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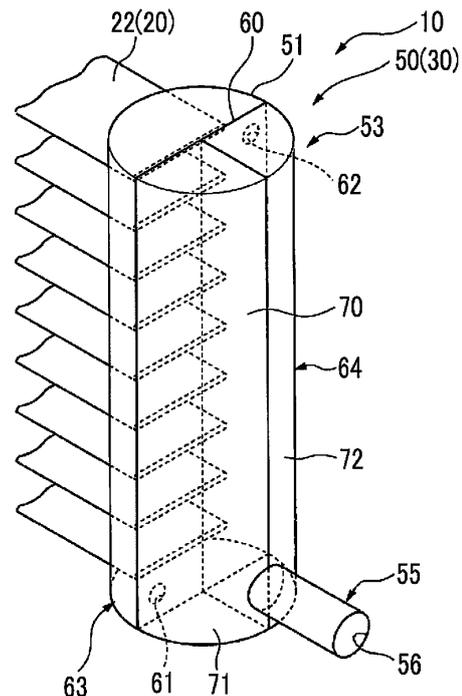
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(54) **HEAT EXCHANGER AND AIR CONDITIONER**

(57) This heat exchanger (10) includes: heat-transfer pipes (20); a header part to which one end of the heat-transfer pipes (20) is connected so as to be in communication with an internal space; a flow passage (56) that is connected to the inside of the header part so as to be in communication therewith and that has a refrigerant flowing therethrough; a main vertical partition plate (60) that divides a horizontal cross-section of the inside of the header part into an outflow-side region (63) that is connected to the heat-transfer pipes (20) and an inflow-side region (64) that is connected to the flow passage (56); and an inflow-side vertical partition plate (70) that divides a horizontal cross-section of the inflow-side region (64) into a first chamber (71) and a second chamber (72) that are adjacent to each other in the circumferential direction of the header part and that are in communication with the flow passage (56). A section of the main vertical partition plate (60) facing the first chamber (71) has formed therein a first horizontal through hole (61) that allows the first chamber (71) to communicate with the outflow-side region (63). A section of the main vertical partition plate (60) facing the second chamber (72) and at a different vertical-direction position from the first horizontal through hole (61) has formed therein a second horizontal through hole (62) that allows the second chamber (72) to communicate with the outflow-side region (63).

FIG. 3



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Description

Technical Field

[0001] The present invention relates to a heat exchanger and an air conditioner. This application claims priority based on Japanese Patent Application No. 2016-038354 filed on February 29, 2016; the contents of which are incorporated herein by reference.

Background Art

[0002] A heat exchanger, in which a plurality of heat-transfer pipes extending in a horizontal direction are disposed at intervals in a vertical direction and a fin is provided on an outer surface of each heat-transfer pipe, is known as a heat exchanger of an air conditioner. Both ends of the plurality of heat-transfer pipes are connected to a pair of headers extending in the vertical direction, respectively. Such a heat exchanger is configured such that a refrigerant, which is introduced into one header and has flown to the other header via the heat-transfer pipes, turns back at the other header to return to one header again via the heat-transfer pipes, in order to secure a flow path length for the refrigerant.

[0003] 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 (first region) of the header via the heat-transfer pipes returns to one header on an entrance side via the plurality of heat-transfer pipes connected to the other region (second region) of the header via a connection pipe.

[0004] For example, it is described in PTL 1 that a partition plate extending in vertical direction is provided in the header, and a refrigerant speed in the header is increased by making a flow path sectional area in the header smaller.

Citation List

Patent Literature

[0005] [PTL 1] Japanese Unexamined Patent Application Publication No. 2015-55405

Summary of Invention

Technical Problem

[0006] In a case where the heat exchanger is used as an evaporator, not the entire refrigerant, which is introduced into one region (first region) of the header via the heat-transfer pipes, 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. In a case where such a gas-liquid two phase re-

frigerant is introduced in a lower portion of the other region (second region) of the header via the connection pipe, a liquid phase refrigerant with a high density is unlikely to reach upper heat-transfer pipes. For this reason, a refrigerant flowing in the upper heat-transfer pipes is a liquid phase refrigerant having a lower flow rate. As a consequence, the heat exchanger does not show a desired performance in some cases.

[0007] In the technique of PTL 1, in particular, in a case where a refrigerant has a low flow rate, it is difficult to supply a liquid phase refrigerant to the upper heat-transfer pipes, thereby causing a performance decrease of the heat exchanger.

[0008] An object of the invention is to provide a heat exchanger which can suppress a performance decrease and an air conditioner in which the heat exchanger is used. Solution to Problem

[0009] According to a first aspect of the invention, there is provided a heat exchanger including a plurality of heat-transfer pipes that extend in a horizontal direction to allow a refrigerant to flow therein and are arranged at intervals in a vertical direction, a header part that has a tubular shape extending in the vertical direction and has an internal space connected to one end of each of the plurality of heat-transfer pipes in a communicating state, a flow passage that is connected to an inside of the header part in a communicating state and allows the refrigerant to flow therein, a main vertical partition plate that partitions the inside of the header part into an outflow-side region connected to each of the heat-transfer pipes and an inflow-side region connected to the flow passage, in horizontal sectional view, and an inflow-side vertical partition plate that partitions the inflow-side region into a first chamber and a second chamber, which are adjacent to each other in a circumferential direction of the header part and each of which communicates with the flow passage, in horizontal sectional view. A first horizontal through-hole that allows the first chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the first chamber. A second horizontal through-hole that allows the second chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the second chamber, the portion having a vertical position different from that of the first horizontal through-hole.

