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(54) **HEAT EXCHANGE PLATE FOR PLATE HEAT EXCHANGER, AND PLATE HEAT EXCHANGER**

(57) Disclosed in embodiments of the present invention are a heat exchange plate for a plate heat exchanger, and a plate heat exchanger having the heat exchange plate. The heat exchange plate comprises: a heat exchange plate body; and a ring-shaped flange projecting obliquely from an edge of the heat exchange plate body. The flange has a protrusion having a reinforcing action. The heat exchange plate and plate heat exchanger according to embodiments of the present invention can, for example, improve the quality of the heat exchange plate of the heat exchanger.

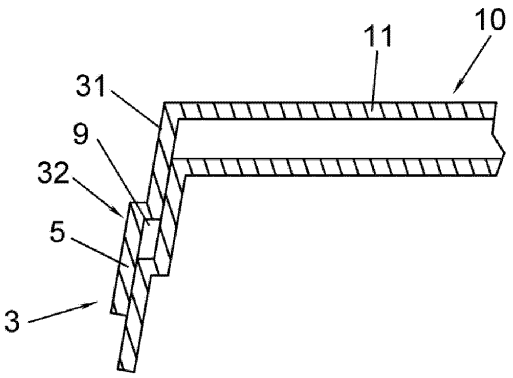

Fig. 2

EP 4 056 941 A1

Description

Technical Field

[0001] The embodiments of the present invention relate to a heat exchange plate for a plate heat exchanger, and a plate heat exchanger.

Background

[0002] A plate heat exchanger comprises cover plates, heat exchange plates and connecting tubes, etc.

Summary of the Invention

[0003] An object of the embodiments of the present invention is to provide a heat exchange plate for a plate heat exchanger, and a plate heat exchanger having the heat exchange plate, whereby, for example, the quality of the heat exchange plate of the heat exchanger can be improved.

[0004] According to an embodiment of the present invention, a heat exchange plate for a plate heat exchanger is provided, comprising: a heat exchange plate body; and a ring-shaped flange projecting obliquely from an edge of the heat exchange plate body, wherein the flange has a protrusion having a reinforcing action.

[0005] According to an embodiment of the present invention, the flange has an inner side facing the center of the heat exchange plate and an outer side remote from the center of the heat exchange plate, and the protrusion protrudes toward the inner side or outer side of the ring-shaped flange.

[0006] According to an embodiment of the present invention, the flange comprises: a first ring-like belt adjoining the heat exchange plate body; and a second ring-like belt which adjoins the first ring-like belt at a side of the first ring-like belt that is remote from the heat exchange plate body, at least a part of the second ring-like belt protruding relative to the first ring-like belt to form the protrusion.

[0007] According to an embodiment of the present invention, the entire second ring-like belt forms a ring-shaped protrusion; or the protrusion is multiple protrusions arranged at intervals along the second ring-like belt.

[0008] According to an embodiment of the present invention, the flange comprises: a first ring-like belt adjoining the heat exchange plate body; a second ring-like belt which adjoins the first ring-like belt at a side of the first ring-like belt that is remote from the heat exchange plate body; and a third ring-like belt which adjoins the second ring-like belt at a side of the second ring-like belt that is remote from the first ring-like belt, at least a part of at least one of the second ring-like belt and the third ring-like belt protruding relative to the first ring-like belt to form the protrusion.

[0009] According to an embodiment of the present invention, the second ring-like belt protrudes relative to the first ring-like belt to form a ring-shaped protrusion, and the third ring-like belt is flush with the first ring-like belt.

[0010] According to an embodiment of the present invention, the flange has an inner side facing the center of the heat exchange plate and an outer side remote from the center of the heat exchange plate, the second ring-like belt protrudes toward the outer side of the ring-shaped flange relative to the first ring-like belt, the third ring-like belt protrudes toward the outer side of the ring-shaped flange relative to the first ring-like belt, to form a ring-shaped protrusion, and

the amount by which the second ring-like belt protrudes relative to the first ring-like belt is less than the amount by which the third ring-like belt protrudes relative to the first ring-like belt.

[0011] According to an embodiment of the present invention, the flange comprises a ring-like flange body, the flange body having a belt shape; the protrusion protrudes from the flange body, and the protrusion is a ring-shaped protrusion extending along the entire ring-like flange body.

[0012] According to an embodiment of the present invention, the protrusion is substantially parallel to the flange body.

[0013] According to an embodiment of the present invention, the flange comprises a ring-like flange body, the flange body having a belt shape; the protrusion protrudes from the flange body, and the protrusion is multiple protrusions arranged at intervals along the ring-like flange body.

[0014] According to an embodiment of the present invention, at least one of the multiple protrusions has a linear shape or a strip-like shape.

[0015] According to an embodiment of the present invention, the at least one of the multiple protrusions crosses the ring-like flange body.

[0016] According to an embodiment of the present invention, the at least one of the multiple protrusions is substantially perpendicular to the ring-like flange body.

[0017] According to an embodiment of the present invention, the at least one of the multiple protrusions extends over the entire width of the belt-shaped flange body.

[0018] According to an embodiment of the present invention, the multiple protrusions have a linear shape or a strip-like shape, a first protrusion of the multiple protrusions is substantially parallel to a part of the ring-like flange body on which the first protrusion is arranged, and a second protrusion of the multiple protrusions is substantially perpendicular to a part of the ring-like flange body on which the second protrusion is arranged.

[0019] According to an embodiment of the present invention, when viewed in a direction perpendicular to the heat exchange plate body, the first protrusion and the second protrusion extend in substantially the same direction.

[0020] According to an embodiment of the present in-

vention, the height of the protrusion is in the range of 0.05 mm - 0.5 mm.

[0021] According to an embodiment of the present invention, the height of the protrusion is in the range of 0.05 mm - 0.2 mm.

[0022] According to an embodiment of the present invention, a plate heat exchanger is further provided, comprising: multiple heat exchange plates, at least one of the multiple heat exchange plates being the heat exchange plate described above.

