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(54) **PLATE HEAT EXCHANGER**

PLATTENWÄRMETAUSCHER

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Description

Technical Field

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

Background

[0002] A plate heat exchanger comprises cover plates, heat exchange plates, ports, distributors, connecting pipes, etc.

Summary of the Invention

[0003] An objective of the embodiments of the present invention is to provide a plate heat exchanger, which can thus simplify the manufacturing process of the plate heat exchanger, for example. The objects of the present invention are solved by the features of the independent claim 1.

[0004] According to an embodiment of the present invention, projections of the second portion of the first annular protrusion and the second portion of the second annular protrusion on a plane perpendicular to the stacking direction have an annular inner overlapping portion, and a projection of the communicating hole on the plane perpendicular to the stacking direction is outside the annular inner overlapping portion. According to an embodiment of the present invention, at least one part of the projection of the second portion of the first annular protrusion on the plane perpendicular to the stacking direction is outside the projection of the second portion of the second annular protrusion in the plane perpendicular to the stacking direction.

[0005] According to an embodiment of the present invention, the first heat exchange plate further comprises an annular portion surrounding the first annular protrusion, the annular portion of the first heat exchange plate has a surface facing the second side, the second heat exchange plate further comprises an annular portion surrounding the second annular protrusion, the annular portion of the second heat exchange plate has a surface facing the first side, and the surface of the annular portion of the first heat exchange plate and the surface of the annular portion of the second heat exchange plate adjacent to each other are in at least partial contact to form a seal.

[0006] According to an embodiment of the present invention, projections of the annular portion of the first heat exchange plate and the annular portion of the second heat exchange plate on the plane perpendicular to the stacking direction have an annular outer overlapping portion, and the projection of the communicating hole on the plane perpendicular to the stacking direction is inside the annular outer overlapping portion.

[0007] According to an embodiment of the present invention, at least one part of the projection of the annular

portion of the second heat exchange plate on the plane perpendicular to the stacking direction is inside the projection of the annular portion of the first heat exchange plate in the plane perpendicular to the stacking direction.

[0008] According to an embodiment of the present invention, the first annular protrusion of the first heat exchange plate has a circular annular shape, the second annular protrusion of the second heat exchange plate has a circular annular shape, and an outer diameter of the first annular protrusion of the first heat exchange plate is larger than an outer diameter of the second annular protrusion of the second heat exchange plate.

[0009] According to an embodiment of the present invention, the annular portion of the first heat exchange plate has a circular annular shape, the annular portion of the second heat exchange plate has a circular annular shape, and an inner diameter of the annular portion of the second heat exchange plate is smaller than an inner diameter of the annular portion of the first heat exchange plate.

[0010] According to an embodiment of the present invention, the annular portion of the first heat exchange plate adjoins the first portion of the first annular protrusion of the first heat exchange plate, and the annular portion of the second heat exchange plate adjoins the first portion of the second annular protrusion of the second heat exchange plate.

[0011] According to an embodiment of the present invention, the first annular protrusion of the first heat exchange plate comprises an annular protrusion main body and a communicating protrusion extending outwardly from the annular protrusion main body; and at least one part of a projection of the communicating protrusion of the first annular protrusion on the plane perpendicular to the stacking direction is outside the projection of the second portion of the second annular projection on the plane perpendicular to the stacking direction, and the projection of the communicating hole on the plane perpendicular to the stacking direction is in the at least one part of the projection of the communicating protrusion of the first annular protrusion.

[0012] According to an embodiment of the present invention, the annular protrusion main body of the first annular protrusion of the first heat exchange plate has a circular annular shape, the second annular protrusion of the second heat exchange plate has a circular annular shape, and an outer diameter of the annular protrusion main body of the first annular protrusion of the first heat exchange plate is substantially equal to an outer diameter of the second annular protrusion of the second heat exchange plate; and the projection of the communicating protrusion of the first annular protrusion on the plane perpendicular to the stacking direction is outside the projection of the second portion of the second annular protrusion on the plane perpendicular to the stacking direction, and the projection of the communicating hole on the plane perpendicular to the stacking direction is in the projection of the communicating protrusion of the first annular pro-

trusion.

[0013] According to an embodiment of the present invention, the communicating hole is a plurality of communicating holes, and the communicating protrusion is a plurality of spaced communicating protrusions.

[0014] According to an embodiment of the present invention, a surface of the second annular protrusion of the second heat exchange plate facing the second side has a second recessed portion, and the second recessed portion forms the communicating hole.

[0015] According to an embodiment of the present invention, the first annular protrusion of the first heat exchange plate has a circular annular shape, the second protrusion of the second heat exchange plate has a circular annular shape, and an outer diameter of the first annular protrusion of the first heat exchange plate is substantially equal to an outer diameter of the second annular protrusion of the second heat exchange plate.

[0016] According to an embodiment of the present invention, an annular first portion of the first annular protrusion of the first heat exchange plate extends obliquely from the first heat exchange plate main body toward the first side, and an annular second portion of the first annular protrusion of the first heat exchange plate extends inwardly from the annular first portion of the first annular protrusion of the first heat exchange plate substantially parallel to the first heat exchange plate main body; and an annular first portion of the second annular protrusion of the second heat exchange plate extends obliquely from the second heat exchange plate main body toward the second side, and an annular second portion of the second annular projection of the second heat exchange plate extends inwardly from the annular first portion of the second annular projection of the second heat exchange plate substantially parallel to the second heat exchange plate main body.

[0017] According to an embodiment of the present invention, the annular second portion of the first annular protrusion of the first heat exchange plate adjoins the first opening, and the annular second portion of the second annular projection of the second heat exchange plate adjoins the second opening.

[0018] According to an embodiment of the present invention, the plurality of first heat exchange plates and the plurality of second heat exchange plates are alternately arranged in the stacking direction.

[0019] According to an embodiment of the present invention, the communicating hole is formed in the first heat exchange plates and/or the second heat exchange plates.

[0020] The plate heat exchanger according to the embodiments of the present invention can simplify the manufacturing process of the plate heat exchanger, for example.

Brief Description of the Drawings

[0021]

Fig. 1 is a schematic top view of a port portion of a first heat exchange plate of a plate heat exchanger according to an embodiment of the present invention;

Fig. 2 is a schematic top view of a port portion of a second heat exchange plate of the plate heat exchanger according to the embodiment of the present invention;

Fig. 3 is a schematic perspective view of a port portion of the plate heat exchanger according to the embodiment of the present invention;

Fig. 4 is a schematic cross-sectional perspective view of the port portion of the plate heat exchanger according to the embodiment of the present invention;

Fig. 5 is a schematic top view of a port portion of a first heat exchange plate of a plate heat exchanger according to another embodiment of the present invention;

Fig. 6 is a schematic top view of a port portion of a second heat exchange plate of the plate heat exchanger according to the other embodiment of the present invention;

Fig. 7 is a schematic perspective view of a port portion of the plate heat exchanger according to the other embodiment of the present invention;

Fig. 8 is a schematic cross-sectional perspective view of the port portion of the plate heat exchanger according to the other embodiment of the present invention;

Fig. 9 is a schematic top view of a port portion of a first heat exchange plate of a plate heat exchanger according to yet another embodiment of the present invention;

Fig. 10 is a schematic top view of a port portion of a second heat exchange plate of the plate heat exchanger according to the yet another embodiment of the present invention;

Fig. 11 is a schematic perspective view of a port portion of the plate heat exchanger according to the yet another embodiment of the present invention;

Fig. 12 is a schematic cross-sectional perspective view of the port portion of the plate heat exchanger according to the yet another embodiment of the present invention;

Fig. 13 is a schematic perspective view of a plate heat exchanger according to an embodiment of the present invention;

Fig. 14 is a schematic cross-sectional view of a port portion of the plate heat exchanger according to the embodiment of the present invention;

Fig. 15 is a schematic enlarged cross-sectional view of the port portion of the plate heat exchanger shown in Fig. 14;

Fig. 16 is a schematic perspective view of a plate heat exchanger according to another embodiment of the present invention; and

Fig. 17 is a schematic cross-sectional view of a port

portion of the plate heat exchanger according to the other embodiment of the present invention.

Detailed Description of the Invention

[0022] The present invention is explained further below in conjunction with the accompanying drawing and specific implementations.

[0023] Referring to Figs. 1 to 17, a plate heat exchanger 100 according to an embodiment of the present invention comprises a plurality of heat exchange plates 1, 2, 3, 4 (Fig. 17) and a port 93 formed in the heat exchange plates 1, 2, 3, 4. The plurality of heat exchange plates 1, 2, 3, 4 are arranged in a stacking direction to form a plurality of heat exchange spaces A, B and C (Fig. 17), the plurality of heat exchange plates 1, 2, 3, 4 comprising a plurality of first heat exchange plates 1 and a plurality of second heat exchange plates 2; and the port 93 communicates with a predetermined heat exchange space A of the plurality of heat exchange spaces A, B and C to distribute a heat exchange medium for the predetermined heat exchange space A. In the embodiments shown in Figs. 1 to 15, the plurality of first heat exchange plates 1 and the plurality of second heat exchange plates 2 are alternately arranged in the stacking direction to form alternately arranged first heat exchange spaces A and second heat exchange spaces B. In the embodiments shown in Figs. 16 and 17, the plurality of heat exchange plates 1, 2, 3, 4 comprise a plurality of first heat exchange plates 1, a plurality of second heat exchange plates 2, a plurality of third heat exchange plates 3 and a plurality of fourth heat exchange plates 4, and the first heat exchange plate 1, the second heat exchange plate 2, the third heat exchange plate 3 and the fourth heat exchange plate 4 constitute one repeating unit. The plate heat exchanger 100 comprises a plurality of repeating units. The plurality of heat exchange spaces A, B and C comprise a first heat exchange space A, a second heat exchange space B and a third heat exchange space C which are separated from each other. The first heat exchange plate 1 comprises: a first heat exchange plate main body 10; a first opening 11 formed in the first heat exchange plate main body 10 for forming the port 93; and a first annular protrusion 12 surrounding the first opening 11, adjoining the first opening 11 and protruding from the first heat exchange plate main body 10 toward a first side in the stacking direction. The second heat exchange plate 2 comprises: a second heat exchange plate main body 20; a second opening 21 formed in the second heat exchange plate main body 20 for forming the port 93; and a second annular protrusion 22 surrounding the second opening 21, adjoining the second opening 21 and protruding from the second heat exchange plate main body 20 toward a second side opposite to the first side in the stacking direction. The sum of heights of the first annular protrusion 12 and the second annular protrusion 22 is equal to a height of the heat exchange space. For example, the heights of the first annular protrusion 12 and the second

annular protrusion 22 are equal to half of the height of the heat exchange space.

[0024] In some embodiments of the present invention, with reference to Figs. 13 and 14, in addition to the port 93 serving as a first heat exchange medium inlet port, the plate heat exchanger 100 further comprises a first heat exchange medium outlet 93A, a second heat exchange medium inlet 93B, and a second heat exchange medium outlet 93C.

[0025] In other embodiments of the present invention, with reference to Figs. 16 and 17, in addition to the port 93 serving as the first heat exchange medium inlet port, the plate heat exchanger 100 further comprises a first heat exchange medium outlet 93A, a second heat exchange medium inlet 93B, a second heat exchange medium outlet 93C, a third heat exchange medium inlet 93D, and a third heat exchange medium outlet 93E. The plurality of heat exchange plates 1, 2, 3, 4 comprise a plurality of first heat exchange plates 1, a plurality of second heat exchange plates 2, a plurality of third heat exchange plates 3 and a plurality of fourth heat exchange plates 4, and the first heat exchange plate 1, the second heat exchange plate 2, the third heat exchange plate 3 and the fourth heat exchange plate 4 constitute one repeating unit. The plate heat exchanger 100 may form three loops. The first heat exchange space A, the second heat exchange space B and the third heat exchange space C are separated from each other. A first heat exchange medium may be a refrigerant, a second heat exchange medium may be water, and a third heat exchange medium may be a refrigerant. The first heat exchange plate 1 and the third heat exchange plate 3 may be the same in the port portion except that one of them has a communicating hole 95 and the other does not have the communicating hole 95. The second heat exchange plate 2 and the fourth heat exchange plate 4 may be the same in the port portion. If the communicating hole 95 is formed in one of the second heat exchange plate 2 and the fourth heat exchange plate 4, the first heat exchange plate 1 and the third heat exchange plate 3 may be the same at the port portion. The first heat exchange plate 1 and the third heat exchange plate 3 may be the same or different in the heat exchange portion, and the second heat exchange plate 2 and the fourth heat exchange plate 4 may be the same or different in the heat exchange portion. The third heat exchange plate 3 may be considered as the first heat exchange plate 1, but has a heat exchange portion that is the same as or different from that of the first heat exchange plate 1, and may or may not have communicating hole 95, regardless of whether the first heat exchange plate 1 has the communicating hole 95 or not. The fourth heat exchange plate 4 may be considered as the second heat exchange plate 2, but has a heat exchange portion that is the same as or different from that of the second heat exchange plate 2, and may or may not have the communicating hole 95, regardless of whether the second heat exchange plate 2 has the communicating hole 95 or not. The port portion comprises

annular portions 14, 24 and portions inside the annular portions 14, 24, and the heat exchange portion is a portion where the heat exchange space is located, and is outside the annular portions 14, 24.

[0026] In some embodiments of the present invention, with reference to Figs. 1, 3, 4, 5, 7, 8, 11, 12, 14, 15 and 17, the first annular protrusion 12 of the first heat exchange plate 1 comprises: an annular first portion 1201 extending from the first heat exchange plate main body 10 toward the first side; and an annular second portion 1202 extending inwardly from the annular first portion 1201, the second portion 1202 of the first annular protrusion 12 having a surface 1203 facing the first side. The second annular protrusion 22 of the second heat exchange plate 2 comprises: an annular first portion 2201 extending from the second heat exchange plate main body 20 toward the second side; and an annular second portion 2202 extending inwardly from the annular first portion 2201 of the second annular protrusion 22 of the second heat exchange plate 2, the second portion 2202 of the second annular protrusion 22 having a surface 2203 facing the second side. The surface 1203 of the second portion 1202 of the first annular protrusion 12 and the surface 2203 of the second portion 2202 of the second annular protrusion 22 adjacent to each other are in at least partial contact to form a seal over at least one part of a circumferential length of the surface 1203 of the second portion 1202 of the first annular protrusion 12 and the surface 2203 of the second portion 2202 of the second annular protrusion 22. Thus, a heat exchange medium from the port 93 does not flow into a predetermined heat exchange space A between the entire surface 1203 of the second portion 1202 of the first annular protrusion 12 and the surface 2203 of the second portion 2202 of the second annular protrusion 22, but only flows into the predetermined heat exchange space A through the communicating hole 95.

