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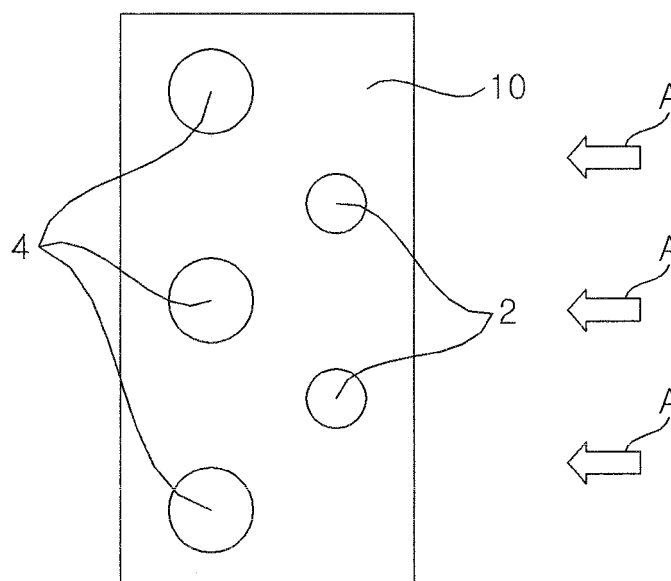
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(54) Heat Exchanger and Refrigeration Cycle Apparatus Having the Same

(57) A heat exchanger including a plurality of first refrigerant tubes, and a plurality of second refrigerant tubes separated from the plurality of first refrigerant tubes in an

air flow direction. Further, a diameter of a respective refrigerant tube of the plurality of first refrigerant tubes is smaller than a diameter of a respective refrigerant tube of the plurality of second refrigerant tubes.

Fig. 2



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Description

[0001] The present invention relates to a heat exchanger for exchanging heat between refrigerant and air and a refrigeration cycle apparatus having the same, and more particularly, to a heat exchanger in which a plurality of refrigerant tubes through which refrigerant passes are provided back and forth in an air flowing direction and a refrigeration cycle apparatus having the same.

[0002] A refrigeration cycle apparatus for cooling/heating the room using a refrigeration cycle generally includes a compressor, a condenser, an expander, and an evaporator. Further, a heat exchanger including the condenser and the evaporator has a refrigerant channel through which refrigerant passes.

[0003] Various types of heat exchangers exist. For example, in a fin-tube type heat exchanger, a fin for increasing a heat transfer area is coupled with a refrigerant tube through which refrigerant passes. In more detail, FIG. 1 is a side view illustrating an enlargement of a part of a background art heat exchanger.

[0004] As shown in the background art heat exchanger, refrigerant flows in the inside of a plurality of columns of refrigerant tubes 102 and 104 and air A flows on the surface of a fin 106 that is an enlarged surface connected to external sides of the refrigerant tubes 102 and 104. To exchange heat between the refrigerant and the air A, the heat exchanger has an optimal heat transfer area suitable for the characteristics of the refrigerant and the air.

[0005] In addition, the columns of refrigerant tubes 102 and 104 are arranged so that refrigerant tubes having the same diameter are positioned back and forth in an air flowing direction and that the latter columns of refrigerant tubes 104 are positioned in the rear between former columns of refrigerant tubes 102.

[0006] Because a heat transfer coefficient of refrigerant varies in accordance with diameters of the refrigerant tubes 102 and 104, the temperature of the external sides of the refrigerant tubes varies. Therefore, the amount of heat exchange between the refrigerant and the air varies. In addition, for the air, the row pitch of the refrigerant tubes 102 and 104 is set to have an enough heat transfer area and the optimal heat transfer area of the air varies in accordance with the diameter of the tubes.

[0007] However, the entire volume of the background art heat exchanger having the above structure is determined by the diameters of the refrigerant tubes 102 and 104 and the width L of the fin 106. Further, the heat exchanger is generally made to have a thin shape. However, because the diameters of the refrigerant tubes 102 and 104 are equal to each other in the heat exchanger having the above-described structure, the heat exchanger cannot be easily made to have a thin shape.

[0008] Further, in the background art heat exchanger having the above-described structure, a dead zone 108 to which the air is not directly transferred exists in the rear parts of the refrigerant tubes 102 and 104 so that

the actual heat transfer area is reduced.

[0009] Accordingly, one object of the present invention is to address the above-noted and other drawbacks.

[0010] Another object of the present invention is to provide a heat exchanger capable of being made thin and that minimizes a dead zone to which air and refrigerant are not transferred to improve the heat transfer performance of the heat exchange.

[0011] Yet another object of the present invention is to provide a refrigeration cycle apparatus having a heat exchanger capable of being made thin and that minimizes the pressure loss of refrigerant.

[0012] To achieve these and other objects and in accordance with the purpose of the present invention, as embodied and broadly described herein, the present invention provides in one aspect a heat exchanger including a plurality of first refrigerant tubes, and a plurality of second refrigerant tubes separated from the plurality of first refrigerant tubes in an air flow direction. Further, a diameter of a respective refrigerant tube of the plurality of first refrigerant tubes is smaller than a diameter of a respective refrigerant tube of the plurality of second refrigerant tubes.