[0010] In such a heat exchanger, a refrigerant is introduced into each of the first chamber and the second chamber in the header part via the flow passage. The refrigerant introduced in the first chamber reaches the outflow-side region in the header part via the first horizontal through-hole. The refrigerant introduced in the second chamber reaches the outflow-side region in the header part via the second horizontal through-hole. That is, refrigerants supplied to the first chamber and the second chamber are forcibly guided by the first horizontal through-hole and the second horizontal through-hole respectively, and are supplied to the outflow-side region.

At this time, a moving route for a refrigerant can be made longer by the refrigerant moving in the first chamber or the second chamber in the vertical direction toward the first horizontal through-hole or the second horizontal through-hole. Accordingly, the mixing of a refrigerant in a gas-liquid two phase state in the first chamber and the second chamber can be caused.

[0011] Since the first horizontal through-hole and the second horizontal through-hole are formed at different vertical positions, refrigerants are supplied from vertical positions different from each other to the outflow-side region. Consequently, a refrigerant can be supplied to a vertically wider area in the outflow-side region. In addition, the homogenization of a gas-liquid ratio of the refrigerant can be achieved in the outflow-side region as a whole by mixing the refrigerant supplied from each of the first horizontal through-hole and the second horizontal through-hole. For this reason, a liquid phase refrigerant can be effectively introduced also into the heat-transfer pipes which are disposed relatively higher.

[0012] In the heat exchanger according to a second aspect of the invention, a plurality of the first horizontal through-holes may be formed at vertical positions different from each other, and a plurality of the second horizontal through-holes may be formed at vertical positions different from each other.

[0013] Accordingly, a refrigerant can be supplied from a plurality of points having vertical positions different from each other of the first chamber to the outflow-side region. A refrigerant can be supplied from a plurality of points having vertical positions different from each other of the second chamber to the outflow-side region. For this reason, the homogenization of a gas-liquid ratio of a refrigerant in the outflow-side region as a whole can be further achieved.

[0014] In the heat exchanger according to a third aspect of the invention, a plurality of the first horizontal through-holes may be formed at horizontal positions different from each other, and a plurality of the second horizontal through-holes may be formed at horizontal positions different from each other.

[0015] Accordingly, a refrigerant can be supplied from a plurality of points having horizontal positions different from each other of the first chamber to the outflow-side region. A refrigerant can be supplied from a plurality of points having vertical positions different from each other of the second chamber to the outflow-side region. For this reason, the homogenization of a gas-liquid ratio of a refrigerant in the outflow-side region as a whole can be further achieved. In addition, the flow rate or pressure loss of an individual flow path in the header part can be adjusted by forming the first horizontal through-hole and the second horizontal through-hole at the same vertical position in the horizontal direction.

[0016] In the heat exchanger according to a fourth aspect of the invention, a first chamber vertical partition plate that partitions the first chamber into a first chamber upstream region connected to the flow passage and a

first chamber downstream region facing the main vertical partition plate, in horizontal sectional view and a second chamber vertical partition plate that partitions the second chamber into a second chamber upstream region connected to the flow passage and a second chamber downstream region facing the main vertical partition plate, in horizontal sectional view may be further included. A third horizontal through-hole that allows the first chamber upstream region to communicate with the first chamber downstream region may be formed in a portion of the first chamber vertical partition plate, which has a vertical position different from that of the first horizontal through-hole. A fourth horizontal through-hole that allows the second chamber upstream region to communicate with the second chamber downstream region may be formed in a portion of the second chamber vertical partition plate, which has a vertical position different from that of the second horizontal through-hole.

[0017] Consequently, a refrigerant supplied to the first chamber proceeds while moving in the first chamber upstream region and the first chamber downstream region in the vertical direction before reaching the outflow-side region. On the other hand, a refrigerant supplied to the second chamber proceeds while moving in the second chamber upstream region and the second chamber downstream region in the vertical direction before reaching the outflow-side region. Consequently, a moving route to the outflow-side region for a refrigerant introduced in the first chamber and the second chamber can be made longer. For this reason, the homogenization of a gas-liquid two phase type refrigerant on the moving route can be further achieved.

[0018] In the heat exchanger according to a fifth aspect of the invention, a first chamber horizontal partition plate that partitions the first chamber into a first chamber lower region connected to the flow passage and a first chamber upper region disposed above the first chamber lower region and a second chamber horizontal partition plate that partitions the second chamber into a second chamber lower region connected to the flow passage and a second chamber upper region disposed above the second chamber lower region may be further included. A vertical through-hole that allows the upper and lower regions to communicate with each other may be formed in at least one of the first chamber horizontal partition plate and the second chamber horizontal partition plate.

