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(57) **ABSTRACT**

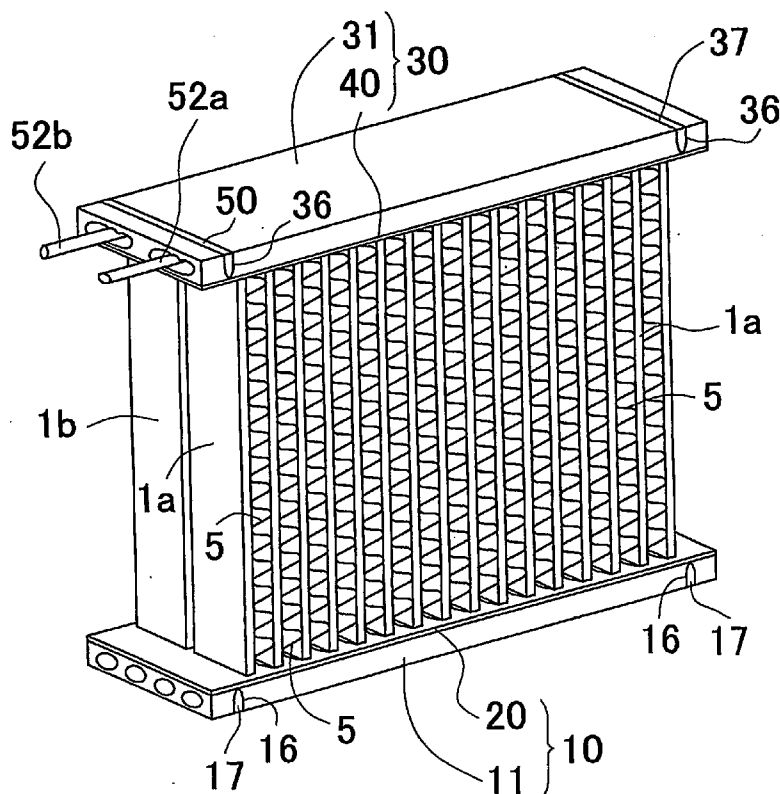
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Jun. 7, 2002	(JP)	2002166686
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In the present invention, a header tank **10** includes a header tank main body **11** and a cover plate **20**. The header tank main body **11** is provided with a refrigerant inlet passage **12a** and a refrigerant outlet passage **12b** arranged in parallel, connecting apertures **14a** and **14b** formed on a tube connecting side **13** and communicating with the passages **12a** and **12b**, and a communicating aperture communicating with the passages **12a** and **12b**. The cover plate **20** has insertion apertures **24a** and **24b** corresponding to the connecting apertures **14a** and **14b**. The tubes **1a** and **1b**, the cover plate **20** and the header tank main body **11** are integrally joined in a state in which each end of the tube **1a** and **1b** is inserted into the insertion aperture **24a** and **24b** of the cover plate **20** disposed on the tube connecting side **13a** of the header tank main body **11** and connected to the connecting apertures **14a** and **14b** of the header tank main body **11**. Thus, a heat exchanger using CO₂ refrigerant capable of decreasing refrigerant flow resistance and enough strength against the inner pressure can be obtained.



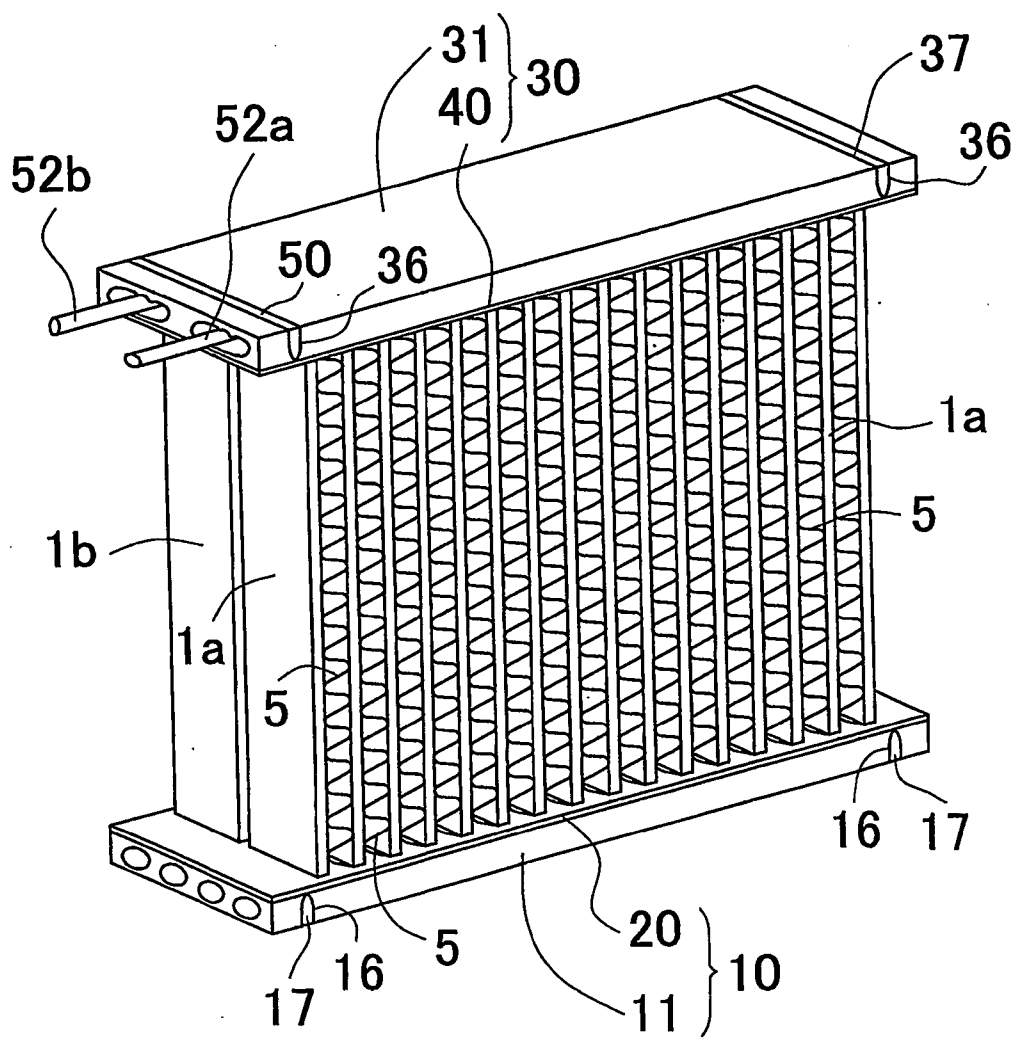


FIG.1

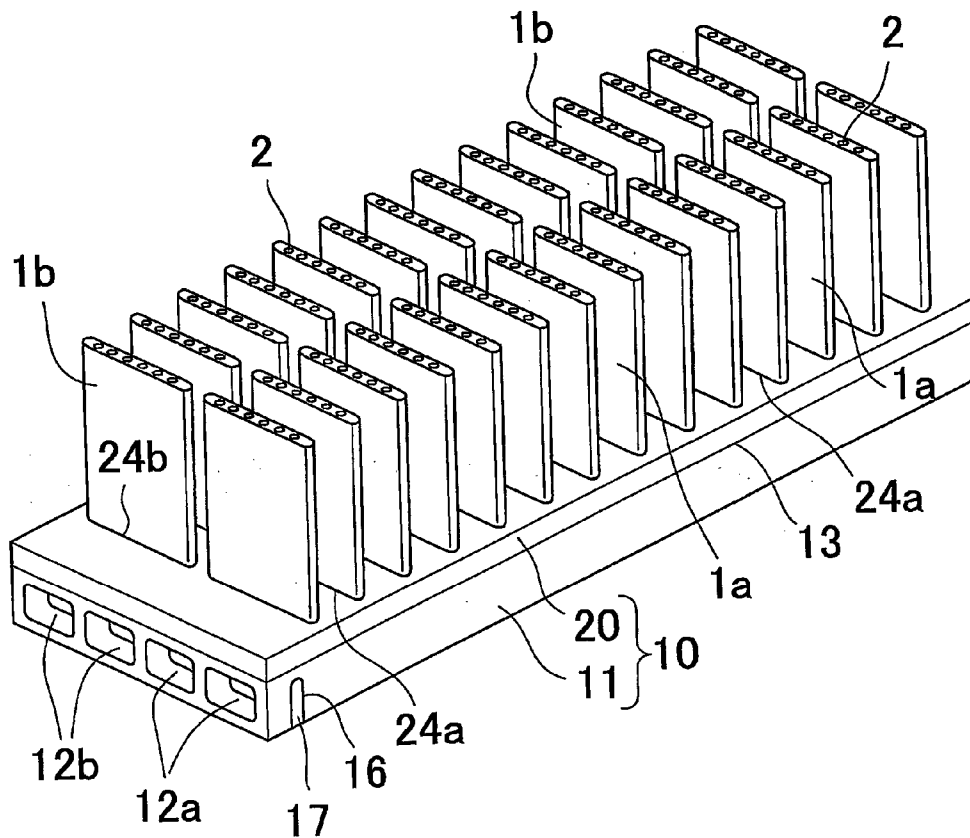
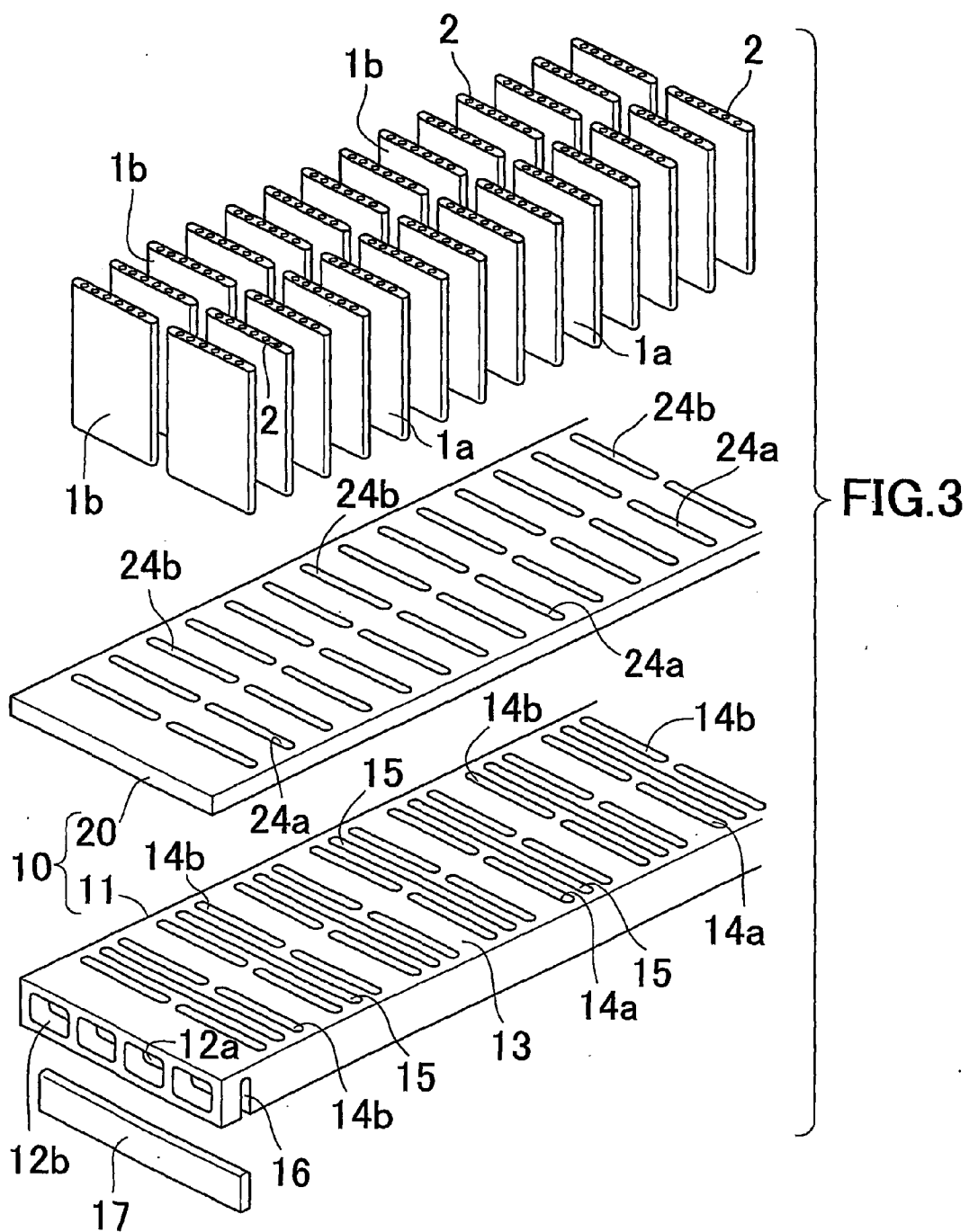


