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(54) **HEAT EXCHANGE TUBE AND HEAT EXCHANGER HAVING SAME**

(57) A heat exchange tube and a heat exchanger (200) having same. The heat exchange tube comprises a tube body (1), a tube body cavity (11), a first member (2) and a welding part (3). The tube body (1) comprises a first side wall (12) and a second side wall (13). A flat tube (100) further comprises a plurality of channels (16); the welding part (3) is positioned in at least one channel; on the cross section of the flat tube (100), the section of the welding part (3) is partially overlapped with the flow

section of the channel, and is connected to the first side wall (12), the maximum height of the section of the welding part (3) in the height direction of the flat tube (100) is D , $N \cdot (W_b + 0.2D) > 0.0017W_t^2 + 0.0175W_t + 0.3713$, or $N \cdot (W_b + 0.2D) < 0.0119W_t^2 + 0.086W_t + 2.9649$, wherein the number of channels of the flat tube (100) is N , the thickness of the first member (2) is W_b , and the width of the flat tube (100) is W_t .

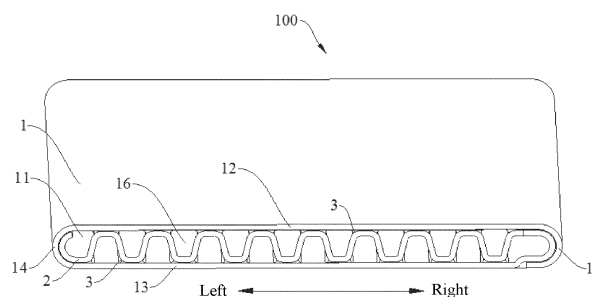


FIG. 1

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Description**CROSS-REFERENCE TO RELATED APPLICATION**

- 5 **[0001]** The present application is proposed based on and claims priority to Chinese Patent Application No. 202120340785.2, filed on February 5, 2021, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

- 10 **[0002]** The present disclosure relates to the field of heat exchange technologies, and in particular, to a heat exchange tube and a heat exchanger provided with the heat exchange tube.

BACKGROUND

- 15 **[0003]** In some applications in the field of refrigeration and air conditioning, a heat exchange tube is formed by folding one or more sheet materials. Generally, such a heat exchange tube formed by folding a sheet material is referred to as a folded flat tube. The folded flat tube is mainly applied to a heat exchanger. Some flat tubes mainly include tube bodies and inner fins. The inner fins divide the tube body into a plurality of channels. The inner fins and an inner wall of the tube body are welded to each other by using a welding material. When there is a relatively large amount of welding material
20 in the channels of the folded flat tube, the channels are likely to be clogged, thereby reducing heat exchange performance of the heat exchanger.

SUMMARY

- 25 **[0004]** Therefore, an aspect of the present disclosure proposes a heat exchange tube, where the heat exchange tube effectively reduces resistance on a refrigerant side, which helps improve heat exchange performance of a heat exchanger.

[0005] Another aspect of the present disclosure proposes a heat exchanger provided with the heat exchange tube.

- [0006]** According to the heat exchange tube in embodiments of the present disclosure, the heat exchange tube is a flat tube, the flat tube includes a tube body and a tube cavity, and the tube body includes a first side wall and a second side wall that are arranged in a height direction of the flat tube. The flat tube includes: a first member, where the flat tube further includes a plurality of channels, the plurality of channels are arranged at intervals in a width direction of the flat tube, length directions of the plurality of channels are parallel to a length direction of the flat tube, and a part of the first member is located between two adjacent channels; and a welding portion, where the welding portion is located in at least one of the channels. On a cross section of the flat tube, a cross section of the welding portion partially overlaps a flow cross section of the channel and is connected to the first side wall, a maximum height of the cross section of the welding portion in the height direction of the flat tube is D, and D meets the following condition: $N \cdot (W_b + 0.2D) > 0.0017W_t^2 + 0.0175W_t + 0.3713$; or $N \cdot (W_b + 0.2D) < 0.0119W_t^2 + 0.086W_t + 2.9649$; where a quantity of the channels of the flat tube is N, a thickness of the first member is W_b , and a width of the flat tube is W_t .
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- [0007]** According to the heat exchange tube in embodiments of the present disclosure, the first member is disposed in the tube cavity of the flat tube, the tube cavity may be divided by the first member into a plurality of channels arranged in the width direction of the flat tube, and the first member is connected to the first side wall of the flat tube and the second side wall of the flat tube by using the welding portion. In addition, the quantity of channels of the flat tube is defined as N, the thickness of the first member is defined as W_b , and the width of the flat tube is defined as W_t . A maximum distance between the cross section of the welding portion and the first side wall in the height direction of the flat tube is D, and the following formula is met: $N \cdot (W_b + 0.2D) > 0.0017W_t^2 + 0.0175W_t + 0.3713$; or $N \cdot (W_b + 0.2D) < 0.0119W_t^2 + 0.086W_t + 2.9649$. In this case, the heat exchange tube in the present disclosure effectively reduces resistance on the refrigerant side, which helps improve heat exchange performance of the heat exchanger.
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[0008] In some embodiments, a height of the flat tube is H, the quantity of the channels of the flat tube is N, the width of the flat tube is W_t , and the following conditions are met: $\{(N-2)/20\}^2 \cdot \{(W_t-16)/16\}^3 > 0.05$; and $H \cdot W_t < 80$.

- 50 **[0009]** In some embodiments, a height of the flat tube is H, the quantity of the channels of the flat tube is N, the width of the flat tube is W_t , and the following conditions are met: $\{(N-2)/20\}^2 \cdot \{(W_t-16)/16\}^3 > 0.3$; and $H \cdot W_t < 80$.

- [0010]** According to the heat exchange tube in embodiments of the present disclosure, the heat exchange tube is a flat tube, the flat tube includes a tube body and a tube cavity, and the tube body includes a first side wall and a second side wall that are arranged in a height direction of the flat tube. The flat tube includes: a first member, where the flat tube further includes a plurality of channels, the plurality of channels are arranged at intervals in a width direction of the flat tube, length directions of the plurality of channels are parallel to a length direction of the flat tube, and a part of the first member is located between two adjacent channels; and a welding portion, where the welding portion is located in at least one of the channels. On a cross section of the flat tube, a cross section of the welding portion partially overlaps a
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flow cross section of the channel and is connected to the first side wall. On the flow cross section of the channel, the cross section of the welding portion includes a contour line, the contour line includes a plurality of circular arcs, a radius of curvature of the circular arc is R, and at least one R meets the following condition: $N*(Wb+0.15R) > 0.0017Wt^2+0.0175Wt+0.3713$; or $N*(Wb+0.15R) < 0.0119Wt^2+0.086Wt+2.9649$; where a quantity of the channels of the flat tube is N, a thickness of the first member is Wb, and a width of the flat tube is Wt.

[0011] In some embodiments, a height H of the flat tube, the quantity N of the channels of the flat tube, and the width Wt of the flat tube meet the following conditions: $\{(N-2)/20\}^2*\{(Wt-16)/16\}^3 > 0.05$; and $H*Wt < 80$.

[0012] In some embodiments, a height H of the flat tube, the quantity N of the channels of the flat tube, and the width Wt of the flat tube meet the following conditions: $\{(N-2)/20\}^2*\{(Wt-16)/16\}^3 > 0.3$; and $H*Wt < 80$.

[0013] In some embodiments, the width Wt of the flat tube is less than 40 mm and greater than 16 mm, and the quantity N of the channels of the flat tube is greater than 14.

[0014] In some embodiments, the width Wt of the flat tube is less than 36 mm and is greater than 16 mm, and the quantity N of the channels of the flat tube is greater than 20.

[0015] In some embodiments, a ratio of the height H of the flat tube to the width Wt of the flat tube is less than 0.0512.

[0016] In some embodiments, D meets: $0.1 < (H-4*D)/H < 0.9$.

[0017] The heat exchanger according to embodiments of the present disclosure includes: a first pipe and a second pipe; and a heat exchange tube, where the heat exchange tube is the heat exchange tube in any embodiment of the present disclosure, and the heat exchange tube communicates the first pipe with the second pipe.

