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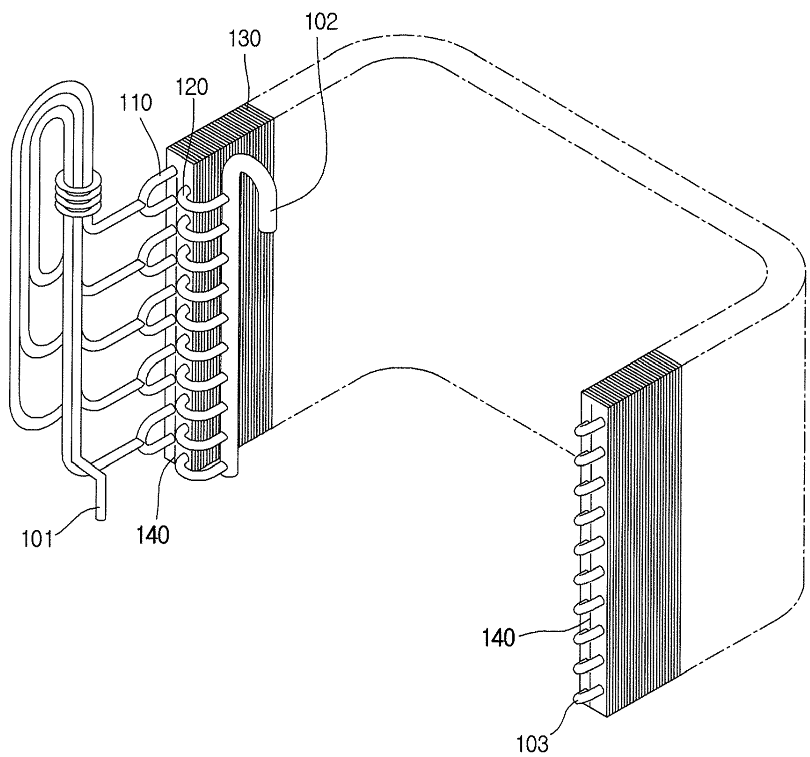
(54) **Heat exchanger**

(57) Provided is heat exchanger. The heat exchanger includes a plurality of first tubes disposed to form a first row, a plurality of second tubes disposed on a side of the plurality of first tubes to form a second row, and a fin in which the plurality of first tubes and the plurality of second tubes are inserted. The fin comprises a heat separation part for preventing heat conduction from occurring between the first tubes and the second tubes.

Fig. 2



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Description

BACKGROUND

[0001] The present disclosure relates to a heat exchanger.

[0002] A heat exchanger of an air-conditioner includes a tube through which a refrigerant flows and a blower fan for blowing air into the tube. Through the above-described structure, the heat exchanger may exchange heat between the refrigerant flowing into the tube and air flowing outside the tube.

[0003] The heat exchanger may serve as a condenser and evaporator that are respectively concerned to condensation and evaporation in a refrigerant cycle of "compression-condensation-expansion-evaporation".

[0004] A fin type heat exchanger includes a fin to improve heat-exchange efficiency. The fin has a hollow for accommodating a tube. In general, the fin has a thin plate shape. The tube is coupled to the fin by being expanded in a state where the tubs is inserted into the hollow of the fin. Thus, an outer circumference surface of the tube completely contacts the fin. Through the above-described structure, heat of the refrigerant flowing into the tube may be transferred to the fin as well as the tube by heat conduction. That is, the fin type heat exchanger may have an effect in which a heat-exchange area is widened when compared to that of a finless type heat exchanger.

[0005] Also, in general, tubes are arranged in a plurality of rows within one heat exchanger to improve heat exchange efficiency. For example, a three-row fin type heat exchanger includes a tube disposed in a first row so that the introduced refrigerant flows initially, a tube disposed in a second row to allow the refrigerant flowing into the tube disposed in the first row to flow, and a tube disposed in a third row to allow the refrigerant flowing into the tube disposed in the second tube to flow. Also, the three-row fin type heat exchanger includes a plurality of fins for respectively accommodating the tubes disposed in the first, second, and third rows.

[0006] The above-described three-row fin type heat exchanger may have limitations as follows.

[0007] If the three-row fin type heat exchanger is used as a condenser, the refrigerant flowing into the first row tube may be heat-exchanged with external air to decrease in temperature. That is, the refrigerant flowing into the first row tube may have a temperature greater than that of the refrigerant flowing into the second row tube. Similarly, the refrigerant flowing into the second row tube may have a temperature greater than that of the refrigerant flowing into the third row tube.

[0008] However, each of the plurality of fins accommodate the first row tube, the second row tube, and the third row tube to transfer heat by heat conduction through the tube between the first row tube and the second row tube and the fin between the second row tube and the third row tube. As a result, the refrigerant flowing into the second row tube and the third row tube may increase in temperature to deteriorate refrigerant condensation efficiency. As described above, if the refrigerant condensation efficiency is deteriorated, the whole refrigeration cycle may be deteriorated in heating efficiency or cooling efficiency.

[0009] If the fin for accommodating each of the tubes is independently provided to solve the above-described limitations, following limitations may occur.

[0010] For example, if a first row fin for fixing the first row tube and a second row fin fixing the second row tube are separately manufactured, changing amounts in position of first rand second row fins are different from each other. Thus, the fins are disposed missing each other.

[0011] When the first row fin and the second row fin are disposed missing each other as described above, an air flow may be interrupted to reduce the heat-exchange efficiency between the refrigerant and the external air.

SUMMARY

[0012] Embodiments provide a heat exchanger in which heat exchange due to conduction is blocked between tubes disposed in rows that are adjacent to each other.

[0013] In one embodiment, a heat exchanger includes: a plurality of first tubes disposed to form a first row; a plurality of second tubes disposed on a side of the plurality of first tubes to form a second row; and a fin in which the plurality of first tubes and the plurality of second tubes are inserted, wherein the fin includes a heat separation part for preventing heat conduction from occurring between the first tubes and the second tubes.