FIG. 2



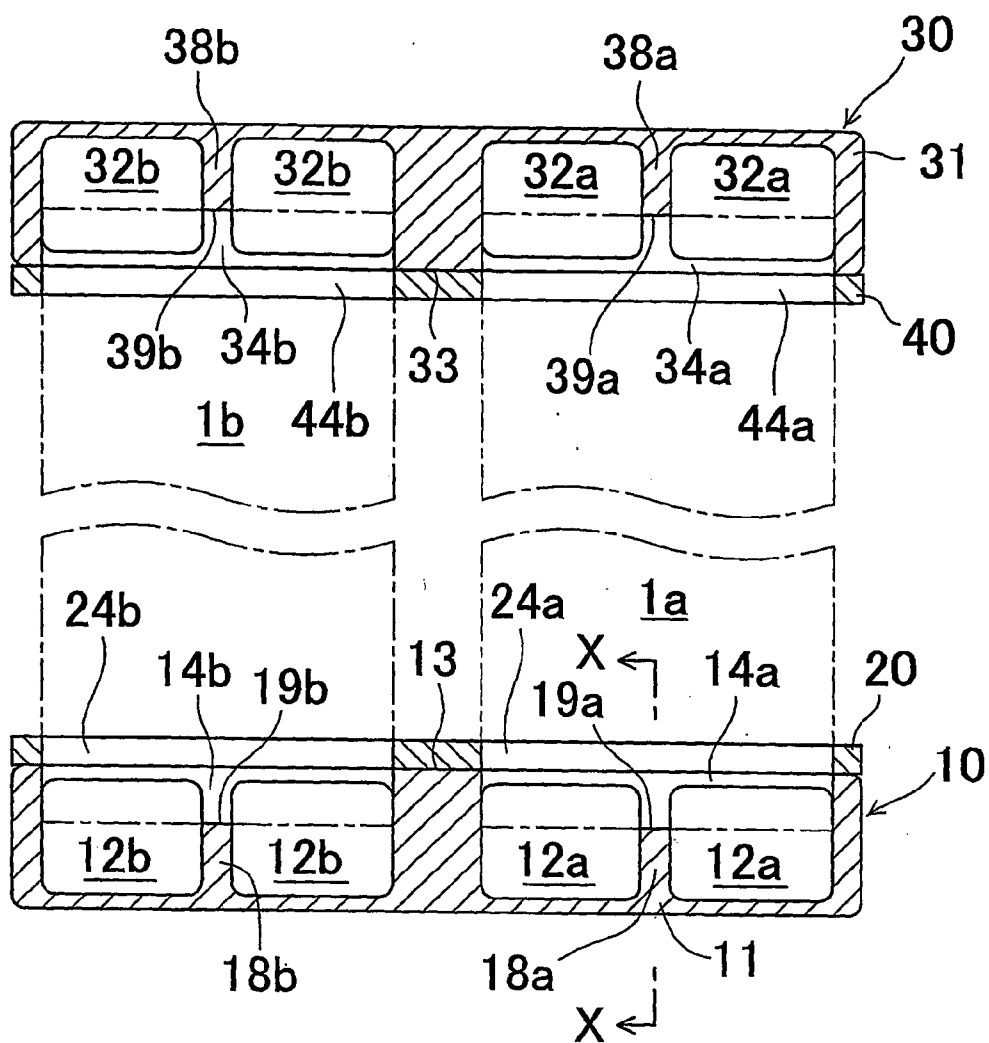


FIG. 4

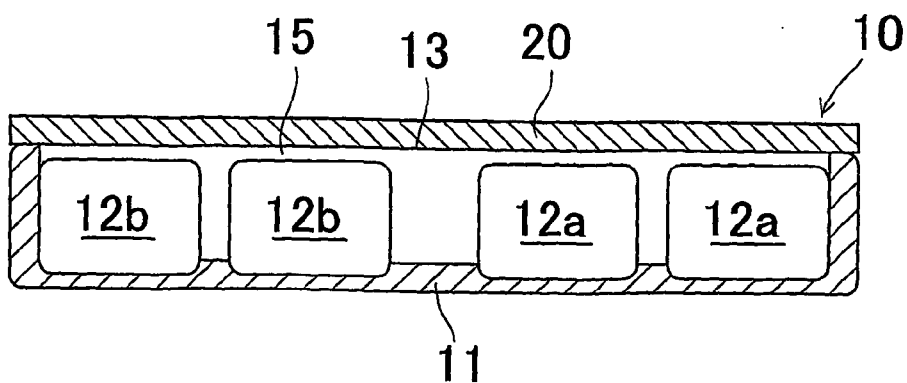


FIG. 5

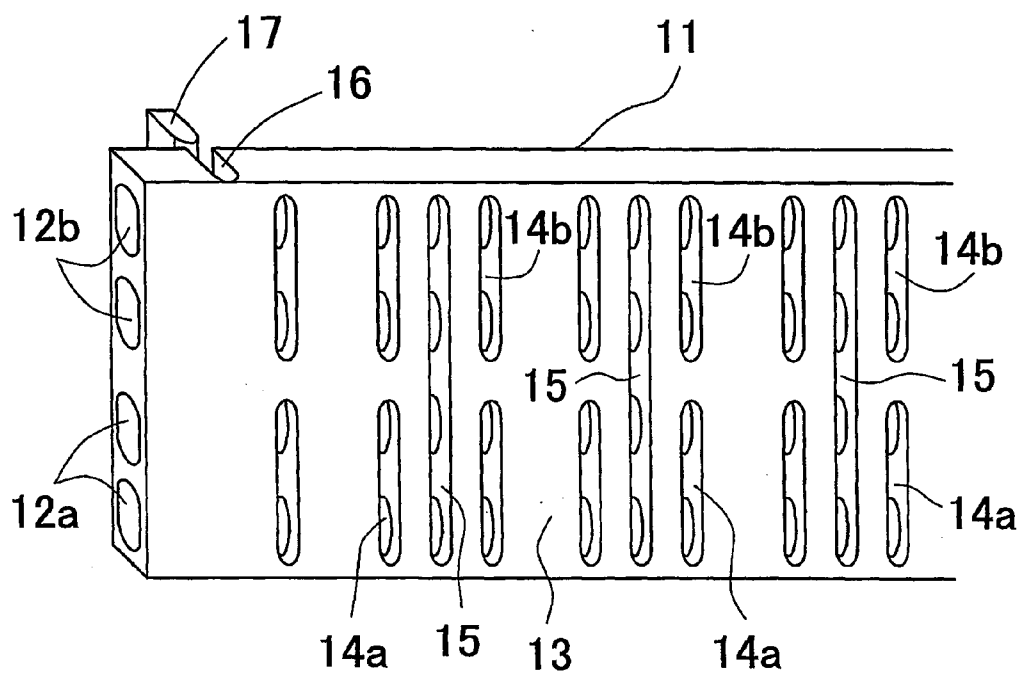


FIG. 6

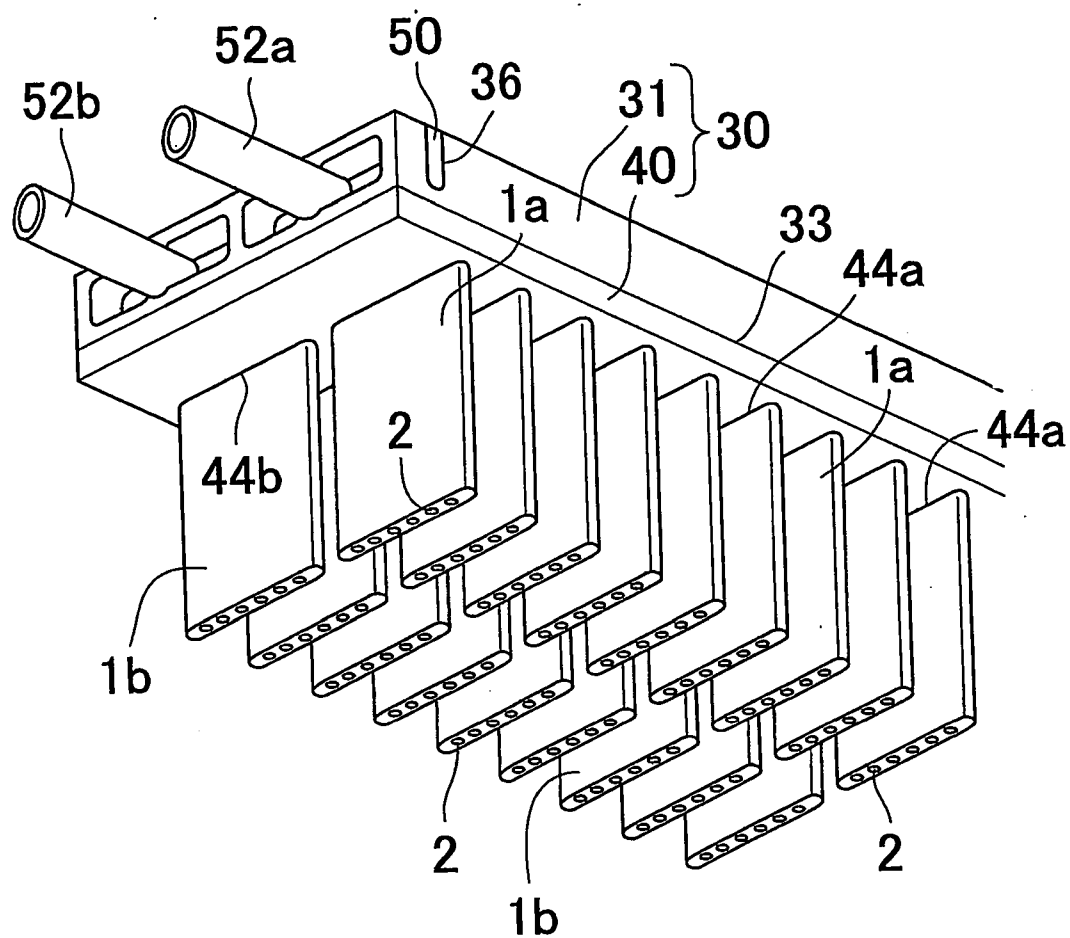
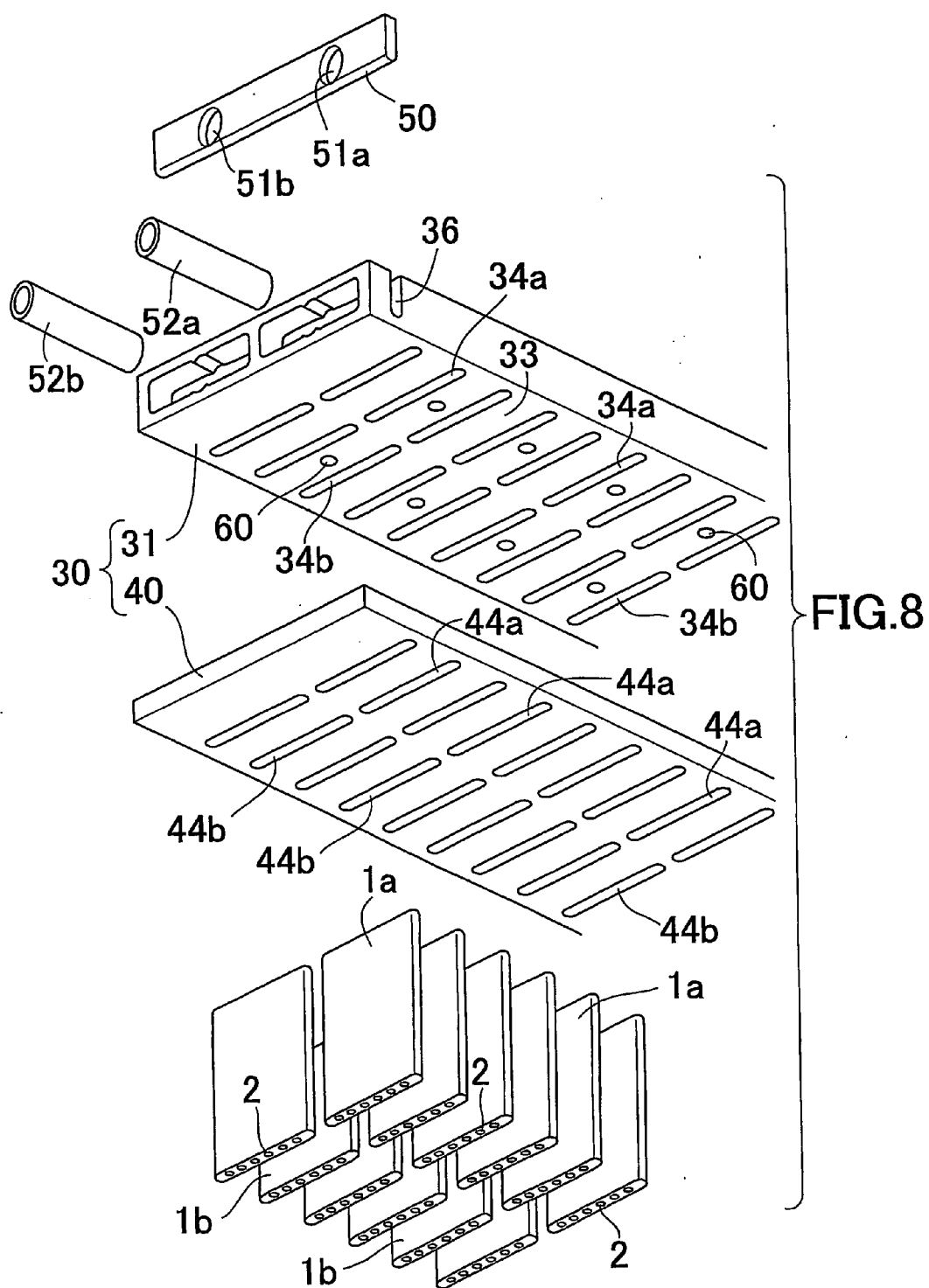