[0027] Referring to Figs. 1, 3, 4, 5, 7, 8, 11, 12, 14, 15 and 17, according to an example of the present invention, the annular first portion 1201 of the first annular protrusion 12 of the first heat exchange plate 1 extends obliquely from the first heat exchange plate main body 10 toward the first side, and the annular second portion 1202 of the first annular protrusion 12 of the first heat exchange plate 1 extends inwardly from the annular first portion 1201 of the first annular protrusion 12 of the first heat exchange plate 1 substantially parallel to the first heat exchange plate main body 10. The annular first portion 2201 of the second annular protrusion 22 of the second heat exchange plate 2 extends obliquely from the second heat exchange plate main body 20 toward the second side, and the annular second portion 2202 of the second annular projection 22 of the second heat exchange plate 2 extends inwardly from the annular first portion 2201 of the second annular projection 22 of the second heat exchange plate 2 substantially parallel to the second heat exchange plate main body 20. For example, the annular second portion 1202 of the first annular protrusion 12 of

the first heat exchange plate 1 adjoins the first opening 11, and the annular second portion 2202 of the second annular protrusion 22 of the second heat exchange plate 2 adjoins the second opening 21.

[0028] In some embodiments of the present invention, with reference to Figs. 1, 3, 4, 5, 7, 8, 11, 12, 14, 15 and 17, the first heat exchange plate 1 further comprises an annular portion 14 surrounding the first annular protrusion 12, the annular portion 14 of the first heat exchange plate 1 has a surface 15 facing the second side, the second heat exchange plate 2 further comprises an annular portion 24 surrounding the second annular protrusion 22, the annular portion 24 of the second heat exchange plate 2 has a surface 25 facing the first side, and the surface 15 of the annular portion 14 of the first heat exchange plate 1 and the surface 25 of the annular portion 24 of the second heat exchange plate 2 adjacent to each other are in at least partial contact to form a seal. Thus, the heat exchange medium from the port 93 does not flow into other heat exchange spaces B and C other than the predetermined heat exchange space A.

[0029] In some embodiments of the present invention, with reference to Figs. 1, 3, 4, 5, 7, 8, 11, 12, 15 and 17, the plate heat exchanger further comprises a communicating hole 95 formed in at least some of the first heat exchange plates 1 and/or at least some of the second heat exchange plates 2, wherein the port 93 communicates with the predetermined heat exchange space A through the communicating hole 95. The communicating hole 95 may have any suitable shape, such as a circular shape, a semi-circular shape, an oval shape, a quadrangular shape or the like.

[0030] In some embodiments of the present invention, with reference to Figs. 4, 8, 14, 15 and 17, projections of the second portion 1202 of the first annular protrusion 12 and the second portion 2202 of the second annular protrusion 22 on a plane perpendicular to the stacking direction have an annular inner overlapping portion (e.g., a radially inner overlapping portion), and a projection of the communicating hole 95 on the plane perpendicular to the stacking direction is outside (e.g., radially outside) the annular inner overlapping portion. For example, at least one part of the projection of the second portion 1202 of the first annular protrusion 12 on the plane perpendicular to the stacking direction is outside (e.g., radially outside) the projection of the second portion 2202 of the second annular protrusion 22 on the plane perpendicular to the stacking direction.

[0031] In some embodiments of the present invention, referring to Figs. 4, 8, 14 and 16, projections of the annular portion 14 of the first heat exchange plate 1 and the annular portion 24 of the second heat exchange plate 2 on the plane perpendicular to the stacking direction have an annular outer overlapping portion (e.g., a radially outer overlapping portion), and the projection of the communicating hole 95 on the plane perpendicular to the stacking direction is inside (e.g., radially inside) the annular outer overlapping portion. For example, at least one

part of the projection of the annular portion 24 of the second heat exchange plate 2 on the plane perpendicular to the stacking direction is inside (e.g., radially inside) the projection of the annular portion 14 of the first heat exchange plate 1 on the plane perpendicular to the stacking direction. For example, the annular portion 14 of the first heat exchange plate 1 has a circular annular shape, the annular portion 24 of the second heat exchange plate 2 has a circular annular shape, and an inner diameter of the annular portion 24 of the second heat exchange plate 2 is smaller than an inner diameter of the annular portion 14 of the first heat exchange plate 1. The annular portion 14 of the first heat exchange plate 1 may adjoin the first portion 1201 of the first annular protrusion 12 of the first heat exchange plate 1, and the annular portion 24 of the second heat exchange plate 2 may adjoin the first portion 2201 of the second annular protrusion 22 of the second heat exchange plate 2.

[0032] In some embodiments of the present invention, with reference to Figs. 4, 8, 14, 15 and 17, the communicating hole 95 is in the annular second portions 1202 of the first annular protrusions 12 of at least some of the first heat exchange plates 1 and/or the communicating hole 95 is in the annular portions 24 of at least some of the second heat exchange plates 2. Thus, it is easy to machine the communicating hole 95 with high accuracy, and it is not easily blocked. For example, in the embodiment shown in Fig. 14, the communicating hole 95 is formed in the first heat exchange plate 1 and/or the second heat exchange plate 2.

[0033] In some embodiments of the present invention, with reference to Figs. 4, 8, 14, 15 and 17, the communicating hole 95 is in the annular first portions 1201 of the first annular protrusions 12 of at least some of the first heat exchange plates 1 and/or the communicating hole 95 is in the annular first portions 2201 of at least some of the second heat exchange plates 2. Thus, the first annular protrusion 12 and the second annular protrusion 22 may have the same shape and the same size.

[0034] Although it is shown in Figs. 1, 3, 4, 5, 7 and 8 that the communicating hole 95 is formed in the first heat exchange plate 1, the communicating hole 95 may be formed in the second heat exchange plate 2, or the communicating hole 95 may be formed in each of the first heat exchange plate 1 and the second heat exchange plate 2. In addition, although it is shown in Figs. 1, 3, 4, 5, 7 and 8 that one communicating hole 95 is formed in the first heat exchange plate 1, but a plurality of communicating holes 95 may be formed in the first heat exchange plate 1, a plurality of communicating holes 95 are formed in the second heat exchange plate 2, or a plurality of communicating holes 95 are formed in each of the first heat exchange plate 1 and the second heat exchange plate 2.

[0035] In some embodiments of the present invention, referring to Fig. 8, the first annular protrusion 12 of the first heat exchange plate 1 has a circular annular shape, the second annular protrusion 22 of the second heat ex-

change plate 2 has a circular annular shape, and an outer diameter of the first annular protrusion 12 of the first heat exchange plate 1 is larger than an outer diameter of the second annular protrusion 22 of the second heat exchange plate 2. When viewed in the stacking direction, the first annular protrusion 12 of the first heat exchange plate 1 and the second annular protrusion 22 of the second heat exchange plate 2 may be substantially concentric.

[0036] In some embodiments of the present invention, referring to Fig. 4, the first annular protrusion 12 of the first heat exchange plate 1 comprises an annular protrusion main body 120 and a communicating protrusion 121 extending outwardly (e.g., radially outwardly in a direction away from the center of the annular protrusion main body 120) from the annular protrusion main body 120, and at least one part of a projection of the communicating protrusion 121 of the first annular protrusion 12 on the plane perpendicular to the stacking direction is outside (e.g., radially outside) the projection of the second portion 2202 of the second annular protrusion 22 on the plane perpendicular to the stacking direction, and the projection of the communicating protrusion 121 of the first annular protrusion 12. Although it is shown in Figs. 1, 3 and 4 that the communicating hole 95 is formed in the communicating protrusion 121 of the first heat exchange plate 1, the communicating hole 95 may be formed in the second heat exchange plate 2, or the communicating hole 95 may be formed in each of the communicating protrusion 121 of the first heat exchange plate 1 and the second heat exchange plate 2. In addition, although it is shown in Figs. 1, 3 and 4 that one communicating hole 95 is formed in the communicating protrusion 121 of the first heat exchange plate 1, a plurality of communicating protrusions 121 may also be provided. Thus, a plurality of communicating holes 95 are formed in the plurality of communicating protrusions 121 of the first heat exchange plate 1, respectively, or a plurality of communicating holes 95 are formed in the second heat exchange plate 2, or a plurality of communicating holes 95 are formed in each of the plurality of communicating protrusions 121 of the first heat exchange plate 1 and the second heat exchange plate 2.

[0037] In some embodiments of the present invention, with reference to Figs. 1 to 4, the annular protrusion main body 120 of the first annular protrusion 12 of the first heat exchange plate 1 has a circular annular shape, the second annular protrusion 22 of the second heat exchange plate 2 has a circular annular shape, and an outer diameter of the annular protrusion main body 120 of the first annular protrusion 12 of the first heat exchange plate 1 is substantially equal to an outer diameter of the second annular protrusion 22 of the second heat exchange plate 2. Moreover, the projection of the communicating protrusion 121 of the first annular protrusion 12 on the plane perpendicular to the stacking direction is outside (e.g.,

radially outside) the projection of the second portion 2202 of the second annular protrusion 22 on the plane perpendicular to the stacking direction, and the projection of the communicating hole 95 on the plane perpendicular to the stacking direction is in the projection of the communicating protrusion 121 of the first annular protrusion 12.

[0038] In some embodiments of the present invention, with reference to Figs. 1 to 4, the communicating hole 95 is a plurality of communicating holes 95, and the communicating protrusion 121 is a plurality of spaced communicating protrusions 121.

[0039] In some embodiments of the present invention, with reference to Figs. 11 and 12, a surface 2203 of the second annular protrusion 22 of the second heat exchange plate 2 facing the second side has a recessed portion 2206, which forms a communicating hole 95. Thus, it is only necessary to machine a recessed portion on one side of the second heat exchange plate 2, which is convenient for machining with high accuracy. Optionally, the surface 1203 of the first annular protrusion 12 of the first heat exchange plate 1 facing the first side has a recessed portion, which forms the communicating hole 95. Alternatively, the surface 1203 of the first annular protrusion 12 of the first heat exchange plate 1 facing the first side has a recessed portion, the surface 2203 of the second annular protrusion 22 of the second heat exchange plate 2 facing the second side has a recessed portion 2206, and the recessed portion of the surface 1203 of the first annular protrusion 12 of the first heat exchange plate 1 facing the first side and the recessed portion 2206 of the surface 2203 of the second annular protrusion 22 of the second heat exchange plate 2 facing the second side are aligned in the stacking direction to form a communicating hole 95, or are misaligned to form communicating holes 95, respectively. According to an example of the present invention, an insert with a hole may be placed in the recessed portion to ensure the accuracy of the communicating hole. For example, the first annular protrusion 12 of the first heat exchange plate 1 has a circular annular shape, the second protrusion of the second heat exchange plate 2 has a circular annular shape, and an outer diameter of the first annular protrusion 12 of the first heat exchange plate 1 is substantially equal to an outer diameter of the second annular protrusion 22 of the second heat exchange plate 2.

[0040] The concepts according to the embodiments of the present invention can be applied to any plate heat exchanger, not limited to the heat exchangers shown in the figures. That is, the port portion of the heat exchange plate of the plate heat exchanger according to the embodiments of the present invention can be applied to any plate heat exchanger.

[0041] The plate heat exchanger according to the embodiments of the present invention can simplify the manufacturing process of the plate heat exchanger, for example. A separate distributor may be omitted for the plate heat exchanger. In addition, the use of the plate heat exchanger according to the embodiments of the present

invention can reduce the cost.

[0042] According to the plate heat exchanger of the embodiments of the present invention, an integrated distributor is formed on the heat exchange plate by means of stamping.

[0043] 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 plate heat exchanger (100), comprising:

a plurality of heat exchange plates (1, 2, 3, 4), the plurality of heat exchange plates (1, 2, 3, 4) being arranged in a stacking direction to form a plurality of heat exchange spaces (A, B, C), and the plurality of heat exchange plates (1, 2, 3, 4) comprising a plurality of first heat exchange plates (1) and a plurality of second heat exchange plates (2); and
a port (93) formed in the heat exchange plates (1, 2, 3, 4), the port (93) communicating with a predetermined heat exchange space of the plurality of heat exchange spaces (A, B, C), wherein the first heat exchange plate (1) comprises: a first heat exchange plate main body (10); a first opening (11) formed in the first heat exchange plate main body (10) for forming the port (93); and a first annular protrusion (12) surrounding the first opening (11), adjoining the first opening (11) and protruding from the first heat exchange plate main body (10) toward a first side in the stacking direction; and
the second heat exchange plate (2) comprises: a second heat exchange plate main body (20); a second opening (21) formed in the second heat exchange plate main body (20) for forming the port (93); and a second annular protrusion (22) surrounding the second opening (21), adjoining the second opening (21) and protruding from the second heat exchange plate main body (20) toward a second side opposite to the first side in the stacking direction;
a communicating hole (95) formed in at least some of the first heat exchange plates (1) and/or at least some of the second heat exchange plates (2), wherein the port communicates (93) with the predetermined heat exchange space through the communicating hole (95),
wherein:

the first annular protrusion (12) of the first heat exchange plate (1) comprises: an an-

- nular first portion (1201) extending from the first heat exchange plate main body (10) toward the first side; and an annular second portion (1202) extending inwardly from the annular first portion (1201), the second portion (1202) of the first annular protrusion (12) having a surface (1203) facing the first side;
- the second annular protrusion (22) of the second heat exchange plate (2) comprises: an annular first portion (2201) extending from the second heat exchange plate main body (20) toward the second side; and an annular second portion (2202) extending inwardly from the annular first portion (2201) of the second annular protrusion (22) of the second heat exchange plate (2), the second portion (2202) of the second annular protrusion (22) having a surface (2203) facing the second side; and
- the surface (1203) of the second portion (1202) of the first annular protrusion (12) and the surface (2203) of the second portion (2202) of the second annular protrusion (22) adjacent to each other are in at least partial contact to form a seal over at least one part of a circumferential length of the surface (1203) of the second portion (1202) of the first annular protrusion (12) and the surface (2203) of the second portion (2202) of the second annular protrusion (22), wherein the second heat exchange plate (2) further comprises an annular portion (24) surrounding the second annular protrusion (22), **characterized in that** the communicating hole (95) is in the annular second portions (1202) of the first annular protrusions (12) of at least some of the first heat exchange plates (1) and/or the communicating hole (95) is in the annular portions (24) of at least some of the second heat exchange plates (2)
2. The plate heat exchanger as claimed in claim 1, wherein:

projections of the second portion (1202) of the first annular protrusion (12) and the second portion (2202) of the second annular protrusion (22) on a plane perpendicular to the stacking direction have an annular inner overlapping portion, and

a projection of the communicating hole (95) on the plane perpendicular to the stacking direction is outside the annular inner overlapping portion.
 3. The plate heat exchanger as claimed in claim 2, wherein:

at least one part of the projection of the second portion (1202) of the first annular protrusion (12) on the plane perpendicular to the stacking direction is outside the projection of the second portion (2202) of the second annular protrusion (22) in the plane perpendicular to the stacking direction.
 4. The plate heat exchanger as claimed in claim 2, wherein:

the first heat exchange plate (1) further comprises an annular portion (14) surrounding the first annular protrusion (12), the annular portion (14) of the first heat exchange plate (1) has a surface (15) facing the second side, the annular portion (24) of the second heat exchange plate (2) has a surface (25) facing the first side, and the surface (15) of the annular portion (14) of the first heat exchange plate (1) and the surface (25) of the annular portion (24) of the second heat exchange plate (2) adjacent to each other are in at least partial contact to form a seal.
 5. The plate heat exchanger as claimed in claim 4, wherein:

projections of the annular portion (14) of the first heat exchange plate (1) and the annular portion (24) of the second heat exchange plate (2) on the plane perpendicular to the stacking direction have an annular outer overlapping portion, and the projection of the communicating hole (95) on the plane perpendicular to the stacking direction is inside the annular outer overlapping portion.
 6. The plate heat exchanger as claimed in claim 4, wherein:

at least one part of the projection of the annular portion (24) of the second heat exchange plate (2) on the plane perpendicular to the stacking direction is inside the projection of the annular portion (14) of the first heat exchange plate (1) in the plane perpendicular to the stacking direction.
 7. The plate heat exchanger as claimed in claim 1 or 2, wherein:

the first annular protrusion (12) of the first heat exchange plate (1) has a circular annular shape, the second annular protrusion (22) of the second heat exchange plate (2) has a circular annular shape, and an outer diameter of the first annular protrusion (12) of the first heat exchange plate (1) is larger than an outer diameter of the second annular protrusion (22) of the second heat exchange plate (2).
 8. The plate heat exchanger as claimed in claim 4 or 5, wherein:

the annular portion of the first heat exchange plate (1) has a circular annular shape, the annular portion

of the second heat exchange plate (2) has a circular annular shape, and an inner diameter of the annular portion of the second heat exchange plate (2) is smaller than an inner diameter of the annular portion of the first heat exchange plate (1).

