



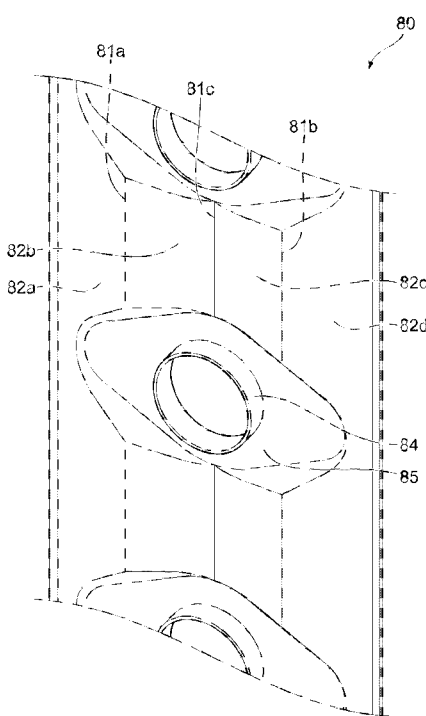
- (51) International Patent Classification:
F28F 1/12 (2006.01) F24F 13/30 (2006.01)
F28D 1/053 (2006.01)
- (21) International Application Number:
PCT/KR2019/013691
- (22) International Filing Date:
17 October 2019 (17.10.2019)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
2018-196701 18 October 2018 (18.10.2018) JP
10-2019-0115907 20 September 2019 (20.09.2019) KR
- (71) Applicant: SAMSUNG ELECTRONICS CO., LTD.
[KR/KR]; 129, Samsung-ro, Yeongtong-gu, Suwon-si,
Gyeonggi-do 16677 (KR).
- (72) Inventors: KIM, Hyun Young; 2-7, Sugasawa-cho,
Tsurumi-ku, Yokohama-shi, Kanagawa 230-0027 (JP).
SATO, Seiji; 2-7, Sugasawa-cho, Tsurumi-ku, Yoko-
hama-shi, Kanagawa 230-0027 (JP). LEE, Sang Mu;
2-7, Sugasawa-cho, Tsurumi-ku, Yokohama-shi, Kanagawa
230-0027 (JP).

(74) Agent: SELIM INTELLECTUAL PROPERTY LAW FIRM; 10F and 11F, Taewoo Bldg., 285, Gangnam-daero, Seocho-gu, Seoul 06729 (KR).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, KE, KG, KH, KN, KP, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: HEAT EXCHANGER AND AIR CONDITIONER HAVING THE SAME



(57) Abstract: Disclosed herein is a heat exchanger including a corrugated fin and an air conditioner including the same. The corrugated fin includes a through hole through which a heat transfer tube passes, a corrugated portion formed in a zigzag shape in the first direction corresponding to an air flow direction and a flat portion provided in the plane adjacent to the through hole, and the flat portion has a first length in the first direction corresponding to an air flow direction, and a second length shorter than the first length in a second direction perpendicular to the air flow direction.



WO 2020/080862 A1

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Description

Title of Invention: HEAT EXCHANGER AND AIR CONDITIONER HAVING THE SAME

Technical Field

- [1] The disclosure relates to a heat exchanger capable of exchanging heat between a refrigerant and air, and an air conditioner including the same.

Background Art

- [2] In general, an air conditioner includes an indoor heat exchanger that exchanges heat with indoor air, and an outdoor heat exchanger that exchanges heat with outdoor air.
- [3] The indoor heat exchanger and the outdoor heat exchanger include heat transfer tubes through which a refrigerant passes, and fins, through which the heat transfer tubes pass, to increase an area on which heat exchange with air is performed.
- [4] Recently, a heat exchanger having improved performance has been disclosed, and the heat exchanger employs a corrugated fin formed by being folded to have a corrugated shape so as to effectively perform heat exchange between the refrigerant and air, thereby improving the performance.

Disclosure of Invention

Technical Problem

- [5] Therefore, it is an aspect of the disclosure to provide a heat exchanger capable of improving a performance by allowing a flat portion of a fin, adjacent to a through hole, on which a heat transfer tube is installed, to be in contact with more air.
- [6] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the disclosure.

Solution to Problem

- [7] In accordance with an aspect of the disclosure, a heat exchanger includes a heat transfer tube configured to guide a refrigerant, and a plurality of corrugated fins provided with a through hole through which the heat transfer tube is installed to pass, and spaced apart from each other to allow air to pass in a first direction, and the corrugated fin includes a corrugated portion formed in a zigzag shape in the first direction corresponding to an air flow direction and a flat portion provided as a flat surface in the vicinity of the through hole, and the flat portion has a first length in the first direction corresponding to the air flow direction, and a second length shorter than the first length, in a second direction perpendicular to the air flow direction
- [8] The corrugated fin may include a collar in surface contact with the heat transfer tube and a sheet portion provided in the vicinity of the through hole so as to form the collar,

and the sheet portion may form the flat portion.

- [9] The flat portion may be formed by a first arc passing through a first point corresponding to one end of the first direction and a tangent line thereof, a second arc passing through a second point corresponding to the other end of the first direction and a tangent line thereof, a third arc passing through a third point corresponding to one end of the second direction and a tangent line thereof, and a fourth arc passing through a fourth point corresponding to the other end of the second direction and a tangent line thereof.
- [10] A center of curvature of the first arc and a center of curvature of the second arc may be symmetrically positioned in the first direction with respect to the center of the heat transfer tube.
- [11] A center of curvature of the third arc and a center of curvature of the fourth arc may be symmetrically positioned in the second direction with respect to the center of the heat transfer tube.
- [12] The first arc and the second arc may have a first radius of curvature, and the third arc and the fourth arc may have a second radius of curvature greater than the first radius of curvature.
- [13] The flat portion may be formed in the oval shape in which two focal points are symmetrically positioned in the first direction with respect to the center of the heat transfer tube.
- [14] A ratio of the first length of the corrugated fin to a width of the corrugated fin in the first direction may be in a range from about 0.6 to about 0.85.
- [15] The corrugated fin may include a plurality of inclined portions connected in a zigzag shape and inclined with respect to the first direction, and louvers formed by cutting and bending a portion of the plurality of inclined portions.
- [16] The corrugated fin may include four inclined portions connected in a zigzag shape, and the louvers may be formed on any one of two inclined portions located on the outside and two inclined portions located on the inside among the four inclined portions.
- [17] The heat exchanger may further include a connecting portion configured to connect the corrugated portion to the flat portion.
- [18] The corrugated portion may include two ridges and one valley formed on four inclined portions, and the center of the heat transfer tube may be placed at a position corresponding to the valley, and the connecting portion may be arranged in a region except the valley.
- [19] In accordance with another aspect of the disclosure, an air conditioner includes an indoor heat exchanger configured to exchange heat with indoor air and an outdoor heat exchanger configured to exchange heat with outdoor air, and at least one of the outdoor

heat exchanger or the indoor heat exchanger include a heat transfer tube configured to guide a refrigerant, and a plurality of corrugated fins provided with a through hole through which the heat transfer tube is installed to pass, and spaced apart from each other to allow air to pass in a first direction, and the corrugated fin includes a corrugated portion formed in a zigzag shape in the first direction corresponding to an air flow direction, and a flat portion provided as a flat surface in the vicinity of the through hole, and the flat portion has a first length in the first direction corresponding to the air flow direction, and a second length shorter than the first length, in a second direction perpendicular to the air flow direction.

Advantageous Effects of Invention

- [20] As is apparent from the above description, the heat exchanger and the air conditioner including the same may have the improved heat exchange performance because the flat portion formed around the heat transfer tube has the first length in the first direction corresponding to the air flow direction and the second length, which is less than the first length, in the second direction perpendicular to the air flow direction and thus it is possible to allow the flat portion to be in contact with larger amount of air.