FIG. 7



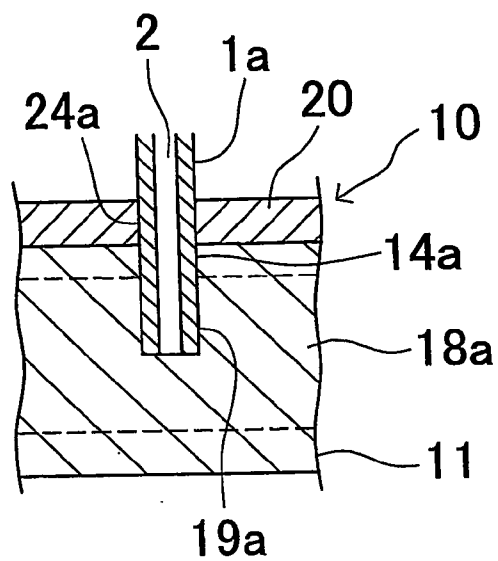


FIG. 9

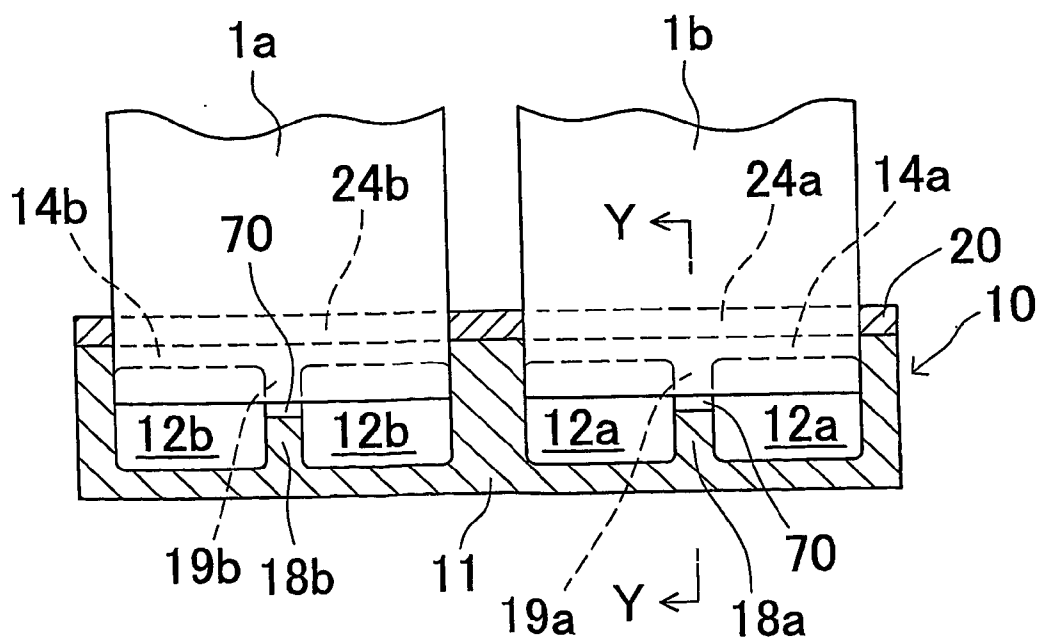


FIG. 10

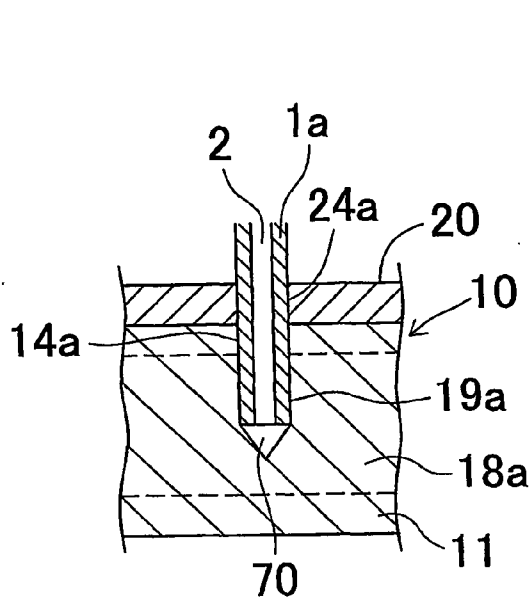


FIG. 11A

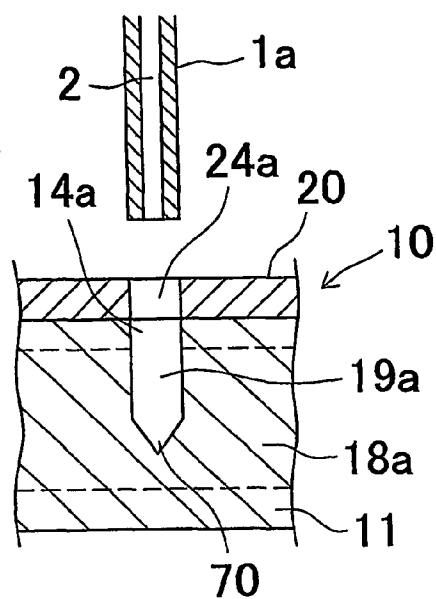


FIG. 11B

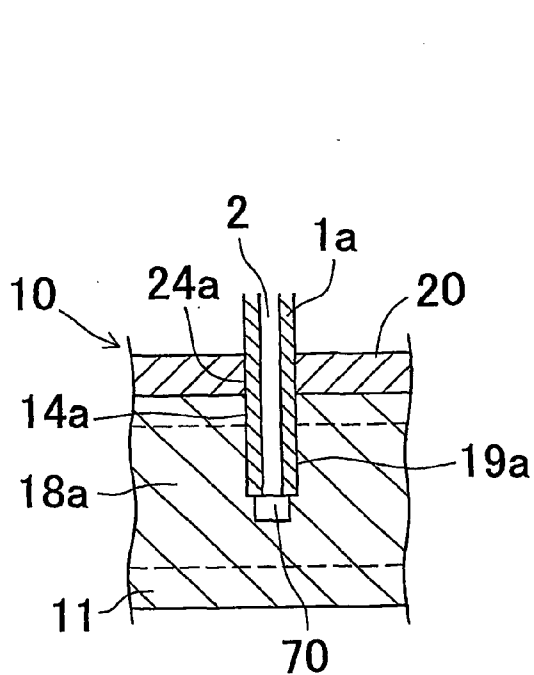


FIG. 12A

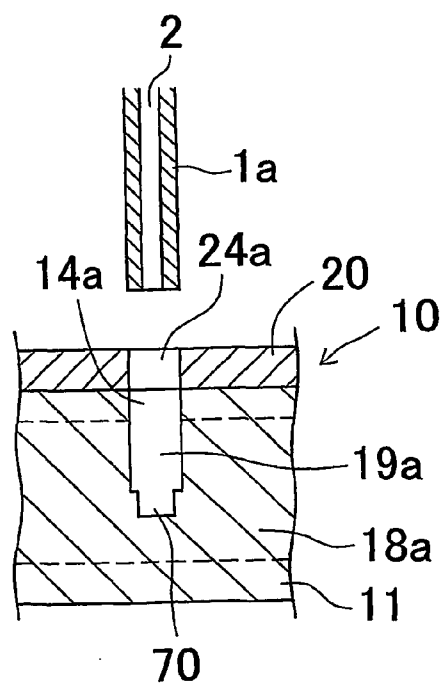


FIG. 12B

HEAT EXCHANGER, HEAT EXCHANGER HEADER TANK AND MANUFACTURING METHOD THEREOF

[0001] Priority is claimed to Japanese Patent Application No. 2001-350573, filed on Nov. 15, 2001, Japanese Patent Application No. 2002-166686, filed on Jun. 7, 2002 and U.S. Provisional Patent Application No. 60/333,170, filed on Nov. 27, 2001, the disclosure of which are incorporated by reference in their entireties.

CROSS REFERENCE TO RELATED APPLICATIONS

[0002] This application is an application filed under 35 U.S.C. §111(a) claiming the benefit pursuant to 35 U.S.C. §119(e)(1) of the filing date of U.S. Provisional Application No. 60/333,170 filed on Nov. 27, 2001 pursuant to 35 U.S.C. §111(b).

TECHNICAL FIELD

[0003] The present invention relates to a heat exchanger, such as a condenser or an evaporator, for use in a refrigeration cycle for an automobile air conditioner, a household air conditioner, a refrigerator or a cooler for electrical/electric equipments, especially for use in a refrigeration cycle using CO₂. It also relates to a header tank for such heat exchangers and methods for manufacturing them.

BACKGROUND ART

[0004] As a refrigerant for air conditioning apparatuses, Freon family refrigerant such as HCFC (hydro chlorofluorocarbon) and HFC (hydro fluorocarbon) is used widely. However, such Freon family refrigerant is ozone depleting substance and greenhouse substance (heat-trapping substance). Accordingly, their discharge into the atmospheric air is severely limited, and the alternatives of Freon family refrigerant, or the so-called defreonization, has been developing.

[0005] As one of the defreonizations, a refrigeration cycle which uses carbon dioxide (CO₂) as refrigerant has been proposed. CO₂ is one of natural refrigerants found in nature, and hardly affects the global environment as compared with Freon.

[0006] However, in cases where CO₂ is used as refrigerant in a refrigeration cycle, the refrigerant working pressure at a higher pressure side becomes high about 10 times as compared with Freon family refrigerant since the thermodynamic property peculiar to CO₂ causes a supercritical cycle. Accordingly, in cases where a structure of a refrigeration cycle apparatus such as a heat exchanger using conventional Freon family refrigerant is applied to a structure of a refrigeration cycle apparatus using CO₂ as refrigerant, it is required to improve the pressure resistance by, for example, increasing the wall thickness of various parts constituting the apparatus. This causes increased weight of the apparatus, and therefore it is difficult to achieve the practical use of such apparatus.

[0007] Under such a technical background, a high pressure resistance heat exchanger using CO₂ refrigerant is known (e.g., Japanese Unexamined Laid-open Patent Publication No. JP 2000-81294 A). In this heat exchanger, the header tank includes a header plate having a number of tube

connection apertures into which end portions of heat exchanging tubes are connected and a plate cover covering one side of the header plate.

[0008] However, in the aforementioned conventional heat exchanger using CO₂ refrigerant, since the peripheral wall of the header tank is constituted by two members, the header plate and the plate cover, enough joining strength therebetween cannot be obtained. Therefore, there has been difficult to secure predetermined pressure resistance. If the cross-sectional area of the refrigerant passage in the header tank is increased in order to reduce the flow resistance, the joining area between the header plate and the cover plate decreases, resulting in decreased joining strength, which in turn further deteriorates the pressure resistance.

[0009] An object of the present invention is to solve the aforementioned problems of the conventional technique, and to provide a heat exchanger having small refrigerant flow resistance and enough pressure resistance, especially a heat exchanger preferably applied to a refrigeration cycle using CO₂ refrigerant. Another object of the present invention is to provide a header tank for such a heat exchanger, a method for manufacturing the heat exchanger and a method for manufacturing the header tank.

[0010] Other objects of the present invention will become apparent from the following explanations.

DISCLOSURE OF INVENTION

[0011] In order to attain the aforementioned objects, according to the first aspect of the present invention, a heat exchanger, comprises:

[0012] a pair of header tanks; and

[0013] a plurality of heat exchanging tubes disposed between the pair of header tanks in parallel in a longitudinal direction of the header tanks with opposite ends thereof connected to the pair of header tanks in fluid communication,

[0014] wherein each of the pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to the plate connecting surface,

[0015] wherein the header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of the header tank main body and a plurality of tube connecting apertures formed in the plate connecting surface at predetermined intervals in a longitudinal direction of the refrigerant passages and communicated with the refrigerant passage,

[0016] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures, and

[0017] wherein the plurality of heat exchanging tubes, the cover plate and the header tank main body are secured with each other in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface

and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication.

[0018] In this heat exchanger, approximately the entire peripheral wall of the header tank is formed by the header tank main body which can be formed integrally and the tube connecting side of the header tank main body is reinforced by the cover plate. Accordingly, enough strength against the inner pressure can be obtained, enabling an increased cross-sectional area of refrigerant passage, which in turn can decrease the flow resistance.

[0019] The heat exchanger according to the first aspect of the present invention can be preferably applied to a heat exchanger in which a plurality of heat exchanging tubes are arranged in plural rows in the front-and-rear direction and the refrigerant is U-turned in one of header tanks.

[0020] According to the 2nd aspect of the present invention, a heat exchanger, comprises:

[0021] a pair of header tanks; and

[0022] a plurality of heat exchanging tubes disposed between the pair of header tanks in parallel in a longitudinal direction of the header tanks with opposite ends thereof connected to the pair of header tanks in fluid communication, the plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of the header tank,

[0023] wherein each of the pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to the plate connecting surface,

[0024] wherein the header tank main body is provided with a refrigerant inlet passage continuously extending along a longitudinal direction of the header tank main body at a front side of the header tank main body, a refrigerant outlet passage continuously extending along a longitudinal direction of the header tank main body at a rear side of the header tank main body, and a plurality of tube connecting apertures formed in front and rear sides of the plate connecting surface at predetermined intervals in a longitudinal direction of the refrigerant inlet passages and the refrigerant outlet passages and communicated with the refrigerant inlet passages and the refrigerant outlet passages respectively,

[0025] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures,

[0026] wherein one of the pair of header tanks is provided with a communication aperture communicating with the refrigerant inlet passage and the refrigerant outlet passage, and

[0027] wherein each of the plurality of heat exchanging tubes, the cover plate and the header tank main body are secured with each other in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate

connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication.

[0028] In this heat exchanger, like the aforementioned heat exchanger, enough strength against the inner pressure can be secured, and the refrigerant flow resistance can also be decreased.

[0029] Furthermore, since the refrigerant passing through the front side heat exchanging tubes is introduced into the rear side heat exchanging tubes via the communication aperture to thereby U-turn the refrigerant flow, the heat exchanging of the refrigerant can be further enhanced.

[0030] In the 2nd aspect of the present invention, it is preferable that the refrigerant inlet passage and the refrigerant outlet passage formed in the header tank main body include plural passages arranged in parallel, respectively.

[0031] In this case, the number of partitioning walls partitioning the refrigerant passages can be increased and the most of them function as reinforcing walls, which further enhances the strength against the inner pressure.

[0032] In the 2nd aspect of the present invention, it is preferable that the header tank main body has a cut portion formed from an outside surface of an end portion of the header tank main body and extending to the refrigeration inlet passage and the refrigeration outlet passage, and wherein end portions of the refrigerant inlet passage and the refrigerant outlet passage are closed by a blocking plate inserted in and secured to the cut portion.