[0014] The fin may include: a first row fin in which the plurality of first tubes are inserted; a second row fin in which the plurality of second tubes are inserted; and a connection part connecting the first row fin to the second row fin.

[0015] The heat separation part may include a cutoff part defined between the first row fin and the second row fin.

[0016] The cutoff part may be provided in plurality so that the plurality of cutoff parts are spaced apart from each other, and the connection part may be disposed between the two cutoff parts adjacent to each other.

[0017] The plurality of second tubes may include a rear tube, and the plurality of first tubes may include an upper tube and a lower tube which are disposed closest to the rear tube of the plurality of first tubes.

[0018] An angle (θ1) between a first extension line ℓ that is a virtual extension line extending from a center (C1) of the rear tube toward the first row fin and a second extension line (ℓ') that is a virtual extension line connecting a center of the upper tube to the center (C1) of the rear tube may be about 45° or less.

[0019] An angle (θ2) between the first extension line (ℓ) and a third extension line (ℓ ") that is an extension line connecting the center of the lower tube to the center of the rear tube may be about 45° or less.

[0020] The first extension line (ℓ) may pass through the connection part.

[0021] The first extension line ℓ may equally divide a virtual center line (P) connecting the centers of the upper and lower tubes to each other.

[0022] The cutoff part between the rear tube and the upper tube may meet two virtual exterior common tangents (t, t') with respect to the rear and upper tubes.

[0023] A length of the cutoff part between the rear tube and the upper tube may be the sum of a length connecting two points at which the cutoff part meets the two virtual exterior common tangents and a length that corresponds to a 1/2 of a center distance between the two first tubes that are disposed closest to the rear tube.

[0024] The plurality of first tubes forming the first row and the plurality of second tubes forming the second row may be disposed in parallel with each other, and the plurality of cutoff parts may be disposed in parallel with the plurality of first and second tubes.

[0025] The heat exchanger may further include a blower fan for blowing air into the plurality of first and second tubes, wherein the plurality of first and second tubes may be vertically disposed in a zigzag shape with respect to a direction in which the air is introduced by the blower fan.

[0026] The plurality of first and second tubes may be disposed spaced apart from each other at the same interval.

[0027] In another embodiment, a heat exchanger includes: a plurality of first tubes constituting a first row; a plurality of second tubes disposed in parallel with the plurality of first tubes at a side of the plurality of first tubes, the plurality of second tubes constituting a second row; a first row fin having a plurality of first through holes coupled to the plurality of first tubes; a second row fin having a plurality of second through holes coupled to the plurality of second tubes; a connection part connecting the first row fin to the second row fin; and a cutoff part disposed on a side of the connection part to space at least one portion of the first row fin from at least one portion of the second row fin.

[0028] The cutoff part may be provided in plurality, and the connection part may be disposed between the plurality of cutoff parts.

[0029] The plurality of first tubes and the plurality of second tubes may be spaced apart from each other at the same interval.

[0030] A virtual first extension line (ℓ) passing through a center of one tube of the plurality of second tubes in a horizontal direction may equally divide a distance between centers of adjacent two tubes of the plurality of first tubes.

[0031] The first extension line (ℓ) may pass through the connection part.

[0032] Exterior common tangents (t, t') which connect two points on an outer circumferential surface to two points on an outer circumferential surface of the second tube may meet the cutoff part.

[0033] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

Fig. 1 is a perspective view of an outdoor unit according to an embodiment.

Fig. 2 is a perspective view of a heat exchanger according to an embodiment.

Fig. 3 is a cross-sectional view of the heat exchanger according to an embodiment.

Fig. 4 is a line graph illustrating an exchanging amount of heat condensed due to overcooling in the heat exchanger according to an embodiment and a heat exchanger according to a related art.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0035] Hereinafter, exemplary embodiments will be described with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, that alternate embodiments included in other retrogressive inventions or falling within the spirit and scope of the present disclosure will fully convey the concept of the invention to those skilled in the art.

[0036] Fig. 1 is a perspective view of an outdoor unit according to an embodiment.

[0037] Referring to Fig. 1, an outdoor unit 10 according to an embodiment may include a casing 11, an air inflow hole 20, an air discharge hole 30, a heat exchanger 100, and a blower fan 200.

[0038] The casing 10 defines an exterior of the outdoor unit 10. The casing 10 may include the heat exchanger 100 and the blower fan 200 therein.

[0039] The air inflow hole 20 may be a passage through which external air induced by the blower fan 200 is introduced into the casing 10. The air inflow hole 20 may have a shape in which three surfaces of side surfaces of the casing 10 are opened, but the present disclosure is not limited thereto. For example, if external air is capable of being introduced, the air inflow hole 20 may have various shapes.

[0040] The air discharge hole 30 may be a passage through which the air induced by the blower fan 200 and thus introduced into the casing 10 is discharged again to the outside. The air discharge hole 30 may have a grill shape in a top surface of the casing 10, but the present disclosure is not limited thereto. For example, if the air introduced into the casing 10 is capable of being discharged again to the outside, the air discharge hole 10 may have various shapes.

[0041] The heat exchanger 100 may be provided in the casing 10. Also, the heat exchanger 100 may be disposed at a position at which the air introduced through the air inflow hole 20 passes, for example, disposed inside the air inflow hole 20. The heat exchanger 100 will be described in detail with reference to Fig. 2.

[0042] The blower fan 200 operates to introduce air outside the casing 10 into the casing 10 through the air inflow hole 20 and then discharge the air within the casing 10 again to the outside through the air discharge hole 30.

[0043] The external air introduced through the air inflow hole 20 by the blower fan 200 is heat-exchanged with the heat exchanger 100 disposed adjacent to the air inflow hole 20 and then is discharged into the air discharge hole 30 via the blower fan 200.

