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(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

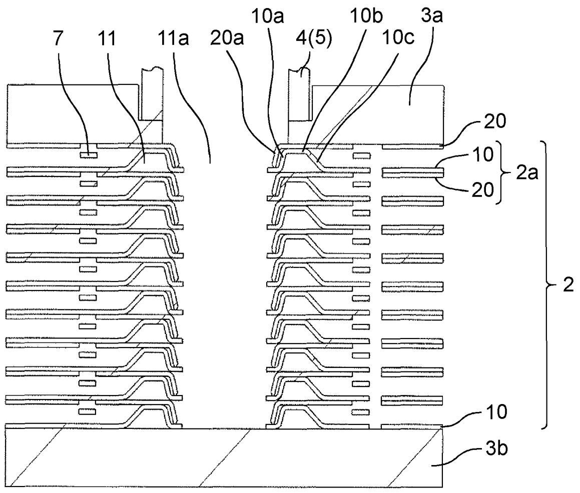
(72) Inventors:
- **NAGOSHI Kenji**
  Chuo-ku, Osaka-shi, Osaka 540-6207 (JP)
- **OKUMURA Takuya**
  Chuo-ku, Osaka-shi, Osaka 540-6207 (JP)
- **YAMAMOTO Noriaki**
  Chuo-ku, Osaka-shi, Osaka 540-6207 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(54) HEAT EXCHANGER

(57) In a heat exchanger that causes second fluid B to flow between layers of plate fin layered body (2) and carries out heat exchange between first fluid A flowing through plate fin flow path (13) and second fluid B, plate fin (2a) includes header opening (11a) to which first fluid A from a supply pipe is supplied, header flow path (11) formed around header opening (11a), header flow path port (8) that causes header opening (11a) and header flow path (11) to communicate with each other, and plate fin flow path (13) through which the first fluid from header flow path (11) flows, and which carries out heat exchange with the second fluid, and in plate fin layered body (2), inner peripheral sides of header flow paths (11) are continuously joined in a layering direction.

FIG. 7



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat exchanger, and more particularly to a layered plate fin heat exchanger configured by layering plate-shaped plate fins through which a refrigerant flows.

BACKGROUND ART

[0002] A heat exchanger used for exchanging thermal energy between fluids having different thermal energies is used in many devices. In particular, a layered plate fin heat exchanger is widely used in, for example, air conditioners, computers, and various electric devices for home use and vehicles.

[0003] The layered plate fin heat exchanger is of a type that performs heat exchange between a fluid (refrigerant) flowing through a flow path formed in the plate-shaped plate fin and a fluid (air) flowing between the layered plate fins.

[0004] In the field of the layered plate fin heat exchanger as described above, various configurations have been proposed for the purpose of weight reduction, size reduction, and efficiency of heat exchange (for example, refer to PTL 1 and PTL 2).

Citation List

Patent Literature

[0005]

PTL 1: Japanese Patent No. 3965901
PTL 2: Japanese Utility Model Registration No. 3192719
PTL 3: Japanese Patent No. 6504367

SUMMARY OF THE INVENTION

[0006] In the field of a layered plate fin heat exchanger, for the purpose of weight reduction, size reduction, and efficiency of heat exchange, it has been studied that a plate fin is made of a material having a high thermal conductivity and has a small thickness, and a fluid (refrigerant) having a pressure higher than a fluid of a heat exchanger in the related art flows through a flow path provided in the plate fin.

[0007] In the layered plate fin heat exchanger, in the configuration in which the high-pressure refrigerant flows through the flow path provided in the plate fin, the flow path is deformed to cause variations in the flow rate and flow velocity of the refrigerant, and thus the performance as the heat exchanger may be deteriorated. In such a heat exchanger configured by layering a plurality of plate fins, a metal member having high rigidity and a large thickness is provided as an end plate on both end sides in a layering direction in order to prevent deformation and distortion in the layering direction due to the flow of the refrigerant in the flow path (refer to PTL 3). Such end plates are joined together with the layered plate fins by brazing. However, such an end plate significantly differs in heat capacity from the plate fin to be joined, and has a problem that brazing failure is likely to occur due to a difference in member strength. For this reason, the layered plate fin heat exchanger in the related art configured as described above has problems in weight reduction and size reduction, and also has problems in pressure resistance to the refrigerant to be supplied and reliability.

[0008] An object of the present disclosure is to provide a highly reliable heat exchanger capable of achieving weight reduction, size reduction, and efficiency of heat exchange, securing pressure resistance as a heat exchanger, and allowing a high-pressure refrigerant to flow through a flow path.

[0009] A heat exchanger according to an aspect of the present disclosure includes a plate fin layered body in which plate fins having a flow path through which a first fluid flows are layered; and a supply and discharge pipe that supplies or discharges the first fluid that flows through the flow path of the plate fin of each layer in the plate fin layered body, in which the heat exchanger causes a second fluid to flow through a gap between the layers of the plate fin layered body and carries out heat exchange between the first fluid flowing through the flow path and the second fluid, the plate fin includes, in a case where the supply and discharge pipe functions as a supply pipe, a header opening to which the first fluid from the supply pipe is supplied, a header flow path formed around the header opening, and a plate fin flow path through which the first fluid from the header flow path flows, and which carries out heat exchange with the second fluid, and the plate fin layered body has a configuration in which inner peripheral sides of the header flow paths are continuously joined in a layering direction.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

FIG. 1 is a perspective view illustrating an appearance of a layered plate fin heat exchanger according to a first exemplary embodiment of the present disclosure.
FIG. 2A is a plan view illustrating a first fin member of a plate fin in the first exemplary embodiment.
FIG. 2B is a plan view illustrating a second fin member of the plate fin in the first exemplary embodiment.
FIG. 3 is an exploded perspective view illustrating a state in which plate fins in the first exemplary embodiment are layered.
FIG. 4 is a perspective view illustrating a part of a plate fin layered body in the first exemplary embodiment.
FIG. 5 is a perspective view illustrating a portion

around a header flow path in the plate fin layered body in the first exemplary embodiment.

FIG. 6 is a perspective view illustrating a section of the plate fin layered body in the first exemplary embodiment cut along line VI-VI in FIG. 2A.

FIG. 7 is a sectional view illustrating a portion around a header opening of the plate fin layered body sandwiched between end plates.

FIG. 8 is a longitudinal sectional view illustrating a section in a longitudinal direction orthogonal to the section of the longitudinal sectional view illustrated in FIG. 7.

FIG. 9 is a longitudinal sectional view illustrating the first fin member in FIG. 7.

FIG. 10 is a longitudinal sectional view illustrating the second fin member in FIG. 7.

FIG. 11 is a longitudinal sectional view illustrating the first fin member in FIG. 8.

FIG. 12 is a longitudinal sectional view illustrating the second fin member in FIG. 8.

FIG. 13 is a perspective view illustrating a longitudinal section of the plate fin layered body in the first exemplary embodiment cut along the longitudinal direction.

FIG. 14 is an end view of the plate fin layered body in the first exemplary embodiment cut along the longitudinal direction.

FIG. 15 is a perspective view illustrating a longitudinal section of the plate fin layered body in the first exemplary embodiment.

FIG. 16 is an end view of the plate fin layered body illustrating a longitudinal section of FIG. 15.

FIG. 17 is an exploded perspective view illustrating the first fin member that is in contact with a second end plate, and the plate fin that is layered on the first fin member, in the configuration of the first exemplary embodiment.

FIG. 18 is an exploded perspective view illustrating the second fin member that is in contact with a first end plate, and the plate fin that is layered below the second fin member, in the configuration of the first exemplary embodiment.

FIG. 19 is a longitudinal sectional view schematically illustrating a modification in the configuration of the first exemplary embodiment.

FIG. 20 is a perspective view illustrating a plate fin layered body in a heat exchanger in a second exemplary embodiment of the present disclosure.

FIG. 21 is a sectional view of a region where a header flow path is formed in the plate fin layered body in the second exemplary embodiment.

DESCRIPTION OF EMBODIMENTS

[0011] A heat exchanger according to an aspect of the present disclosure includes a plate fin layered body in which plate fins having a flow path through which a first fluid flows are layered; and a supply and discharge pipe that supplies or discharges the first fluid that flows through the flow path of the plate fin of each layer in the plate fin layered body, in which the heat exchanger causes a second fluid to flow through a gap between the layers of the plate fin layered body and carries out heat exchange between the first fluid flowing through the flow path and the second fluid, the plate fin includes, in a case where the supply and discharge pipe functions as a supply pipe, a header opening to which the first fluid from the supply pipe is supplied, a header flow path formed around the header opening, and a plate fin flow path through which the first fluid from the header flow path flows, and which carries out heat exchange with the second fluid, and the plate fin layered body has a configuration in which inner peripheral sides of the header flow paths are continuously joined in a layering direction.

[0012] The plate fin layered body may have a configuration in which outer peripheral sides of the header flow paths are continuously joined in the layering direction.

[0013] The inner peripheral sides of the header flow paths may be formed by wall surfaces continuous in the layering direction.

[0014] In the plate fin layered body, the inner peripheral side of the header flow path may be formed by a wall surface having a double structure.

[0015] The plate fin may have a header flow path port that is provided on the inner peripheral side of the header flow path, the header flow path port causing the header opening and the header flow path to communicate with each other.

[0016] The plate fin may have a plurality of header flow path ports that are provided on the inner peripheral side of the header flow path, the header flow path ports causing the header opening and the header flow path to communicate with each other.

[0017] The header flow path ports may be formed at positions to face each other on the inner peripheral side of the header flow path.

[0018] The header flow path ports may be formed at positions to face each other on a center line extending in a longitudinal direction of the plate fin.

[0019] The plate fin may have a flow path formed by joining a first fin member and a second fin member, the first fin member may have a recess for forming the header flow path, and the second fin member may have a flat surface that is joined to the first fin member to form the header flow path with the recess in the first fin member.

[0020] In the first fin member, the recess for forming the header flow path may have a header flow path inner peripheral support portion, a header flow path top portion, and a header flow path outer peripheral support portion, the header flow path inner peripheral support portion and the header flow path outer peripheral support portion may be joined to the flat surface of the second fin member to form the header flow path, and the header flow path port that causes the header opening and the header flow path to communicate with each other may be formed in a portion of the header flow path inner peripheral support portion.

[0021] The second fin member may have the flat surface, and an inner peripheral support portion that is bent to be continuous with the flat surface and serves as an outer edge portion of the header opening on the inner peripheral side of the header flow path, and the inner peripheral support portion of the second fin member may be joined to a first fin member of another plate fin that is adjacent in the layering direction, and the inner peripheral side of the header flow path in the plate fin layered body may have a double wall surface.

[0022] Hereinafter, a layered plate fin heat exchanger will be described with reference to the accompanying drawings as a heat exchanger according to exemplary embodiments of the present disclosure. The heat exchanger of the present disclosure is not limited to the configurations of the layered plate fin heat exchanger described in the following exemplary embodiments, but includes a heat exchanger having a configuration equivalent to the technical idea described in the following exemplary embodiments. Exemplary embodiments described below illustrate an example of the present invention, and configurations, functions, operations, and the like illustrated in the exemplary embodiments are merely examples and do not limit the present disclosure. The components introduced in the following exemplary embodiments that are not recited in the independent claim(s) representing the most superordinate concept are illustrated herein as optional components.

(First exemplary embodiment)

[0023] FIG. 1 is a perspective view illustrating an appearance of a layered plate fin heat exchanger (hereinafter, simply referred to as a heat exchanger) 1 according to a first exemplary embodiment. As illustrated in FIG. 1, heat exchanger 1 according to the first exemplary embodiment includes supply pipe 4 to which a refrigerant that is first fluid A is supplied, plate fin layered body 2 configured by layering a plurality of plate fins 2a each having a rectangular plate shape, and discharge pipe 5 that discharges the refrigerant flowing through the flow paths formed in plate fins 2a.

[0024] In heat exchanger 1 of the first exemplary embodiment, supply pipe 4 and discharge pipe 5 have substantially the same configuration, and functions corresponding to the operations at that time are used as names. In the present disclosure, supply pipe 4 and discharge pipe 5 are collectively referred to as a supply and discharge pipe (4, 5).

[0025] End plates 3 (3a, 3b) are disposed at both ends of plate fin layered body 2 in the layering direction, and end plates 3 (3a, 3b) have substantially the same shape as rectangular plate fins 2a in plan view. Supply pipe 4 or discharge pipe 5 is joined to both end sides of one end plate 3 (3a) in the longitudinal direction. In the configuration of the first exemplary embodiment, a configuration in which supply pipe 4 or discharge pipe 5 is joined to both end sides of one end plate 3 (3a) will be described, but supply pipe 4 may be joined to one end plate 3 (3a) and discharge pipe 5 may be joined to other end plate 3 (3b) according to the specification of the apparatus in which heat exchanger 1 is used.

[0026] In the following exemplary embodiment, the layering direction of plate fin layered body 2 in heat exchanger 1 illustrated in FIG. 1 is defined as an up-down direction, a position of one end plate 3 (3a) provided in plate fin layered body 2 is defined as an upper side, and a position of other end plate 3 (3b) is defined as a lower side. However, in a state where heat exchanger 1 is provided in the apparatus (for example, an air conditioner), the layering direction is not specified to the up-down direction (vertical direction).