9. The plate heat exchanger as claimed in claim 2, wherein:

the first annular protrusion (12) of the first heat exchange plate (1) comprises an annular protrusion main body (120) and a communicating protrusion (121) extending outwardly from the annular protrusion main body (120); and at least one part of a projection of the communicating protrusion (121) of the first annular protrusion (12) on the plane perpendicular to the stacking direction is outside the projection of the second portion (2202) of the second annular projection (22) on the plane perpendicular to the stacking direction, and the projection of the communicating hole (95) on the plane perpendicular to the stacking direction is in the at least one part of the projection of the communicating protrusion (121) of the first annular protrusion (12).

10. The plate heat exchanger as claimed in claim 9, wherein:

the annular protrusion main body (120) of the first annular protrusion (12) of the first heat exchange plate (1) has a circular annular shape, the second annular protrusion (22) of the second heat exchange plate (2) has a circular annular shape, and an outer diameter of the annular protrusion main body (120) of the first annular protrusion (12) of the first heat exchange plate (1) is substantially equal to an outer diameter of the second annular protrusion (22) of the second heat exchange plate (2); and the projection of the communicating protrusion (121) of the first annular protrusion (12) on the plane perpendicular to the stacking direction is outside the projection of the second portion (2202) of the second annular protrusion (22) on the plane perpendicular to the stacking direction, and the projection of the communicating hole (95) on the plane perpendicular to the stacking direction is in the projection of the communicating protrusion (121) of the first annular protrusion (12).

11. The plate heat exchanger as claimed in claim 1, wherein:

a surface (2203) of the second annular protrusion (22) of the second heat exchange plate (2) facing the second side has a second recessed portion (2206), and the second recessed portion (2206)

forms the communicating hole (95).

12. The plate heat exchanger as claimed in claim 1, wherein:

an annular first portion (1201) of the first annular protrusion (12) of the first heat exchange plate (1) extends obliquely from the first heat exchange plate main body (10) toward the first side, and an annular second portion (1202) of the first annular protrusion (12) of the first heat exchange plate (1) extends inwardly from the annular first portion (1201) of the first annular protrusion (12) of the first heat exchange plate (1) substantially parallel to the first heat exchange plate main body (10); and an annular first portion (2201) of the second annular protrusion (22) of the second heat exchange plate (2) extends obliquely from the second heat exchange plate main body (20) toward the second side, and an annular second portion (2202) of the second annular projection (22) of the second heat exchange plate (2) extends inwardly from the annular first portion (2201) of the second annular projection (22) of the second heat exchange plate substantially parallel to the second heat exchange plate main body (20).

Patentansprüche

1. Plattenwärmetauscher (100), der Folgendes umfasst:

mehrere Wärmeaustauschplatten (1, 2, 3, 4), wobei die mehreren Wärmeaustauschplatten (1, 2, 3, 4) in einer Stapelrichtung angeordnet sind, um mehrere Wärmeaustauschräume (A, B, C) zu bilden, und wobei die mehreren Wärmeaustauschplatten (1, 2, 3, 4) mehrere erste Wärmeaustauschplatten (1) und mehrere zweite Wärmeaustauschplatten (2) umfassen; und eine Öffnung (93), gebildet in den Wärmeaustauschplatten (1, 2, 3, 4), wobei die Öffnung (93) mit einem vorbestimmten Wärmeaustauschraum der mehreren Wärmeaustauschräume (A, B, C) kommuniziert, wobei die erste Wärmeaustauschplatte (1) Folgendes umfasst:

einen ersten Wärmeaustauschplattenhauptkörper (10); einen ersten Durchgang (11), gebildet im ersten Wärmeaustauschplattenhauptkörper (10), zum Bilden der Öffnung (93); und einen ersten ringförmigen Vorsprung (12), der den ersten Durchgang (11) umgibt, angrenzend an den ersten Durchgang (11) und aus dem ersten Wär-

meaustauschplattenhauptkörper (10) in Richtung einer ersten Seite in der Stapelrichtung herausragend; und die zweite Wärmeaustauschplatte (2) Folgendes umfasst:

einen zweiten Wärmeaustauschplattenhauptkörper (20); einen zweiten Durchgang (21), gebildet im zweiten Wärmeaustauschplattenhauptkörper (20), zum Bilden der Öffnung (93); und einen zweiten ringförmigen Vorsprung (22), der den zweiten Durchgang (21) umgibt, angrenzend an den zweiten Durchgang (21) und aus dem zweiten Wärmeaustauschplattenhauptkörper (20) in Richtung einer zweiten Seite gegenüber der ersten Seite in der Stapelrichtung herausragend; ein Verbindungsloch (95), gebildet in zumindest einigen der ersten Wärmeaustauschplatten (1) und/oder zumindest einigen der zweiten Wärmeaustauschplatten (2), wobei die Öffnung (93) über das Verbindungsloch (95) mit dem vorbestimmten Wärmeaustauschraum kommuniziert, wobei:

der erste ringförmige Vorsprung (12) der ersten Wärmeaustauschplatte (1) Folgendes umfasst: einen ringförmigen ersten Teil (1201), der sich vom ersten Wärmeaustauschplattenhauptkörper (10) in Richtung der ersten Seite erstreckt; und einen ringförmigen zweiten Teil (1202), der sich vom ringförmigen ersten Teil (1201) nach innen erstreckt, wobei der zweite Teil (1202) des ersten ringförmigen Vorsprungs (12) eine Oberfläche (1203) aufweist, die zur ersten Seite zeigt; der zweite ringförmige Vorsprung (22) der zweiten Wärmeaustauschplatte (2) Folgendes umfasst: einen ersten ringförmigen Teil (2201), der sich vom zweiten Wärmeaustauschplattenhauptkörper (20) in Richtung der zweiten Seite erstreckt; und einen ringförmigen zweiten Teil (2202), der sich vom ringförmigen ersten Teil (2201) des zweiten ringförmigen Vorsprungs (22) der zweiten Wärmeaustauschplatte (2) nach innen erstreckt, wobei der zweite Teil

(2202) des zweiten ringförmigen Vorsprungs (22) eine Oberfläche (2203) aufweist, die zur zweiten Seite zeigt; und die Oberfläche (1203) des zweiten Teils (1202) des ersten ringförmigen Vorsprungs (12) und die Oberfläche (2203) des zweiten Teils (2202) des zweiten ringförmigen Vorsprungs (22), die aneinander angrenzen, in zumindest teilweise Kontakt sind, um eine Dichtung über zumindest einem Teil einer umlaufenden Länge der Oberfläche (1203) des zweiten Teils (1202) des ersten ringförmigen Vorsprungs (12) und der Oberfläche (2203) des zweiten Teils (2202) des zweiten ringförmigen Vorsprungs (22) zu bilden, wobei die zweite Wärmeaustauschplatte (2) ferner einen ringförmigen Teil (24) umfasst, der den zweiten ringförmigen Vorsprung (22) umgibt, **dadurch gekennzeichnet, dass** das Verbindungsloch (95) in den ringförmigen zweiten Teilen (1202) des ersten ringförmigen Vorsprungs (12) zumindest einiger der ersten Wärmeaustauschplatten (1) ist und/oder das Verbindungsloch (95) in den ringförmigen Teilen (24) zumindest einiger der zweiten Wärmeaustauschplatten (2) ist.

2. Plattenwärmetauscher nach Anspruch 1, wobei:

Überstände des zweiten Teils (1202) des ersten ringförmigen Vorsprungs (12) und des zweiten Teils (2202) des zweiten ringförmigen Vorsprungs (22) auf einer Ebene senkrecht zur Stapelrichtung einen ringförmigen inneren überlappenden Teil aufweisen, und ein Überstand des Verbindungslochs (95) auf der Ebene senkrecht zur Stapelrichtung außerhalb des ringförmigen inneren überlappenden Teils ist.

3. Plattenwärmetauscher nach Anspruch 2, wobei: zumindest ein Teil des Überstands des zweiten Teils (1202) des ersten ringförmigen Vorsprungs (12) auf der Ebene senkrecht zur Stapelrichtung außerhalb des Überstands des zweiten Teils (2202) des zweiten ringförmigen Vorsprungs (22) in der Ebene senkrecht zur Stapelrichtung ist.

4. Plattenwärmetauscher nach Anspruch 2, wobei: die erste Wärmeaustauschplatte (1) ferner einen

ringförmigen Teil (14) umfasst, der den ersten ringförmigen Vorsprung (12) umgibt, wobei der ringförmige Teil (14) der ersten Wärmeaustauschplatte (1) eine Oberfläche (15) aufweist, die zur zweiten Seite zeigt, wobei der ringförmige Teil (24) der zweiten Wärmeaustauschplatte (2) eine Oberfläche (25) aufweist, die zur ersten Seite zeigt, und wobei die Oberfläche (15) des ringförmigen Teils (14) der ersten Wärmeaustauschplatte (1) und die Oberfläche (25) des ringförmigen Teils (24) der zweiten Wärmeaustauschplatte (2), die aneinander angrenzen, in zumindest teilweise Kontakt sind, um eine Dichtung zu bilden.

5. Plattenwärmetauscher nach Anspruch 4, wobei:

Überstände des ringförmigen Teils (14) der ersten Wärmeaustauschplatte (1) und des ringförmigen Teils (24) der zweiten Wärmeaustauschplatte (2) auf der Ebene senkrecht zur Stapelrichtung einen ringförmigen äußeren überlappenden Teil aufweisen, und der Überstand des Verbindungslochs (95) auf der Ebene senkrecht zur Stapelrichtung innerhalb des ringförmigen äußeren überlappenden Teils ist.

6. Plattenwärmetauscher nach Anspruch 4, wobei: zumindest ein Teil des Überstands des ringförmigen Teils (24) der zweiten Wärmeaustauschplatte (2) auf der Ebene senkrecht zur Stapelrichtung innerhalb des ringförmigen Teils (14) der ersten Wärmeaustauschplatte (1) in der Ebene senkrecht zur Stapelrichtung ist.

7. Plattenwärmetauscher nach Anspruch 1 oder 2, wobei: der erste ringförmige Vorsprung (12) der ersten Wärmeaustauschplatte (1) eine kreisförmige ringförmige Form aufweist, wobei der zweite ringförmige Vorsprung (22) der zweiten Wärmeaustauschplatte (2) eine kreisförmige ringförmige Form aufweist, und wobei ein Außendurchmesser des ersten ringförmigen Vorsprungs (12) der ersten Wärmeaustauschplatte (1) größer als ein Außendurchmesser des zweiten ringförmigen Vorsprungs (22) der zweiten Wärmeaustauschplatte (2) ist.

8. Plattenwärmetauscher nach Anspruch 4 oder 5, wobei: der ringförmige Teil der ersten Wärmeaustauschplatte (1) eine kreisförmige ringförmige Form aufweist, wobei der ringförmige Teil der zweiten Wärmeaustauschplatte (2) eine kreisförmige ringförmige Form aufweist, und wobei ein Innendurchmesser des ringförmigen Teils der zweiten Wärmeaustauschplatte (2) kleiner als ein Innendurchmesser des ringförmigen Teils der ersten Wärmeaustauschplatte (1) ist.

9. Plattenwärmetauscher nach Anspruch 2, wobei:

der erste ringförmige Vorsprung (12) der ersten Wärmeaustauschplatte (1) einen ringförmigen Vorsprungshauptkörper (120) und einen Verbindungsvorsprung (121), der sich vom ringförmigen Vorsprungshauptkörper (120) nach außen erstreckt, umfasst; und zumindest ein Teil eines Überstands des Verbindungsvorsprungs (121) des ersten ringförmigen Vorsprungs (12) auf der Ebene senkrecht zur Stapelrichtung außerhalb des Überstands des zweiten Teils (2202) des zweiten ringförmigen Überstands (22) auf der Ebene senkrecht zur Stapelrichtung ist, und wobei der Überstand des Verbindungslochs (95) auf der Ebene senkrecht zur Stapelrichtung in dem zumindest einen Teil des Überstands des Verbindungsvorsprungs (121) des ersten ringförmigen Vorsprungs (12) ist.

10. Plattenwärmetauscher nach Anspruch 9, wobei:

der ringförmige Vorsprungshauptkörper (120) des ersten ringförmigen Vorsprungs (12) der ersten Wärmeaustauschplatte (1) eine kreisförmige ringförmige Form aufweist, der zweite ringförmige Vorsprung (22) der zweiten Wärmeaustauschplatte (2) eine kreisförmige ringförmige Form aufweist, und ein Außendurchmesser des ringförmigen Vorsprungshauptkörpers (120) des ersten ringförmigen Vorsprungs (12) der ersten Wärmeaustauschplatte (1) im Wesentlichen gleich einem Außendurchmesser des zweiten ringförmigen Vorsprungs (22) der zweiten Wärmeaustauschplatte (2) ist; und der Überstand des Verbindungsvorsprungs (121) des ersten ringförmigen Vorsprungs (12) auf der Ebene senkrecht zur Stapelrichtung außerhalb des Überstands des zweiten Teils (2202) des zweiten ringförmigen Vorsprungs (22) auf der Ebene senkrecht zur Stapelrichtung ist, und wobei der Überstand des Verbindungslochs (95) auf der Ebene senkrecht zur Stapelrichtung im Überstand des Verbindungsvorsprungs (121) des ersten ringförmigen Vorsprungs (12) ist.