[0023] According to an embodiment of the present invention, the multiple heat exchange plates comprise a first heat exchange plate and a second heat exchange plate which are adjacent to each other; a protrusion of a flange of the first heat exchange plate protrudes toward a side remote from a flange of the second heat exchange plate, and a gap is formed between the protrusion of the flange of the first heat exchange plate and the flange of the second heat exchange plate, the gap being filled with solder for soldering the plate heat exchanger, in order to solder together the protrusion of the flange of the first heat exchange plate and the flange of the second heat exchange plate.

[0024] The heat exchange plate and plate heat exchanger according to embodiments of the present invention can, for example, improve the quality of the heat exchange plate of the heat exchanger.

Brief Description of the Drawings

[0025]

Fig. 1 is a schematic three-dimensional drawing of a heat exchange plate of a plate heat exchanger according to an embodiment of the present invention.

Fig. 2 is a schematic partial enlarged sectional drawing showing the cross-sectional structure of a protrusion of a heat exchange plate of a plate heat exchanger according to an embodiment of the present invention.

Fig. 3 is a schematic partial enlarged sectional drawing showing the cross-sectional structure of a protrusion of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 4 is a schematic partial enlarged sectional drawing showing the cross-sectional structure of a protrusion of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 5 is a schematic partial enlarged sectional drawing showing the cross-sectional structure of a protrusion of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 6A is a schematic bottom view showing an arrangement of a protrusion of a heat exchange plate of a plate heat exchanger according to an embodiment of the present invention.

Fig. 6B is a schematic main view showing an arrangement of a protrusion of a heat exchange plate of a plate heat exchanger according to an embodiment of the present invention.

Fig. 6C is a schematic left view showing an arrangement of a protrusion of a heat exchange plate of a plate heat exchanger according to an embodiment of the present invention.

Fig. 7A is a schematic bottom view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 7B is a schematic main view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 7C is a schematic left view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 8A is a schematic bottom view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 8B is a schematic main view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 8C is a schematic left view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 9A is a schematic bottom view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 9B is a schematic main view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Fig. 9C is a schematic left view showing an arrangement of protrusions of a heat exchange plate of a plate heat exchanger according to another embodiment of the present invention.

Detailed Description of the Invention

[0026] The present invention is explained further below in conjunction with the drawings and particular embodiments.

[0027] Referring to Figs. 1 - 9C, a plate heat exchanger according to an embodiment of the present invention comprises: multiple heat exchange plates 10; and a heat exchange space formed between adjacent heat exchange plates 10 of the multiple heat exchange plates 10. The plate heat exchanger further comprises a cover plate, etc.

[0028] Referring to Figs. 1 - 9C, a heat exchange plate 10 for a plate heat exchanger according to an embodiment of the present invention comprises: a heat exchange plate body 11; and a ring-shaped flange 3 projecting obliquely from an edge of the heat exchange plate body 11, the flange 3 having a protrusion 5 which has a reinforcing action. The flange 3 of this heat exchange plate 10 is in a lap joint with a flange 3 of an adjacent heat exchange plate 10. Through the reinforcing action of the protrusion 5, the strength and rigidity of the flange 3 can be increased.

[0029] The terms "ring-shaped" and "ring-like" mentioned herein refer to a shape in which a head end and a tail end are connected to form a closed contour, and do not refer exclusively to a circular shape. For example, when viewed in a direction perpendicular to the heat exchange plate, the overall shape of the flange 3 depends on the shape of the heat exchange plate 10, and for example is a rectangular ring. The same principle applies to the term "ring-like belt" below.

[0030] Referring to Figs. 1 - 9C, in some embodiments of the present invention, the flange 3 has an inner side facing the center of the heat exchange plate 10 and an outer side remote from the center of the heat exchange plate 10, and the protrusion 5 protrudes toward the inner side or outer side of the ring-shaped flange 3.

[0031] Referring to Figs. 1 - 9C, in some embodiments of the present invention, the flange 3 comprises: a first ring-like belt 31 adjoining the heat exchange plate body 11; and a second ring-like belt 32 which adjoins the first ring-like belt 31 at a side of the first ring-like belt 31 that is remote from the heat exchange plate body 11, at least a part of the second ring-like belt 32 protruding relative to the first ring-like belt 31 to form the protrusion 5.

[0032] Referring to Figs. 4 - 5, Figs. 6A - 6C and Figs. 9A - 9C, in some embodiments of the present invention, the second ring-like belt 32 comprises the protrusion 5. Referring to Figs. 6A - 6C, according to some examples of the present invention, the protrusion 5 is a ring-shaped protrusion 5 along the entire second ring-like belt 32, and thereby forms a step structure. In this case, when multiple heat exchange plates 10 are welded together, the first ring-like belts 31 of adjacent heat exchange plates 10 are in contact with each other, and the second ring-like belts 32 of adjacent heat exchange plates 10 are in contact with each other. Alternatively, referring to Figs. 9A - 9C, according to some other examples of the present invention, the protrusion 5 is multiple protrusions 5 arranged at intervals along the second ring-like belt 32.

[0033] Referring to Figs. 3 - 5, in some embodiments of the present invention, the flange 3 comprises: a first ring-like belt 31 adjoining the heat exchange plate body 11; a second ring-like belt 32 which adjoins the first ring-like belt 31 at a side of the first ring-like belt 31 that is remote from the heat exchange plate body 11; and a third ring-like belt 33 which adjoins the second ring-like belt 32 at a side of the second ring-like belt 32 that is remote from the first ring-like belt 31, at least a part of at least one of the second ring-like belt 32 and the third ring-like belt 33 protruding relative to the first ring-like belt 31 to form the protrusion 5. According to some examples of the present invention, the second ring-like belt 32 protrudes relative to the first ring-like belt 31 to form a ring-shaped protrusion 5. In the example shown in Fig. 3, the flange 3 has an inner side facing the center of the heat exchange plate 10 and an outer side remote from the center of the heat exchange plate 10, the second ring-like belt 32 protrudes toward the outer side of the ring-shaped flange 3 relative to the first ring-like belt 31, the third ring-like belt 33 protrudes toward the outer side of the ring-shaped flange 3 relative to the first ring-like belt 31, to form a ring-shaped protrusion 5, and the amount by which the second ring-like belt 32 protrudes relative to the first ring-like belt 31 is less than the amount by which the third ring-like belt 33 protrudes relative to the first ring-like belt 31; multiple steps are thereby formed, for example multiple ring-shaped steps. In the example shown in Fig. 4, the second ring-like belt 32 of the lower heat exchange plate 10 protrudes toward the outer side of the flange 3 relative to the first ring-like belt, and the third ring-like belt 33 is substantially flush with the first ring-like belt 31. In the example shown in Fig. 5, the second ring-like belts 32 of the two heat exchange plates 10 protrude toward the outer side and the inner side of the flange 3, respectively, relative to the first ring-like belts, and the third ring-like belts 33 of the two heat exchange plates 10 are both substantially flush with the first ring-like belts 31.