[0019] Accordingly, out of refrigerants introduced from the flow passage to the first chamber lower region or the second chamber lower region, a refrigerant that proceeds upwards collides with the first chamber horizontal partition plate or the second chamber horizontal partition plate. Therefore, the homogenization of a gas-liquid two phase type refrigerant can be achieved. In addition, since the speed of a refrigerant, which passes through the first chamber upper region and the second chamber upper region, out of the first chamber and the second chamber, to be introduced into the outflow-side region, increases when heading upwards via the vertical through-hole, the

refrigerant is likely to spread further upwards. Accordingly, a liquid phase content of a refrigerant can be effectively supplied also into the heat-transfer pipes which are disposed higher.

[0020] In the heat exchanger according to a sixth aspect of the invention, a connection portion of the flow passage to the header part may straddle the first chamber and the second chamber by making the circumferential position of the connection portion of the flow passage to the header part be the same point as the inflow-side vertical partition plate.

[0021] In the heat exchanger according to a seventh aspect of the invention, the flow passage may have a first flow passage connected to the first chamber in the header part in a communicating state and a second flow passage connected to the second chamber in the header part in a communicating state.

[0022] Accordingly, a refrigerant can be forcibly supplied to each of the first chamber and the second chamber.

[0023] According to an eighth aspect of the invention, there is provided an air conditioner including the heat exchanger of any one of the aspects.

[0024] Accordingly, the homogenization of a refrigerant supplied from the inside of the header part to the heat-transfer pipes can be achieved, and thus a decrease in a cooling and heating performance can be avoided.

Advantageous Effects of Invention

[0025] In the heat exchanger and the air conditioner of the present invention, a performance decrease caused by the non-homogenization of a refrigerant flowing in the plurality of heat-transfer pipes can be suppressed.

Brief Description of Drawings

[0026]

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. 4 is a horizontal sectional view of a second header part of the heat exchanger according to the first embodiment of the invention.

Fig. 5 is a perspective view of a heat exchanger according to a second embodiment of the invention.

Fig. 6 is a horizontal sectional view of a second header part of the heat exchanger according to the second embodiment of the invention.

Fig. 7 is a perspective view of a heat exchanger according to a third embodiment of the invention.

Fig. 8 is a horizontal sectional view of a second head-

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

Fig. 9 is a horizontal sectional view of a second header part of a heat exchanger according to a modification example of the third embodiment of the invention.

Fig. 10 is a perspective view of a heat exchanger according to a fourth embodiment of the invention.

Fig. 11 is a horizontal sectional view of a second header part of the heat exchanger according to the fourth embodiment of the invention.

Fig. 12 is a horizontal sectional view of a second header part of a heat exchanger according to a fifth embodiment of the invention.

Description of Embodiments

[0027] 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 4.

[0028] 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.

[0029] The compressor 2 compresses a refrigerant and supplies the compressed refrigerant to the refrigerant circuit.

[0030] 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. The outdoor heat exchanger 5 performs heat exchange between the refrigerant and outdoor air.

[0031] The expansion valve 4 reduces a pressure by expanding the high-pressure refrigerant liquefied by the condenser exchanging heat.

[0032] The outdoor heat exchanger 5 is used as a condenser to radiate heat to the outside during cooling operation and is used as an evaporator to absorb heat from the outside during heating operation.

[0033] The four-way valve 6 switches between directions where a refrigerant flows 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.

[0034] 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 4.

[0035] As illustrated in Figs. 2 to 4, the heat exchanger 10 includes a plurality of heat-transfer pipes 20, a plurality of fins 23, a pair of headers 30, a connection pipe 55, a main vertical partition plate 60, and an inflow-side vertical partition plate 70.

[0036] The heat-transfer pipes 20 are tubular members linearly extending in a horizontal direction, and flow paths through which a refrigerant flows are formed therein. The plurality of heat-transfer pipes 20 are arranged at intervals in a vertical direction, and are disposed so as to be parallel to each other.

[0037] In the embodiment, the heat-transfer pipes 20 each have a flat tubular shape, and the plurality of flow paths arranged in the horizontal direction orthogonal to an extending direction of the heat-transfer pipes 20 are formed inside the heat-transfer pipes 20. The plurality of flow paths are arranged so as to be parallel to each other. Consequently, a sectional shape orthogonal to the extending direction of the heat-transfer pipes 20 is a flat shape of which a longitudinal direction is the horizontal direction orthogonal to the extending direction of the heat-transfer pipes 20.

[0038] The fins 23 each are disposed between the heat-transfer pipes 20 arranged as described above. In the embodiment, the fins 23 extend in a so-called corrugated shape so as to be alternately in contact with the vertically adjacent heat-transfer pipes 20 as facing the extending direction of each of the heat-transfer pipes 20. Without being limited thereto, the shapes of the fins 23 may be any shape insofar as the fins are provided so as to protrude from outer peripheral surfaces of the heat-transfer pipes 20.

[0039] At both ends of the plurality of heat-transfer pipes 20, the pair of headers 30 is provided such that the heat-transfer pipes 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.