[0044] Fig. 2 is a perspective view of a heat exchanger according to an embodiment, and Fig. 3 is a cross-sectional view of the heat exchanger according to an embodiment.

[0045] Referring to Fig. 2, the heat exchanger 100 according to an embodiment may include a refrigerant inflow tube 101, a refrigerant discharge tube 102, a U-shaped tube 103, a first tube 110, a second tube 120, a fin 130, and a heat separation part 140.

[0046] The refrigerant inflow tube 101 may be a refrigerant tube for introducing the refrigerant into the first tube 110, and the refrigerant discharge tube 102 may be a refrigerant tube for discharging the refrigerant flowing into the second tube 120.

[0047] When the air-conditioner operates in a cooling or heating mode, the refrigerant inflow tube 101 and the refrigerant discharge tube 102 may be changed in function according to functional characteristics of the air-conditioner.

[0048] As illustrated in Fig. 2, the U-shaped tube 103 connects an end of the first tube 110 to an end of the second tube 120 to allow the first and second tubes 110 and 120 to communicate with each other. However, the U-shaped tube 103 may be omitted when the refrigerant discharge tube 102 is disposed at the position of the U-shaped tube 103.

[0049] The refrigerant introduced through the refrigerant inflow tube 101 may flow into the second tube 120 via the U-shaped tube 103, and the refrigerant within the second tube 120 may be discharged to the heat exchanger 100 through the refrigerant discharge tube 102.

[0050] Each of the first and second tubes 110 and 120 may be a refrigerant tube through which the refrigerant flows. The first and second tubes 110 and 120 may have the same shape and size, but the present invention is not limited thereto. For example, the first and second tubes 110 and 120 may be manufactured in shapes and sized different from each other. For example, each of the first and second tubes 110 and 120 may have a circular tube shape, but the present invention is not limited thereto.

[0051] The first tube 110 may be provided in plurality. The plurality of first tubes 110 may be disposed in a front row of the fin 130. Here, the front row of the fin 130 means a row that is relatively close to the air inflow hole 20. On the other hand, a rear row of the fin 130 means a row that is relatively away from the air inflow hole 20 than the front row.

[0052] The plurality of first tubes 110 may horizontally extend along the inner space of the casing 11, be vertically spaced apart from each other, and thus be disposed in the front row of the fin 130. For example, as illustrated in Fig. 2, a total of ten first tubes 110 may be vertically spaced apart from each other and arranged to form one row (the front row), but the present disclosure is not limited to the number of first tube 110.

[0053] The second tube 120 may be provided in plurality. The plurality of second tubes 120 may be disposed in a rear row of the fin 130.

[0054] The plurality of second tubes 120 may horizontally extend along the inner space of the casing 11, be vertically spaced apart from each other, and thus be disposed in the rear row of the fin 130. As described above, the first and second tubes 110 and 120 may be connected to each other by the U-shaped tube 103.

[0055] For example, as illustrated in Fig. 2, a total of ten second tubes 120 may be vertically spaced apart from each other and arranged to form one row (the rear row). However, the present disclosure is not limited to the number of second tube 120.

[0056] The fin 130 may be provided to have the plurality of rows, i.e., the front and rear rows, in the horizontal direction. Here, the first and second tubes 110 and 120 are coupled to each other.

[0057] In detail, a plurality of through holes may be defined in the fin 130. The first and second tubes 110 and 120 may be inserted into the plurality of through holes 110, respectively.

[0058] For example, the fin 130 may have the front row to which the total of ten first tubes 110 is coupled and the rear row to which the total of second tubes 120 is coupled. Also, a total of ten through holes vertically defined in a line may be defined in the front row of the fin 130, and a total of the other ten through holes vertically defined in a line may be defined in the rear row of the fin 130. For convenience of description, the through holes defined in the front row of the fin 130 may be referred to as "first through holes", and the through holes defined in the rear row of the fin 130 may be referred to as "second through holes".

[0059] That is, the fin 130 may constitute a first row and a second row. Also, the plurality of through holes may be vertically spaced apart from each other and defined in the fin 130 having the first and second rows.

[0060] The fin 130 constituting the first row and the fin 130 constituting the second row may be integrated with each other and thus distinguished or partitioned by the heat separation part 140. For convenience of description, the fin constituting the first row may be called a "first row fin 131", and the fin constituting the second row may be called a "second row fin 132".

[0061] The external air may pass through the first row fin 131 and then be heat-exchanged with the refrigerant of the first tube 110. Then, the external air may pass through the second row fin 132 and then be heat-exchanged with the refrigerant of the second tube 120.

[0062] For example, the fin 130 may have a thin plate shape, but the present disclosure is not limited thereto. That is, the fin 130 may have various shapes if the fin 130 is capable of easily transferring heat of the refrigerant flowing into the first and second tubes 110 and 120 and exchanging the transferred heat with the external air.

[0063] The first and second tubes 110 and 120 may be inserted into the fin 130 through a tube expansion process that will be described below.

[0064] In detail, the first and second tubes 110 and 120 each of which has an outer diameter slightly less than an inner diameter of the through hole are inserted into the through holes of the first fin 130 constituting the first row and the second fin 130 constituting the second row, respectively. Also, a ball may pass through the inside of each of the first and second tubes 110 and 120 to expand the outer diameter of each of the first and second tubes 110 and 120.

[0065] In this process, an outer circumferential surface of each of the first and second tubes 110 and 120 may be closely attached or fixed to the through hole of the fin 130. However, the limitation in which the first and second row fins are disposed missing each other through the tube expansion process was described in the related art.

[0066] The first row fin 131 and the second row fin 132 are connected to each other by a connection part 135. That is, the first and second row fins 131 and 132 may be integrated with each other by the connection part 135.