[0013] In another aspect, the present invention provides a refrigeration cycle apparatus including a compressor configured to compress a refrigerant, a condenser connected to the compressor and configured to condense the refrigerant, an expander connected to the condenser and configured to expand the refrigerant, and an evaporator connected to the expander and the compressor and configured to evaporate the refrigerant. Further, at least one of the condenser and the evaporator includes a plurality of first refrigerant tubes, and a plurality of second refrigerant tubes separated from the plurality of first refrigerant tubes in an air flow direction, a diameter of a respective refrigerant tube of the plurality of first refrigerant tubes is smaller than a diameter of a respective refrigerant tube of the plurality of second refrigerant tubes, and the at least one of the condenser and the evaporator further includes a connector configured to connect together the respective refrigerant tube of the plurality of first refrigerant tubes and the respective refrigerant tube of the plurality of second refrigerant tubes so that liquid refrigerant passes through the plurality of first refrigerant tubes and that gas refrigerant passes through the plurality of second refrigerant tubes.

[0014] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

[0015] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings, which are given

by illustration only, and thus are not limitative of the present invention, and wherein:

[0016] FIG. 1 is a side view illustrating an enlargement of a part of a background art heat exchanger;

[0017] FIG. 2 is an overview illustrating a heat exchanger according to an embodiment of the present invention;

[0018] FIG. 3 is a side view illustrating an enlargement of a part of the heat exchanger according to an embodiment of the present invention;

[0019] FIG. 4 is a perspective view illustrating an enlargement of a part of a fin of FIG. 3;

[0020] FIG. 5 is a partial sectional view illustrating a connector connecting the former and latter columns of refrigerant tubes of FIG. 3;

[0021] FIG. 6 is a graph illustrating a change in performance in accordance with a diameter ratio of the columns of refrigerant tubes of the heat exchanger according to an embodiment of the present invention;

[0022] FIG. 7 is an overview illustrating a refrigeration cycle apparatus having the heat exchanger according to an embodiment of the present invention; and

[0023] FIG. 8 is a graph schematically comparing a heat transfer performance of the heat exchanger according to an embodiment of the present invention with a heat transfer performance of the background art heat exchanger.

[0024] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0025] FIG. 2 is an overview illustrating a heat exchanger according to an embodiment of the present invention. As shown, the heat exchanger includes a plurality of columns of refrigerant tubes 2 and 4 through which refrigerant passes and fins 10 coupling the plurality of columns of refrigerant tubes 2 and 4. Further, the plurality of fins 10 are coupled to the refrigerant tubes 2 and 4 by a predetermined distance.

[0026] In addition, the refrigerant tubes 2 and 4 are longitudinally arranged to be orthogonal to the flowing direction of air A and the fins 10 are arranged to run parallel to the flowing direction of the air A. The refrigerant tubes 2 and 4 also include former columns of refrigerant tubes 2 positioned in the front in the air flowing direction and latter columns of refrigerant tubes 4 positioned in the rear. The former columns of refrigerant tubes 2 and the latter columns of refrigerant tubes 4 are integrally connected to each other so that refrigerant that passes through the refrigerant tubes 2 and 4.

[0027] In addition, as shown in FIG. 3, the refrigerant tubes 2 and 4 are formed so that the diameter D1 of the former columns of refrigerant tubes 2 is smaller than the diameter D2 of the latter columns of refrigerant tubes 4. That is, in the heat exchanger according to the present embodiment, the diameter of the former columns of refrigerant tubes 2 is different from the diameter of the latter columns of refrigerant tubes 4 such that the heat exchanger can be made thinner. In particular, the refriger-

ant tubes 2 having a small diameter are used for the former columns to increase the flow rate of the refrigerant affected by the sectional area of the tubes and to increase the heat transfer coefficient of the refrigerant tubes, in particular, the heat transfer coefficient of the insides of the former columns of refrigerant tubes 2.

[0028] Further, when the refrigerant tubes having the small diameter are used, the heat transfer coefficient increases in accordance with an increase in the flow rate of the refrigerant. However, because the heat transfer area of the insides of the refrigerant tubes having the small diameter is reduced, when the refrigerant tubes having the small diameter are used for the former and latter columns of refrigerant tubes of the heat exchanger, the total heat transfer amount is reduced so that the pressure loss of the refrigeration apparatus is increased. In addition, when the refrigerant tubes having the small diameter and the refrigerant tubes having the large diameter are mixedly used for the former and latter columns of refrigerant tubes 2 and 4, the increase in heat transfer coefficient caused by the increase in the refrigerant flow rate and the increase in the pressure loss are offset so that the heat transfer amount is increased overall.

[0029] Further, the pressure loss is reduced than when all of the former and latter columns of the refrigerant tubes 2 and 4 are formed of the tubes having the large diameter. That is, although the distance SP between the former and latter columns of refrigerant tubes 2 and 4 is reduced, the pressure loss of the air is not increased. Also, when the distance SP between the former and latter columns of refrigerant tubes 2 and 4 is reduced, the fin efficiency can be increased. In addition, due to the reduction in the pressure loss of the air, the noise is minimized and the power consumption of a fan for flowing the air to the heat exchanger is reduced.