[0040] 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 are closed and the inside of the entrance side header is partitioned into two upper and lower regions with a partition plate. The lower region partitioned with an entrance side partition plate 41 is set as a lower entry region 42 and 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.

[0041] Herein, out of the plurality of heat-transfer pipes 20, the heat-transfer pipes 20 connected to the lower entry region 42 in a communicating state are set as first heat-transfer pipes 21, and the heat-transfer pipes 20 connected to the upper entry region 43 in a communicat-

ing state are set as second heat-transfer pipes 22 (heat-transfer pipes 20).

[0042] The turnback side header 50 includes a header body 51 and a turnback side partition plate 54.

5 **[0043]** The header body 51 is a cylindrical member extending in the vertical direction, and an upper end and a lower end of the header body are closed. The turnback side partition plate 54 is provided in the header body 51, and partitions a space in the header body 51 into two upper and lower regions. A portion of the header body 51 below the turnback side partition plate 54 is set as a first header part 52, and a portion of the header body 51 above the turnback side partition plate 54 is set as a second header part 53 (header part). That is, in the embodi-
10 ment, 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 turnback side partition plate 54.

20 **[0044]** In other words, the turnback side header 50 is configured with the first header part 52 and the second header part 53.

[0045] The first heat-transfer pipes 21 each are connected to one side (first side) of the first header part 52
25 in the horizontal direction so as to be in a communicating state with the inside of the first header part 52. The second heat-transfer pipes 22 each are connected one side (first side) of the second header part 53 in the horizontal direction so as to be in a communicating state with the
30 second header part 53. In other words, the heat-transfer pipes 20 connected to the first header part 52 are set as the first heat-transfer pipes 21, and the heat-transfer pipes 20 connected to the second header part 53 are set as the second heat-transfer pipes 22.

35 **[0046]** The connection pipe 55 is a tubular member in which a flow path is formed. One end (first end) of the connection pipe 55 is connected to the first header part 52 in a communicating state with the inside of the first header part 52. The other end (second end) of the con-
40 nection pipe 55 is connected to the second header part 53 in a communicating state with the inside of the second header part 53. More specifically, one end (first end) of the connection pipe 55 is connected to a middle portion of the first header part 52 in the vertical direction. On the other hand, the other end (second end) of the connection pipe 55 is connected to a lower portion of the second header part 53. The connection pipe 55 is connected to the other side (second side) of each of the first header part 52 and the second header part 53 in the horizontal
45 direction, which is the opposite side to one side (first side) connected to the first heat-transfer pipes 21 and the second heat-transfer pipes 22 in the horizontal direction.

[0047] The flow path formed inside the connection pipe 55 is a flow passage 56 that allows a refrigerant to flow
50 between the inside of the first header part 52 and the inside of the second header part 53.

[0048] As illustrated in Figs. 2 and 3, the main vertical partition plate 60 is a plate-shaped member extending in

the vertical direction, and is provided in the second header part 53. The main vertical partition plate 60 partitions a space in the second header part 53 into two regions including a region connected to each of the second heat-transfer pipes 22 and a region connected to the connection pipe 55, in horizontal sectional view. The region which is partitioned with the main vertical partition plate 60 and is connected to the second heat-transfer pipes 22 is set as an outflow-side region 63. The region which is partitioned with the main vertical partition plate 60 and is connected to the connection pipe 55 is set as an inflow-side region 64.

[0049] In the embodiment, the headers 30 have a cylindrical shape extending in the vertical direction, and accordingly an internal space thereof also has a cylindrical shape. The main vertical partition plate 60 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 64 and the outflow-side region 63 has a semicircular shape, in horizontal sectional view.

[0050] The inflow-side vertical partition plate 70 is a plate-shaped member extending in the vertical direction, and is provided in the inflow-side region 64 of the second header part 53. The inflow-side vertical partition plate 70 partitions the inflow-side region 64 into two adjacent regions in a circumferential direction of the second header part 53, in horizontal sectional view. When seen from the other side (second side) in the horizontal direction, which is a direction in which the connection pipe 55 is connected, a left region is set as a first chamber 71 and a right region is set as a second chamber 72, out of the two regions.

[0051] In the embodiment, the inflow-side vertical partition plate 70 is disposed in a radial direction in horizontal sectional view of the internal space of the second header part 53 having a cylindrical shape. In addition, the inflow-side vertical partition plate 70 is disposed such that the inflow-side vertical partition plate extends to be orthogonal to the main vertical partition plate 60, and accordingly the volume of the first chamber 71 and the volume of the second chamber 72 are the same.

[0052] Herein, a first horizontal through-hole 61 that allows the first chamber 71 to communicate with the outflow-side region 63 is formed in a portion of the main vertical partition plate 60 facing the first chamber 71. In addition, a second horizontal through-hole 62 that allows the second chamber 72 to communicate with the outflow-side region 63 is formed in a portion of the main vertical partition plate 60 facing the second chamber 72.