[0067] The heat separation part 140 may be disposed on the fin 130 to restrict heat conduction between the first and second tubes 110 and 120. The heat separation part 140 may include a cutoff part 141 for partitioning the fin 130 into the first and second row fins 131 and 132.

[0068] The cutoff part 141 may be formed by cutting at least one portion of the fin 130. At least one portion of the first row fin 131 and at least one portion of the second row fin 132 may be spaced apart from each other by the cutoff part 141.

[0069] The cutoff part 141 may be provided in plurality, and also, the plurality of cutoff parts 141 may be spaced apart from each other. For example, the plurality of cutoff part 141 may be spaced apart from each other and disposed in a line between the first and second tubes 110 and 120.

[0070] Also, the plurality of first tubes 110 constituting the first row and the plurality of second tubes 120 constituting the second row are disposed in parallel with each other. The plurality of cutoff parts 141 may be disposed in parallel with the plurality of first tubes 110 and the plurality of second tubes 120.

[0071] However, the present disclosure is not limited to the arrangement of the plurality of cutoff parts. That is, since the cutoff part 141 is provided to restrict the heat exchange (conduction) through the fin 130, the fin 130 may have various non-continuous shapes.

[0072] The connection part 135 is disposed between the adjacent cutoff parts 141 of the plurality of cutoff parts 141.

[0073] When the cutoff part 141 is disposed at a rear side of the first row fin 131, the performance for restricting the heat conduction from the first row fin 131 to the second row fin 132 may be improved.

[0074] Referring to Fig. 3, the plurality of first tubes 110 may be vertically spaced apart from each other at a center in a horizontal direction of the first row fin 131. Also, the plurality of second tubes 120 may be horizontally spaced apart from each other at a center in a vertical direction of the second row fin 132.

[0075] Also, the plurality of first tubes 110 and the plurality of second tubes 120 are spaced apart from each other at the same interval. A horizontal extension line passing through a center of one first tube 110 may be disposed to equally divide a line connecting two second tubes 120 to each other.

[0076] The first and second tubes 110 and 120 are vertically aligned in a zigzag shape. The first and second tubes 110 and 120 may be inserted into the first and second row fins 131 and 132, respectively. That is to say, the first and second tubes 110 and 120 may be vertically disposed in the zigzag shape with respect to a direction of air introduced into the air inflow hole 20 by the blower fan 200.

[0077] Hereinafter, for convenience of description, one of the second tubes 120 disposed in the rear row may be called a rear tube 121, and two first tubes 110 of the plurality of first tubes that are disposed closest to the rear tube 121 in the front row may be called an upper tube 111 and a lower tube 112. Here, the upper tube 111 may be disposed above the lower tube 122.

[0078] A first extension line ℓ that is a virtual extension line extending forward from a center C1 of the rear tube 121 toward the first row fin 131 does not pass through the cutoff part 141. That is, the first extension line ℓ may pass a space between the two adjacent cutoff parts 141 of the plurality of cutoff parts 141 spaced apart from each other, i.e., the connection part 135.

[0079] For example, an angle $\theta1$ between the first extension line ℓ and a second extension line ℓ' that is a virtual extension line connecting a center of the upper tube 111 to a center of the rear tube 121 may be about 45° or less.

[0080] Also, an angle $\theta2$ between the first extension line ℓ and a third extension line ℓ'' that is a virtual extension line connecting the center of the lower tube 112 to the center of the rear tube 121 may be about 45° or less.

[0081] As described above, when the angle $\theta1$ between the first extension line ℓ and the second extension line ℓ' or an angle $\theta2$ between the first extension line ℓ and the third extension line ℓ'' is about 45° or less, a distance between the rear tube 121 and the upper tube 111 or a distance between the rear tube 121 and the lower tube 112 may be relatively shortened.

[0082] Thus, the heat conduction between the rear tube 121 and the upper tube 111 or between the rear tube 121 and the lower tube 112 may increase to reduce heat-exchange efficiency. To prevent the heat conduction from occurring, the heat separation part 140 may be provided.

[0083] In detail, the plurality of first tubes 110 and the plurality of second tubes 120 are vertically disposed at the same interval. Also, the first extension line ℓ may be disposed to equally divide a virtual center line P connecting the center of the upper tube 111 to the center of the lower tube 112.

[0084] In this case, the angle $\theta1$ between the first extension line ℓ and the second extension line ℓ' and the angle $\theta2$ between the first extension line ℓ and the third extension line ℓ'' are the same.

[0085] When an optimum length of the cutoff part 141 is calculated on the basis of the above-described conditions, the optimum length may be expressed by the following Equation 1. Here, the optimum length of the cutoff part 141 may be understood as a length that is capable of being calculated when the cutoff part 141 is disposed at a rear side of the first tube 110 and sufficiently extends to both sides of the first tube 110.

[Equation 1]

$$C = 2*(SP/44 + L),\ L = r/\cos\theta$$

C: Optimum length of cutoff part 141,
SP: Distance between two tubes that are disposed adjacent to the same row,
r: Radius of each of first and second tube,
θ : Angle $\theta1$ between first extension line ℓ and second extension line ℓ' and angle $\theta2$ between first extension line ℓ and third extension line ℓ'' " (where, $\theta1=\theta2=\theta$).

[0086] Also, L may be determined as follows.

[0087] The cutoff part 141 between the rear tube 121 and the upper tube 111 is disposed to meet virtual two exterior common tangents t and t' with respect to the rear tube 121 and the upper tube 111. Here, the exterior common tangents t and t' may be understood as lines respectively connecting two points on an outer circumferential surface of the rear tube 121 to two points on an outer circumferential surface of the upper tube 111.

[0088] When there are two points a and b at which the exterior common tangents t and t' meet the cutoff part 141, the reference symbol L may correspond to about 1/2 of a length between the two points a and b.