11. Plattenwärmetauscher nach Anspruch 1, wobei: eine Oberfläche (2203) des zweiten ringförmigen Vorsprungs (22) der zweiten Wärmeaustauschplatte (2), die zur zweiten Seite zeigt, einen eingesenkten Teil (2206) aufweist, und wobei der zweite eingesenkte Teil (2206) das Verbindungsloch (95) bildet.

12. Plattenwärmetauscher nach Anspruch 1, wobei:

sich ein ringförmiger erster Teil (1201) des ers-

ten ringförmigen Vorsprungs (12) der ersten Wärmeaustauschplatte (1) vom ersten Wärmeaustauschplattenhauptkörper (10) schräg in Richtung der ersten Seite erstreckt und wobei sich ein ringförmiger zweiter Teil (1202) des ersten ringförmigen Vorsprungs (12) der ersten Wärmeaustauschplatte (1) vom ringförmigen ersten Teil (1201) des ersten ringförmigen Vorsprungs (12) der ersten Wärmeaustauschplatte (1) im Wesentlichen parallel zum ersten Wärmeaustauschplattenhauptkörper (10) nach innen erstreckt; und sich ein ringförmiger erster Teil (2201) des zweiten ringförmigen Vorsprungs (22) der zweiten Wärmeaustauschplatte (2) vom zweiten Wärmeaustauschplattenhauptkörper (20) schräg in Richtung der zweiten Seite erstreckt und wobei sich ein ringförmiger zweiter Teil (2202) des zweiten ringförmigen Überstands (22) der zweiten Wärmeaustauschplatte (2) vom ringförmigen ersten Teil (2201) des zweiten ringförmigen Überstands (22) der zweiten Wärmeaustauschplatte im Wesentlichen parallel zum zweiten Wärmeaustauschplattenhauptkörper (20) nach innen erstreckt.

Revendications

1. Échangeur de chaleur à plaques (100), comprenant :

une pluralité de plaques d'échange de chaleur (1, 2, 3, 4), la pluralité de plaques d'échange de chaleur (1, 2, 3, 4) étant agencées dans une direction d'empilage pour former une pluralité d'espaces d'échange de chaleur (A, B, C), et la pluralité de plaques d'échange de chaleur (1, 2, 3, 4) comprenant une pluralité de premières plaques d'échange de chaleur (1) et une pluralité de secondes plaques d'échange de chaleur (2); et un port (93) formé dans les plaques d'échange de chaleur (1, 2, 3, 4), le port (93) communiquant avec un espace prédéterminé d'échange de chaleur de la pluralité d'espaces d'échange de chaleur (A, B, C), dans lequel la première plaque d'échange de chaleur (1) comprend : un corps principal de première plaque d'échange de chaleur (10); une première ouverture (11), formée dans le corps principal de première plaque d'échange de chaleur (10), destinée à former le port (93); et une première saillie annulaire (12) entourant la première ouverture (11), contiguë à la première ouverture (11) et faisant saillie à partir du corps principal de première plaque d'échange de chaleur (10) vers un premier côté dans la direction

d'empilage; et la seconde plaque d'échange de chaleur (2) comprend : un corps principal de seconde plaque d'échange de chaleur (20); une seconde ouverture (21), formée dans le corps principal de seconde plaque d'échange de chaleur (20), destinée à former le port (93); et une seconde saillie annulaire (22) entourant la seconde ouverture (21), contiguë à la seconde ouverture (21) et faisant saillie à partir du corps principal de seconde plaque d'échange de chaleur (20) vers un second côté opposé au premier côté dans la direction d'empilage; un trou de communication (95) formé dans au moins certaines des premières plaques d'échange de chaleur (1) et/ou au moins certaines des secondes plaques d'échange de chaleur (2), dans lequel le port (93) communique avec l'espace prédéterminé d'échange de chaleur par l'intermédiaire du trou de communication (95), dans lequel :

la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) comprend : une première portion annulaire (1201) s'étendant depuis le corps principal de première plaque d'échange de chaleur (10) vers le premier côté; et une seconde portion annulaire (1202) s'étendant vers l'intérieur depuis la première portion annulaire (1201), la seconde portion (1202) de la première saillie annulaire (12) ayant une surface (1203) faisant face au premier côté; la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2) comprend : une première portion annulaire (2201) s'étendant depuis le corps principal de seconde plaque d'échange de chaleur (20) vers le second côté; et une seconde portion annulaire (2202) s'étendant vers l'intérieur depuis la première portion annulaire (2201) de la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2), la seconde portion (2202) de la seconde saillie annulaire (22) ayant une surface (2203) faisant face au second côté; et la surface (1203) de la seconde portion (1202) de la première saillie annulaire (12) et la surface (2203) de la seconde portion (2202) de la seconde saillie annulaire (22) adjacentes l'une à l'autre sont en contact au moins partiel pour former un dispositif d'étanchéité par-dessus au moins une partie d'une longueur circonférentielle de la surface (1203) de la seconde portion (1202)

- de la première saillie annulaire (12) et de la surface (2203) de la seconde portion (2202) de la seconde saillie annulaire (22), dans lequel la seconde plaque d'échange de chaleur (2) comprend en outre une portion annulaire (24) entourant la seconde saillie annulaire (22), **caractérisé en ce que** le trou de communication (95) est dans les secondes portions annulaires (1202) des premières saillies annulaires (12) d'au moins certaines des premières plaques d'échange de chaleur (1) et/ou le trou de communication (95) est dans les portions annulaires (24) d'au moins certaines des secondes plaques d'échange de chaleur (2).
2. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 1, dans lequel :
- des projections de la seconde portion (1202) de la première saillie annulaire (12) et de la seconde portion (2202) de la seconde saillie annulaire (22) sur un plan perpendiculaire à la direction d'empilage ont une portion de chevauchement intérieure annulaire, et une projection du trou de communication (95) sur le plan perpendiculaire à la direction d'empilage est à l'extérieur de la portion de chevauchement intérieure annulaire.
3. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 2, dans lequel :
- au moins une partie de la projection de la seconde portion (1202) de la première saillie annulaire (12) sur le plan perpendiculaire à la direction d'empilage est à l'extérieur de la projection de la seconde portion (2202) de la seconde saillie annulaire (22) dans le plan perpendiculaire à la direction d'empilage.
4. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 2, dans lequel :
- la première plaque d'échange de chaleur (1) comprend en outre une portion annulaire (14) entourant la première saillie annulaire (12), la portion annulaire (14) de la première plaque d'échange de chaleur (1) a une surface (15) faisant face au second côté, la portion annulaire (24) de la seconde plaque d'échange de chaleur (2) a une surface (25) faisant face au premier côté, et la surface (15) de la portion annulaire (14) de la première plaque d'échange de chaleur (1) et la surface (25) de la portion annulaire (24) de la seconde plaque d'échange de chaleur (2) adjacentes l'une à l'autre sont en contact au moins partiel pour former un dispositif d'étanchéité.
5. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 4, dans lequel :
- des projections de la portion annulaire (14) de la première plaque d'échange de chaleur (1) et de la portion annulaire (24) de la seconde plaque d'échange de chaleur (2) sur le plan perpendiculaire à la direction d'empilage ont une portion de chevauchement extérieure annulaire, et la projection du trou de communication (95) sur le plan perpendiculaire à la direction d'empilage est à l'intérieur de la portion de chevauchement extérieure annulaire.
6. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 4, dans lequel :
- au moins une partie de la projection de la portion annulaire (24) de la seconde plaque d'échange de chaleur (2) sur le plan perpendiculaire à la direction d'empilage est à l'intérieur de la projection de la portion annulaire (14) de la première plaque d'échange de chaleur (1) dans le plan perpendiculaire à la direction d'empilage.
7. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 1 ou 2, dans lequel :
- la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) a une forme annulaire circulaire, la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2) a une forme annulaire circulaire, et un diamètre extérieur de la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) est plus grand qu'un diamètre extérieur de la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2).
8. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 4 ou 5, dans lequel :
- la portion annulaire de la première plaque d'échange de chaleur (1) a une forme annulaire circulaire, la portion annulaire de la seconde plaque d'échange de chaleur (2) a une forme annulaire circulaire, et un diamètre intérieur de la portion annulaire de la seconde plaque d'échange de chaleur (2) est plus petit qu'un diamètre intérieur de la portion annulaire de la première plaque d'échange de chaleur (1).
9. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 2, dans lequel :
- la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) comprend un corps principal de saillie annulaire (120) et une saillie de communication (121) s'étendant vers l'extérieur depuis le corps principal de saillie annulaire (120) ; et au moins une partie d'une projection de la saillie de communication (121) de la première saillie annulaire (12) sur le plan perpendiculaire à la direction d'empilage est à l'extérieur de la projection de la seconde portion (2202) de la se-

conde projection annulaire (22) sur le plan perpendiculaire à la direction d'empilage, et la projection du trou de communication (95) sur le plan perpendiculaire à la direction d'empilage est dans l'au moins une partie de la projection de la saillie de communication (121) de la première saillie annulaire (12).

10. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 9, dans lequel :

le corps principal de saillie annulaire (120) de la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) a une forme annulaire circulaire, la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2) a une forme annulaire circulaire, et un diamètre extérieur du corps principal de saillie annulaire (120) de la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) est sensiblement égal à un diamètre extérieur de la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2) ; et la projection de la saillie de communication (121) de la première saillie annulaire (12) sur le plan perpendiculaire à la direction d'empilage est à l'extérieur de la projection de la seconde portion (2202) de la seconde saillie annulaire (22) sur le plan perpendiculaire à la direction d'empilage, et la projection du trou de communication (95) sur le plan perpendiculaire à la direction d'empilage est dans la projection de la saillie de communication (121) de la première saillie annulaire (12).

11. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 1, dans lequel :

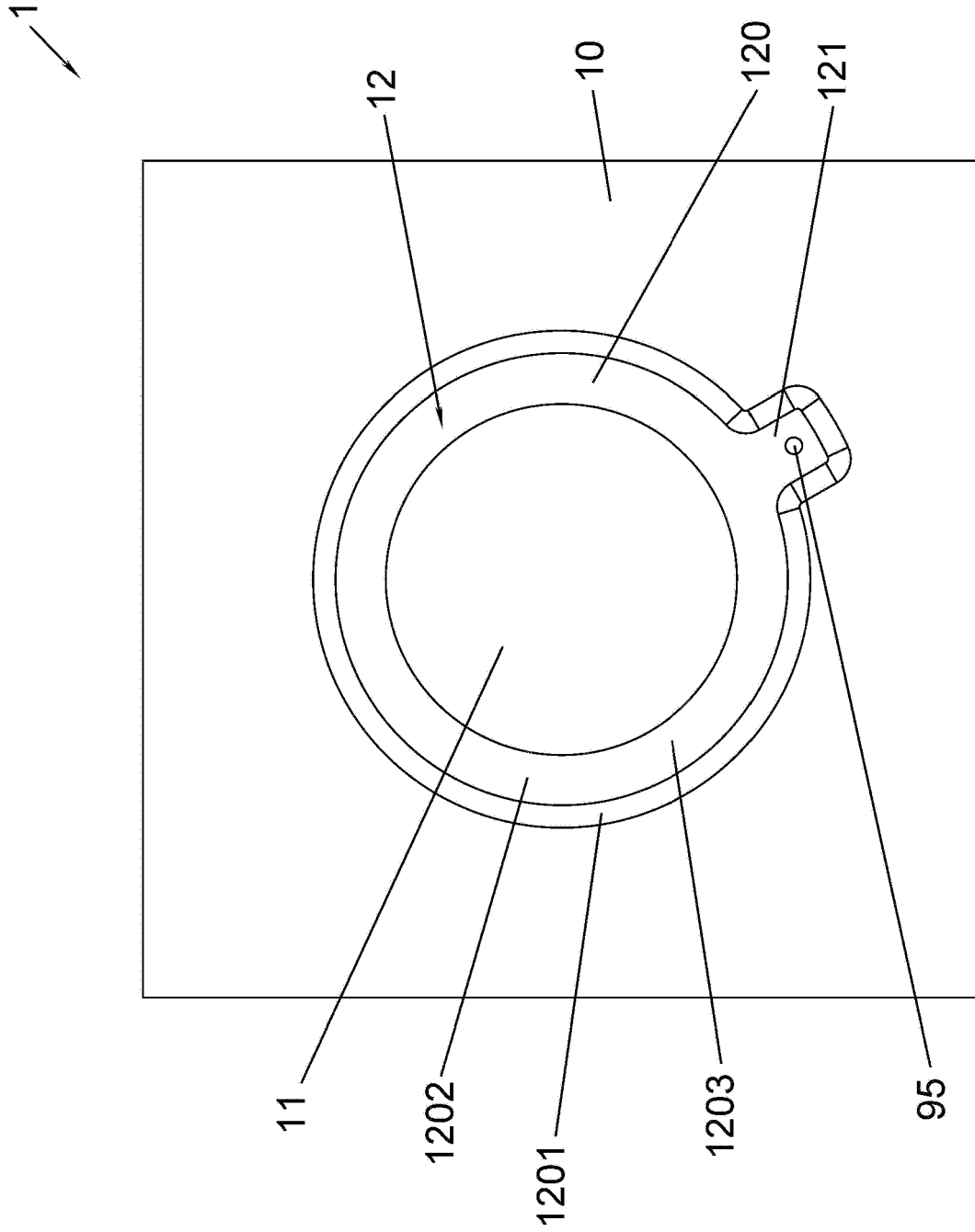
une surface (2203) de la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2) faisant face au second côté a une seconde portion évidée (2206), et la seconde portion évidée (2206) forme le trou de communication (95).

12. Échangeur de chaleur à plaques tel que revendiqué dans la revendication 1, dans lequel :

une première portion annulaire (1201) de la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) s'étend obliquement depuis le corps principal de première plaque d'échange de chaleur (10) vers le premier côté, et une seconde portion annulaire (1202) de la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) s'étend vers l'intérieur depuis la première portion annulaire (1201) de la première saillie annulaire (12) de la première plaque d'échange de chaleur (1) sensiblement parallèlement au corps principal

de première plaque d'échange de chaleur (10) ; et

une première portion annulaire (2201) de la seconde saillie annulaire (22) de la seconde plaque d'échange de chaleur (2) s'étend obliquement depuis le corps principal de seconde plaque d'échange de chaleur (20) vers le second côté, et une seconde portion annulaire (2202) de la seconde projection annulaire (22) de la seconde plaque d'échange de chaleur (2) s'étend vers l'intérieur depuis la première portion annulaire (2201) de la seconde projection annulaire (22) de la seconde plaque d'échange de chaleur sensiblement parallèlement au corps principal de seconde plaque d'échange de chaleur (20).