[0030] In addition, when the refrigerant tubes having the small diameter are used as the former columns of refrigerant tubes 2, a dead zone in the rear of the former columns of refrigerant tubes 2 is smaller than when the former columns of refrigerant tubes 2 have the same diameter as the diameter of the latter columns of refrigerant tubes 4.

[0031] Also, as shown in FIG. 3, the size of former columns of colars 12 coupled to the former columns of refrigerant tubes 2 is smaller than the size of latter columns of colars 14 coupled to the latter columns of refrigerant tubes 4. Further, the diameter of the latter columns of refrigerant tubes 4 is preferably set to be 3mm to 12mm and the former columns of refrigerant tubes 2 and the latter columns of refrigerant tubes 4 are formed so that the distance SP between the tubes is 15mm to 25mm in a direction perpendicular to the flowing direction of the air.

[0032] As illustrated in FIGs. 3 and 4, when the fin 10 is divided back and forth into a forward fin unit 16 around the former columns of refrigerant tubes 2 and a backward fin unit 18 around the latter columns of refrigerant tubes 4 in the flowing direction of the air, the sum of the width RP1 of the forward fin unit 16 and the width RP2 of the

backward fin unit 18 is about 10mm to 30mm.

[0033] Further, the fin 10 also includes slits 20 and 22 that increase the heat transfer area through which the air passes. In this embodiment, at least three columns of forward slits 20 are formed in the forward fin unit 16 and at least three columns of backward slits 22 are formed in the backward fin unit 18.

[0034] Also, the length SL1 of the forward slits 20 is preferably 0.3mm to 1.5mm and the length SL2 of the backward slits 22 is preferably 0.3mm to 1.5mm. The forward slits 20 and the backward slits 22 are also asymmetrical with each other so that heat transfer performance is maximally improved. Further, the area of a space between the former columns of refrigerant tubes 2 in the forward fin unit 16 is larger when the diameter of the former columns of refrigerant tubes 2 is different from the diameter of the later columns of refrigerant tubes 4 than when the diameter of the former columns of refrigerant tubes 2 is equal to the diameter of the latter columns of refrigerant tubes 4. In addition, the length SL1 of the forward slits 20 is longer than the length SL2 of the backward slits 22.

[0035] Further, the width d1 of the forward slits 20 and the width d2 of the backward slits 22 are preferably 0.5mm to 2mm. The slits 20 and 22 are also formed in the same or opposite directions as to the direction in which the colars 12 and 14 protrude and the minimum distance between adjacent slits is preferably 0.5mm.

[0036] In addition, in the slits 20 and 22, the length SL1, the width d1, and the number of former columns of slits 20 are designed to be optimal in accordance with the area of the latter columns of slits 22 and the area of the parts excluding the slits 20 and 22 so as to maximally secure the heat transfer performance. The distance between the slits is also designed so that condensed water can be easily discharged to actively transfer heat. In addition, the length SL2, the width d2, and the number of the latter columns of slits 22 are designed in accordance with the fin area different from the fin area of the former columns of slits 20 so that it is possible to maximally transfer the heat.

[0037] Further, as shown in FIG. 3, flat units 17 and 19 are formed between the slits in the forward fin unit 16 and the backward fin unit 18 and the widths d3 and d4 of the flat units 17 and 19 are made large so that the condensed water can be easily discharged. In addition, as illustrated in FIG. 5, a U-shaped connector 24 connected to a former column of refrigerant tube 2 and a latter column of refrigerant tube 4 is provided to connect the refrigerant tubes 2 and 4.

[0038] The connector 24 is also formed so that the diameter D3 of a part 26 connected to the former column of refrigerant tube 2 is smaller than the diameter D4 of a part 28 connected to the latter column of refrigerant tube 4. In addition, the connector 24 is formed so that the area of a channel increases from the part connected to the former column of refrigerant tube 2 toward the part 28 connected to the latter column of refrigerant tube 4.

[0039] Next, FIG. 6 is a graph illustrating a change in performance in accordance with the diameter ratio of the former and latter columns of refrigerant tubes of the heat exchanger according to an embodiment of the present invention. In particular, FIG. 6 illustrates a heat transfer performance in accordance with the ratio D1/D2 of the tubes 2 and 4.

[0040] Further, FIG. 6 illustrates an embodiment when the diameter of the latter columns of refrigerant tubes 4 is 3mm to 12mm, the distance SP between the former columns of refrigerant tubes 2 and the distance SP between the latter columns of refrigerant tubes 4 are 15mm to 25mm and when the width of the air flowing direction of the fin is 10 mm to 30mm.

[0041] As shown, proper heat transfer performance can be maintained when the ratio D1/D2 is 0.3 to 0.95. Further, the heat transfer performance rapidly deteriorates when the ratio D1/D2 is less than 0.3. That is, in the heat exchanger according to an embodiment of the present embodiment, the ratio D1/D2 is 0.3 to 0.95. For example, when the diameter D2 of the latter columns of refrigerant tubes 4 is 7mm, the diameter of the former columns of refrigerant tubes 2 is set to be 2.1mm to 6.65mm.