[0089] Thus, the optimum length C of the cutoff part 141 may correspond to a value obtained by adding the length between the points a and b to a length corresponding to a half of a center length SP between the upper tube 111 and the lower tube 1112.

[0090] Here, if the distance between the plurality of first tubes 110 disposed in the front row and the distance between the plurality of second tubes 120 disposed in the rear line are the same, the length corresponding to a half of the center length between the upper tube 111 and the lower tube 112 may be the same as that of a half of a center distance between the two rear tubes 121 of the second tubes 120.

[0091] As described above, if the cutoff part 141 meets all of the exterior common tangents t and t' of the rear and upper tubes 121 and 111 and includes the virtual line connecting the met points a and b to each other, the heat transfer due to the heat conduction between the rear and upper tubes 121 and 111 may be blocked.

[0092] Hereinafter, an operation of the heat exchanger according to an embodiment will be described in detail with reference to Figs. 1 to 3.

[0093] The heat exchanger according to an embodiment may serve as the condenser or evaporator. Hereinafter, for convenience of description, although only the heat exchanger serving as the condenser is described as an example, it is obvious to a person skilled in the art that the heat exchanger serves as the evaporator.

[0094] The high-temperature high-pressure refrigerant discharged through a compressor (not shown) of the air conditioner is introduced into the heat exchanger 100 according to an embodiment. The refrigerant introduced into the heat exchanger 100 is successively introduced into the first tube 110 through the refrigerant inflow tube 101. Since the refrigerant introduced into the first tube 110 has a high temperature, heat may be transferred to the fin 130 contacting the first tube 110 as well as the first tube 110.

[0095] The heat transferred into the first tube 110 and the fin 130 may be heat-exchanged with external air having a relatively low temperature and introduced into the air inflow hole 20 by the blower fan 200. The refrigerant decreasing in temperature through the heat-exchange as described above may be introduced into the U-shaped tube 103.

[0096] Since the refrigerant introduced into the second tube 120 has a temperature less than that of the refrigerant flowing into the first tube 110 and relatively greater than that of the external air introduced into the air inflow hole 20, heat may be conducted into the second tube 120 and the fin 130 and then heat-exchanged with the external air. The refrigerant flowing into the second tube 120 may be condensed through the heat-exchange with the external air.

[0097] The condensed refrigerant may be expanded in the expiation unit (not shown) and then evaporated in an evaporator (not shown). Thereafter, the refrigerant may be introduced into the compressor to circulate a refrigeration cycle of "compression-condensation-expansion-evaporation".

[0098] However, if a distance between the first tube 110 disposed in the front row and the second tube 120 disposed in the rear row is narrow, particularly, when an angle $\theta 1$ between the first extension line ℓ and the second extension line ℓ' or an angle $\theta 2$ between the first extension line ℓ and the third extension line ℓ'' about 45° or less, even though the heat conduction between the rear tube 121 and the upper tube 111 or between the rear tube 121 and the lower tube 112 may occur, the occurrence of the heat conduction may be prevented by the plurality of cutoff parts 141 of the heat separation part 140.

[0099] Therefore, the heat-exchange efficiency between the refrigerant and the external air may be improved, and thus, the cooling or heating efficiency in the whole refrigeration cycle may be improved.

<u>Experimental Example 1</u>

[0100] Hereinafter, an experimental example for comparing the heat exchanger according to an embodiment to the heat exchanger according to the related art will be described with reference to Fig. 4.

<Experimental Group>

[0101] The experiment is performed by using the three-row fin type heat exchanger including a plurality of heat isolation part 140 according to an embodiment.

<Comparison Group>

[0102] The experiment is performed by using the three-row fin type heat exchanger.

<Experimental Method>

[0103] A condensation heat exchange amount is measured in each of the experimental group and the comparison group while changing a supercooling degree. The supercooling degree was adjusted by changing a flow amount of refrigerant flowing into the experimental group and the comparison group. To increase the supercooling degree, the flow amount of refrigerant decreases. Also, to decrease the supercooling degree, the flow amount of refrigerant increases.

[0104] Referring to Fig. 4, if the supercooling degree ranges from about 3°C to about 9°C, a difference between the condensation heat exchange amounts in the experimental group and the comparison group is not large. However, if the supercooling degree exceeds about 9°C, the condensation heat exchange amounts in the experimental group is significantly larger than that in the comparison group ($S1<S2<S3<S4<S5$).

[0105] Thus, it is seen that the plurality of heat separation part 140 according to an embodiment blocks the heat conduction.

[0106] According to the embodiment, the heat exchange between the tubes may be prevented to improve the heat-exchange efficiency between the refrigerant flowing into the tube and the external air flowing outside the tube.

[0107] Therefore, the air conditioner may be reduced in cost of maintenance, i.e., have a power saving effect.

[0108] Although the exemplary embodiments are described above, the present disclosure is not limited the specific embodiment. That is, various changes and modifications may be made thereto by one skilled in the art without departing from the scope and spirit of the invention as set forth in the appended claims. It is also understood that the terms used herein are merely descriptive, rather than limiting, and that various changes may be made without departing from the scope and spirit of the invention.

Claims

1. A heat exchanger comprising:

   a plurality of first tubes (110) disposed to form a first row;
   a plurality of second tubes (120) disposed on a side of the plurality of first tubes (110) to form a second row; and
   a fin (130) into which the plurality of first tubes (110) and the plurality of second tubes (120) are inserted,
   wherein the fin (130) comprises a heat separation part (140) to prevent heat conduction from occurring between the first tubes (110) and the second tubes (120).

2. The heat exchanger according to claim 1, wherein the fin (130) comprises:

   a first row fin (131) into which the plurality of first tubes (110) are inserted;
   a second row fin (12) into which the plurality of second tubes (120) are inserted; and
   a connection part (135) connecting the first row fin (131) to the second row fin (132).