1
圖

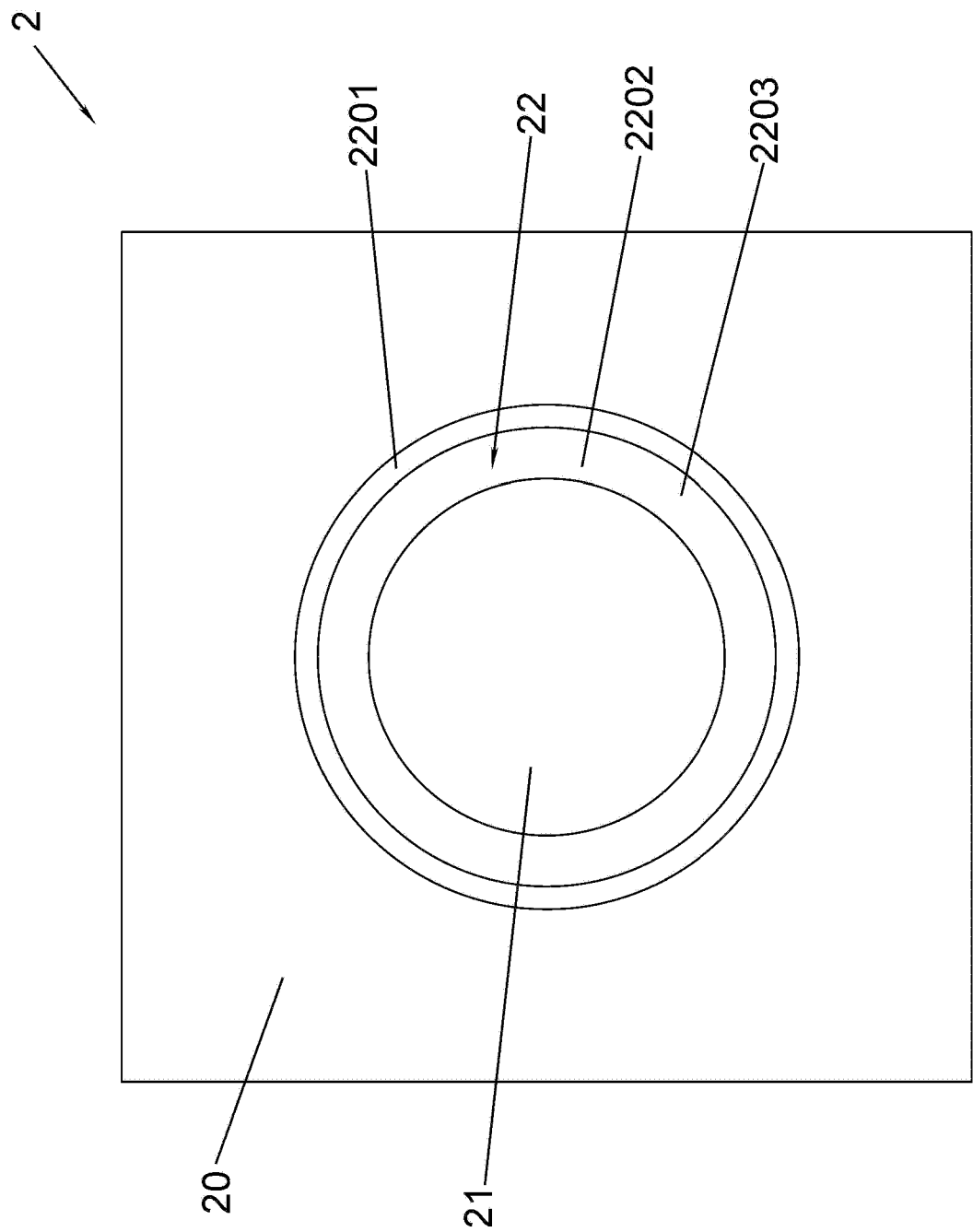
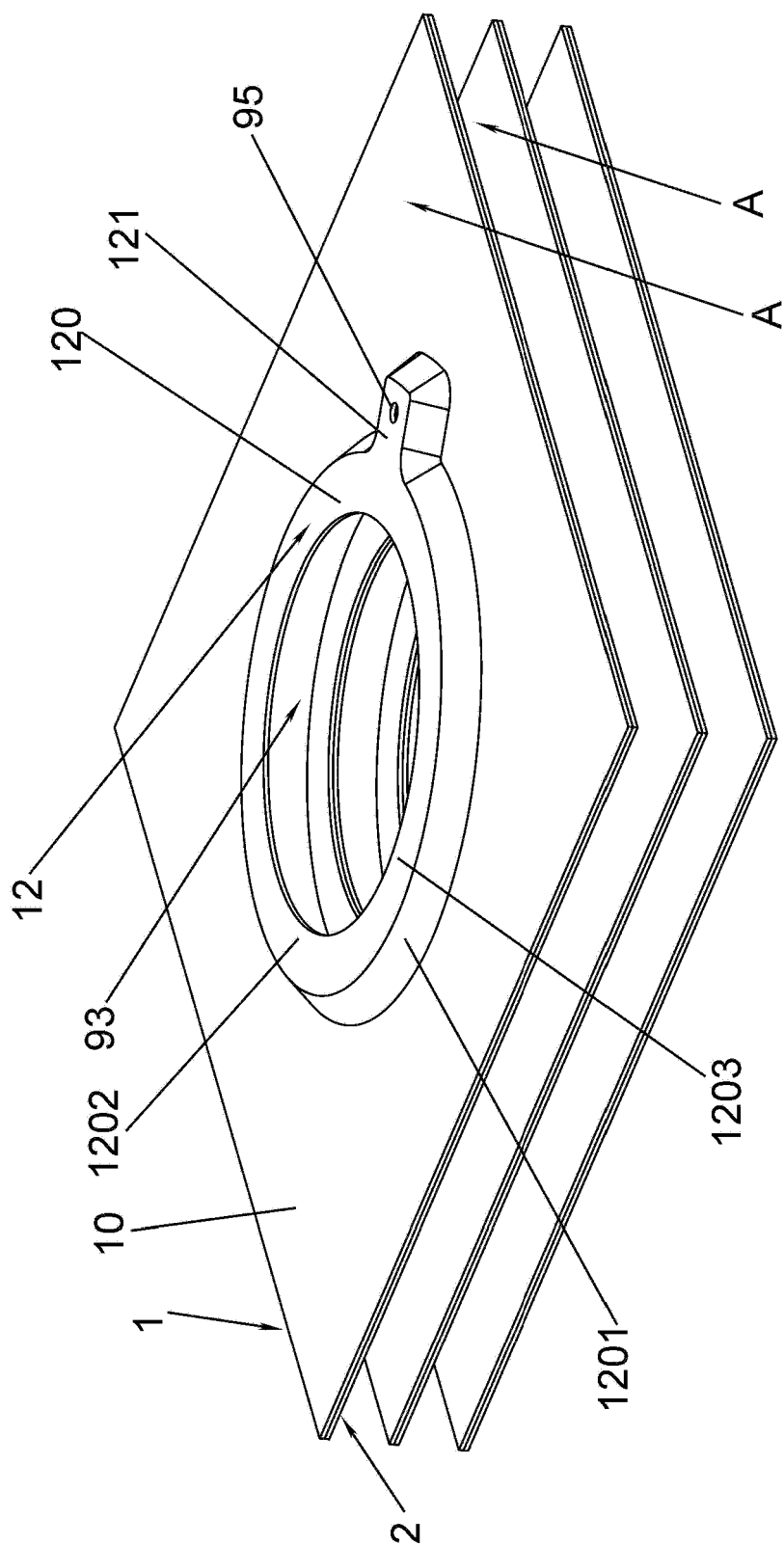


图2



3
[X]