[0018] According to the heat exchanger in embodiments of the present disclosure, the heat exchange tube is the heat exchange tube in any one of the foregoing embodiments, and the heat exchange tube effectively reduces resistance on a refrigerant side, which helps improve heat exchange performance of the heat exchanger.

BRIEF DESCRIPTION OF DRAWINGS

[0019]

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

FIG. 2 is a front view of the heat exchange tube in FIG. 1;

FIG. 3 is an enlarged schematic view of part A in FIG. 2;

FIG. 4 is a perspective view of a heat exchange tube according to another embodiment of the present disclosure;

FIG. 5 is a front view of the heat exchange tube in FIG. 4;

FIG. 6 is an enlarged schematic view of part B in FIG. 5;

FIG. 7 is a perspective view of a heat exchange tube according to still another embodiment of the present disclosure;

FIG. 8 is a front view of the heat exchange tube in FIG. 7;

FIG. 9 is an enlarged schematic view of part C in FIG. 8;

FIG. 10 is a perspective view of a heat exchange tube according to yet another embodiment of the present disclosure;

FIG. 11 is a front view of the heat exchange tube in FIG. 10;

FIG. 12 is an enlarged schematic view of part D in FIG. 11;

FIG. 13 is a perspective view of a heat exchange tube according to still yet another embodiment of the present disclosure;

FIG. 14 is a front view of the heat exchange tube in FIG. 13;

FIG. 15 is an enlarged schematic view of part E in FIG. 14;

FIG. 16 is a perspective view of a heat exchange tube according to a further embodiment of the present disclosure;

FIG. 17 is a front view of the heat exchange tube in FIG. 16;

FIG. 18 is an enlarged schematic view of part F in FIG. 17;

FIG. 19 is a perspective view of a heat exchange tube according to a further embodiment of the present disclosure;

FIG. 20 is a front view of the heat exchange tube in FIG. 19;

FIG. 21 is an enlarged schematic view of part G in FIG. 20; and

FIG. 22 is a schematic diagram of a heat exchanger according to an embodiment of the present disclosure.

Reference numerals:

[0020]

flat tube 100;

tube body 1, tube cavity 11, first sub-cavity 111, second sub-cavity 112, first side wall 12, second side wall 13, third side wall 14, fourth side wall 15, channel 16, gap 17, first member 2, first sub-member 21, second sub-member 22, welding portion 3; and

heat exchanger 200, first pipe 201, second pipe 202.

DESCRIPTION OF EMBODIMENTS

[0021] The following describes in detail embodiments of the present disclosure, examples of which are shown in the accompanying drawings. The embodiments described below with reference to the accompanying drawings are examples, and are intended to explain the present disclosure, but shall not be understood as a limitation on the present disclosure.

[0022] As shown in FIG. 1 to FIG. 18, according to a heat exchange tube in an embodiment of the present disclosure, the heat exchange tube is a flat tube 100.

[0023] The flat tube 100 includes a tube body 1 and a tube cavity 11, and the tube body 1 includes a first side wall 12 and a second side wall 13 that are arranged opposite to each other in a height direction (as shown by the up-down direction in FIG. 1) of the flat tube 100. As shown in FIG. 1, the flat tube 100 includes the first side wall 12 and the second side wall 13 that are arranged opposite to each other in the up-down direction, and a third side wall 14 and a fourth side wall 15 that are arranged opposite to each other in the left-right direction. The first side wall 12, the second side wall 13, the third side wall 14, and the fourth side wall 15 form the tube cavity 11 of the flat tube 100.

[0024] The flat tube 100 further includes a first member 2, where the first member 2 is located in the tube cavity 11, the first member 2 divides the tube cavity 11 into a plurality of channels 16, the plurality of channels 16 are arranged at intervals in a width direction (as shown by the left-right direction in FIG. 1) of the flat tube 100, and length directions of the plurality of channels 16 are parallel to a length direction of the flat tube 100.

[0025] A welding portion 3 is located in at least one of the channels 16. As shown in FIG. 1, the first member 2 is corrugated in the left-right direction, at least a part of an upper side of the first member 2 is welded to the first side wall 12, at least a part of a lower side of the first member 2 is welded to the second side wall 13, and the welding portion 3 is located between the first member 2 and the first side wall 12 and second side wall 13.

[0026] On a cross section of the flat tube 100, a cross section of the welding portion 3 partially overlaps a flow cross section of the channel 16 and is connected to the first side wall 12. A maximum height of the cross section of the welding portion 3 in the height direction of the flat tube 100 is D , and D meets the following condition: $N \cdot (W_b + 0.2D) > 0.0017W_t^2 + 0.0175W_t + 0.3713$; or $N \cdot (W_b + 0.2D) < 0.0119W_t^2 + 0.086W_t + 2.9649$; where a quantity of the channels 16 of the flat tube 100 is N , a thickness of the first member 2 is W_b , and a width of the flat tube 100 is W_t .

[0027] Units of W_b , W_t , and D in the foregoing formula are mm. In this case, the heat exchange tube in the present disclosure effectively reduces resistance on a refrigerant side, which helps improve heat exchange performance of a heat exchanger. In addition, the flat tube 100 and the first member 2 are formed by processing a same sheet material.

[0028] Further, the heat exchange tube in the present disclosure can further improve corrosion resistance of the heat exchange tube.

[0029] It may be understood that at least a part of the first member 2 extends in an up-down direction of the tube cavity 11, and the thickness of the first member 2 means a part that is of the first member 2 and that extends in the tube cavity 11 in the up-down direction.

[0030] In some embodiments, a height of the flat tube 100 is H , the quantity of the channels 16 of the flat tube 100 is N , the width of the flat tube 100 is W_t , and the following conditions are met: $\{(N-2)/20\}^2 \cdot \{(W_t-16)/16\}^3 > 0.05$; and $H \cdot W_t < 80$. In this case, the heat exchange tube in the present disclosure effectively reduces resistance on the refrigerant side, which helps improve heat exchange performance of the heat exchanger.

[0031] In some embodiments, a height of the flat tube 100 is H , the quantity of the channels of the flat tube 100 is N , the width of the flat tube 100 is W_t , and the following conditions are met: $\{(N-2)/20\}^2 \cdot \{(W_t-16)/16\}^3 > 0.3$; and $H \cdot W_t < 80$. In this case, the heat exchange tube in the present disclosure effectively reduces resistance on the refrigerant side, which helps improve heat exchange performance of the heat exchanger. In addition, the flat tube 100 is formed by processing one sheet material, and the first member 2 is formed by processing another sheet material.

[0032] As shown in FIG. 1 to FIG. 18, according to a heat exchange tube in an embodiment of the present disclosure, the heat exchange tube is a flat tube 100.

[0033] The flat tube 100 includes a tube body 1 and a tube cavity 11, and the tube body 1 includes a first side wall 12 and a second side wall 13 that are arranged opposite to each other in a height direction (as shown by the up-down direction in FIG. 1) of the flat tube 100. As shown in FIG. 1, the flat tube 100 includes the first side wall 12 and the second side wall 13 that are arranged opposite to each other in the up-down direction, and a third side wall 14 and a fourth side wall 15 that are arranged opposite to each other in the left-right direction. The first side wall 12, the second side wall 13, the third side wall 14, and the fourth side wall 15 form the tube cavity 11 of the flat tube 100.

[0034] The flat tube 100 further includes a first member 2, where the first member 2 is located in the tube cavity 11, the first member 2 divides the tube cavity 11 into a plurality of channels 16, the plurality of channels 16 are arranged at intervals in a width direction (as shown by the left-right direction in FIG. 1) of the flat tube 100, and length directions of the plurality of channels 16 are parallel to a length direction of the flat tube 100.

[0035] A welding portion 3 is located in at least one of the channels 16. As shown in FIG. 1, the first member 2 is

corrugated in the left-right direction, at least a part of an upper side of the first member 2 is welded to the first side wall 12, at least a part of a lower side of the first member 2 is welded to the second side wall 13, and the welding portion 3 is located between the first member 2 and the first side wall 12 and second side wall 13.