[0027] End plates 3 (3a, 3b) disposed at both ends of plate fin layered body 2 in the layering direction are fixed to each other with a predetermined interval by positioning means (for example, positioning bolts or the like), and sandwich plate fin layered body 2. The positioning mean that maintains and fixes end plates 3 (3a, 3b) at both ends at a predetermined interval has a function of positioning with respect to each of layered plate fins 2a. End plate 3 is made of, for example, a plate material formed of a metal material such as aluminum, an aluminum alloy, or stainless steel.

[0028] Heat exchanger 1 of the first exemplary embodiment is configured such that the refrigerant that is first fluid A flows through the flow path (plate fin flow path 13) formed in each plate fin 2a of plate fin layered body 2. On the other hand, air that is second fluid B passes through a gap formed between layered plate fins 2a in plate fin layered body 2. Heat exchanger 1 configured as described above carries out heat exchange between first fluid A and second fluid B in plate fin layered body 2.

[0029] Each of the plurality of plate fins 2a constituting plate fin layered body 2 in heat exchanger 1 of the first exemplary embodiment has a configuration in which first fin member 10 and second fin member 20, which are two plate materials, are bonded and joined (brazed) to be opposite to each other to form a flow path. Plate fins 2a configured as described above are joined (brazed) by being pressurized and heated in a state where a plurality of plate fins 2a are layered to form plate fin layered body 2.

[0030] FIGS. 2A and 2B are plan views respectively illustrating first fin member 10 and second fin member 20 which constitute plate fin 2a. FIG. 2A is a plan view of first fin member 10, and FIG. 2B is a plan view of second fin member 20. First fin member 10 and second fin member 20 are made of, for example, a metal plate material such as aluminum, an aluminum alloy, or stainless steel, and have at least a brazing material layer on a core material of the metal plate material. In addition, first fin member 10 and second fin member 20 are processed into a predetermined shape using, for example, a thin plate material having a thickness of 0.2 mm. First fin member 10 and second fin member 20 processed into a predetermined shape are pressurized and heated to be in close contact with each other at a predetermined position, and thereby the facing flat predetermined regions are reliably joined (brazed) to each other.

[0031] In first fin member 10 illustrated in FIG. 2A, a recess for annular header flow path 11 to which the refrigerant from supply pipe 4 is supplied or which discharges the refrigerant to discharge pipe 5 is formed on both end sides in the longitudinal direction. Header flow path 11 in first fin member 10 is formed by an annular recess protruding toward the front side of the paper surface in FIG. 2A. Header communication flow path 12 leading out by a predetermined distance is formed from a part of the outer peripheral portion of header flow path 11. An end portion of plate fin flow path 13 formed in heat exchange region C (refer to FIG. 5 described later) in plate fin 2a is disposed on an extension line in a lead-out direction of header communication flow path 12.

[0032] In first fin member 10, plate fin flow path 13 formed on the extension line in the lead-out direction of header communication flow path 12 is formed by a recess similarly to header communication flow path 12. Plate fin flow path 13 is formed to meander over entire heat exchange region C of plate fin 2a. Plate fin flow path 13 includes first plate fin flow path 13a formed by a linear recess, and second plate fin flow path 13b formed by an arc-shaped recess. In the configuration of the first exemplary embodiment, a plurality of (for example, three) linear first plate fin flow paths 13a are provided in parallel to extend in the longitudinal direction in heat exchange region C of plate fin 2a, and arc-shaped second plate fin flow paths 13b connect the end portions of the first plate fin flow paths 13a to form meandering flow paths. Heat exchange region C in plate fin 2a indicates a region other than the header region where header flow path 11 is formed.

[0033] As described above, header flow path 11 communicating with supply pipe 4 or discharge pipe 5 is formed on both end sides of first fin member 10 in the longitudinal direction. In first fin member 10, each flow path of header flow path 11, header communication flow path 12, and plate fin flow path 13 is disposed to be point-symmetric with a center point of first fin member 10 in plan view as a center of symmetry.

[0034] In first fin member 10, heat transfer blocking slit 6, which is a missing portion (gap), is formed between meandering plate fin flow paths 13. Heat transfer blocking slit 6 that is a missing portion (gap) is formed in this manner to suppress the heat transfer action between adjacent plate fin flow paths 13. Further, in first fin member 10, positioning pin opening 9 for the insertion of a positioning pin (not illustrated) is formed at a plurality of locations (three locations) to surround header flow path 11. Similarly to the respective flow paths (header flow path 11 and plate fin flow path 13), heat transfer blocking slit 6 and positioning pin opening 9 are formed in point symmetry with the center point of first fin member 10 in plan view as the center of symmetry.

[0035] As illustrated in FIG. 2A, in first fin member 10, header communication flow path 12 led out from header flow path 11 is not directly connected to plate fin flow path 13 formed on the extension line in the lead-out direction, and flat flow path transfer region 16 is formed between header communication flow path 12 and plate fin flow path 13. That is, in first fin member 10, the recess of header communication flow path 12 and the recess of first plate fin flow path 13a are not connected.

[0036] On the other hand, in second fin member 20, as illustrated in FIG. 2B, transfer flow path 21 is formed at a position facing flow path transfer region 16 of first fin member 10. In FIG. 2B, transfer flow path 21 is formed by a recess recessed to protrude to the back side of the paper surface. Accordingly, in plate fin 2a in which first fin member 10 and second fin member 20 are joined, header communication flow path 12 and plate fin flow path 13 communicate with each other via transfer flow path 21. As a result, the refrigerant supplied from supply pipe 4 flows through header flow path 11, header communication flow path 12, transfer flow path 21, plate fin flow path 13, transfer flow path 21, header communication flow path 12, and header flow path 11, and is discharged from discharge pipe 5.

[0037] In second fin member 20, plate fin protrusion region 22 is formed in a region facing linear first plate fin flow path 13a of first fin member 10 (refer to the sectional view of FIG. 16 to be described later). Plate fin protrusion region 22 is combined and joined with first plate fin flow path 13a to secure a flow path shape of a linear portion of plate fin flow path 13 and to suppress the deformation of a sectional shape orthogonal to a flow direction of the refrigerant.

[0038] In second fin member 20, similar heat transfer blocking slit 6 is formed at a position that corresponds to heat transfer blocking slit 6 formed in first fin member 10 and is between plate fin protrusion regions 22. Heat transfer blocking slit 6 is formed in this manner to suppress the heat transfer action between adjacent plate fin flow paths 13 and to enhance the efficiency of heat exchange.

[0039] In the configuration of the first exemplary embodiment, a plurality of interval defining protrusions 7 for defining the interval between layered plate fins 2a at a constant interval are provided on second fin member 20. Since interval defining protrusions 7 maintain a constant interval between plate fins 2a adjacent in the layering direction, it is sufficient that interval defining protrusions 7 are provided on the outer surface side (surface of plate fin 2a opposite to the surface where first fin member 10 and second fin member 20 are brazed) of any one of first fin member 10 and second fin member 20 or on the outer surface sides of both first fin member 10 and second fin member 20, and the arrangement position of interval defining protrusion 7 is appropriately set according to the position of the flow path to be formed.

[0040] Also in second fin member 20 configured as described above, similarly to first fin member 10, each element (heat transfer blocking slit 6, interval defining protrusion 7, positioning pin opening 9) is disposed to be point-symmetric with the center point of second fin member 20 in plan view as the center of symmetry.

[0041] FIG. 3 is an exploded perspective view illustrating a state in which two sets of plate fins 2a (first fin member 10 and second fin member 20) are layered, and illustrates a portion around header flow path 11. As illustrated in FIG. 3, in first fin member 10, header flow path port 8 which is a notch is formed on an inner peripheral side of an annular recess that forms header flow path 11. A plurality of header flow path ports 8 are formed on the inner peripheral side of annular header flow path 11. In the configuration of the first exemplary embodiment, for example, header flow path ports 8 (8a, 8b) are formed at positions facing each other on the inner peripheral side of header flow path 11. Header flow path ports 8 (8a, 8b) in the first exemplary embodiment are formed at facing positions in header flow path 11, on a center line extending in the longitudinal direction of plate fin 2a passing through the center of annular header flow path 11 (refer to FIG. 2A).

[0042] Note that it is preferable that formation positions of the plurality of header flow path ports 8 in header flow path 11 include up-down positions in the vertical direction in a state where an apparatus (for example, an air conditioner) including heat exchanger 1 is installed.

[0043] FIG. 4 is a perspective view illustrating a part of plate fin layered body 2 in the first exemplary embodiment. In FIG. 4, plate fin layered body 2 in which the plurality of plate fins 2a are layered is illustrated, but the number of plate fins 2a to be layered is appropriately set according to the specification of heat exchanger 1. In plate fin layered body 2 illustrated in FIG. 4, a state is illustrated in which end plate 3 (3a, 3b) is removed and no positioning pin is inserted into positioning pin opening 9.

[0044] FIG. 5 is a perspective view illustrating a portion around header flow path 11 in plate fin layered body 2 illustrated in FIG. 4. FIG. 6 is a perspective view illustrating a section of plate fin layered body 2 of FIG. 4 cut along line VI-VI in FIG. 2A. As illustrated in FIGS. 5 and 6, header opening 11a penetrating in the layering direction is formed on the inner peripheral side of header flow path 11 in plate fin layered body 2. The refrigerant from supply pipe 4 to header flow path 11 or the refrigerant from header flow path 11 to discharge pipe 5 flows through header opening 11a.

[0045] In plate fin layered body 2, the inner peripheral sides of header flow paths 11 constituting the inner surface side of header opening 11a penetrating in the layering direction are joined to be continuous in the layering direction by brazing. The outer peripheral sides of header flow paths 11 are also joined to be continuous in the layering direction. As a result, the inner peripheral sides and the outer peripheral sides of header flow paths 11 in plate fin layered body 2 are securely joined in the layering direction, and the rigidity in header flow paths 11 is enhanced.

[0046] The refrigerant supplied from supply pipe 4 flows through header opening 11a, and flows into header flow path 11 through header flow path port 8 (8a, 8b) formed on the inner peripheral side of header flow path 11. In FIGS. 5 and 6, first header flow path port 8a that is one of two header flow path ports 8 facing each other on the inner peripheral side of header flow path 11 is illustrated. First header flow path port 8a and second header flow path port 8b are disposed at positions facing each other on a center line extending in the longitudinal direction passing through the center of header opening 11a, that is, on the center line extending in the longitudinal direction in plate fin 2a.

[0047] FIG. 7 is a sectional view illustrating a portion around header opening 11a of plate fin layered body 2 sandwiched between end plates 3 (3a, 3b). The sectional view of FIG. 7 is a longitudinal sectional view cut along line VI-VI illustrated in FIG. 2A. FIG. 8 is a longitudinal sectional view illustrating a section in a longitudinal direction orthogonal to the section of the longitudinal sectional view illustrated in FIG. 7. FIG. 8 illustrates a portion around header opening 11a in plate fin layered body 2, and is a sectional view including first header flow path port 8a and second header flow path port 8b.

[0048] As illustrated in FIG. 7, plate fin layered body 2 is configured by layering a plurality of plate fins 2a that is formed by bonding first fin member 10 and second fin member 20. In first fin member 10, a recess for forming header flow path 11 is formed on the outer periphery of header opening 11a. Header flow path 11 (recess) in first fin member 10 is formed by header flow path inner peripheral support portion 10a constituting a wall surface on the outer peripheral side of header opening 11a, header flow path top portion 10b, and header flow path outer peripheral support portion 10c. That is, in first fin member 10, the recess for forming header flow path 11 includes header flow path top portion 10b that has an annular top portion and a flat surface; header flow path inner peripheral support portion 10a that serves as an inner peripheral wall supporting header flow path top portion 10b in the layering direction on the inner peripheral side; and header flow path outer peripheral support portion 10c that serves as an outer peripheral wall supporting header flow path top portion 10b in the layering direction on the outer peripheral side.

[0049] On the other hand, in second fin member 20, inner peripheral support portion 20a that serves an outer edge portion of the outer periphery of header opening 11a is formed, and flat portion 20b is formed to be continuous from inner peripheral support portion 20a. Flat portion 20b and inner peripheral support portion 20a are bent to be continuous. Inner peripheral support portion 20a of second fin member 20 constitutes the wall surface on the outer peripheral side of header opening 11a. Flat portion 20b of second fin member 20 is a portion that closes the recess formed by header flow path inner peripheral support portion 10a, header flow path top portion 10b, and header flow path outer peripheral support portion 10c of first fin member 10, and constitutes annular header flow path 11 on the outer periphery of header opening 11a.

[0050] As described above, in first fin member 10 of plate fin layered body 2 in the first exemplary embodiment, the recess for forming header flow path 11 includes header flow path inner peripheral support portion 10a, header flow path top portion 10b, and header flow path outer peripheral support portion 10c. Header flow path inner peripheral support portion 10a and header flow path outer peripheral support portion 10c are joined to the flat surface of second fin member 20 to form the header flow path, and header flow path port 8 is formed in a portion of header flow path inner peripheral support portion 10a.