[0033] In this case, the ends of the refrigerant passages can be assuredly closed by a simple work such that a cut portion is formed in the end portion of the header tank main body and the blocking plate is inserted therein.

[0034] According to the 3rd aspect of the present invention, a heat exchanger, comprises:

[0035] a pair of header tanks; and

[0036] a plurality of heat exchanging tubes disposed between the pair of header tanks in parallel in a longitudinal direction of the header tanks with opposite ends thereof connected to the pair of header tanks in fluid communication,

[0037] wherein each of the pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to the plate connecting surface,

[0038] wherein the header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of the header tank main body and a plurality of tube connecting apertures formed in the plate connecting surface at predetermined intervals in a longitudinal direction of the refrigerant passages and communicated with the refrigerant passage,

[0039] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures,

[0040] wherein the refrigerant passage in the header tank main body is provided with engaging stepped

portions each engaging an end portion of each of the plurality of heat exchanging tubes, and

[0041] wherein the plurality of heat exchanging tubes, the cover plate and the header tank main body are secured with each other in a state in which the end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging stepped portion.

[0042] In this heat exchanger, like the heat exchanger according to the 1st aspect of the present invention, enough strength against the inner pressure can be secured, and the refrigerant flow resistance can be decreased.

[0043] Furthermore, since engaging stepped portions each engaging an end portion of each of the plurality of heat exchanging tubes are formed at portions corresponding to the tube connecting apertures of the header tank main body, when inserting the heat exchanging tube into the connecting aperture of the header tank main body, the end portion of the heat exchanging tube is engaged with the engaging stepped portion. Thus, the heat exchanging tube can be positioned in the insertion direction thereof, which enables an easy tube connecting work.

[0044] According to the 4th aspect of the present invention, a heat exchanger, comprises:

[0045] a pair of header tanks; and

[0046] a plurality of heat exchanging tubes disposed between the pair of header tanks in parallel in a longitudinal direction of the header tanks with opposite ends thereof connected to the pair of header tanks in fluid communication,

[0047] wherein each of the pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to the plate connecting surface,

[0048] wherein the header tank main body is provided with a plurality of refrigerant passages continuously extending along a longitudinal direction of the header tank main body and arranged in a widthwise direction of the header tank main body, and a plurality of tube connecting apertures formed in the plate connecting surface so as to bridge the plurality of refrigerant passages at predetermined intervals in a longitudinal direction of the refrigerant passage and communicated with the plurality of refrigerant passages,

[0049] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures,

[0050] wherein a partitioning wall partitioning the plurality of refrigerant passages in the header tank main body is provided with engaging dented stepped portions corresponding to the plurality of tube con-

necting apertures and engaged with end portions of the plurality of heat exchanging tubes, and

[0051] wherein the plurality of heat exchanging tubes, the cover plate and the header tank main body are secured with each other in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging dented stepped portion.

[0052] In this heat exchanger, like the heat exchanger according to the 3rd aspect of the present invention, enough strength against the inner pressure can be secured, and the refrigerant flow resistance can be decreased. Furthermore, when inserting the heat exchanging tube into the connecting aperture of the header tank main body, the end portion of the heat exchanging tube is engaged with the engaging stepped portion. Thus, the heat exchanging tube can be positioned in the insertion direction thereof.

[0053] Like the 4th aspect of the present invention, in cases where the refrigerant passages are arranged in parallel, it is possible to form an engaging dented stepped portion as an engaging stepped portion at the partitioning wall partitioning the passages.

[0054] In this 4th aspect of the present invention, it is preferable that a communication groove communicating with end openings of tube apertures of the plurality of heat exchanging tubes and the plurality of refrigerant passages is formed at a bottom surface of the engaging dented stepped portion.

[0055] That is, in cases where the end face of the heat exchanging tube is engaged with the bottom surface of the engaging dented stepped portion, some of the end openings of the tube apertures may be blocked by the bottom surface of the engaging dented stepped portion. However, when the aforementioned communication groove is formed, all of the tube apertures can be communicated with the refrigerant passage, which can prevent the deterioration of the flow amount of refrigerant.

[0056] According to the 5th aspect of the present invention, a heat exchanger, comprises:

[0057] a pair of header tanks; and

[0058] a plurality of heat exchanging tubes disposed between the pair of header tanks in parallel in a longitudinal direction of the header tank with opposite ends of each of the plurality of heat exchanging tubes connected to the pair of header tanks in fluid communication, the plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of the header tank,

[0059] wherein each of the pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to the plate connecting surface,

- [0060] wherein the header tank main body is provided with a plurality of refrigerant inlet passage continuously extending along a longitudinal direction of the header tank main body at a front side of the header tank main body and disposed in parallel in a widthwise direction of the header tank main body, a plurality of refrigerant outlet passage continuously extending along a longitudinal direction of the header tank main body at a rear side of the header tank main body and disposed in parallel in a widthwise direction of the header tank main body, a plurality of tube connecting apertures formed in a front side of the plate connecting surface so as to bridge the plurality of refrigerant inlet passages at predetermined intervals in a longitudinal direction of the refrigerant inlet passage and communicated with the plurality of refrigerant inlet passages, and a plurality of tube connecting apertures formed in a rear side of the plate connecting surface so as to bridge the plurality of refrigerant outlet passages at predetermined intervals in a longitudinal direction of the refrigerant outlet passage and communicated with the plurality of refrigerant outlet passages,
- [0061] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures,
- [0062] wherein one of the pair of header tanks is provided with a communication aperture communicating with the plurality of refrigerant inlet passages and the plurality of refrigerant outlet passages,
- [0063] wherein a partitioning wall partitioning the plurality of refrigerant inlet passages and a partitioning wall partitioning the plurality of refrigerant outlet passages in the header tank main body are provided with engaging dented stepped portions corresponding to the plurality of tube connecting apertures respectively, and
- [0064] wherein the plurality of heat exchanging tubes, the cover plate and the header tank main body are secured with each other in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging dented stepped portion.
- [0065] In this heat exchanger according to the 4th aspect of the present invention, like the 4th aspect of the present invention, enough strength against the inner pressure can be secured, and the refrigerant flow resistance can be decreased. Furthermore, when inserting the heat exchanging tube into the connecting aperture of the header tank main body, the heat exchanging tube can be positioned in the insertion direction thereof.
- [0066] In the 5th aspect of the present invention, it is preferable that a communication groove communicating with end openings of tube apertures of the plurality of heat exchanging tubes and the plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of the plurality of heat exchanging tubes and the plurality of refrigerant outlet passages are formed at a bottom surface of the engaging dented stepped portion respectively.
- [0067] In this case, all of the tube apertures can be communicated with the refrigerant inlet passages and the refrigerant outlet passages, which secures an sufficient refrigerant flow amount.
- [0068] As the configuration of the communication aperture, the following can be exemplified.
- [0069] In the 5th aspect of the present invention, the communication groove may be formed into a generally V-shape, and the communication groove may be formed into a generally U-shape.
- [0070] In the heat exchanger according to the 1st to 5th aspect of the present invention, since the heat exchanger has enough strength against the inner pressure, the heat exchanger can be preferably applied to a heat exchanger for use in a vapor compression type refrigeration cycle using CO₂ refrigerant.
- [0071] That is, in the heat exchanger according to the 1st to 5th aspect of the present invention, it is preferable that carbon dioxide refrigerant (CO₂ refrigerant) is used as the refrigerant.
- [0072] The 6th aspect of the present invention specifies one of manufacturing processes of the heat exchanger according to the 1st aspect of the present invention.
- [0073] According to the 6th aspect of the present invention, a method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between the pair of header tanks and arranged in parallel in a longitudinal direction of the header tank with opposite ends thereof connected to the pair of header tanks in fluid communication, the method, comprises:
- [0074] preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a refrigerant passage extending in a longitudinal direction of the intermediate;
- [0075] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the refrigerant passage in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate;
- [0076] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and
- [0077] integrally joining the header tank main body, the cover plate and the plurality of heat exchanging tubes in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corre-

sponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication.

[0078] The 7th aspect of the present invention specifies one of manufacturing processes of the heat exchanger according to the 2nd aspect of the present invention.

[0079] According to the 7th aspect of the present invention, a method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between the pair of header tanks and arranged in parallel in a longitudinal direction of the header tank with opposite ends thereof connected to the pair of header tanks in fluid communication, the plurality of heat exchanging tubes being arranged in plural rows in a width-wise direction of the header tank, the method, comprises:

[0080] preparing an intermediate having a flat plate connecting surface at a tube connecting side, a refrigerant inlet passage extending in a longitudinal direction of the intermediate at a front side of the intermediate, and a refrigerant outlet passage extending in a longitudinal direction of the intermediate at a rear side of the intermediate;

[0081] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the refrigerant inlet passage in a front side of the plate connecting surface of the intermediate at predetermined intervals, in a longitudinal direction of the intermediate and a plurality of tube connecting apertures communicating with the refrigerant outlet passage in a rear side of the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate;

[0082] forming a communication aperture communicating with the refrigerant inlet passage and the refrigerant outlet passage in the plate connecting surface of the header tank main body corresponding to one of the pair of header tanks;

[0083] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0084] integrally joining the header tank main body, the cover plate and the plurality of heat exchanging tubes in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication.

[0085] In the 7th aspect of the present invention, it is preferable that the refrigerant inlet passage and the refrigerant outlet passage are formed to have plural rows arranged in parallel, respectively.

[0086] In this case, the number of partitioning walls partitioning the refrigerant passages can be increased, which further enhances the strength against the inner pressure.

[0087] In the 7th aspect of the present invention, it is preferable that the intermediate having the refrigerant inlet passage and the refrigerant outlet passage is formed by extrusion molding or drawing molding.

[0088] In this case, the intermediate can be formed easily, which in turn can manufacture the heat exchanger efficiently. Furthermore, the header tank main body can be formed as an integral formed member having high strength, which can further enhance the strength against the inner pressure.

[0089] The 7th aspect of the present invention, it is preferable that the plate connecting surface is formed by milling.

[0090] In this case, the plate connecting surface can be formed into a flat and smooth surface, resulting in strong joining of the cover plate, which in turn can further enhance the strength against the inner pressure.

[0091] In the 7th aspect of the present invention, it is preferable to employ the tube connecting apertures formed by cutting, and the communication apertures formed by cutting.

[0092] In this case, the tube connecting apertures and the communication apertures can be formed in high accuracy.

[0093] In the 7th aspect of the present invention, it is preferable that the tube connecting apertures and the communication apertures are formed simultaneously.

[0094] In this case, the simultaneous forming of these apertures can decrease the number of working processes, resulting in further enhanced productivity.

[0095] The 8th aspect of the present invention specifies one of manufacturing processes of the heat exchanger according to the 3rd aspect of the present invention.

[0096] According to the 8th aspect of the present invention, a method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between the pair of header tanks and arranged in parallel in a longitudinal direction of the header tank with opposite ends thereof connected to the pair of header tanks in fluid communication, the method, comprises:

[0097] preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a refrigerant passage extending in a longitudinal direction of the intermediate;

[0098] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the refrigerant passage in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate and engaging stepped portions each capable of engaging with an end portion of the heat exchanging tube at a portion corresponding to each of the plurality of tube connecting apertures;

[0099] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0100] integrally joining the header tank main body, the cover plate and the plurality of heat exchanging tubes in a state in which an end portion of each of the

plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging stepped portion.

[0101] The 9th aspect of the present invention specifies one of manufacturing processes of the heat exchanger according to the 4th aspect of the present invention.

[0102] According to the 9th aspect of the present invention, a method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between the pair of header tanks and arranged in parallel in a longitudinal direction of the header tank with opposite ends thereof connected to the pair of header tanks in fluid communication, the method, comprises:

[0103] preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a plurality of refrigerant passages extending in a longitudinal direction of the intermediate and disposed in a widthwise direction of the intermediate;

[0104] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the plurality of refrigerant passages so as to bridge the plurality of refrigerant passages in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate and engaging dented stepped portions each capable of engaging with an end portion of the heat exchanging tube at a partitioning walls partitioning the plurality of refrigerant passages portion corresponding to each of the plurality of tube connecting apertures;

[0105] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0106] integrally joining the header tank main body, the cover plate and the plurality of heat exchanging tubes in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging dented stepped portion.

[0107] In the 9th aspect of the present invention, it is preferable that, at a step of obtaining the header tank main body, a communication groove communicating with end openings of tube apertures of the heat exchanging tube and the plurality of refrigerant passages is formed at a bottom surface of each of the engaging dented stepped portions.

[0108] In this case, in the similar manner as mentioned above, all of the tube apertures can be communicated with the refrigerant passage, resulting in enough refrigerant flow amount.

[0109] The 10th aspect of the present invention specifies one of manufacturing processes of the heat exchanger according to the 5th aspect of the present invention.

[0110] According to the 10th aspect of the present invention, a method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between the pair of header tanks and arranged in parallel in a longitudinal direction of the header tank with opposite ends thereof connected to the pair of header tanks in fluid communication, the plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of the header tank, the method, comprises:

[0111] preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof, refrigerant inlet passages extending in a longitudinal direction of the intermediate at a front side of the intermediate and arranged in a widthwise direction of the intermediate, and refrigerant outlet passages extending in a longitudinal direction of the intermediate at a rear side of the intermediate and arranged in a widthwise direction of the intermediate;

[0112] obtaining a header tank main body by forming a plurality of front side tube connecting apertures communicating with the plurality of refrigerant inlet passages so as to bridge the plurality of refrigerant inlet passages in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate, a plurality of rear side tube connecting apertures communicating with the plurality of refrigerant outlet passages so as to bridge the plurality of refrigerant outlet passages in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate, engaging dented stepped portions each capable of engaging with an end portion of the front side heat exchanging tube at partitioning walls partitioning the plurality of refrigerant inlet passages corresponding to each of the plurality of tube connecting apertures, and engaging dented stepped portions each capable of engaging with an end portion of the rear side heat exchanging tube at partitioning walls partitioning the plurality of refrigerant outlet passages corresponding to each of the plurality of tube connecting apertures;

[0113] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0114] integrally joining the header tank main body, the cover plate and the plurality of heat exchanging tubes in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid

communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging dented stepped portion.