Brief Description of Drawings

- [21] FIG. 1 illustrates a schematic diagram of an air conditioner according to an embodiment of the disclosure;
- [22] FIG. 2 illustrates a perspective view of a heat exchanger according to an embodiment of the disclosure;
- [23] FIG. 3 illustrates an enlarged-perspective view of a part of a corrugated fin according to an embodiment of the disclosure;
- [24] FIG. 4 illustrates a side view of a sheet portion according to an embodiment of the disclosure;
- [25] FIG. 5 is a table illustrating data evaluated for the effects of a first length HL of the sheet portion in a first direction corresponding to an air flow direction, on the performance;
- [26] FIG. 6 is a graph illustrating results according to FIG. 5;
- [27] FIG. 7 is a plan view illustrating a case in which two heat exchangers of FIG. 2 are arranged in parallel and a bending process is performed thereon;
- [28] FIG. 8 is a side view of a sheet portion illustrating a bending strength when the sheet portion has a circular shape;
- [29] FIG. 9 is a side view of a sheet portion illustrating a bending strength when the sheet portion has an oval shape;
- [30] FIG. 10 illustrates perspective view of a corrugated fin according to an embodiment of the disclosure; and

[31] FIG. 11 is perspective view of a corrugated fin according to an embodiment of the disclosure.

Mode for the Invention

[32] FIGS. 1 through 11, discussed below, and the various embodiments used to describe the principles of the present disclosure in this patent document are by way of illustration only and should not be construed in any way to limit the scope of the disclosure. Those skilled in the art will understand that the principles of the present disclosure may be implemented in any suitably arranged system or device.

[33] Embodiments described in the disclosure and configurations shown in the drawings are merely examples of the embodiments of the disclosure, and may be modified in various different ways at the time of filing of the present application to replace the embodiments and drawings of the disclosure.

[34] In addition, the same reference numerals or signs shown in the drawings of the disclosure indicate elements or components performing substantially the same function.

[35] Also, the terms used herein are used to describe the embodiments and are not intended to limit and / or restrict the disclosure. The singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. In this disclosure, the terms "including", "having", and the like are used to specify features, numbers, steps, operations, elements, components, or combinations thereof, but do not preclude the presence or addition of one or more of the features, elements, steps, operations, elements, components, or combinations thereof.

[36] It will be understood that, although the terms first, second, third, etc., may be used herein to describe various elements, but elements are not limited by these terms. These terms are only used to distinguish one element from another element. For example, without departing from the scope of the disclosure, a first element may be termed as a second element, and a second element may be termed as a first element. The term of "and / or" includes a plurality of combinations of relevant items or any one item among a plurality of relevant items.

[37] In the following detailed description, the terms of "front end", "rear end", "upper portion", "lower portion", "upper end", "lower end" and the like may be defined by the drawings, but the shape and the location of the component is not limited by the term.

[38] FIG. 1 illustrates a schematic diagram of an air conditioner according to an embodiment of the disclosure and a view illustrating a heating operation is performed.

[39] As illustrated in FIG. 1, an air conditioner includes an outdoor unit 10 arranged in an outdoor space, a plurality of indoor units 20 installed in an indoor space, and refrigerant pipes 31 and 32 configured to connect the outdoor unit 10 to the plurality of

indoor units 20 so as to circulate a refrigerant between the outdoor unit 10 and the plurality of indoor units 20.

[40] According to the embodiment, two indoor units 20 are connected to a single outdoor unit 10, but this is only an example and is not limited thereto. That is, a single indoor unit 20 may be connected to a single outdoor unit 10, or three or more indoor units 20 may be connected to a single outdoor unit 10.

[41] The outdoor unit 10 includes an outdoor heat exchanger 11 configured to exchange heat between outdoor air and a refrigerant, an outdoor blower 12 configured to allow the outdoor air to pass through the outdoor heat exchanger 11, a compressor 16 configured to compress a refrigerant, a four-way valve 14 configured to guide the refrigerant discharged from the compressor 16 to one of the outdoor unit 10 and the indoor unit 20, an outdoor expansion valve 13 configured to decompress and expand the refrigerant, and an accumulator 15 configured to separate a liquid refrigerant from the refrigerant flowing to the compressor 16 and configured to allow the liquid refrigerant to be vaporized and to flow into the compressor 16.

[42] The outdoor unit 10 also includes a controller 17 configured to control the operation of the outdoor blower 12, the outdoor expansion valve 13, the compressor 16, and the four-way valve 14. The controller 17 may be constituted by a microcomputer.

[43] The indoor unit 20 includes an indoor heat exchanger 21 configured to exchange heat between indoor air and a refrigerant, an indoor blower 22 configured to allow the indoor air to pass through the indoor heat exchanger 21, and an indoor expansion valve 23 configured to decompress and expand the refrigerant.

[44] The refrigerant pipe 30 includes a liquid refrigerant pipe 31 through which a liquid refrigerant passes, and a gaseous refrigerant pipe 32 through which a gaseous refrigerant passes. The liquid refrigerant pipe 31 allows the refrigerant to flow between the indoor expansion valve 23 and the outdoor expansion valve 13. The gaseous refrigerant pipe 32 guides the refrigerant to move between the four-way valve 14 of the outdoor unit 10 and the gas side of the indoor heat exchanger 21 of the indoor unit 20.

[45] Any one of a single HC refrigerant, a mixed refrigerant including HC, R32, R410A, R407C, or carbon dioxide may be used as the refrigerant used in the air conditioner.

[46] FIG. 2 illustrates a perspective view of the heat exchanger 40 according to an embodiment of the disclosure.

[47] As illustrated in FIG. 2, the heat exchanger 40 corresponds to at least one of the outdoor heat exchanger 11 and the indoor heat exchanger 21 shown in FIG. 1.

[48] The heat exchanger 40 is a fin tube type heat exchanger, and includes a plurality of fins 50 formed of aluminum and a heat transfer tube 60 having a circular cross section formed of copper or aluminum.

[49] The plurality of fins 50 are arranged perpendicular to the heat transfer tube and

spaced apart from each other so that air passes between the plurality of fins 50 in a first direction. The heat transfer tube 60 is installed to pass through the through holes provided in each of the fins 50 and arranged in parallel with each other. The heat transfer tube 60 is connected to the refrigerant pipes 30 of the air conditioner of FIG. 1 to form a closed loop refrigeration cycle.

[50] In addition, because the heat transfer tube 60 is in contact with the fin 50 to transfer heat or receive heat through the fin 50, a contact area with the air passing through the heat exchanger 40 is increased through the fin 50. Therefore, heat exchange between the refrigerant passing through the heat transfer tube 60 and the refrigerant passing through the heat exchanger 40 is efficiently performed through the fin 50.

[51] In order to effectively perform the heat transfer between the fin 50 and the air, the fin 50 may have a corrugated form formed in such a way that the fin 50 is bent in a zigzag shape through the press die, in a first direction corresponding to an air flow direction. Hereinafter the fin 50, in which the corrugated form is formed, as described above is referred to as a corrugated fin 80.

[52] The corrugated fin 80 includes a collar 84 in surface contact with the heat transfer tube 60, and a sheet portion 85 provided as a flat surface around the collar 84 to form the collar 84. The sheet portion 85 is adjacent to the collar 84 in contact with the heat transfer tube 60 and thus the sheet portion 85 has a temperature similar to that of the refrigerant passing through the heat transfer tube 60.

[53] Therefore, heat exchange between the refrigerant and the air may be efficiently performed in the sheet portion 85, and thus, more air may be in contact with the sheet portion 85, thereby improving the heat exchange efficiency of the heat exchanger 40.

[54] FIG. 3 illustrates an enlarged-perspective view of a part of the corrugated fin 80 according to an embodiment of the disclosure.

[55] As illustrated in FIG. 3, the sheet portion 85 is formed to have a first length in the first direction corresponding to the air flow direction, and have a second length that is shorter than the first length in a second direction that is perpendicular to the first direction. The heat exchange efficiency of the heat exchanger 40 may be improved by allowing more air to be in contact with the sheet portion 85.

[56] According to the embodiment, the sheet portion 85 is formed in an oval type shape extending in the first direction corresponding to the air flow direction.