[0051] Second fin member 20 has flat portion 20b that has a flat surface, and inner peripheral support portion 20a that is bent to be continuous with the flat surface of flat portion 20b and serves as the outer edge portion of header opening 11a on the inner peripheral side of header flow path 11. Inner peripheral support portion 20a of second fin member 20 is joined to first fin member 10 of another plate fin 2a adjacent in the layering direction to configure a double wall surface in which the inner peripheral sides of header flow paths 11 in plate fin layered body 2 in the layering direction.

[0052] Further, as illustrated in the longitudinal sectional view in the longitudinal direction of FIG. 8, in facing regions on the inner peripheral side of header flow path 11, in order to form header flow path port 8 (8a, 8b), header flow path inner peripheral support portion 10a of first fin member 10 is formed to have a short protrusion length from header flow path top portion 10b. Similarly, inner peripheral support portion 20a of second fin member 20 is formed to have a short protrusion length. Thus, in header flow path inner peripheral support portion 10a and inner peripheral support portion 20a, regions facing each other in the longitudinal direction are notched, and header flow path port 8 (8a, 8b) is formed on the inner peripheral side of header flow path 11.

[0053] FIG. 9 is a longitudinal sectional view illustrating first fin member 10 illustrated in FIG. 7, and illustrates first fin member 10 around header opening 11a. FIG. 10 is a longitudinal sectional view illustrating second fin member 20 illustrated in FIG. 7, and illustrates a portion to be joined to first fin member 10 illustrated in FIG. 9. FIG. 11 is a longitudinal sectional view illustrating first fin member 10 illustrated in FIG. 8, and illustrates header flow path port 8 (8a, 8b) formed on the outer periphery of header opening 11a. Similarly, FIG. 12 is a longitudinal sectional view illustrating second fin member 20 illustrated in FIG. 8, and illustrates a portion to be joined to first fin member 10 illustrated in FIG. 11.

[0054] First fin member 10 illustrated in FIG. 9 and second fin member 20 illustrated in FIG. 10 are bonded and joined, and header flow path 11 is formed on the outer periphery of header opening 11a in one plate fin 2a. In a case where header flow path 11 is formed in this way, header flow path port 8 (8a, 8b) in header flow path 11 is formed in header flow path inner peripheral support portion 10a of first fin member 10 illustrated in FIG. 11 and inner peripheral support portion 20a of second fin member 20 illustrated in FIG. 12, and header opening 11a communicates with the inside of header flow path 11 via header flow path port 8 (8a, 8b).

[0055] As illustrated in FIG. 9, in first fin member 10, the inner peripheral-side end portion of header flow path inner peripheral support portion 10a protrudes toward the inner peripheral side, and protrusion end portion 10d on the inner peripheral side is formed. The inner peripheral-side end portion of inner peripheral support portion 20a of second fin member 20 in plate fin 2a adjacent in the layering direction is in contact with protrusion end portion 10d on the inner peripheral side. Therefore, in plate fin layered body 2, protrusion end portion 10d on the inner peripheral side of first fin member 10 and the inner peripheral-side end portion of inner peripheral support portion 20a of second fin member 20 are joined (refer to FIG. 7).

[0056] As described above, in each plate fin 2a in plate fin layered body 2, header communication flow path 12 connected to header flow path 11 is connected to first plate fin flow path 13a via transfer flow path 21 formed in second fin member 20.

[0057] FIG. 13 is a perspective view illustrating a longitudinal section of plate fin layered body 2 cut along the longitudinal direction of plate fin layered body 2. FIG. 13 illustrates a section in which header communication flow path 12 and first plate fin flow path 13a communicate with each other via transfer flow path 21 in each plate fin 2a. FIG. 14 is an end view of plate fin layered body 2 cut along the longitudinal direction, and illustrates a portion around transfer flow path 21.

[0058] As illustrated in FIGS. 13 and 14, in each plate fin 2a, header communication flow path 12 formed in first fin member 10 communicates with plate fin flow path 13 formed in first fin member 10 via transfer flow path 21 formed in second fin member 20. Therefore, in plate fin layered body 2, for example, the refrigerant supplied from supply pipe 4 flows through header opening 11a, header flow path 11, header communication flow path 12, transfer flow path 21, and plate fin flow path 13. At this time, in the configuration illustrated in FIG. 14, the refrigerant flows downward from header communication flow path 12 to transfer flow path 21, and the refrigerant flows upward from transfer flow path 21 to plate fin flow path 13. That is, the refrigerant is moved while undulating in the up-down direction (layering direction) before and after transfer flow path 21, so that the flow path becomes longer than the planar flow path.

[0059] FIG. 15 is a perspective view illustrating a longitudinal section of plate fin layered body 2 in the first exemplary embodiment cut along a plane orthogonal to the longitudinal direction of plate fin layered body 2. FIG. 16 is an end view of plate fin layered body 2 illustrating the longitudinal section of FIG. 15. As illustrated in FIGS. 15 and 16, in plate fin layered body 2 layered between end plates 3 (3a, 3b) at both ends, second fin member

20 that is one of plate fin 2a is disposed at an upper end of plate fin layered body 2, and first fin member 10 that is the other one of plate fin 2a is disposed at a lower end of plate fin layered body 2.

[0060] In the heat exchanger of the first exemplary embodiment, a lower surface of upper-side first end plate 3a of end plates 3 at both ends and a joint surface of second fin member 20 that is disposed immediately below first end plate 3a are in full contact with each other. Here, the joint surface refers to a surface of plate fin 2a where first fin member 10 and second fin member 20 are joined.

[0061] On the other hand, first fin member 10 that is the other one of plate fin 2a is disposed at the lower end of plate fin layered body 2, and an upper surface of lower-side second end plate 3b and a joint surface of first fin member 10 are in full contact with each other. This is because by causing the joint surface of second fin member 20 joined to first fin member 10 to face upper-side first end plate 3a, the flat surface is widened and the contact area is increased. Similarly, by causing the joint surface of first fin member 10 joined to second fin member 20 to face lower-side second end plate 3b, the flat surface is widened and the contact area is increased.

[0062] FIG. 17 is an exploded perspective view illustrating first fin member 10 that is in contact with lower-side second end plate 3b, and plate fin 2a that is formed by second fin member 20 and first fin member 10 that are layered on first fin member 10 that is in contact with second end plate 3b. FIG. 17 is a perspective view seen from below in the layering direction. FIG. 18 is an exploded perspective view illustrating second fin member 20 that is in contact with upper-side first end plate 3a, and plate fin 2a that is formed by first fin member 10 and second fin member 20 that are layered below second fin member 20 that is in contact with first end plate 3a. FIG. 18 is a perspective view seen from above in the layering direction.

[0063] In FIGS. 17 and 18, regions where fin members (10, 20) are in contact with and joined to each other are indicated by hatched portions. Note that a region where first fin member 10 and second fin member 20 constituting plate fin 2a are in contact with each other is a brazed region. As illustrated in FIGS. 17 and 18, since the region where the end plate 3 (3a, 3b) and first fin member 10 or second fin member 20 are in contact with each other is wide and entire, end plate 3 is substantially uniformly joined to first fin member 10 or second fin member 20 without being subjected to special processing, and plate fin layered body 2 can be reliably held.

[0064] Since first fin member 10 and second fin member 20 disposed at both ends of the plate fin layered body 2 in the layering direction are in contact with the end plate 3 as described above, the refrigerant from supply pipe 4 flows to the header openings 11a of first fin member 10 and second fin member 20. However, in first fin member 10 in contact with second end plate 3b, the end from header communication flow path 12 is closed to form a flat flow path transfer region 16. Therefore, the refrigerant does not flow to plate fin flow path 13 in first fin member 10 in contact with second end plate 3b. On the other hand, in second fin member 20 in contact with first end plate 3a, since only transfer flow path 21 is formed as the flow path and header flow path 11 is not formed, there is no flow path to which the refrigerant from header opening 11a flows.

[0065] As described above, in the configuration of heat exchanger 1 of the first exemplary embodiment, since one of the members constituting plate fin 2a is disposed at both ends of plate fin layered body 2 in the layering direction, end plate 3 is not subjected to special processing, and plate fin layered body 2 can be reliably held. In plate fin layered body 2 held by end plate 3, a region between the header regions where header flow paths 11 provided on both sides of plate fin 2a in the longitudinal direction are formed is heat exchange region C, and plate fin flow paths 13 having a desired shape are formed in heat exchange region C. A predetermined gap is formed between heat exchange regions C of layered plate fins 2a to make air that is second fluid B efficiently come into contact with and flow through plate fin flow paths 13 formed in heat exchange regions C. As described above, the gap between plate fins 2a adjacent in the layering direction is secured by the plurality of interval defining protrusions 7 (refer to FIG. 2B) provided on first end plate 3a and/or second end plate 3b.

[0066] In heat exchanger 1 of the first exemplary embodiment configured as described above, header flow path 11 is formed by the recess formed by header flow path inner peripheral support portion 10a, header flow path top portion 10b, and header flow path outer peripheral support portion 10c of first fin member 10, and flat portion 20b formed by the substantially flat surface of second fin member 20, and the refrigerant from supply pipe 4 is supplied via header flow path port 8 formed in header flow path inner peripheral support portion 10a.

[0067] In plate fin layered body 2 of the first exemplary embodiment, header flow path 11 formed on the outer periphery of header opening 11a in each plate fin 2a is joined on the inner peripheral side of header flow path inner peripheral support portion 10a and the outer peripheral side of header flow path outer peripheral support portion 10c of first fin member 10. In layered plate fins 2a, header flow paths adjacent to each other in the layering direction are joined. Therefore, header flow path 11 in first exemplary embodiment has a configuration with high rigidity, and even in a case where the high-pressure refrigerant from supply pipe 4 is supplied from header opening 11a to header flow path 11 through header flow path port 8, deformation such as expansion of header flow path 11 is suppressed, and a flow path having a desired shape is reliably maintained. Therefore, in heat exchanger 1 of the first exemplary embodiment, highly efficient heat exchange can be carried out with high reliability.

[0068] As described above, in heat exchanger 1 of the first exemplary embodiment, due to the layered structure of first fin member 10 and second fin member 20, the strength of the header flow path in each plate fin 2a can be increased, and weight reduction, size reduction, and efficiency of heat exchange in plate fin layered body 2 can be achieved. According to the configuration of the first exemplary embodiment, it is possible to provide a highly reliable heat exchanger capable of allowing a high-pressure refrigerant to flow through a flow path.

[0069] In the configuration of the first exemplary embodiment described above, the inner peripheral side of header flow path 11 of plate fin 2a is configured by a wall surface having a double structure of header flow path inner peripheral support portion 10a of first fin member 10 and inner peripheral support portion 20a of second fin member 20. As a result, in heat exchanger 1 of the first exemplary embodiment, the strength of the inner peripheral side of header flow path 11 to which the refrigerant is supplied from supply pipe 4 is increased, and the high-pressure refrigerant can flow to header flow path 11.

[0070] In the configuration of the first exemplary embodiment, the joint surface of first fin member 10 or second fin member 20 constituting plate fin 2a is brought into contact with end plate 3 provided at both ends of heat exchanger 1. Therefore, plate fin layered body 2 can be reliably sandwiched without special processing subjected to end plate 3, and first fin member 10 or second fin member 20 in contact with end plate 3 can prevent the flow of the refrigerant without performing special processing to prevent the refrigerant from leaking in end plate 3.

[Modification]

[0071] FIG. 19 is a longitudinal sectional view schematically illustrating a modification in the configuration of the first exemplary embodiment. FIG. 19 illustrates a portion around header flow paths 11 in first fin member 10A and second fin member 20A. As illustrated in FIG. 19, a recess for forming header flow path 11 in first fin member 10A includes header flow path top portion 10Ab that is formed in an annular shape and has a flat surface, and header flow path support portion (header flow path inner peripheral support portion 10Aa and header flow path outer peripheral support portion 10Ac) formed to support header flow path top portion 10Ab in the layering direction on both the inner peripheral side and the outer peripheral side. Header flow path outer peripheral support portion 10Ac that supports header flow path top portion 10Ab on the outer peripheral side is continuous, via a bent portion, to heat exchange region C where plate fin flow path 13 is formed. As illustrated in the longitudinal sectional view of FIG. 19, the recess for forming header flow path 11 is obtained by a portion between header flow path inner peripheral support portion 10Aa, header flow path top portion 10Ab, and header flow path outer peripheral support portion 10Ac being bent to be continuous in a U-shape, and is a flow path of which the section orthogonal to the flow path direction has a substantially square shape.

[0072] On the other hand, in order to form header flow path 11 in each plate fin 2Aa, second fin member 20A joined to first fin member 10A has flat portion 20Ab that is a flat surface for covering the recess formed by header flow path inner peripheral support portion 10Aa, header flow path top portion 10Ab, and header flow path outer peripheral support portion 10Ac, as illustrated in FIG. 19. Unlike inner peripheral support portion 20a of second fin member 20 illustrated in FIG. 6 described above, second fin member 20A in the modification illustrated in FIG. 19 does not have a shape in which the inner peripheral-side end portion of second fin member 20A hangs down.