[0034] Referring to Figs. 4 - 9C, in some embodiments of the present invention, the flange 3 comprises a ring-like flange body 30, the flange body 30 having a belt shape; the protrusion 5 protrudes from the flange body 30, and as shown in Figs. 6A - 6C, the protrusion 5 is a ring-shaped protrusion 5 extending along the entire ring-like flange body 30. According to some examples of the present invention, the protrusion 5 is substantially parallel to the flange body 30.

[0035] Referring to Figs. 4 - 9C, in some embodiments of the present invention, the flange 3 comprises a ring-like flange body 30, the flange body 30 having a belt shape; the protrusion 5 protrudes from the flange body 30, and as shown in Figs. 7A - 9C, the protrusion 5 is multiple protrusions 5 arranged at intervals along the ring-like flange body 30.

[0036] Referring to Figs. 6A - 9C, in some embodiments of the present invention, at least one of multiple protrusions 5 has a linear shape or a strip-like shape. In the examples shown in Figs. 7A - 8C, at least one of multiple protrusions 5 crosses the ring-like flange body 30. For example, at least one of multiple protrusions 5 is substantially perpendicular to the ring-like flange body 30. According to some examples of the present invention, at least one of multiple protrusions 5 extends over the entire width of the belt-shaped flange body 30.

[0037] Referring to Figs. 8A - 8C, in some embodiments of the present invention, the multiple protrusions

5 have a linear shape or a strip-like shape, a first protrusion 5A of the multiple protrusions 5 is substantially parallel to a part of the ring-like flange body 30 on which the first protrusion 5A is arranged, and a second protrusion 5B of the multiple protrusions 5 is substantially perpendicular to a part of the ring-like flange body 30 on which the second protrusion 5B is arranged. For example, referring to Fig. 8B, when viewed in a direction perpendicular to the heat exchange plate body 11, the first protrusion 5A and the second protrusion 5B extend in substantially the same direction.

[0038] Referring to Figs. 1 - 9C, in some embodiments of the present invention, the height of the protrusion 5 is in the range of 0.05 mm - 0.5 mm; for example, the height of the protrusion 5 is in the range of 0.05 mm - 0.2 mm. It must be noted that the protrusion 5 has been drawn in an exaggerated manner in Figs. 2 - 5, but as stated above, the protrusion 5 is actually very small, and takes the form of an indentation, so that the thickness thereof is very difficult to see at a larger scale, for example in Figs. 6A and 6C.

[0039] Referring to Figs. 1 - 9C, a plate heat exchanger according to an embodiment of the present invention comprises: multiple heat exchange plates 10, at least one of the multiple heat exchange plates 10 being the heat exchange plate 10 described above.

[0040] Referring to Figs. 2 - 5, according to an embodiment of the present invention, the multiple heat exchange plates 10 comprise a first heat exchange plate 10 (e.g. the upper heat exchange plate 10 of the two heat exchange plates 10 in Figs. 2, 3, 4 and 5) and a second heat exchange plate 10 (e.g. the lower heat exchange plate 10 of the two heat exchange plates 10 in Figs. 2, 3, 4 and 5) which are adjacent to each other. A protrusion 5 of a flange 3 of the first heat exchange plate 10 protrudes toward a side remote from a flange 3 of the second heat exchange plate 10, and a gap 9 is formed between the protrusion 5 of the flange 3 of the first heat exchange plate 10 and the flange 3 of the second heat exchange plate 10, the gap 9 being filled with solder for soldering the plate heat exchanger, in order to solder together the protrusion 5 of the flange 3 of the first heat exchange plate 10 and the flange 3 of the second heat exchange plate 10. The reinforcing effect of the protrusion 5 on the flange 3 can thereby be further improved for example.

[0041] According to an embodiment of the present invention, by providing the protrusion 5 in the flange 3, it is possible to prevent warping of the heat exchange plate, improve the quality of heat exchanger brazing, and facilitate heat exchanger assembly.

[0042] According to an embodiment of the present invention, by providing the protrusion 5 in the flange 3, it is possible to prevent a heat exchange region of the heat exchange plate 10 from being affected, thus preventing the heat exchange performance of the heat exchanger from being affected.

[0043] According to an embodiment of the present invention, by providing the protrusion 5 in the flange 3, it is possible to prevent elastic rebound after forming of the heat exchange plate 10, thus making the structure of the heat exchange plate more stable.

[0044] According to an embodiment of the present invention, when the protrusion 5 is provided in the flange 3, the protrusion can be formed more easily, and the difficulty of manufacture of the heat exchanger is thereby reduced.

[0045] It must be explained that features in one or more of the embodiments above may be combined to form new embodiments. A feature in one embodiment may be used in another embodiment, unless the feature in one embodiment clashes with the technical solution of the other embodiment.

Claims

1. A heat exchange plate for a plate heat exchanger, comprising:

   a heat exchange plate body; and
   a ring-shaped flange projecting obliquely from an edge of the heat exchange plate body, wherein the flange has a protrusion having a reinforcing action.

2. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
   the flange has an inner side facing the center of the heat exchange plate and an outer side remote from the center of the heat exchange plate, and the protrusion protrudes toward the inner side or outer side of the ring-shaped flange.

3. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
   the flange comprises: a first ring-like belt adjoining the heat exchange plate body; and a second ring-like belt which adjoins the first ring-like belt at a side of the first ring-like belt that is remote from the heat exchange plate body, at least a part of the second ring-like belt protruding relative to the first ring-like belt to form the protrusion.

