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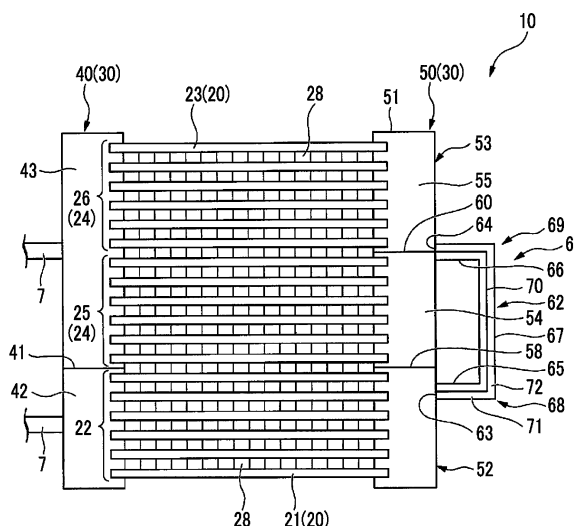
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(54) **HEAT EXCHANGER AND AIR CONDITIONER**

(57) Provided is a heat exchanger comprising a connection pipe having a connection pipe body. The connection pipe body is configured such that: a first end of the pipe body is connected to the outer peripheral surface of a first header (52) so as to be in communication with the inner space of the first header (52); a second end of the pipe body, the second end being located on the side opposite the first end, is connected to the outer peripheral

surface of a second header (53) so as to be in communication with the inner space of the second header (53); and the opening of the second end is in contact with a partition plate (60) within the second header to cause the opening of the second end to be mounted to bridge two regions separated by the partition plate (60) within the second header.

FIG. 2



Description

Technical Field

[0001] The present invention relates to a heat exchanger and an air conditioner.

[0002] This application claims priority based on Japanese Patent Application No. 2016-038327 filed on February 29, 2016; the contents of which are incorporated herein by reference.

Background Art

[0003] A heat exchanger, in which a plurality of heat transfer tubes extending in a horizontal direction are disposed with a gap left therebetween in a vertical direction and a fin is provided on an outer surface of each heat transfer tube, is known as a heat exchanger of an air conditioner. Both ends of the plurality of heat transfer tubes are connected to a pair of headers extending in the vertical direction, respectively.

[0004] Such a heat exchanger is configured such that a refrigerant, which is introduced into one header out of the pair of headers and is circulated in the other header via the heat transfer tubes, turns back at the other header to return to the one header again via the heat transfer tubes, in order to secure a flow passage length for the refrigerant.

[0005] The inside of the header at a turnback side is partitioned into a plurality of regions with a partition plate partitioning the inside of the header in the vertical direction. Accordingly, a refrigerant introduced in one region of the header via the heat transfer tubes returns to one header on an entrance side via the plurality of heat transfer tubes connected to the other region after being introduced into the other region of the header via a connection pipe.

[0006] For example, a heat exchanger including a connection pipe which has one main pipe portion and branch pipe portions that extend so as to branch off into two portions from the main pipe portion is disclosed in PTL 1. In the heat exchanger, the main pipe portion is connected to one region in the header, and the branch pipe portions each are connected to any one of the two regions in the header.

[0007] In a case where the heat exchanger is used as an evaporator, a refrigerant introduced in one region of the header via the heat transfer tubes is diverted and introduced into the other region of the two regions of the header via the main pipe portion and the branch pipe portions of the connection pipe.

Citation List

Patent Literature

[0008] [PTL 1] Japanese Unexamined Patent Application Publication No. 2015-55404

Summary of Invention

Technical Problem

[0009] However, in a case where the heat exchanger is used as an evaporator, not the entire refrigerant introduced into one region of the header via heat transfer tubes evaporates, and the refrigerant is in a state of a gas-liquid two phase refrigerant, in which a liquid phase refrigerant and a gas phase refrigerant are mixed.

[0010] For this reason, a larger amount of a liquid phase refrigerant circulates only in some of the branch pipes depending on a disposed location of each branch pipe, and thus a deviation in the flow rate or the gas-liquid ratio of the refrigerant occurs between the branch pipes. In particular, in a case where the main pipe portion has a bent portion on an upstream side of the branch pipe and the main pipe portion and the branch pipes extend in the same plane as the bent portion, a liquid phase refrigerant tends to concentrate only in the branch pipe located outside the bend.

[0011] As described above, if a deviation of a liquid phase refrigerant occurs in each branch pipe, a significant change in a refrigerant distribution ratio occurs at the time of diversion also due to a change in the flow rate of the entire refrigerant. In addition, if a refrigerant is diverted in a state where there is a deviation in the flow rate or the gas-liquid ratio of the refrigerant, some heat transfer tubes end up having a refrigerant with an extremely low flow rate, and thus a heat transfer region of the heat exchanger cannot be sufficiently used.

[0012] In the connection pipe of PTL 1, handling for avoiding interference between a plurality of connection pipes is complicated, and thus processing or brazing is difficult. In addition, as a result of making an area occupied by the connection pipes larger, it is necessary to make an effective area exchanging heat with air smaller, and thus a heat exchange performance decreases.

[0013] An object of the invention is to provide a heat exchanger which can suppress a performance decrease (efficiency decrease) and an air conditioner in which the heat exchanger is used.

Solution to Problem

[0014] According to a first aspect of the invention, there is provided a heat exchanger including a plurality of first heat transfer tubes that allow a refrigerant to circulate therein and are arranged with a gap left therebetween, a first header part that has a cylindrical shape and has an internal space connected to each of the first heat transfer tubes in a communicating state, a plurality of second heat transfer tubes that allow the refrigerant to circulate therein and are arranged with a gap left therebetween, a second header part that has a cylindrical shape extending along an axis and has an internal space connected to each of the second heat transfer tubes in a communicating state, an in-second header partition plate that par-

titions the internal space of the second header part into two regions, and a connection pipe that has a connection pipe body having a first end connected to an outer circumferential surface of the first header part in a communicating state with the internal space of the first header part and a second end on an opposite side to the first end connected to an outer circumferential surface of the second header part in a communicating state with the internal space of the second header part and being disposed so as to straddle the two regions such that an opening of the second end is in contact with the in-second header partition plate to partition the opening of the second end with the in-second header partition plate.

[0015] In such a heat exchanger, since the opening of the second end of the connection pipe body straddles the two regions of the second header part, the refrigerant introduced in the connection pipe body from the first header part is introduced into each of the two regions. Accordingly, since there is only one connection portion of the connection pipe to each of the first header part and the second header part, the handling of the connection pipe is easy. In addition, an area occupied by the connection pipe can be made small compared to a case where the connection pipe branches off. Accordingly, a wide effective area of the heat exchanger, in which heat is exchanged with air, can be secured.

[0016] The refrigerant, which is introduced from the first end of the connection pipe body to be introduced into the two regions of the second header part from the second end, circulates on the same route in the connection pipe body. For this reason, a deviation in the gas-liquid ratio of the refrigerant introduced into the two regions can be reduced. Thus, a performance decrease (efficiency decrease) of the heat exchanger can be suppressed.

[0017] In the heat exchanger according to a second aspect of the invention, the in-second header partition plate may have a plate shape extending along a plane orthogonal to the axis of the second header part, one of the two regions may be a first space that is partitioned on one side of an axis direction, the axis direction being a direction in which the axis extends, with the in-second header partition plate, and the other one of the two regions may be a second space which is partitioned on the other side in the axis direction with the in-second header partition plate.

[0018] By configuring in such a manner, the homogenization of gas-liquid ratios of refrigerants introduced into the respective first space and second space, which are divided in the axis direction of the second header part, can be achieved.

[0019] In the heat exchanger according to a third aspect of the invention, the in-second header partition plate may have a vertical partition portion which has a plate shape extending along a plane including the axis in the second header part and is in contact with the opening of the second end of the connection pipe, a first horizontal partition portion which has a plate shape extending from

an edge of the vertical partition portion on one side of an axis direction, the axis direction being a direction in which the axis extends, toward only one side of a direction orthogonal to a plate surface of the vertical partition portion, and a second horizontal partition portion which has a plate shape extending from an edge of the vertical partition portion on the other side of the axis direction toward only the other side of the direction orthogonal to the plate surface of the vertical partition portion. One of the two regions may be a first space which is partitioned on one side of the axis direction with the first horizontal partition portion and the second horizontal partition portion. The other one of the two regions may be a second space which is partitioned on the other side of the axis direction with the first horizontal partition portion and the second horizontal partition portion.

[0020] By configuring in such a manner, the homogenization of gas-liquid ratios of refrigerants introduced into the respective first space and second space partitioned with the in-second header partition plate can be achieved.

[0021] In the heat exchanger according to a fourth aspect of the invention, a vertical partition plate that partitions a space in the second header part into an outflow-side region connected to each of the second heat transfer tubes and an inflow-side region connected to the second end of the connection pipe, in sectional view orthogonal to the axis, and a horizontal partition plate that partitions the outflow-side region into a first outflow-side space and a second outflow-side space, which are arranged in an axis direction, the axis direction being a direction in which the axis extends, may be further included. The in-second header partition plate may have a plate shape extending along a plane including the axis so as to partition the inflow-side region into a first chamber and a second chamber, which are adjacent to each other in a circumferential direction of the second header part in horizontal sectional view. A first through-hole that allows the first chamber to communicate with the first outflow-side space may be formed in a portion of the vertical partition plate facing the first chamber. A second through-hole that allows the second chamber to communicate with an upper region of the second outflow-side space may be formed in a portion of the vertical partition plate facing the second chamber. One of the two regions may be the first chamber, and the other one of the two regions may be the second chamber.

[0022] By configuring in such a manner, the homogenization of gas-liquid ratios of refrigerants introduced into the respective first chamber and second chamber, which are divided in the circumferential direction by the in-second header partition plate, can be achieved.

[0023] In heat exchanger according to a fifth aspect of the invention, the connection pipe may have a dividing portion which extends to be continuous in the connection pipe body from the in-second header partition plate and divides a portion including at least the second end of the connection pipe body into a first flow passage commu-

nicating only with one region, out of the two regions, and a second flow passage communicating only with the other region.

[0024] The refrigerant introduced in the connection pipe body is separated into a gas phase content and a liquid phase content in some cases in the process of circulating in the connection pipe body. On the contrary, by the dividing portion dividing the inside of the connection pipe body into the first flow passage and the second flow passage, a deviation in the gas-liquid ratios of refrigerants introduced into the two regions from the second end can be reduced.

[0025] In the heat exchanger according to a sixth aspect of the invention, the connection pipe body may have a first pipe portion extending from the first header part to a radially outside of the first header part, a second pipe portion extending from the second header part to a radially outside of the second header part, and a connection pipe portion which extends so as to bend with respect to the first pipe portion and the second pipe portion such that the first pipe portion and the second pipe portion are connected to each other. The dividing portion may extend to be continuous from the second end to at least to a middle of the first pipe portion via the second pipe portion and the connection pipe portion.

[0026] In general, in a bent portion between the first pipe portion and the connection pipe portion and a bent portion between the connection pipe portion and the second pipe portion, a refrigerant with a large proportion of a liquid phase is unevenly distributed in an outside of each of the bends due to centrifugal force at each bend in some cases. In this case, a larger amount of the unevenly distributed refrigerant is introduced into one of the two regions of the second header part, thereby causing a performance decrease of the heat exchanger.

[0027] On the contrary, by configuring such that the dividing portion of the connection pipe extends to a first header side of the bent portion between the first pipe portion and the connection pipe portion, the amounts of refrigerants to be introduced into the two regions of the second header part are determined immediately before the bent portion where a liquid phase and a gas phase are easily separated. Accordingly, the homogenization of gas-liquid ratios of refrigerants introduced into the two regions can be achieved.

[0028] In the heat exchanger of a seventh aspect of the invention, the dividing portion may extend from the second end to the first end.

[0029] By configuring in such a manner, at a time point when the refrigerant is introduced from the first header part into the connection pipe, the amounts of refrigerants circulating in the first flow passage and the second flow passage of the connection pipe are determined. Since the first flow passage and the second flow passage are connected to each other at the same location as the first header, refrigerants with the same gas-liquid ratio are introduced into the first flow passage and the second flow passage. Accordingly, the homogenization of gas-liquid

ratios of refrigerants introduced into the two regions of the second header part can be achieved further.

[0030] In the heat exchanger according to an eighth aspect of the invention, the first header may have a cylindrical shape extending along the axis on one side of the second header part in the axis direction, and the first pipe portion, the second pipe portion, and the connection pipe portion of the connection pipe may extend on an imaginary plane including the axis.

[0031] Even in the connection pipe having such a structure, a difference in the gas-liquid ratio at the first flow passage and the second flow passage can be reduced by the connection pipe being provided with the dividing portion.

[0032] In the heat exchanger of a ninth aspect of the invention, the first flow passage and the second flow passage may be adjacent to each other in a vertical direction on a first end side of the connection pipe body.

[0033] Even in a case of having such a configuration, the homogenization of gas-liquid ratios of refrigerants introduced into the two regions of the second header can be achieved since refrigerants with gas-liquid ratios close to each other are introduced into the first flow passage and the second flow passage.

[0034] In the heat exchanger of a tenth aspect of the invention, the first flow passage and the second flow passage may be adjacent to each other in a horizontal direction on a first end side of the connection pipe body.

[0035] In general, a refrigerant in a liquid phase state is likely to gather downwards due to gravity, and a refrigerant in a gas phase state is likely to gather upwards. For this reason, even in the first header part, the gas-liquid ratio of a refrigerant varies according to the vertical direction in some cases. Even in this case, refrigerants with the same gas-liquid ratio are introduced into the first flow passage and the second flow passage by the first flow passage and the second flow passage being adjacent to each other in the horizontal direction. Consequently, the homogenization of gas-liquid ratios of refrigerants introduced into the two regions of the second header can be achieved.

[0036] In the heat exchanger of an eleventh aspect of the invention, each of the first flow passage and the second flow passage may have a plurality of small flow passages arranged in a direction where the first flow passage and the second flow passage are adjacent to each other. The connection pipe may have a flat tubular shape of which a longitudinal direction is an arranging direction of the small flow passages.