[0042] Next, FIG. 7 is an overview illustrating a refrigeration cycle apparatus having the heat exchanger according to an embodiment of the present invention. As shown, the refrigeration cycle apparatus includes a compressor 32 for circulating refrigerant, a condenser 34, an expander 36 and an evaporator 38. Also included is a condenser fan 35 for blowing the air to the condenser 34 rotatably provided around the condenser 34. An evaporator fan 39 for blowing the air to the evaporator 38 is also rotatably provided around the evaporator 38.

[0043] Further, in the refrigeration cycle apparatus, the evaporator 38 functions as an indoor heat exchanger for extracting heat from the indoor air and evaporating the refrigerant, and the condenser 34 functions as an outdoor heat exchanger for discharging heat to the outdoor air and condensing the refrigerant.

[0044] Further, at least one of the condenser 34 and the evaporator 38 is formed of the heat exchanger illustrated in FIGs. 2 to 5. That is, at least one of the condenser 34 and the evaporator 38 is formed so that the diameter of the former columns of refrigerant tubes 2 is smaller than the diameter of the latter columns of refrigerant tubes 4 in the flowing direction of the air. In the next description, both of the condenser 34 and the evaporator 38 are formed of the heat exchanger illustrated in FIGs. 2 to 5.

[0045] Further, when the condenser 34 and the evaporator 38 are connected to each other so that liquid refrigerant passes through the former columns of refrigerant tubes 2 and that gas refrigerant passes through the latter columns of refrigerant tubes 4, the condenser 34 and the evaporator 38 can be made thin and the pressure loss of the refrigerant is minimized.

[0046] In addition, in the condenser 34, the latter col-

umns of refrigerant tubes 4, the former columns of refrigerant tubes 2, and the expander are sequentially connected to each other in a refrigerant flowing direction so that the refrigerant compressed by the compressor 32 passes through the latter columns of refrigerant tubes 4, passes through the former columns of refrigerant tubes 2, and flows to the expander.

[0047] In the evaporator 38, the former columns of refrigerant tubes 2 and the latter columns of refrigerant tubes 4 are sequentially connected to each other in a refrigerant flowing direction so that the refrigerant expanded by the expander 36 passes through the former columns of refrigerant tubes 2, passes through the latter columns of refrigerant tubes 4, and flows to the compressor 32.

[0048] Next, FIG. 8 is a graph schematically comparing a heat transfer performance of the heat exchanger according to an embodiment of the present invention with a heat transfer performance when the diameters of the background art heat exchanger.

[0049] In more detail, in FIG. 8, the heat transfer performance is illustrated when the diameter of the former columns of refrigerant tubes 2 is 5mm, the diameter of the latter columns of refrigerant tubes 4 is 7mm, the sum of the width RP1 of the forward fin unit 16 and the width RP2 of the backward fin unit 18 is about 20mm, the distance between the center of the former column of refrigerant tube 2 and the center of the latter column of refrigerant tube 4 is 9.5mm, and the heat exchanger is used as the evaporator and the condenser and is compared with the heat transfer performance when the diameter of the former columns of refrigerant tubes 2 and the diameter of the latter columns of refrigerant tubes 4 are 7mm, the sum of the width RP1 of the forward fin unit 16 and the width RP2 of the backward fin unit 18 is about 25.4mm, the distance between the center of the former column of refrigerant tube 2 and the center of the latter column of refrigerant tube 4 is 10.5mm, and the heat exchanger is used as the evaporator and the condenser.

[0050] As shown, the heat transfer performance of the present invention is greater than that of the background art. That is, in the heat exchanger according to the present embodiment, as illustrated in FIG. 5, although the width RP1 of the forward fin unit 16 of the fin 10 and the width RP2 of the backward fin unit 18 of the fin 10 are smaller, when the heat exchanger is used as the evaporator and the condenser, the heat transfer performance is higher than when the diameter of the former columns of refrigerant tubes 2 and the diameter of the latter columns of refrigerant tubes 4 are 7mm.

[0051] In the heat exchanger according to embodiments of the present invention having the above structure, among the plurality of columns of refrigerant tubes, the diameter of the former columns of refrigerant tubes is smaller than the diameter of the latter columns of refrigerant tubes in the air flowing direction. Therefore, the heat exchanger can be made thin in the air flowing direction and a dead zone in which air and heat are not ex-

changed among the refrigerant tubes of the heat exchanger can be minimized to improve the heat transfer performance.

[0052] In the refrigeration cycle apparatus having the heat exchanger according to the present invention, liquid refrigerant flows through the former columns of refrigerant tubes having the small diameter and gas refrigerant flows through the latter columns of refrigerant tubes having the large diameter so that the condenser and the evaporator can be made thin and the pressure loss of the refrigerant can be minimized.

[0053] Thus, according to an embodiment of the present invention, the heat exchanger includes the plurality of columns of refrigerant tubes and the diameter of the former columns of refrigerant tubes is smaller than the diameter of the latter columns of refrigerant tubes in the air flowing direction. Therefore, the heat exchanger can be made thin and can be used for a refrigeration cycle apparatus capable of minimizing the pressure loss of the refrigerant. The dead zone and pressure loss can also be minimized.

[0054] As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.

Claims

1. A heat exchanger, comprising:

a plurality of first refrigerant tubes(2); and
a plurality of second refrigerant tubes(4) separated from the plurality of first refrigerant tubes (2) in an air flow direction,

wherein a diameter(D1) of a respective refrigerant tube of the plurality of first refrigerant tubes(2) is smaller than a diameter(D2) of a respective refrigerant tube of the plurality of second refrigerant tubes (4).