4. The heat exchange plate for a plate heat exchanger as claimed in claim 3, wherein:

   the entire second ring-like belt forms a ring-shaped protrusion; or
   the protrusion is multiple protrusions arranged at intervals along the second ring-like belt.

5. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
   the flange comprises: a first ring-like belt adjoining the heat exchange plate body; a second ring-like belt which adjoins the first ring-like belt at a side of the

first ring-like belt that is remote from the heat exchange plate body; and a third ring-like belt which adjoins the second ring-like belt at a side of the second ring-like belt that is remote from the first ring-like belt, at least a part of at least one of the second ring-like belt and the third ring-like belt protruding relative to the first ring-like belt to form the protrusion.

6. The heat exchange plate for a plate heat exchanger as claimed in claim 5, wherein:
the second ring-like belt protrudes relative to the first ring-like belt to form a ring-shaped protrusion, and the third ring-like belt is flush with the first ring-like belt.

7. The heat exchange plate for a plate heat exchanger as claimed in claim 5, wherein:

the flange has an inner side facing the center of the heat exchange plate and an outer side remote from the center of the heat exchange plate, the second ring-like belt protrudes toward the outer side of the ring-shaped flange relative to the first ring-like belt,
the third ring-like belt protrudes toward the outer side of the ring-shaped flange relative to the first ring-like belt, to form a ring-shaped protrusion, and
the amount by which the second ring-like belt protrudes relative to the first ring-like belt is less than the amount by which the third ring-like belt protrudes relative to the first ring-like belt.

8. The heat exchange plate for a plate heat exchanger as claimed in claim 1 or 2, wherein:
the flange comprises a ring-like flange body, the flange body having a belt shape; the protrusion protrudes from the flange body, and the protrusion is a ring-shaped protrusion extending along the entire ring-like flange body.

9. The heat exchange plate for a plate heat exchanger as claimed in claim 8, wherein:
the protrusion is substantially parallel to the flange body.

10. The heat exchange plate for a plate heat exchanger as claimed in claim 1 or 2, wherein:
the flange comprises a ring-like flange body, the flange body having a belt shape; the protrusion protrudes from the flange body, and the protrusion is multiple protrusions arranged at intervals along the ring-like flange body.

11. The heat exchange plate for a plate heat exchanger as claimed in claim 10, wherein:
at least one of the multiple protrusions has a linear shape or a strip-like shape.

12. The heat exchange plate for a plate heat exchanger as claimed in claim 11, wherein:
the at least one of the multiple protrusions crosses the ring-like flange body.

13. The heat exchange plate for a plate heat exchanger as claimed in claim 11, wherein:
the at least one of the multiple protrusions is substantially perpendicular to the ring-like flange body.

14. The heat exchange plate for a plate heat exchanger as claimed in claim 12 or 13, wherein:
the at least one of the multiple protrusions extends over the entire width of the belt-shaped flange body.

15. The heat exchange plate for a plate heat exchanger as claimed in claim 10, wherein:
the multiple protrusions have a linear shape or a strip-like shape, a first protrusion of the multiple protrusions is substantially parallel to a part of the ring-like flange body on which the first protrusion is arranged, and a second protrusion of the multiple protrusions is substantially perpendicular to a part of the ring-like flange body on which the second protrusion is arranged.

16. The heat exchange plate for a plate heat exchanger as claimed in claim 15, wherein:
when viewed in a direction perpendicular to the heat exchange plate body, the first protrusion and the second protrusion extend in substantially the same direction.

17. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
the height of the protrusion is in the range of 0.05 mm - 0.5 mm.

18. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
the height of the protrusion is in the range of 0.05 mm - 0.2 mm.

19. A plate heat exchanger, comprising:
multiple heat exchange plates, at least one of the multiple heat exchange plates being the heat exchange plate as claimed in any one of claims 1 - 18.

20. The plate heat exchanger as claimed in claim 19, wherein:
the multiple heat exchange plates comprise a first heat exchange plate and a second heat exchange plate which are adjacent to each other; a protrusion of a flange of the first heat exchange plate protrudes toward a side remote from a flange of the second heat exchange plate, and a gap is formed between the protrusion of the flange of the first heat exchange plate and the flange of the second heat exchange

plate, the gap being filled with solder for soldering the plate heat exchanger, in order to solder together the protrusion of the flange of the first heat exchange plate and the flange of the second heat exchange plate.

Amended claims under Art. 19.1 PCT

1. A heat exchange plate for a plate heat exchanger, comprising:

a heat exchange plate body; and
a ring-shaped flange projecting obliquely from an edge of the heat exchange plate body, wherein the flange has a protrusion having a reinforcing action.

2. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
the flange has an inner side facing the center of the heat exchange plate and an outer side remote from the center of the heat exchange plate, and the protrusion protrudes toward the inner side or outer side of the ring-shaped flange.

3. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
the flange comprises: a first ring-like belt adjoining the heat exchange plate body; and a second ring-like belt which adjoins the first ring-like belt at a side of the first ring-like belt that is remote from the heat exchange plate body, at least a part of the second ring-like belt protruding relative to the first ring-like belt to form the protrusion.

4. The heat exchange plate for a plate heat exchanger as claimed in claim 3, wherein:

the entire second ring-like belt forms a ring-shaped protrusion; or
the protrusion is multiple protrusions arranged at intervals along the second ring-like belt.

5. The heat exchange plate for a plate heat exchanger as claimed in claim 1, wherein:
the flange comprises: a first ring-like belt adjoining the heat exchange plate body; a second ring-like belt which adjoins the first ring-like belt at a side of the first ring-like belt that is remote from the heat exchange plate body; and a third ring-like belt which adjoins the second ring-like belt at a side of the second ring-like belt that is remote from the first ring-like belt, at least a part of at least one of the second ring-like belt and the third ring-like belt protruding relative to the first ring-like belt to form the protrusion.

6. The heat exchange plate for a plate heat exchanger as claimed in claim 5, wherein:
the second ring-like belt protrudes relative to the first ring-like belt to form a ring-shaped protrusion, and the third ring-like belt is flush with the first ring-like belt.