[0053] The first horizontal through-hole 61 and the second horizontal through-hole 62 are disposed at points having vertical positions different from each other. In the embodiment, the first horizontal through-hole 61 is formed at a point close to a lowermost portion of the second header part 53, which is a lower portion of the main vertical partition plate 60. In addition, the second horizontal through-hole 62 is formed at a point close to an

uppermost portion of the second header part 53, which is an upper portion of the main vertical partition plate 60. The vertical positions of the first horizontal through-hole 61 and the second horizontal through-hole 62 are positions different from the vertical position of a connection portion of the connection pipe 55 to the second header part 53. Only one of the first horizontal through-hole 61 and the second horizontal through-hole 62 may have a vertical position different from the connection portion of the connection pipe 55 to the second header part 53.

[0054] The connection portion of the connection pipe 55 to the second header part 53 is the same point as the circumferential position of the inflow-side vertical partition plate 70 on the second header part 53. Consequently, the connection portion of the connection pipe 55 to the second header part 53 is disposed so as to straddle the first chamber 71 and the second chamber 72. Thus, a refrigerant introduced from the connection pipe 55 into the second header part 53 is introduced into both of the first chamber 71 and the second chamber 72.

[0055] 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 is used as an evaporator during cooling operation of the air conditioner 1, and 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.

[0056] When 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 pipes 21 in the lower entry region 42, and exchanges heat with the external atmosphere of the first heat-transfer pipes 21 in the process of flowing in the first heat-transfer pipes 21, thereby causing evaporation. Consequently, the refrigerant supplied from the first heat-transfer pipes 21 into the first header part 52 of the turnback side header 50 becomes a gas-liquid two phase refrigerant, in which the proportion of a liquid phase has dropped, by some of the refrigerant changing from the liquid phase to a gas phase.

[0057] The refrigerant in a gas-liquid two phase state supplied into the first header part 52 is introduced into the connection pipe 55 connected to the first header part 52, and is introduced into the second header part 53 via the connection pipe 55. At this time, as illustrated in Fig. 4, the refrigerant is introduced into each of the first chamber 71 and the second chamber 72 since the connection portion of the connection pipe 55 to the second header part 53 straddles the first chamber 71 and the second chamber 72.

[0058] The refrigerant introduced in the first chamber 71 is introduced into a lower portion of the outflow-side region 63 via the first horizontal through-hole 61 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 the lower portion of the outflow-side region 63 via the first horizontal through-hole 61 without being stored in the first chamber 71. On the other hand, in a case where the flow rate of the refrigerant is high, the refrigerant is introduced into the lower portion of the outflow-side region 63 via the first horizontal through-hole 61 in turn in a state where the refrigerant is stored in the first chamber 71 to some extent.

[0059] On the other hand, the refrigerant introduced in the second chamber 72 moves upwards in turn in the second chamber 72 as the refrigerant continues to be supplied, and is introduced into an upper portion of the outflow-side region 63 via the second horizontal through-hole 62 formed in the upper portion of the second header part 53. That is, while the connection portion between the connection pipe 55 and the second header part 53 is disposed in the lower portion of the second header part 53, the second horizontal through-hole 62 that allows the second chamber 72 to communicate with the outflow-side region 63 is disposed in the upper portion of the second header part 53. Therefore, the refrigerant introduced in the second chamber 72 is introduced into the upper portion of the outflow-side region 63 after being moved from the lower side to the upper side in the second chamber 72.

[0060] The respective refrigerants in a gas-liquid two phase state introduced from the first chamber 71 and the second chamber 72 to the outflow-side region 63 is introduced into each of the heat-transfer pipes 20 connected to the second header part 53 after being mixed with each other in the outflow-side region 63. Then, the refrigerant again causes evaporation by exchanging heat with the external atmosphere of the second heat-transfer pipes 22 in the process of flowing in the second heat-transfer pipes 22. Consequently, in the second heat-transfer pipes 22, the remaining liquid phase in the refrigerant changes to the gas phase, and thus the refrigerant in a gas phase state is supplied to the upper entry region 43 of the entrance side header 40. Then, the refrigerant is introduced from the upper entry region 43 to the pipe 7, thereby circulating in the refrigerant circuit.

[0061] As described above, in the heat exchanger 10 of the embodiment, refrigerants supplied to the first chamber 71 and the second chamber 72 are forcibly guided by the first horizontal through-hole 61 and the second horizontal through-hole 62 respectively, and are supplied to the outflow-side region 63. In the embodiment, since the second horizontal through-hole 62 is at a position vertically spaced apart from a point where a refrigerant is introduced, a moving route to the outflow-side region 63 for a refrigerant introduced in the second chamber 72 is made longer. Accordingly, the mixing of a refrigerant in a gas-liquid two phase state in the second chamber 72 can be caused.

[0062] Since the first horizontal through-hole 61 and the second horizontal through-hole 62 are formed at different vertical positions, refrigerants are supplied from

vertical positions different from each other to the outflow-side region 63. In the embodiment, since a refrigerant is introduced from each of the lowermost portion and the uppermost portion of the outflow-side region 63, a gas-liquid ratio of the refrigerant over the entire area of the outflow-side region 63 in the vertical direction can be homogenized.