[0037] By configuring in such a manner, the curvature radiuses of the bent portions of the connection pipe can be made small, for example, compared to a case where a section of the connection pipe is circular. For this reason, by making the occupying volume of the connection pipe small, a wide effective area of the heat exchanger, in which heat is exchanged with air, can be secured.

[0038] In the heat exchanger of a twelfth aspect of the invention, flow passage sectional areas of the first flow

passage and the second flow passage may be different from each other.

[0039] In a case where the heat exchange efficiency of the second heat transfer tubes connected to each of the two regions of the second header part differs, the heat exchange efficiency of the heat exchanger can be improved by making the flow passage sectional areas of the first flow passage and the second flow passage different from each other according to a difference in the heat exchange efficiency.

[0040] In the heat exchanger according to a thirteenth aspect of the invention, a notch dented from a radially outside to a radially inside of the second header part may be formed in the in-second header partition plate, and the second end of the connection pipe body may be fitted into the notch.

[0041] By configuring in such a manner, the connection pipe can be easily positioned, and thus workability can be improved.

[0042] In the heat exchanger according to the fourteenth aspect of the invention, a slit extending from the second end along the dividing portion may be formed in the connection pipe, and the slit and the in-second header partition plate may be fitted to each other.

[0043] By configuring in such a manner, the connection pipe can be easily positioned, and thus workability can be improved.

[0044] In the heat exchanger according to a fifteenth aspect of the invention, the first header part may be a portion of a header, which has a header body having a cylindrical shape of which a center is the axis and a main partition plate partitioning an inside of the header body in an axis direction, the axis direction being a direction in which the axis extends, on one side of the main partition plate in the axis direction. The second header part may be a portion of the header on the other side of the main partition plate in the axis direction, the axis direction may be a vertical direction.

[0045] As described above, the heat exchanger having the first header part and the second header part can be easily configured by forming the first header part and the second header part with the main partition plate provided in one header.

[0046] According to a sixteenth aspect of the invention, there is provided an air conditioner including the heat exchanger according to any one of the aspects.

[0047] As described above, since the heat exchanger according to any one of the aspects are included, a decrease in a heat exchange performance can be suppressed, and thus the air conditioner with a high efficiency can be realized.

Advantageous Effects of Invention

[0048] According to the invention, a performance decrease (efficiency decrease) of the heat exchanger or the air conditioner can be suppressed.

Brief Description of Drawings

[0049]

Fig. 1 is an overall configuration view of an air conditioner according to a first embodiment of the invention.

Fig. 2 is a longitudinal sectional view of a heat exchanger according to the first embodiment of the invention.

Fig. 3 is a perspective view of the heat exchanger according to the first embodiment of the invention.

Fig. 4A is a sectional view of a first pipe portion of a connection pipe of the heat exchanger according to the first embodiment of the invention.

Fig. 4B is a sectional view of a second pipe portion of the connection pipe of the heat exchanger according to the first embodiment of the invention.

Fig. 5 is a longitudinal sectional view of a heat exchanger according to a first modification example of the first embodiment of the invention.

Fig. 6 is a longitudinal sectional view of a heat exchanger according to a second modification example of the first embodiment of the invention.

Fig. 7 is a horizontal sectional view of a second header part of a heat exchanger according to a third modification example of the first embodiment of the invention.

Fig. 8A is a sectional view of a first pipe portion of a connection pipe of a heat exchanger according to a fourth modification example of the first embodiment of the invention.

Fig. 8B is a sectional view of a second pipe portion of the connection pipe of the heat exchanger according to the fourth modification example of the first embodiment of the invention.

Fig. 9 is a perspective view of a heat exchanger according to a second embodiment of the invention.

Fig. 10 is a view of a second header part of the heat exchanger according to the second embodiment of the invention seen from a connecting direction of a connection pipe.

Fig. 11 is a sectional view of a connection pipe of a heat exchanger according to a first modification example of the second embodiment of the invention.

Fig. 12 is a sectional view of a connection pipe of a heat exchanger according to a second modification example of the second embodiment of the invention.

Fig. 13 is a perspective view of a connection pipe of a heat exchanger according to a third modification example of the second embodiment of the invention.

Fig. 14 is a sectional view of a connection pipe of a heat exchanger according to a fourth modification example of the second embodiment of the invention.

Fig. 15 is a perspective view of a second header part of a heat exchanger according to a third embodiment of the invention.

Fig. 16 is a horizontal sectional view of the second

header part of the heat exchanger according to the third embodiment of the invention.

Description of Embodiments

[First embodiment]

[0050] Hereinafter, an air conditioner 1 including heat exchangers 10 according to a first embodiment of the invention will be described with reference to Figs. 1 to 3 and Figs. 4A and 4B.

[0051] As illustrated in Fig. 1, the air conditioner 1 includes a compressor 2, an indoor heat exchanger 3 (heat exchanger 10), an expansion valve 4, an outdoor heat exchanger 5 (heat exchanger 10), a four-way valve 6, and a pipe 7 that connects the configuration elements together, and a refrigerant circuit formed of the configuration elements is configured.

[0052] The compressor 2 compresses a refrigerant and supplies the compressed refrigerant to the refrigerant circuit.

[0053] The indoor heat exchanger 3 performs heat exchange between the refrigerant and indoor air. The indoor heat exchanger 3 is used as an evaporator to absorb heat from the inside during cooling operation, and is used as a condenser to radiate heat to the inside during heating operation.

[0054] The expansion valve 4 reduces a pressure by expanding the high-pressure refrigerant liquefied by the condenser exchanging heat.

[0055] The outdoor heat exchanger 5 performs heat exchange between the refrigerant and outdoor air. The outdoor heat exchanger 5 is used as a condenser to radiate heat to the outside during cooling operation. The outdoor heat exchanger 5 is used as an evaporator to absorb heat from the outside during heating operation.

[0056] The four-way valve 6 switches between directions where a refrigerant circulates during heating operation and during cooling operation. Consequently, a refrigerant circulates in the compressor 2, the outdoor heat exchanger 5, the expansion valve 4, and the indoor heat exchanger 3 in this order during cooling operation. On the other hand, a refrigerant circulates in the compressor 2, the indoor heat exchanger 3, the expansion valve 4, and the outdoor heat exchanger 5 in this order during heating operation.

[0057] Next, the heat exchangers 10 which are used as the indoor heat exchanger 3 and the outdoor heat exchanger 5 will be described with reference to Figs. 2 to 5.

[0058] The heat exchangers 10 each include a plurality of heat transfer tubes 20, a plurality of fins 28, a pair of headers 30, and a connection pipe 61.

[0059] The heat transfer tubes 20 are tubular members linearly extending in a horizontal direction, and flow passages through which a refrigerant circulates are formed therein. The plurality of heat transfer tubes 20 are arranged with a gap left therebetween in a vertical direction,

and are disposed so as to be parallel to each other.

[0060] In the first embodiment, the heat transfer tubes 20 each have a flat tubular shape, and the plurality of flow passages arranged in the horizontal direction orthogonal to an extending direction of the heat transfer tubes 20 are formed inside the heat transfer tubes 20. The plurality of flow passages are arranged so as to be parallel to each other. For this reason, a sectional shape orthogonal to the extending direction of the heat transfer tubes 20 is a flat shape of which a longitudinal direction is the horizontal direction orthogonal to the extending direction of the heat transfer tubes 20.

[0061] The fins 28 each are disposed between the heat transfer tubes 20 arranged as described above. In the first embodiment, the fins 28 extend so as to be alternately in contact with the vertically nearby heat transfer tubes 20 (extend in a corrugated shape) as facing the extending direction of each of the heat transfer tubes 20. Without being limited thereto, the shapes of the fins 28 may be any shape insofar as the fins are provided so as to protrude from outer peripheral surfaces of the heat transfer tubes 20.

[0062] At both ends of the plurality of heat transfer tubes 20, the pair of headers 30 is provided such that the heat transfer tubes 20 are sandwiched therebetween. One of the pair of headers 30 is set as an entrance side header 40, which is an entrance of a refrigerant from the outside into the heat exchanger 10, and the other one is set as a turnback side header 50 for a refrigerant to turn back in the heat exchanger 10.

[0063] The entrance side header 40 is a cylindrical member extending in the vertical direction. An upper end and a lower end of the entrance side header 40 are closed and the inside of the entrance side header is partitioned into two upper and lower regions with a partition plate 41. The lower region partitioned with the partition plate 41 is set as a lower entry region 42. The upper region is set as an upper entry region 43. The lower entry region 42 and the upper entry region 43 are in a state of not communicating with each other in the entrance side header 40. The lower entry region 42 and the upper entry region 43 each are connected to the pipe 7 configuring the refrigerant circuit.

[0064] Out of the plurality of heat transfer tubes 20, the heat transfer tubes 20 connected to the lower entry region 42 in a communicating state are set as first heat transfer tubes 21. The heat transfer tubes 20 connected to the upper entry region 43 in a communicating state are set as second heat transfer tubes 23.

[0065] The turnback side header 50 includes a header body 51, a main partition plate 58, and an in-second header partition plate 60.

[0066] The header body 51 is a cylindrical member which has a center, the center being an axis O of the header body 51, and which extends along the axis O. An upper end and a lower end of the header body 51 are closed. The header body 51 of the first embodiment extends in a state where the axis O matches the vertical

direction. That is, the vertical direction is set as an axis O direction.

[0067] The main partition plate 58 is provided in the header body 51, and partitions a space in the header body 51 into two upper and lower regions.

[0068] A portion that includes the lower region (on one side of the axis O direction) partitioned with the main partition plate 58 is set as a first header part 52. That is, the lower region partitioned with the main partition plate 58 is set as an internal space of the first header part 52.

[0069] A portion that includes the upper region (on the other side of the axis O direction) partitioned with the main partition plate 58 is set as a second header part 53. That is, the upper region partitioned with the main partition plate 58 is set as an internal space of the second header part 53.

[0070] In the first embodiment, the first header part 52 and the second header part 53 each of which has a space therein are formed in the turnback side header 50 by the inside of the header body 51 being partitioned with the main partition plate 58. In other words, the turnback side header 50 is configured with first header part 52 and second header part 53.

[0071] The in-second header partition plate 60 partitions the internal space of the second header part 53 into two regions. The in-second header partition plate 60 of the first embodiment has a plate shape extending along a horizontal plane (plane orthogonal to the axis O).

[0072] Accordingly, the in-second header partition plate 60 partitions the internal space of the second header part 53 into a lower region and an upper region. In the second header part 53, the lower region below the in-second header partition plate 60 is set as a lower space 54 (first space), and the upper region above the in-second header partition plate 60 is set as an upper space 55 (second space).

[0073] The plurality of first heat transfer tubes 21 each are connected to the first header part 52 so as to be in a communicating state with the inside of the first header part 52. A first tube group 22 is configured with the plurality of first heat transfer tubes 21. In other words, the heat transfer tubes 20 connected to the first header part 52 are set as the first heat transfer tubes 21.

[0074] The second heat transfer tubes 23 each are connected to the second header part 53 so as to be in a communicating state with the inside of the lower space 54 and the inside of the upper space 55 of the second header part 53. That is, the heat transfer tubes 20 connected to the second header part 53 are set as the second heat transfer tubes 23. A lower second tube group 25 is configured with the plurality of second heat transfer tubes 23, each of which is connected to the lower space 54 in a communicating state, out of the second heat transfer tubes 23. In addition, an upper second tube group 26 is configured with the plurality of second heat transfer tubes 23 each of which is connected to the upper space 55 in a communicating state.

[0075] The connection pipe 61 allows the internal

space of the first header part 52 to communicate with the lower space 54 and the upper space 55 in the second header part 53. The connection pipe 61 has a connection pipe body 62 and a dividing portion 70.

[0076] The connection pipe body 62 is a tubular member, and is configured with a first pipe portion 65, a second pipe portion 66, and a connection pipe portion 67.

[0077] The first pipe portion 65 is connected to an outer circumferential side of the first header part 52. That is, the first pipe portion 65 is a tubular member extending in the horizontal direction (direction orthogonal to the axis O), and has one end connected to a region of the header body 51 where the first header part 52 is formed such that the inside of the first pipe portion is in a communicating state with the inside of the first header part 52. The first pipe portion 65 is connected to an opposite portion to a portion, to which the heat transfer tubes 20 are connected, at a circumferential position in the first header part 52 (header body 51) with the axis O interposed therebetween.

[0078] The second pipe portion 66 is connected to a circumferential side of the second header part 53. That is, the second pipe portion 66 is a tubular member extending in the horizontal direction, and has one end connected to a region of the header body 51 where the second header part 53 is formed such that the inside of the second pipe portion is in a communicating state with the inside of the second header part 53. The second pipe portion 66 is connected to a portion which is the same as the connection portion of the first pipe portion 65 at a circumferential position in the second header part 53 (header body 51).

[0079] The connection pipe portion 67 connects the first pipe portion 65 and the second pipe portion 66 together in the vertical direction. That is, the connection pipe portion 67 is a tubular member extending in the vertical direction, and has a lower end connected to the first pipe portion 65 such that the inside of the connection pipe portion and the inside of the first pipe portion are in a communicating state with each other. In addition, an upper end of the connection pipe portion is connected to the second pipe portion 66 such that the inside of the connection pipe portion and the inside of the second pipe portion are in a communicating state with each other.

[0080] Accordingly, a first bent portion 68 in which a flow passage in the connection pipe 61 bends from the horizontal direction to the vertical direction is configured in a connection portion between the connection pipe portion 67 and the first pipe portion 65. In addition, a second bent portion 69 in which a flow passage in the connection pipe 61 bends from the horizontal direction to the vertical direction is configured in a connection portion between the connection pipe portion 67 and the second pipe portion 66.

[0081] The first pipe portion 65, the second pipe portion 66, and the connection pipe portion 67 of the connection pipe body 62 configured as described above extend on an imaginary plane including the axis O.

[0082] An end portion of the first pipe portion 65 of the connection pipe body 62, which is connected to the first header part 52, is set as a first end 63 of the connection pipe body 62. In addition, an end portion of the second pipe portion 66 of the connection pipe body 62, which is connected to the second header part 53, is set as a second end 64 of the connection pipe body 62.