[0115] In the 10th aspect of the present invention, like the 5th aspect of the present invention, it is preferable that, at a step of obtaining the header tank main body, a communication groove communicating with end openings of tube apertures of the heat exchanging tube and the plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of the heat exchanging tube and the plurality of refrigerant outlet passages are formed at a bottom surface of each of the engaging dented stepped portions.

[0116] The 11th aspect of the present invention specifies the header tank as a main component of the heat exchanger according to the 1st aspect of the present invention.

[0117] According to the 11th aspect of the present invention, a heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, the heat exchanger header tank, comprises:

[0118] a header tank main body having a plate connecting surface located at a tube connecting side thereof; and

[0119] a cover plate secured to the plate connecting surface,

[0120] wherein the header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of the header tank main body and a plurality of tube connecting apertures formed in the plate connecting surface at predetermined intervals in a longitudinal direction of the refrigerant passages and communicated with the refrigerant passage, and

[0121] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures,

[0122] whereby each of the plurality of heat exchanging tubes and the cover plate are secured with each other in a state in which an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication.

[0123] The 12th aspect of the present invention specifies the header tank as a main component of the heat exchanger according to the 2nd aspect of the present invention.

[0124] According to the 12th aspect of the present invention, a heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, the heat exchanger header tank, comprises:

[0125] a header tank main body having a plate connecting surface located at a tube connecting side thereof; and

[0126] a cover plate secured to the plate connecting surface,

[0127] wherein the header tank main body is provided with a refrigerant inlet passage continuously extending along a longitudinal direction of the header tank main body at a widthwise front side of the header tank main body, a refrigerant outlet passage continuously extending along a longitudinal direction of the header tank main body at a widthwise rear side of the header tank main body, and a plurality of tube connecting apertures formed in front and rear sides of the plate connecting surface at predetermined intervals in a longitudinal direction of the refrigerant inlet passages and the refrigerant outlet passages and communicated with the refrigerant inlet passages and the refrigerant outlet passages respectively, and

[0128] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures,

[0129] whereby an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication.

[0130] In the 12th aspect of the present invention, like the 2nd aspect of the present invention, it is preferable to employ the flowing structure.

[0131] That is, in the 12th aspect of the present invention, 1) it is preferable that the refrigerant inlet passage and the refrigerant outlet passage formed in the header tank main body include plural passages arranged in parallel, respectively; 2) it is preferable that the header tank main body has a cut portion formed from an outside surface of an end portion of the header tank main body and extending to the refrigeration inlet passage and the refrigeration outlet passage, and wherein end portions of the refrigerant inlet passage and the refrigerant outlet passage are closed by a blocking plate inserted in and secured to the cut portion; 3) it is preferable that the header tank main body has a communication aperture communicating with the refrigerant inlet passage and the refrigerant outlet passage.

[0132] The 13th aspect of the present invention specifies the header tank as a main component of the heat exchanger according to the 3rd aspect of the present invention.

[0133] According to the 13th aspect of the present invention, a heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, the heat exchanger header tank, comprises:

[0134] a header tank main body having a plate connecting surface located at a tube connecting side thereof; and

[0135] a cover plate secured to the plate connecting surface,

[0136] wherein the header tank main body is provided with a refrigerant passage continuously

extending along a longitudinal direction of the header tank main body and a plurality of tube connecting apertures formed in the plate connecting surface at predetermined intervals in a longitudinal direction of the refrigerant passage and communicated with the refrigerant passage,

[0137] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures, and

[0138] wherein the refrigerant passage in the header tank main body is provided with engaging stepped portions for engaging end portions of the plurality of heat exchanging tubes,

[0139] whereby the end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portions of the plurality of heat exchanging tubes engaged with the engaging stepped portions.

[0140] The 14th aspect of the present invention specifies the header tank as a main component of the heat exchanger according to the 4th aspect of the present invention.

[0141] According to the 14th aspect of the present invention, a heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, the heat exchanger header tank, comprises:

[0142] a header tank main body having a plate connecting surface located at a tube connecting side thereof; and

[0143] a cover plate secured to the plate connecting surface,

[0144] wherein the header tank main body is provided with a plurality of refrigerant passages continuously extending along a longitudinal direction of the header tank main body and arranged in a widthwise direction of the header tank main body, and a plurality of tube connecting apertures formed in the plate connecting surface so as to bridge the plurality of refrigerant passages at predetermined intervals in a longitudinal direction of the refrigerant passage and communicated with the plurality of refrigerant passages,

[0145] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures, and

[0146] wherein a partitioning wall partitioning the plurality of refrigerant passages in the header tank main body is provided with an engaging dented stepped portion corresponding to the tube connecting aperture and engaging with an end portion of each of the plurality of heat exchanging tubes,

[0147] whereby an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion

apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging dented stepped portion.

[0148] In the 14th aspect of the present invention, like the 4th aspect of the present invention, it is preferable that a communication groove communicating with end openings of tube apertures of the plurality of heat exchanging tubes and the plurality of refrigerant passages is formed at a bottom surface of the engaging dented stepped portion.

[0149] The 15th aspect of the present invention specifies the header tank as a main component of the heat exchanger according to the 5th aspect of the present invention.

[0150] According to the 15th aspect of the present invention, a heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, the heat exchanger header tank, comprising:

[0151] a header tank main body having a plate connecting surface located at a tube connecting side; and

[0152] a cover plate secured to the plate connecting surface,

[0153] wherein the header tank main body is provided with a plurality of refrigerant inlet passages continuously extending along a longitudinal direction of the header tank main body at a front side of the header tank main body and disposed in parallel in a widthwise direction of the header tank main body, a plurality of refrigerant outlet passage continuously extending along a longitudinal direction of the header tank main body at a rear side of the header tank main body and disposed in parallel in a widthwise direction of the header tank main body, a plurality of tube connecting apertures formed in a front side of the plate connecting surface so as to bridge the plurality of refrigerant inlet passages at predetermined intervals in a longitudinal direction of the refrigerant inlet passage and communicated with the plurality of refrigerant inlet passages, and a plurality of tube connecting apertures formed in a rear side of the plate connecting surface so as to bridge the plurality of refrigerant outlet passages at predetermined intervals in a longitudinal direction of the refrigerant outlet passage and communicated with the plurality of refrigerant outlet passages,

[0154] wherein the cover plate is provided with a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures, and

[0155] wherein a partitioning wall partitioning the plurality of refrigerant inlet passages and a partitioning wall partitioning the plurality of refrigerant outlet passages in the header tank main body are provided with an engaging dented stepped portion corresponding to the tube connecting aperture respectively,

[0156] whereby an end portion of each of the plurality of heat exchanging tubes is inserted into a corresponding one of the plurality of tube insertion

apertures formed in the cover plate disposed on the plate connecting surface and connected to a corresponding one of the plurality of tube connecting aperture of the header tank main body in a fluid communication with the end portion of each of the plurality of heat exchanging tubes engaged with the engaging dented stepped portion.

[0157] In the 15th aspect of the present invention, like the 5th aspect of the present invention, it is preferable that a communication groove communicating with end openings of tube apertures of the plurality of heat exchanging tubes and the plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of the plurality of heat exchanging tubes and the plurality of refrigerant outlet passages are formed at a bottom surface of the engaging dented stepped portion respectively.

[0158] The 16th aspect of the present invention specifies one of manufacturing processes of the heat exchanger header tank according to the 6th aspect of the present invention.

[0159] According to the 16th aspect of the present invention, a method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, the method, comprises:

[0160] preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a refrigerant passage extending in a longitudinal direction of the intermediate;

[0161] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the refrigerant passage in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate;

[0162] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0163] joining the cover plate to the plate connecting surface of the header tank main body in a state in which the plurality of heat exchanging tubes are fitted in the plurality of tube insertion apertures.

[0164] The 17th aspect of the present invention specifies one of manufacturing processes of the heat exchanger header tank according to the 7th aspect of the present invention.

[0165] According to the 17th aspect of the present invention, a method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, the method, comprises:

[0166] preparing an intermediate having a flat plate connecting surface at a tube connecting side, a refrigerant inlet passage extending in a longitudinal direction of the intermediate at a front side of the intermediate, and a refrigerant outlet passage extending in a longitudinal direction of the intermediate at a rear side of the intermediate;

[0167] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the refrigerant inlet passage in a front side of the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate and a plurality of tube connecting apertures communicating with the refrigerant outlet passage in a rear side of the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate;

[0168] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0169] joining the cover plate to the plate connecting surface of the header tank main body in a state in which the plurality of heat exchanging tubes are fitted in the plurality of tube insertion apertures.

[0170] In the 17th aspect of the present invention, it is preferable that the refrigerant inlet passage and the refrigerant outlet passage are formed to have plural rows arranged in parallel, respectively.

[0171] The 18th aspect of the present invention specifies one of manufacturing processes of the heat exchanger header tank according to the 8th aspect of the present invention.

[0172] According to the 18th aspect of the present invention, a method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, the method, comprises:

[0173] preparing an intermediate having a flat plate connecting surface at a tube connecting side and a refrigerant passage extending in a longitudinal direction of the;

[0174] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the refrigerant passage in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate and engaging stepped portions each capable of engaging with an end portion of the heat exchanging tube at a portion corresponding to each of the plurality of tube connecting apertures;

[0175] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and

[0176] joining the cover plate to the plate connecting surface of the header tank main body in a state in which the plurality of heat exchanging tubes are fitted in the plurality of tube insertion apertures.

[0177] The 19th aspect of the present invention specifies one of manufacturing processes of the heat exchanger header tank according to the 9th aspect of the present invention.

[0178] According to the 19th aspect of the present invention, a method for manufacturing a heat exchanger header

tank for connecting a plurality of heat exchanging tubes arranged in parallel, the method, comprises:

- [0179] preparing an intermediate having a flat plate connecting surface at a tube connecting side and a plurality of refrigerant passages extending in a longitudinal direction of the intermediate and arranged in a widthwise direction of the intermediate;
 - [0180] obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with the plurality of refrigerant passages so as to bridge the plurality of refrigerant passages in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate and engaging dented stepped portions each capable of engaging with an end portion of the heat exchanging tube at partitioning walls partitioning the plurality of refrigerant passages at a portion corresponding to each of the plurality of tube connecting apertures;
 - [0181] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and
 - [0182] joining the cover plate to the plate connecting surface of the header tank main body in a state in which the plurality of heat exchanging tubes are fitted in the plurality of tube insertion apertures.
- [0183] In the 19th aspect of the present invention, like the 9th aspect of the present invention, it is preferable that, at a step of obtaining the header tank main body, a communication groove communicating with end openings of tube apertures of the heat exchanging tube and the plurality of refrigerant passages is formed at a bottom surface of the engaging dented stepped portion.
- [0184] The 20th aspect of the present invention specifies one of manufacturing processes of the heat exchanger header tank according to the 10th aspect of the present invention.
- [0185] According to the 20th aspect of the present invention, a method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, the method, comprises:

- [0186] preparing an intermediate having a flat plate connecting surface at a tube connecting side, refrigerant inlet passages extending in a longitudinal direction of the intermediate at a front side of the intermediate and arranged in a widthwise direction of the intermediate, and refrigerant outlet passages extending in a longitudinal direction of the intermediate at a rear side of the intermediate and arranged in a widthwise direction of the intermediate;
- [0187] obtaining a header tank main body by forming a plurality of front side tube connecting apertures communicating with the plurality of refrigerant inlet passages so as to bridge the plurality of refrigerant inlet passages in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate, a plurality of rear side tube connecting apertures communicating with the plurality of refrigerant outlet passages so as to

bridge the plurality of refrigerant outlet passages in the plate connecting surface of the intermediate at predetermined intervals in a longitudinal direction of the intermediate, engaging dented stepped portions each capable of engaging with an end portion of the front side heat exchanging tube at partitioning walls partitioning the plurality of refrigerant inlet passages corresponding to each of the plurality of tube connecting apertures, and engaging dented stepped portions each capable of engaging with an end portion of the rear side heat exchanging tube at partitioning walls partitioning the plurality of refrigerant outlet passages corresponding to each of the plurality of tube connecting apertures;

- [0188] preparing a cover plate to be fitted to the plate connecting surface, the cover plate having a plurality of tube insertion apertures corresponding to the plurality of tube connecting apertures; and
 - [0189] joining the cover plate to the plate connecting surface of the header tank main body in a state in which the plurality of heat exchanging tubes are fitted in the plurality of tube insertion apertures.
- [0190] In the 20th aspect of the present invention, like the 10th aspect of the present invention, it is preferable that, at a step of obtaining the header tank main body, a communication groove communicating with end openings of tube apertures of the heat exchanging tube and the plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of the heat exchanging tube and the plurality of refrigerant outlet passages are formed at a bottom surface of the engaging dented stepped portion.

[0191] The above and/or other aspects, features and/or advantages of various embodiments will be further appreciated in view of the following description in conjunction with the accompanying figures. Various embodiments can include and/or exclude different aspects, features and/or advantages where applicable. In addition, various embodiments can combine one or more aspect or feature of other embodiments where applicable. The descriptions of aspects, features and/or advantages of particular embodiments should not be construed as limiting other embodiments or the claims.