[0063] For this reason, a liquid phase refrigerant can be effectively introduced also into the second heat-transfer pipes 22 which are disposed relatively higher. As a consequence, a cooling performance and a heating performance are not impaired in the air conditioner in which the heat exchanger 10 of the embodiment is used.

[0064] Next, a heat exchanger 80 according to a second embodiment of the invention will be described with reference to Figs. 5 and 6. In the second 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.

[0065] As illustrated in Figs. 5 and 6, the heat exchanger 80 of the second embodiment is different from the first embodiment in that a plurality of first horizontal through-holes 61 and a plurality of second horizontal through-holes 62 are formed in the main vertical partition plate 60.

[0066] In the embodiment, two first horizontal through-holes 61 are formed. The first one of the first horizontal through-holes 61 is in the lower portion of the main vertical partition plate 60 as in the first embodiment, and is formed in a radially outside portion of the second header part 53. On the other hand, the second one of the first horizontal through-holes 61 is in a vertically middle portion of the main vertical partition plate 60, and is formed in a radially inside portion of the second header part 53.

[0067] In addition, in the embodiment, two second horizontal through-holes 62 are formed. The first one of the second horizontal through-holes 62 is in the upper portion of the main vertical partition plate 60 as in the first embodiment, and is formed in a radially outside portion of the second header part 53. On the other hand, the second one of the second horizontal through-holes 62 is in a vertically middle portion of the main vertical partition plate 60, and is formed in a radially inside portion of the second header part 53. Although the second one of the second horizontal through-holes 62 is formed above the second one of the first horizontal through-holes 61, a relationship of vertical positions thereof may be the opposite.

[0068] In the heat exchanger 80, a refrigerant introduced in the first chamber 71 is introduced into the outflow-side region 63 via the first horizontal through-hole 61 in the vertically middle portion in addition to the first horizontal through-hole 61 in the lower portion.

[0069] In addition, a refrigerant introduced in the second chamber 72 is introduced into the outflow-side region 63 via the second horizontal through-hole 62 in the vertically middle portion in addition to the second horizontal through-hole 62 in the upper portion.

[0070] Accordingly, a refrigerant can be supplied from

a plurality of points having vertical positions different from each other of the first chamber 71 to the outflow-side region 63. A refrigerant can be supplied from a plurality of points having vertical positions different from each other of the second chamber 72 to the outflow-side region 63. For this reason, the homogenization of a gas-liquid ratio of a refrigerant in the outflow-side region 63 as a whole can be further achieved.

[0071] The plurality of first horizontal through-holes 61 having different horizontal positions may be formed at the same vertical position, or the plurality of second horizontal through-holes 62 having different horizontal positions may be formed at the same vertical position. Accordingly, the flow rate or pressure loss of an individual flow path in the header part can be adjusted.

[0072] In the embodiment, the two first horizontal through-holes 61 and the two second horizontal through-holes 62 have horizontal positions different from each other. For this reason, a refrigerant can be supplied to the outflow-side region 63 from a plurality of points not only having vertical positions different from each other but also having horizontal positions different from each other of the first chamber 71. A refrigerant can be supplied to the outflow-side region 63 from a plurality of points not only having vertical positions different from each other but also having horizontal positions different from each other of the second chamber 72. For this reason, the homogenization of a gas-liquid ratio of a refrigerant in the outflow-side region 63 as a whole can be further achieved.

[0073] Next, a heat exchanger 90 according to a third embodiment of the invention will be described with reference to Figs. 7 and 8. 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.

[0074] As illustrated in Figs. 7 and 8, the heat exchanger 90 of the third embodiment is different from the first embodiment in that a first chamber partition plate 91 and a second chamber vertical partition plate 95 are further included.

[0075] A first chamber vertical partition plate 91 is a plate-shaped member extending in the vertical direction, and is disposed in the first chamber 71. The first chamber vertical partition plate 91 partitions the first chamber 71 into two regions, in horizontal sectional view. Out of the two regions, a region on a side to which the connection pipe 55 is connected is set as a first chamber upstream region 93, and a region facing the main vertical partition plate 60 is set as a first chamber downstream region 94.

[0076] The first chamber vertical partition plate 91 is disposed so as to extend in parallel with the main vertical partition plate 60. In addition, a third horizontal through-hole 92 that allows the first chamber upstream region 93 to communicate with the first chamber downstream region 94 is formed in the first chamber vertical partition plate 91. The third horizontal through-hole 92 is formed

to have a position in vertical direction different from that of the first horizontal through-hole 61 formed in the main vertical partition plate 60. In the embodiment, the third horizontal through-hole 92 is formed below the first horizontal through-hole 61.

[0077] In addition, the horizontal positions of the first horizontal through-hole 61 and the third horizontal through-hole 92 are different from each other. In the embodiment, the first horizontal through-hole 61 is formed in the radially inside of the second header part 53, and the third horizontal through-hole 92 is formed in the radially outside of the second header part 53.

[0078] The second chamber vertical partition plate 95 is a plate-shaped member extending in the vertical direction, and is disposed in the second chamber 72. The second chamber vertical partition plate 95 partitions the second chamber 72 into two regions, in horizontal sectional view. Out of the two regions, a region on the side to which the connection pipe 55 is connected is set as a second chamber upstream region 97, and a region facing the main vertical partition plate 60 is set as a second chamber downstream region 98.