[0073] Therefore, in plate fin layered body 2A of the modification, the inner peripheral side of header flow path 11 is formed by header flow path inner peripheral support portion 10Aa of first fin member 10A, and the inner peripheral side of header flow path 11 of plate fin 2Aa has a single structure. In FIG. 19, the lead-out end that is the lower end of header flow path inner peripheral support portion 10Aa is joined to a tip end portion on the inner peripheral side of second fin member 20A. Header flow path top portion 10Ab connected to the upper end of header flow path inner peripheral support portion 10Aa is joined to flat portion 20Ab of second fin member 20A of plate fin 2Aa adjacent in the layering direction. That is, the inner peripheral side and the outer peripheral side of header flow path 11 of the modification illustrated in FIG. 19 are formed by header flow path support portions which are wall surfaces joined and connected vertically in the layering direction.

[0074] As a result, in plate fin layered body 2A of the modification, even in a case where the inner peripheral side has the single structure, header flow path 11 has the configuration with high rigidity. The inner peripheral sides of header flow paths 11 in plate fins 2Aa to be layered have the single structure, but since the respective layers are continuously joined, a refrigerant passage with high rigidity is formed. Header flow path port 8 is formed in the refrigerant passage for each layer, and a high-pressure refrigerant can be supplied to header flow path 11 of plate fin 2Aa of each layer.

[0075] Other configurations (for example, header communication flow path 12, plate fin flow path 13, transfer flow path 21, and the like) in the modification illustrated in FIG. 19 are the same as the configurations described in the first exemplary embodiment.

(Second exemplary embodiment)

[0076] Next, a layered plate fin heat exchanger (hereinafter, simply referred to as a heat exchanger) according to a second exemplary embodiment of the present disclosure will be described. FIG. 20 is a perspective view illustrating plate fin layered body 100 of the heat exchanger in the second exemplary embodiment. FIG. 21 is a sectional view of a region where header flow path 130 is formed in plate fin layered body 100 in the second exemplary embodiment.

[0077] In FIGS. 20 and 21, elements having substantially the same functions and configurations as those of the first exemplary embodiment are denoted by the same reference numerals. Since the basic operation of the heat exchanger of the second exemplary embodiment is the same as the operation of heat exchanger 1 of the first exemplary embodiment, the second exemplary embodiment will be described focusing on differences from the first exemplary embodiment. The heat exchanger of the second exemplary embodiment is largely different from heat exchanger 1 of the first exemplary embodiment in the shape of the header flow path.

[0078] As illustrated in FIGS. 20 and 21, similarly to the configuration of the first exemplary embodiment, first fin member 110 and second fin member 120 are joined (brazed) to form one plate fin 100a. First fin member 110 and second fin member 120 in the second exemplary embodiment have annular recesses at facing positions where header flow paths 130 are to be formed. First fin member 110 and second fin member 120 are joined to form header flow path 130. Accordingly, header flow path 130 in the second exemplary embodiment has a larger section, which is orthogonal to a flow direction of the flow path, than the section of header flow path 11 in the first exemplary embodiment (for example, in the case of the similar plate fin, the area of the section orthogonal to the flow path direction is substantially doubled).

[0079] On the surface side of first fin member 110 in the second exemplary embodiment, a plurality of interval defining protrusions 7 are formed entirely in order to secure a distance from plate fin 100a adjacent in the layering direction. Similarly to second fin member 20 (refer to FIG. 2B) in the first exemplary embodiment, interval defining protrusions 7 are dispersed and arranged to obtain an uniform distance from plate fin 100a adjacent in the layering direction. In first fin member 110, positioning pin openings 9 are formed on both sides of header flow path 130 side by side in a direction orthogonal to the longitudinal direction of plate fin layered body 100. That is, header flow path 130 and positioning pin openings 9 are disposed in a line in the direction orthogonal to the longitudinal direction of plate fin layered body 100, and are disposed in parallel with the flow direction of air that is second fluid B.

[0080] In second fin member 120 in the second exemplary embodiment, similarly to first fin member 10 in the first exemplary embodiment, header communication flow path 12 and plate fin flow path 13 are formed (refer to FIG. 2A). Therefore, in order to cause header communication flow path 12 of second fin member 120 and plate fin flow path 13 to communicate with each other, transfer flow path 21 is formed in first fin member 110 (refer to FIG. 20).

[0081] In the heat exchanger in the second exemplary embodiment, similar to heat exchanger 1 of the first exemplary embodiment, header flow path port 80 is formed on the inner peripheral side of header flow path 130 in order to supply the high-pressure refrigerant from supply pipe 4 to header flow path 130 (refer to FIG. 21). Header flow path port 80 in the second exemplary embodiment is formed by cutting out a part of an inner peripheral-side end portion of first fin member 110 forming header flow path 130.

[0082] As illustrated in FIG. 21, in first fin member 110 and second fin member 120 constituting one plate fin 100a, the inner peripheral side and the outer peripheral side of header flow path 130 are regions to be joined (brazed). Therefore, header flow path 130 has a configuration in which the deformation of the header flow path is prevented in the configuration in which the high-pressure refrigerant is sucked from header flow path port 80, and has a highly reliable header flow path.

[0083] In the configuration of the second exemplary embodiment, header flow path ports 80 are formed at positions facing each other on the inner peripheral side of header flow path 130, and are formed at positions on a center line extending in the longitudinal direction of plate fin 100a passing through the center of annular header flow path 130. In this way, since header flow path ports 80 are formed at positions facing each other in the longitudinal direction of header flow path 130, in a state where the heat exchanger is provided in an apparatus (for example, an air conditioner), plate fin layered body 100 is provided to be inclined at a predetermined angle from the vertical line with respect to the longitudinal direction, for example, inclined by 45 degrees, and thus, header flow path ports 80 facing each other are located at up-down positions in the vertical direction. Therefore, in a case where the refrigerant in supply pipe 4 flows separately in the liquid phase and the gas phase, the refrigerant in the liquid phase and the refrigerant in the gas phase are supplied to header flow path ports 80 at the up-down positions. As a result, similar refrigerant with a balance between the liquid phase and the gas phase is supplied to plate fin flow path 13 of each layer layered in the heat exchange region, and a configuration is obtained in which highly balanced and efficient heat exchange can be carried out entirely in plate fin layered body 100.

[0084] In the configurations of the first and second exemplary embodiments, the header flow path has been described as having an annular shape, but the present disclosure is not limited to the shape, and includes various shapes such as a flow path shape that is not annularly connected, for example, a C shape and an arc shape, in addition to a simple annular shape.

[0085] According to the present disclosure, it is possible to provide a heat exchanger in which weight reduction, size reduction, and efficiency improvement are achieved, and which is highly reliable even in a configuration in which a high-pressure refrigerant flows.

[0086] As described in the first and second exemplary embodiments, the heat exchanger of the present disclosure has a configuration in which the refrigerant is supplied from the inner peripheral side of the header flow path as the header flow path, and has a configuration in which the inner peripheral side and the outer peripheral side of the header flow path of each layer in the plate fin layered body are joined to have high rigidity. In the heat exchanger configured as described above, a refrigerant having a desired high pressure can be supplied to the plate fin layered body, and a highly efficient heat exchange function is obtained.

[0087] In the plate fin layered body of the heat exchanger of the present disclosure, since the header flow path is formed by the multilayer support portions (header flow path inner peripheral support portion, header flow path outer peripheral support portion) continuous in the layering direction, the pressure resistance vulnerability in the header flow path is considerably reduced, and the rigidity of the header flow path is enhanced. As a result, in the heat exchanger of the present disclosure, a stable operation can be maintained even in a case where the refrigerant having a high pressure equal to or higher than a certain value flows.

[0088] In the plate fin layered body of the heat exchanger of the present disclosure, the header flow path port is formed in the support portion on the inner peripheral side of the header flow path, and the header flow path port is the first flow port with respect to the flow path of each plate fin. Since the header flow path port of the header flow path has a configuration in which the opening shape and the formation position of the header flow path port can be appropriately set, in the heat exchanger of the present disclosure, the configuration can be optimized to an ideal refrigerant state (liquid phase-gas layer balance state), and performance can be further improved.

[0089] Furthermore, in the configuration of the heat exchanger according to the present disclosure, since the plate fin layered body of the layered plate fins is joined as a whole to have rigidity, the end plate can be made of a relatively thin metal material. Since the end plate has a configuration in which the positioning member with respect to the layered plate fins is mounted and the supply and discharge pipe is mounted, it is not necessary to use a thick material having high rigidity in order to strongly clamp the plate fin layered body in the layering direction. As a result, since the end plate in the heat exchanger of the present disclosure does not significantly differ in heat capacity from the plate fin to be joined, and does not significantly differ in member strength, occurrence of brazing failure between the end plate and the plate fin is significantly suppressed. Therefore, the heat exchanger of the present disclosure has pressure resistance to the refrigerant to be supplied and has high reliability.

[0090] As described above, in the configuration of the heat exchanger according to the present disclosure, weight reduction, size reduction, and high efficiency of heat exchange can be achieved, and it is possible to provide a heat exchanger in which the high-pressure refrigerant can flow through the plate fin of each layer in the plate fin layered body, and which is highly reliable and has high efficiency of heat exchange.

[0091] Although the present disclosure has been described in each exemplary embodiment with a certain degree of detail, these configurations are examples, and the disclosure content of these exemplary embodiments should change in the details of the configuration. In the present disclosure, replacement, combination, and order change of elements in each exemplary embodiment can be implemented without departing from the scope and spirit of the claims.

INDUSTRIAL APPLICABILITY

[0092] The present disclosure can provide a highly reliable heat exchanger capable of achieving weight reduction, size reduction, and high efficiency of heat exchange, and thus can construct an air conditioner having high market value.

REFERENCE MARKS IN THE DRAWINGS

[0093]

1	heat exchanger
2, 2A, 100	plate fin layered body
2a, 2Aa, 100a	plate fin
3	end plate
3a	first end plate
3b	second end plate
4	supply pipe
5	discharge pipe
6	heat transfer blocking slit
7	interval defining protrusion
8, 80	header flow path port
8a	first header flow path port
8b	second header flow path port
9	positioning pin opening
10, 10A, 110	first fin member
10a, 10Aa	header flow path inner peripheral support portion
10b, 10Ab	header flow path top portion
10c, 10Ac	header flow path outer peripheral support portion
10d	protrusion end portion on inner peripheral side
11, 130	header flow path
11a	header opening
12	header communication flow path
13	plate fin flow path
13a	first plate fin flow path (linear)
13b	second plate fin flow path (arc shape)
16	flow path transfer region
20, 20A, 120	second fin member
20a	inner peripheral support portion
20b, 20Ab	flat portion
21	transfer flow path

Claims

1. A heat exchanger comprising:

a plate fin layered body including plate fins layered, the plate fins each having a flow path through which a first fluid flows; and
a supply and discharge pipe that supplies or discharges the first fluid that flows through the flow path of each of the plate fins of the plate fin layered body,
wherein the heat exchanger causes a second fluid to flow through a gap between the plate fins of the plate fin layered body and carries out heat exchange between the first fluid flowing through the flow path and the second fluid,
each of the plate fins includes
in a case where the supply and discharge pipe functions as a supply pipe, a header opening to which the first fluid from the supply pipe is supplied,
a header flow path formed around the header opening, and
a plate fin flow path through which the first fluid from the header flow path flows, and which carries out heat exchange with the second fluid, and
the plate fin layered body has a configuration in which inner peripheral sides of header flow paths, the header flow paths each being the header flow path, are continuously joined in a layering direction.

2. The heat exchanger according to claim 1, wherein the plate fin layered body has a configuration in which outer peripheral sides of header flow paths, the header flow paths each being the header flow path, are continuously joined in the layering direction.

3. The heat exchanger according to claim 1 or 2, wherein in the plate fin layered body, the inner peripheral sides of the header flow paths are formed by wall surfaces continuous in the layering direction.

4. The heat exchanger according to any one of claims 1 to 3, wherein in the plate fin layered body, the inner peripheral sides of the header flow paths are each formed by a wall surface having a double structure.

5. The heat exchanger according to any one of claims 1 to 4, wherein the plate fin has a header flow path port that is provided on an inner peripheral side of the header flow path, the header flow path port causing the header opening and the header flow path to communicate with each other.

6. The heat exchanger according to any one of claims 1 to 5, wherein the plate fin has a plurality of header flow path ports that are provided on an inner peripheral side of the header flow path, the plurality of header flow path ports causing the header opening and the header flow path to communicate with each other.

7. The heat exchanger according to claim 6, wherein header flow path ports among the plurality of header flow path ports are formed at positions to face each other on the inner peripheral side of the header flow path.

8. The heat exchanger according to claim 7, wherein the header flow path ports are formed at positions to face each other on a center line extending in a longitudinal direction of the plate fin.

9. The heat exchanger according to any one of claims 1 to 8,

wherein the plate fin has a flow path formed by joining a first fin member and a second fin member,
the first fin member has a recess for forming the header flow path, and
the second fin member has a flat surface that is joined to the first fin member to form the header flow path with the recess in the first fin member.

10. The heat exchanger according to claim 9,

wherein in the first fin member, the recess for forming the header flow path has a header flow path inner peripheral support portion, a header flow path top portion, and a header flow path outer peripheral support portion,
the header flow path inner peripheral support portion and the header flow path outer peripheral support portion are joined to the flat surface of the second fin member to form the header flow path, and
the header flow path port that causes the header opening and the header flow path to communicate with each other is formed in a portion of the header flow path inner peripheral support portion.