[57] The corrugated fin 80 includes four inclined portions 82a, 82b, 82c, and 82d, two ridges 81a and 81b and one valley 81c formed by the four inclined portions. The four inclined portions 82a, 82b, 82c, and 82d include the inclined portion 82a positioned on the left side of the left ridge 81a according to the drawings, the inclined portions 82b and 82c positioned between the two ridges 81a and 81b, and the valley 81c, and the inclined portion 82d positioned on the right side of the right ridge 81b according to the

drawings. The ridges 81a and 81b, and the valley 81c correspond to folded parts that is generated when the corrugated fin 80 is bent to form the inclined portions 82a, 82b, 82c, and 82d. The inclined portions 82a, 82b, 82c, and 82d are inclined surfaces inclined with respect to a surface of the fin 50 having a shape in a state before the inclined portions 82a, 82b, 82c, and 82d are formed. Therefore, the corrugated fin 80 includes the ridges 81a and 81b, and the valley 81c, and the inclined portions 82a, 82b, 82c, and 82d connected to each other in a zigzag shape through the ridges 81a and 81b, and the valley 81c. Therefore, the corrugated portion having the zigzag shape is formed by the ridges 81a and 81b, and the valley 81c, and the inclined portions 82a, 82b, 82c, and 82d. A flat portion having a flat shape is formed by the sheet portion 85.

[58] FIG. 4 illustrates the sheet portion 85. A width of the corrugated fin 80 (hereinafter referred to as "fin width") is referred to as RP, and a distance between the heat transfer tubes 60 is referred to as SP. The sheet portion 85 has a first length HL in the first direction (left and right direction in the drawing) corresponding to the air flow direction, and a second length VL in the second direction (up and down direction in the drawing) which is perpendicular to the first direction corresponding to the air flow direction. When opposite ends of the first direction in the sheet portion 85 are referred to as points A and B, the points A and B are provided at positions symmetric in the first direction with respect to a center O of the heat transfer tube 60. In addition, when opposite ends of the second direction in the sheet portion 85 are referred to as points C and D, the points C and D are provided at positions symmetric in the second direction with respect to the center O of the heat transfer tube 60. Therefore, a distance between the point A and the point B is the first length HL mentioned above, and a distance between the point C and the point D is the second length VL mentioned above. The center O of the heat transfer tube 60 is located at a position corresponding to the valley 81c.

[59] "Oval type shape" refers to a shape having a shape similar to an oval shape formed in such a way that a first length in the first direction corresponding to the air flow direction is greater than a second length in the second direction perpendicular to the air flow direction. According to the embodiment, the sheet portion 85 has an approximately oval type shape formed by a first arc passing through the point A on the left side and a tangent line thereof, a second arc passing through the point B on the right side and a tangent line thereof, a third arc passing through the point C on the upper side and a tangent line thereof, and a fourth arc passing through the point D on a lower side and a tangent line thereof.

[60] It is appropriate that the first and second arcs have a center of curvature on a straight line connecting the point A, the center O of the heat transfer tube 60 and the point B, and the third and fourth arcs have a center of curvature on a straight line connecting the

point C, the center O of the heat transfer tube 60 and the point D, but is not limited thereto.

- [61] As for the sheet portion 85 having the oval type shape, the first and second arcs have a radius of curvature R1 and the third and fourth arcs have a radius of curvature R2 greater than R1, but are not limited thereto. Therefore, the sheet portion 85 may be formed in various oval type shapes in which the first length HL is longer than the second length VL.
- [62] The corrugated fin 80 includes a connecting portion 87 connecting the corrugated portion to the flat portion. The connecting portion 87 connects between the ridges 81a and 81b and the valley 81c forming the corrugated portion, and the sheet portion 85 forming the flat portion. The connecting portion 87 is formed to surround the sheet portion 85 but is not formed in the valley 81c. Vertices E and F of the connecting portion 87 are formed in the ridge 81a and vertices G and H of the connecting portion 87 are formed in the ridge 81b.
- [63] Therefore, because condensed water generated in the heat exchanger 40 may be easily moved along the valley 81c, the condensed water is prevented from being collected in the sheet portion 85, thereby preventing the increase in the air resistance in the sheet portion 85.
- [64] FIG. 5 illustrates data for showing the effect of the first length HL of the sheet portion 85 on the heat exchange performance of the sheet portion 85.
- [65] FIG. 5 illustrates the heat exchange efficiency / air resistance value for various sheet portions including the sheet portion 85 having a circular shape in which a second length VL is fixed at 8.5mm and a first length HL is 8.5 mm, and the sheet portions 85 having various oval type shapes #1 to #4 in which a second length VL is fixed at 8.5mm and a first length HL is gradually increased. When it is assumed that the heat exchange efficiency / air resistance of the sheet portion 85 having a circular shape is 100, the heat exchange efficiency / air resistance value is expressed by a relative value of the heat exchange efficiency / air resistance of the sheet portion 85 having the oval shapes #1 to #4 with respect to the heat exchange efficiency / air resistance of the sheet portion 85 having the circular shape.
- [66] FIG. 6 is a graph illustrating the evaluation results of the above. It can be seen from the graph of FIG. 6 that the heat exchange efficiency / air resistance value becomes optimal when a ratio of the first length HL to the fin width RP of the sheet portion 85 is in a range of from about 0.6 to about 0.85.
- [67] As mentioned above, by allowing the ratio of the first length HL of the sheet portion 85 to the fin width RP to be the range of 0.6 to 0.85, it is possible to improve the heat exchange performance per air resistance value.
- [68] Further, by lengthening the sheet portion 85 in the first direction corresponding to the

air flow direction, the bending strength of the corrugated fin 80 may be sufficiently secured.

[69] Hereinafter securing the bending strength of the corrugated fin 80 will be described.

[70] As illustrated in FIG. 2, the heat exchanger 40 is manufactured to be elongated in one direction and then bent to be placed in the outdoor unit 10 or the indoor unit 20.

[71] FIG. 7 is a plan view of the heat exchanger 40 and illustrates a case in which two straight heat exchangers 40 extending in one direction are arranged in parallel and then bent.

[72] When the bending process is performed on the heat exchanger 40, one end 86 of the corrugated fin 80 is in contact with a roller 94 or a die 95 and receives a force. Therefore, it is beneficial that the corrugated fin 80 has a sufficient bending strength. When the bending strength of the corrugated fin 80 is low, an adjacent portion of the one end 86 of the corrugated fin 80 in contact with the roller 94 or the die 95 may be deformed during the bending process of the heat exchanger 40. A bent portion of the corrugated fin 80 interferes with the flow of air, so resistance of the flow path is increased and the performance of the heat exchanger 40 is reduced.

[73] FIGS. 8 and 9 are views illustrating the bending strength. FIG. 8 illustrates the case where the sheet portion 85 is in the circular shape, and FIG. 9 illustrates the case where the sheet portion 85 is in the oval type shape. The bending strength of the corrugated fin 80 is increased by the connecting portion 87. Because a portion to which a force is applied by the roller 94 is the one end 86 of the corrugated fin 80, the bending strength of the corrugated fin 80 is increased as a distance between the one end of the corrugated fin 80 and the connecting portion 87 is reduced. That is, because a distance Y when the sheet portion 85 is formed in the oval type shape as shown in FIG. 9 is less than a distance X when the sheet portion 85 is formed in the circular shape as shown in FIG. 8, the bending strength of the corrugated fin 80 shown in FIG. 9 is high.

[74] Accordingly, because the bending strength of the corrugated fin 80 is fully secured by the sheet portion 85 and the connecting portion 87, it is possible to easily perform the bending process on the heat exchanger 40. In addition, as described above, it is possible to by sufficiently secure the bending strength of the corrugated fin 80 and thus it is possible to form the corrugated fin 80 having a shape that is suitable for the air flow, thereby generating the effective air flow.

[75] In FIG. 3, the inclined portions 82a, 82b, 82c, and 82d may be formed in a flat plate shape without any separate configuration, but is not limited thereto.

[76] FIG. 10 illustrates a perspective view of a corrugated fin 80 according to another embodiment of the disclosure.

[77] As illustrated in FIG. 10, a corrugated fin 80 includes ridges 81a and 81b and a valley 81c, an inclined portion 82a positioned on the left side of the left ridge 81a

according to the drawing, inclined portions 82b and 82c between the ridges 81a and 81b and the valley 81c, and an inclined portion 82d positioned on the right side of the right ridge 81b according to the drawings, so as to have a corrugated portion by the ridges 81a and 81b, the valley 81c and the inclined portions 82a, 82b, 82c, and 82d.

[78] The corrugated fin 80 includes a collar 84 in surface contact with a heat transfer tube 60, and a sheet portion 85 forming the collar 84, and particularly the sheet portion 85 corresponds to a flat portion.

[79] Louvers 83a, 83b, 83c, 83d are formed in the inclined portions 82a, 82b, 82c, and 82d, respectively.