[0079] The second chamber vertical partition plate 95 is disposed so as to extend in parallel with the main vertical partition plate 60 as the first chamber vertical partition plate 91. In addition, a fourth horizontal through-hole 96 that allows the second chamber upstream region 97 to communicate with the second chamber downstream region 98 is formed in the second chamber vertical partition plate 95. The fourth horizontal through-hole 96 is formed to have a position in vertical direction different from that of the second horizontal through-hole 62 formed in the main vertical partition plate 60. In the embodiment, the fourth horizontal through-hole 96 is formed above the second horizontal through-hole 62.

[0080] In addition, the horizontal positions of the second horizontal through-hole 62 and the fourth horizontal through-hole 96 are different from each other. In the embodiment, the second horizontal through-hole 62 is formed in the radially inside of the second header part 53, and the fourth horizontal through-hole 96 is formed in the radially outside of the second header part 53.

[0081] In such a heat exchanger 90, a refrigerant supplied to the first chamber 71 proceeds while moving in the first chamber upstream region 93 and the first chamber downstream region 94 in the vertical direction before reaching the outflow-side region 63. A refrigerant supplied to the second chamber 72 proceeds while moving in the second chamber upstream region 97 and the second chamber downstream region 98 in the vertical direction before reaching the outflow-side region 63. Consequently, a moving route to the outflow-side region 63 for a refrigerant introduced in the first chamber 71 and the second chamber 72 can be made longer. For this reason, the homogenization of a gas-liquid two phase type refrigerant on the moving route can be further achieved.

[0082] In a modification example of the third embodiment, for example, the first chamber vertical partition

plate 91 and the second chamber vertical partition plate 95 may be disposed in the first chamber 71 and the second chamber 72 respectively so as to be in the radial direction of the second header part 53, as illustrated in Fig. 9. Even in this example, the moving route for a refrigerant can be made longer as described above.

[0083] Next, a heat exchanger 100 according to a fourth embodiment of the invention will be described with reference to Figs. 10 and 11. In the fourth 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.

[0084] As illustrated in Figs. 10 and 11, the heat exchanger 100 of the fourth embodiment is different from the first embodiment in that a first chamber horizontal partition plate 101 and a second chamber horizontal partition plate 105 are further included.

[0085] The first chamber horizontal partition plate 101 is a plate-shaped member extending in the horizontal direction, and is disposed in the first chamber 71. The first chamber horizontal partition plate 101 partitions the inside of the first chamber 71 into two upper and lower regions. Out of the two regions, a lower region connected to the connection pipe 55 is set as a first chamber lower region 103, and an upper region is set as a first chamber upper region 104.

[0086] A first vertical through-hole 102 that allows the first chamber lower region 103 to communicate with the first chamber upper region 104 is formed in the first chamber horizontal partition plate 101.

[0087] The second chamber horizontal partition plate 105 is a plate-shaped member extending in the horizontal direction, and is disposed in the second chamber 72. The second chamber horizontal partition plate 105 partitions the inside of the second chamber 72 into two upper and lower regions. Out of the two regions, a lower region connected to the connection pipe 55 is set as a second chamber lower region 107, and an upper region is set as a second chamber upper region 108.

[0088] A second vertical through-hole 106 that allows the second chamber lower region 107 to communicate with the second chamber upper region 108 is formed in the second chamber horizontal partition plate 105.

[0089] In the embodiment, the first horizontal through-hole 61 formed in the main vertical partition plate 60 allows the first chamber lower region 103 to communicate with the outflow-side region 63. In addition, the second horizontal through-hole 62 formed in the main vertical partition plate 60 allows the second chamber upper region 108 to communicate with the outflow-side region 63.

[0090] In such a heat exchanger 100, a refrigerant that proceeds upwards, out of refrigerants introduced from the flow passage 56 to the first chamber lower region 103 or the second chamber lower region 107, collides with the first chamber horizontal partition plate 101 or the second chamber horizontal partition plate 105. Accordingly, since a refrigerant in a gas-liquid two phase type state is

further stirred, the homogenization of the refrigerant can be further achieved.

[0091] In particular, since the speed of a refrigerant in the second chamber 72, which passes through the second chamber upper region 108 to be introduced into the outflow-side region 63, increases when heading upwards via the second vertical through-hole 106, the refrigerant is likely to spread further upwards. Accordingly, a liquid phase content of a refrigerant can be effectively supplied also into the second heat-transfer pipes 22 which are disposed higher.

[0092] Although the first vertical through-hole 102 is formed in the first chamber horizontal partition plate 101 in the embodiment, the first vertical through-hole may not necessarily be formed. If the first vertical through-hole 102 is formed, there is an advantage in that a refrigerant can be temporarily stored in the first chamber upper region 104, for example, in a case where the flow rate of the refrigerant is relatively high. There is another advantage in that a pressure resistance can be improved by reducing an internal pressure difference between the first chamber upper region 104 and other regions.