[0036] On a cross section of the flat tube 100, a cross section of the welding portion 3 partially overlaps a flow cross section of the channel 16 and is connected to the first side wall 12. On the flow cross section of the channel 16, the cross section of the welding portion 3 includes a contour line, the contour line includes a plurality of circular arcs, a radius of curvature of the circular arc is R , and at least one R meets the following condition: $N*(Wb+0.15R) > 0.0017Wt^2+0.0175Wt+0.3713$; or $N*(Wb+0.15R) < 0.0119Wt^2+0.086Wt+2.9649$; where a quantity of the channels 16 of the flat tube 100 is N , a thickness of the first member 2 is Wb , and a width of the flat tube 100 is Wt . The heat exchange tube in the present disclosure effectively reduces resistance on a refrigerant side, which helps improve heat exchange performance of a heat exchanger. In addition, a radius of curvature of the circular arc is R , so that a stress structure of the welding portion 3 between the flat tube 100 and the first member 2 is more appropriate, and a welding effect is better. The flat tube 100 and the first member 2 are formed by processing a same sheet material.

[0037] In some embodiments, a height of the flat tube 100 is H , the quantity of the channels 16 of the flat tube 100 is N , the width of the flat tube 100 is Wt , and the following conditions are met: $\{(N-2)/20\}^2\{(Wt-16)/16\}^3 > 0.05$; and $H*Wt < 80$. In this way, the heat exchange tube can obtain high heat transfer performance while ensuring design strength.

[0038] In some embodiments, a height of the flat tube 100 is H , the quantity of the channels 16 of the flat tube 100 is N , the width of the flat tube 100 is Wt , and the following conditions are met: $\{(N-2)/20\}^2\{(Wt-16)/16\}^3 > 0.3$; and $H*Wt < 80$. In this case, the heat exchange tube in the present disclosure effectively reduces resistance on the refrigerant side, which helps improve heat exchange performance of the heat exchanger. In addition, the flat tube 100 is formed by processing one sheet material, and the first member 2 is formed by processing another sheet material.

[0039] In some embodiments, as shown in FIG. 1 to FIG. 18, the width Wt of the flat tube 100 is less than 40 mm and greater than 16 mm, and the quantity N of the channels 16 of the flat tube 100 is greater than 14. It may be understood that, a larger width Wt of the flat tube 100 indicates a larger quantity of channels 16 in the flat tube 100, and is more capable of effectively improving a heat exchange area of the flat tube 100 and improving a heat exchange capability of the heat exchange tube. However, if the width Wt of the flat tube 100 is too large, a volume of the flat tube 100 increases, which hinders installation of the flat tube 100. The flat tube 100 and the first member 2 are formed by processing a same sheet material.

[0040] In some embodiments, as shown in FIG. 1 to FIG. 18, the width Wt of the flat tube 100 is less than 36mm and greater than 16 mm, and the quantity N of the channels 16 of the flat tube 100 is greater than 20. It may be understood that, a larger width Wt of the flat tube 100 indicates a larger quantity of channels 16 in the flat tube 100, and is more capable of effectively improving a heat exchange area of the flat tube 100 and improving a heat exchange capability of the heat exchange tube. However, if the width Wt of the flat tube 100 is too large, a volume of the flat tube 100 increases, which hinders installation of the flat tube 100. In addition, the flat tube 100 is formed by processing one sheet material, and the first member 2 is formed by processing another sheet material.

[0041] In some embodiments, a ratio of the height H of the flat tube 100 to the width Wt of the flat tube 100 is less than 0.0512. In this case, the flat tube 100 can obtain high heat transfer performance while ensuring design strength.

[0042] In some embodiments, D meets: $0.1 < (H-4*D)/H < 0.9$. It may be understood that in the flat tube 100, the first member 2 and an inner wall of the flat tube 100 are welded by using the welding portion 3. A larger value of D indicates that a larger welding portion 3 is used between the first member 2 and the inner wall of the flat tube 100, and connection between the first member 2 and the inner wall of the flat tube 100 is more secure. However, a larger welding portion 3 indicates a smaller flow area of the channel 16, which affects heat exchange performance of the heat exchange tube. In the present disclosure, $0.1 < (H-4*D)/H < 0.9$, so that the heat exchange tube can obtain high heat transfer performance while ensuring design strength.

[0043] Specifically, FIG. 1 to FIG. 6 show two specific embodiments of the heat exchange tube.

[0044] As shown in FIG. 1 to FIG. 3, the right side of the sheet material is fixed, and the left side of the sheet material is first bent to form the structure of the flat tube 100. In this case, the right side of the sheet material is proximately in contact with the middle section of the sheet material, and the other part of the sheet material is continuously bent in the tube cavity 11 to be a corrugated structure, so as to form the first member 2. In this case, an upper side and a lower side of the other part of the sheet material are respectively connected to an upper side wall and a lower side wall of the flat tube 100. The first member 2 and the flat tube 100 are welded together by using the welding portion 3. In addition, a right side edge of the flat tube 100 and the middle section of the flat tube 100 are welded together by using a right-side portion of the flat tube 100.

[0045] As shown in FIG. 4 to FIG. 6, a middle portion of the sheet material is fixed, a left-side portion of the sheet material is bent toward the middle portion of the sheet material, and a right-side portion of the sheet material is bent toward the middle portion of the sheet material, to form the flat tube 100. In this case, a tube cavity 11 includes a first sub-cavity 111 and a second sub-cavity 112, and the first sub-cavity 111 and the second sub-cavity 112 are not communicated. The left-side portion of the sheet material is further bent in the first sub-cavity 111 toward the left end of the

first sub-cavity 111, to form a first sub-member 21. The right-side portion of the sheet material is further bent in the second sub-cavity 112 toward the right end of the second sub-cavity 112, to form a second sub-member 22.

[0046] FIG. 7 to FIG. 12 show another two specific embodiments of the heat exchange tube.

[0047] As shown in FIG. 7 to FIG. 9, a sheet material is bent to form the flat tube 100. Specifically, the right side of the sheet material is fixed, and the left side of the sheet material is bent by one fold to connect to the right side of the plate, so as to form the flat tube 100.

[0048] Another sheet material is first bent to form the first member 2, and then the first member 2 is welded in the tube cavity 11, so as to form the heat exchange tube.

[0049] As shown in FIG. 10 to FIG. 12, a sheet material is bent to form a flat tube 100. Specifically, the middle section of the sheet material is fixed, both a left-side portion and a right-side portion of the sheet material are bent toward the middle section of the sheet material, and the left-side portion and the right-side portion of the sheet material approximately meet at a centerline of the sheet material, so as to form the flat tube 100. There is a gap 17 between the left side and right side of the sheet material and a middle portion of the sheet material.

[0050] Another sheet material is first bent to form the first member 2, and then the first member 2 is welded in the tube cavity 11, so as to form the heat exchange tube. The middle section of the another sheet material may be welded in the gap 17.

[0051] FIG. 13 to FIG. 18 show still another two specific embodiments of the heat exchange tube.

[0052] As shown in FIG. 13 to FIG. 15, a first sheet material is bent to form the flat tube 100. Specifically, the middle section of the first sheet material is fixed, both a left-side portion and a right-side portion of the first sheet material are bent toward the middle section of the first plate, and the left-side portion and the right-side portion of the first sheet material approximately meet at a centerline of the first sheet material, so as to form the flat tube 100. The left side and the right side of the first sheet material are connected to the middle section of the first sheet material. Therefore, the first sheet material divides the tube cavity 11 into a first sub-cavity 111 and a second sub-cavity 112.

[0053] A second plate and a third plate are respectively bent to form a first sub-member 21 and a second sub-member 22, where the first sub-member 21 is welded in the first sub-cavity 111, and the second sub-member 22 is welded in the second sub-cavity 112.

[0054] As shown in FIG. 16 to FIG. 18, a first sheet material is connected to a second sheet material to form the flat tube 100. Specifically, a structure of the first sheet material is the same as that of the second sheet material. The left end of the first sheet material is connected to the left end of the second sheet material, and the right end of the first sheet material is connected to the right end of the second sheet material, so as to form the flat tube 100.