7. The heat exchange plate for a plate heat exchanger as claimed in claim 5, wherein:

the flange has an inner side facing the center of the heat exchange plate and an outer side remote from the center of the heat exchange plate,
the second ring-like belt protrudes toward the outer side of the ring-shaped flange relative to the first ring-like belt,
the third ring-like belt protrudes toward the outer side of the ring-shaped flange relative to the first ring-like belt, to form a ring-shaped protrusion, and
the amount by which the second ring-like belt protrudes relative to the first ring-like belt is less than the amount by which the third ring-like belt protrudes relative to the first ring-like belt.

8. The heat exchange plate for a plate heat exchanger as claimed in claim 1 or 2, wherein:
the flange comprises a ring-like flange body, the flange body having a belt shape; the protrusion protrudes from the flange body, and the protrusion is a ring-shaped protrusion extending along the entire ring-like flange body.

9. The heat exchange plate for a plate heat exchanger as claimed in claim 1 or 2, wherein:
the flange comprises a ring-like flange body, the flange body having a belt shape; the protrusion protrudes from the flange body, and the protrusion is multiple protrusions arranged at intervals along the ring-like flange body.

10. The heat exchange plate for a plate heat exchanger as claimed in claim 9, wherein:
at least one of the multiple protrusions has a linear shape or a strip-like shape.

11. The heat exchange plate for a plate heat exchanger as claimed in claim 10, wherein:
the at least one of the multiple protrusions crosses the ring-like flange body.

12. The heat exchange plate for a plate heat exchanger as claimed in claim 11, wherein:
the at least one of the multiple protrusions extends over the entire width of the belt-shaped flange body.

13. The heat exchange plate for a plate heat exchanger as claimed in claim 9, wherein:
the multiple protrusions have a linear shape or a

strip-like shape, a first protrusion of the multiple protrusions is substantially parallel to a part of the ring-like flange body on which the first protrusion is arranged, and a second protrusion of the multiple protrusions is substantially perpendicular to a part of the ring-like flange body on which the second protrusion is arranged.

14. A plate heat exchanger, comprising:
multiple heat exchange plates, at least one of the multiple heat exchange plates being the heat exchange plate as claimed in any one of claims 1 - 13.

15. The plate heat exchanger as claimed in claim 14, wherein:
the multiple heat exchange plates comprise a first heat exchange plate and a second heat exchange plate which are adjacent to each other; a protrusion of a flange of the first heat exchange plate protrudes toward a side remote from a flange of the second heat exchange plate, and a gap is formed between the protrusion of the flange of the first heat exchange plate and the flange of the second heat exchange plate, the gap being filled with solder for soldering the plate heat exchanger, in order to solder together the protrusion of the flange of the first heat exchange plate and the flange of the second heat exchange plate.

