 56 provided at the rear of the top surface 54.

[0049] The second inclined surfaces 52 protrude from the plate 40 so that the second inclined surfaces 52 are disposed at a predetermined angle relative to the plate 40 to define a space, in which external air flows, between the plate 40 and the top surface 54.

[0050] The top surface 54 is formed in an approximately trapezoidal shape. The top surface 54 is disposed between the second inclined surfaces 52. Air, passing through each of the slits 50, is divided by the top surface 54 and flows along the front and rear of the top surface 54, resulting in turbulent flow. As a result, the air is further accelerated.

[0051] The top surface 54 may be formed in other shapes. For example, the top surface 54 may be formed in the shape of a triangle, a semicircle, an arc or a quadrangle. Even if the top surface 54 is formed in any one of the above-specified shapes, the same effect in that air, passing through each of the slits 50, is divided by the top surface 54 is achieved.

[0052] An edge 58 is formed between top surface 54 and each of the second inclined surfaces 52. The edge 58 prevents frost formation. Frost formation is a phenomenon in which moisture contained in external air is attached to the surface of the heat exchanger fin 30 in a frozen state. Frost is formed at a flat surface on which more than a predetermined amount of moisture is easily collected. More than a predetermined amount of moisture is prevented from being collected by the provision of the edge 58, thereby preventing or retarding frost formation.

[0053] The second cutout 56 is provided at the rear of the top surface 54 to guide external air, introduced to the heat exchanger 10, to the louver unit 60 and to minimize

resistance applied to the air flowing along the top surface 54.

[0054] When the heat exchanger 10 is used as an evaporator to heat a room, the refrigerant, flowing in the refrigerant pipe 20, is expanded from a liquid state to a gas state to absorb heat from the surroundings. As a result, the surface temperature of the refrigerant pipe 20 is generally lowered to below zero degrees Celsius. The second cutout 56 retards heat exchange between the refrigerant pipe 20 and the corresponding slit 50, thereby preventing frost formation.

[0055] The width D of the top surface 54 may be 0.5 to 5.0 mm in consideration of resistance applied to air passing through the corresponding slit 50.

[0056] The slits 50 are disposed at opposite sides of the protrusion 70. At least two slits 50 may be disposed in the vertical direction of the plate 40 so that the slits 50 are spaced apart from each other.

[0057] When the slits are disposed in the vertical direction of the plate 40 so that the slits 50 are spaced apart from each other, the strength of the slits 50 and the plate 40 is higher than when the slits are disposed without separation.

[0058] The louver unit 60 is provided at the protrusion 70.

[0059] The louver unit 60 includes guide plates 62 provided at the first inclined surfaces 72 and first cutout 64 alternating with the guide plates 62.

[0060] The guide plates 62 are disposed at a predetermined angle relative to the first inclined surfaces 72. The guide plates 62 are arranged in parallel to each other so that the guide plates 62 are spaced apart from each other.

[0061] External air, accelerated after having passed through the slits 50, flows along the first inclined surfaces 72 and contacts the guide plates 62 to perform heat exchange with the guide plates 62. The guide plates 62 increase contact area between the heat exchanger fin 30 and external air to increase heat exchange efficiency.

[0062] When the pitch (width) P of each of the guide plates 62 is small or when the inclination angle α between each of the guide plates 62 and the first inclined angle 72 is small, contact area between the heat exchanger fin 30 and external air increases. If the pitch P is too small or the inclination angle α is too large, however, speed of air passing through the louver unit 60 is reduced by the guide plates 62, resulting in pressure loss. As a result, overall heat exchange efficiency is lowered. Consequently, the pitch P and the inclination angle α are properly adjusted. For example, the pitch P may be 0.5 mm to 3.0 mm and the inclination angle α may be 10 degrees to 60 degrees.

[0063] Also, the edge of each of the guide plates 62 prevents or retards frost formation, as previously described.

[0064] The first cutouts 64 are provided at the first inclined surfaces 72 so that the first cutouts 64 and the guide plates 62 are alternately disposed. The first cutouts

64 guide external air, accelerated after having passed through the slits 50, to flow along one side of each of the guide plates 62, thereby effectively achieving heat transfer between the guide plates 62 and external air.

[0065] FIG. 6 is a view illustrating air flow around the heat exchanger fin of FIG. 3, and FIG. 7 is a sectional view taken along line II-II of FIG. 6.

[0066] FIGS. 6 and 7 illustrate calculation results of air flow around the heat exchanger fin 30 using computational fluid dynamics (CFD). In the drawings, lines indicate air flow direction, and lengths of the lines indicate air speed. Longer lengths of the lines represent higher air speed.

[0067] As shown in FIGS. 6 and 7, air passing through the slits 50 of the heat exchanger fin 30 moves faster than air not passing through the slits 50 since the air introduced into the slits 50 is accelerated by the top surface 54 of each of the slits 50.

[0068] The air, accelerated by the slits 50, flows to the louver unit 60 without reduction of air speed. As previously described, the slits 50 accelerate air introduced into the slits 50 and guide the introduced air to the louver unit 60.

[0069] The air flows on the surfaces of the guide plates 62 and between the guide plates 62, i.e. at the first cutouts 64, at high speed to perform heat exchange with the guide plates 62.

[0070] FIG. 8 is a table illustrating heat exchange efficiency of the heat exchanger fin of FIG. 3. FIGS. 9 and 10 are a front view and a sectional view illustrating a conventional fin compared with the heat exchange efficiency of the heat exchanger fin of FIG. 3.

[0071] As shown in FIGS. 9 and 10, a conventional fin 1 is provided at the middle thereof with slits 5 but does not include a protrusion 70 and a louver unit 60, which are included in the heat exchanger fin 30 of FIG. 3.

[0072] In the table of FIG. 8, wind speed indicates speed of external air introduced to the fin, and fin pitch indicates the distance between the respective fins. Smaller pitch means that a larger number of fins may be disposed in a limited space.

[0073] As the result of a comparison of heat transfer efficiency between the conventional fins and the inventive fins having the same pitch (1.5 mm), the inventive fins have approximately 7.4 % to 8.2 % higher heat transfer efficiency in all wind speed sections than the conventional fins.

[0074] Also, even when the pitch of the inventive fins is increased from 1.5 mm to 1.7 mm, the inventive fins have higher heat transfer efficiency than the conventional fins having a pitch of 1.5 mm. This means that higher heat transfer efficiency is achieved using a smaller number of inventive fins, thereby reducing material costs.

[0075] FIGS. 11 to 19 are front views and sectional views illustrating heat exchanger fins 200, 300, 400, 500 and 600 according to other embodiments of the present disclosure.

[0076] FIG. 11 illustrates a heat exchanger fin 200 ac-

cording to another embodiment of the present disclosure. A slit 250, protruding frontward from the heat exchanger fin 200, is formed as a single body.

[0077] FIGS. 12 and 13 illustrate a heat exchanger fin 300 according to another embodiment of the present disclosure. A protrusion 370 of the heat exchanger fin 300 is formed in a non-symmetrical shape. That is, first inclined surfaces 372a and 372b constituting the protrusion 370 are formed in a non-symmetrical 'V' shape.