[0083] A vertical position of the second end 64 of the connection pipe body 62 is the same position as the in-second header partition plate 60 partitioning the inside of the second header part 53 into two upper and lower regions. Accordingly, an opening of the second end 64 of the connection pipe body 62 is in contact with the in-second header partition plate 60.

[0084] In addition, the thickness (vertical dimension) of the in-second header partition plate 60 is set to be smaller than the vertical dimension of an opening of the second pipe portion 66 of the connection pipe body 62. The in-second header partition plate 60 is provided within a range of the vertical dimension of the opening of the second pipe portion 66. Accordingly, the opening of the second end 64 is disposed so as to straddle both spaces including the lower space 54 and the upper space 55, and the inside of the second pipe portion 66 of the connection pipe body 62 is in a communicating state with both of the lower space 54 and the upper space 55 in the second header part 53.

[0085] The dividing portion 70 divides the inside of the connection pipe body 62 into a first flow passage 71 and a second flow passage 72. In the first embodiment, the dividing portion 70 is formed inside the connection pipe body 62 so as to extend from a connection portion of the first pipe portion 65 to the first header part 52 to a connection portion of the second pipe portion 66 to the second header part 53 via the connection pipe portion 67. Accordingly, the first flow passage 71 and the second flow passage 72 are formed over the entire area extending from the first end 63 to the second end 64 in the connection pipe body 62.

[0086] As illustrated in Fig. 6, the dividing portion 70 extends in a plate shape along the horizontal plane inside each of the first pipe portion 65 and the second pipe portion 66. Consequently, the dividing portion 70 divides the inside of the first pipe portion 65 and the inside of the second pipe portion 66 into two upper and lower flow passages.

[0087] The dividing portion 70 extends along a vertical plane orthogonal to the plane including the axis O of the header body 51 inside the connection pipe portion 67. Consequently, the dividing portion 70 divides the inside of the connection pipe portion 67 into a flow passage close to the header body 51 and a flow passage separated apart from the header body 51.

[0088] In the first embodiment, the first flow passage 71 is configured by a lower flow passage in the first pipe portion 65, the flow passage separated apart from the header body 51 in the connection pipe portion 67, and an upper flow passage in the second pipe portion 66.

The second flow passage 72 is configured by an upper flow passage in the first pipe portion 65, the flow passage close to the header body 51 in the connection pipe portion 67, and a lower flow passage in the second pipe portion 66. Consequently, the first flow passage 71 and the second flow passage 72 are adjacent to each other in the vertical direction even in the openings of both of the first end 63 and the second end 64 of the connection pipe 61.

[0089] An end portion of the dividing portion 70 on a second end 64 side is in contact with the in-second header partition plate 60 in the second header part 53. Consequently, the dividing portion 70 extends from the in-second header partition plate 60 so as to be continuous in the connection pipe body 62. For this reason, the first flow passage 71 of the connection pipe 61 communicates only with the upper space 55 out of the spaces inside the second header part 53. The second flow passage 72 of the connection pipe 61 communicates only with the lower space 54 out of the spaces in the second header part 53.

[0090] Next, operation and effects in a case where the heat exchanger 10 is used as an evaporator will be described. In a case where the heat exchanger 10 is the indoor heat exchanger 3, the heat exchanger 10 is used as an evaporator during cooling operation of the air conditioner 1. In a case where the heat exchanger is the outdoor heat exchanger 5, the heat exchanger is used as an evaporator during heating operation of the air conditioner 1.

[0091] In a case where the heat exchanger 10 is used as an evaporator, a gas-liquid two phase refrigerant having a high liquid phase content is supplied from the pipe 7 to the lower entry region 42 of the entrance side header 40 illustrated in Fig. 2. The refrigerant is divided and supplied to the plurality of first heat transfer tubes 21 in the lower entry region 42, and exchanges heat with the external atmosphere of the first heat transfer tubes 21 in the process of circulating in the first heat transfer tubes 21, thereby causing evaporation.

[0092] Consequently, some of the refrigerant supplied from the first heat transfer tubes 21 into the first header part 52 of the turnback side header 50 changes from the liquid phase to a gas phase, and thus the refrigerant becomes a gas-liquid two phase refrigerant which has a higher proportion of a gas phase than that of the refrigerant in the lower entry region 42.

[0093] The refrigerant in the first header part 52 is introduced into the second header part 53 via the connection pipe 61. More specifically, the refrigerant is introduced into each of the first flow passage 71 and the second flow passage 72 in the connection pipe 61 from the opening of the first end 63 of the connection pipe 61, and the refrigerant circulating in the first flow passage 71 is introduced into the upper space 55 of the second header part 53 that communicates with the first flow passage 71. The refrigerant circulating in the second flow passage 72 is introduced into the upper space 55 of the second header part 53 that communicates with the second flow passage 72.

[0094] Out of gas-liquid two phase refrigerants supplied into the first header part 52, a refrigerant with a high liquid phase content and a high density gathers at the lower portion of the first header part 52 due to gravity, and a refrigerant with a high gas phase content and a low density gathers at the upper portion of the first header part 52. That is, in the first header part 52, the gas-liquid ratio of a refrigerant differs according to a vertical position.

[0095] In the first embodiment, the first flow passage 71 and the second flow passage 72, which communicate with the lower space 54 and the upper space 55 of the second header part 53 respectively, are formed over the entire area of the connection pipe 61, and only the first end 63 of the connection pipe body 62, in which the first flow passage 71 and the second flow passage 72 are arranged side by side, is connected to the first header part 52.

[0096] For this reason, refrigerants, which are at almost the same vertical position, are supplied to the first flow passage 71 and the second flow passage 72 respectively. Therefore, gas-liquid ratios of refrigerants in the lower space 54 and the upper space 55 are close to each other since the refrigerants with almost the same gas-liquid ratio are introduced into the lower space 54 and the upper space 55 of the second header part 53 via the first flow passage 71 and the second flow passage 72.

[0097] After then, the refrigerants in the lower space 54 and the upper space 55 of the second header part 53 are diverted to the plurality of second heat transfer tubes 23 and circulate in the second heat transfer tubes 23. Then, the refrigerants again cause evaporation by exchanging heat with the external atmosphere of the second heat transfer tubes 23 in the process of circulating in the second heat transfer tubes 23. Consequently, in the second heat transfer tubes 23, the remaining liquid phase in the refrigerants changes to the gas phase and the refrigerants in a gas phase state are supplied to the upper entry region 43 of the entrance side header 40. Then, the refrigerants are introduced from the upper entry region 43 to the pipe 7, thereby circulating in the refrigerant circuit.

[0098] As described above, in the first embodiment, the first flow passage 71 and the second flow passage 72 are formed over the entire area of the connection pipe 61 in the extending direction, and the first flow passage 71 and the second flow passage 72 are connected to the first end 63 at the vertical position of the first header part 52.

[0099] For this reason, refrigerants with almost the same gas-liquid ratio are introduced into the first flow passage 71 and the second flow passage 72. In addition, the refrigerants introduced in the first flow passage 71 and the second flow passage 72 are introduced into the lower space 54 and the upper space 55 of the second header part 53 as it is without branching off. That is, at a time point when the refrigerants are introduced in the connection pipe 61 from the first header part 52, the gas-

liquid ratios of the refrigerants to be introduced into the lower space 54 and the upper space 55 are determined.

[0100] Thus, the homogenization of gas-liquid ratios of refrigerants introduced into the lower space 54 and the upper space 55 can be achieved. After then, it is possible to perform an efficient heat exchange at the second heat transfer tubes 23 into which the refrigerants are introduced, and a performance decrease of the heat exchanger 10 can be suppressed.

[0101] In a case where the first header part 52 and the lower space 54 and the upper space 55 of the second header part 53 are connected to a flow passage branching off on the way thereto, in particular, in a case where the flow rate of a refrigerant has changed, the gas-liquid ratio of the refrigerant flowing into the two spaces also changes significantly in some cases.

[0102] In the first embodiment, since the refrigerant introduced in the first flow passage 71 and the second flow passage 72 from the first header part 52 is introduced into the lower space 54 and the upper space 55 of the second header part 53 as it is, the gas-liquid ratio of the refrigerant introduced into the lower space 54 and the upper space 55 do not change significantly even in a case where the flow rate of the refrigerant has changed.

[0103] In the first embodiment, there is only one connection portion of the connection pipe 61 to each of the first header part 52 and the second header part 53. As a consequence, handling of the connection pipe 61 becomes easy, for example, compared to a case where a plurality of flow passages are used or a case where a flow passage branches off.

[0104] An area occupied by the connection pipe 61 can be made small by forming the plurality of flow passages (the first flow passage 71 and the second flow passage 72) in the single connection pipe 61. For example, in a case where the overall size of the heat exchanger 10 is determined in advance when designing, an effective area exchanging heat with air can be increased by the amount of a decrease in the size of the connection pipe 61. Therefore, the heat exchanger 10 with a higher efficiency can be realized.

[0105] Next, a first modification example of the first embodiment will be described with reference to Fig. 5. A configuration where the connection pipe 61 does not have the dividing portion 70 may be adopted as the first modification example of the first embodiment. In this case, the connection pipe 61 is configured by only the connection pipe body 62.

[0106] According to the first modification example of the first embodiment configured in such a manner, even in a configuration where the connection pipe 61 does not have the dividing portion 70, a refrigerant, which is introduced from the first end 63 of the connection pipe body 62 to be introduced into the two regions of the second header part 53 from the second end 64, circulates on the same route in the connection pipe body 62, and is introduced into the lower space 54 and the upper space 55 of the second header part 53. For this reason, a deviation

in the gas-liquid ratio of the refrigerant introduced into the two regions can be reduced.

[0107] Next, a second modification example of the first embodiment will be described with reference to Fig. 6. In the second modification example of the first embodiment, an area where the dividing portion 70 is formed may be different from that of the first embodiment.

[0108] In the second modification example of the first embodiment, the dividing portion 70 of the connection pipe 61 is formed to extend from the second end 64 of the connection pipe body 62 to a middle of the middle of the first pipe portion 65, that is, immediately before the first end 63 via the second pipe portion 66 and the connection pipe portion 67.

[0109] For example, in a case of the connection pipe 61 having the configuration where the dividing portion 70 is not included as in the first modification example, a gas phase and a liquid phase of a refrigerant are separated at the first bent portion 68 or the second bent portion 69 in some cases depending on the speed or the flow rate of the refrigerant.

[0110] That is, due to centrifugal force received when the refrigerant passes through the first bent portion 68 of the connection pipe body 62, a liquid phase content of the refrigerant with a higher density is unevenly distributed in an outside of the bend. In this case, a liquid phase refrigerant is distributed in the connection pipe body 62 in the circumferential direction. As a result, the refrigerant, of which a gas-liquid ratio has changed significantly, is introduced into the lower space 54 and the upper space 55 of the second header part 53.

[0111] On the contrary, in the second modification example, since the dividing portion 70 extends further toward the first end 63 of the connection pipe 61 than the first bent portion 68 does, a refrigerant introduced from the first end 63 of the connection pipe body 62 diverts and circulates in the first flow passage 71 and the second flow passage 72 in the previous stage when a liquid phase and a gas phase are separated at the first bent portion 68. For this reason, the gas-liquid ratio of a refrigerant circulating between the first flow passage 71 and the second flow passage 72 does not change significantly. Therefore, a performance decrease of the heat exchanger 10 can be suppressed as in the first embodiment.

[0112] Next, a third modification example of the first embodiment will be described with reference to Fig. 7. In the third modification example of the first embodiment, a notch 75 dented from an outer circumferential side of the in-second header partition plate 60 is configured to be provided in a region where the connection pipe 61 is connected to the in-second header partition plate 60, and the second end 64 of the connection pipe 61, which has entered the inside of the second header part 53, is configured to be fitted into the notch 75.

[0113] The notch 75 is formed in the in-second header partition plate 60 before being attached into the header 30. A slit for inserting the in-second header partition plate

60 into the header 30 is provided, and the in-second header partition plate 60 is inserted into the header 30 from the outer circumferential side of the header 30.

[0114] After then, the second end 64 of the connection pipe 61 is inserted into the header 30 from a hole for connection of the connection pipe 61, which is formed in the header 30, and the second end 64 is fitted into the slit of the in-second header partition plate 60. After assembling in such a manner, the header 30, the in-second header partition plate 60, and the connection pipe 61 are integrally brazed together.

[0115] It is preferable to form the connection pipe 61 of an aluminum alloy, and it is preferable to form the in-second header partition plate 60 of a clad material, which is formed by bonding a brazing filler metal.

[0116] According to the third modification example of the first embodiment, it is possible to improve workability since the connection pipe 61 can be easily positioned when manufacturing the heat exchanger 10.

[0117] Next, a fourth modification example of the first embodiment will be described with reference to Figs. 8A and 8B. In the fourth modification example of the first embodiment, while the first flow passage 71 and the second flow passage 72 of the connection pipe 61 are configured to be arranged in the second pipe portion 66 in the vertical direction, the first flow passage and the second flow passage are configured to be arranged in the first pipe portion 65 in the horizontal direction.

[0118] That is, in the fourth modification example, the dividing portion 70 in the first pipe portion 65 has a plate shape extending in the vertical direction, thereby dividing the first pipe portion into the first flow passage 71 and the second flow passage 72 which are arranged in the first pipe portion 65 in the horizontal direction.

[0119] According to such a connection pipe 61, the vertical positions of the first flow passage 71 and the second flow passage 72 are the same in the first end 63 since the first flow passage 71 and the second flow passage 72 are arranged in the opening of the first end 63 in the horizontal direction. Consequently, refrigerants with the same gas-liquid ratio are introduced into the first flow passage 71 and the second flow passage 72 respectively. Thus, the homogenization of gas-liquid ratios of the refrigerants introduced into the lower space 54 and the upper space 55 of the second header part 53 can be achieved further compared to a case where the first flow passage 71 and the second flow passage 72 are arranged in the first end 63 in the vertical direction.

[0120] In the fourth modification example, it is sufficient that the first flow passage 71 and the second flow passage 72 are arranged in the horizontal direction at least in the first end 63. In addition, it is sufficient that the first flow passage 71 and the second flow passage 72 are arranged in the horizontal direction at least in the second end 64, and the first flow passage 71 and the second flow passage 72 may be arranged in any state between the first end 63 and the second end 64. That is, the dividing portion 70 may be formed so as to be twisted in

at least one portion of the first pipe portion 65, the second pipe portion 66, and the connection pipe portion 67.