BRIEF DESCRIPTION OF DRAWINGS

- [0192] The accompanying figures are provided by way of example, without limiting the broad scope of the invention or various other embodiments, wherein:
- [0193] FIG. 1 is a perspective view showing an embodiment of a exchanger according to the present invention;
- [0194] FIG. 2 is a perspective view showing a lower header tank of the heat exchanger and therearound;
- [0195] FIG. 3 is an exploded perspective view showing the lower header tank of the heat exchanger and therearound;
- [0196] FIG. 4 is a cross-sectional view showing tube connecting portions of the upper and lower header tanks of the heat exchanger and therearound;
- [0197] FIG. 5 is a cross-sectional view showing a communication aperture of the lower header tank of the heat exchanger and therearound;

[0198] FIG. 6 is a perspective view showing the lower header tank main body applied to the heat exchanger and therearound;

[0199] FIG. 7 is a perspective view showing the upper header tank of the heat exchanger and therearound;

[0200] FIG. 8 is an exploded perspective view showing the upper header tank of the heat exchanger and therearound;

[0201] FIG. 9 is a cross-sectional view taken along the line X-X in FIG. 4;

[0202] FIG. 10 is a cross-sectional view showing tube connecting portions of a lower header tank of a heat exchanger according to a first modification of the present invention;

[0203] FIG. 11A is a cross-sectional view taken along the line Y-Y in FIG. 10;

[0204] FIG. 11B is an exploded cross-sectional view of FIG. 11A;

[0205] FIG. 12A is a cross-sectional view corresponding to the cross-sectional view taken along the line Y-Y in FIG. 10, and shows the tube connecting portion of the lower header of a heat exchanger according to a second embodiment of the present invention; and

[0206] FIG. 12B is an exploded cross-sectional view of the tube connecting portion of the lower header and the tube shown in FIG. 11A.

BEST MODE FOR CARRYING OUT THE INVENTION

[0207] FIG. 1 is a perspective view showing a heat exchanger according to an embodiment of the present invention. This is a heat exchanger to be used in a vapor compression refrigeration cycle using CO₂ as refrigerant. As shown in this figure, this heat exchanger is provided with, as fundamental components, a pair of lower and upper flat header tanks 10 and 30, flat heat exchanging tubes 1a and 1b disposed in parallel with each other along the longitudinal direction of the header tanks (right and left direction) between the pair of header tanks 10 and 30 with opposite ends communicated with the pair of header tanks 10 and 30, the tubes forming two rows in the widthwise direction of the header tank (front and rear direction) and corrugated fins 5 disposed between the adjacent tubes 1a and 1b arranged in the right and left direction.

[0208] As shown in FIGS. 1 to 6, the lower refrigerant turn-side header tank 10 includes a header tank main body 11 and a cover plate 20.

[0209] The header tank main body 11 has four refrigerant passages 12a and 12b disposed in parallel with each other in the widthwise direction of the header tank main body 11 and each extending in the longitudinal direction of the header tank main body 11. Among four refrigerant passages 12a and 12b, two front side refrigerant passages are constituted as refrigerant inlet flow passage 12a and 12a, and two rear side refrigerant passages are constituted as refrigerant discharging passages 12b and 12b.

[0210] The inner side surface (upper surface) of the header tank main body 11 is formed into a plate connecting surface

13. The front half portion and the rear half portion of this plate connecting surface 13 is provided with a plurality of tube connecting apertures 14a and 14b disposed at predetermined intervals respectively. Each front side tube connecting aperture 14a is formed into an elongated aperture corresponding to the cross-sectional configuration of the heat exchanging tube 1a and disposed in the header tank main body 11 so as to bridge the two front side refrigerant inlet flow passages 12a and 12a and communicate with them. Like the front side tube connecting aperture 14a, each rear side tube connecting aperture 14b is formed into an elongated aperture corresponding to the cross-sectional configuration of the heat exchanging tube 1b and disposed in the header tank main body 11 so as to bridge the two rear side refrigerant inlet flow passages 12b and 12b and communicate with them.

[0211] The aforementioned tube connecting apertures 14a (14b) are formed by cutting operation which will be explained below. By this cutting operation, an engaging dented portion 19a and 19b as an engaging stepped portion is formed at the partitioning wall 18a between the two front side refrigerant inlet passages 12a and 12a and the partitioning wall 18b between the two rear side refrigerant outlet passages 12b and 12b, respectively.

[0212] In the plate connecting surface 13 of the header tank main body 11, a plurality of elongated communication apertures 15 each extending in the widthwise direction of the header tank main body 11 are formed at predetermined positions between the tube connecting apertures 14a and 14b. Each communication aperture 15 is disposed so as to cross the four refrigerant passages 12a and 12b and communicate with these passages in the header tank main body 11. Thereby, the refrigerant inlet passages 12a and the refrigerant outlet passages 12b are communicated with each other.

[0213] In the outside surface (lower surface) at both end portions of the header tank main body 11, a cut portions 16 is formed from the front side surface of the header tank main body 11 to the rear side surface thereof so as to cross the four refrigerant passages 12a and 12b.

[0214] In each of these cut portions 16 and 16, a blocking plate 17 is fitted and fixed therein, thereby hermetically closing the end portions of each refrigerant passage 12a(12b).

[0215] The cover plate 20 has a dimension corresponding to the plate connecting surface 13 of the header tank main body 11. In this cover plate 20, a plurality of elongated tube insertion apertures 24a and 24b forming two rows are formed at predetermined intervals in the longitudinal direction of the header tank main body 11.

[0216] This cover plate 20 is joined to the plate connecting surface 13 of the header tank main body 11 in a laminated state. In this state, the communication apertures 15 of the header tank main body 11 is sealed by the cover plate 20, while each of the tube connecting apertures 14a and 14b is disposed so as to coincide with each of the tube insertion apertures 24a and 24b.

[0217] As shown in FIGS. 5, 7 and 8, the upper header tank 30 for introducing and discharging refrigerant has a header tank main body 31 and the cover plate 40 like the aforementioned lower header tank.

[0218] Like the lower header tank 10, the upper header tank 31 is provided with refrigerant inlet passages 32a and 32a, refrigerant outlet passages 32b and 32b, a plate connecting surface 33, tube connecting apertures 34a and 34b, cut portions 36 and 36, partitioning walls 38a and 38b and engaging dented portions 39a and 39b. Furthermore, the header tank main body 31 is provided with a plurality of communication apertures 60 disposed at predetermined intervals for allowing the communication of the adjacent refrigerant inlet passages 32a and 32a and the communication of the adjacent refrigerant outlet passages 32b and 32b. In this header tank main body 31, no communication passage for allowing the communication between the refrigerant inlet passages 32a and the refrigerant outlet passages 32b is provided.

[0219] Furthermore, like the lower cover plate 20, this cover plate 40 is provided with tube insertion apertures 44a and 44b.

[0220] Furthermore, like the lower header tank main body 11, a blocking plate 37 is inserted in a cut portion 36 formed in one end of the header tank main body 31, thereby closing each one end portion of the refrigerant inlet passages 32a and the refrigerant outlet passages 32b.

[0221] Furthermore, into the other cut portion 36, a refrigerant inlet/outlet plate 50 are inserted. This refrigerant inlet/outlet plate 50 is provided with a refrigerant flow inlet 51a and a refrigerant flow outlet 51b. The refrigerant flow inlet 51a communicates with the end portions of the two front side refrigerant inlet flow passages 32a and 32a in the header tank main body 31, and the refrigerant flow outlet 51b communicates with the end portions of the two rear side refrigerant inlet flow passages 32b and 32b in the header tank main body 31.

[0222] Furthermore, a refrigerant inlet pipe 52a and a refrigerant outlet pipe 52b are inserted into the end portion of the header tank main body 3 respectively. The insertion end portion of the refrigerant inlet pipe 52a is connected to the refrigerant flow inlet 51a of the plate 50, while the insertion end portion of the refrigerant outlet pipe 52b is connected to the refrigerant flow outlet 51b of the plate 50. Thereby, the refrigerant inlet pipe 52a is connected to the refrigerant inlet passages 32a of the upper header tank 30 in fluid communication, while the refrigerant outlet pipe 52b is connected to the refrigerant outlet passages 32b of the upper header tank 30 in fluid communication.

[0223] In this embodiment, the header tanks 10 and 30 are formed by an extrusion method or a drawing method.

[0224] In detail, an intermediate having refrigerant passages 12a and 12b (32a and 32b) is formed by an extrusion method or a drawing method. Thereafter, the intermediate is subjected to cutting processing for forming tube connecting apertures 14a and 14b (34a, 34b), communication apertures 15 and cut portions 16(36) to thereby obtain the aforementioned header tank main body 11 (31).

[0225] In cases where communication apertures 15 are formed, like the refrigerant-turn side header tank main body 11, the processing for cutting the communication apertures 15 and the tube connecting apertures 14a and 14b may be performed simultaneously, which can reduce the number of processing steps. This in turn can improve the productivity.

[0226] In this embodiment, after the aforementioned cutting processing, it is preferable to conduct milling processing to the plate connecting surface 13 (33) of the header tank main body 11 (31) to obtain a flat and smooth surface with no uneven portion. That is, by forming the connecting surface 13 (33) into a flat and smooth surface, the joining area of the connecting surface 13 (33) to which the cover plate 20(40) is integrally connected can be increased, resulting in improved joining (adhering) strength, which can improve the joining strength. As a result, the pressure resistance can be further improved.

[0227] The cover plate 20(40) can be made by, for example, a calendar forming method, a extrusion method and a drawing method. That is, after manufacturing a plate-shaped intermediate by the aforementioned method, the intermediate is subjected to cutting processing or drilling processing to form tube insertion aperture 24a and 24b (44a and 44b). Thus, a cover plate 20(40) can be obtained.

[0228] As shown in, for example, FIGS. 2 and 3, the heat exchanging tube 1a and 1b is constituted by an extruded article or a drawn article, and has a flat cross-sectional configuration. The heat exchanging tube 1a and 1b has a plurality of circular passages extending in the longitudinal direction thereof and disposed in parallel with each other in the widthwise direction of the tube.

[0229] The lower and upper end portions of each heat exchanging tube 1a (1b) are inserted in the tube insertion apertures 24a and 44a (24b and 44b) of the cover plates 20 and 40 of the aforementioned header tanks 10 and 30, and inserted into and secured to the tube connecting apertures 14a and 34a (14b and 34b) of the header tank main bodies 11 and 31 respectively. At this time, as shown in FIGS. 4 and 9, the end portions of the heat exchanging tube 1a(1b) is engaged with the engaging dented portion 19a and 39a (19b and 39b) formed in the partitioning wall 18a and 38a (18b and 38b) to thereby be positioned in the insertion direction of the heat exchanging tube 1a and 1b.

[0230] In the state in which the heat exchanging tubes 1a and 1b are inserted in the header tanks 10 and 30 and corrugated fins 5 are disposed between the adjacent heat exchanging tubes 1a and 1b, these components are integrally joined to form a heat exchanger according to this embodiment.

[0231] In the heat exchanger of this embodiment, each component is made of, for example, aluminum or its alloy, or an aluminum brazing sheet formed by laminating a brazing material layer on at least one surface of an aluminum sheet. These components are assembled into a predetermined configuration of a heat exchanger via brazing material if necessary and temporarily fixed. This temporarily fixed provisional assembly is brazed in a furnace to secure the components.

[0232] In the present invention, when assembling the heat exchanger, any assembling method may be employed. For example, all of the components may be brazed individually, or some of the components may be brazed and then the remaining components may be brazed in a furnace.

[0233] In the aforementioned heat exchanger constituted as mentioned above, the CO₂ refrigerant flowed into the refrigerant inlet passages 32a and 32a of the upper header tank 30 through the refrigerant inlet pipe 52a goes down

through a plurality of heat exchanging tubes **1a** located at the front side of the heat exchanger, and then flows into the refrigerant inlet passages **12a** and **12a** of the lower header tank **10**. The refrigerant flowed into the inlet passages **12a** and **12a** is led to the refrigerant outlet passages **12b** and **12b** through the communication apertures **15**, and then goes up through a plurality of heat exchanging tubes **1b** located at the rear side of the heat exchanger, and flows into the refrigerant outlet passages **32b** and **32b** of the upper header tank **30**. Thereafter, the refrigerant is sent to the following portion in a refrigeration cycle through the refrigerant outlet pipe **52b**.

[0234] As explained above, in the heat exchanger according to this embodiment, almost the entire periphery of the external wall of the header tank **10(30)** is formed by an integrally formed header tank main body **11(31)**, and the tube connecting side of the header tank main body **11(31)** is reinforced by the cover plate **20(40)** joined to the tube connecting side. Therefore, enough strength against the inner pressure can be obtained.

[0235] Furthermore, in the heat exchanger of this embodiment, since enough strength against the inner pressure can be secured, the cross-sectional area of the refrigerant passage **12a**, **12b**, **32a** and **32b** can be increased, resulting in decreased flow resistance, which in turn can further improve the heat exchange performance.

[0236] Furthermore, since four refrigerant passages **12a** and **12b** (**32a** and **32b**) are formed in the header tank **10(30)**, a plurality of partitioning walls partitioning the passages function as reinforcing walls, which further increase the strength against the inner pressure.

[0237] Furthermore, the communication apertures **15** of the refrigerant-turn side header tank **10** are formed by cutting processing simultaneously with the tube connecting apertures. Therefore, the number of processing steps can be reduced as compared with the case where the communication apertures **15** are formed separately. Accordingly, the header tank can be manufactured easily and efficiently.

[0238] Furthermore, since the communication apertures **15** are hermetically sealed by the cover plate **20**, no additional step for sealing the communication apertures is required, resulting in further enhanced productivity.

[0239] In cases where the communication aperture **15** is formed to have a small width, the joining area between the cover plate **20** and the header tank main body **11** can be increased, which in turn can further increase the strength against the inner pressure.