[0078] An inclination angle β between the first inclined surface 372a and the front of a plate 40 is larger than an inclination angle β' between the first inclined surface 372b and the front of the plate 40. Consequently, the area of the first inclined surface 372a is smaller than that of the first inclined surface 372b. Also, a contact line 374 at which the first inclined surfaces 372a and 372b join each other deviates from the middle of the plate 40.

[0079] FIGS. 14 and 15 illustrate a heat exchanger fin 400 according to another embodiment of the present disclosure. Guide plates 462 provided at a louver unit 60 of the heat exchanger fin 400 have different inclination angles.

[0080] That is, the guide plates 462 may be provided at first inclined surfaces 72 so that the guide plates 462 are at different inclination angles relative to the first inclined surfaces 72.

[0081] FIGS. 16 and 17 illustrate a heat exchanger fin 500 which does not form part of the present invention. Slits 50, protruding frontward from the heat exchanger fin 500, are provided at only one side of a protrusion 700.

[0082] In this case, the slits 50 are disposed at an external air introduction side.

[0083] FIGS. 18 and 19 illustrate a heat exchanger fin 600 according to yet another embodiment of the present disclosure. A protrusion 670 of the heat exchanger fin 600 includes a flat surface 676.

[0084] The flat surface 676 is provided between first inclined surfaces 672. The first inclined surfaces 672 may be symmetric with respect to the flat surface 676. The distance between the flat surface 676 and a plate 40 constitutes the height of the protrusion 670. The height of the protrusion 670 is 0.5 mm to 4.0 mm.

[0085] Guide plates 62 may be selectively provided at the first inclined surfaces 672 or the flat surface 676. Alternatively, the guide plates 62 may be provided at both the first inclined surfaces 672 and the flat surface 676.

[0086] At least two of the previous embodiments may be combined. For example, when the embodiment of FIGS. 12 and 13 and the embodiment of FIGS. 14 and 15 are combined, the guide plates 462 may be provided at the first inclined surfaces 372a and 372b of the protrusion 370 formed in a non-symmetrical shape (characteristic of the embodiment of FIG. 12 and 13) so that the guide plates 462 are at different inclination angles to the first inclined surfaces 372a and 372b (characteristic of the embodiment of FIGS. 14 and 15).

[0087] As is apparent from the above description, heat exchange between air and the heat exchanger fins of the

embodiments of the present disclosure is effectively achieved, thereby improving heat exchange efficiency.

[0088] Also, frost formation is restrained on the surfaces of the heat exchanger fins, thereby improving heat exchange efficiency.

[0089] Although a few embodiments of the present disclosure have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims.

Claims

1. A heat exchanger (10) comprising:

a refrigerant pipe (20) in which a refrigerant flows; and

a heat exchanger fin (30, 200, 300, 400, 600) coupled to an outer circumference of the refrigerant pipe (20), wherein the heat exchanger fin comprises:

a plate (40);

a protrusion (70, 370, 670) protruding from the plate (40); a louver unit (60) provided at the protrusion to perform heat exchange;

characterized by

slits (50) disposed at right and left sides of the protrusion (70, 370, 670) to guide air to the protrusion, wherein said louver unit (60) is adapted to perform said heat exchange with the air having passed through the slits (50), and wherein air flows in the slits disposed at the right side of the protrusion, and then passes through the protrusion, and finally flows out of the slits disposed at the left side of the protrusion.

2. The heat exchanger according to claim 1, wherein the louver unit (60) comprises:

first cutouts (64) provided at the protrusion (70); and

a plurality of guide plates (62, 462) provided in parallel to each other so that the guide plates are spaced apart from each other by the respective first cutouts (64),

the first cutouts (64) and the guide plates (62, 462) being alternately arranged.

3. The heat exchanger according to claim 2, wherein each of the guide plates (62) has a width of 0.5 mm to 3 mm.

4. The heat exchanger according to claim 2, wherein

the protrusion (70, 470) comprises first inclined surfaces (72, 672, 372 a, b) inclined relative to the plate (40),

the guide plates (62, 462) are provided at the first inclined surfaces, and

an angle between the guide plates and the first inclined surfaces is 10 to 60 degrees.

5. The heat exchanger according to claim 1, wherein each of the slits (50) comprises:

second inclined surfaces (52) inclined relative to the plate (40);

a top surface (54) formed between the second inclined surfaces (52); and

a second cutout (56) provided at a rear of the top surface (54).

6. The heat exchanger according to claim 5, wherein the top surface (54) has a width of 0.5 mm to 5 mm.

7. The heat exchanger according to claim 4, wherein the first inclined surfaces (52) are disposed at the plate (40) in a symmetrical fashion, a distance between a line formed at a position where the first inclined surfaces join each other and the plate constitutes a height (H) of the protrusion (70, 470), and the protrusion has a height of 0.5 mm to 4 mm.

8. The heat exchanger according to claim 4, wherein the first inclined surfaces (52) are disposed at the plate (40) in a symmetrical fashion, a distance between a flat surface (676) connected between the first inclined surfaces (52) and the plate (40) constitutes a height (H) of the protrusion, and the protrusion has a height of 0.5 mm to 4 mm.

9. The heat exchanger according to claim 1, wherein the heat exchanger fin (30, 200, 300, 400, 600) comprises a plurality of plates (40) stacked at an interval.

Patentansprüche

1. Wärmetauscher (10), welcher aufweist:

eine Kühlmittelleitung (20) in welcher ein Kühlmittel fließt und

eine Wärmetauscherrippe (30, 200, 300, 400, 600), die an einem Außenumfang der Kühlmittelleitung (20) angekoppelt ist, wobei die Wärmetauscherrippe umfasst:

eine Platte (40);

einen Vorsprung (70, 370, 670), welcher von der Platte (40) vorsteht, und eine Gittereinheit (60), die an dem Vorsprung zur Durchführung des Wärmeaustauschs vor-

gesehen ist,

gekennzeichnet durch

an rechten und linken Seiten des Vorsprungs (70, 370, 670) angeordnete Schlitze (50) zur Führung von Luft zu dem Vorsprung, wobei die Gittereinheit (60) zur Durchführung des Wärmeaustauschs mit der Luft ausgebildet ist, nachdem diese **durch** die Schlitz (50) hindurchgetreten ist, und wobei Luft in die Schlitze an der rechten Seite des Vorsprungs einfließt, dann **durch** den Vorsprung hindurchtritt und schließlich aus den Schlitzen, welche auf der linken Seite des Vorsprungs angeordnet sind, herausfließt.

2. Wärmetauscher nach Anspruch 1, wobei die Gittereinheit (60) aufweist:

erste Durchbrüche (64) vorgesehen an dem Vorsprung (70) und

eine Vielzahl von Führungsplatten (62, 462), die parallel zueinander vorgesehen sind, so dass die Führungsplatten voneinander beabstandet sind durch die entsprechenden ersten Durchbrüche (64), wobei die ersten Durchbrüche (64) und die Führungsplatten (62, 462) alternierend angeordnet sind.