[0121] The dividing portion 70 of the fourth modification example may be applied to the second modification example such that the first flow passage 71 and the second flow passage 72 are arranged in the horizontal direction in the end portion of the dividing portion 70 located in a middle of the first pipe portion 65 in an extending direction thereof.

[Second embodiment]

[0122] A heat exchanger 80 according to a second embodiment of the invention will be described with reference to Figs. 9 and 10. In Figs. 9 and 10, the same configuration elements as the first embodiment will be assigned with the same reference signs as the first embodiment, and the detailed description thereof will be omitted.

[0123] The heat exchanger 80 of the second embodiment is different from that of the first embodiment in terms of structures of an in-second header partition plate 81 and a connection pipe 90.

[0124] The in-second header partition plate 81 of the second embodiment has a vertical partition portion 82, a first horizontal partition portion 83, and a second horizontal partition portion 84. The vertical partition portion 82 is a member having a plate shape which extends along a plane including the axis O, and extends in a diameter direction of the second header part 53 (extending direction of the heat transfer tubes 20, a first pipe 94, and a second pipe portion 95) in a part of a vertical area of the second header part 53.

[0125] In the second embodiment, the vertical partition portion 82 extends in the second header part 53 in the diameter direction from a side connected to the second heat transfer tubes 23 to a side connected to the connection pipe 90. The vertical partition portion 82 has a rectangular plate shape. Edges in a longitudinal direction are a lower edge and an upper edge of the vertical partition portion 82, which extend in the diameter direction, and edges in a lateral direction are in contact with an inner circumferential surface of the second header part 53 and extend in the vertical direction.

[0126] The first horizontal partition portion 83 extends from the lower edge of the vertical partition portion 82 toward one side (the left in Fig. 10) of a direction orthogonal to a pair of plate surfaces of the vertical partition portion 82. The vertical partition portion 82 is a semicircular plate member in plan view. A linear edge of the semicircle forms an intersection ridge with the lower edge of the vertical partition portion 82, and an arc-shaped edge is in contact with a half region of the inner circumferential surface of the second header part 53 in the circumferential direction.

[0127] The second horizontal partition portion 84 extends from the upper edge of the vertical partition portion 82 toward the other side (the right in Fig. 10) of the direction orthogonal to the pair of plate surfaces of the ver-

tical partition portion 82. The vertical partition portion 82 is a semicircular plate member in plan view. A linear edge of a semicircle forms an intersection ridge with the upper edge of the vertical partition portion 82, and the arc-shaped edge is in contact with the half region of the inner circumferential surface of the second header part 53 in the circumferential direction.

[0128] Such an in-second header partition plate 81 partitions the inside of the second header part 53 into two spaces. Out of the two spaces, a space below the first horizontal partition portion 83 and the second horizontal partition portion 84, that is, a space in contact with a lower surface of the first horizontal partition portion 83, a lower surface of the second horizontal partition portion 84, and a surface of the vertical partition portion 82 on the other side (the right in Fig. 10) is set as a lower space 86. In addition, out of the two spaces, a space above the first horizontal partition portion 83 and the second horizontal partition portion 84, that is, a space in contact with an upper surface of the first horizontal partition portion 83, an upper of the second horizontal partition portion 84, and a surface of the vertical partition portion 82 on the one side (the left in Fig. 10) is set as an upper space 87.

[0129] As in the first embodiment, the connection pipe 90 has a connection pipe body 91 and a dividing portion 100. The connection pipe body 91 is a tubular member which allows the inside of the first header part 52 to communicate with the inside of the second header part 53, has a first end 92 connected to the outer circumferential surface of the first header part 52, and has a second end 93 connected to the outer circumferential surface of the second header part 53.

[0130] The outer diameter of the connection pipe body 91 in a section orthogonal to an extending direction thereof has a flat shape of which a longitudinal direction is one direction. In the second embodiment, the outer diameter of the connection pipe body has a flat shape with the horizontal direction as a longitudinal direction thereof. The connection pipe body 91 is configured with three tubular members including a first pipe portion 94, a second pipe portion 95, and a connection pipe portion 96 as in the first embodiment, a first bent portion 97 is formed between the first pipe portion 94 and the connection pipe portion 96, and a second bent portion 98 is formed between the second pipe portion 95 and the connection pipe portion 96.

[0131] The first end 92 of the connection pipe body 91 is connected to the first header part 52 with the horizontal direction as a longitudinal direction thereof and the vertical direction as a lateral direction thereof. As in the first end 92, also the second end 93 of the connection pipe body 91 is connected to the second header part 53 with the horizontal direction as a longitudinal direction thereof and the vertical direction as a lateral direction thereof.

[0132] The vertical position and the circumferential position of such a second end 93 of the connection pipe body 91 are the same as those of the vertical partition portion 82 of the in-second header partition plate 81. For

this reason, an opening of the second end 93 portion of the connection pipe body 91 is in contact with the vertical partition portion 82. Accordingly, the opening of the second end 93 extends over both sides of a direction, in which the pair of plate surfaces of the vertical partition portion 82 faces, and the inside of the second pipe portion 95 of the connection pipe body 91 is in a communicating state with the lower space 86 and the upper space 87 in the second header part 53.

[0133] As described above, in the second embodiment, the second end 93 of the connection pipe body 91 is in a communicating state with the lower space 86 and the upper space 87 so as to straddle horizontally adjacent portions of both of the spaces in the horizontal direction.

[0134] The dividing portion 100 is provided in the connection pipe body 91 so as to divide the inside of the connection pipe body 91 into two flow passages arranged from first end 92 to the second end 93 in the horizontal direction. That is, the dividing portion 100 is provided to bisect the inside of the connection pipe body 91 in a middle portion of the connection pipe body 91 in the longitudinal direction.

[0135] One of the flow passages formed by the dividing portion 100 is set as a first flow passage 101 that allows the inside of the first header part 52 to communicate with the lower space 86 of the second header part 53. The other one of the flow passages formed by the dividing portion 100 is set as a second flow passage 103 that allows the inside of the first header part 52 to communicate with the upper space 87 of the second header part 53. The first flow passage 101 and the second flow passage 103 each have a flow passage sectional shape of which a longitudinal direction is a direction of being arranged side by side, and extend from the first end 92 to the second end 93 in a state where the flow passage sectional shape is maintained.

[0136] In the heat exchanger 80 of the second embodiment described above, a refrigerant, which is introduced in the first flow passage 101 and the second flow passage 103 from the first end 92 of the connection pipe body 91, circulates in the first flow passage 101 and the second flow passage 103 and is introduced into the lower space 86 and the upper space 87 of the second header part 53, as in the first embodiment.

[0137] The connection portions of the first flow passage 101 and the second flow passage 103 to the first header part 52 are at the same vertical position. Therefore, while refrigerants with the same gas-liquid ratio are introduced into each of the first flow passage and the second flow passage, the refrigerants are introduced into the lower space 86 and the upper space 87 of the second header part 53 as it is without branching off on the way thereto. For this reason, the homogenization of the gas-liquid ratios of the refrigerants in the two spaces can be achieved, and thus a performance decrease of the heat exchanger 80 can be suppressed, as in the first embodiment.

[0138] In the second embodiment, since the shape of

the connection pipe body 91 is a flat tubular shape, the curvature radiuses of the first bent portion 97 and the second bent portion 98 can be made small, for example, compared to a circular connection pipe body having the same flow passage sectional area. For this reason, by making the occupying volume of the connection pipe 90 small, a wide effective area of the heat exchanger 80, in which heat is exchanged with air, can be secured.

[0139] Next, a first modification example of the second embodiment will be described with reference to Fig. 11. In the first modification example of the second embodiment, a structure where the first flow passage 101 and the second flow passage 103, each of which is obtained by linearly cutting out a part of a circular section of the flow passage, are provided so as to be arranged side by side via the dividing portion 100 configuring a linear portion is adopted. Such a structure may be adopted.

[0140] Next, a second modification example of the second embodiment will be described with reference to Fig. 12. In the second modification example of the second embodiment, the connection pipe 90 may have a flat tubular structure in which the first flow passage 101 and the second flow passage 103 have a plurality of small flow passages 102 and 104 respectively arranged in a direction where the first flow passage 101 and the second flow passage 103 are adjacent to each other.

[0141] Accordingly, also in the second embodiment, a refrigerant can be introduced from the first header part 52 to each space of the second header part 53 via each of the small flow passages 102 and 104.

[0142] Next, a third modification example of the second embodiment will be described with reference to Fig. 13. In the third modification example of the second embodiment, the connection pipe body 91 and the dividing portion 100 of the connection pipe 90 have a structure in which a slit 105 extending along the dividing portion 100 toward the first end 92 from the second end 93 is formed and the slit 105 and the in-second header partition plate 81 are fitted to each other.

[0143] By configuring in such a manner, the connection pipe 90 can be easily positioned while maintaining a state where the first flow passage 101 and the second flow passage 103 do not communicate with each other and a state where the first flow passage 101 communicates with the upper space 87 and the second flow passage 103 communicates with the lower space 86. Therefore, workability can be improved.

[0144] Next, a fourth modification example of the second embodiment will be described with reference to Fig. 14. In the fourth modification example of the second embodiment, the flow passage sectional areas of the first flow passage 101 and the second flow passage 103 are made different from each other. In the fourth modification example of the second embodiment, the flow passage sectional area of the second flow passage 103 is smaller than the flow passage sectional area of the first flow passage 101.

[0145] For example, in a case where the number of the

second heat transfer tubes 23 of the lower second tube group 25 connected to the lower space 86 of the second header part 53 is larger than the number of the second heat transfer tubes 23 of the upper second tube group 26 connected to the upper space 87, the sectional area of the first flow passage 101 is set to be large as described above to increase the flow rate of a refrigerant introduced into the lower space 86. Therefore, the heat exchange efficiency of the heat exchanger 80 can be improved as a whole.

[0146] For example, also in a case where the speed of blowing air to the lower second tube group 25 is higher than the speed of blowing air to the upper second tube group 26, the sectional area of the first flow passage 101 is set to be large to increase the flow rate of a refrigerant introduced into the lower space 86, as described above. Therefore, the heat exchange efficiency of the heat exchanger 80 can be improved as a whole.

[0147] That is, by changing the amount of a refrigerant introduced into each of the lower space 86 and the upper space 87 according to the heat exchange performance of the second tube group 24 into which the refrigerant is introduced from the lower space 86 and the upper space 87, heat exchange efficiency can be improved.

[0148] The vertical partition portion 82 of the second embodiment extends only in the vertical direction. Without being limited thereto, however, the vertical partition portion may be inclined with respect to the vertical direction and the horizontal direction.

[0149] In addition, although each of the first horizontal partition portion 83 and the second horizontal partition portion 84 extends only in the horizontal plane, the first horizontal partition portion and the second horizontal partition portion may be somewhat inclined, and may not necessarily have a flat plate shape.

[Third embodiment]

[0150] A heat exchanger 110 according to a third embodiment of the invention will be described with reference to Figs. 15 and 16. In the third embodiment, the same configuration elements as the first embodiment will be assigned with the same reference signs as the first embodiment, and the detailed description thereof will be omitted.

[0151] The heat exchanger 110 of the third embodiment is different from that of the first embodiment in terms of a structure of the second header part 53. Although illustration thereof is omitted in Figs. 15 and 16, the first header part 52 which is the same as in the first embodiment is disposed below the second header part 53, and the heat transfer tubes 20 which are the same as in the first embodiment are connected to the first header part 52 and the second header part 53.

[0152] A vertical partition plate 111, a horizontal partition plate 116, and an in-second header partition plate 119 are provided in the second header part 53 of the third embodiment.

[0153] The vertical partition plate 111 partitions a space in the second header part 53 into two regions including a region connected to each of the second heat transfer tubes 23 and a region connected to the connection pipe 61, in horizontal sectional view. The region which is partitioned with the vertical partition plate 111 and is connected to the second heat transfer tubes 23 is set as an outflow-side region 112. The region which is partitioned with the vertical partition plate 111 and is connected to the connection pipe 61 is set as an inflow-side region 113.

[0154] In the third embodiment, the second header part 53 has a cylindrical shape extending in the vertical direction, and accordingly an internal space thereof also has a cylindrical shape. The vertical partition plate 111 is disposed in a diameter direction of the internal space of the second header part 53 having a cylindrical shape, in horizontal sectional view. Accordingly, each of the inflow-side region 113 and the outflow-side region 112 has a semicircular shape, in horizontal sectional view.

[0155] The horizontal partition plate 116 partitions the outflow-side region 112 into two spaces in the vertical direction. A lower space, out of the two spaces, is set as a first outflow-side space 117. In addition, an upper space, out of the two spaces, is set as a second outflow-side space 118. The second heat transfer tubes 23 are connected to each of the first outflow-side space 117 and the second outflow-side space 118. The horizontal partition plate 116 has a semicircular plate shape in plan view.

[0156] The in-second header partition plate 119 is a plate-shaped member extending in the vertical direction, and is provided in the inflow-side region 113 of the second header part 53. The in-second header partition plate 119 partitions the inflow-side region 113 into two adjacent regions in the circumferential direction of the second header part 53, in horizontal sectional view. When seen from the other side in the horizontal direction, which is a connecting direction of the connection pipe 61, a left region is set as a first chamber 120 and a right region is set as a second chamber 121, out of the two regions.

[0157] In the third embodiment, the in-second header partition plate 119 is disposed in a radial direction of the internal space of the second header part 53 having a cylindrical shape, in horizontal sectional view. In addition, the in-second header partition plate 119 is disposed such that the in-second header partition plate extends to be orthogonal to the vertical partition plate 111, and accordingly the volume of the first chamber 120 and the volume of the second chamber 121 are the same.

[0158] Herein, a first through-hole 114 that allows the first chamber 120 to communicate with the first outflow-side space 117 of the outflow-side region 112 is formed in a portion of the vertical partition plate 111 facing the first chamber 120. In addition, a second through-hole 115 that allows the second chamber 121 to communicate with the second outflow-side space 118 of the outflow-side region 112 is formed in a portion of the vertical partition

plate 111 facing the second chamber 121.