[0240] Furthermore, in this embodiment, cut portions **16(36)** are formed in the outer sides of the opposite end portions of the header tank main body **11(31)**, and blocking plates **17(37)** are inserted in the cut portions **16(36)** to hermetically seal the end portions of each refrigerant passages **12a** and **12b** (**32a** and **32b**). This enables an easy manufacturing of the header tank. For example, in cases where caps or the like are attached to end portions of a header tank to close the ends of the refrigeration passages, it is required to prepare components having a complicate configuration like a cap, which makes it difficult to manufacture a header. To the contrary, in this embodiment, since cut portions **16(36)** are formed by cutting the end portions of the header tank main body **11(31)** and the plate-shaped

blocking plates **17(37)** are inserted and secured therein, the manufacturing of the header tank can be performed easily.

[0241] Furthermore, in this embodiment, since the header tank main bodies **11** and **31** are manufactured by an extrusion method or a drawing method which is suitable for mass production, they can be manufactured more efficiently.

[0242] Furthermore, in this embodiment, since the plate connecting surface **11(13)** of the header tank main body **11(31)** is formed into a flat and smooth surface by milling, the cover plate **20(40)** can be more assuredly secured to the plate connecting surface **13(33)**, which can further enhance the strength against the inner pressure.

[0243] Furthermore, in this embodiment, when inserting the heat exchanging tubes **1a** and **1b** into the tube insertion apertures **14a**, **14b**, **34a** and **34b** of the header tank main bodies **11** and **31**, since the end faces of the heat exchanging tubes **1a** and **1b** engage with the engaging dented portions **19a**, **19b**, **39a** and **39b** formed in the partitioning walls **18a**, **18b**, **38a** and **38b**, the heat exchanging tubes **1a** and **1b** can be properly positioned with regard to the insertion direction. Accordingly, the tube insertion can be performed easily.

[0244] As shown in FIG. 9, in this embodiment, the end face of the tube **1a(1b)** is joined to the bottom surface of the engaging dented portion **19a(19b)**. Therefore, a part of the end opening of the aperture (passages) **2** of the tube is blocked by the bottom surface of the engaging dented portion **19a(19b)**. Accordingly, the refrigerant cannot flow through a part of the aperture **2** of the tube, causing a decreased flow amount of refrigerant, which may deteriorate the heat exchange performance.

[0245] Accordingly, as shown in FIGS. 10 and 11, it is recommended to provide communication grooves **70** communicating with the adjacent refrigerant inlet (outlet) passages **12a** and **12a** (**12b** and **12b**) at the bottom surface of each engaging dented portion **19a(19b)**. In this case, the end opening of the aperture **2** of the tube **1a(1b)** can communicate with the refrigerant inlet passage **12a** and the refrigerant outlet passage **12b** via the communication groove **70**. This allows the refrigerant to pass through all of the tube apertures **2**, resulting in an increased refrigerant flow amount, which in turn can enhance the heat exchanging performance.

[0246] The aforementioned communication groove **70** may be formed into a V-shape as shown in FIG. 11 or a generally U-shape as shown in FIG. 12. As a method for forming the communication grooves **70**, for example, a method in which the tube connecting apertures **14a** and **14b** are formed in the header tank main body **11** by cutting and then the communication grooves **70** are formed by cutting may be preferably employed. In this case, the width of the communication groove **70** formed by the second cutting is preferably set smaller than the tube-width by 0.4 to 0.5 mm.

[0247] Needless to say, such a communication groove **70** may be formed in the upper header tank **30** as well as in the refrigerant outlet passage **12b** side.

[0248] In the aforementioned embodiment, the heat exchanger in which heat exchanging tubes **1a** and **1b** are arranged in two rows was exemplified. However, the present invention is not limited to the above, and may be applied to a heat exchanger in which heat exchanging tubes **1a** and **1b** are arranged in one row or three or more rows.

[0249] Furthermore, in the present invention, the number or the configuration of the refrigerant passage 12a, 12b 32a and 32b, the tube connecting aperture 14a, 14b, 34a and 34b and the tube insertion aperture 24a, 24b, 44a and 44b are not limited to the aforementioned embodiments.

[0250] As mentioned above, in the heat exchanger according to the 1th to 5th aspects of the present invention, the approximately entire periphery of the external wall of the header tank is constituted by a header tank main body which can be integrally formed, and the tube connecting side surface of the header tank main body is reinforced by joining the cover plate. Accordingly, sufficient strength against the inner pressure can be obtained, which enables to secure a larger cross-sectional area of the refrigerant flow passage. Thus, the flow resistance can be decreased and the heat exchange performance can be improved. Especially, in the heat exchanger according to the 3rd to 5th aspects of the present invention, the positioning of the heat exchanging tube with regard to the tube insertion direction can be attained when inserting the heat exchanging tube into the header tank, the tube connection work can be performed easily.

[0251] The method for manufacturing the heat exchanger according to the 6th to 10th aspects of the present invention specifies an embodiment of the manufacture process of the heat exchanger according to the 1st to 5th aspects of the present invention. Therefore, the heat exchanger having the aforementioned effects can be manufactured.

[0252] The header tank for heat exchangers according to the 11th to 15th aspects of the present invention specifies an embodiment of the header tank as a main component of the heat exchanger according to the 1st to 5th aspects of the present invention. Accordingly, the heat exchanger having the aforementioned effects can be obtained.

[0253] The header tank for heat exchangers according to the 16th to 20th aspects of the present invention specifies the header tank as a main component of the heat exchanger according to the 1st to 5th aspects of the present invention. Accordingly, the heat exchanger having the aforementioned effects can be obtained.

[0254] While illustrative embodiments of the present invention have been described herein, the present invention is not limited to the various preferred embodiments described herein, but includes any and all embodiments having modifications, omissions, combinations (e.g., of aspects across various embodiments), adaptations and/or alterations as would be appreciated by those in the art based on the present disclosure. The limitations in the claims are to be interpreted broadly based the language employed in the claims and not limited to examples described in the present specification or during the prosecution of the application, which examples are to be construed as non-exclusive. For example, in the present disclosure, the term “preferably” is non-exclusive and means “preferably, but not limited to.” Means-plus-function or step-plus-function limitations will only be employed where for a specific claim limitation all of the following conditions are present in that limitation: a) “means for” or “step for” is expressly recited; b) a corresponding function is expressly recited; and c) structure, material or acts that support that structure are not recited.

INDUSTRIAL APPLICABILITY

[0255] The present invention can improve a heat exchange performance of a heat exchanger, and therefore can be preferably applied to a refrigeration cycle for an automobile air conditioner, a household air conditioner, a refrigerator or a cooler for electrical/electric equipments, especially a refrigeration cycle using CO₂.

1. A heat exchanger, comprising:

a pair of header tanks; and

a plurality of heat exchanging tubes disposed between said pair of header tanks in parallel in a longitudinal direction of said header tanks with opposite ends thereof connected to said pair of header tanks in fluid communication,

wherein each of said pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of said header tank main body and a plurality of tube connecting apertures formed in said plate connecting surface at predetermined intervals in a longitudinal direction of said refrigerant passages and communicated with said refrigerant passage,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures, and

wherein said plurality of heat exchanging tubes, said cover plate and said header tank main body are secured with each other in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication.

2. A heat exchanger, comprising:

a pair of header tanks; and

a plurality of heat exchanging tubes disposed between said pair of header tanks in parallel in a longitudinal direction of said header tanks with opposite ends thereof connected to said pair of header tanks in fluid communication, said plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of said header tank,

wherein each of said pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a refrigerant inlet passage continuously extending along a longitudinal direction of said header tank main body at a front side of said header tank main body, a refrigerant outlet passage continuously extending along a longitudinal direction of said header tank main body at a rear side of said header tank main body, and a

plurality of tube connecting apertures formed in front and rear sides of said plate connecting surface at predetermined intervals in a longitudinal direction of said refrigerant inlet passages and said refrigerant outlet passages and communicated with said refrigerant inlet passages and said refrigerant outlet passages respectively,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures,

wherein one of said pair of header tanks is provided with a communication aperture communicating with said refrigerant inlet passage and said refrigerant outlet passage, and

wherein each of said plurality of heat exchanging tubes, said cover plate and said header tank main body are secured with each other in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication.

3. The heat exchanger as recited in claim 2, wherein said refrigerant inlet passage and said refrigerant outlet passage formed in said header tank main body include plural passages arranged in parallel, respectively.

4. The heat exchanger as recited in claim 2, wherein said header tank main body has a cut portion formed from an outside surface of an end portion of said header tank main body and extending to said refrigeration inlet passage and said refrigeration outlet passage, and wherein end portions of said refrigerant inlet passage and said refrigerant outlet passage are closed by a blocking plate inserted in and secured to said cut portion.

5. A heat exchanger, comprising:

a pair of header tanks; and

a plurality of heat exchanging tubes disposed between said pair of header tanks in parallel in a longitudinal direction of said header tanks with opposite ends thereof connected to said pair of header tanks in fluid communication,

wherein each of said pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of said header tank main body and a plurality of tube connecting apertures formed in said plate connecting surface at predetermined intervals in a longitudinal direction of said refrigerant passages and communicated with said refrigerant passage,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures,

wherein said refrigerant passage in said header tank main body is provided with engaging stepped portions each engaging an end portion of each of said plurality of heat exchanging tubes, and

wherein said plurality of heat exchanging tubes, said cover plate and said header tank main body are secured with each other in a state in which said end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging stepped portion.

6. A heat exchanger, comprising:

a pair of header tanks; and

a plurality of heat exchanging tubes disposed between said pair of header tanks in parallel in a longitudinal direction of said header tanks with opposite ends thereof connected to said pair of header tanks in fluid communication,

wherein each of said pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a plurality of refrigerant passages continuously extending along a longitudinal direction of said header tank main body and arranged in a widthwise direction of said header tank main body, and a plurality of tube connecting apertures formed in said plate connecting surface so as to bridge said plurality of refrigerant passages at predetermined intervals in a longitudinal direction of said refrigerant passage and communicated with said plurality of refrigerant passages,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures,

wherein a partitioning wall partitioning said plurality of refrigerant passages in said header tank main body is provided with engaging dented stepped portions corresponding to said plurality of tube connecting apertures and engaged with end portions of said plurality of heat exchanging tubes, and

wherein said plurality of heat exchanging tubes, said cover plate and said header tank main body are secured with each other in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging dented stepped portion.

7. The heat exchanger as recited in claim 6, wherein a communication groove communicating with end openings of tube apertures of said plurality of heat exchanging tubes and said plurality of refrigerant passages is formed at a bottom surface of said engaging dented stepped portion.

8. A heat exchanger, comprising:

a pair of header tanks; and

a plurality of heat exchanging tubes disposed between said pair of header tanks in parallel in a longitudinal direction of said header tank with opposite ends of each of said plurality of heat exchanging tubes connected to said pair of header tanks in fluid communication, said plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of said header tank,

wherein each of said pair of header tanks includes a header tank main body having a plate connecting surface located at a tube connecting side thereof and a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a plurality of refrigerant inlet passages continuously extending along a longitudinal direction of said header tank main body at a front side of said header tank main body and disposed in parallel in a widthwise direction of said header tank main body, a plurality of refrigerant outlet passages continuously extending along a longitudinal direction of said header tank main body at a rear side of said header tank main body and disposed in parallel in a widthwise direction of said header tank main body, a plurality of tube connecting apertures formed in a front side of said plate connecting surface so as to bridge said plurality of refrigerant inlet passages at predetermined intervals in a longitudinal direction of said refrigerant inlet passage and communicated with said plurality of refrigerant inlet passages, and a plurality of tube connecting apertures formed in a rear side of said plate connecting surface so as to bridge said plurality of refrigerant outlet passages at predetermined intervals in a longitudinal direction of said refrigerant outlet passage and communicated with said plurality of refrigerant outlet passages,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures,

wherein one of said pair of header tanks is provided with a communication aperture communicating with said plurality of refrigerant inlet passages and said plurality of refrigerant outlet passages,

wherein a partitioning wall partitioning said plurality of refrigerant inlet passages and a partitioning wall partitioning said plurality of refrigerant outlet passages in said header tank main body are provided with engaging dented stepped portions corresponding to said plurality of tube connecting apertures respectively, and

wherein said plurality of heat exchanging tubes, said cover plate and said header tank main body are secured with each other in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of

said plurality of heat exchanging tubes engaged with said engaging dented stepped portion.

9. The heat exchanger as recited in claim 8, wherein a communication groove communicating with end openings of tube apertures of said plurality of heat exchanging tubes and said plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of said plurality of heat exchanging tubes and said plurality of refrigerant outlet passages are formed at a bottom surface of said engaging dented stepped portion respectively.

10. The heat exchanger as recited in claim 9, wherein said communication groove is formed into a generally V-shape.

11. The heat exchanger as recited in claim 9, wherein said communication groove is formed into a generally U-shape.

12. The heat exchanger as recited in claim 1, wherein said refrigerant is carbon dioxide refrigerant.

13. A method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between said pair of header tanks and arranged in parallel in a longitudinal direction of said header tank with opposite ends thereof connected to said pair of header tanks in fluid communication, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a refrigerant passage extending in a longitudinal direction of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said refrigerant passage in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

integrally joining said header tank main body, said cover plate and said plurality of heat exchanging tubes in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication.

14. A method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between said pair of header tanks and arranged in parallel in a longitudinal direction of said header tank with opposite ends thereof connected to said pair of header tanks in fluid communication, said plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of said header tank, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side, a refrigerant inlet passage extending in a longitudinal direction of said intermediate at a front side of said intermediate, and a refrigerant outlet passage extending in a longitudinal direction of said intermediate at a rear side of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said refrigerant inlet passage in a front side of said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate and a plurality of tube connecting apertures communicating with said refrigerant outlet passage in a rear side of said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate;

forming a communication aperture communicating with said refrigerant inlet passage and said refrigerant outlet passage in said plate connecting surface of said header tank main body corresponding to one of said pair of header tanks;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

integrally joining said header tank main body, said cover plate and said plurality of heat exchanging tubes in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication.