2. The heat exchanger as claimed in claim 1, further comprising:

at least one fin(10) configured to couple the plurality of first refrigerant tubes(2) to the plurality of second refrigerant tubes(4),

wherein the at least one fin(10) includes first openings(12) configured to receive the plurality of first re-

- frigerant tubes(2) and second openings(14) configured to receive the plurality of second refrigerant tubes(4), and
 wherein a diameter of a respective opening of the first openings(12) is smaller than a respective opening of the second openings(14).
3. The heat exchanger as claimed in claim 2, wherein the at least one fin(10) includes a first fin unit(16) configured to couple the plurality of first refrigerant tubes(2) and a second fin unit(18) configured to couple the plurality of second refrigerant tubes(4), wherein the first fin unit(16) includes a plurality of first slits(20) and the second fin unit(18) includes a plurality of second slits(22), and
 wherein forward slits of the plurality of first slits(20) are longer than backward slits of the plurality of second slits(22).
4. The heat exchanger as claimed in any one of claims 1 to 3,
 wherein a ratio of the diameter of the respective refrigerant tube of the plurality of first refrigerant tubes (2) to the diameter of the respective refrigerant tube of the plurality of second refrigerant tubes(4) is 0.3 to 0.95.
5. A refrigeration cycle apparatus comprising:
 a compressor(32) configured to compress a refrigerant;
 a condenser(34) connected to the compressor (32) and configured to condense the refrigerant;
 an expander(36) connected to the condenser (34) and configured to expand the refrigerant;
 and
 an evaporator(38) connected to the expander (36) and the compressor(32) and configured to evaporate the refrigerant,
 wherein at least one of the condenser(34) and the evaporator(38) includes a plurality of first refrigerant tubes(2), and a plurality of second refrigerant tubes (4) separated from the plurality of first refrigerant tubes(2) in an air flow direction,
 wherein a diameter of a respective refrigerant tube of the plurality of first refrigerant tubes(2) is smaller than a diameter of a respective refrigerant tube of the plurality of second refrigerant tubes(4), and
 wherein the at least one of the condenser(34) and the evaporator(38) further includes a connector(24) configured to connect together the respective refrigerant tube of the plurality of first refrigerant tubes(2) and the respective refrigerant tube of the plurality of second refrigerant tubes(4) so that liquid refrigerant passes through the plurality of first refrigerant tubes (2) and that gas refrigerant passes through the plurality of second refrigerant tubes(4).
6. The refrigeration cycle apparatus as claimed in claim 5,
 wherein the connector(24) is further configured to sequentially connect the respective refrigerant tube of the plurality of second refrigerant tubes(4) and the respective refrigerant tube of the plurality of first refrigerant tubes(2) in a refrigerant flowing direction so that refrigerant compressed by the compressor(32) passes through the plurality of second refrigerant tubes(4), passes through the plurality of first refrigerant tubes(2), and flows to the expander(36).
7. The refrigeration cycle apparatus as claimed in claim 5,
 wherein the connector(24) is further configured to sequentially connect the respective refrigerant tube of the plurality of first refrigerant tubes(2) and the respective refrigerant tube of the plurality of second refrigerant tubes(4) in a refrigerant flowing direction so that the refrigerant expanded by the expander(36) passes through the plurality of first refrigerant tubes (2), passes through the plurality of second refrigerant tubes(4), and flows to the compressor(32).
8. The refrigeration cycle apparatus as claimed in any one of claims 5 to 7, wherein a diameter of a first part of the connector(24) connected to the respective refrigerant tube of the plurality of first refrigerant tubes(2) is smaller than a diameter of a second part of the connector(24) connected to the respective refrigerant tube of the plurality of second refrigerant tubes(4) and an area of a channel increases from the first part toward the second part.
9. The refrigeration cycle apparatus as claimed in any one of claims 5 to 8, wherein said at least one of the condenser(34) and the evaporator(36) further includes at least one fin(10) configured to couple the plurality of first refrigerant tubes(2) to the plurality of second refrigerant tubes(4),
 wherein the at least one fin(10) includes first openings(12) configured to receive the plurality of first refrigerant tubes(2) and second openings(14) configured to receive the plurality of second refrigerant tubes(4), and
 wherein a diameter of a respective opening of the first openings(12) is smaller than a respective opening of the second openings(14).
10. The refrigeration cycle apparatus as claimed in claim 9,
 wherein the at least one fin(10) includes a first fin unit(16) configured to couple the plurality of first refrigerant tubes(2) and a second fin unit(18) configured to couple the plurality of second refrigerant tubes(4),
 wherein the first fin unit(16) includes a plurality of first slits(20) and the second fin unit(18) includes a

plurality of second slits(22), and
wherein forward slits of the plurality of first slits(20)
are longer than backward slits of the plurality of second
slits(22).

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11. The refrigeration cycle apparatus as claimed in claim
10,
wherein the plurality of first slits(20) are arranged
asymmetrically with respect to the plurality of second
slits(22).