3. The heat exchanger according to claim 2, wherein the heat separation part (140) comprises a cutoff part (141) defined between the first row fin (131) and the second row fin (132).

4. The heat exchanger according to claim 3, wherein the cutoff part (141) is provided in plurality so that the plurality of cutoff parts (141) are spaced apart from each other, and the connection part (135) is disposed between two cutoff parts adjacent to each other.

5. The heat exchanger according to any one of claims 1 to 4, wherein the plurality of second tubes (120) comprise a rear tube (121), and
   the plurality of first tubes (110) comprise an upper tube (111) and a lower tube (112) which are disposed closest to the rear tube (121) of the plurality of first tubes (110).

6. The heat exchanger according to claim 5, wherein an angle θ 1 between a first extension line ℓ that is a virtual extension line extending from a center of the rear tube (121) an being perpendicular to the first row fin (131) and a second extension line ℓ' that is a virtual extension line connecting a center of the upper tube (111) to the center of the rear tube (121) is about 45° or less.

7. The heat exchanger according to claim 6, wherein an angle θ2 between the first extension line ℓ and a third extension line ℓ" " that is an extension line connecting the center of the lower tube (112) to the center of the rear tube (121) is about 45° or less.

8. The heat exchanger according to claim 6, wherein the first extension line ℓ passes through the connection part (135).

9. The heat exchanger according to claim 6, wherein the first extension line ℓ equally divides a virtual center line P connecting the centers of the upper and lower tubes (111, 112) to each other.

10. The heat exchanger according to claim 5, wherein the cutoff part (141) between the rear tube (121) and the upper tube (111) meets two virtual exterior common tangents (t, t') with respect to the rear and upper tubes (121, 111).

11. The heat exchanger according to claim 10, wherein a length of the cutoff part (141) between the rear tube (121) and the upper tube (111) is the sum of a length connecting two points at which the cutoff part (141) meets the two virtual exterior common tangents and a length that corresponds to a 1/2 of a center distance between the two first tubes (110) that are disposed closest to the rear tube (121).

12. The heat exchanger according to any one of claims 4 to 11, wherein the plurality of first tubes (110) forming the first row and the plurality of second tubes (120) forming the second row are disposed in parallel with each other, and the plurality of cutoff parts (141) are disposed in parallel with the plurality of first and second tubes (110, 120).

13. The heat exchanger according to any one of claims 1 to 12, further comprising a blower fan (200) for blowing air into the plurality of first and second tubes (110, 120),
    wherein the plurality of first and second tubes (110, 120) are vertically disposed in a zigzag shape with respect to a direction in which the air is introduced by the blower fan (200).

14. The heat exchanger according to claim 1, wherein the plurality of first and second tubes (110, 120) are disposed spaced apart from each other at the same interval.