[80] In FIG. 10, the louvers 83a, 83b, 83c, and 83d are formed in all the inclined portions 82a, 82b, 82c, and 82d of the corrugated fin 80, but are not limited thereto. As illustrated in FIG. 11 according to an embodiment of the disclosure, louvers 83a and 83d may be formed on inclined portions 82a and 82d among inclined portions 82a, 82b, 82c, and 82d.

[81] FIG. 11 illustrates perspective view of a corrugated fin 80 according to an embodiment of the disclosure.

[82] As illustrated in FIG. 11, a corrugated fin 80 includes ridges 81a and 81b and a valley 81c, an inclined portion 82a positioned on the left side of the left ridge 81a according to the drawing, inclined portions 82b and 82c between the ridges 81a and 81b and the valley 81c, and an inclined portion 82d positioned on the right side of the right ridge 81b according to the drawings, so as to have a corrugated portion by the ridges 81a and 81b, the valley 81c and the inclined portions 82a, 82b, 82c, and 82d.

[83] The corrugated fin 80 includes a collar 84 in surface contact with a heat transfer tube 60, and a sheet portion 85 forming the collar 84, and particularly the sheet portion 85 corresponds to a flat portion.

[84] Louvers 83a and 83d are formed in the inclined portions 82a and 82d positioned on the outside among inclined portions 82a, 82b, 82c, and 82d.

[85] In FIG. 11, the louvers 83a and 83d are formed in the inclined portions 82a and 82d positioned on the outside among the inclined portions 82a, 82b, 82c, and 82d, but are not limited thereto. Although not shown drawings, louvers 83a and 83d may be formed in the inclined portions 82b and 82c positioned on the inside among the inclined portions 82a, 82b, 82c, and 82d.

[86] The corrugated fin 80 includes four inclined portions 82a, 82b, 82c, and 82d, but is not limited thereto, and the corrugated fin 80 may include two, three, or five or more inclined portions.

[87] In addition, in FIG. 4, the sheet portion 85 is formed in the oval type shape, but is not limited thereto. It is also possible for the sheet portion to be formed in an oval shape.

[88] In this case, it is appropriate that the two focal points of the sheet portion 85 having

the oval shape are symmetrically positioned in the first direction with respect to the center O of the heat transfer tube 60, but is not limited thereto.

[89] Although a few embodiments of the 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 and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

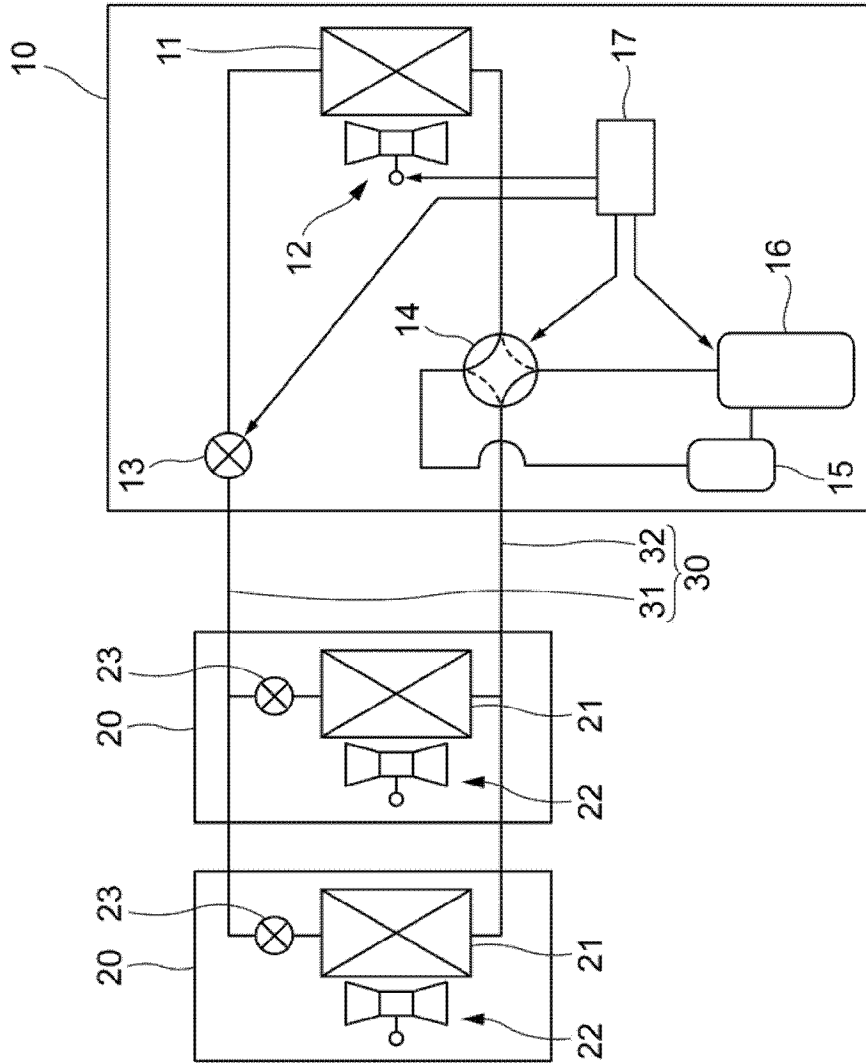
[90] Although the present disclosure has been described with various embodiments, various changes and modifications may be suggested to one skilled in the art. It is intended that the present disclosure encompass such changes and modifications as fall within the scope of the appended claims.

Claims

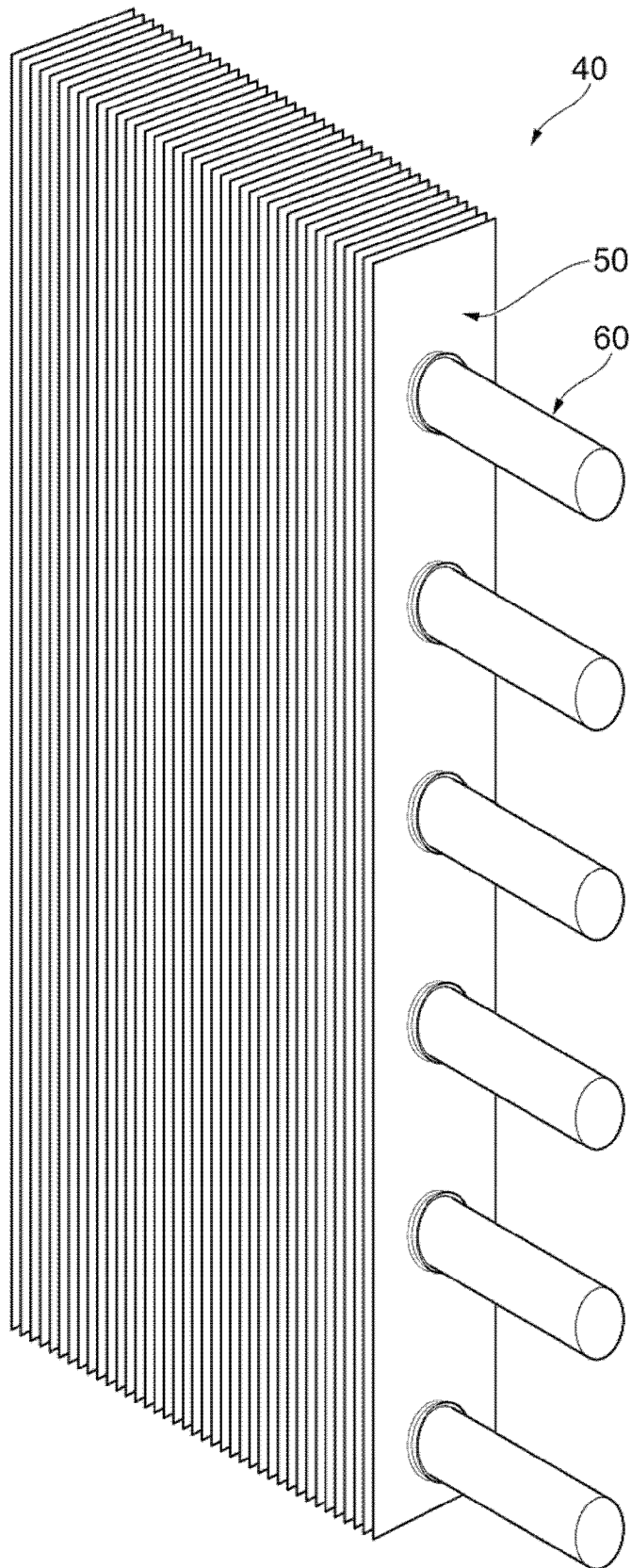
- [Claim 1] A heat exchanger comprising:
a heat transfer tube configured to guide a refrigerant; and
a plurality of corrugated fins provided with a through hole through which the heat transfer tube is installed to pass, the plurality of corrugated fins spaced apart from each other to allow air to pass in a first direction,
wherein each of the plurality of the corrugated fins comprises:
a corrugated portion formed in a zigzag shape in the first direction corresponding to an air flow direction; and
a flat portion provided as a flat surface in a vicinity of the through hole, wherein the flat portion has a first length in the first direction corresponding to the air flow direction, and a second length shorter than the first length, in a second direction perpendicular to the air flow direction.
- [Claim 2] The heat exchanger of claim 1, wherein each of the plurality of the corrugated fins further comprises a collar in surface contact with the heat transfer tube and a sheet portion provided in the vicinity of the through hole so as to form the collar,
wherein the sheet portion forms the flat portion.
- [Claim 3] The heat exchanger of claim 1, wherein the flat portion is formed by a first arc passing through a first point corresponding to one end of the first direction and a tangent line thereof, a second arc passing through a second point corresponding to the other end of the first direction and a tangent line thereof, a third arc passing through a third point corresponding to one end of the second direction and a tangent line thereof, and a fourth arc passing through a fourth point corresponding to the other end of the second direction and a tangent line thereof.
- [Claim 4] The heat exchanger of claim 3, wherein a center of curvature of the first arc and a center of curvature of the second arc are symmetrically positioned in the first direction with respect to a center of the heat transfer tube.
- [Claim 5] The heat exchanger of claim 3, wherein a center of curvature of the third arc and a center of curvature of the fourth arc are symmetrically positioned in the second direction with respect to a center of the heat transfer tube.
- [Claim 6] The heat exchanger of claim 3, wherein:

- the first arc and the second arc have a first radius of curvature, and the third arc and the fourth arc have a second radius of curvature greater than the first radius of curvature.
- [Claim 7] The heat exchanger of claim 1, wherein the flat portion is formed in an oval shape in which two focal points are symmetrically positioned in the first direction with respect to a center of the heat transfer tube.
- [Claim 8] The heat exchanger of claim 1, wherein a ratio of the first length of the flat portion to the second length of the flat portion is in a range from about 0.6 to about 0.85.
- [Claim 9] The heat exchanger of claim 1, wherein each of the plurality of the corrugated fins further comprises:
a plurality of inclined portions connected in a zigzag shape and inclined with respect to the first direction; and
louvers formed by cutting and bending a portion of the plurality of inclined portions.
- [Claim 10] The heat exchanger of claim 9, wherein:
each of the plurality of the corrugated fins further comprises four inclined portions connected in a zigzag shape, and
the louvers are formed on any one of two inclined portions located on the outside and two inclined portions located on the inside among the four inclined portions.
- [Claim 11] The heat exchanger of claim 1, further comprising:
a connecting portion configured to connect the corrugated portion to the flat portion.
- [Claim 12] The heat exchanger of claim 11, wherein
the corrugated portion further comprises two ridges and one valley formed on four inclined portions,
a center of the heat transfer tube is placed at a position corresponding to the valley, and
the connecting portion is arranged in a region except the valley.
- [Claim 13] An air conditioner comprising the heat exchanger of any one of claim 1 to claim 12.

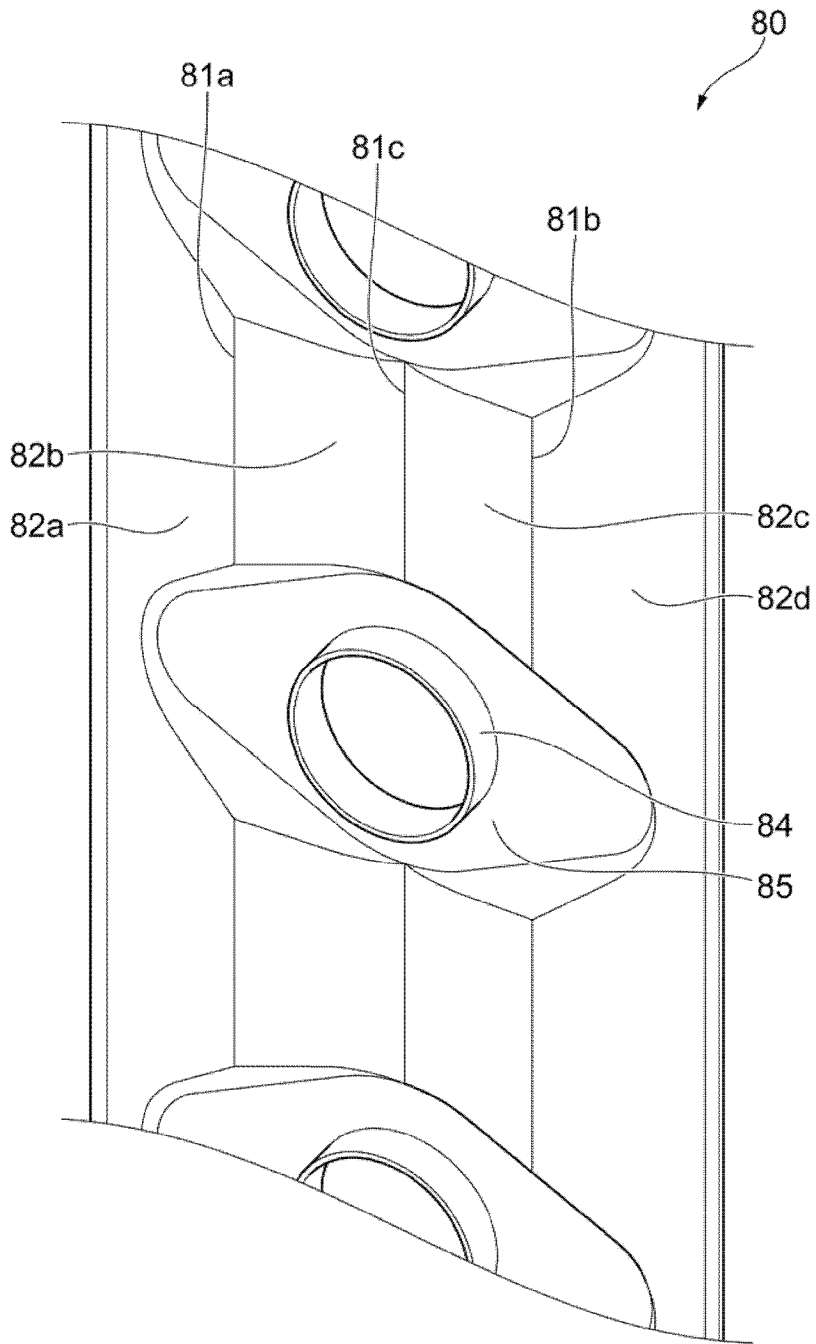
[Fig. 1]