11. The heat exchanger according to claim 9 or 10,

wherein the second fin member has the flat surface, and an inner peripheral support portion that is bent to be continuous with the flat surface and serves as an outer edge portion of the header opening on the inner peripheral side of the header flow path, and
the inner peripheral support portion of the sec-

ond fin member is joined to a first fin member of another plate fin that is adjacent in the layering direction, and the inner peripheral side of the header flow path in the plate fin layered body has a double wall surface.

FIG. 1

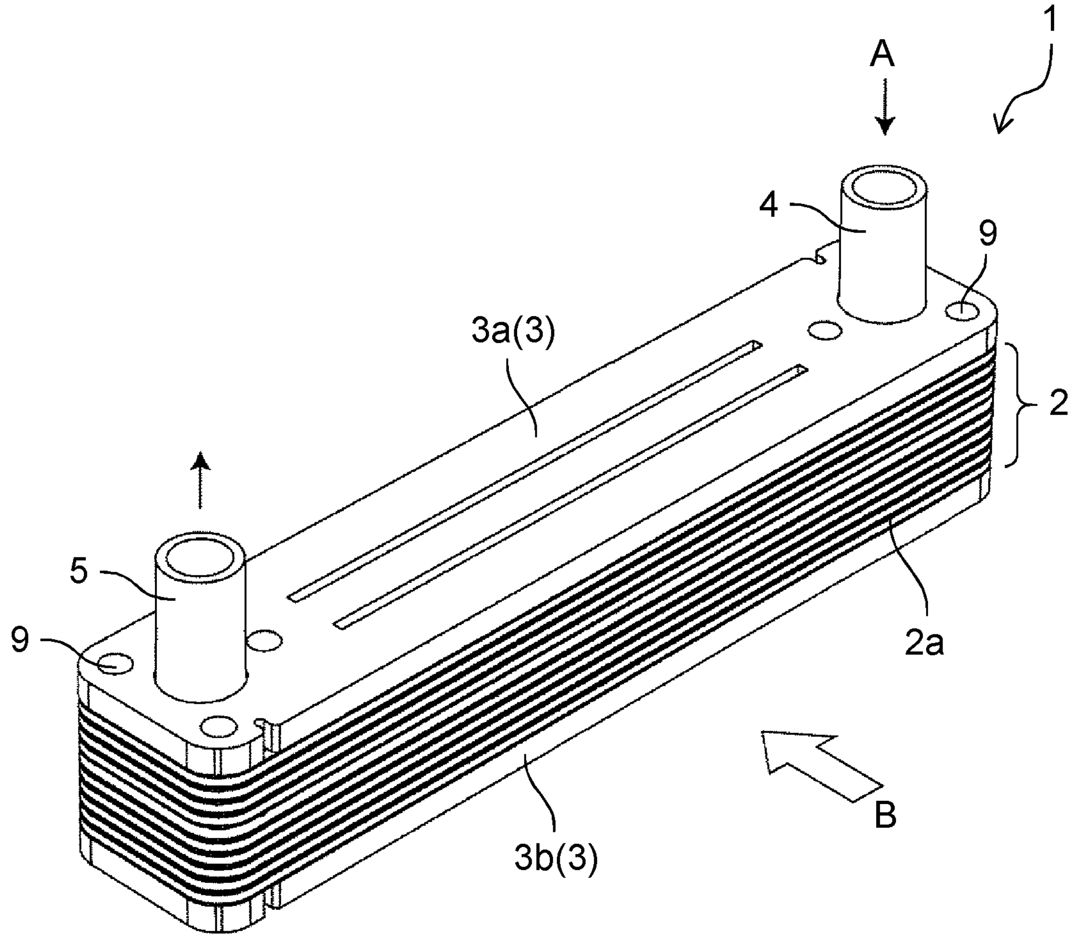
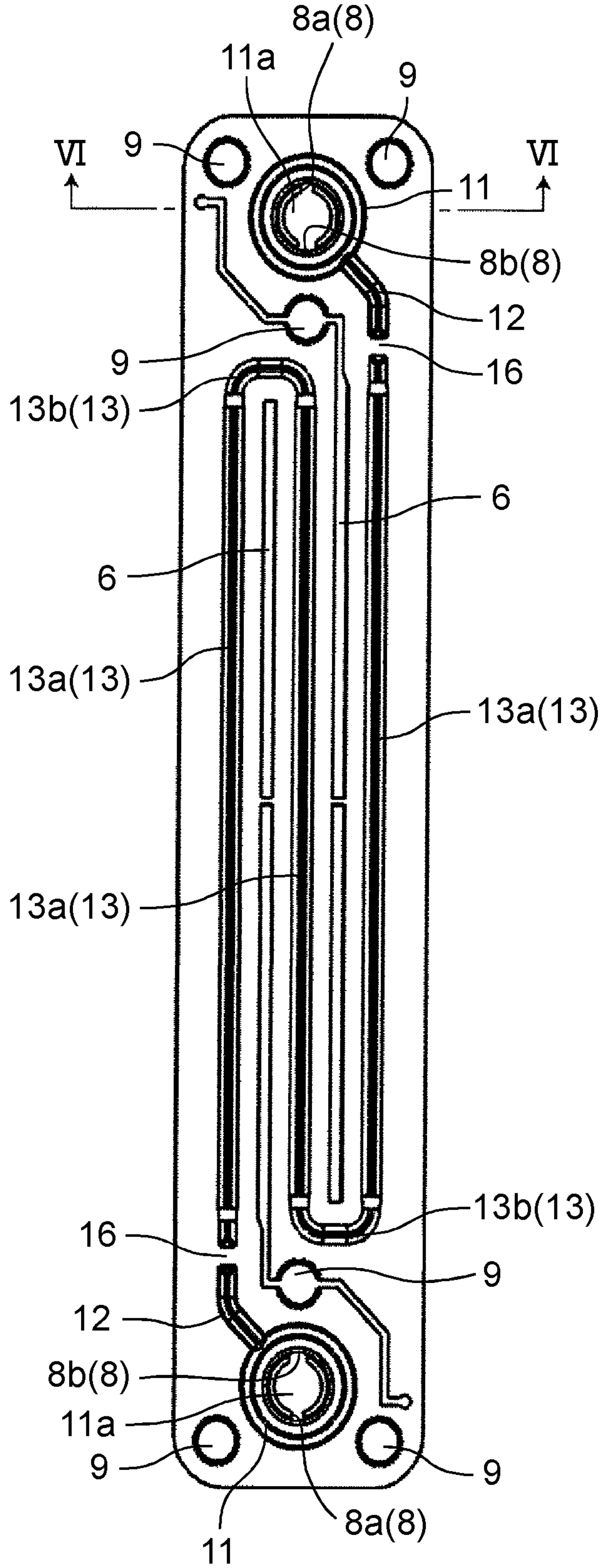


FIG. 2A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11a
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VI
9
VI
11
8b(8)
12
9
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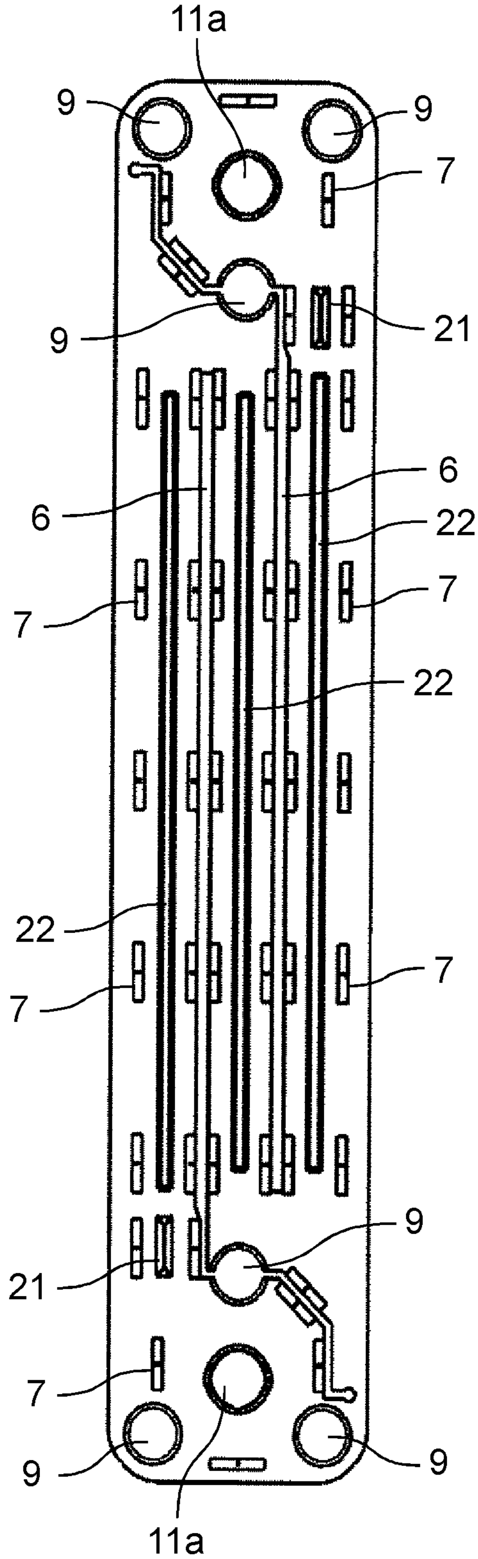
11
8a(8)

FIG. 2B


11a
9
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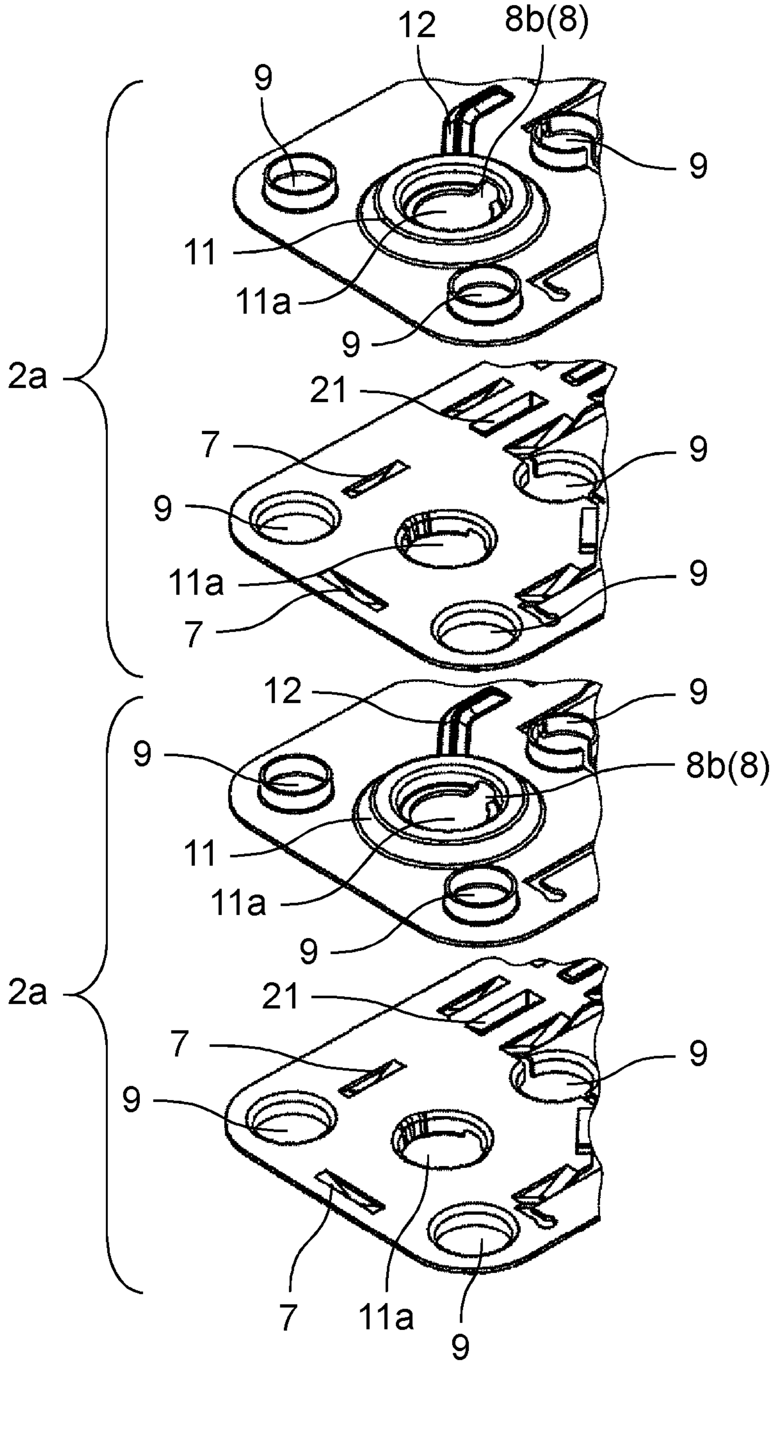
9
11a