Fig. 1

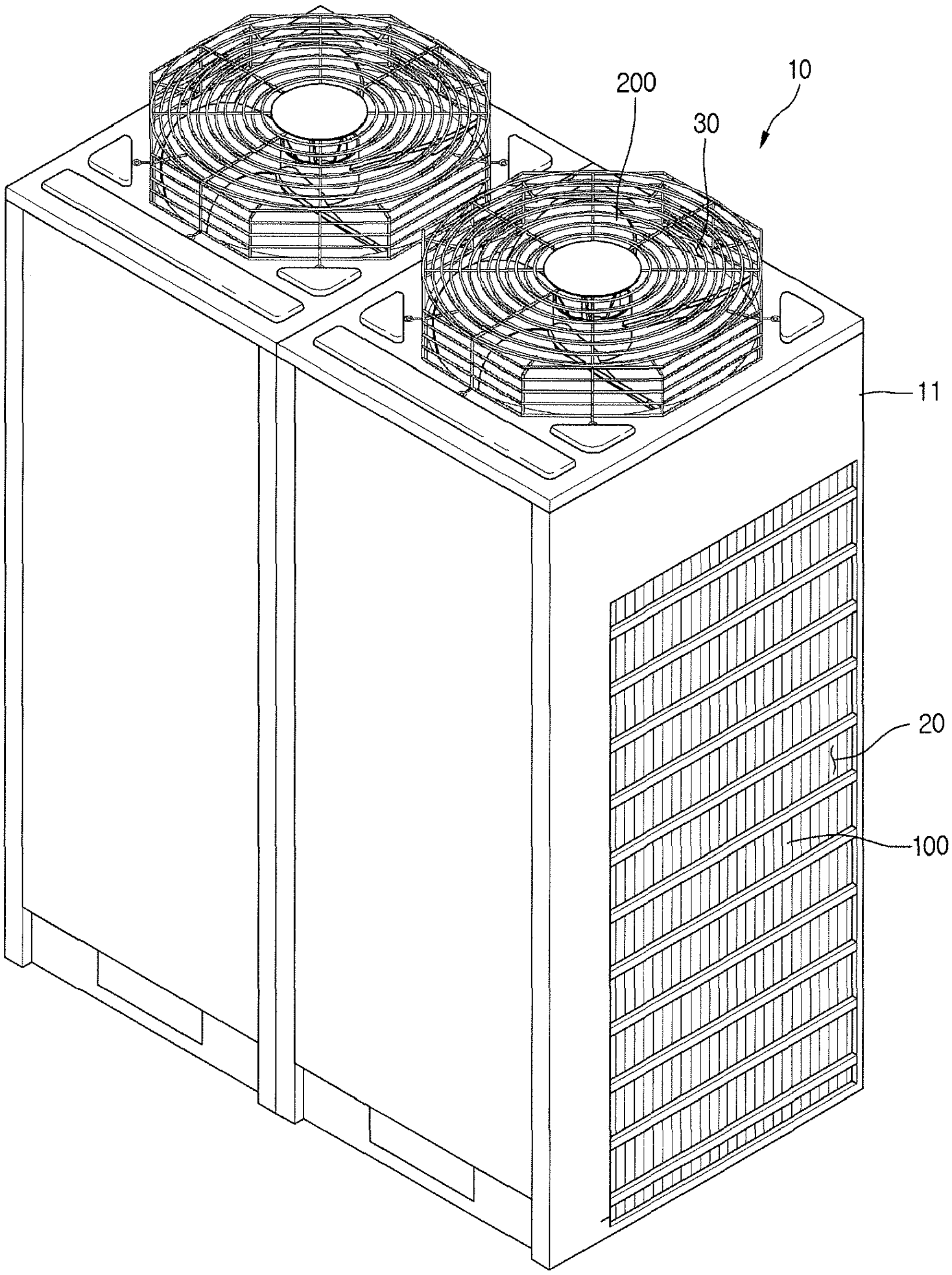


Fig. 2

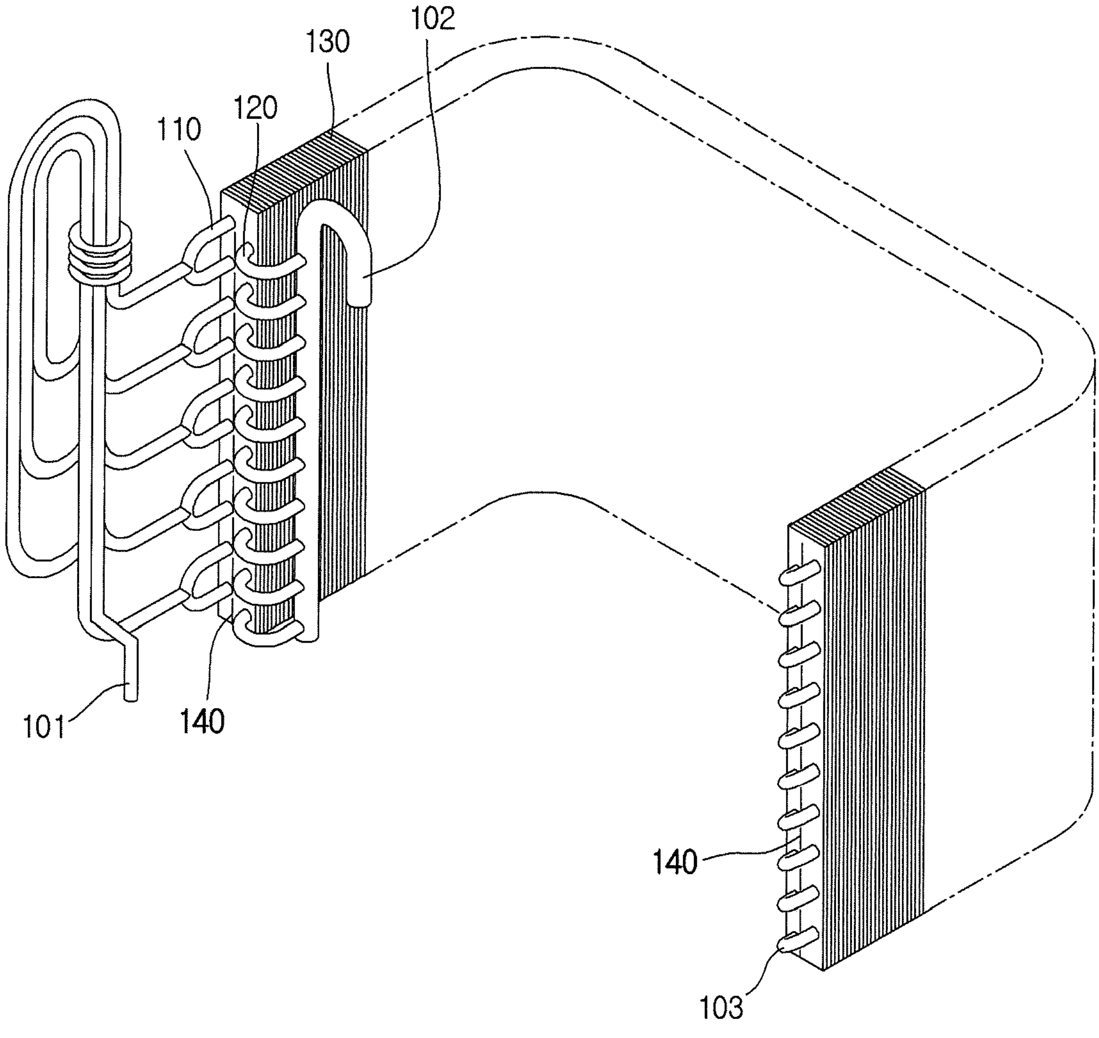


Fig. 3

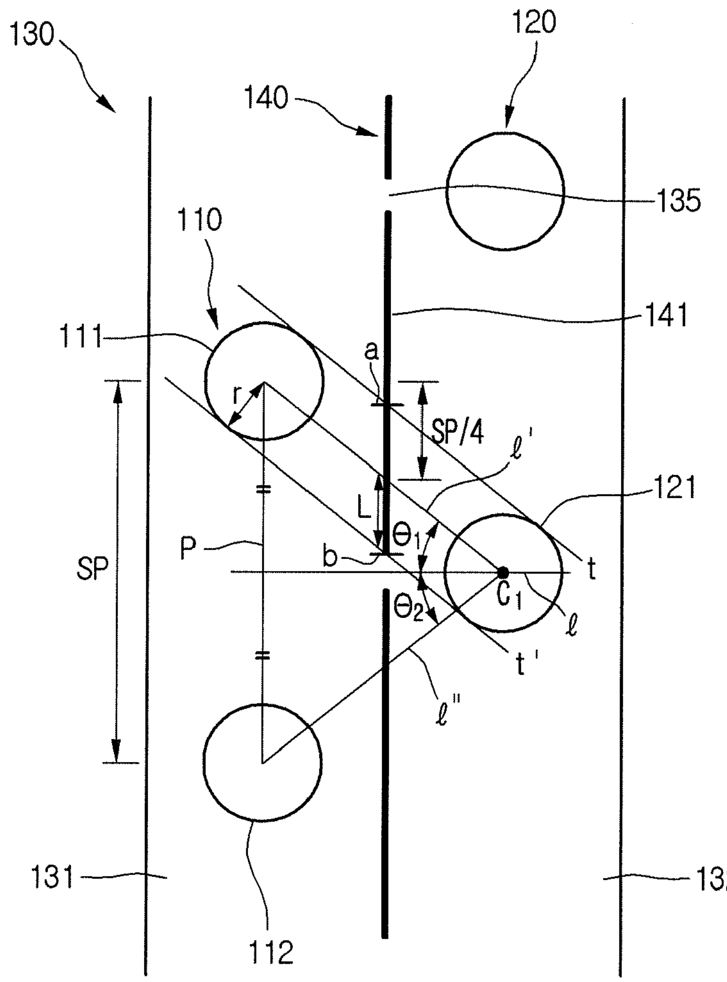
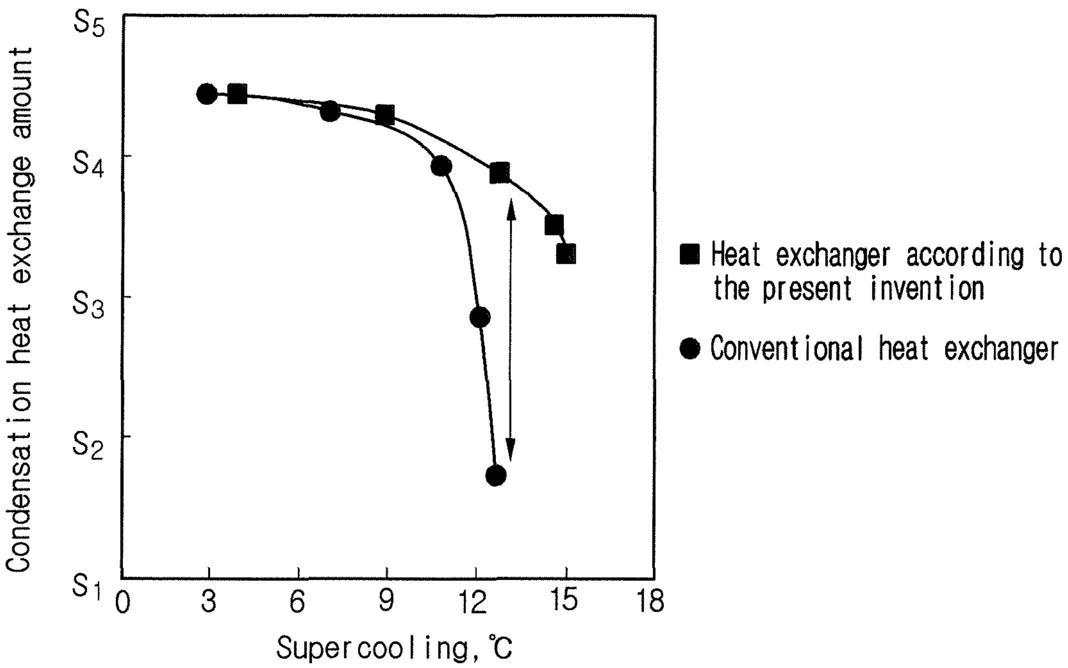

130
140
120
135
110
141
111
a
SP/4
ℓ'
121
r
L
SP
P
b
Θ1
t
C1
ℓ
Θ2
t'
ℓ"
131
132
112

Fig. 4


S5
S4
S3
S2
S1
Condensation heat exchange amount
0
3
6
9
12
15
18
Supercooling, ℃
Heat exchanger according to the present invention
Conventional heat exchanger

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EUROPEAN SEARCH REPORT

Application Number
EP 14 16 1462

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP H08 54194 A (MITSUBISHI ELECTRIC CORP) 27 February 1996 (1996-02-27) * abstract; figures * -----	1-14	INV. F28D1/047 F28F1/32
X	EP 0 936 432 A1 (DAIKIN IND LTD [JP]) 18 August 1999 (1999-08-18) * figures * -----	1-14	
X	JP S58 108394 A (HITACHI LTD) 28 June 1983 (1983-06-28) * abstract; figures * -----	1-14	
X	JP H02 254269 A (HITACHI LTD) 15 October 1990 (1990-10-15) * abstract; figures * -----	1-14	
X	JP S58 138994 A (FUJI HEAVY IND LTD) 18 August 1983 (1983-08-18) * figures * -----	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

F28D
F28F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 June 2014	Mellado Ramirez, J

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EPO FORM 1503 03.82 (P04C01)

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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20-06-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H0854194 A	27-02-1996	JP 3256634 B2	12-02-2002
		JP H0854194 A	27-02-1996
EP 0936432 A1	18-08-1999	AU 710016 B2	09-09-1999
		AU 4573197 A	22-05-1998
		CN 1228833 A	15-09-1999
		DE 69718343 D1	13-02-2003
		DE 69718343 T2	18-09-2003
		EP 0936432 A1	18-08-1999
		ES 2190544 T3	01-08-2003
		HK 1019354 A1	29-08-2003
		JP H10132480 A	22-05-1998
		KR 20000034784 A	26-06-2000
		MY 118256 A	30-09-2004
		PT 936432 E	31-03-2003
		TW 415582 U	11-12-2000
		WO 9819126 A1	07-05-1998
JP S58108394 A	28-06-1983	NONE	
JP H02254269 A	15-10-1990	NONE	
JP S58138994 A	18-08-1983	NONE	

EPO FORM P0459

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