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12. The refrigeration cycle apparatus as claimed in any
one of claims 5 to 11, wherein a ratio of the diameter
of the respective refrigerant tube of the plurality of
first refrigerant tubes(2) to the diameter of the re-
spective refrigerant tube of the plurality of second
refrigerant tubes(4) is 0.3 to 0.95.

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13. The refrigeration cycle apparatus as claimed in claim
12,
wherein the diameter of the respective refrigerant
tube of the plurality of second refrigerant tubes(4) is
3mm to 12mm, and
wherein a distance between centers of the plurality
of first refrigerant tubes(2) and a distance between
centers of the plurality of second refrigerant tubes
(4) are 15mm to 25mm.

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14. The refrigeration cycle apparatus as claimed in claim
13,
wherein the at least one fin(10) has a width of 10mm
to 30mm in the air flowing direction.

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15. The refrigeration cycle apparatus as claimed in any
one of claims 5 to 11, wherein each diameter of the
plurality of first refrigerant tubes(2) is smaller than
each diameter of the plurality of second refrigerant
tubes(4).

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Fig. 1

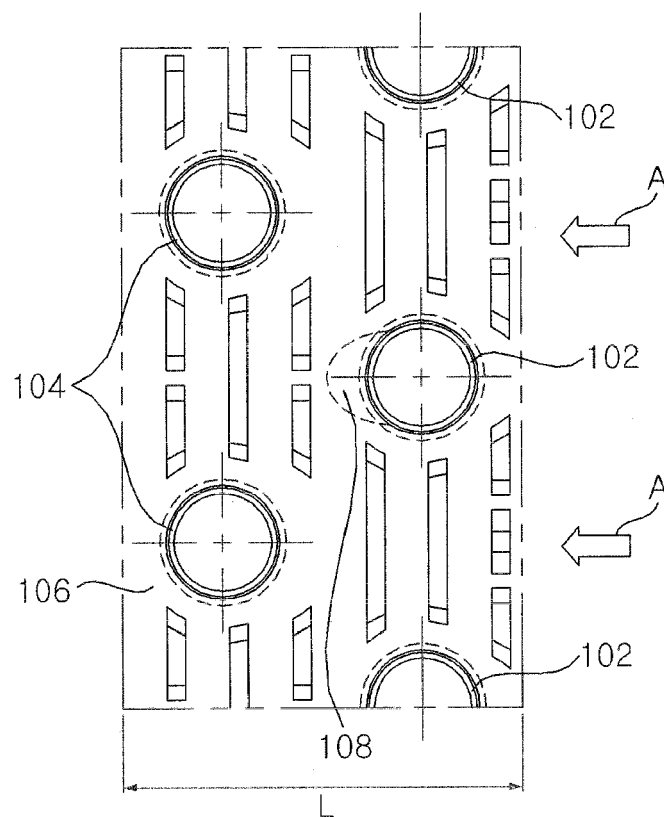


Fig. 2

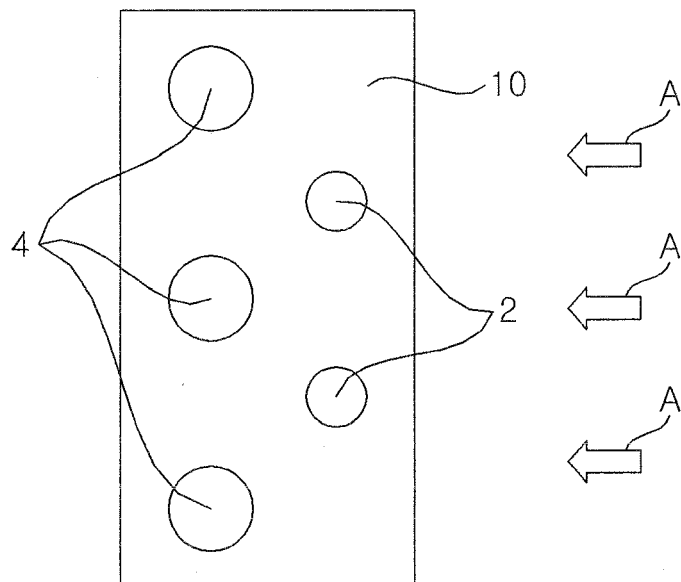


Fig. 3

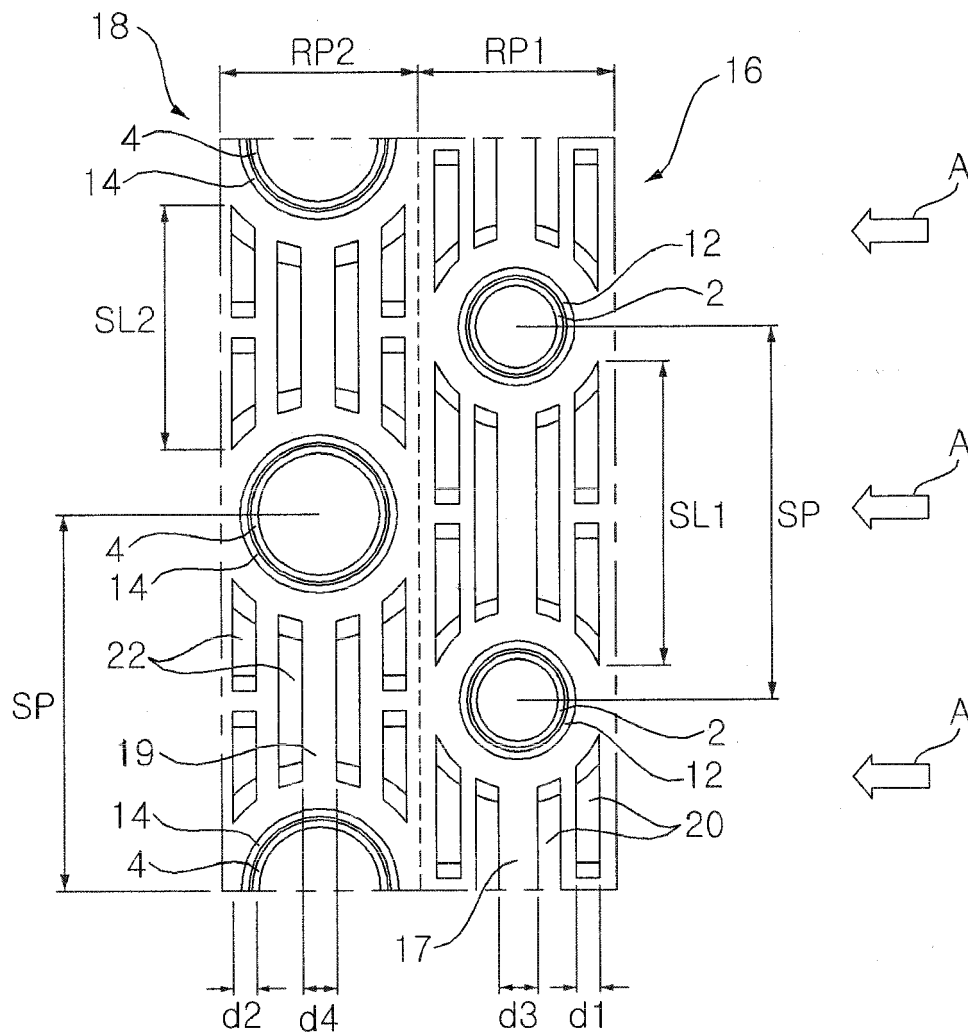


Fig. 4

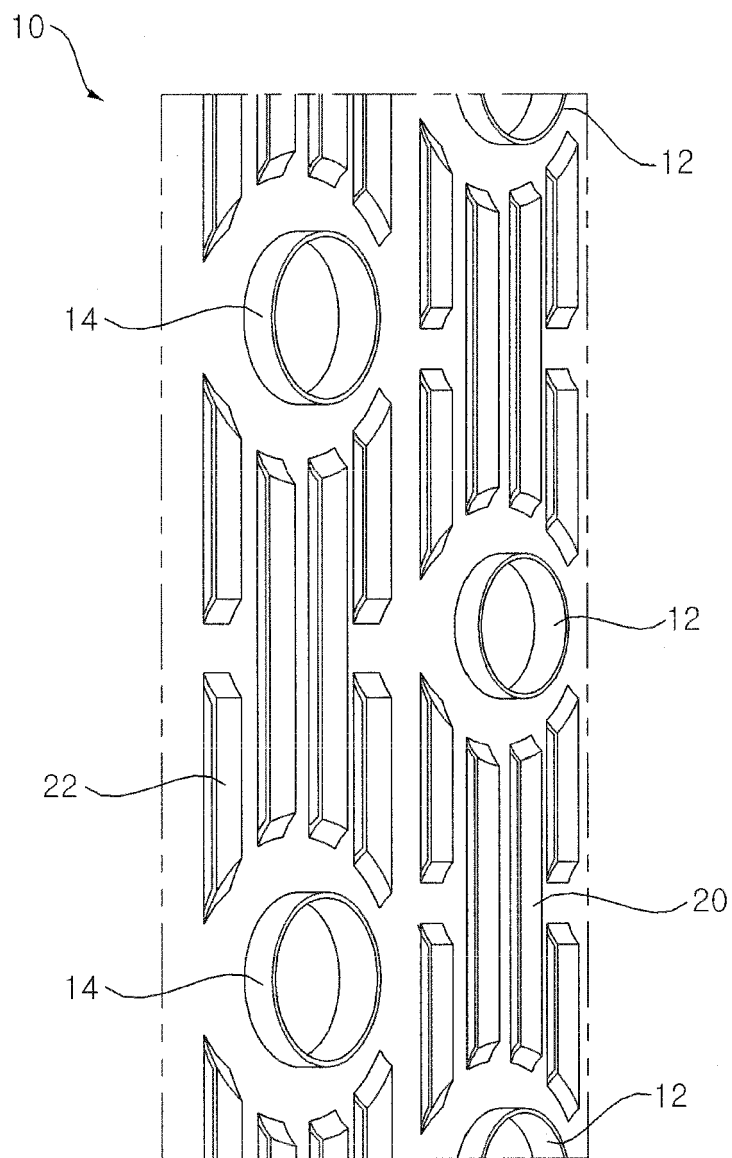


Fig. 5

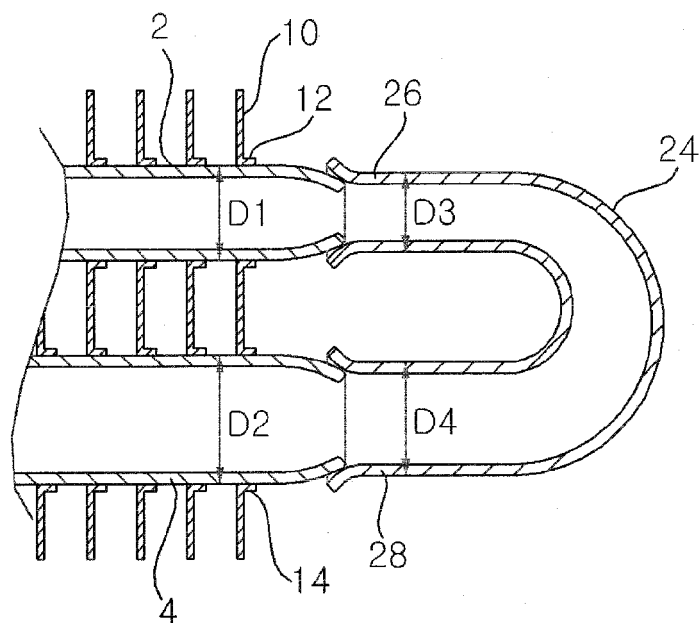


Fig. 6

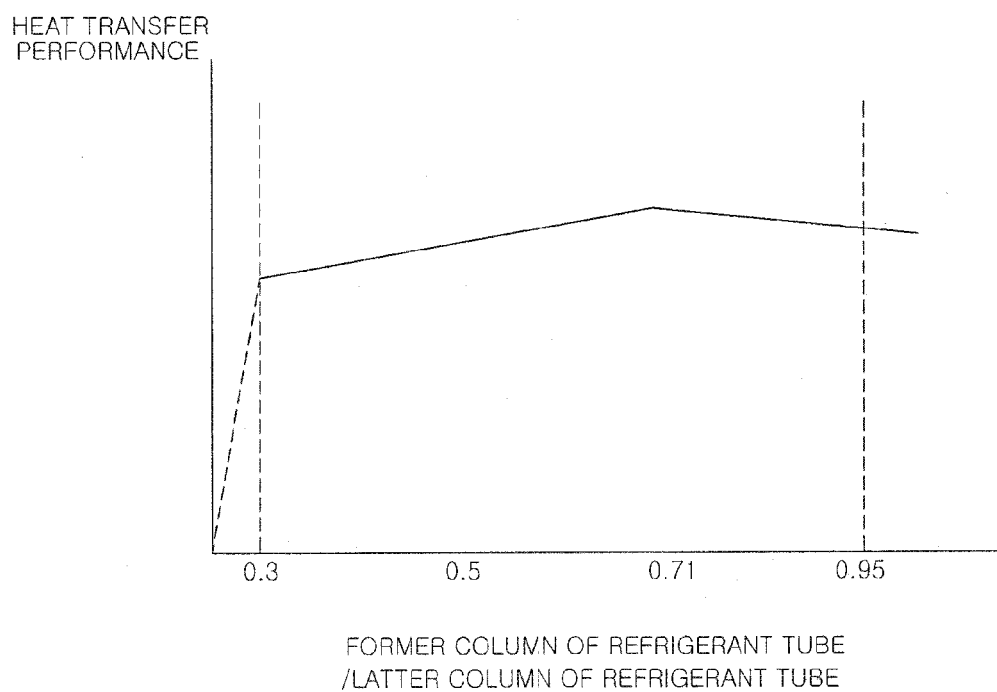


Fig. 7

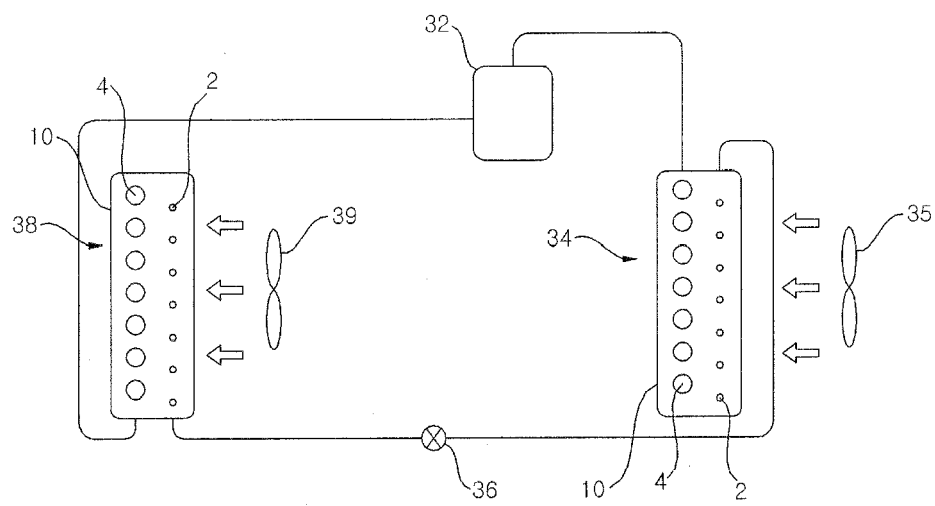


Fig. 8