[0055] A third sheet material is first bent to form the first member 2, and then the first member 2 is welded in the tube cavity 11, so as to form the heat exchange tube.

[0056] As shown in FIG. 19 to FIG. 21, the first sheet material is bent to form the flat tube 100. In this case, the tube cavity 11 includes a first sub-cavity 111 and a second sub-cavity 112, and the first sub-cavity 111 and the second sub-cavity 112 are not communicated.

[0057] There are two first members 2, and the two first members 2 are respectively disposed in the first sub-cavity 111 and the second sub-cavity 112. During bending, the first member 2 is bent at a right angle.

[0058] As shown in FIG. 22, a heat exchanger 200 according to an embodiment of the present disclosure includes a first pipe 201 and a second pipe 202.

[0059] Specifically, as shown in FIG. 22, a structure of the first pipe 201 and the second pipe 202 is proximately the same, both the first pipe 201 and the second pipe 202 extend in a front-rear direction, and the first pipe 201 and the second pipe 202 are parallel to each other.

[0060] A plurality of heat exchange tubes each are the heat exchange tube according to any embodiment of the present disclosure, and the heat exchange tube communicates the first pipe 201 with the second pipe 202. One end of the plurality of heat exchange tubes (for example, the left end of the heat exchange tube shown in the FIG. 22) is connected to the first pipe 201, and the other end of the plurality of heat exchange tubes (for example, the right end of the heat exchange tube shown in the FIG. 22) is connected to the second pipe 202. The heat exchange tube is the flat tube 100.

[0061] In the descriptions of the present disclosure, it should be understood that directions or position relationships indicated by the terms such as "center", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "counterclockwise", "axial", "radial", "circumferential", and the like are based on the accompanying drawings, are merely used for the convenience of describing the present disclosure and simplifying the description, but are not intended to indicate or imply that an apparatus or element referred to must have a particular orientation or must be constructed and operated in a particular orientation, and therefore shall not be understood as a limitation on the present disclosure.

[0062] Besides, the terms "first" and "second" are used for descriptive purposes only, and shall not be understood as indicating or implying relative importance or implicitly indicating the quantity of indicated technical features. Therefore, a feature limited by "first" or "second" may expressly or implicitly include at least one of such features. In the description of the present disclosure, "a plurality of" means at least two, such as two or three, unless otherwise specifically defined.

[0063] In the present disclosure, unless otherwise expressly specified and defined, terms such as "install", "connect", "connected to", and "fasten" should be understood in a broad sense. For example, unless otherwise expressly defined, a "connection" may be a fixed connection, may be a detachable connection, or may be an integrated connection; or may be a mechanical connection, or an electrical connection, or a mutually communicative connection; or may be a direct connection, or an indirect connection through an intermediate medium; or may be an inner connection between two elements, or interaction between two elements. A person of ordinary skill in the art may understand specific meanings of the foregoing terms in the present disclosure with reference to specific circumstances.

[0064] In the present disclosure, unless otherwise expressly specified and defined, that a first feature is "above" or "below" a second feature means that the first feature and the second feature are in direct contact, or are in indirect contact through an intermediate medium. Moreover, that the first feature is "over", "above", or "on" the second feature may mean that the first feature is over or obliquely above the second feature, or merely mean that the first feature is higher than the second feature in terms of heights. That the first feature is "under", "below", or "beneath" the second feature may mean that the first feature is under or obliquely below the second feature, or merely mean that the first feature is lower than the second feature in terms of heights.

[0065] In the present disclosure, the term such as "an embodiment", "some embodiments", "example", "specific example", or "some examples" mean that specific features, structures, materials, or characteristics described with reference to the embodiment or example are included in at least one embodiment or example of the present disclosure. In this specification, illustrative descriptions of the foregoing terms do not necessarily refer to a same embodiment or example. Moreover, the described specific features, structures, materials, or characteristics can be combined in any one or more embodiments or examples in an appropriate manner. In addition, a person skilled in the art may combine different embodiments or examples described in the specification and features of the different embodiments or examples without contradicting each other.

[0066] Although the embodiments of the present disclosure are shown and described above, it can be understood that the foregoing embodiments are examples and shall not be construed as a limitation on the present disclosure. A person of ordinary skill in the art may make changes, modifications, substitutions, and variants based on the foregoing embodiments within the scope of the present disclosure.

Claims

1. A heat exchange tube, wherein the heat exchange tube is a flat tube;

the flat tube comprises a tube body and a tube cavity, and the tube body comprises a first side wall and a second side wall that are arranged in a height direction of the flat tube;

the flat tube comprises: a first member, wherein the flat tube further comprises a plurality of channels, the plurality of channels are arranged at intervals in a width direction of the flat tube, length directions of the plurality of channels are parallel to a length direction of the flat tube, and a part of the first member is located between two adjacent channels; and

a welding portion, wherein the welding portion is located in at least one of the channels; and

on a cross section of the flat tube, a cross section of the welding portion partially overlaps a flow cross section of the channel and is connected to the first side wall, a maximum height of the cross section of the welding portion in the height direction of the flat tube is D, and D meets the following condition:

$$N*(W_b+0.2D) > 0.0017W_t^2+0.0175W_t+0.3713;$$

or

$$N*(W_b+0.2D) < 0.0119W_t^2+0.086W_t+2.9649;$$

wherein a quantity of the channels of the flat tube is N, a thickness of the first member is W_b , and a width of the flat tube is W_t .

2. The heat exchange tube according to claim 1, wherein a height of the flat tube is H, the height H of the flat tube, the quantity N of the channels of the flat tube, and the width W_t of the flat tube meet the following conditions:

$$\{(N-2)/20\}^2 * \{(W_t-16)/16\}^3 > 0.05;$$

and

$$H * W_t < 80.$$

3. The heat exchange tube according to claim 1, wherein a height of the flat tube is H, the height H of the flat tube, the quantity N of the channels of the flat tube, and the width W_t of the flat tube meet the following conditions:

$$\{(N-2)/20\}^2 * \{(W_t-16)/16\}^3 > 0.3;$$

and

$$H * W_t < 80.$$

4. The heat exchange tube according to claim 1, wherein D meets: $0.1 < (H-4*D)/H < 0.9$.

5. A heat exchange tube, wherein the heat exchange tube is a flat tube;

the flat tube comprises a tube body and a tube cavity, and the tube body comprises a first side wall and a second side wall that are arranged in a height direction of the flat tube;

the flat tube comprises: a first member, wherein the flat tube further comprises a plurality of channels, the plurality of channels are arranged at intervals in a width direction of the flat tube, length directions of the plurality of channels are parallel to a length direction of the flat tube, and a part of the first member is located between two adjacent channels; and

a welding portion, wherein the welding portion is located in at least one of the channels; and on a cross section of the flat tube, a cross section of the welding portion partially overlaps a flow cross section of the channel and is connected to the first side wall; and on the flow cross section of the channel, the cross section of the welding portion comprises a contour line, the contour line comprises a plurality of circular arcs, a radius of curvature of the circular arc is R, and at least one R meets the following condition:

$$N * (W_b + 0.15R) > 0.0017W_t^2 + 0.0175W_t + 0.3713;$$

or

$$N * (W_b + 0.15R) < 0.0119W_t^2 + 0.086W_t + 2.9649;$$

wherein a quantity of the channels is N, a thickness of the first member is W_b , and a width of the flat tube is W_t .

6. The heat exchange tube according to claim 5, wherein a height of the flat tube is H, the width H of the flat tube, the quantity N of the channels of the flat tube, and the width W_t of the flat tube meet the following conditions:

$$\{(N-2)/20\}^2 * \{(W_t-16)/16\}^3 > 0.05;$$

and

$$H * W_t < 80.$$

7. The heat exchange tube according to claim 5, wherein a height of the flat tube is H, the width H of the flat tube, the quantity N of the channels of the flat tube, and the width W_t of the flat tube meet the following conditions:

$$\{(N-2)/20\}^2 \cdot \{(W_t-16)/16\}^3 > 0.3;$$

and

$$H \cdot W_t < 80.$$

8. The heat exchange tube according to any one of claims 1 to 7, wherein the width W_t of the flat tube is less than 40 mm and greater than 16 mm, and the quantity N of the channels of the flat tube is greater than 14.