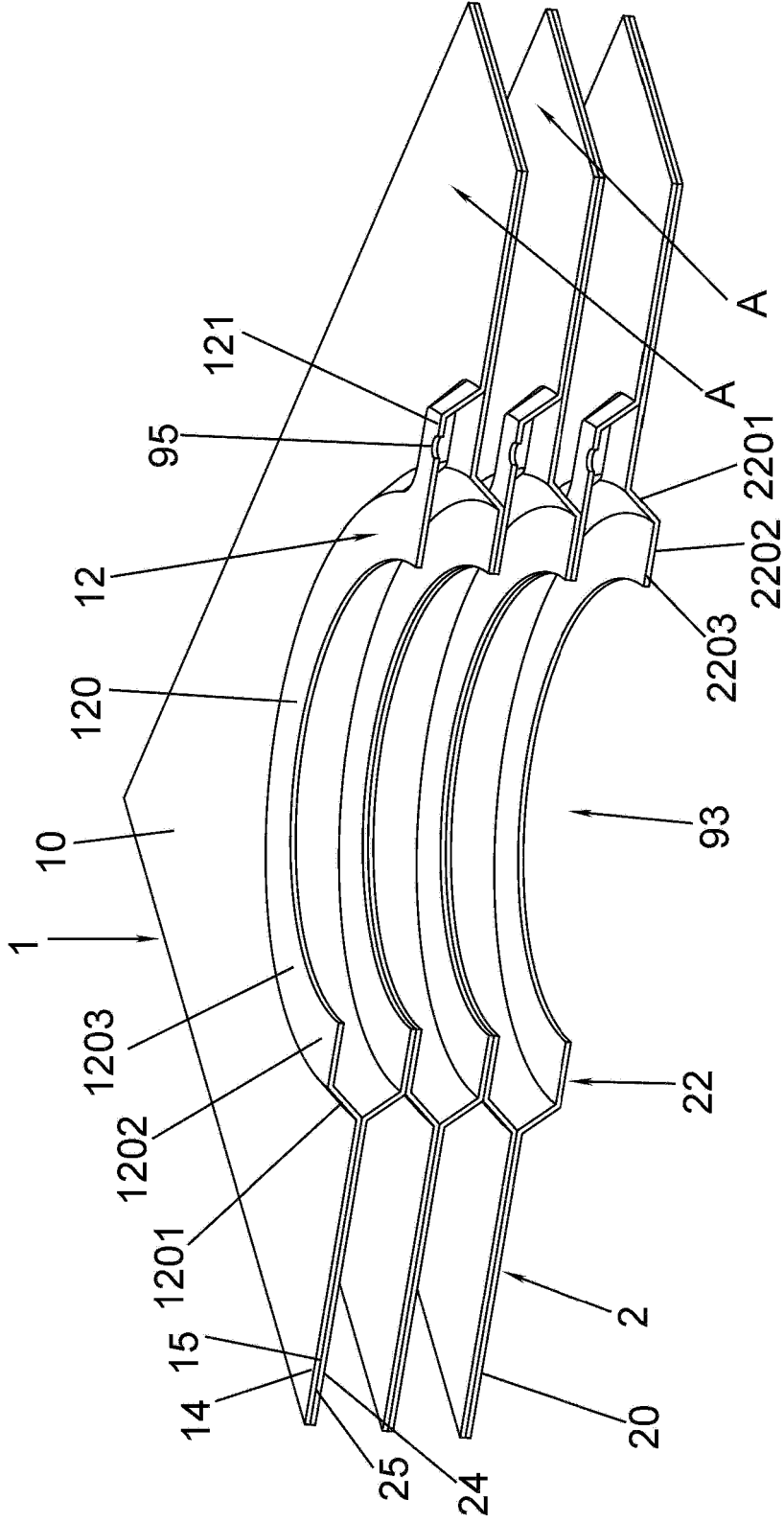


图4

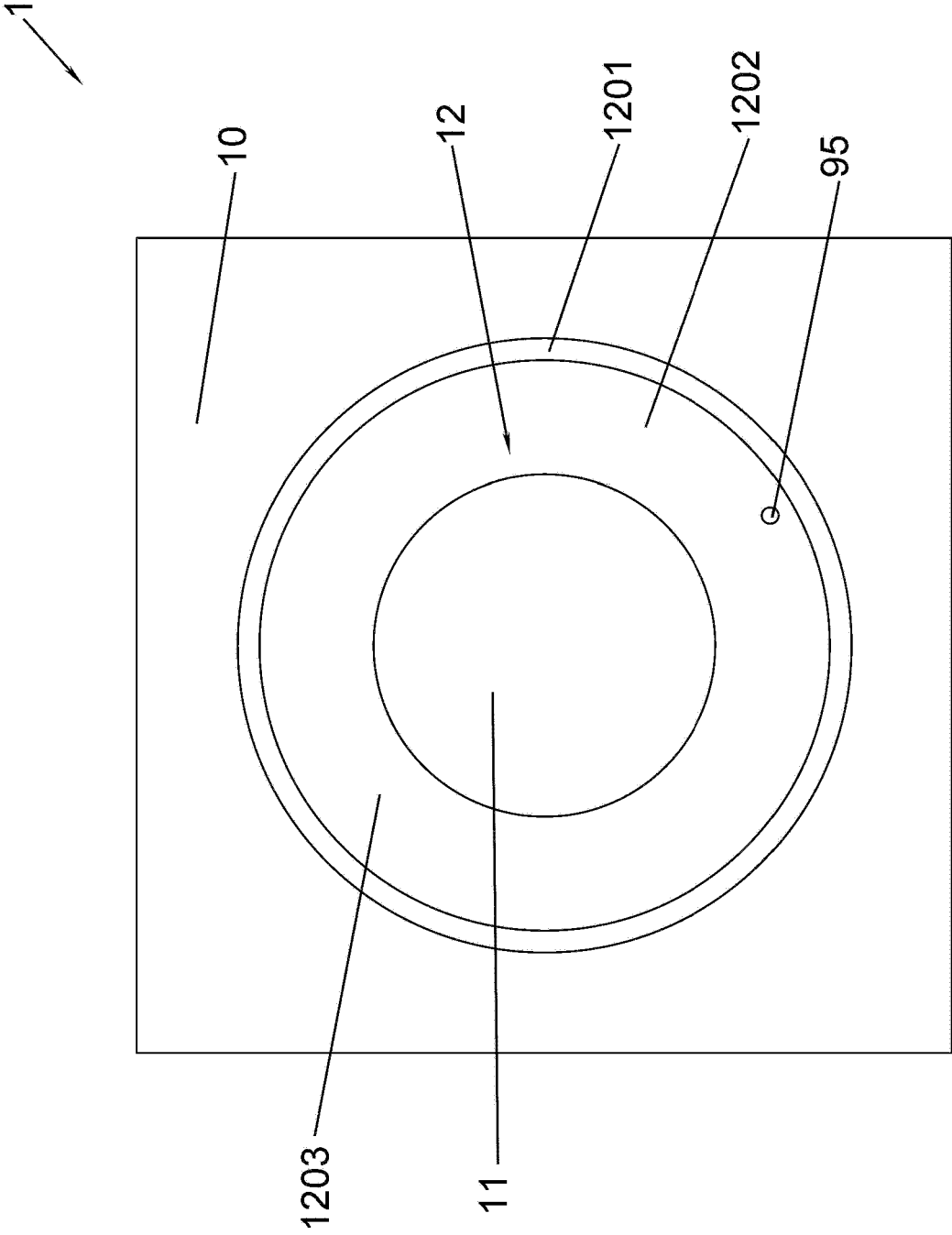


图5

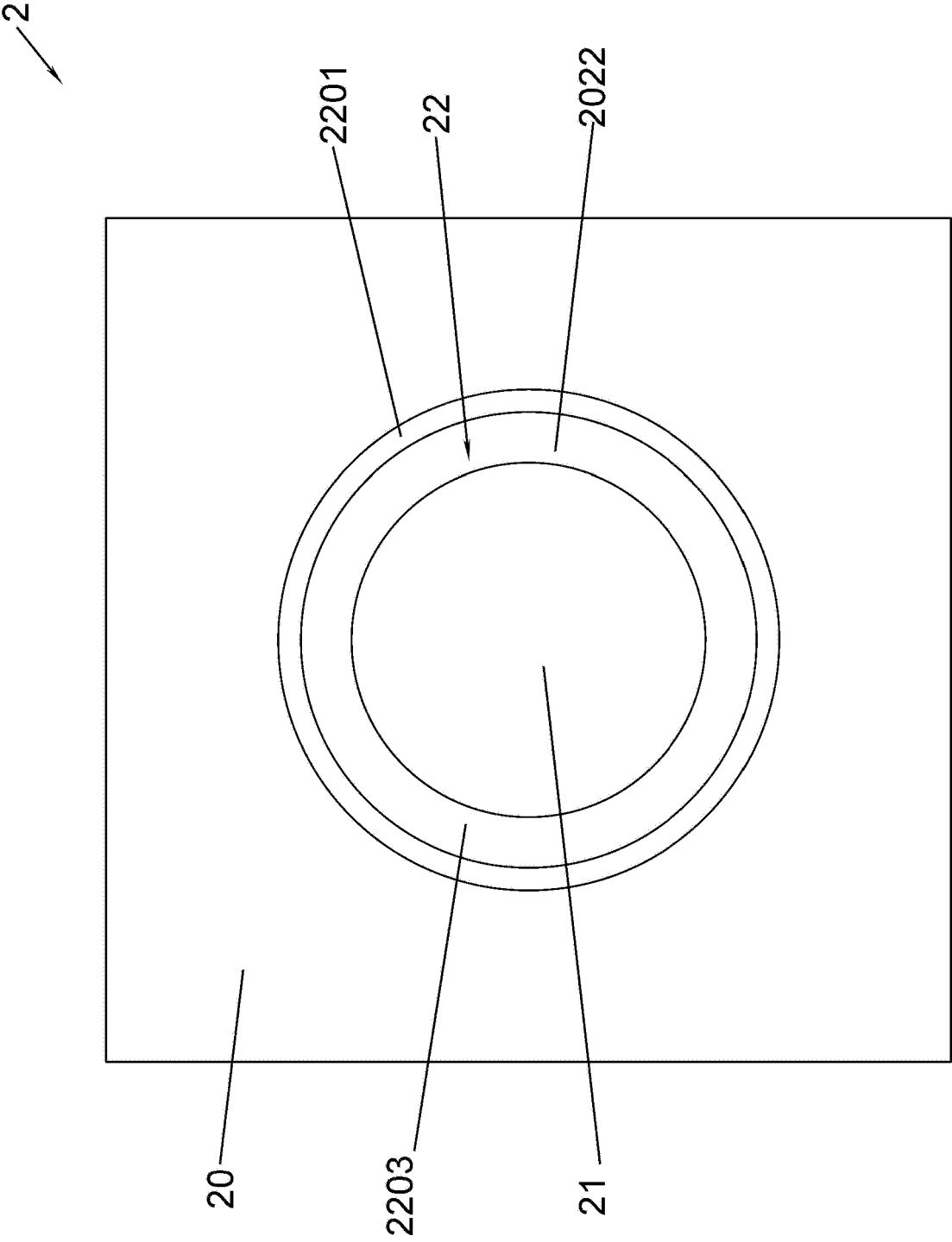
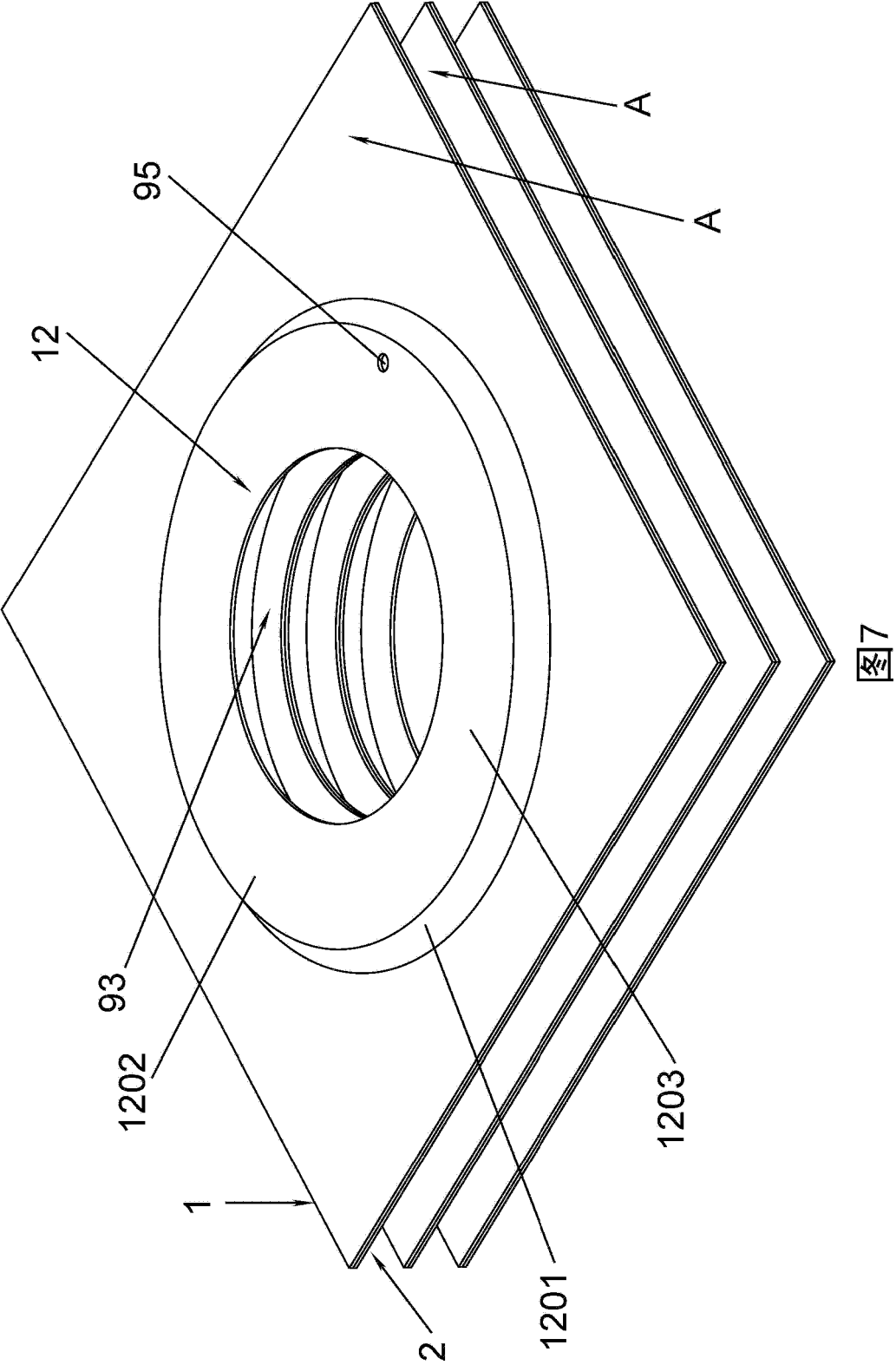
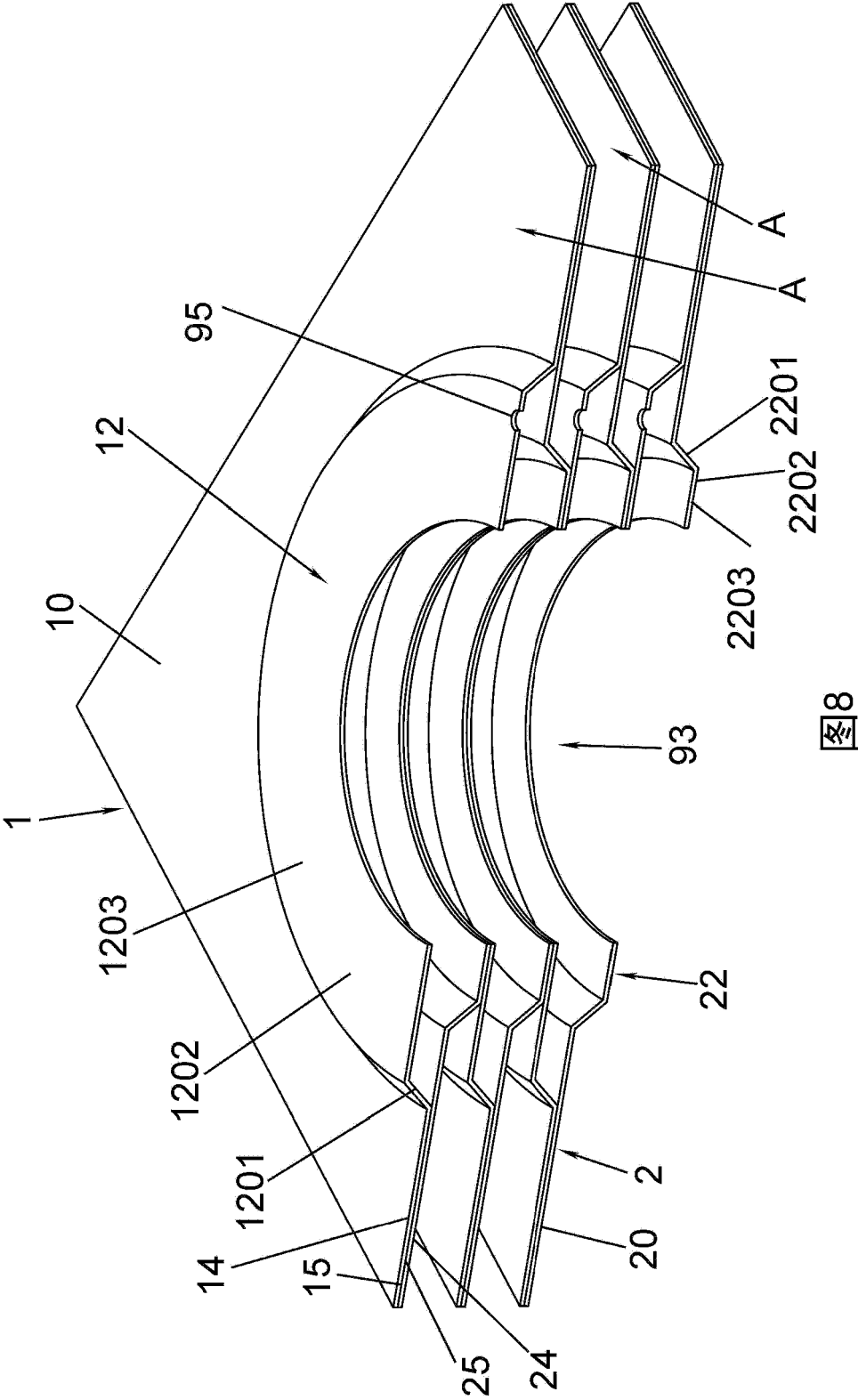