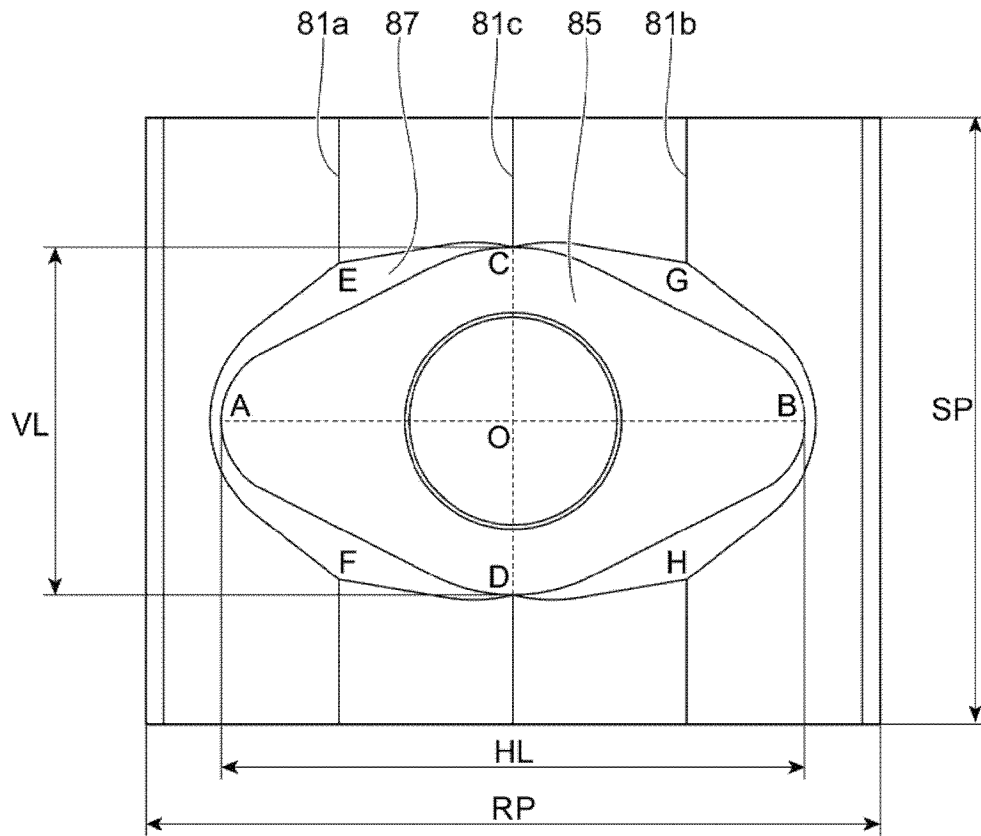
[Fig. 2]



[Fig. 3]



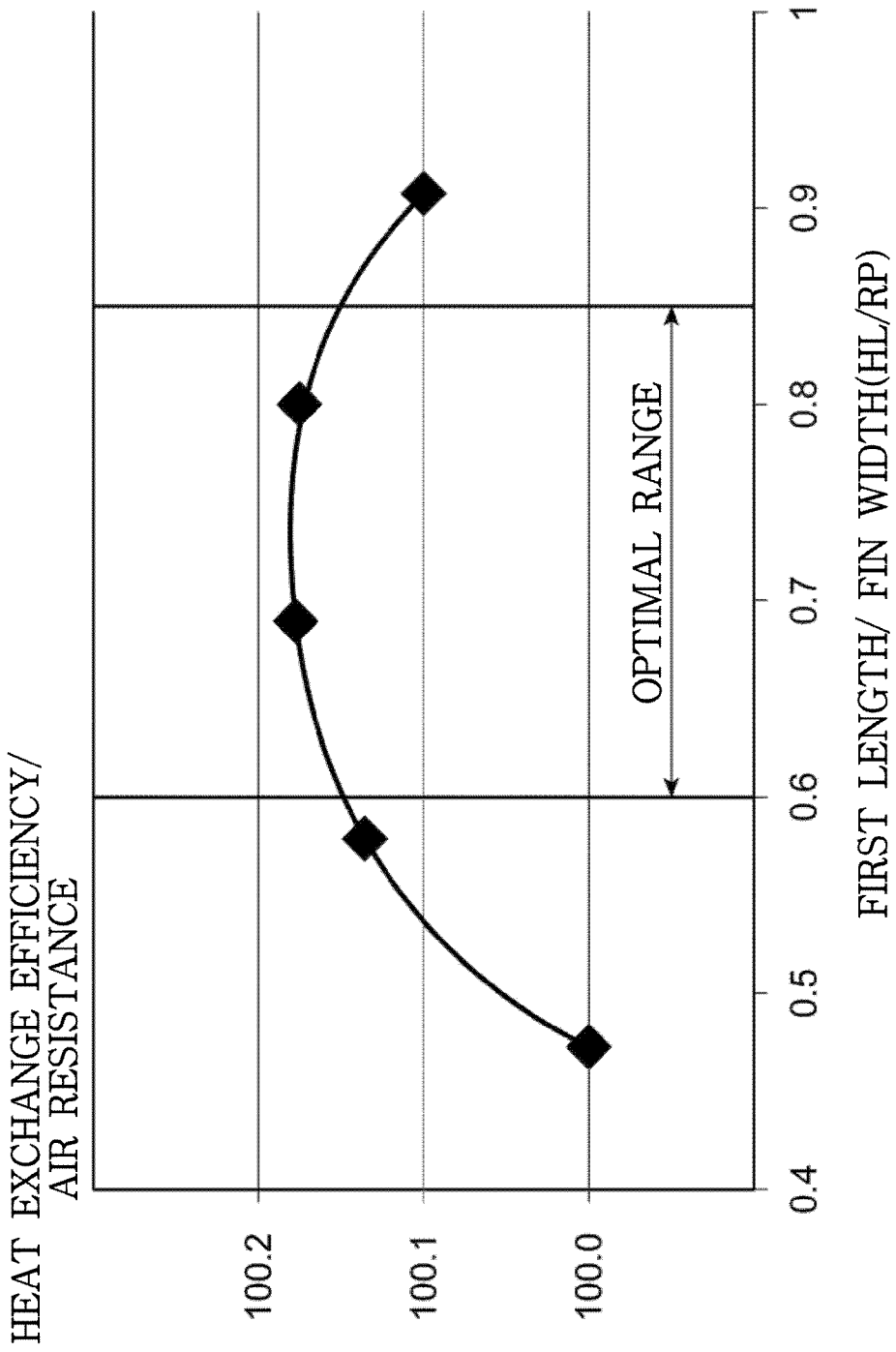
[Fig. 4]



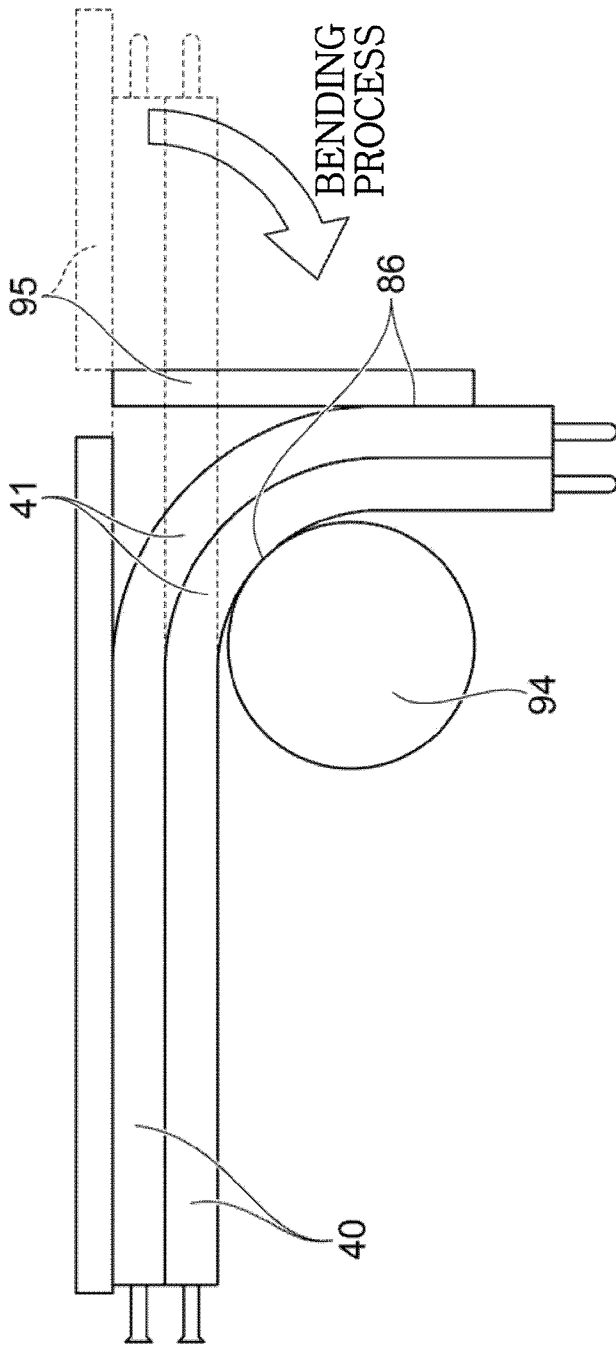
[Fig. 5]