9. The heat exchange tube according to any one of claims 1 to 7, wherein the width W_t of the flat tube is less than 36 mm and greater than 16 mm, and the quantity N of the channels of the flat tube is greater than 20.

10. The heat exchange tube according to any one of claims 2, 3, 6 or 7, wherein a ratio of the height H of the flat tube to the width W_t of the flat tube is less than 0.0512.

11. A heat exchanger, comprising:

a first pipe and a second pipe; and

a heat exchange tube, wherein the heat exchange tube is a heat exchange tube according to any one of claims 1 to 10, and the heat exchange tube communicates the first pipe with the second pipe.

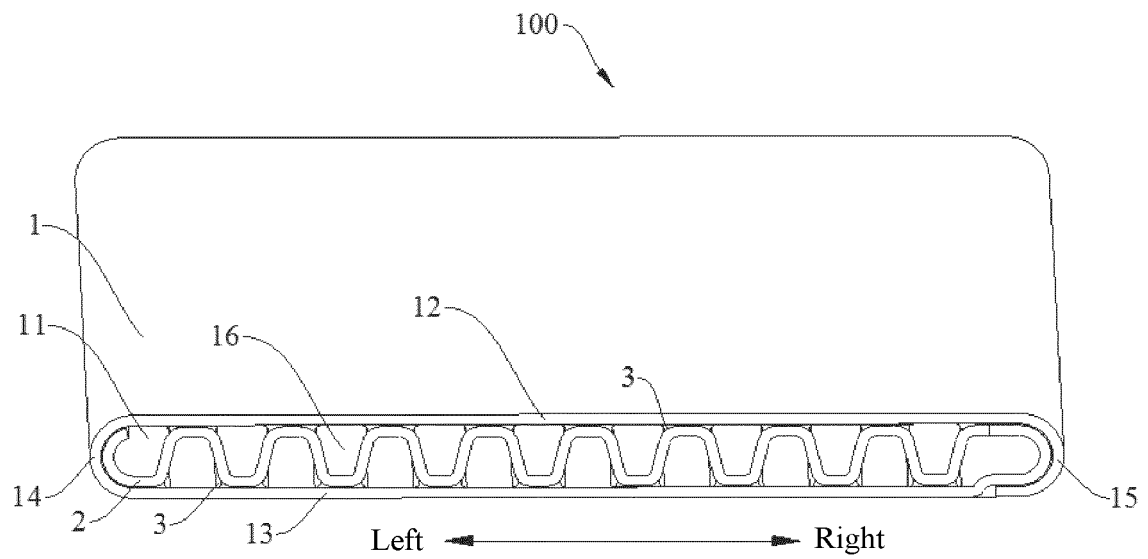


FIG. 1

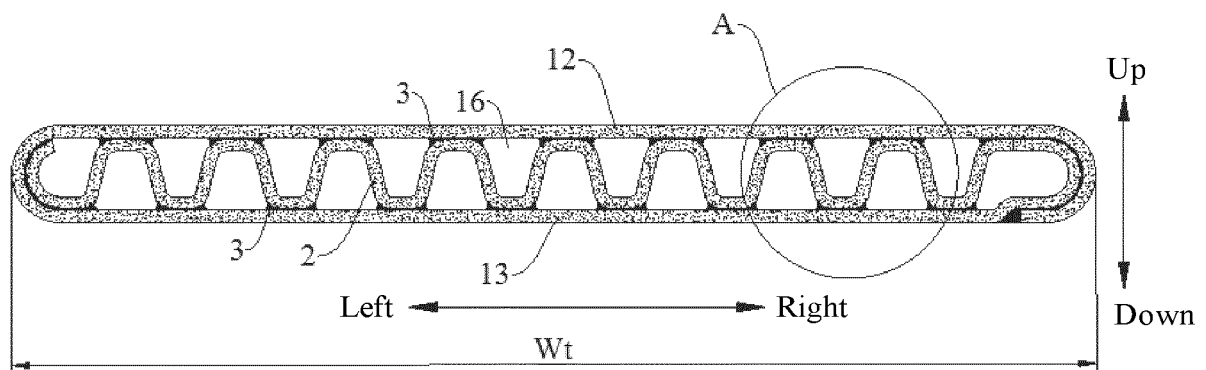


FIG. 2

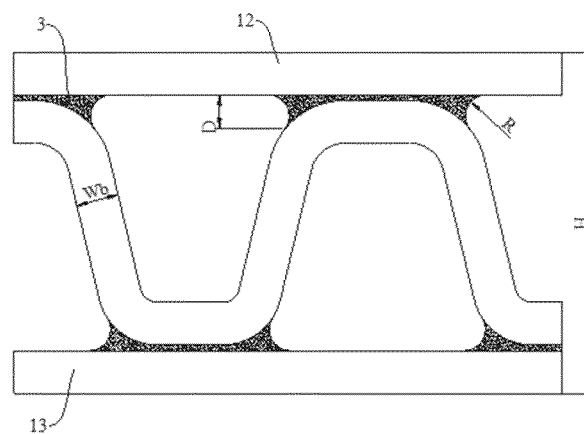


FIG. 3

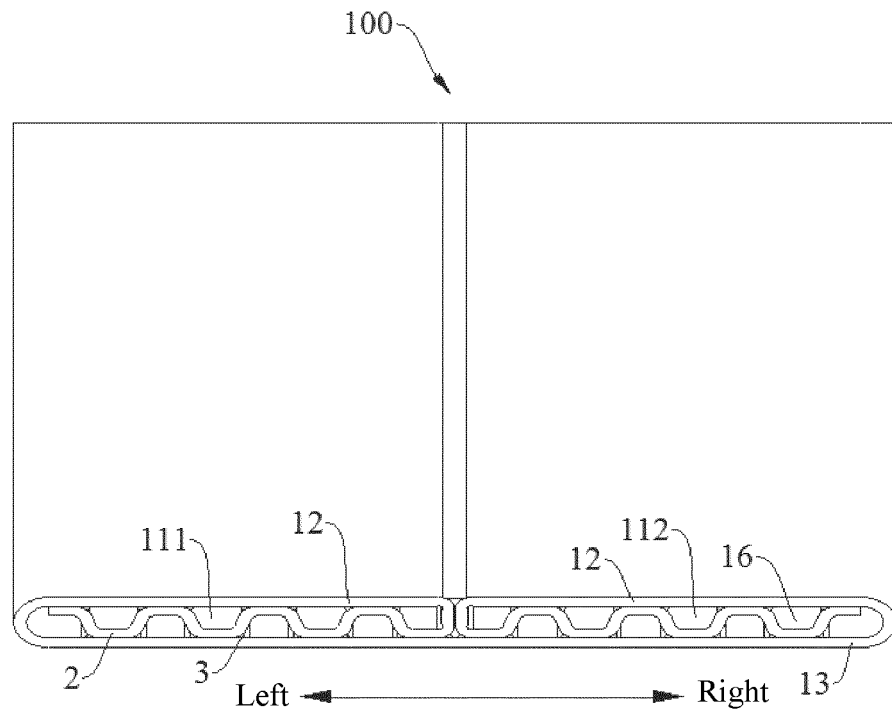


FIG. 4

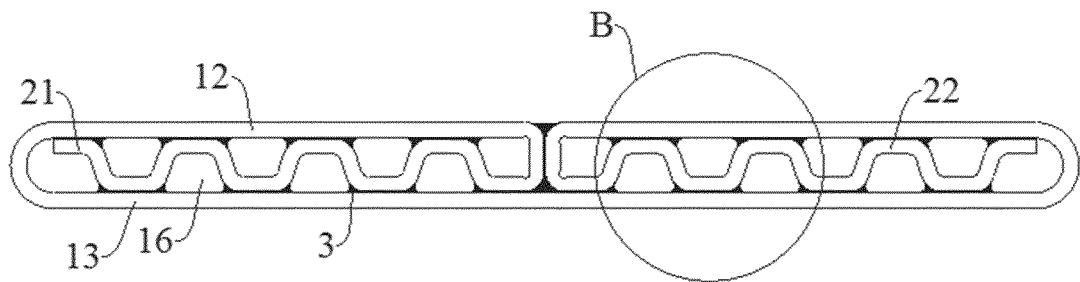


FIG. 5

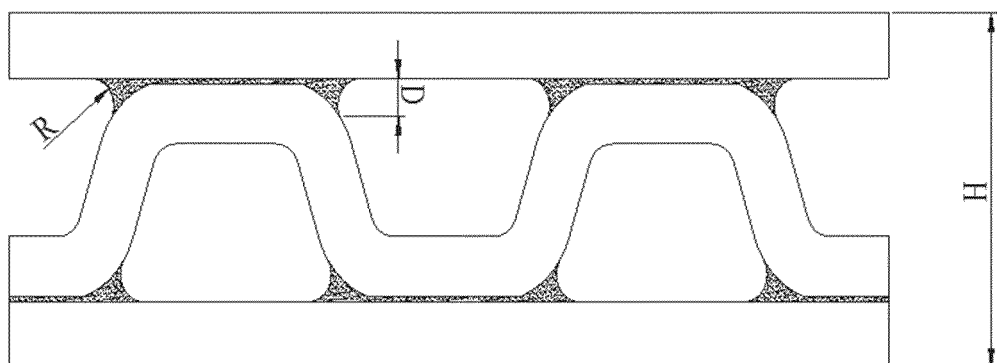


FIG. 6

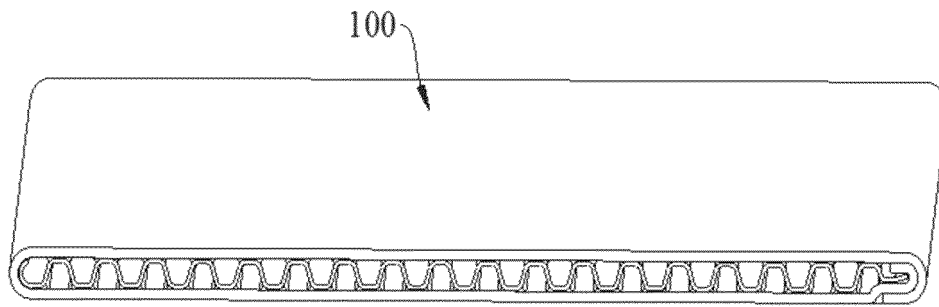


FIG. 7

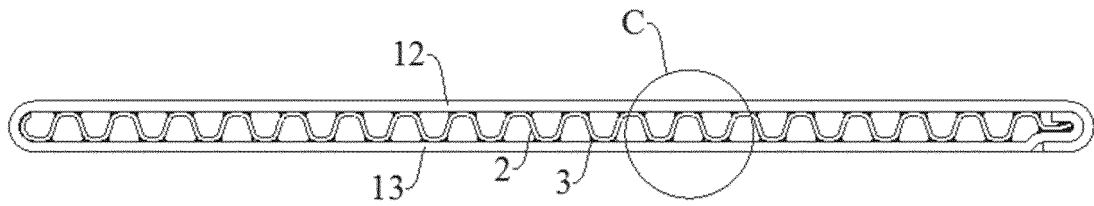


FIG. 8

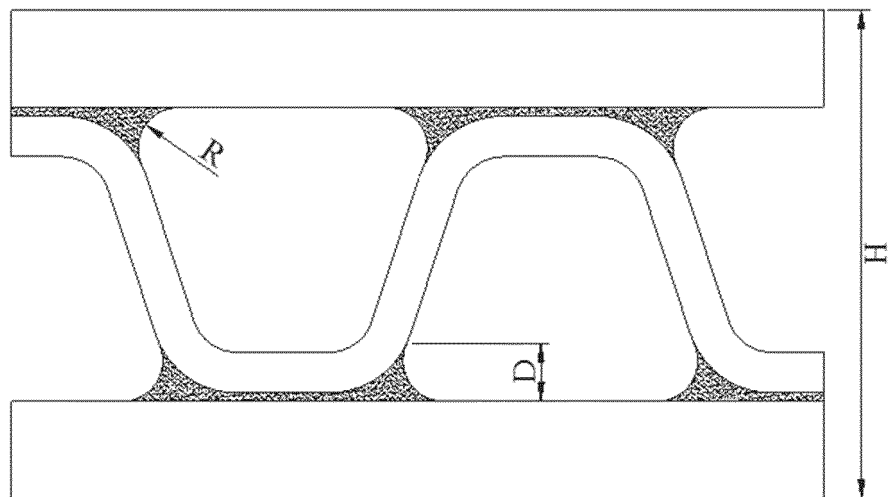


FIG. 9