[0159] The first through-hole 114 and the second through-hole 115 are disposed at locations having vertical positions different from each other. In the third embodiment, the first through-hole 114 is formed at a location close to a lowermost portion of the second header part 53, which is a lower portion of the vertical partition plate 111. In addition, the second through-hole 115 is formed at a location close to an uppermost portion of the second header part 53, which is an upper portion of the vertical partition plate 111. The vertical positions of the first through-hole 114 and the second through-hole 115 are positions different from the vertical position of a connection portion of the connection pipe 61 to the second header part 53.

[0160] Only one of the first through-hole 114 and the second through-hole 115 may have a vertical position different from the connection portion of the connection pipe 61 to the second header part 53.

[0161] The connection portion of the connection pipe body 62 of the connection pipe 61 to the second header part 53 is the same portion as the circumferential position of the vertical partition plate 111 in the second header part 53. Consequently, the connection portion of the connection pipe body 62 to the second header part 53 is disposed so as to straddle the first chamber 120 and the second chamber 121. Thus, a refrigerant introduced from the connection pipe body 62 into the second header part 53 is introduced into both of the first chamber 120 and the second chamber 121.

[0162] In the third embodiment, the connection portion of the connection pipe body 62 to the second header part 53 is at a lower portion of the second header part 53.

[0163] The dividing portion 70 may be formed inside the connection pipe 61 as in the first embodiment. In this case, out of the first flow passage 71 and the second flow passage 72, which are partitioned with the dividing portion 70, the first flow passage 71 is in a communicating state with the first chamber 120, and the second flow passage 72 is in a communicating state with the second chamber 121.

[0164] Also in the heat exchanger 110 of the third embodiment, since the connection pipe body 62 communicates with both of the first chamber 120 and the second chamber 121, refrigerants introduced from the connection pipe 61 into the second header part 53, in particular, refrigerants with almost the same gas-liquid ratio are introduced into the first chamber 120 and the second chamber 121.

[0165] The refrigerant introduced in the first chamber 120 is introduced into the first outflow-side space 117 of the outflow-side region 112 via the first through-hole 114 formed in the lower portion of the second header part 53. At this time, in a case where the flow rate of the refrigerant is low, the refrigerant is introduced into a lower portion of the outflow-side region 112 via the first through-hole 114 without being stored in the first chamber 120. On the other hand, in a case where the flow rate of the refrigerant

is high, the refrigerant is introduced into the first outflow-side space 117 via the first through-hole 114 in turn in a state where the refrigerant is stored in the first chamber 120 to some extent.

[0166] On the other hand, the refrigerant introduced in the second chamber 121 moves upwards in the second chamber 121 in turn as the refrigerant continues to be supplied, and is introduced into the second outflow-side space 118 of the outflow-side region 112 via the second through-hole 115 formed in the upper portion of the second header part 53. That is, while the connection portion of the connection pipe 61 to the second header part 53 is disposed in the lower portion of the second header part 53, the second through-hole 115 that allows the second chamber 121 to communicate with the outflow-side region 112 is disposed in the upper portion of the second header part 53. Therefore, the refrigerant introduced in the second chamber 121 is introduced into an upper portion of the outflow-side region 112 after being moved from the lower side to the upper side in the second chamber 121.

[0167] By making the moving route of a refrigerant longer as described above, a liquid phase content and a gas phase content in the refrigerant are mixed. Each of refrigerants in a gas-liquid two phase state introduced from the first chamber 120 and the second chamber 121 to the first outflow-side space 117 and the second outflow-side space 118 of the outflow-side region 112 is introduced into each of the heat transfer tubes 20 connected to the second header part 53.

[0168] As described above, also in the third embodiment, since the connection pipe body 62 is connected to the first chamber 120 and the second chamber 121 of the second header part 53 so as to straddle the chambers as in the first embodiment and the second embodiment, refrigerants with almost the same gas-liquid ratio can be introduced into the two chambers. Each of the refrigerants is introduced into the second heat transfer tubes 23 via the flow passages of the second header part 53. Thus, the homogenization of gas-liquid ratios of refrigerants introduced into the second heat transfer tubes 23 can be achieved, and a decrease in a heat exchange performance can be avoided.

[0169] The first through-hole 114 and the second through-hole 115 are not limited to the disposition described above. For example, both of the through-holes may be disposed in the lower portion of the vertical partition plate 111. That is, the first through-hole 114 and the second through-hole 115 may be disposed at any locations in the vertical partition plate 111. In addition, a plurality of first through-holes 114 and a plurality of second through-holes 115 may be formed without being limited to forming only one first through-hole and one second through-hole.

[0170] Although the embodiments of the invention are described, the invention is not limited to the embodiments, and can be modified as appropriate without departing from the technical scope of the invention.

[0171] For example, although the first header part 52 and the second header part 53 share the axis O and the axis O extends in the vertical direction in the third embodiment, the axis is not limited thereto. For example, the axis O direction may be the horizontal direction, or may be an inclination direction of inclining with respect to the horizontal direction and the vertical direction.

[0172] In addition, although a case where the first header part 52 and the second header part 53 are formed in the same header 30 is described as an example, the first header part 52 and the second header part 53 may be separately configured. In this case, the posture of the first header part 52 and the posture of the second header part 53 may be different from each other, that is, the first header part 52 may have a cylindrical shape extending along an axis O different from the axis O of the second header part 53.

Industrial Applicability

[0173] The invention can be applied to a heat exchanger and an air conditioner including the heat exchanger.

Reference Signs List

[0174]

1	air conditioner
2	compressor
3	indoor heat exchanger
4	expansion valve
5	outdoor heat exchanger
6	four-way valve
7	pipe
10, 80, 110	heat exchanger
20	heat transfer tube
21	first heat transfer tube
22	first tube group
23	second heat transfer tube
24	second tube group
25	lower second tube group
26	upper second tube group
28	fin
30	header
40	entrance side header
41	partition plate
42	lower entry region
43	upper entry region
50	turnback side header
51	header body
52	first header part
53	second header part
54, 86	lower space
55, 87	upper space
58	main partition plate
60, 81, 119	in-second header partition plate
61, 90	connection pipe
62, 91	connection pipe body

63, 92	first end
64, 93	second end
65, 94	first pipe portion
66, 95	second pipe portion
5 67, 96	connection pipe portion
68, 97	first bent portion
69, 98	second bent portion
70, 100	dividing portion
71, 101	first flow passage
10 72, 103	second flow passage
75	notch
82	vertical partition portion
83	first horizontal partition portion
84	second horizontal partition portion
15 102, 104	small flow passage
105	slit
111	vertical partition plate
112	outflow-side region
113	inflow-side region
20 114	first through-hole
115	second through-hole
116	horizontal partition plate
117	first outflow-side space
118	second outflow-side space
25 120	first chamber
121	second chamber
O	axis

30 Claims

1. A heat exchanger comprising:

- 35 a plurality of first heat transfer tubes that allow a refrigerant to circulate therein and are arranged with a gap left therebetween;
- 40 a first header part that has a cylindrical shape and has an internal space connected to each of the first heat transfer tubes in a communicating state;
- 45 a plurality of second heat transfer tubes that allow the refrigerant to circulate therein and are arranged with a gap left therebetween;
- 50 a second header part that has a cylindrical shape extending along an axis and has an internal space connected to each of the second heat transfer tubes in a communicating state;
- 55 an in-second header partition plate that partitions the internal space of the second header part into two regions; and
- a connection pipe that has a connection pipe body having a first end connected to an outer circumferential surface of the first header part in a communicating state with the internal space of the first header part and a second end on an opposite side to the first end connected to an outer circumferential surface of the second header part in a communicating state with the

- internal space of the second header part,
wherein an opening of the second end is disposed so as to straddle the two regions partitioned with the in-second header partition plate by the opening of the second end being in contact with the in-second header partition plate. 5
2. The heat exchanger according to Claim 1,
wherein the in-second header partition plate has a plate shape extending along a plane orthogonal to the axis of the second header part, 10
one of the two regions is a first space that is partitioned on one side of an axis direction, the axis direction being a direction in which the axis extends, with the in-second header partition plate, and 15
the other one of the two regions is a second space which is partitioned on the other side in the axis direction with the in-second header partition plate.
3. The heat exchanger according to Claim 1, 20
wherein the in-second header partition plate has
a vertical partition portion which has a plate shape extending along a plane including the axis in the second header part and is in contact with the opening of the second end of the connection pipe, 25
a first horizontal partition portion which has a plate shape extending from an edge of the vertical partition portion on one side of an axis direction, the axis direction being a direction in which the axis extends, toward only one side of a direction orthogonal to a plate surface of the vertical partition portion, and 30
a second horizontal partition portion which has a plate shape extending from an edge of the vertical partition portion on the other side of the axis direction toward only the other side of the direction orthogonal to the plate surface of the vertical partition portion, 35
one of the two regions is a first space which is partitioned on one side of the axis direction with the first horizontal partition portion and the second horizontal partition portion, and 40
the other one of the two regions is a second space which is partitioned on the other side of the axis direction with the first horizontal partition portion and the second horizontal partition portion. 45
4. The heat exchanger according to Claim 1, further comprising: 50
a vertical partition plate that partitions a space in the second header part into an outflow-side region connected to each of the second heat transfer tubes and an inflow-side region connected to the second end of the connection pipe, 55
- in sectional view orthogonal to the axis; and
a horizontal partition plate that partitions the outflow-side region into a first outflow-side space and a second outflow-side space, which are arranged in an axis direction, the axis direction being a direction in which the axis extends, wherein the in-second header partition plate has a plate shape extending along a plane including the axis so as to partition the inflow-side region into a first chamber and a second chamber, which are adjacent to each other in a circumferential direction of the second header part in horizontal sectional view,
a first through-hole that allows the first chamber to communicate with the first outflow-side space is formed in a portion of the vertical partition plate facing the first chamber,
a second through-hole that allows the second chamber to communicate with an upper region of the second outflow-side space is formed in a portion of the vertical partition plate facing the second chamber,
one of the two regions is the first chamber, and the other one of the two regions is the second chamber.
5. The heat exchanger according to any one of Claims 1 to 4,
wherein the connection pipe has
a dividing portion which extends to be continuous in the connection pipe body from the in-second header partition plate and divides a portion including at least the second end of the connection pipe body into a first flow passage communicating only with one region, out of the two regions, and a second flow passage communicating only with the other region.
6. The heat exchanger according to Claim 5,
wherein the connection pipe body has
a first pipe portion extending from the first header part to a radially outside of the first header part,
a second pipe portion extending from the second header part to a radially outside of the second header part, and
a connection pipe portion which extends so as to bend with respect to the first pipe portion and the second pipe portion such that the first pipe portion and the second pipe portion are connected to each other, and
- the dividing portion extends to be continuous from the second end to at least to a middle of the first pipe portion via the second pipe portion and the connection pipe portion.
7. The heat exchanger according to Claim 6,

wherein the dividing portion extends from the second end to the first end.

8. The heat exchanger according to Claim 6 or 7,
wherein the first header part has a cylindrical shape
extending along the axis on one side of the second
header part in the axis direction, and
the first pipe portion, the second pipe portion, and
the connection pipe portion of the connection pipe
extend on an imaginary plane including the axis. 5 10
9. The heat exchanger according to any one of Claims
5 to 8,
wherein the first flow passage and the second flow
passage are adjacent to each other in a vertical di-
rection on a first end side of the connection pipe
body. 15
10. The heat exchanger according to any one of Claims
5 to 8, 20
wherein the first flow passage and the second flow
passage are adjacent to each other in a horizontal
direction on a first end side of the connection pipe
body. 25
11. The heat exchanger according to any one of Claims
5 to 10,
each of the first flow passage and the second flow
passage has a plurality of small flow passages ar-
ranged in a direction where the first flow passage
and the second flow passage are adjacent to each
other, and 30
the connection pipe has a flat tubular shape of which
a longitudinal direction is an arranging direction of
the small flow passages. 35
12. The heat exchanger according to any one of Claims
5 to 11,
wherein flow passage sectional areas of the first flow
passage and the second flow passage are different 40
from each other.
13. The heat exchanger according to any one of Claims
5 to 12,
wherein a notch dented from a radially outside to a
radially inside of the second header part is formed
in the in-second header partition plate, and
the second end of the connection pipe body is fitted
into the notch. 45 50
14. The heat exchanger according to any one of Claims
5 to 12,
wherein a slit extending from the second end along
the dividing portion is formed in the connection pipe,
and the slit and the in-second header partition plate 55
are fitted to each other.
15. The heat exchanger according to any one of Claims

1 to 14,

wherein the first header part is a portion of a header,
which has a header body having a cylindrical shape
of which a center is the axis and a main partition
plate partitioning an inside of the header body in an
axis direction, the axis direction being a direction in
which the axis extends, on one side of the main par-
tition plate in the axis direction,
the second header part is a portion of the header on
the other side of the main partition plate in the axis
direction, and
the axis direction is a vertical direction.