3. Wärmetauscher nach Anspruch 2, wobei jede der Führungsplatten (62) eine Breite von 0,5 mm bis 3 mm aufweist.

4. Wärmetauscher nach Anspruch 2, wobei der Vorsprung (70, 470) erste geneigte Flächen (72, 672, 372a,b) aufweist, die relativ zu der Platte (40) geneigt sind, die Führungsplatten (62, 462) an den ersten geneigten Flächen vorgesehen sind und ein Winkel zwischen den Führungsplatten und den ersten geneigten Flächen 10° bis 60° beträgt.

5. Wärmetauscher nach Anspruch 1, wobei jeder der Schlitze (50) aufweist:

zweite geneigte Flächen (52), die relativ zur Platte (40) geneigt sind;

eine Oberseite (54), die zwischen den zweiten geneigten Flächen (52) gebildet ist, und einen zweiten Durchbruch (56), der auf einer Rückseite der Oberseite (54) vorgesehen ist.

6. Wärmetauscher nach Anspruch 5, wobei die Oberseite (54) eine Breite von 0,5 mm bis 5 mm aufweist.

7. Wärmetauscher nach Anspruch 4, wobei die ersten geneigten Flächen (52) an der Platte (40) in einer symmetrischen Weise angeordnet sind, ein Abstand zwischen einer Linie, die an einer Position gebildet ist, wo die ersten geneigten Flächen aufeinander treffen und der Platte eine Höhe (H) des Vorsprungs

(70, 470) festlegt und der Vorsprung eine Höhe von 0,5 mm bis 4 mm aufweist.

8. Wärmetauscher nach Anspruch 4, wobei die ersten geneigten Flächen (52) an der Platte (40) in symmetrischer Weise angeordnet sind, ein Abstand zwischen einer flachen Oberfläche (676) die zwischen den ersten geneigten Flächen (52) verbunden ist und der Platte (40) eine Höhe (H) des Vorsprungs bestimmt, und der Vorsprung eine Höhe von 0,5 mm bis 4 mm aufweist. 5 10
9. Wärmetauscher nach Anspruch 1, wobei die Wärmetauscherrippe (30, 200, 300, 400, 600) eine Vielzahl von im Intervall gestapelten Platten (40) umfasst. 15

Revendications

1. Echangeur de chaleur (10), comprenant:

un tuyau de réfrigérant (20) dans lequel un réfrigérant s'écoule; et
une ailette d'échangeur de chaleur (30, 200, 300, 400, 600) couplée à une circonférence extérieure du tuyau de réfrigérant (20), dans lequel l'aillette d'échangeur de chaleur comprend:

une plaque (40);
une saillie (70, 370, 670) faisant saillie à partir de la plaque (40); et
une unité de persienne (60) prévue au niveau de la saillie pour exécuter un échange de chaleur,

caractérisé par des fentes (50) formées sur les côtés droit et gauche de la saillie (70, 370, 670) afin de guider l'air vers la saillie, dans lequel ladite unité de persienne (60) est apte à exécuter ledit échange de chaleur en utilisant l'air qui est passé à travers les fentes (50), et
dans lequel de l'air s'écoule dans les fentes sur le côté droit de la saillie, et passe ensuite à travers la saillie, et s'écoule enfin hors de fentes formées sur le côté gauche de la saillie. 40 45

2. Echangeur de chaleur selon la revendication 1, dans lequel l'unité de persienne (60) comprend:

des premières découpes (64) formées au niveau de la saillie (70); et
une pluralité de plaques de guidage (64, 462) disposées parallèlement les unes aux autres de telle sorte que les plaques de guidage soient espacées les unes des autres par les premières découpes respectives (64), 50 55

les premières découpes (64) et les plaques de guidage (62, 462) étant agencées de manière alternée.

3. Echangeur de chaleur selon la revendication 2, dans lequel chacune des plaques de guidage (62) présente une largeur comprise entre 0,5 mm et 3 mm.

4. Echangeur de chaleur selon la revendication 2, dans lequel:

la saillie (70, 470) présente des premières surfaces inclinées (72, 672, 372 a, b) inclinées par rapport à la plaque (40);
les plaques de guidage (62, 462) sont prévues au niveau des premières surfaces inclinées; et
un angle entre les plaques de guidage et les premières surfaces inclinées est compris entre 10 degrés et 60 degrés.

5. Echangeur de chaleur selon la revendication 1, dans lequel chacune des fentes (50) présente:

des secondes surfaces inclinées (52) inclinées par rapport à la plaque (40);
une surface supérieure (54) formée entre les secondes surfaces inclinées (52); et
une seconde découpe (56) formée à l'arrière de la surface supérieure (54).

6. Echangeur de chaleur selon la revendication 5, dans lequel la surface supérieure (54) présente une largeur comprise entre 0,5 mm et 5 mm.

7. Echangeur de chaleur selon la revendication 4, dans lequel:

les premières surfaces inclinées (52) sont disposées au niveau de la plaque (40) d'une façon symétrique;
une distance entre une ligne formée à une position où les premières surfaces inclinées se rejoignent mutuellement et la plaque constitue une hauteur (H) de la saillie (70, 470); et
la saillie présente une hauteur comprise entre 0,5 mm et 4 mm.

8. Echangeur de chaleur selon la revendication 4, dans lequel:

les premières surfaces inclinées (52) sont disposées au niveau de la plaque (40) d'une façon symétrique;
une distance entre une surface plate (676) connectée entre les premières surfaces inclinées (52) et la plaque (40) constitue une hauteur (H) de la saillie; et
la saillie présente une hauteur comprise entre 0,5 mm et 4 mm.

9. Echangeur de chaleur selon la revendication 1, dans lequel l'aillette d'échangeur de chaleur (30, 200, 300, 400, 600) comprend une pluralité de plaques (40) superposées suivant un intervalle.