15. The method for manufacturing a heat exchanger as recited in claim 14, wherein said refrigerant inlet passage and said refrigerant outlet passage are formed to have plural rows arranged in parallel, respectively.

16. The method for manufacturing a heat exchanger as recited in claim 14, wherein said intermediate having said refrigerant inlet passage and said refrigerant outlet passage is formed by extrusion molding or drawing molding.

17. The method for manufacturing a heat exchanger as recited in claim 14, wherein said plate connecting surface is formed by milling.

18. The method for manufacturing a heat exchanger as recited in claim 14, wherein said tube connecting apertures are formed by cutting.

19. The method for manufacturing a heat exchanger as recited in claim 14, wherein said communication apertures are formed by cutting.

20. The method for manufacturing a heat exchanger as recited in claim 14, wherein said tube connecting apertures and said communication apertures are formed simultaneously.

21. A method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between said pair of header tanks and arranged in parallel in a longitudinal direction of said header tank with opposite ends thereof connected to said pair of header tanks in fluid communication, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a refrigerant passage extending in a longitudinal direction of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said

refrigerant passage in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate and engaging stepped portions each capable of engaging with an end portion of said heat exchanging tube at a portion corresponding to each of said plurality of tube connecting apertures;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

integrally joining said header tank main body, said cover plate and said plurality of heat exchanging tubes in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging stepped portion.

22. A method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between said pair of header tanks and arranged in parallel in a longitudinal direction of said header tank with opposite ends thereof connected to said pair of header tanks in fluid communication, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a plurality of refrigerant passages extending in a longitudinal direction of said intermediate and disposed in a widthwise direction of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said plurality of refrigerant passages so as to bridge said plurality of refrigerant passages in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate and engaging dented stepped portions each capable of engaging with an end portion of said heat exchanging tube at a partitioning walls partitioning said plurality of refrigerant passages portion corresponding to each of said plurality of tube connecting apertures;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

integrally joining said header tank main body, said cover plate and said plurality of heat exchanging tubes in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging dented stepped portion.

23. The method for manufacturing a heat exchanger as recited in claim 22, wherein, at a step of obtaining said header tank main body, a communication groove communicating with end openings of tube apertures of said heat exchanging tube and said plurality of refrigerant passages is formed at a bottom surface of each of said engaging dented stepped portions.

24. A method for manufacturing a heat exchanger including a pair of header tanks and a plurality of heat exchanging tubes disposed between said pair of header tanks and arranged in parallel in a longitudinal direction of said header tank with opposite ends thereof connected to said pair of header tanks in fluid communication, said plurality of heat exchanging tubes being arranged in plural rows in a widthwise direction of said header tank, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof, refrigerant inlet passages extending in a longitudinal direction of said intermediate at a front side of said intermediate and arranged in a widthwise direction of said intermediate, and refrigerant outlet passages extending in a longitudinal direction of said intermediate at a rear side of said intermediate and arranged in a widthwise direction of said intermediate;

obtaining a header tank main body by forming a plurality of front side tube connecting apertures communicating with said plurality of refrigerant inlet passages so as to bridge said plurality of refrigerant inlet passages in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate, a plurality of rear side tube connecting apertures communicating with said plurality of refrigerant outlet passages so as to bridge said plurality of refrigerant outlet passages in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate, engaging dented stepped portions each capable of engaging with an end portion of said front side heat exchanging tube at partitioning walls partitioning said plurality of refrigerant inlet passages corresponding to each of said plurality of tube connecting apertures, and engaging dented stepped portions each capable of engaging with an end portion of said rear side heat exchanging tube at partitioning walls partitioning said plurality of refrigerant outlet passages corresponding to each of said plurality of tube connecting apertures;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

integrally joining said header tank main body, said cover plate and said plurality of heat exchanging tubes in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging dented stepped portion.

25. The method for manufacturing a heat exchanger as recited in claim 24, wherein, at a step of obtaining said header tank main body, a communication groove communicating with end openings of tube apertures of said heat exchanging tube and said plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of said heat exchanging tube and said plurality of refrigerant outlet passages are formed at a bottom surface of each of said engaging dented stepped portions.

26. A heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, said heat exchanger header tank, comprising:

a header tank main body having a plate connecting surface located at a tube connecting side thereof; and
a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of said header tank main body and a plurality of tube connecting apertures formed in said plate connecting surface at predetermined intervals in a longitudinal direction of said refrigerant passages and communicated with said refrigerant passage, and

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures,

whereby each of said plurality of heat exchanging tubes and said cover plate are secured with each other in a state in which an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication.

27. A heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, said heat exchanger header tank, comprising:

a header tank main body having a plate connecting surface located at a tube connecting side thereof; and
a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a refrigerant inlet passage continuously extending along a longitudinal direction of said header tank main body at a widthwise front side of said header tank main body, a refrigerant outlet passage continuously extending along a longitudinal direction of said header tank main body at a widthwise rear side of said header tank main body, and a plurality of tube connecting apertures formed in front and rear sides of said plate connecting surface at predetermined intervals in a longitudinal direction of said refrigerant inlet passages and said refrigerant outlet passages and communicated with said refrigerant inlet passages and said refrigerant outlet passages respectively, and

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures,

whereby an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication.

28. The heat exchanger header tank as recited in claim 27, wherein said refrigerant inlet passage and said refrigerant outlet passage formed in said header tank main body include plural passages arranged in parallel, respectively.

29. The heat exchanger header tank as recited in claim 27, wherein said header tank main body has a cut portion formed from an outside surface of an end portion of said header tank main body and extending to said refrigeration inlet passage and said refrigeration outlet passage, and wherein end portions of said refrigerant inlet passage and said refrigerant outlet passage are closed by a blocking plate inserted in and secured to said cut portion.

30. The heat exchanger header tank as recited in claim 27, wherein said header tank main body has a communication aperture communicating with said refrigerant inlet passage and said refrigerant outlet passage.

31. A heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, said heat exchanger header tank, comprising:

- a header tank main body having a plate connecting surface located at a tube connecting side thereof; and
- a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a refrigerant passage continuously extending along a longitudinal direction of said header tank main body and a plurality of tube connecting apertures formed in said plate connecting surface at predetermined intervals in a longitudinal direction of said refrigerant passage and communicated with said refrigerant passage,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures, and

wherein said refrigerant passage in said header tank main body is provided with engaging stepped portions for engaging end portions of said plurality of heat exchanging tubes,

whereby said end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portions of said plurality of heat exchanging tubes engaged with said engaging stepped portions.

32. A heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, said heat exchanger header tank, comprising:

- a header tank main body having a plate connecting surface located at a tube connecting side thereof; and
- a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a plurality of refrigerant passages continuously extending along a longitudinal direction of said header tank main body and arranged in a widthwise direction of said header tank main body, and a plurality of tube connecting apertures formed in said plate connecting surface so as to bride said plurality of refrigerant passages at predetermined intervals in a longitudinal direction of said refrigerant passage and communicated with said plurality of refrigerant passages,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures, and

wherein a partitioning wall partitioning said plurality of refrigerant passages in said header tank main body is provided with an engaging dented stepped portion corresponding to said tube connecting aperture and engaging with an end portion of each of said plurality of heat exchanging tubes,

whereby an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging dented stepped portion.

33. The heat exchanger header tank as recited in claim 32, wherein a communication groove communicating with end openings of tube apertures of said plurality of heat exchanging tubes and said plurality of refrigerant passages is formed at a bottom surface of said engaging dented stepped portion.

34. A heat exchanger header tank for connecting end portions of a plurality of heat exchanging tubes disposed in parallel in fluid communication, said heat exchanger header tank, comprising:

- a header tank main body having a plate connecting surface located at a tube connecting side; and

- a cover plate secured to said plate connecting surface,

wherein said header tank main body is provided with a plurality of refrigerant inlet passages continuously extending along a longitudinal direction of said header tank main body at a front side of said header tank main body and disposed in parallel in a widthwise direction of said header tank main body, a plurality of refrigerant outlet passage continuously extending along a longitudinal direction of said header tank main body at a rear side of said header tank main body and disposed in parallel in a widthwise direction of said header tank main body, a plurality of tube connecting apertures formed in a front side of said plate connecting surface so as to bride said plurality of refrigerant inlet passages at predetermined intervals in a longitudinal direction of said refrigerant inlet passage and communicated with said plurality of refrigerant inlet passages, and a plurality of tube connecting apertures formed in a rear side of said plate connecting surface so as to bride said plurality of refrigerant outlet passages at predetermined

intervals in a longitudinal direction of said refrigerant outlet passage and communicated with said plurality of refrigerant outlet passages,

wherein said cover plate is provided with a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures, and

wherein a partitioning wall partitioning said plurality of refrigerant inlet passages and a partitioning wall partitioning said plurality of refrigerant outlet passages in said header tank main body are provided with an engaging dented stepped portion corresponding to said tube connecting aperture respectively,

whereby an end portion of each of said plurality of heat exchanging tubes is inserted into a corresponding one of said plurality of tube insertion apertures formed in said cover plate disposed on said plate connecting surface and connected to a corresponding one of said plurality of tube connecting aperture of said header tank main body in a fluid communication with said end portion of each of said plurality of heat exchanging tubes engaged with said engaging dented stepped portion.

35. The heat exchanger as recited in claim 34, wherein a communication groove communicating with end openings of tube apertures of said plurality of heat exchanging tubes and said plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of said plurality of heat exchanging tubes and said plurality of refrigerant outlet passages are formed at a bottom surface of said engaging dented stepped portion respectively.

36. A method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side thereof and a refrigerant passage extending in a longitudinal direction of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said refrigerant passage in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

joining said cover plate to said plate connecting surface of said header tank main body in a state in which said plurality of heat exchanging tubes are fitted in said plurality of tube insertion apertures.

37. A method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side, a refrigerant inlet passage extending in a longitudinal direction of said intermediate at a front side of said intermediate, and a refrigerant outlet passage extending in a longitudinal direction of said intermediate at a rear side of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said refrigerant inlet passage in a front side of said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate and a plurality of tube connecting apertures communicating with said refrigerant outlet passage in a rear side of said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

joining said cover plate to said plate connecting surface of said header tank main body in a state in which said plurality of heat exchanging tubes are fitted in said plurality of tube insertion apertures.

38. The method for manufacturing a heat exchanger header tank as recited in claim 37, wherein said refrigerant inlet passage and said refrigerant outlet passage are formed to have plural rows arranged in parallel, respectively.

39. A method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side and a refrigerant passage extending in a longitudinal direction of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said refrigerant passage in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate and engaging stepped portions each capable of engaging with an end portion of said heat exchanging tube at a portion corresponding to each of said plurality of tube connecting apertures;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

joining said cover plate to said plate connecting surface of said header tank main body in a state in which said plurality of heat exchanging tubes are fitted in said plurality of tube insertion apertures.

40. A method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side and a plurality of refrigerant passages extending in a longitudinal direction of said intermediate and arranged in a widthwise direction of said intermediate;

obtaining a header tank main body by forming a plurality of tube connecting apertures communicating with said plurality of refrigerant passages so as to bridge said plurality of refrigerant passages in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate and

engaging dented stepped portions each capable of engaging with an end portion of said heat exchanging tube at partitioning walls partitioning said plurality of refrigerant passages at a portion corresponding to each of said plurality of tube connecting apertures;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

joining said cover plate to said plate connecting surface of said header tank main body in a state in which said plurality of heat exchanging tubes are fitted in said plurality of tube insertion apertures.

41. The method for manufacturing a heat exchanger header tank as recited in claim 40, wherein, at a step of obtaining said header tank main body, a communication groove communicating with end openings of tube apertures of said heat exchanging tube and said plurality of refrigerant passages is formed at a bottom surface of said engaging dented stepped portion.

42. A method for manufacturing a heat exchanger header tank for connecting a plurality of heat exchanging tubes arranged in parallel, said method, comprising:

preparing an intermediate having a flat plate connecting surface at a tube connecting side, refrigerant inlet passages extending in a longitudinal direction of said intermediate at a front side of said intermediate and arranged in a widthwise direction of said intermediate, and refrigerant outlet passages extending in a longitudinal direction of said intermediate at a rear side of said intermediate and arranged in a widthwise direction of said intermediate;

obtaining a header tank main body by forming a plurality of front side tube connecting apertures communicating with said plurality of refrigerant inlet passages so as to bridge said plurality of refrigerant inlet passages in said plate connecting surface of said intermediate at prede-

termined intervals in a longitudinal direction of said intermediate, a plurality of rear side tube connecting apertures communicating with said plurality of refrigerant outlet passages so as to bridge said plurality of refrigerant outlet passages in said plate connecting surface of said intermediate at predetermined intervals in a longitudinal direction of said intermediate, engaging dented stepped portions each capable of engaging with an end portion of said front side heat exchanging tube at partitioning walls partitioning said plurality of refrigerant inlet passages corresponding to each of said plurality of tube connecting apertures, and engaging dented stepped portions each capable of engaging with an end portion of said rear side heat exchanging tube at partitioning walls partitioning said plurality of refrigerant outlet passages corresponding to each of said plurality of tube connecting apertures;

preparing a cover plate to be fitted to said plate connecting surface, said cover plate having a plurality of tube insertion apertures corresponding to said plurality of tube connecting apertures; and

joining said cover plate to said plate connecting surface of said header tank main body in a state in which said plurality of heat exchanging tubes are fitted in said plurality of tube insertion apertures.

43. The method for manufacturing a heat exchanger header tank as recited in claim 42, wherein, at a step of obtaining said header tank main body, a communication groove communicating with end openings of tube apertures of said heat exchanging tube and said plurality of refrigerant inlet passages and a communication groove communicating with end openings of tube apertures of said heat exchanging tube and said plurality of refrigerant outlet passages are formed at a bottom surface of said engaging dented stepped portion.

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