16. An air conditioner comprising the heat exchanger
according to any one of Claims 1 to 15.

FIG. 1

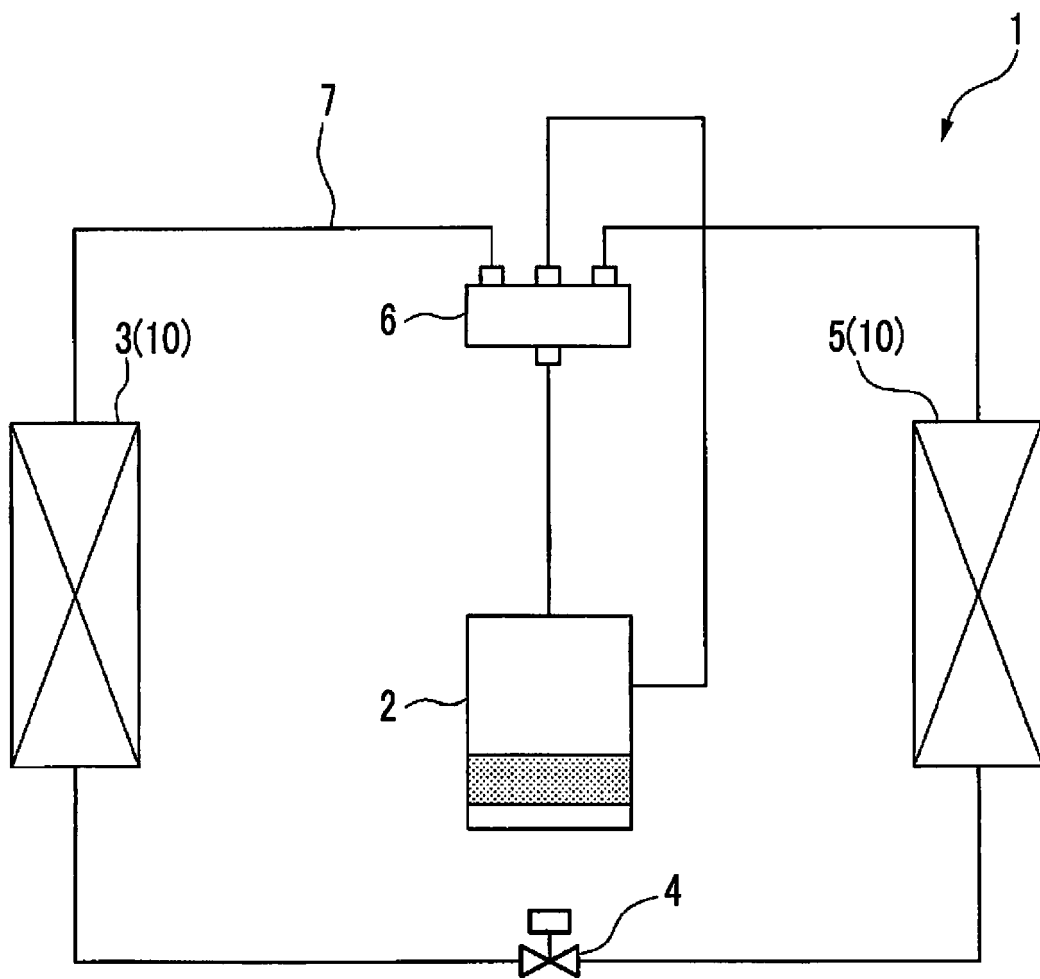


FIG. 2

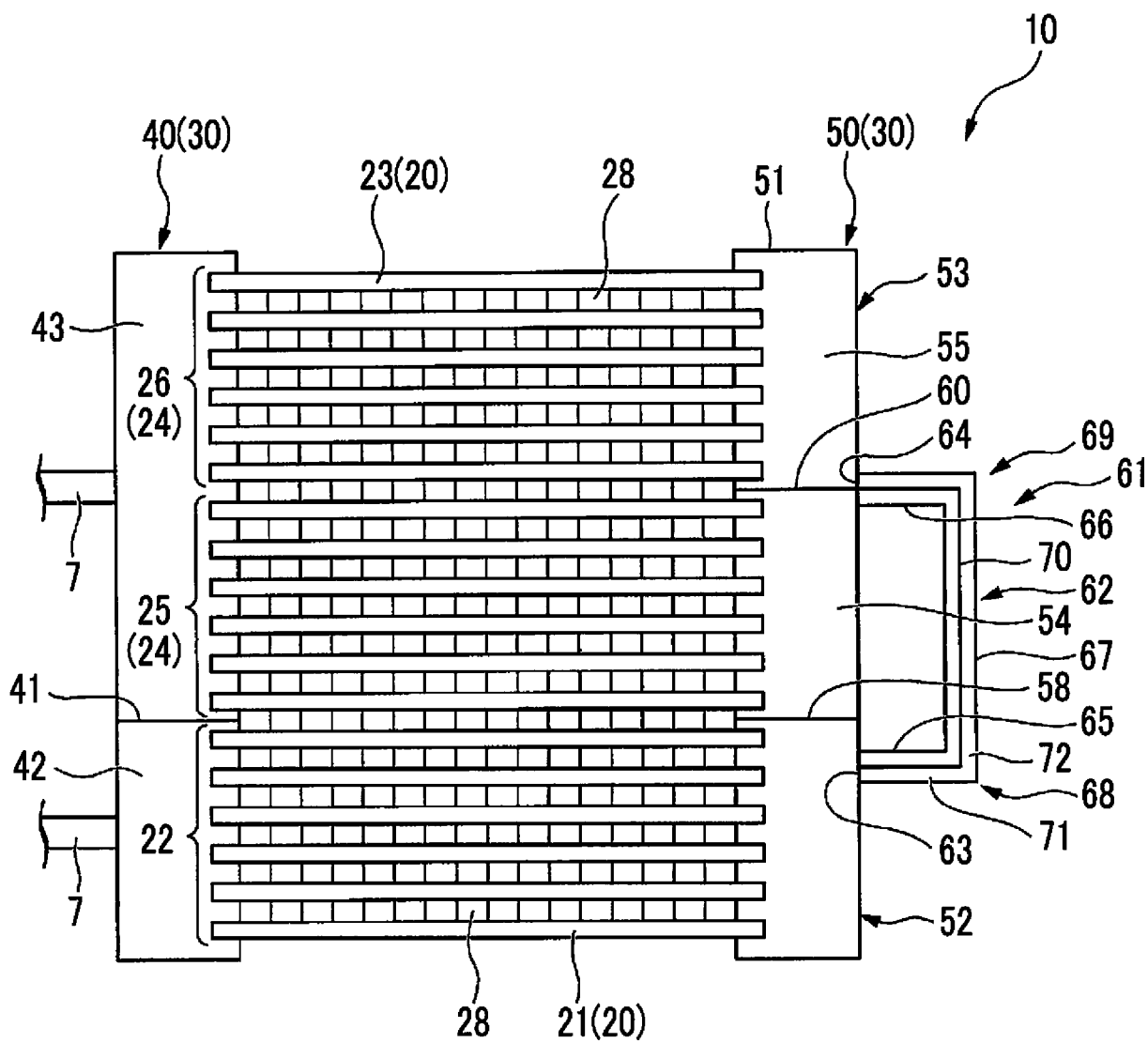


FIG. 3

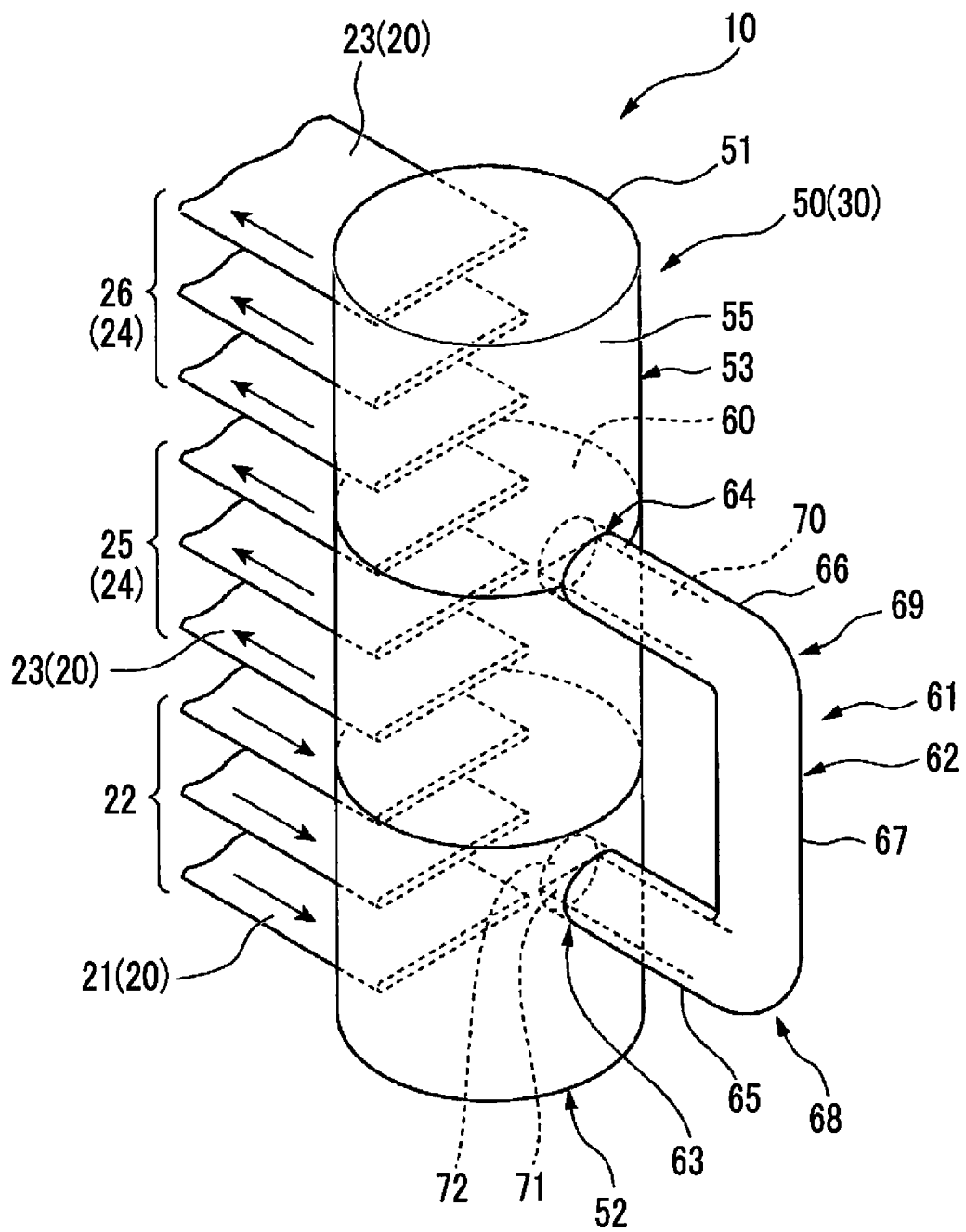


FIG. 4A

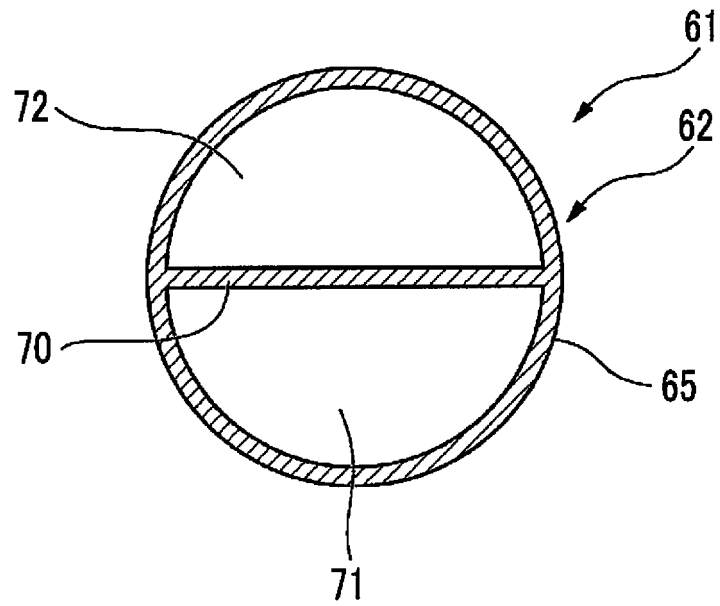


FIG. 4B

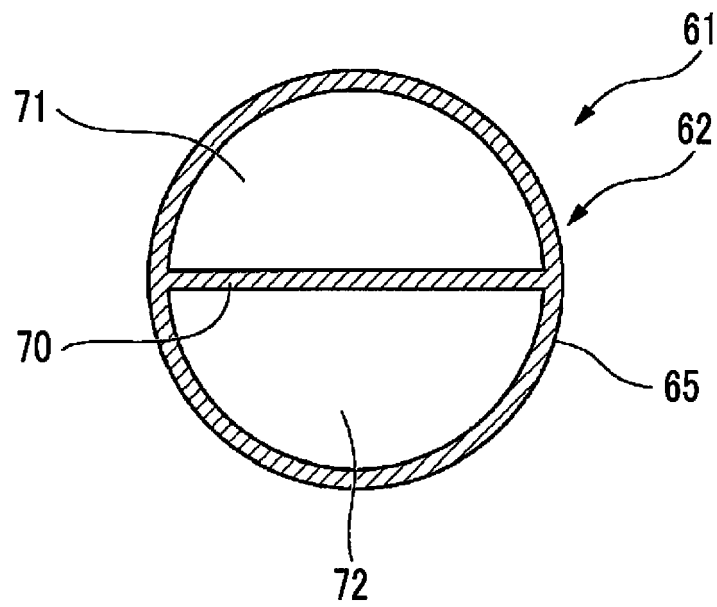


FIG. 5

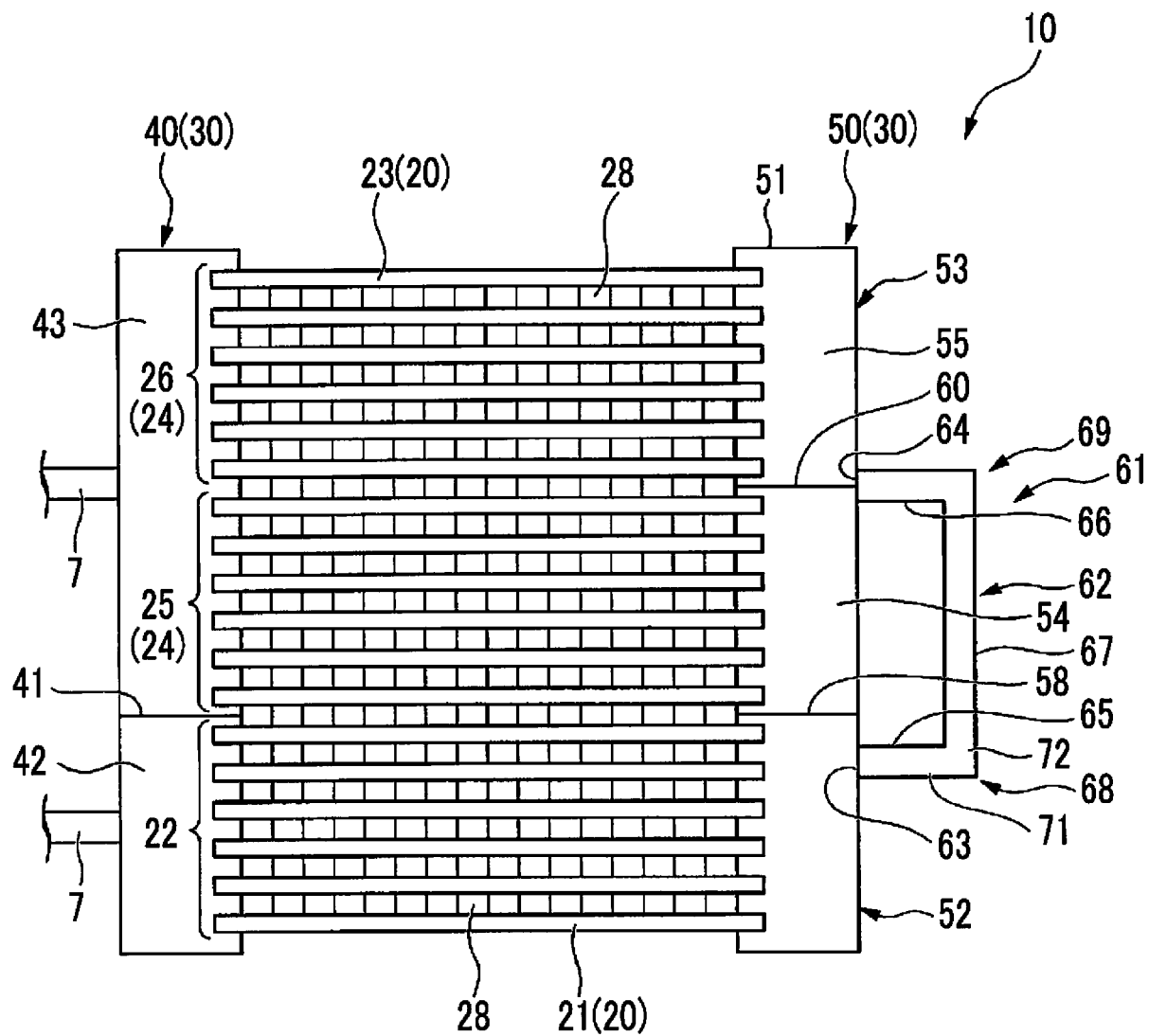


FIG. 6

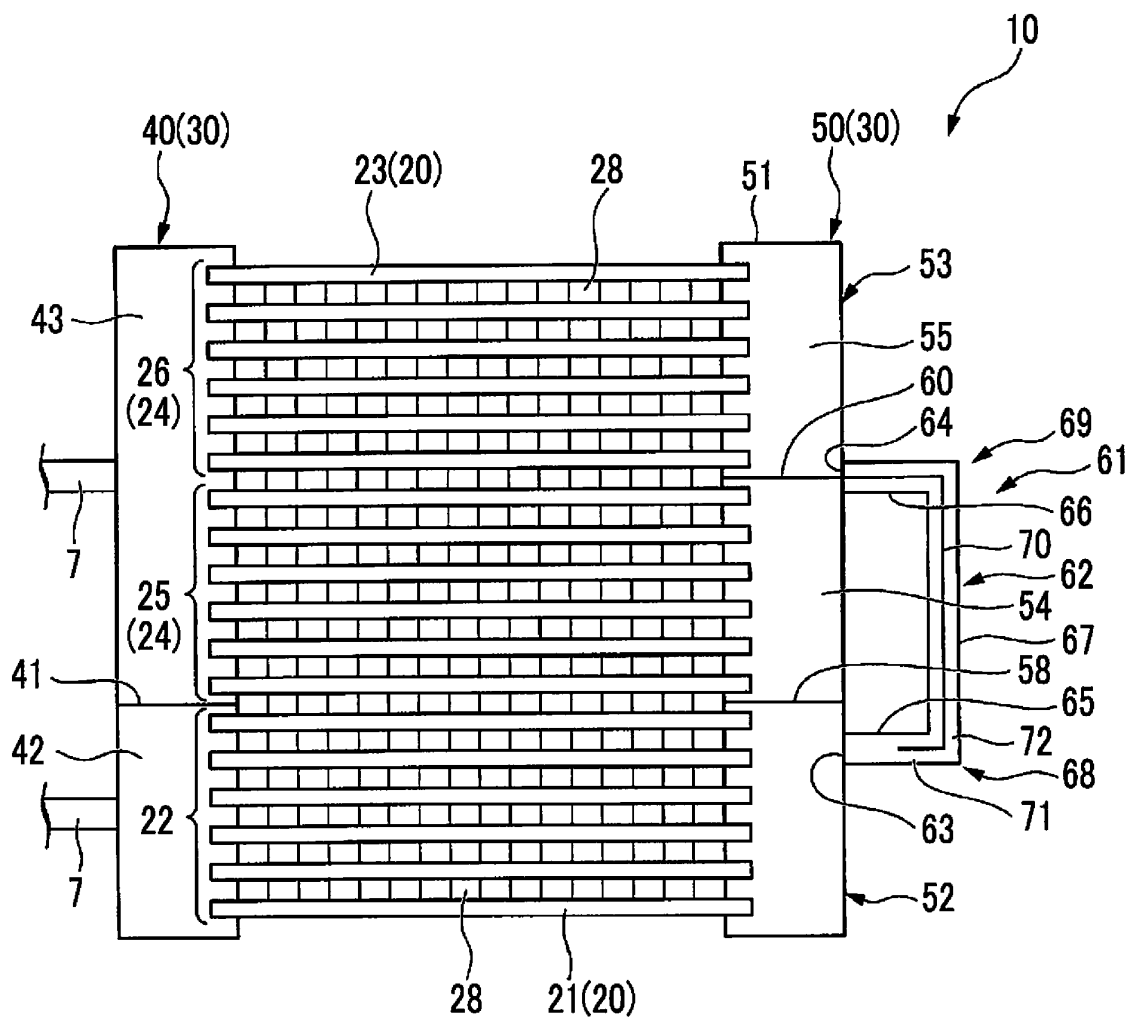


FIG. 7

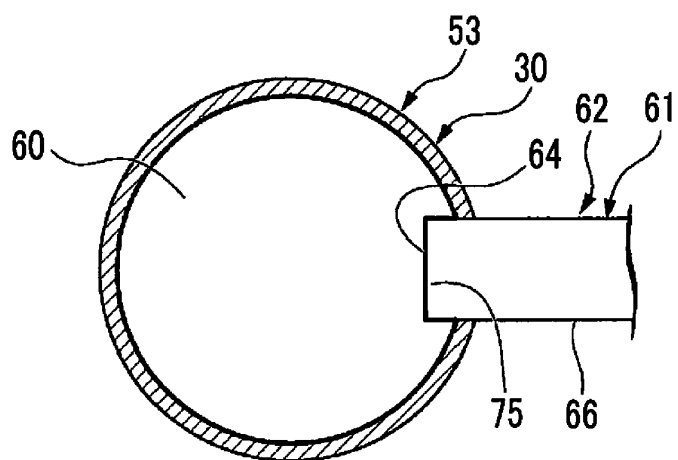


FIG. 8A

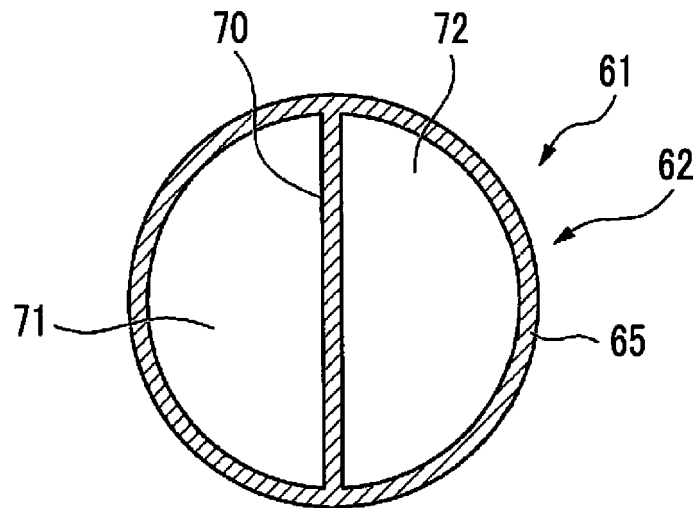


FIG. 8B

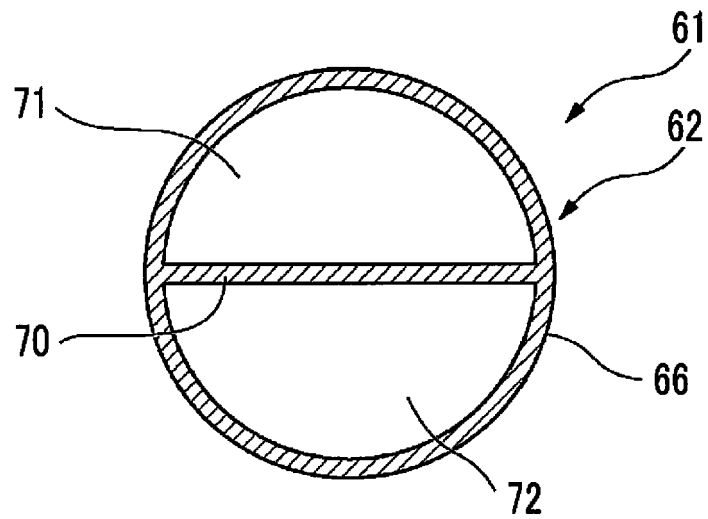


FIG. 9

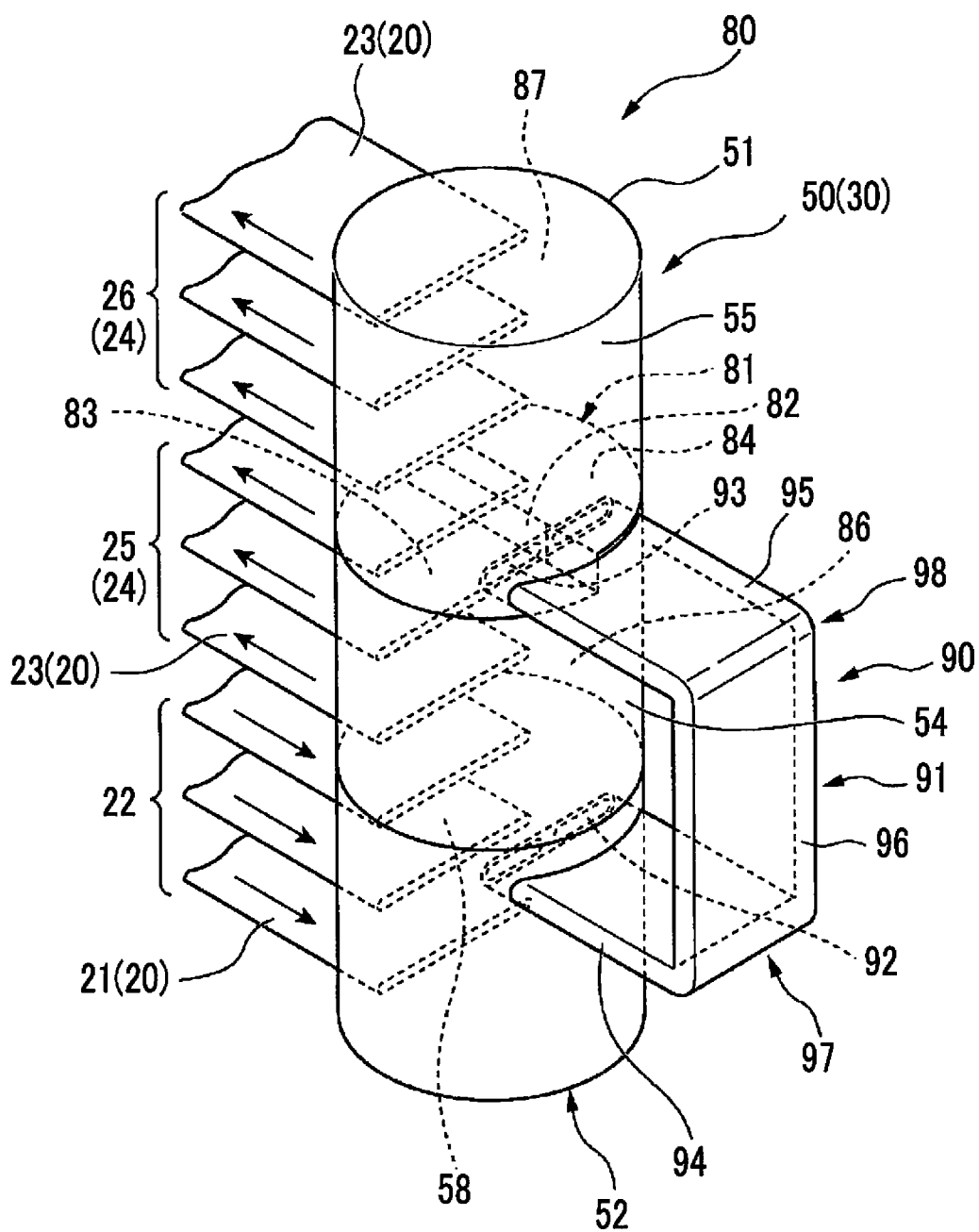


FIG. 10

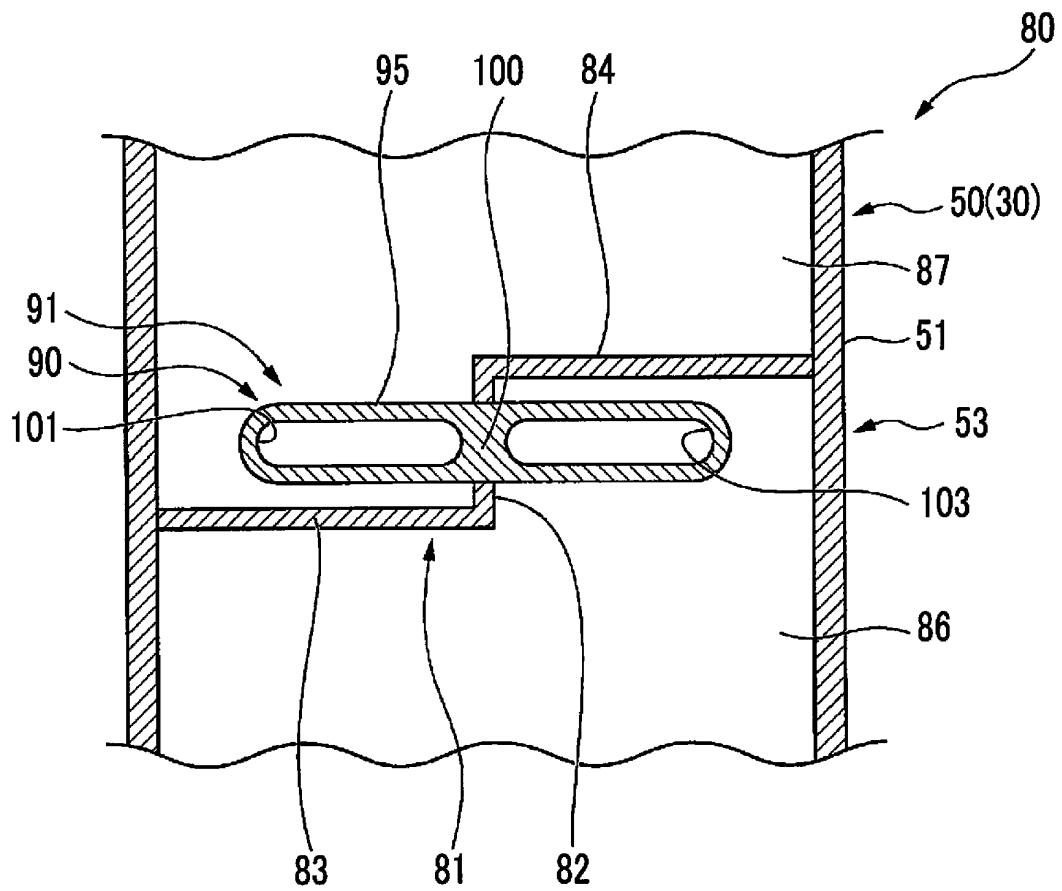


FIG. 11

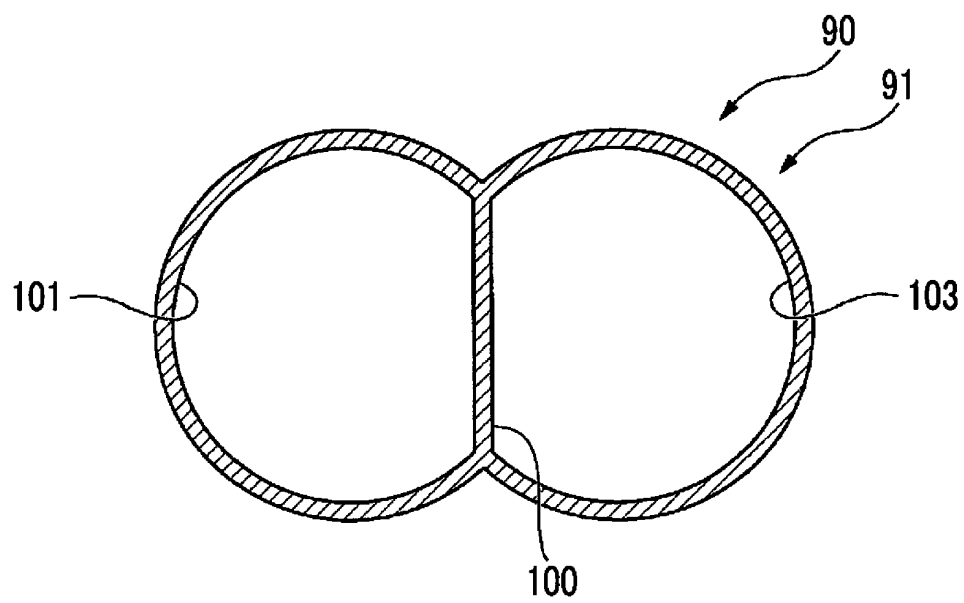


FIG. 12

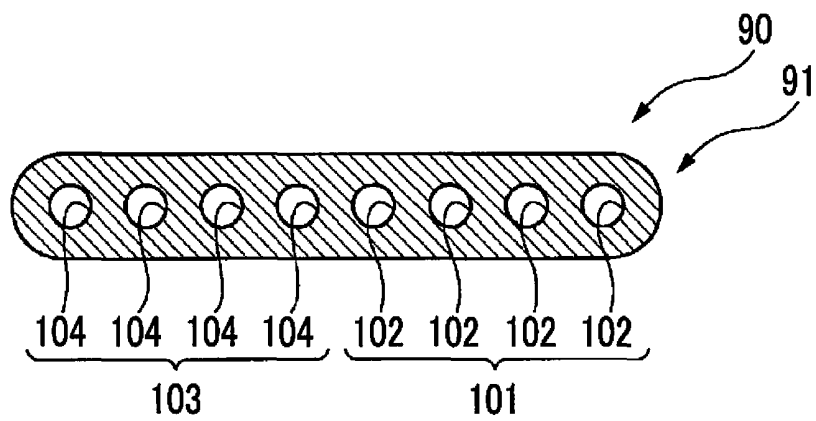


FIG. 13