5

10

15

20

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FIG. 1

10

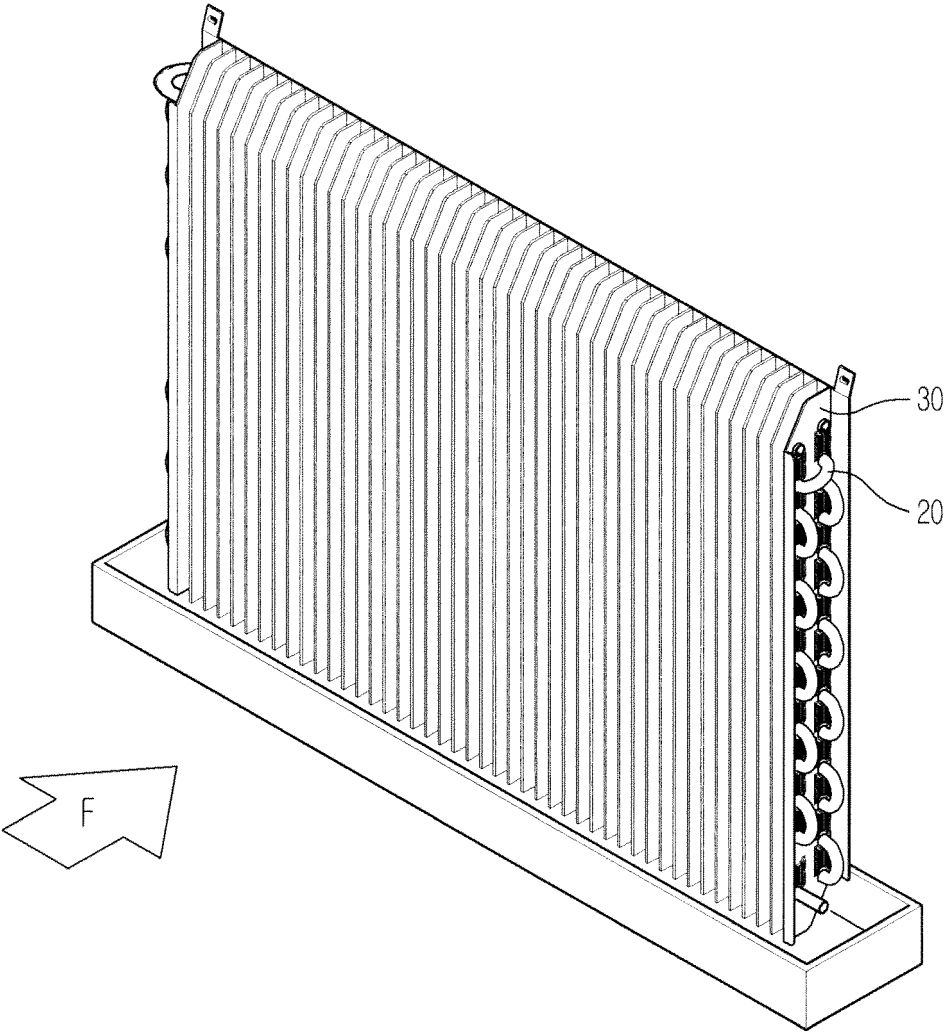


FIG. 2

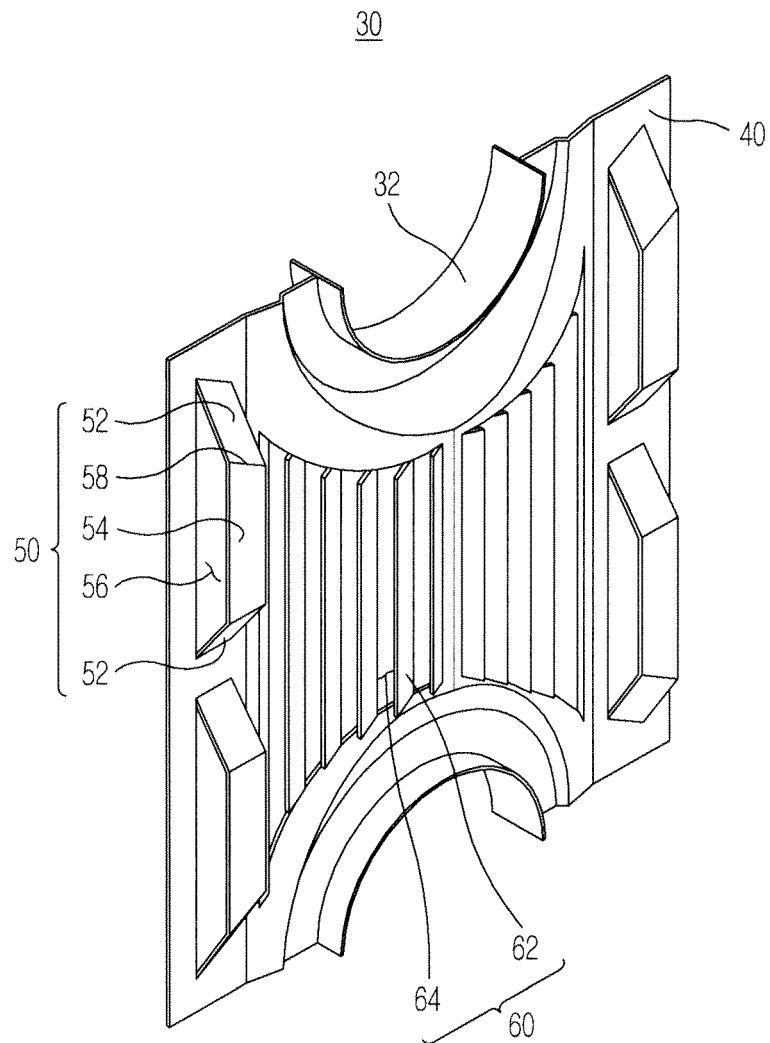


FIG. 3

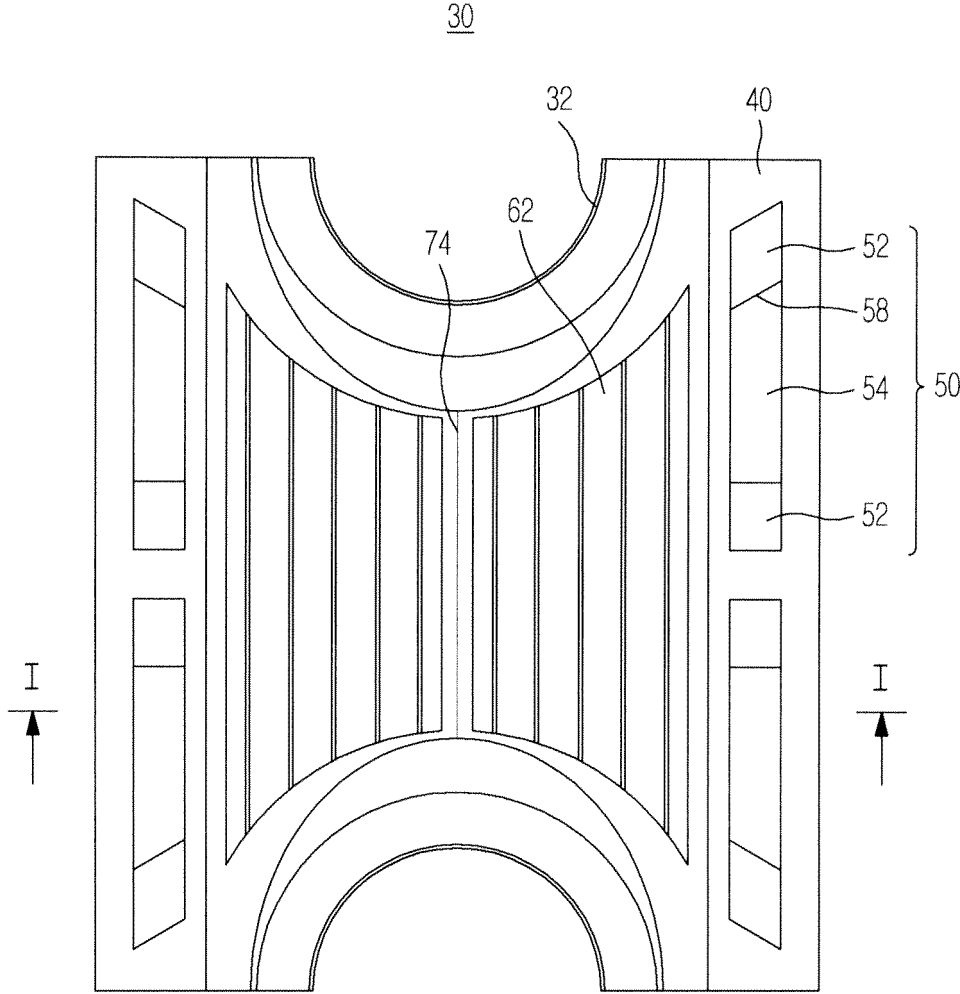


FIG. 4

30

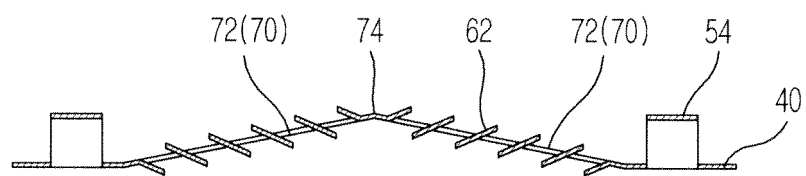


FIG. 5

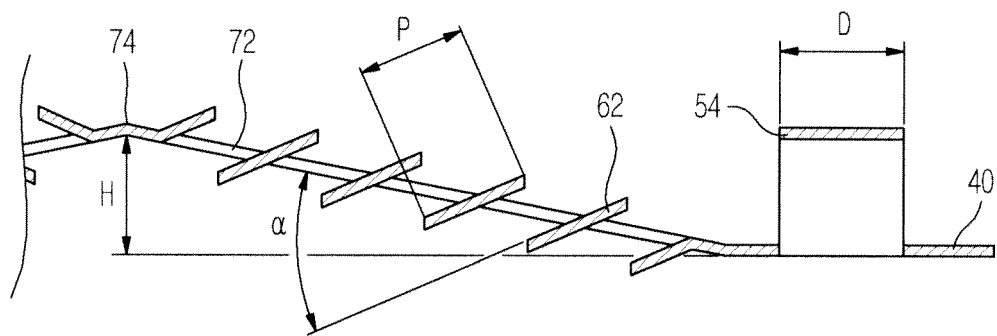


FIG. 6

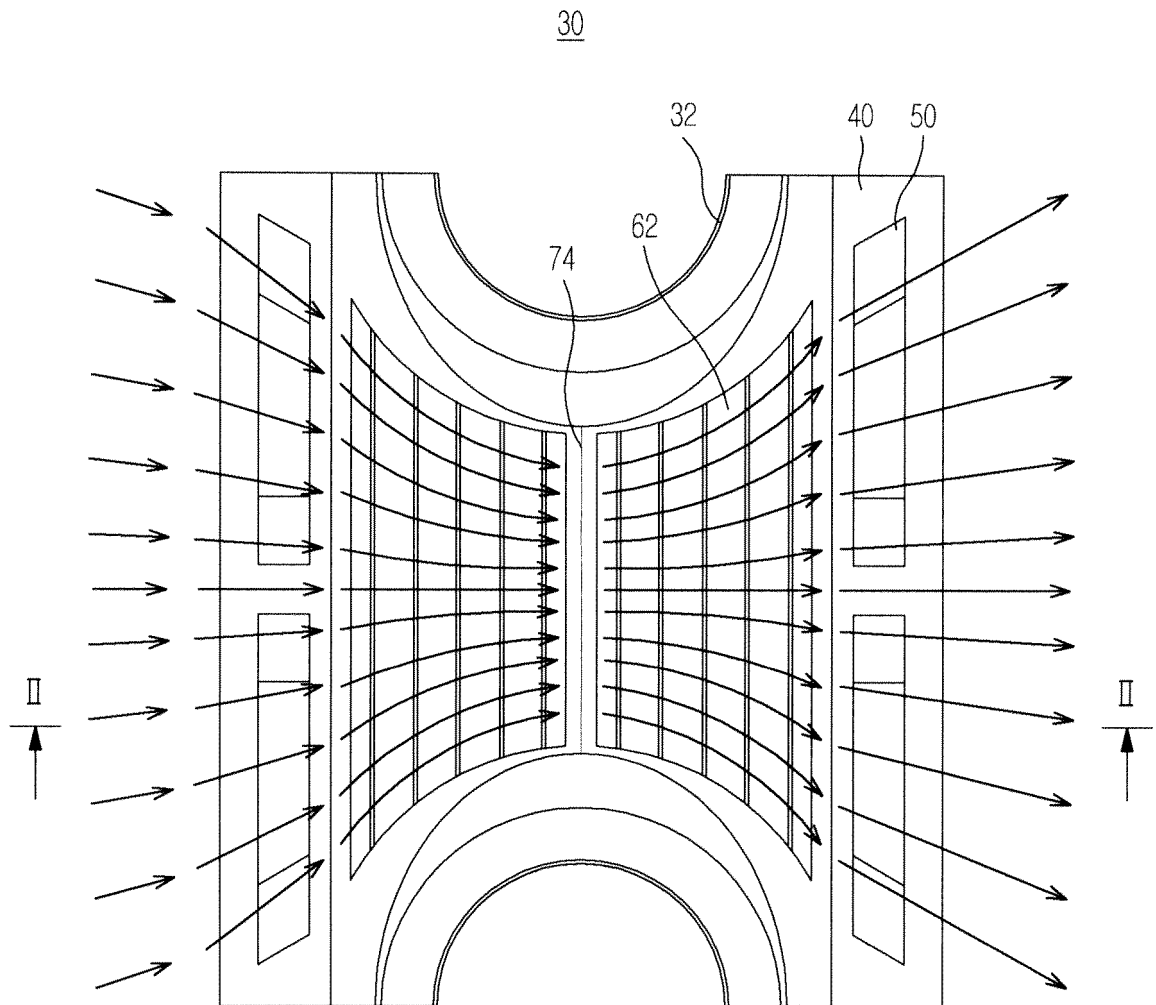


FIG. 7

30

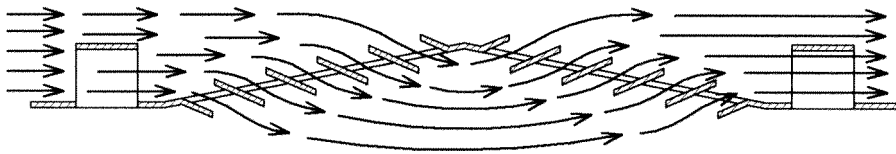


FIG. 8

		Fin Pitch (mm)	WIND SPEED (m/s)			
			1.0	1.5	2.0	2.5
HEAT TRANSFER EFFICIENCY(W)	CONVENTIONAL FINS	1.5	1222.5	1602.5	1896.0	2139.5
	INVENTIVE FINS	1.5	1323.0	1727.5	2042.5	2298.0
			108.2%	107.8%	107.7%	107.4%
		1.7	1267.0	1635.0	1915.5	2146.5
			103.6%	102.0%	101.0%	100.3%