图6





1

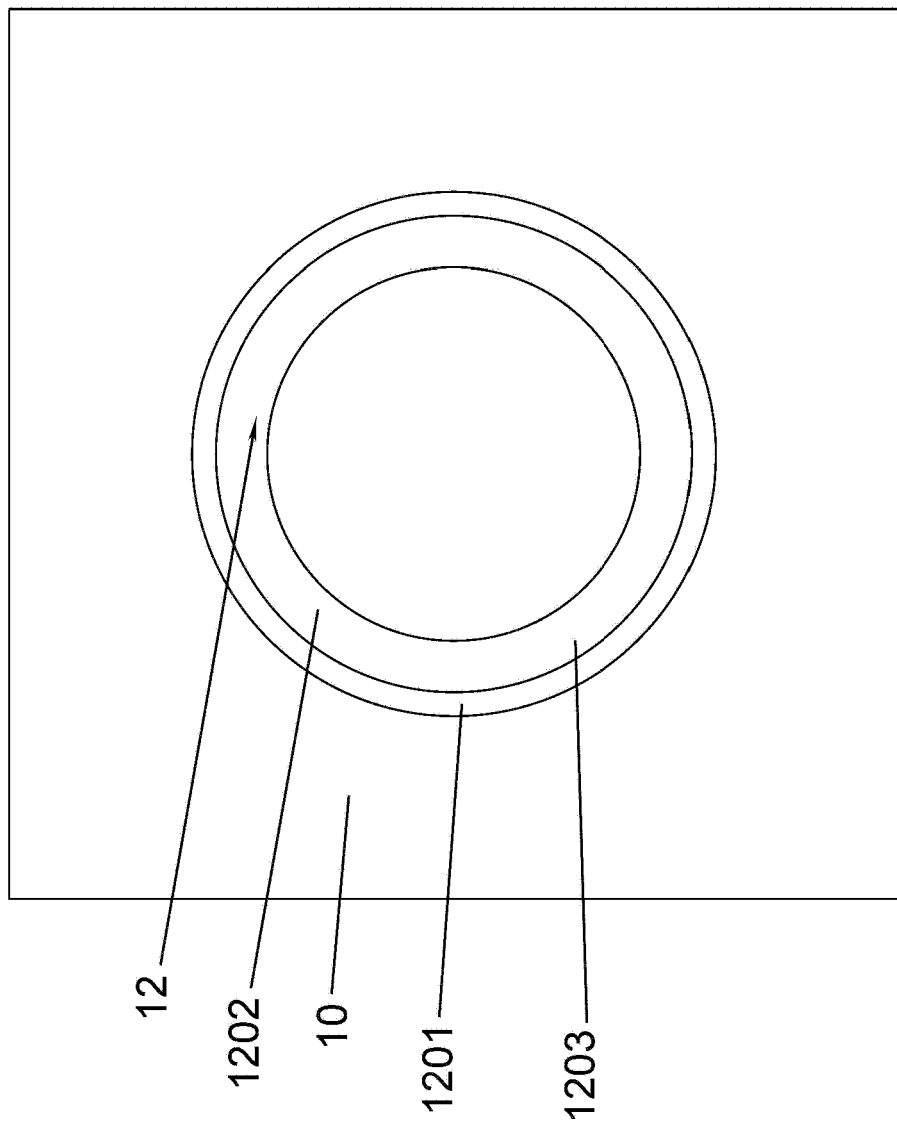


图9

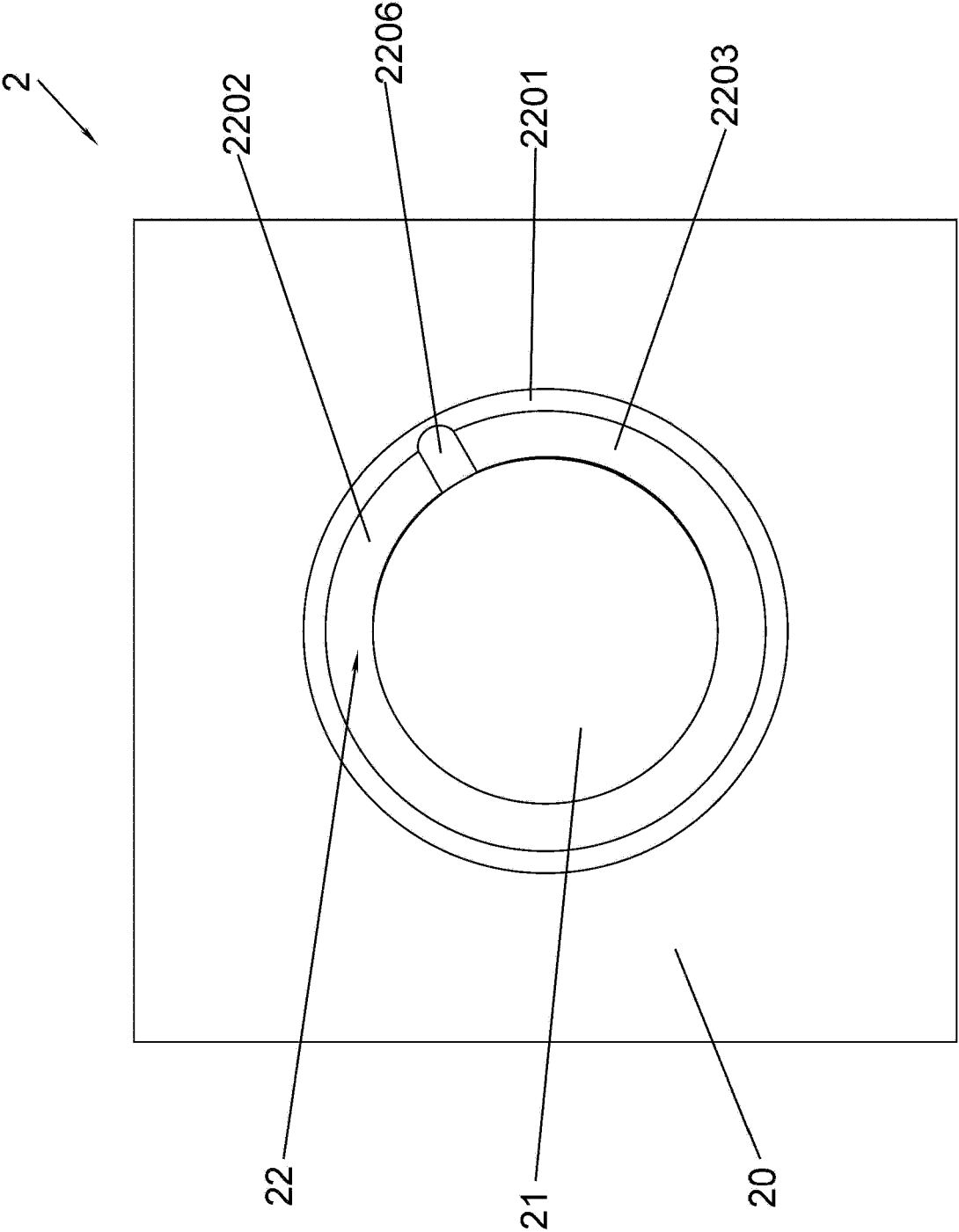


图10

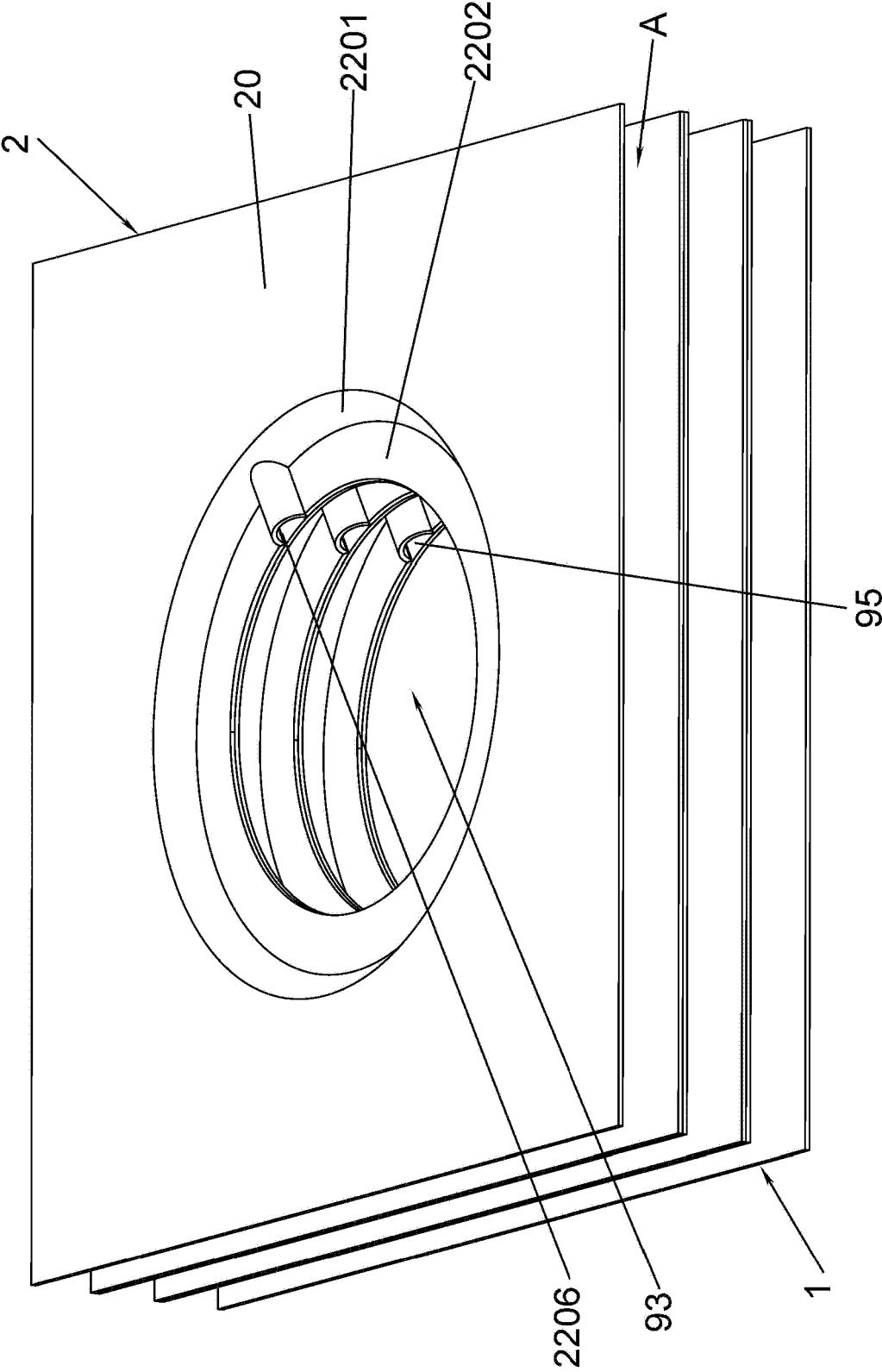


图11

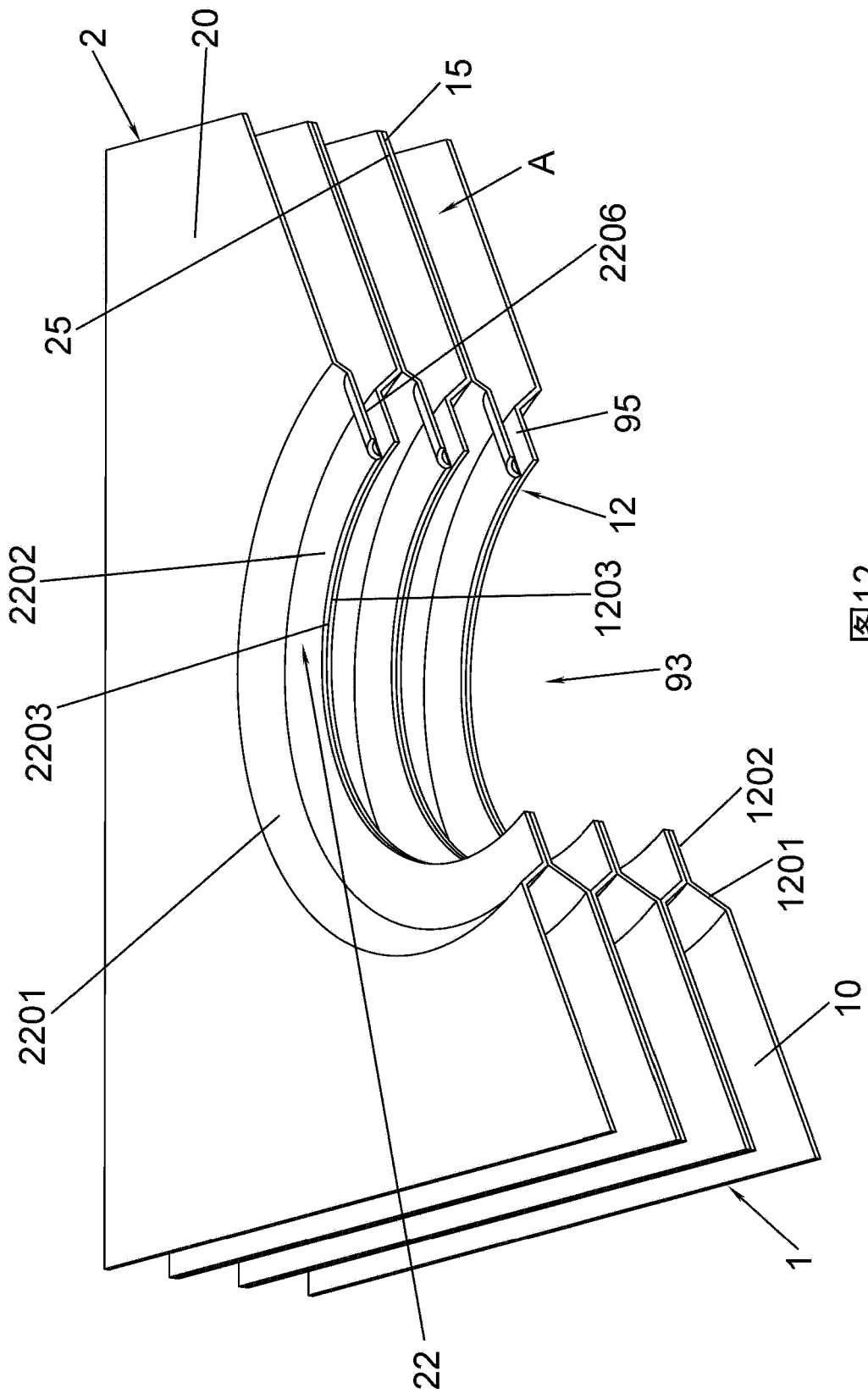


图12