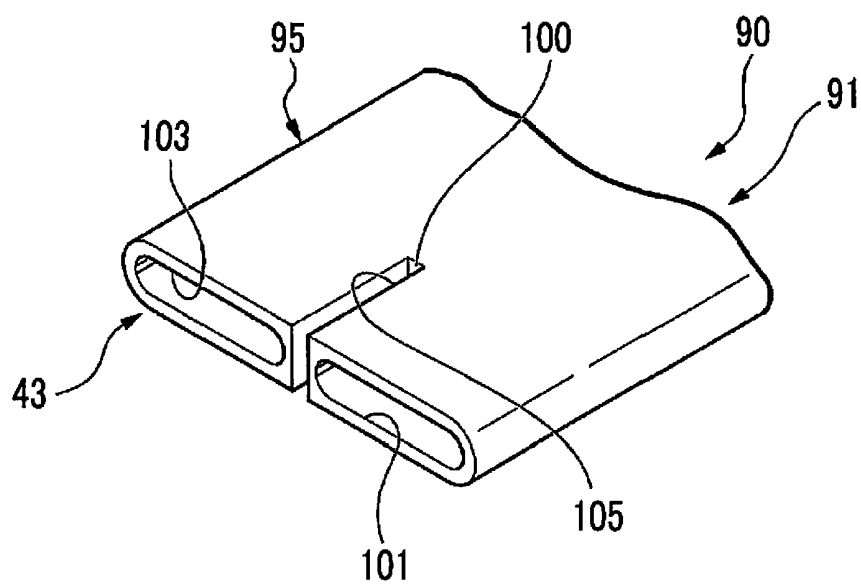


FIG. 14

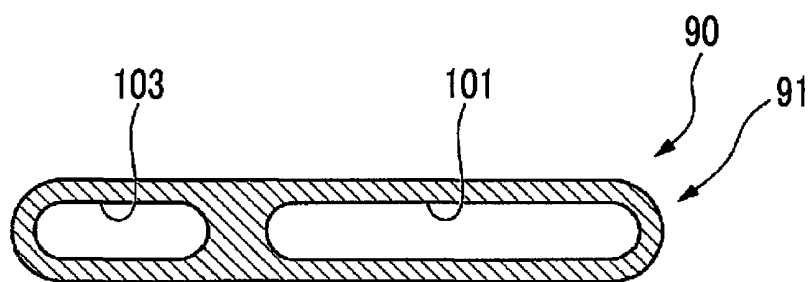


FIG. 15

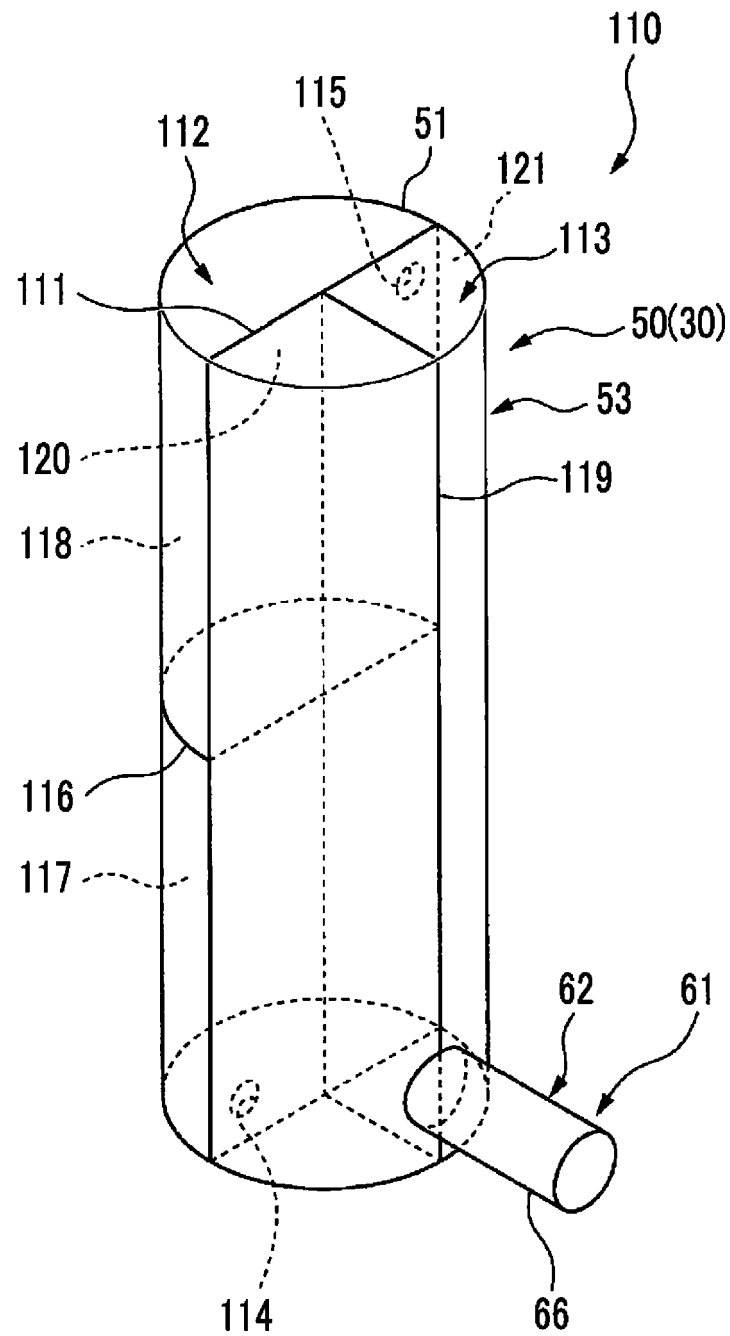
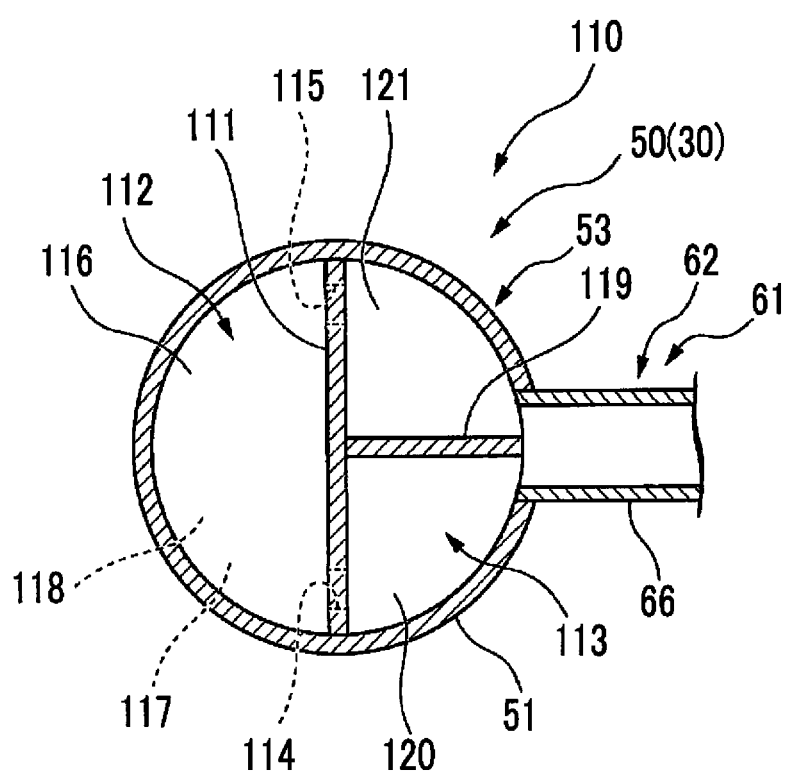


FIG. 16



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/004744

A. CLASSIFICATION OF SUBJECT MATTER

F28F9/02(2006.01)i, F25B39/02(2006.01)i, F28F9/22(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F28F9/02, F25B39/02, F28F9/22

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017

Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2013-130386 A (Daikin Industries, Ltd.), 04 July 2013 (04.07.2013), paragraphs [0057], [0079] to [0082], [0166] to [0167]; fig. 16 to 17 (Family: none)	1-16
A	JP 2007-333311 A (Calsonic Kansei Corp.), 27 December 2007 (27.12.2007), paragraphs [0022] to [0024]; fig. 2 (Family: none)	1-16

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

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search
23 February 2017 (23.02.17)Date of mailing of the international search report
09 May 2017 (09.05.17)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/004744

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 102108/1987 (Laid-open No. 8086/1989) (Diesel Kiki Co., Ltd.), 17 January 1989 (17.01.1989), page 3, lines 9 to 15; fig. 2 (Family: none)	1-16
A	JP 2009-97838 A (T. RAD Co., Ltd.), 07 May 2009 (07.05.2009), paragraphs [0013] to [0016]; fig. 1, 7 (Family: none)	1-16
A	JP 2015-55414 A (Daikin Industries, Ltd.), 23 March 2015 (23.03.2015), paragraphs [0081] to [0082]; fig. 9 to 10 (Family: none)	1-16

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2016038327 A [0002]
- JP 2015055404 A [0008]