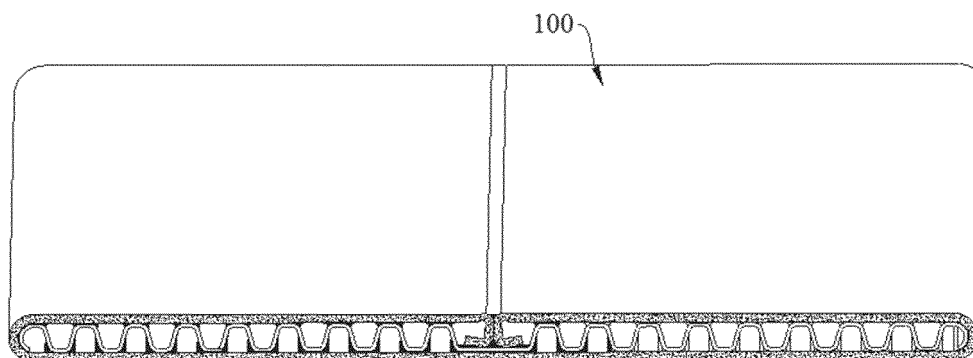


FIG. 10

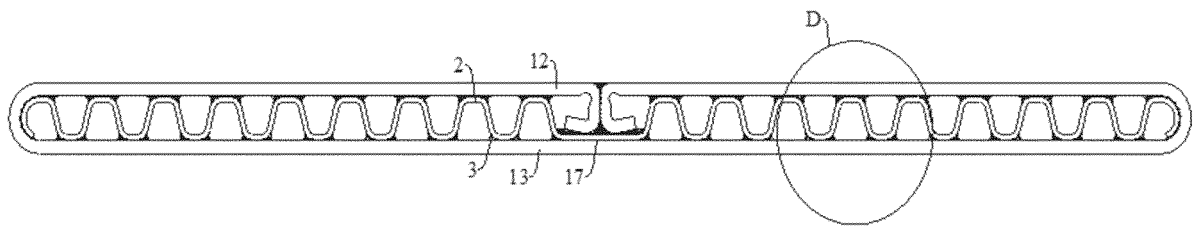


FIG. 11

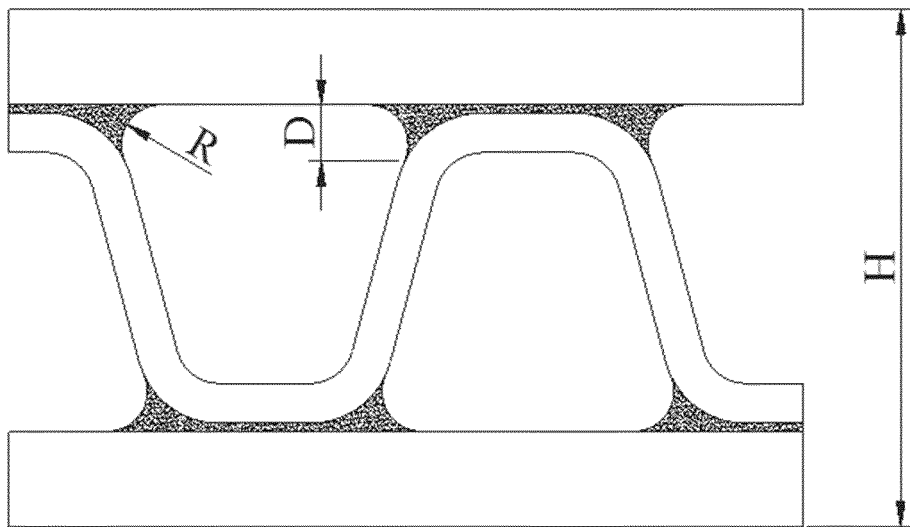


FIG. 12

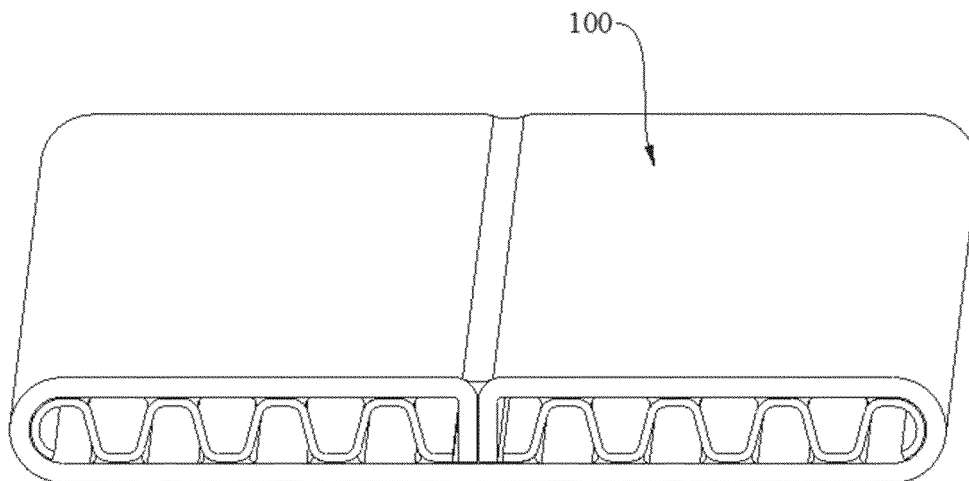


FIG. 13

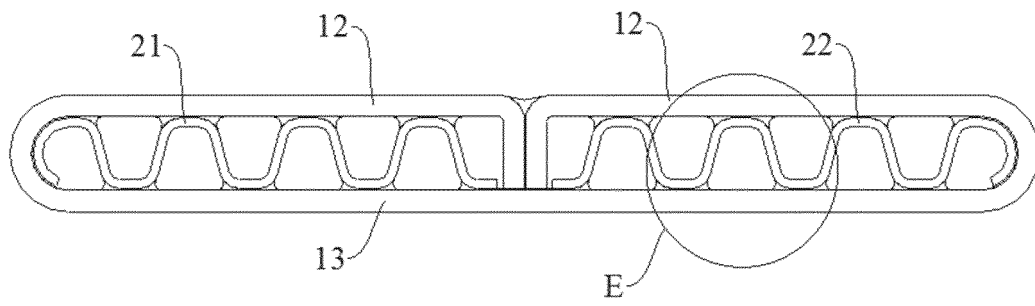


FIG. 14

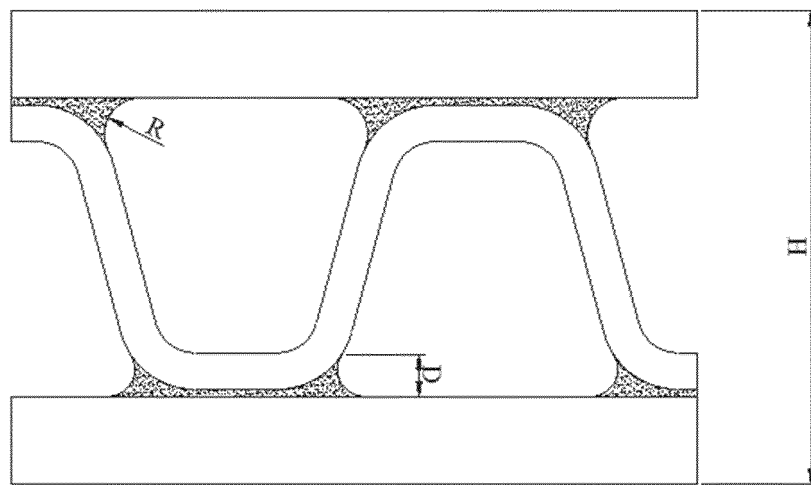


FIG. 15

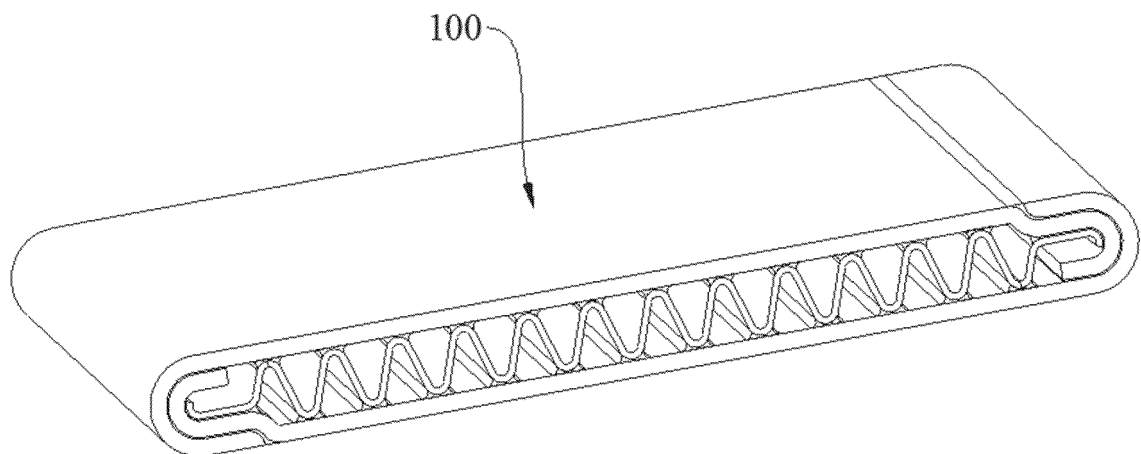


FIG. 16

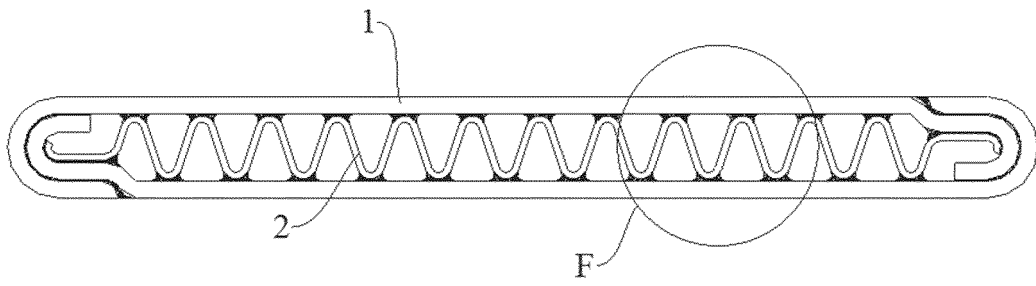


FIG. 17

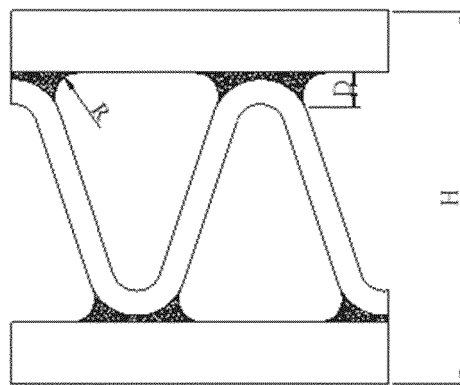


FIG. 18

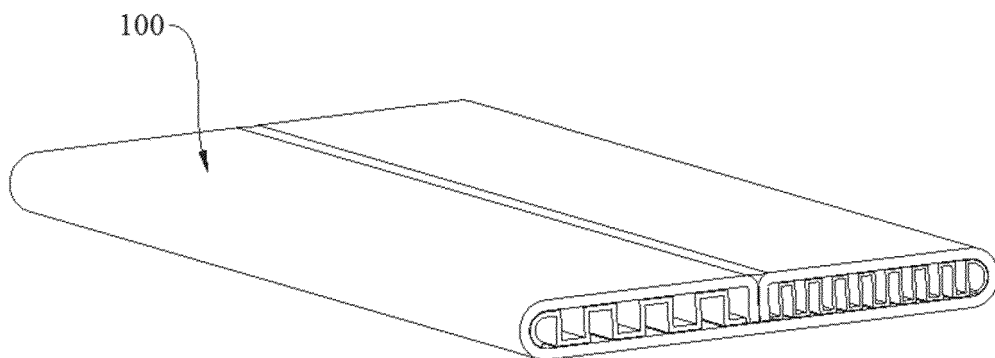


FIG. 19

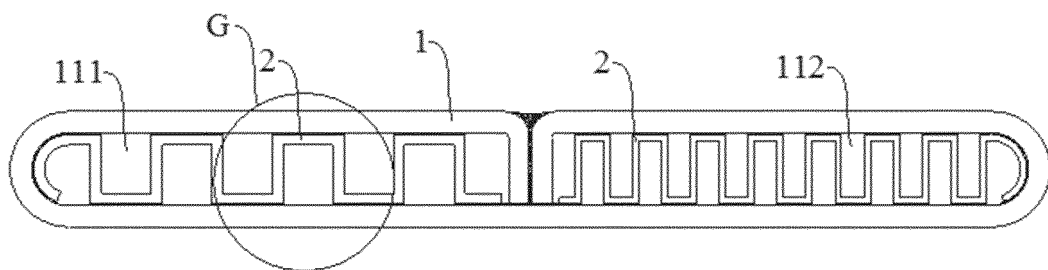


FIG. 20

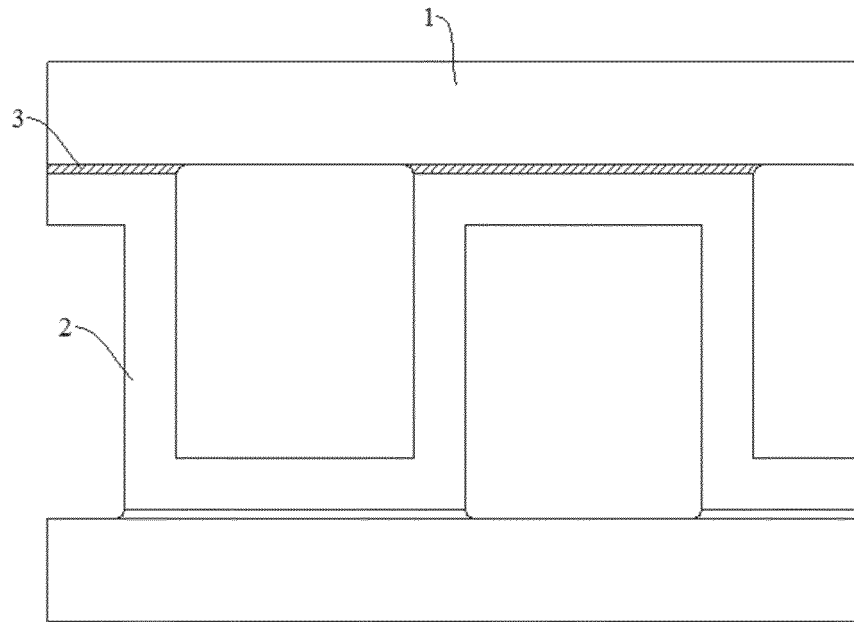


FIG. 21

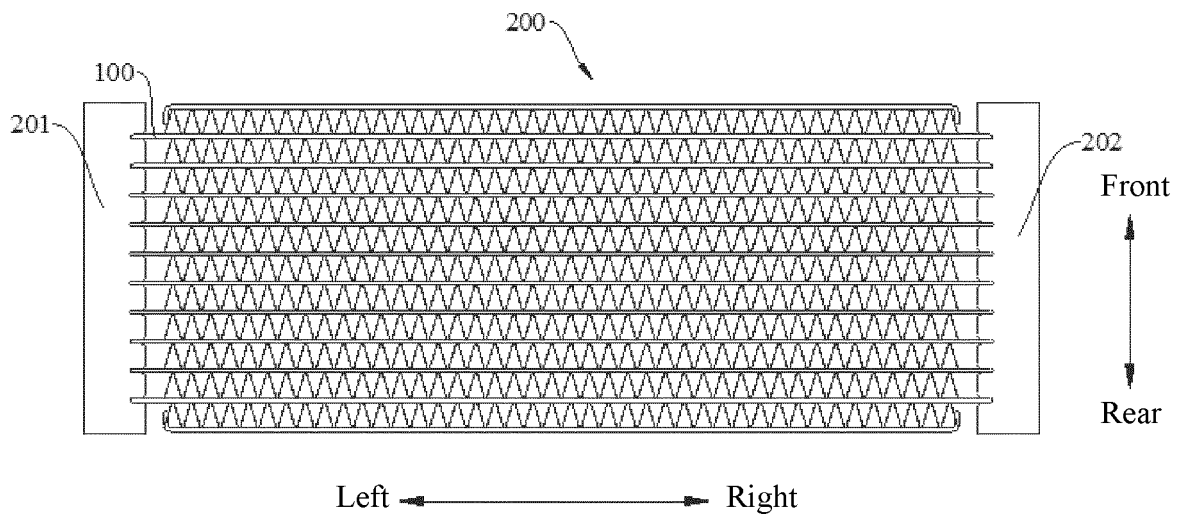


FIG. 22

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/074983

A. CLASSIFICATION OF SUBJECT MATTER

F28F 1/40(2006.01)i; F28F 9/26(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, F28D, F25B

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

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

VEN; CNTXT; CNABS; CNKI: 三花, 宽度, 焊接, 换热管, 厚度, 扁管, 高度, 热交换管, heat exchanger, thick, width, weld, flat tube, height, jointing