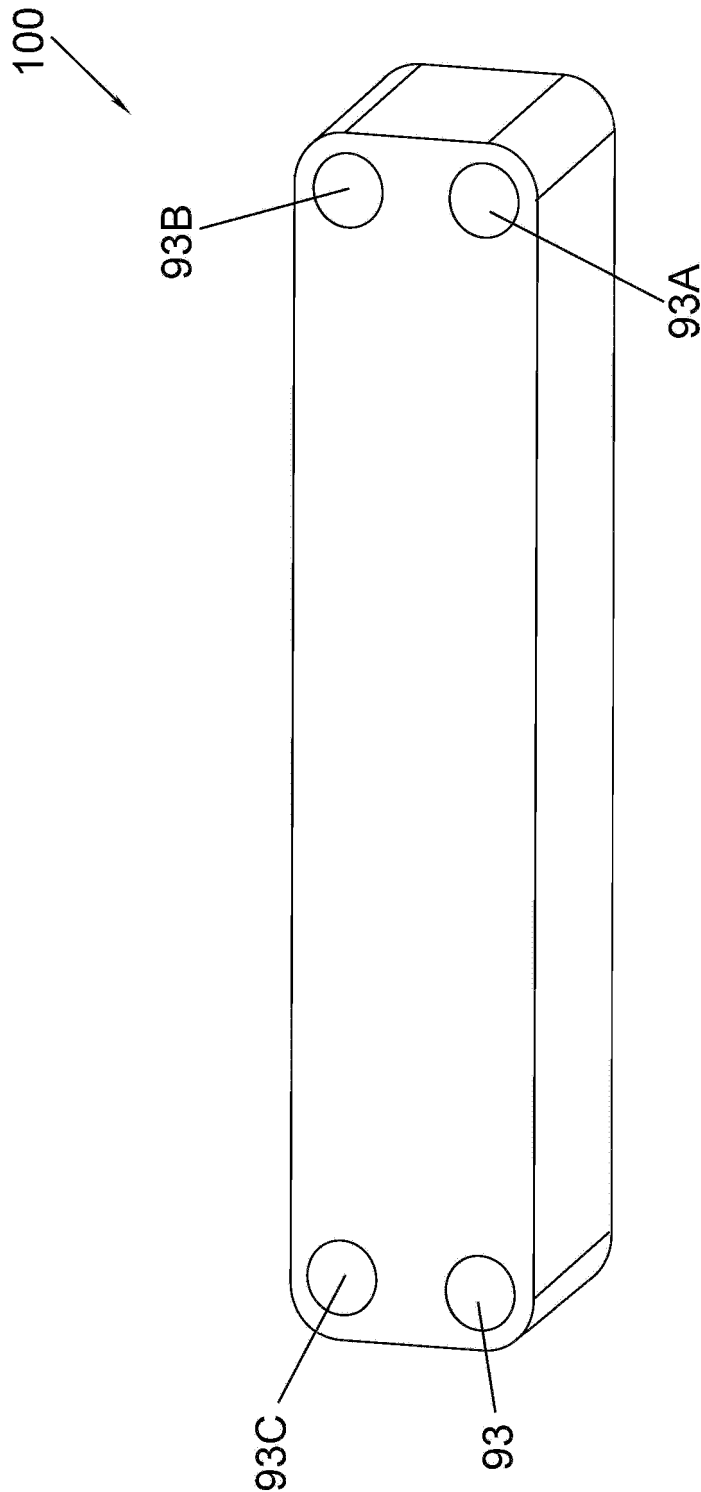


图13

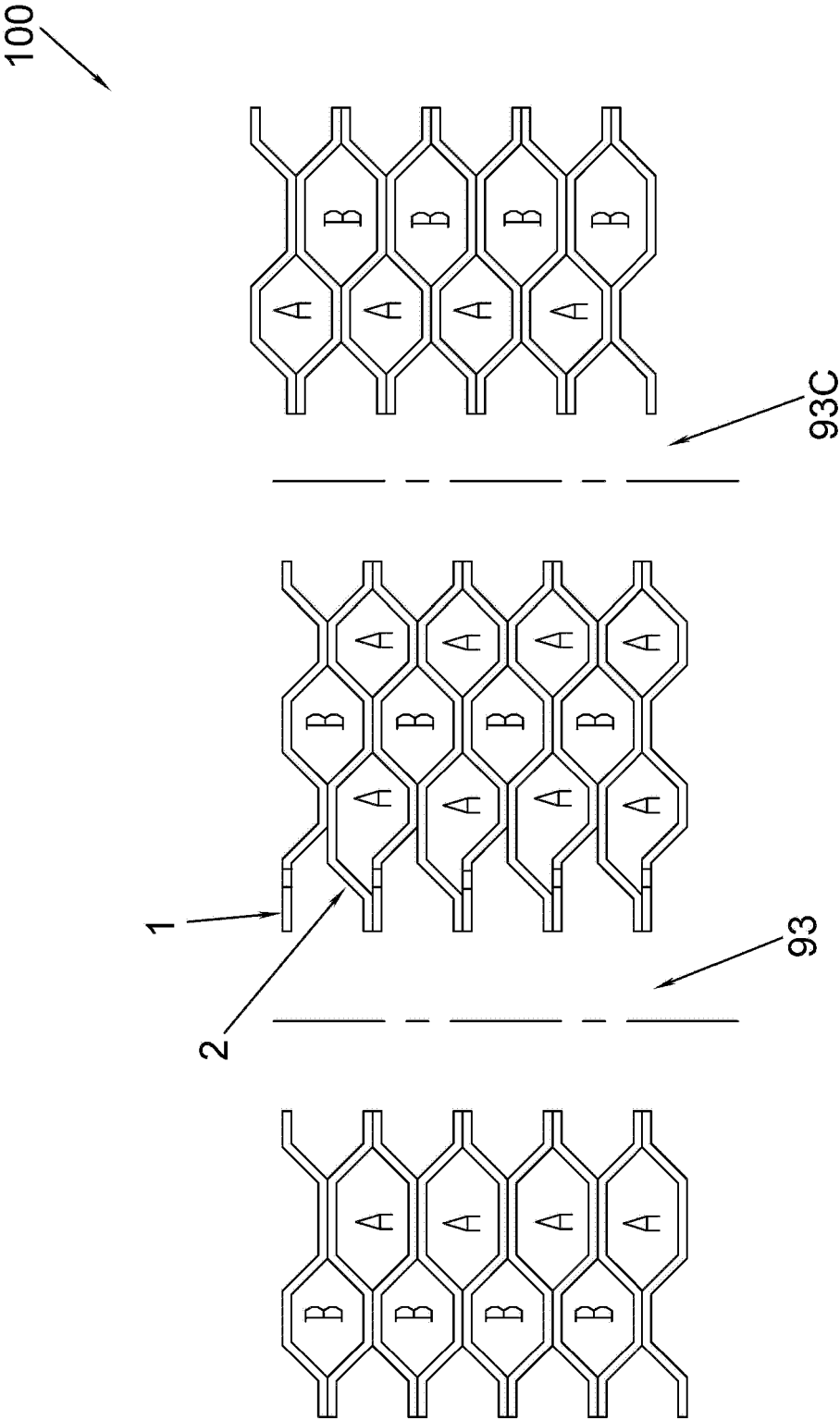


图14

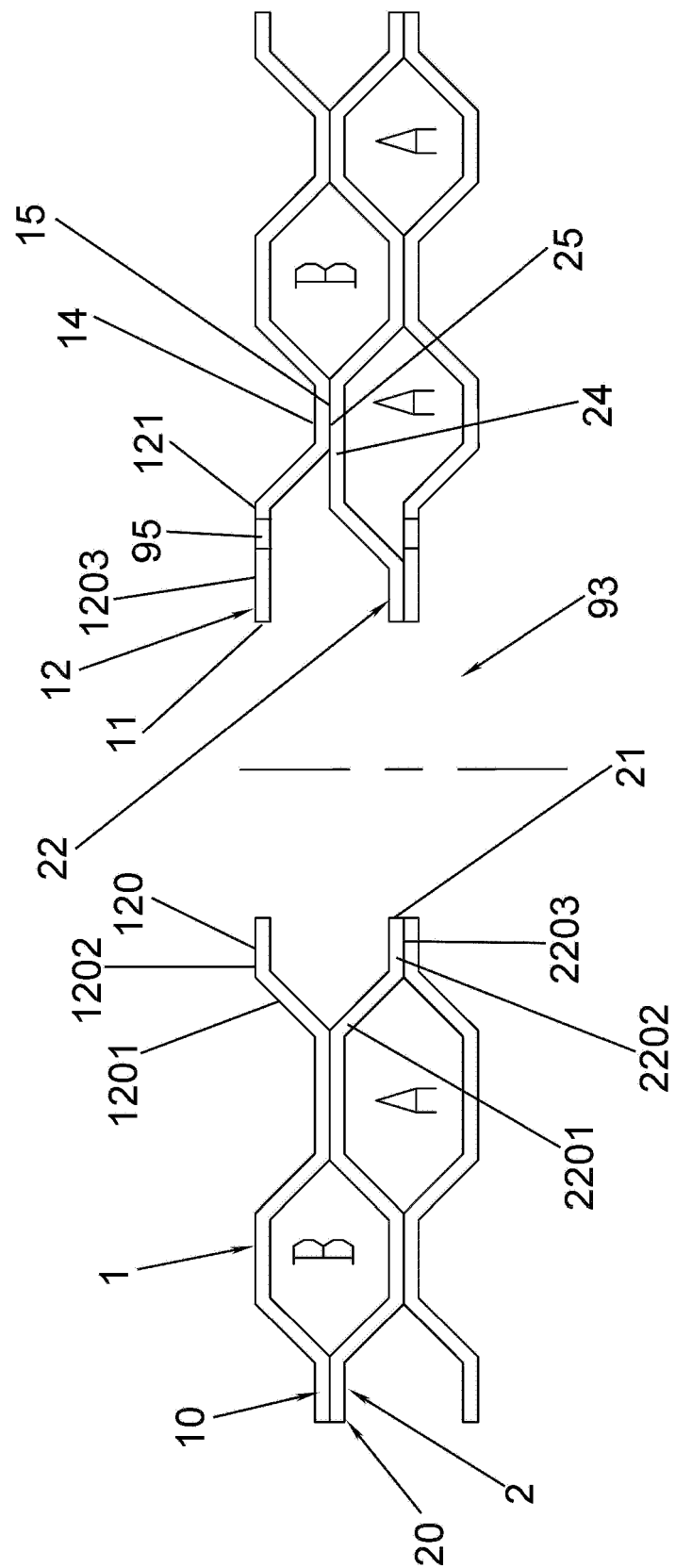


图15

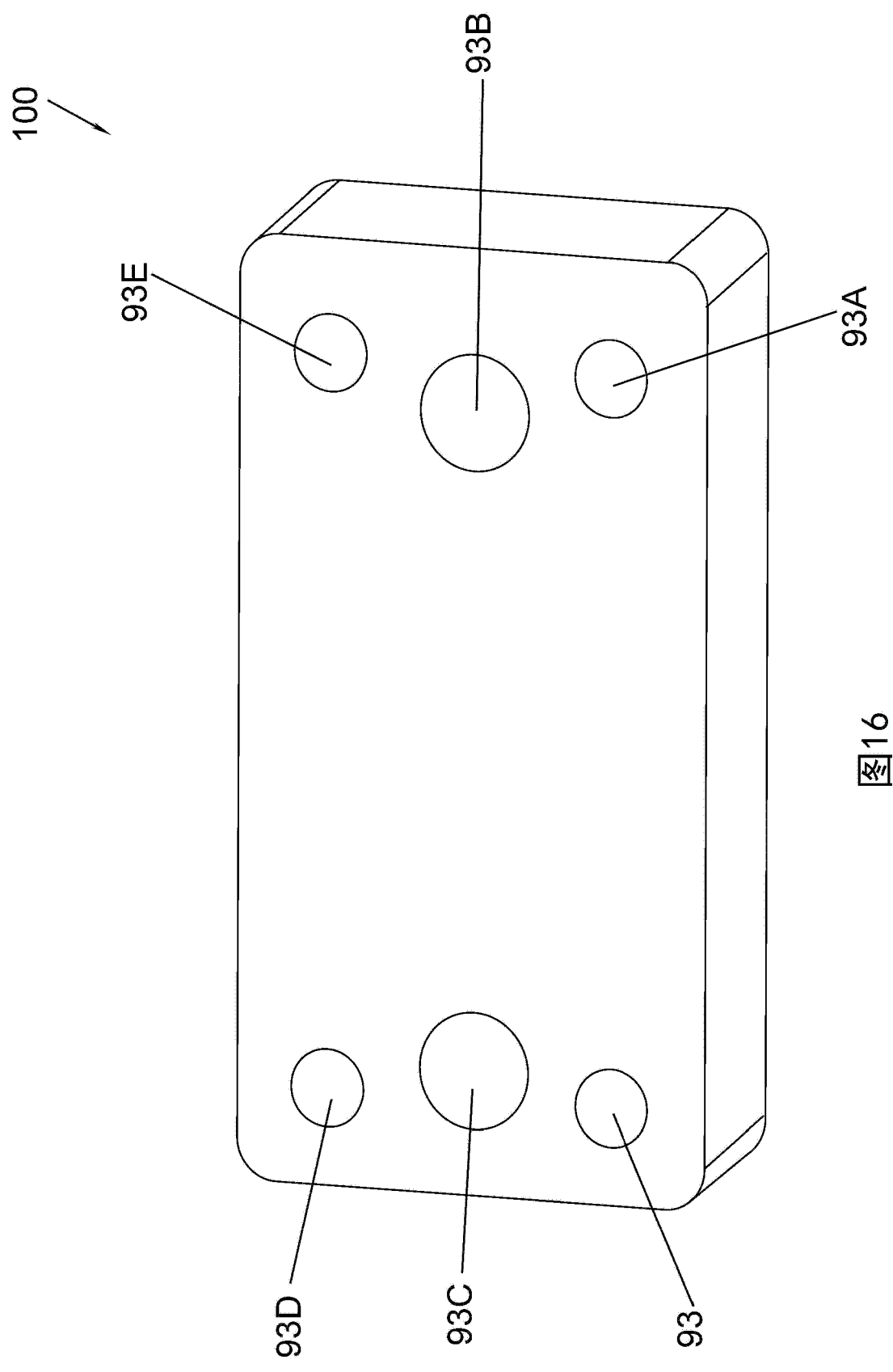


图16

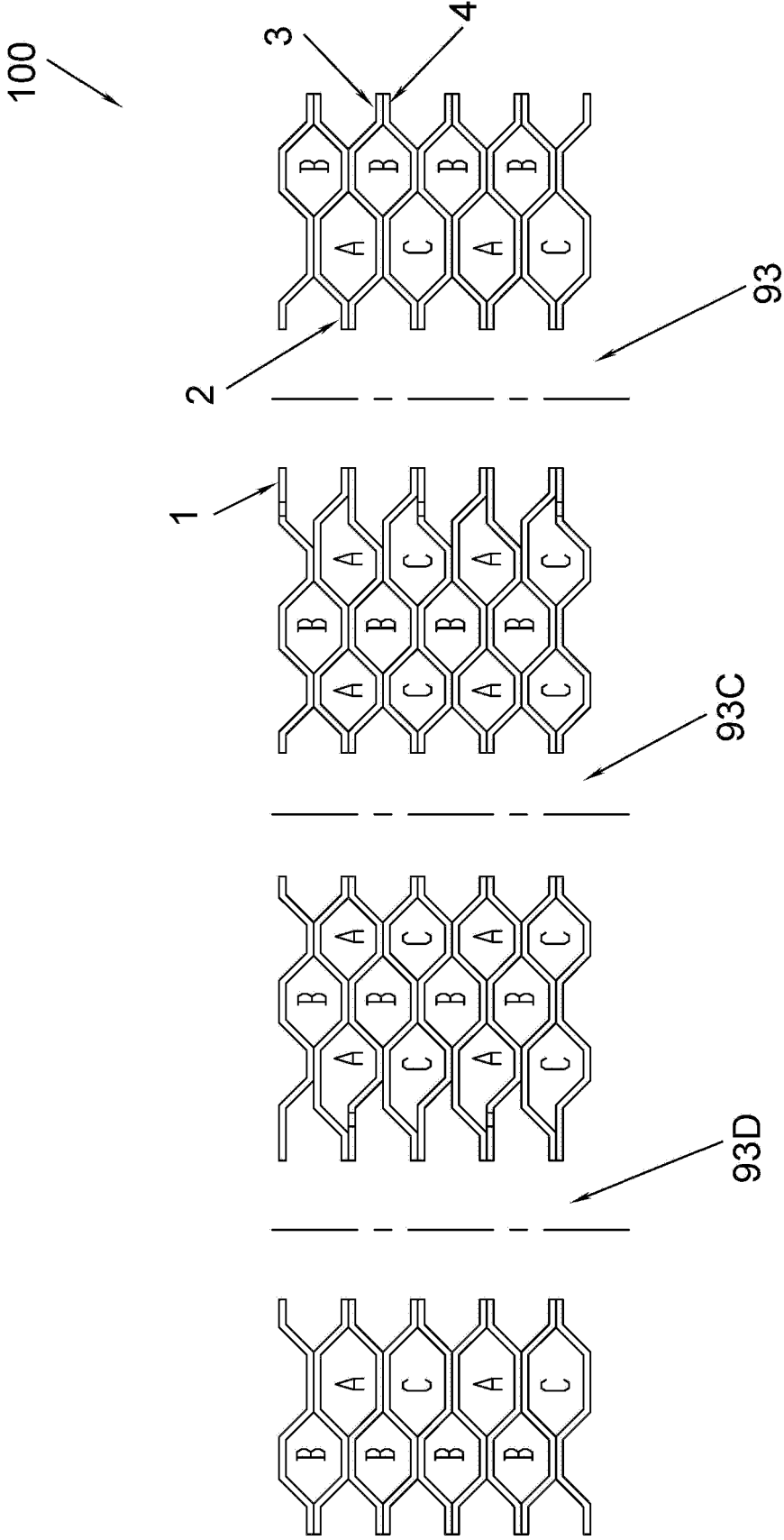


图17