	CIRCULAR SHAPE	OVAL TYPE SHAPE #1	OVAL TYPE SHAPE #2	OVAL TYPE SHAPE #3	OVAL TYPE SHAPE #4
SHEET PORTION SIZE (VL x HL)	8.5 x 8.5	8.5 x 10.5	8.5 x 12.5	8.5 x 14.5	8.5 x 16.5
FIRST LENGTH/ FIN WIDTH (HL/VP)	0.47	0.58	0.69	0.8	0.91
HEAT EXCHANGE EFFICIENCY/ AIR RESISTANCE	100.00	100.14	100.14	100.17	100.09

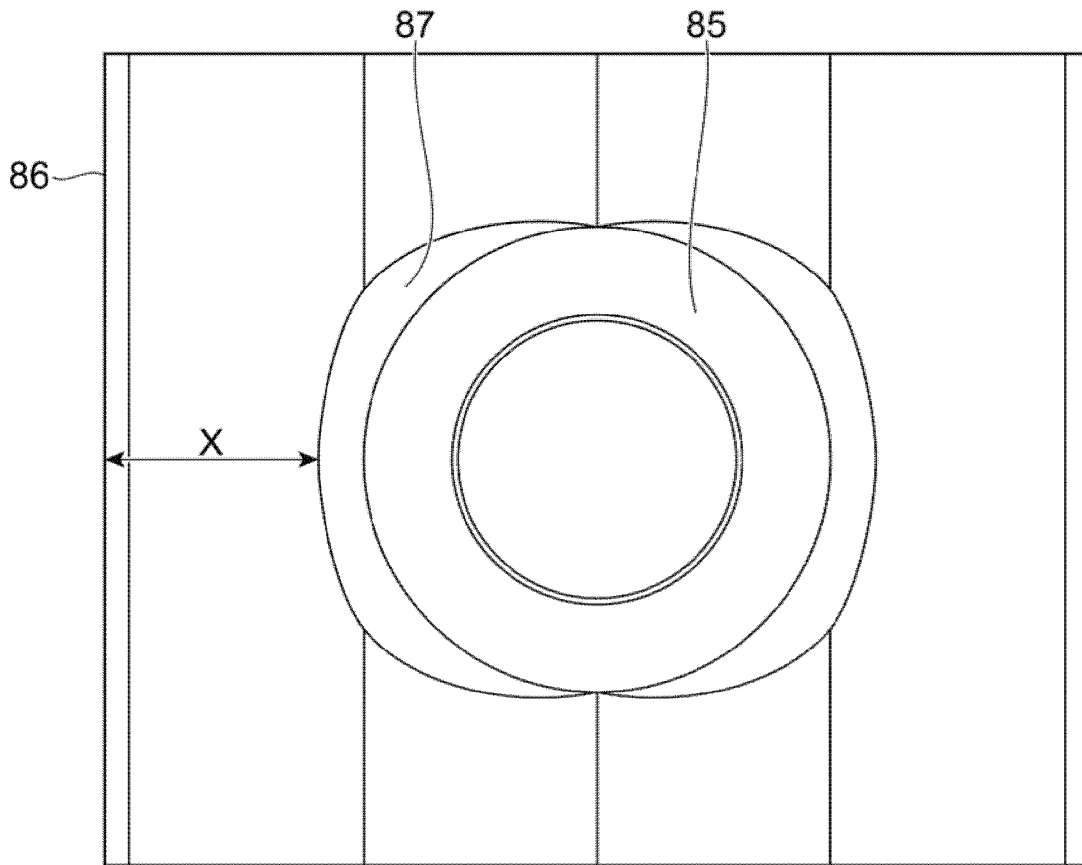
[Fig. 6]



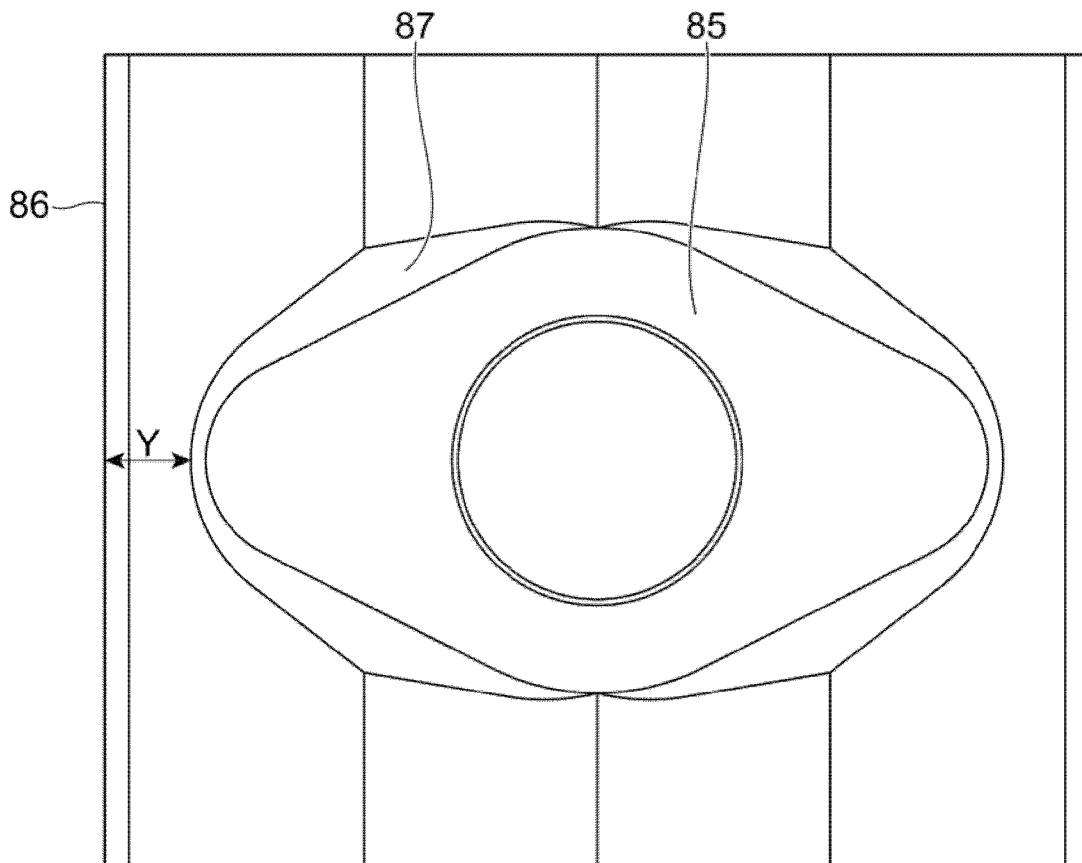
[Fig. 7]