FIG. 9 – Related Art

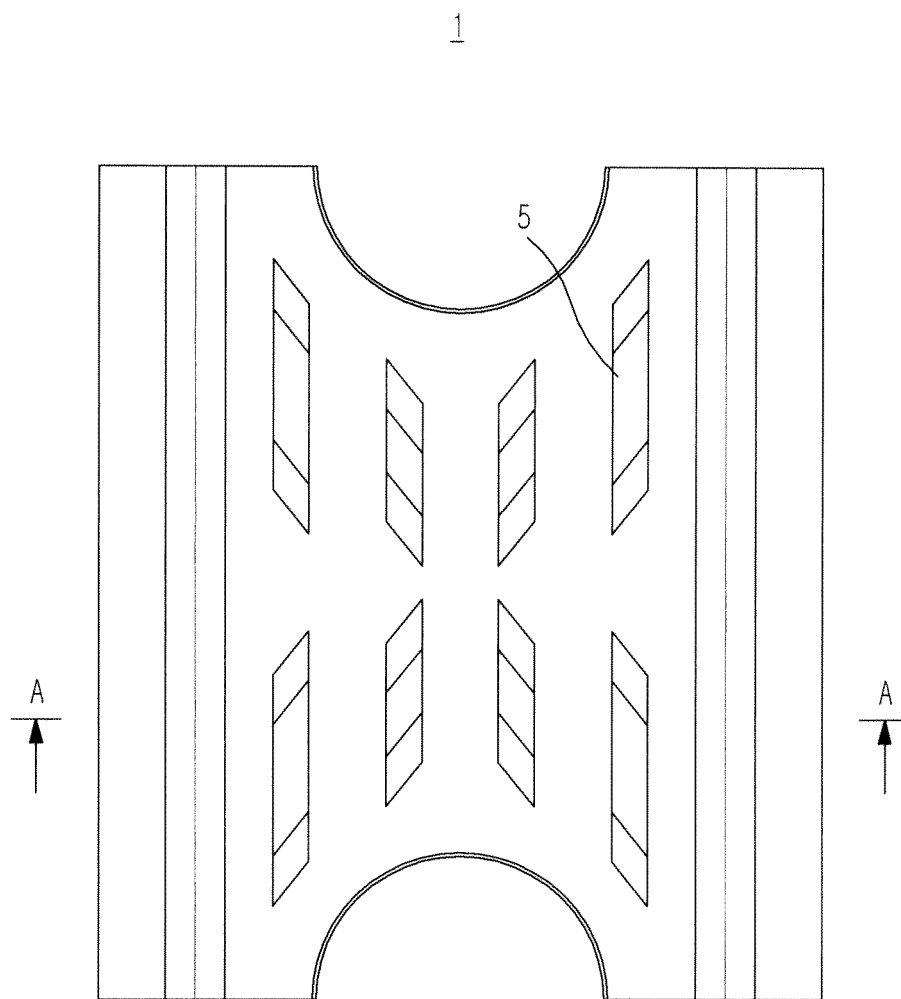


FIG. 10 – Related Art

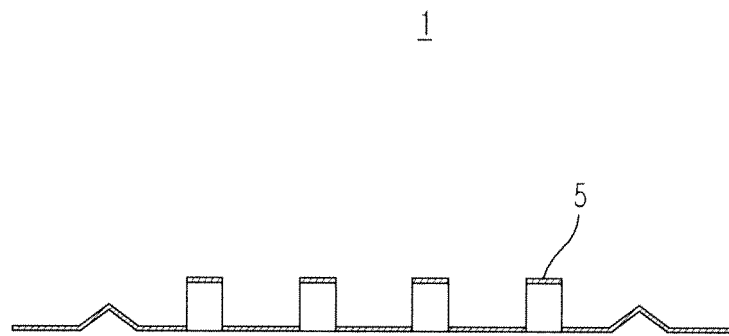


FIG. 11

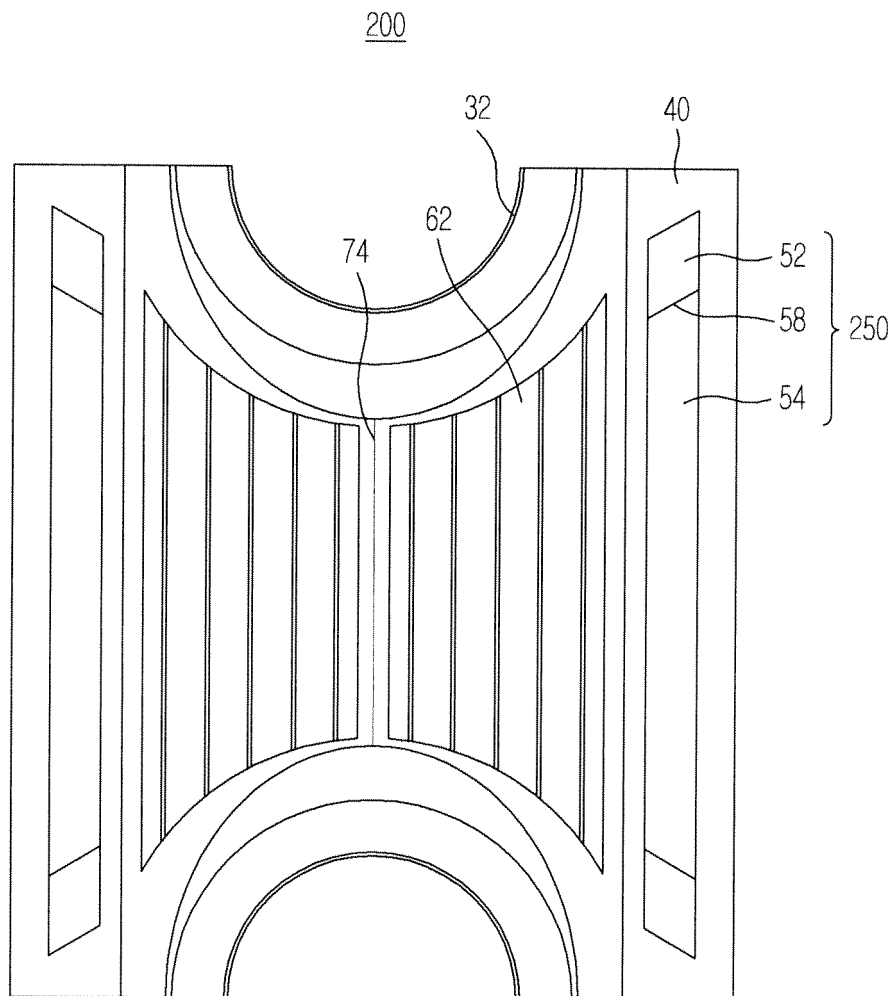


FIG. 12

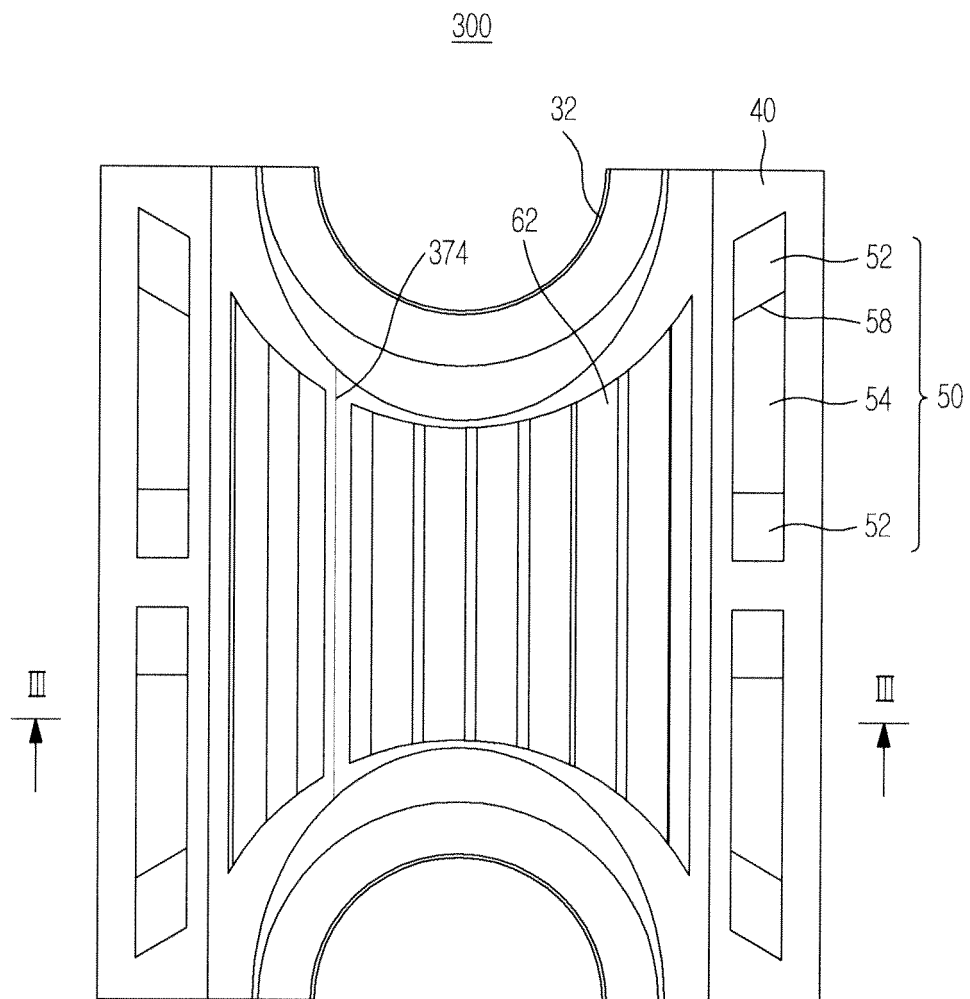