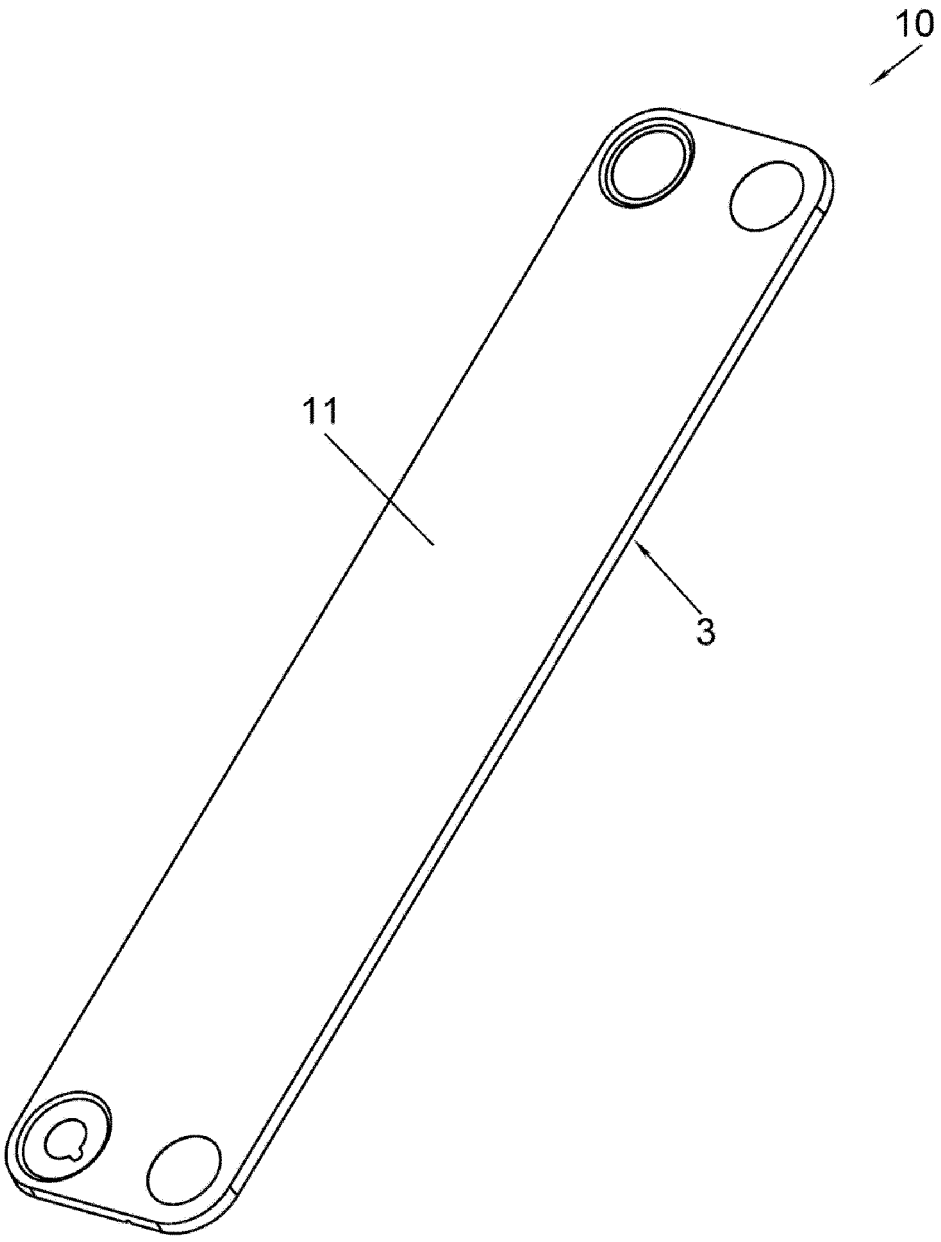

Fig. 1

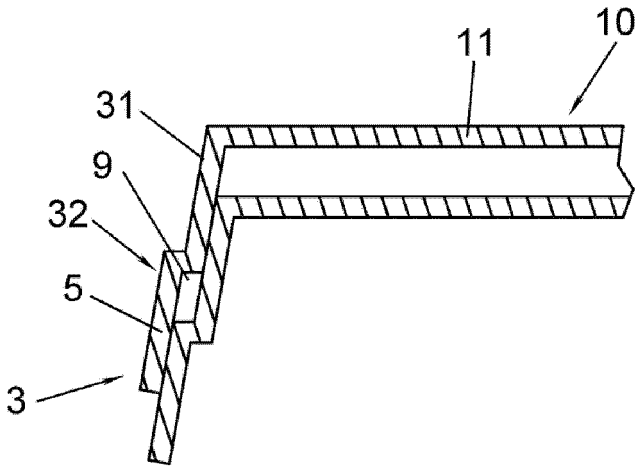

Fig. 2

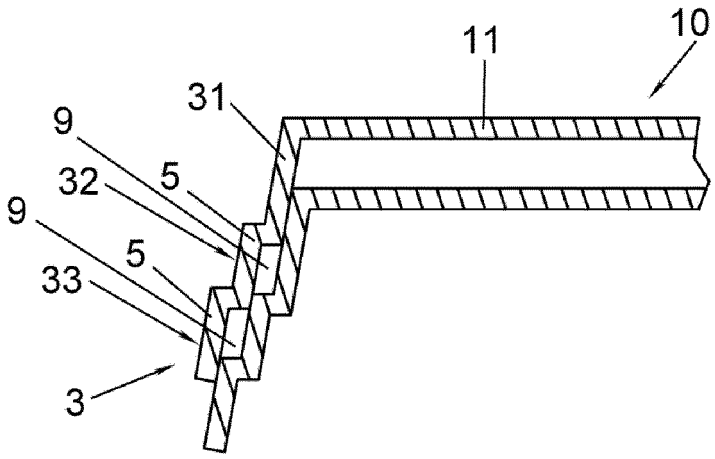

Fig. 3

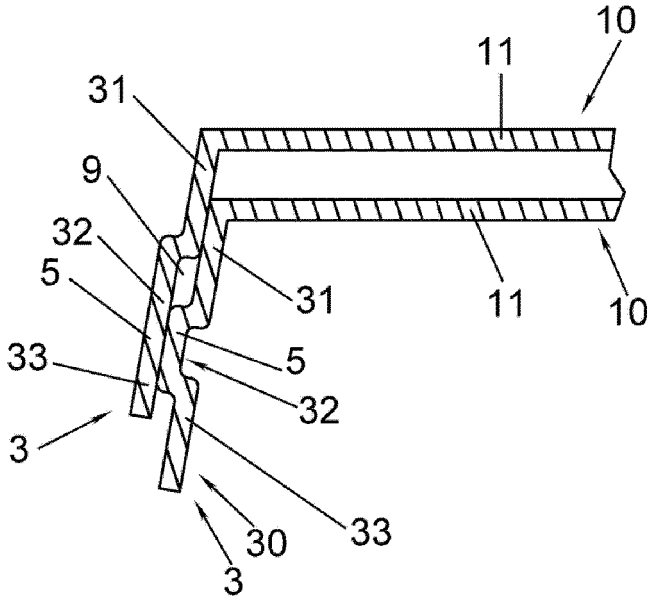
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Fig. 4

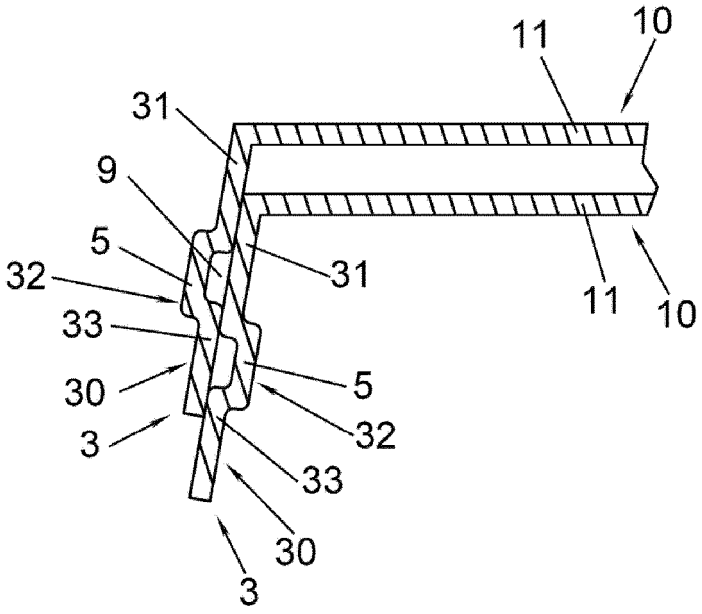
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Fig. 5