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 214582724 U (SANHUA (HANGZHOU) MICRO CHANNEL HEAT EXCHANGER CO., LTD.) 02 November 2021 (2021-11-02) claims 1-11	1-11
A	CN 203190861 U (SAPA HEAT TRANSFER (SHANGHAI) CO., LTD.) 11 September 2013 (2013-09-11) description, paragraphs [0023]-[0031], and figures 1-3	1-11
A	CN 106949769 A (SHANGHAI JIAO TONG UNIVERSITY) 14 July 2017 (2017-07-14) entire document	1-11
A	CN 106949768 A (SHANGHAI JIAO TONG UNIVERSITY) 14 July 2017 (2017-07-14) entire document	1-11
A	CN 107907000 A (SONGZ AUTOMOBILE AIR CONDITIONING CO., LTD.) 13 April 2018 (2018-04-13) entire document	1-11
A	US 2011005738 A1 (MODINE MFG CO.) 13 January 2011 (2011-01-13) entire document	1-11

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

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“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

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“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

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“&” document member of the same patent family

Date of the actual completion of the international search

06 April 2022

Date of mailing of the international search report

20 April 2022

Name and mailing address of the ISA/CN

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Facsimile No. (86-10)62019451

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/074983

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2013250018 A (KEIHIN THERMAL TECHNOLOGY CORP.) 12 December 2013 (2013-12-12) entire document	1-11
A	CN 106403681 A (SHANGHAI JIAO TONG UNIVERSITY) 15 February 2017 (2017-02-15) entire document	1-11

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2022/074983

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	214582724	U	02 November 2021	None			
CN	203190861	U	11 September 2013	None			
CN	106949769	A	14 July 2017	None			
CN	106949768	A	14 July 2017	None			
CN	107907000	A	13 April 2018	None			
US	2011005738	A1	13 January 2011	BR	PI0719079	A2	04 March 2014
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				CN	101548149	A	30 September 2009
				WO	2008064079	A1	29 May 2008
JP	2013250018	A	12 December 2013	None			
CN	106403681	A	15 February 2017	None			

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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