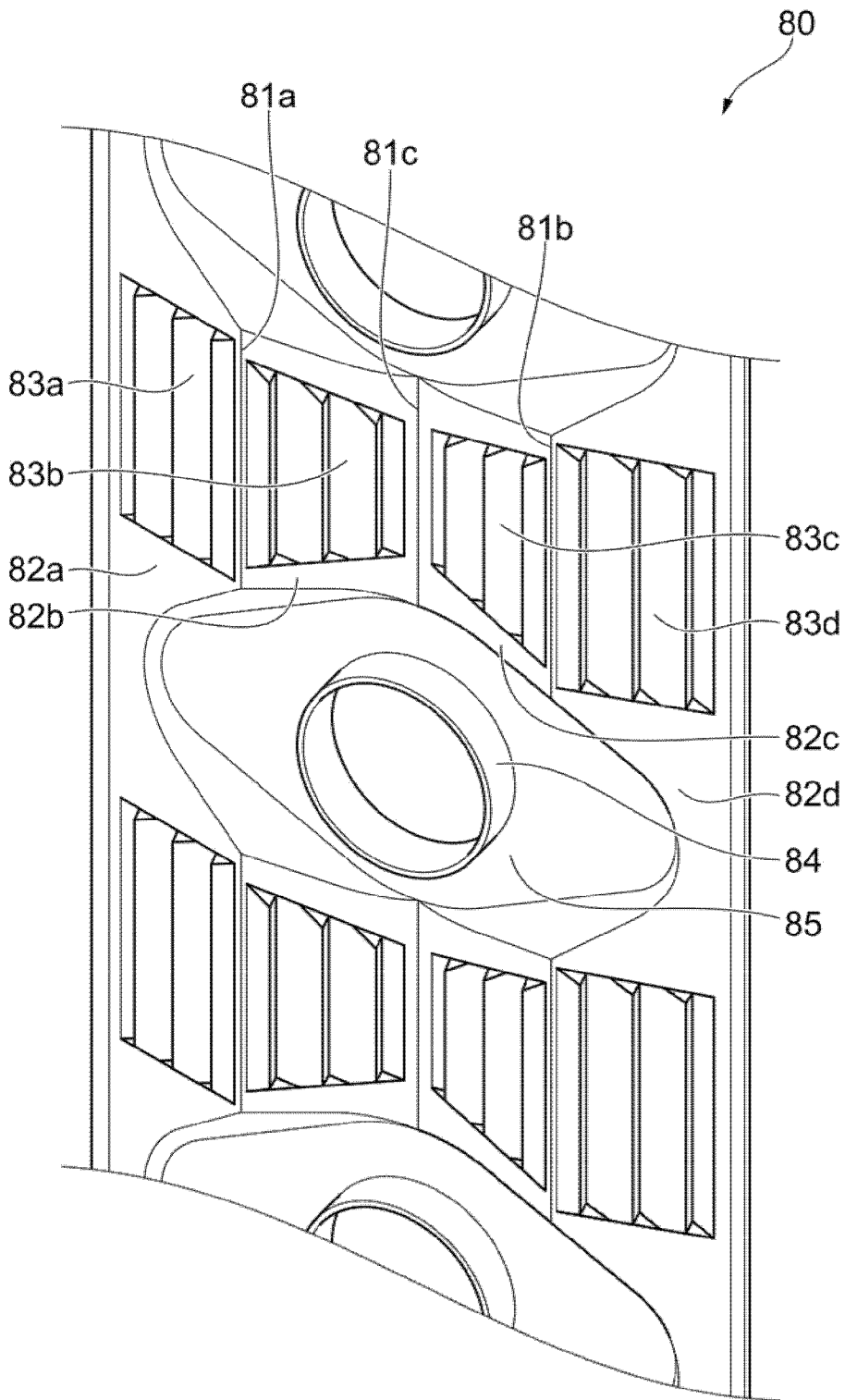
[Fig. 8]



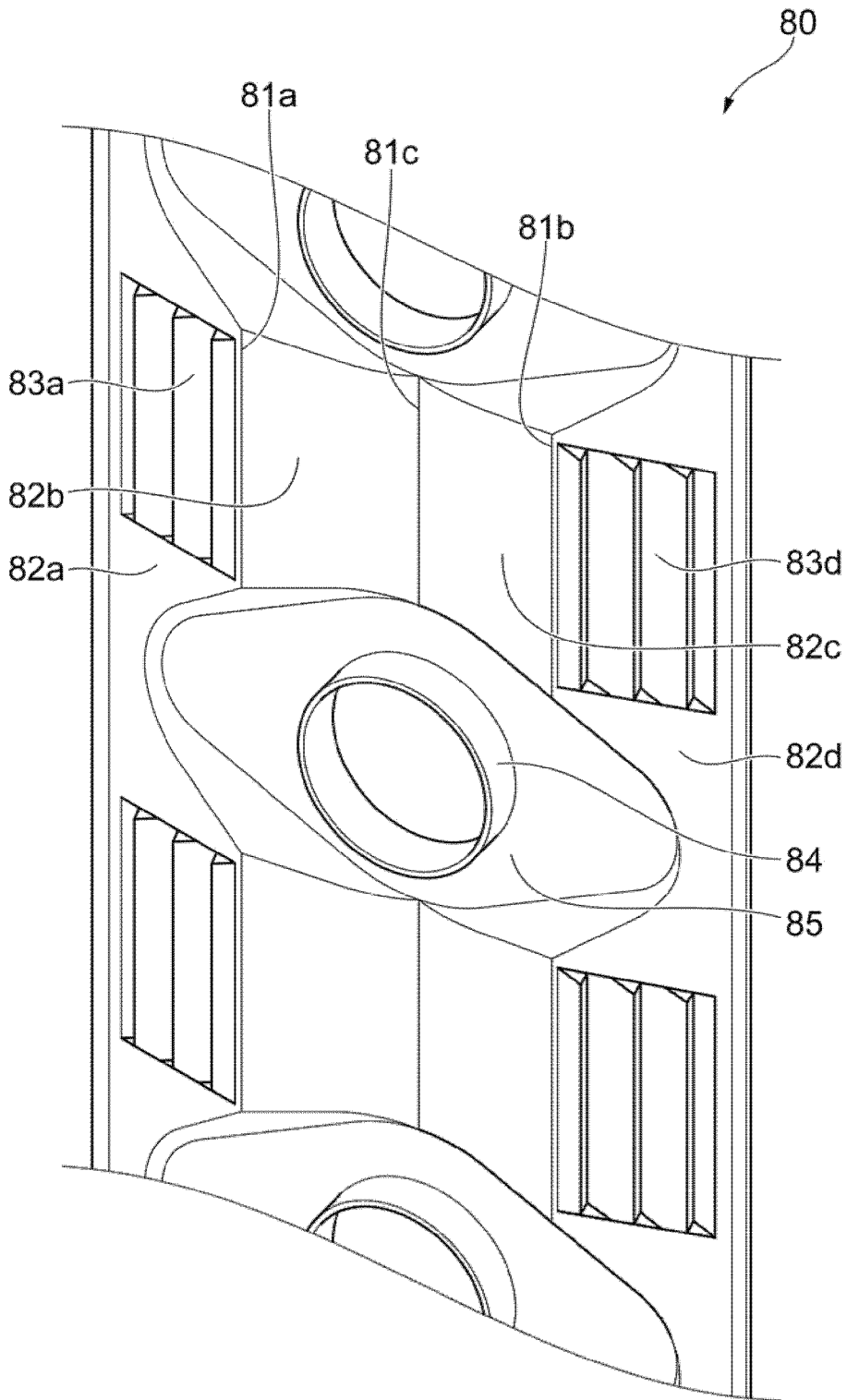
[Fig. 9]



[Fig. 10]



[Fig. 11]



A. CLASSIFICATION OF SUBJECT MATTER**F28F 1/12(2006.01)i, F28D 1/053(2006.01)i, F24F 13/30(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F28F 1/12; F28D 1/02; F28F 1/32; F28D 1/053; F24F 13/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: heat transfer tube, corrugated portion, heat exchanger, first length, second length

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5203403 A (YOKOYAMA et al.) 20 April 1993 See column 2, line 3 - column 4, line 4; claim 1; and figures 1-14.	1-13
A	JP 07-017955 Y2 (DAIKIN IND. LTD.) 26 April 1995 See claims 1-8; and figures 1-7.	1-13
A	US 2016-0054065 A1 (PANASONIC INTELLECTUAL PROPERTY MANAGEMENT CO., LTD.) 25 February 2016 See paragraphs [0047]-[0078]; and figures 1, 2A-2D, 3A-3B.	1-13
A	JP 2004-085013 A (DAIKIN IND. LTD.) 18 March 2004 See paragraphs [0009]-[0028]; and figures 1-5.	1-13
A	JP 07-280479 A (DAIKIN IND. LTD.) 27 October 1995 See claims 1-9; and figures 1-7.	1-13

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

07 February 2020 (07.02.2020)

Date of mailing of the international search report

19 February 2020 (19.02.2020)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

LEE, Eon Su

Telephone No. +82-42-481-8539



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2019/013691

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5203403 A	20/04/1993	CN 1051150 C CN 1064349 A JP 04-268195 A JP 2834339 B2 KR 10-1992-0016809 A	05/04/2000 09/09/1992 24/09/1992 09/12/1998 25/09/1992
JP 07-017955 Y2	26/04/1995	JP 02-062279 U	09/05/1990
US 2016-0054065 A1	25/02/2016	CN 105190216 A CN 105190216 B EP 2985558 A1 EP 2985558 A4 EP 2985558 B1 JP 6186430 B2 US 9644896 B2 WO 2014-167845 A1	23/12/2015 16/06/2017 17/02/2016 18/05/2016 01/03/2017 23/08/2017 09/05/2017 16/10/2014
JP 2004-085013 A	18/03/2004	None	
JP 07-280479 A	27/10/1995	JP 3259510 B2	25/02/2002