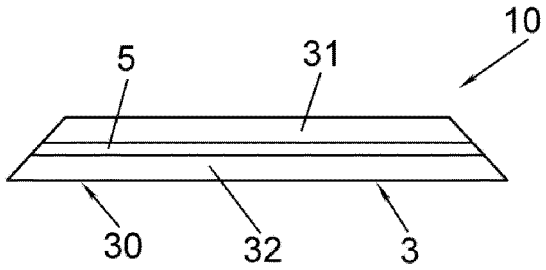

Fig. 6A

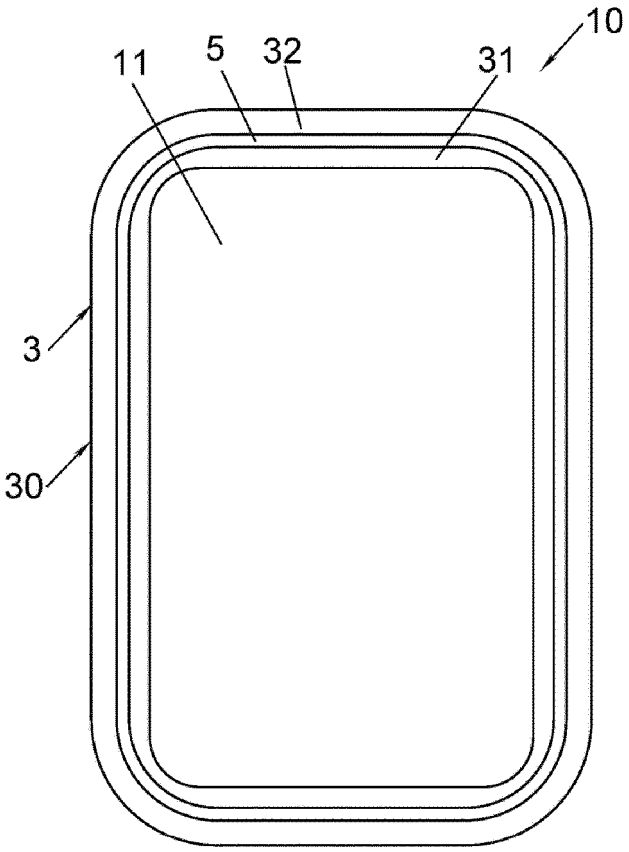

Fig. 6B

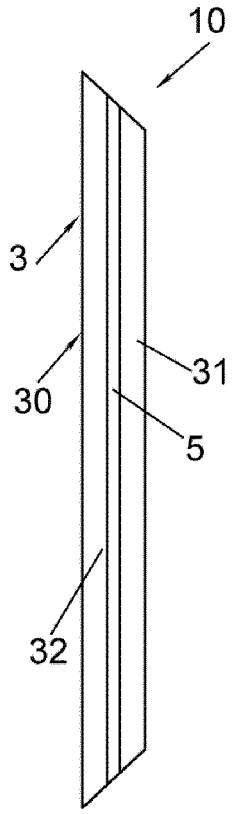

Fig. 6C

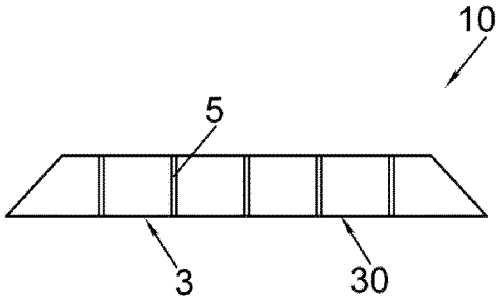

Fig. 7A

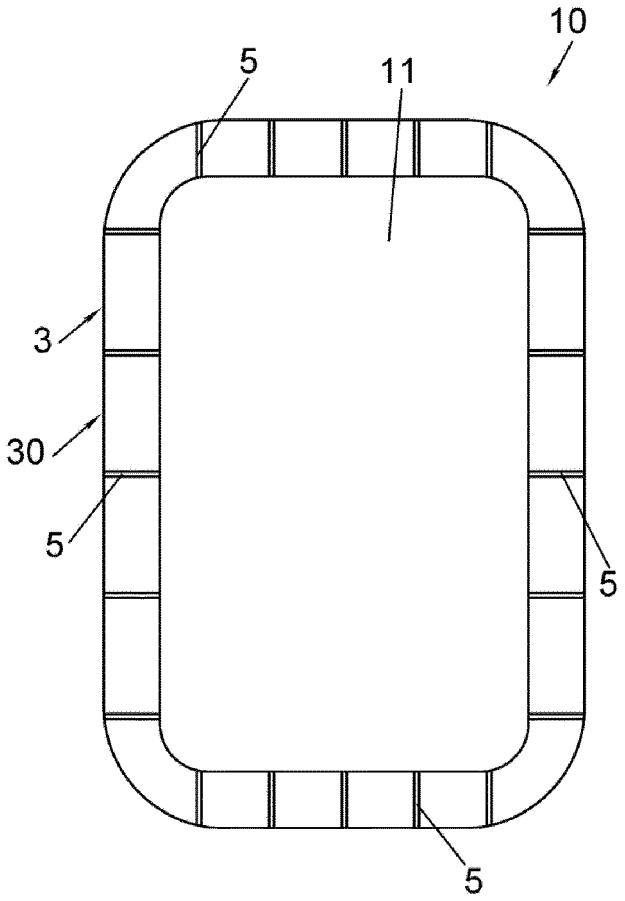

Fig. 7B

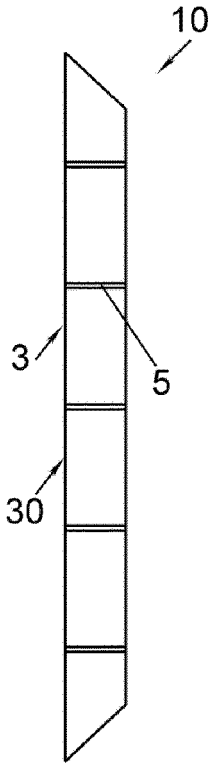

Fig. 7C

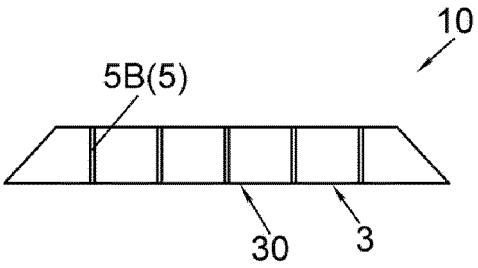

Fig. 8A

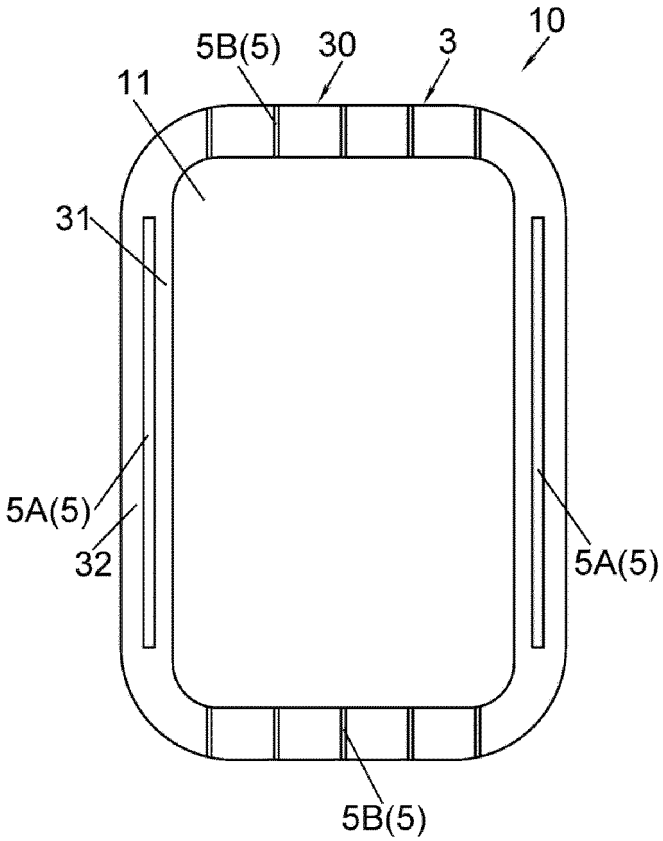

Fig. 8B

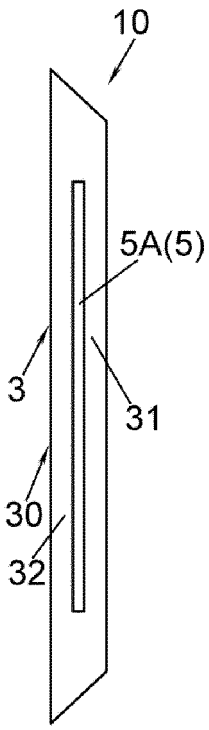

Fig. 8C

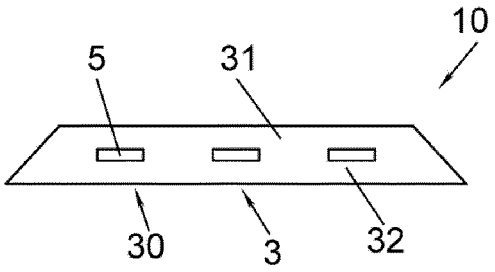

Fig. 9A

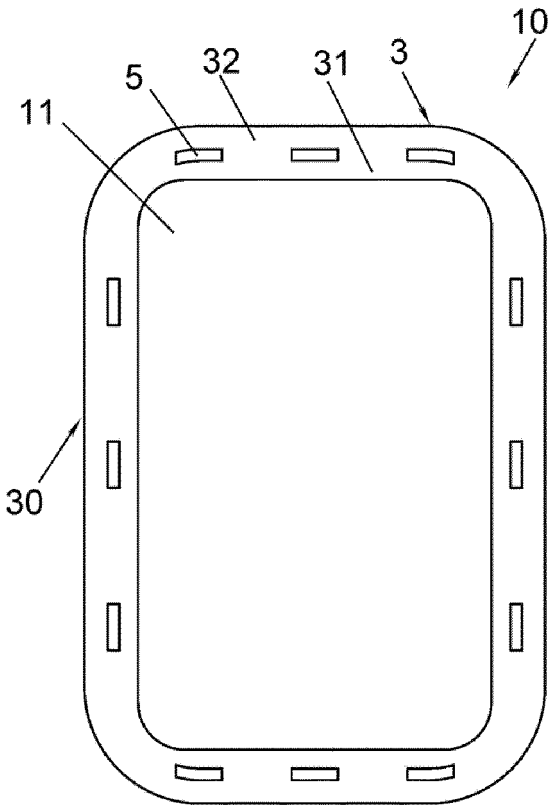

Fig. 9B

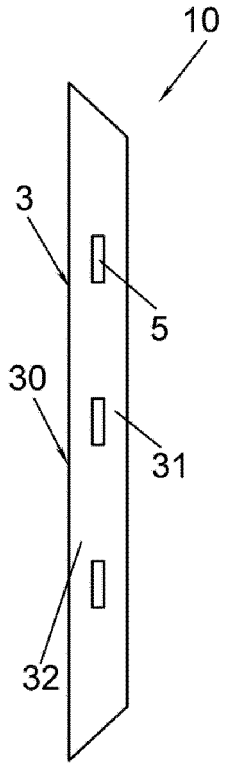

Fig. 9C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/126738

A. CLASSIFICATION OF SUBJECT MATTER

F28D 9/02(2006.01)i; F28F 3/08(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)

F28D9; F28D3

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; CNABS; CNKI: 板式换热器, 换热板, 凸起, 外缘, 翻边, 加强, 肋herm, edge, raised, brim, flange, enhance, protuberant, heave, reinforce, margin, strengthen, fringe

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 200950015 Y (MIU, Zhixian et al.) 19 September 2007 (2007-09-19) description, page 4 lines 21-23, figures 1-5	1-20
A	CN 205690942 U (SONGZ AUTOMOBILE AIR CONDITIONING CO., LTD.) 16 November 2016 (2016-11-16) entire document	1-20
A	CN 1930440 A (BEHR GMBH & CO., KG.) 14 March 2007 (2007-03-14) entire document	1-20
A	JP 2000105096 A (HISAKA WORKS LTD.) 11 April 2000 (2000-04-11) entire document	1-20
A	DE 202016106346 U1 (KAORI HEAT TREAT CO., LTD.) 23 February 2017 (2017-02-23) entire document	1-20

☐ 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
"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	Date of mailing of the international search report
14 January 2021	**21 January 2021**

Name and mailing address of the ISA/CN
China National Intellectual Property Administration (ISA/CN)
No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088
China

Facsimile No. **(86-10)62019451**

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/126738

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