FIG. 3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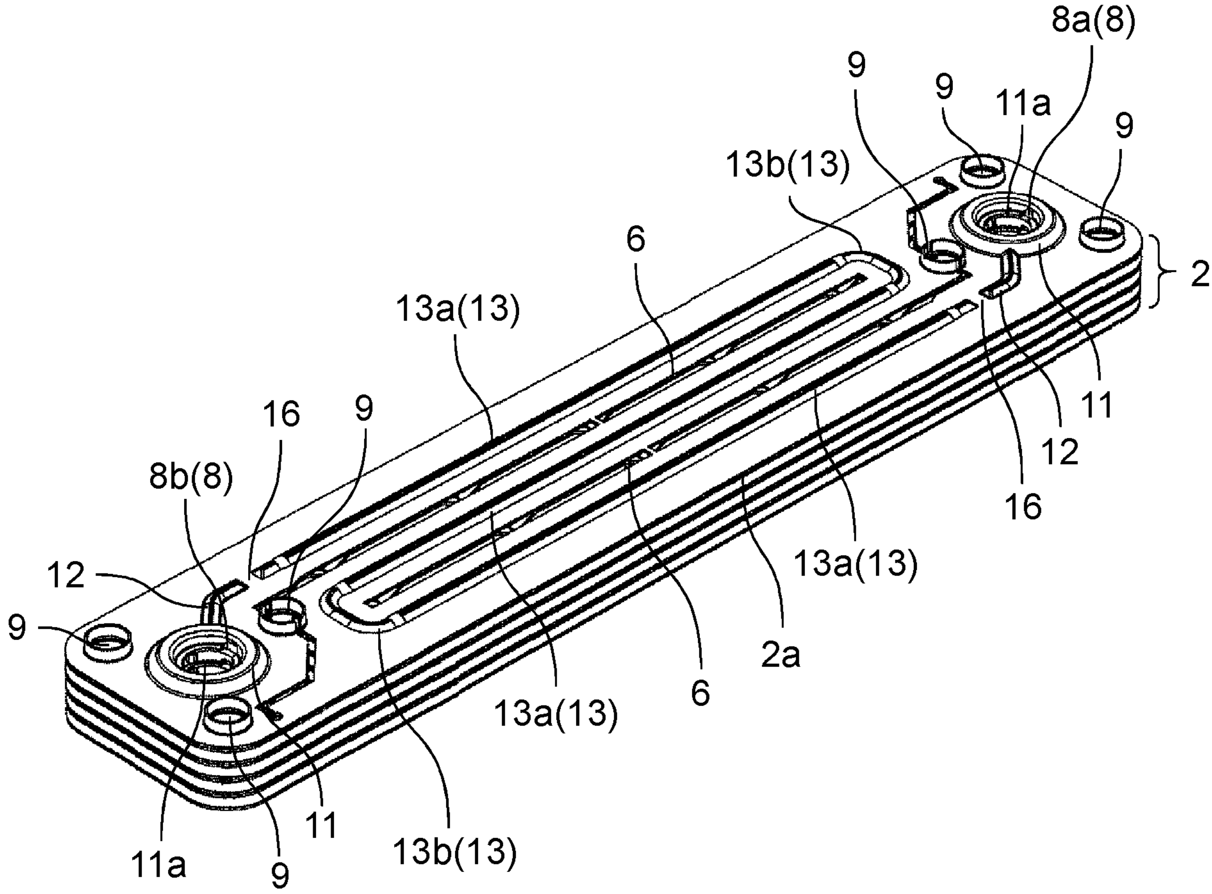
7
11a
9

FIG. 4


8a(8)
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13b(13)
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13a(13)
11
12
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13a(13)
9
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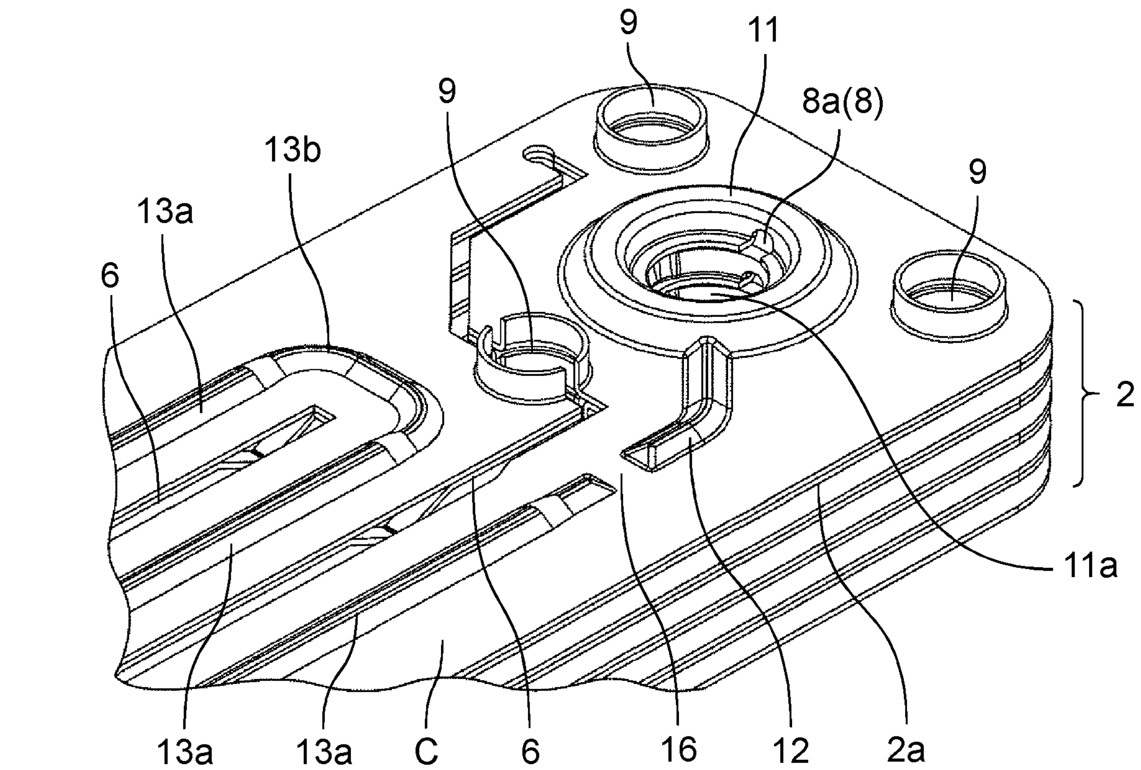
6
2a
11a
11
9
13b(13)

FIG. 5


9
11
9
8a(8)
13b
9
13a
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2
11a
13a
13a
C
6
16
12
2a