FIG. 13

300

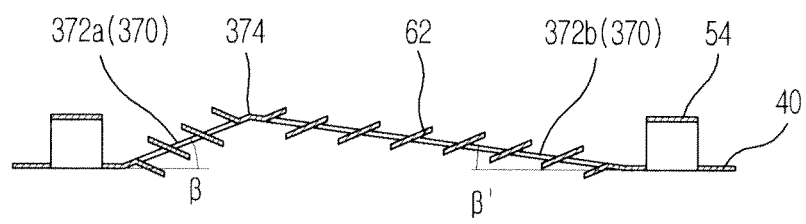


FIG. 14

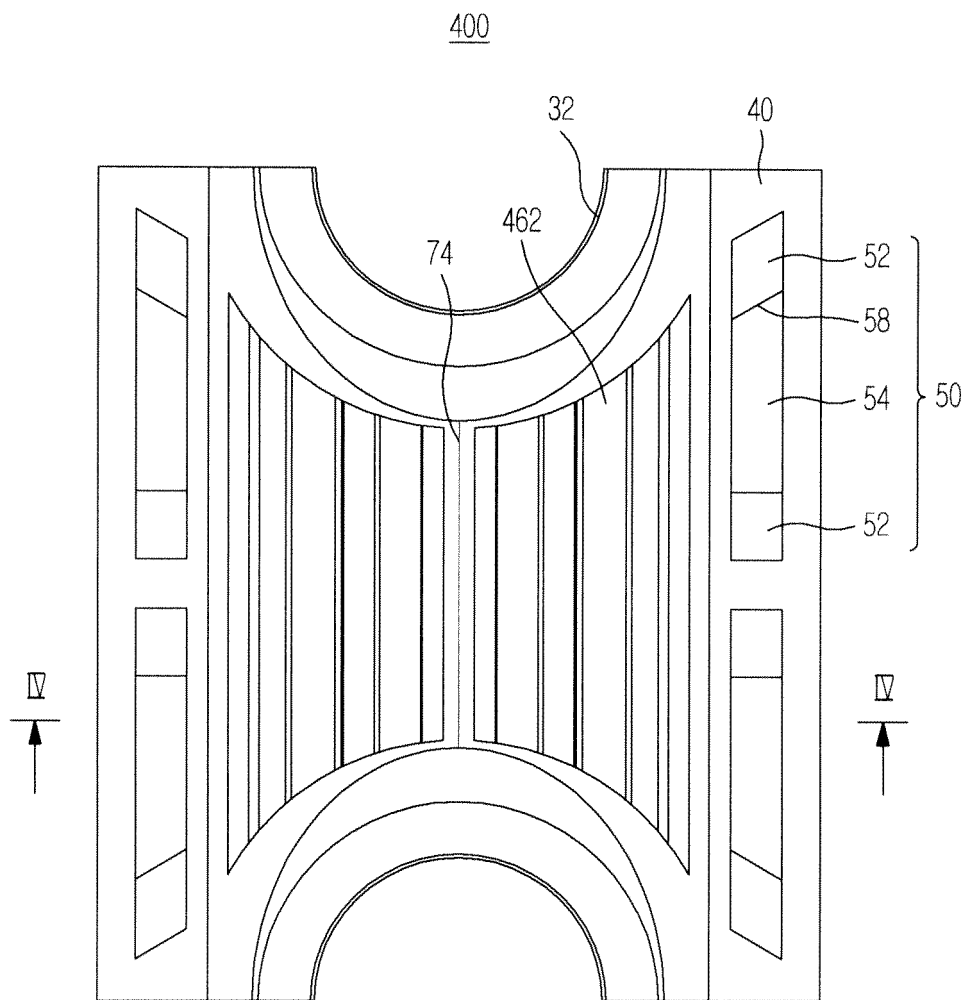


FIG. 15

400

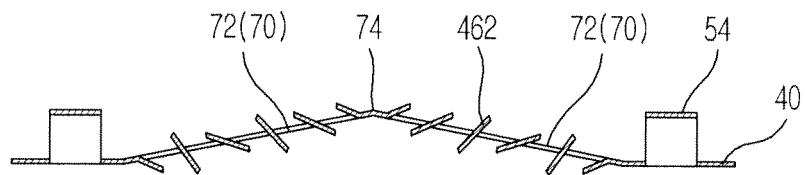


FIG. 16

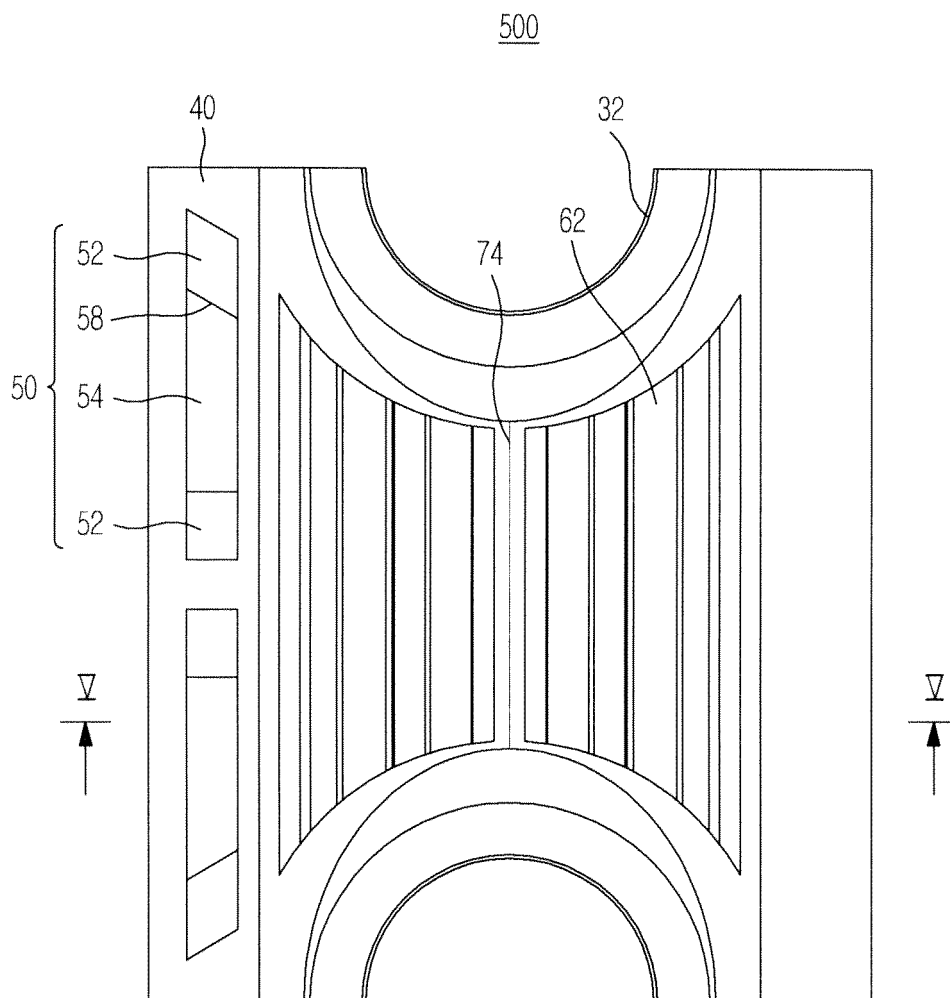


FIG. 17

500