FIG. 6

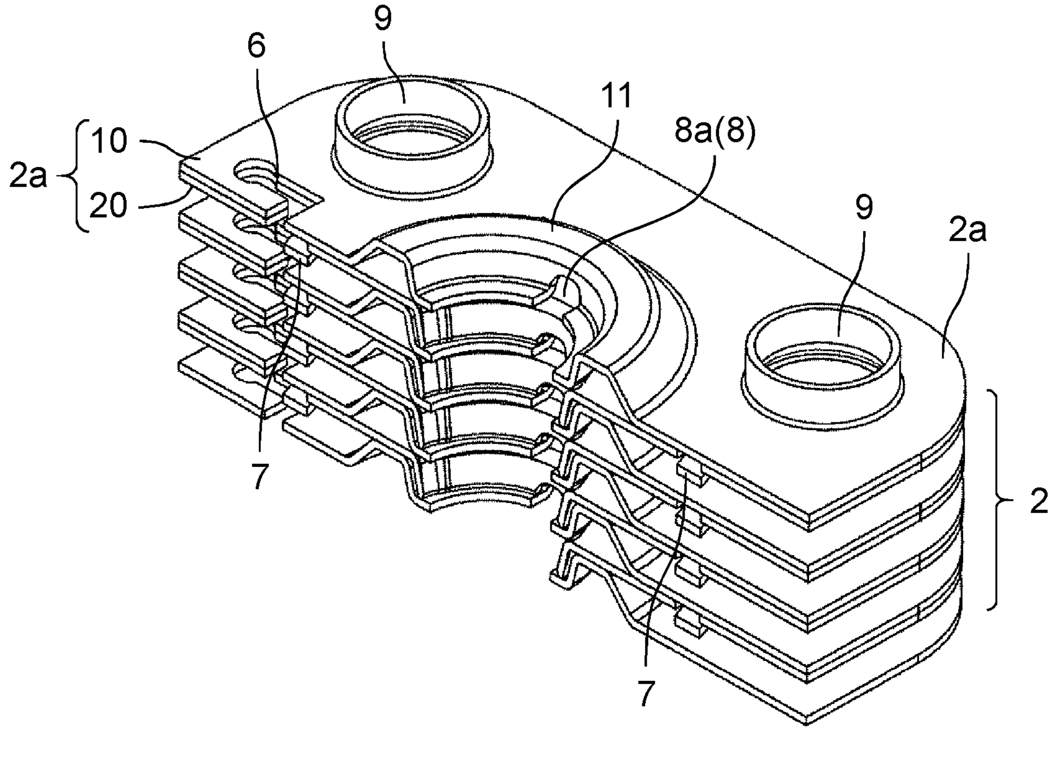

9
6
11
8a(8)
10
2a
20
9
2a
7
2
7

FIG. 7

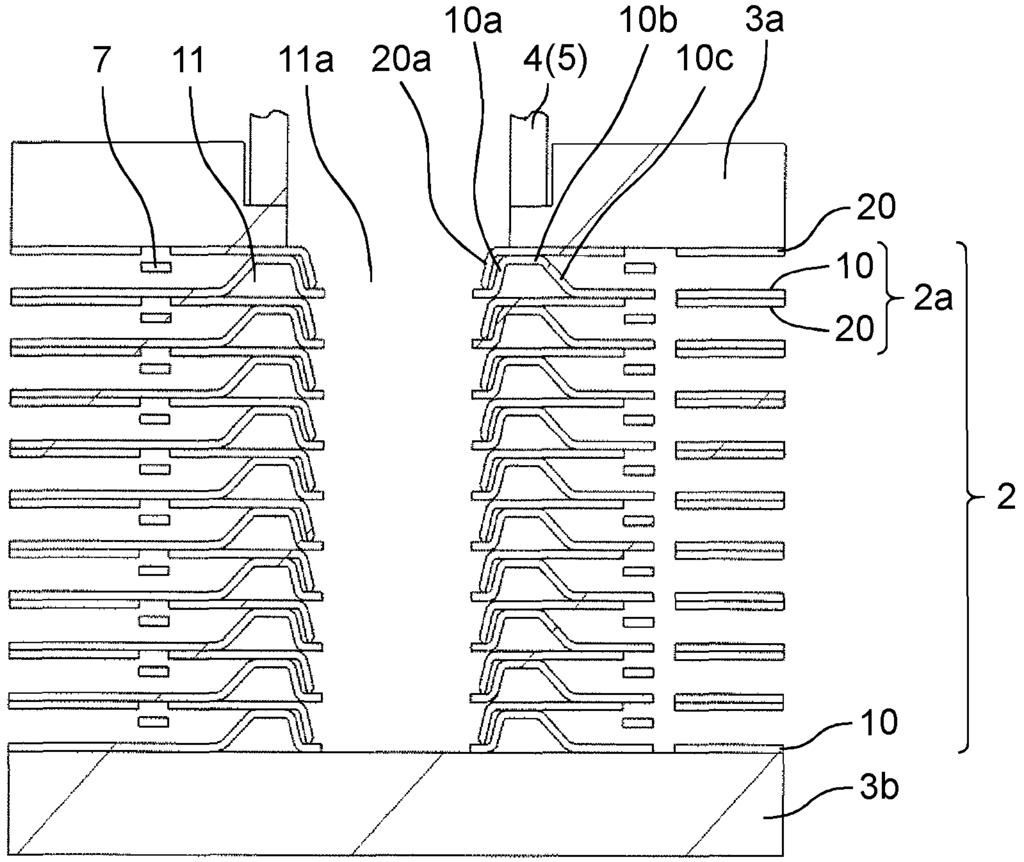


FIG. 8

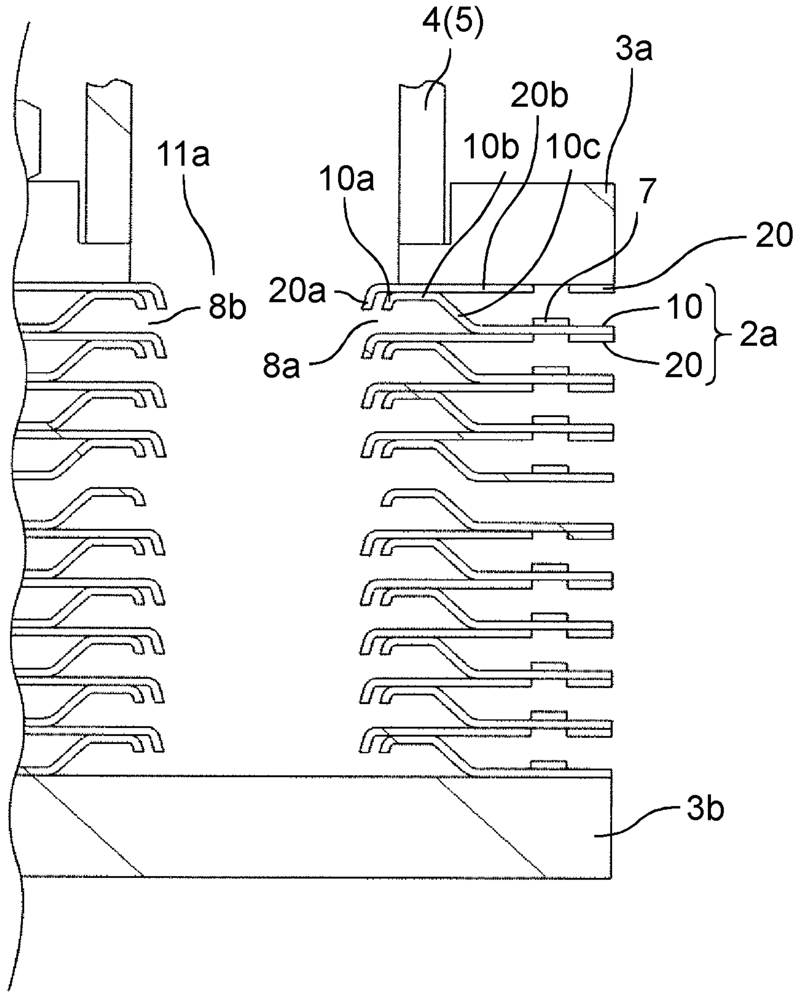


FIG. 9

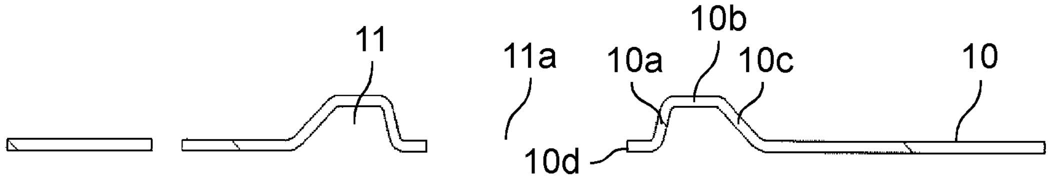


FIG. 10

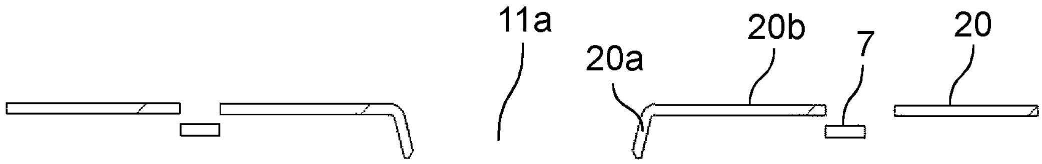


FIG. 11

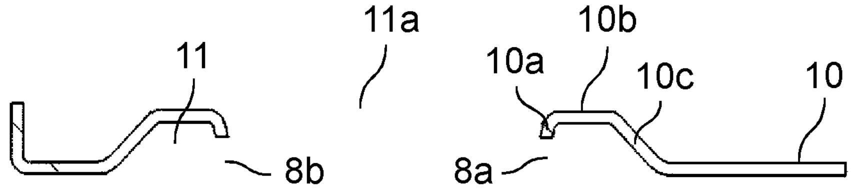


FIG. 12

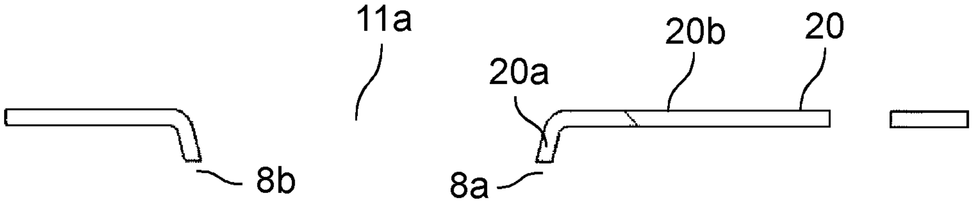


FIG. 13

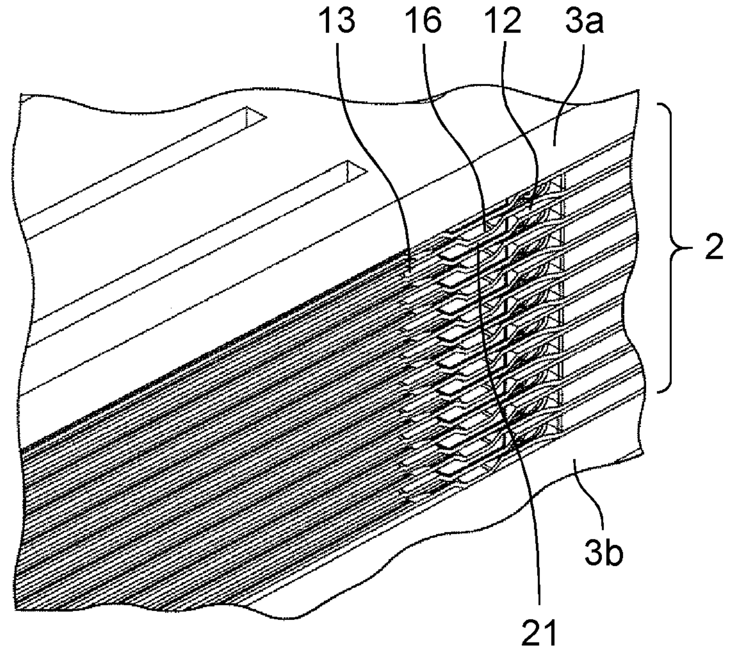


FIG. 14

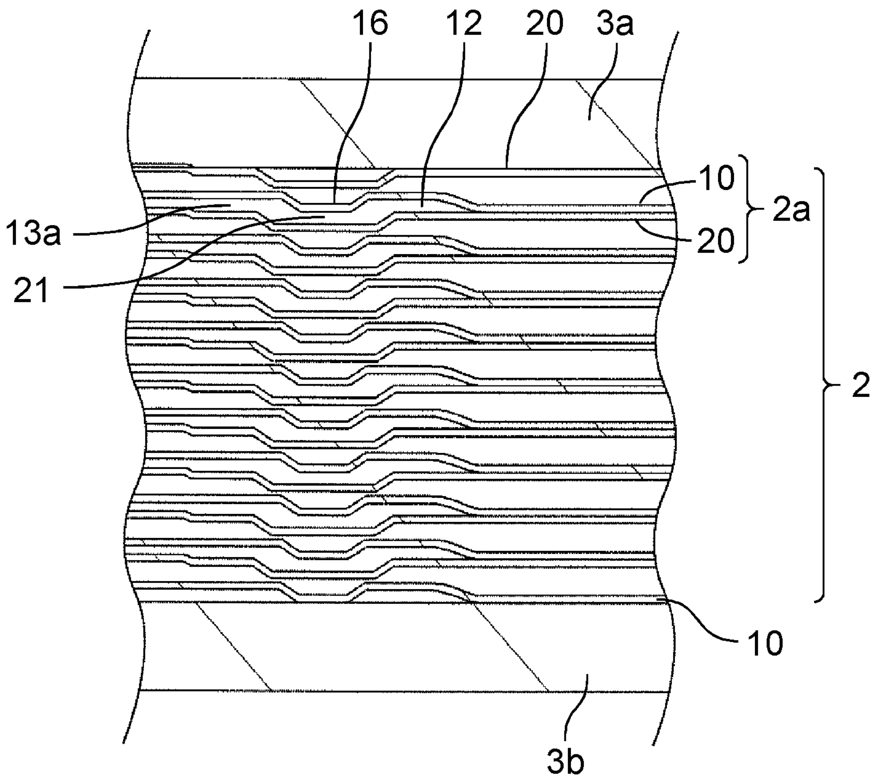


FIG. 15

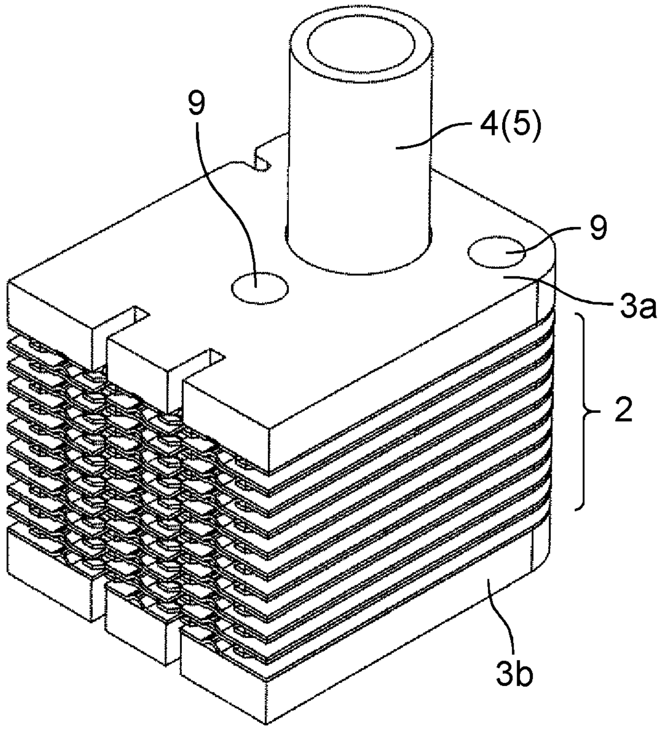


FIG. 16

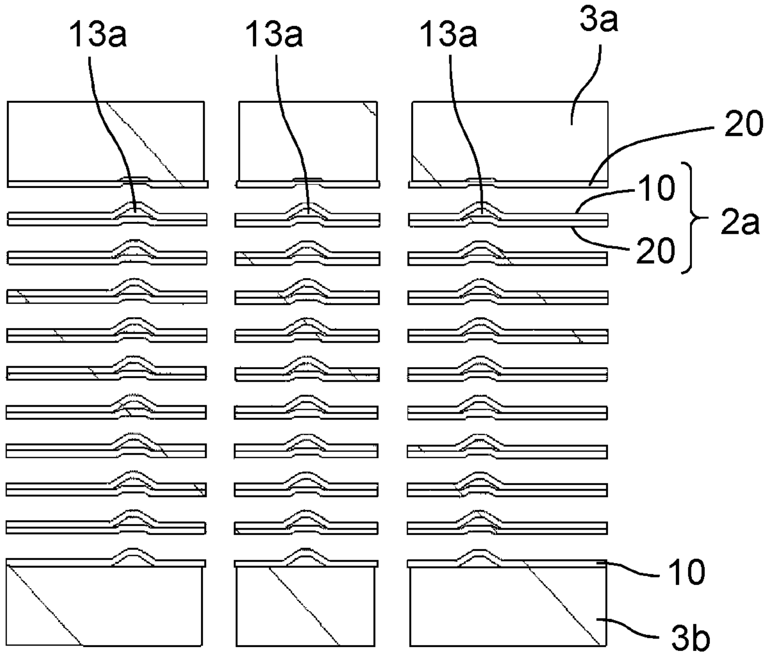


FIG. 17

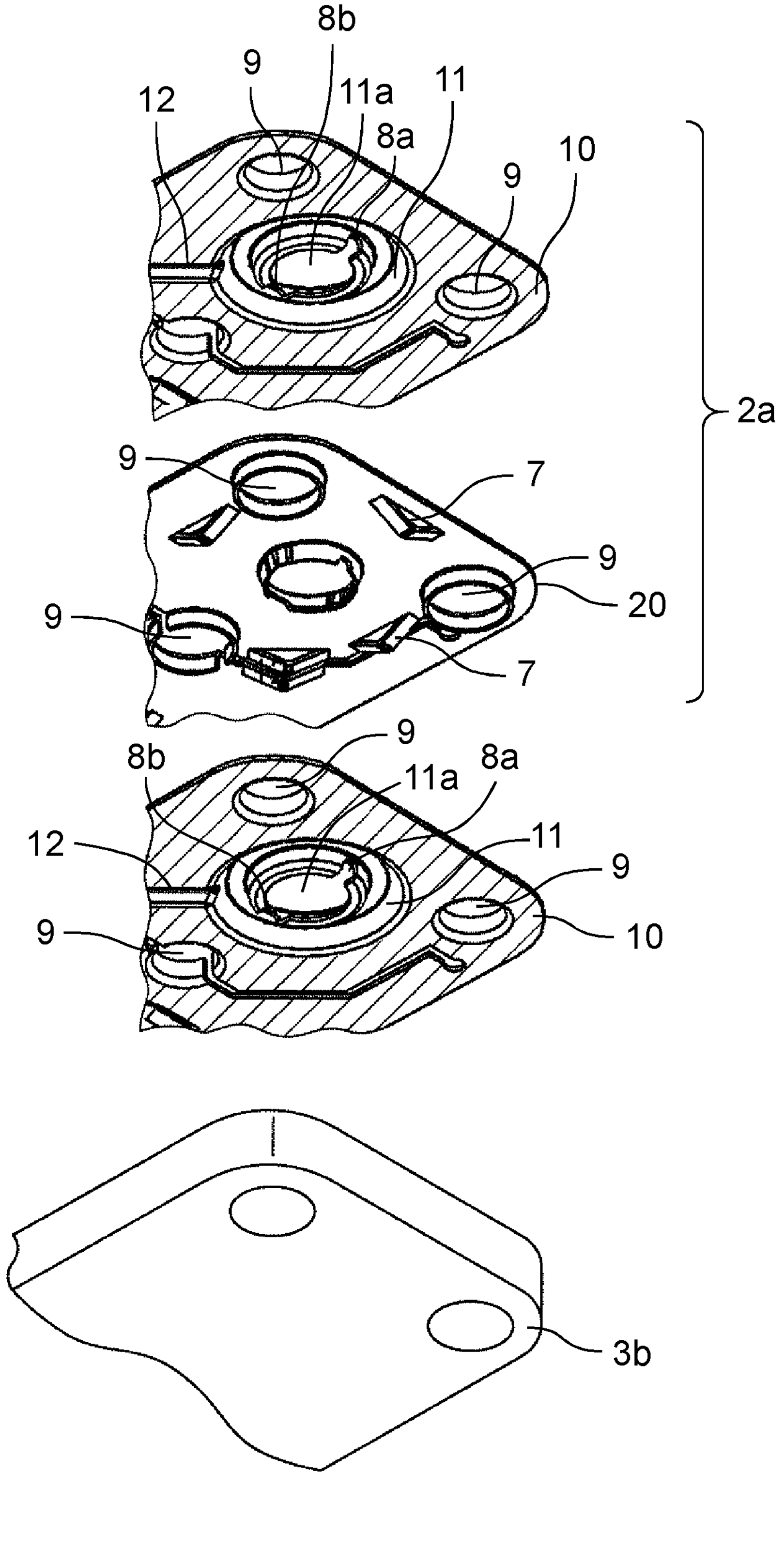


FIG. 18

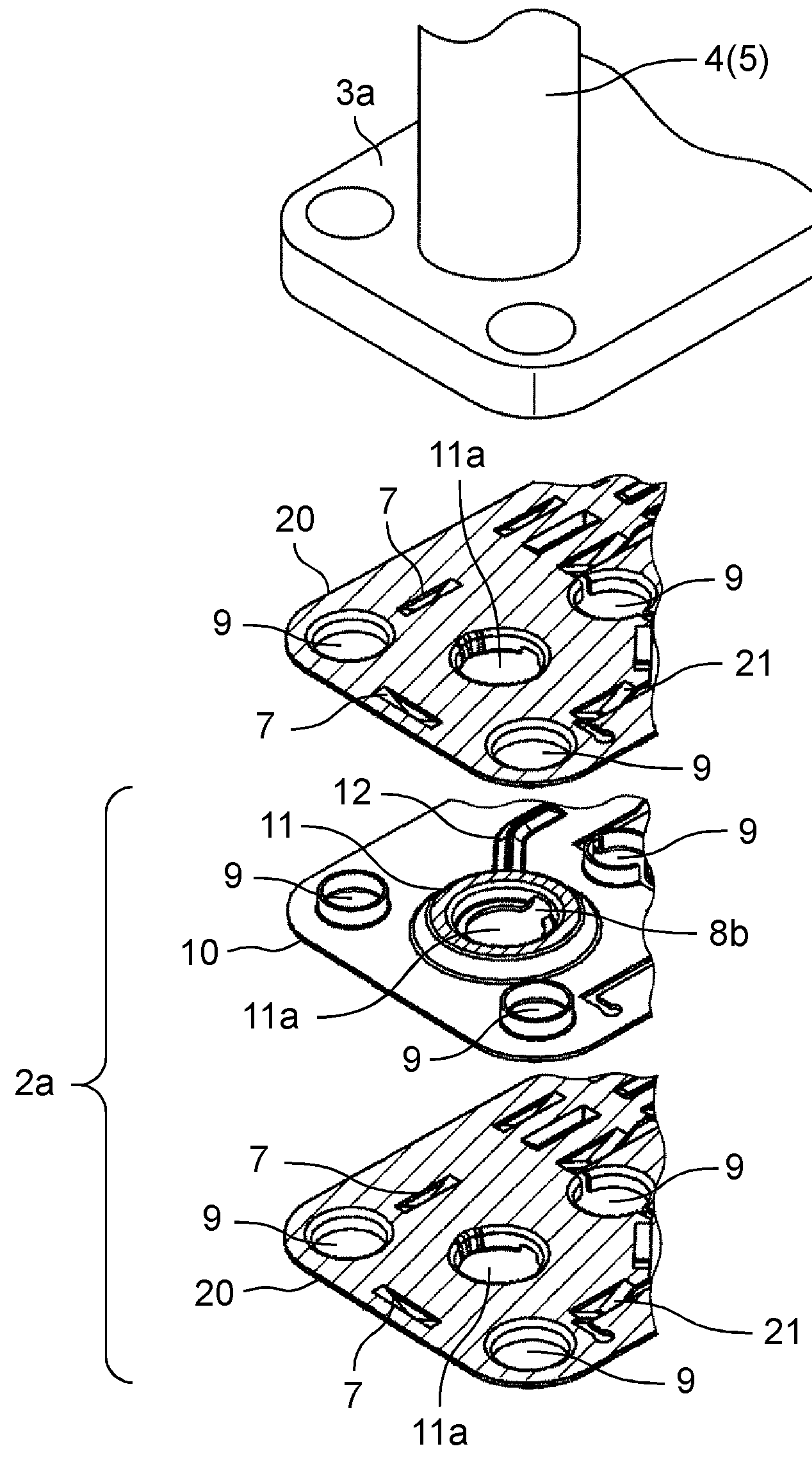


FIG. 19

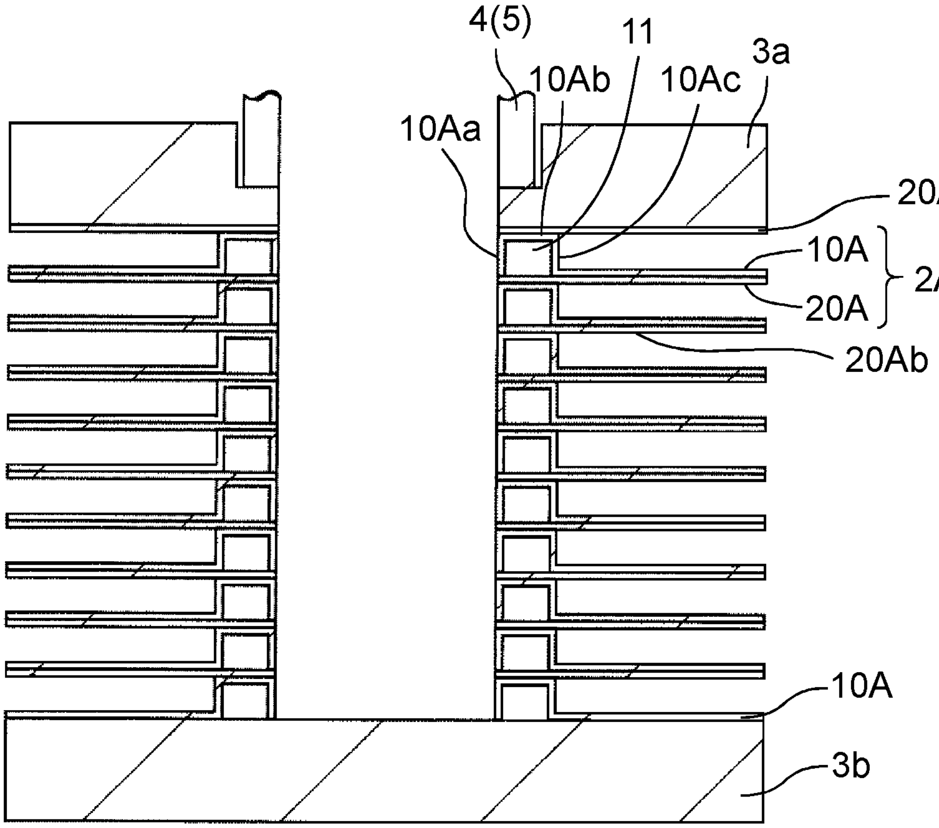

4(5)
11
3a
10Ab
10Ac
10Aa
20A
10A
2Aa
20A
20Ab
10A
3b

FIG. 20

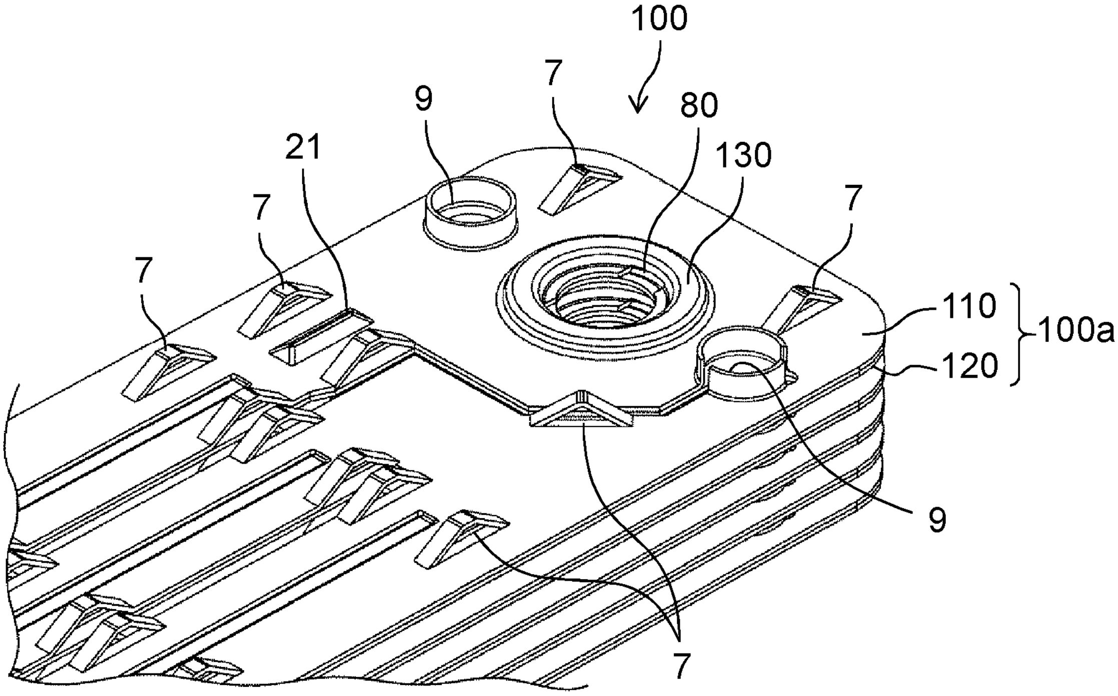
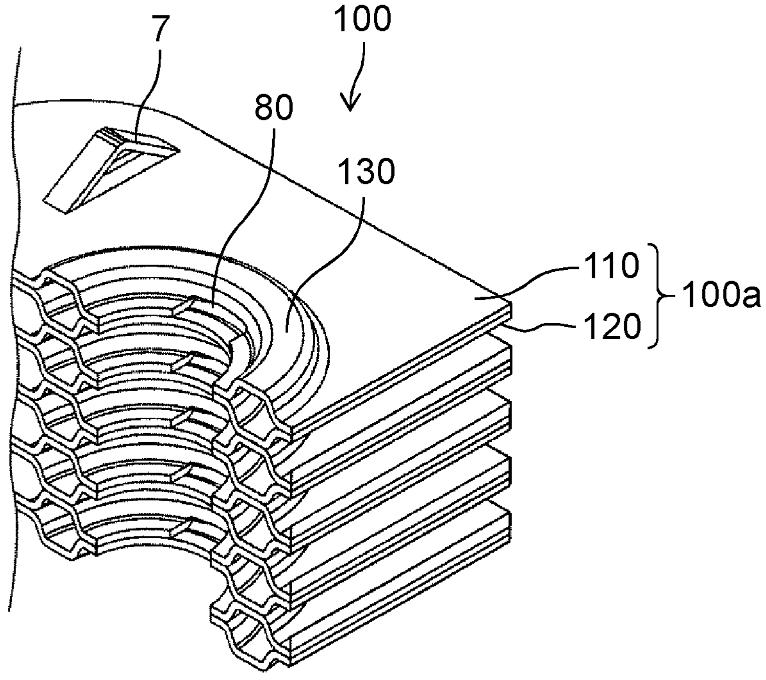

100
7
9
80
21
130
7
7
7
110
100a
120
9
7

FIG. 21



INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2020/038071

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F28F9/02(2006.01)i, F28F3/08(2006.01)i
FI: F28F9/02301J, F28F3/08311

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)
Int.Cl. F28F9/02, F28F3/08

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2019/176567 A1 (MITSUBISHI ELECTRIC CORPORATION) 19 September 2019 (2019-09-19), paragraphs [0011]-[0027], fig. 1-4	1-11
A	JP 2001-133184 A (EBARA CORPORATION) 18 May 2001 (2001-05-18), paragraphs [0007], [0008], fig. 1	1-11

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
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"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
30 October 2020	10 November 2020

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/038071

WO 2019/176567 A1	19 September 2019	JP 6641544 B1
JP 2001-133184 A	18 May 2001	(Family: none)

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3965901 B **[0005]**
- JP 3192719 U **[0005]**
- JP 6504367 B **[0005]**