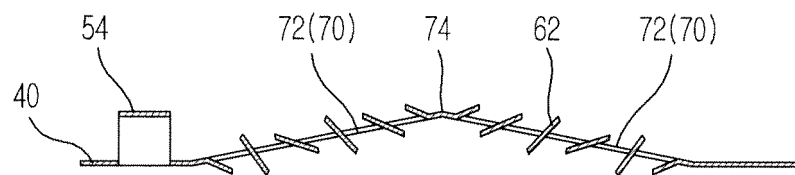


FIG. 18

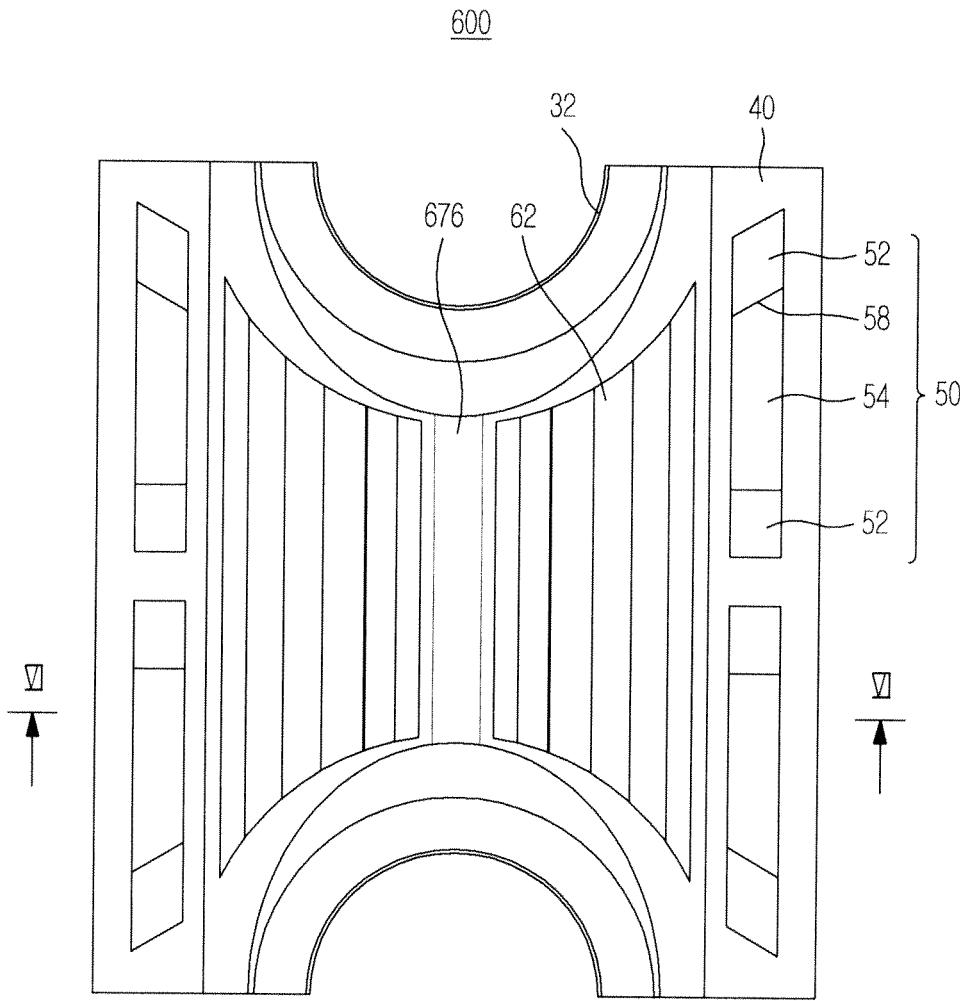
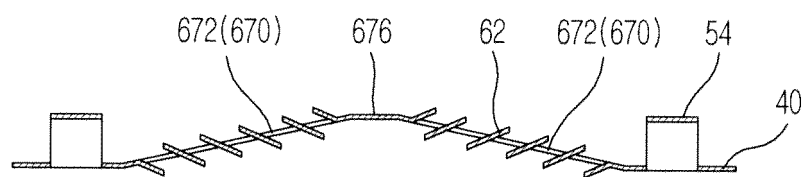


FIG. 19

600



REFERENCES CITED IN THE DESCRIPTION

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