[0093] On the other hand, in a case where the flow rate of a refrigerant is relatively low, a refrigerant introduced from the connection pipe 55 into the first chamber lower region 103 heads for the outflow-side region 63 via the first horizontal through-hole 61. Thus, a liquid phase refrigerant does not reach the first chamber upper region 104.

[0094] In the fourth embodiment, a first vertical chamber partition plate 91 and the second chamber vertical partition plate 95 described in the third embodiment may be provided.

[0095] Next, a heat exchanger 110 according to a fifth embodiment of the invention will be described with reference to Fig. 12. Although one connection pipe 55 is connected to the second header part 53 so as to straddle the first chamber 71 and the second chamber 72 in the first to fourth embodiments, two connection pipes 55 are connected to the second header part 53 in the embodiment. Each of the connection pipes 55 is also connected to the first header part 52, and the inside of each of the connection pipes is set as a communication passage. Even in this case, a refrigerant can be forcibly introduced into the first chamber 71 and the second chamber 72 as in the first to fourth embodiments.

[0096] In addition, the flow rate of a refrigerant introduced into each of the first chamber 71 and the second chamber 72 can be adjusted as appropriate by changing the flow path sectional areas of the connection pipes 55 as appropriate. The optimization of a heat exchange rate of a refrigerant with a different flow rate can also be achieved by intentionally introducing a refrigerant with a different gas-liquid ratio into each of the connection pipes 55.

[0097] Although the embodiments of the invention are described, the invention is not limited thereto, and can be modified as appropriate without departing from the

technical scope of the invention.

Industrial Applicability

[0098] In the heat exchanger and the air conditioner, a performance decrease caused by the non-homogenization of a refrigerant flowing in the plurality of heat-transfer pipes can be suppressed.

Reference Signs List

[0099]

1	air conditioner	
2	compressor	
3	indoor heat exchanger	
4	expansion valve	
5	outdoor heat exchanger	
6	four-way valve	
7	pipe	
10	heat exchanger	
20	heat-transfer pipe	
21	first heat-transfer pipe	
22	second heat-transfer pipe	
23	fin	
30	header	
40	entrance side header	
41	entrance side 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	turnback side partition plate	
55	connection pipe	
56	flow passage	
60	main vertical partition plate	
61	first horizontal through-hole	
62	second horizontal through-hole	
63	outflow-side region	
64	inflow-side region	
70	inflow-side vertical partition plate	
71	first chamber	
72	second chamber	
80	heat exchanger	
90	heat exchanger	
91	first chamber vertical partition plate	
92	third horizontal through-hole	
93	first chamber upstream region	
94	first chamber downstream region	
95	second chamber vertical partition plate	
96	fourth horizontal through-hole	
97	second chamber upstream region	
98	second chamber downstream region	
100	heat exchanger	
101	first chamber horizontal partition plate	
102	first vertical through-hole	

103	first chamber lower region
104	first chamber upper region
105	second chamber horizontal partition plate
106	second vertical through-hole
107	second chamber lower region
108	second chamber upper region
110	heat exchanger

10 **Claims**

1. A heat exchanger comprising:

- | | |
|----|--|
| 15 | a plurality of heat-transfer pipes that extend in a horizontal direction to allow a refrigerant to flow therein and are arranged at intervals in a vertical direction; |
| 20 | a header part that has a tubular shape extending in the vertical direction and has an internal space connected to one end of each of the plurality of heat-transfer pipes in a communicating state; |
| 25 | a flow passage that is connected to an inside of the header part in a communicating state and allows the refrigerant to flow therein; |
| 30 | a main vertical partition plate that partitions the inside of the header part into an outflow-side region connected to each of the heat-transfer pipes and an inflow-side region connected to the flow passage, in horizontal sectional view; and an inflow-side vertical partition plate that partitions the inflow-side region into a first chamber and a second chamber, which are adjacent to each other in a circumferential direction of the header part and each of which communicates with the flow passage, in horizontal sectional view, |
| 35 | wherein a first horizontal through-hole that allows the first chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the first chamber, and |
| 40 | a second horizontal through-hole that allows the second chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the second chamber, the portion having a vertical position different from that of the first horizontal through-hole. |
| 45 | |
| 50 | 2. The heat exchanger according to Claim 1, wherein a plurality of the first horizontal through-holes are formed at vertical positions different from each other, and a plurality of the second horizontal through-holes are formed at vertical positions different from each other. |
| 55 | 3. The heat exchanger according to Claim 1 or 2, wherein a plurality of the first horizontal through-holes are formed at horizontal positions different |

from each other, and
a plurality of the second horizontal through-holes are formed at horizontal positions different from each other.

4. The heat exchanger according to any one of Claims 1 to 3, further comprising:

a first chamber vertical partition plate that partitions the first chamber into a first chamber upstream region connected to the flow passage and a first chamber downstream region facing the main vertical partition plate, in horizontal sectional view; and

a second chamber vertical partition plate that partitions the second chamber into a second chamber upstream region connected to the flow passage and a second chamber downstream region facing the main vertical partition plate, in horizontal sectional view,

wherein a third horizontal through-hole that allows the first chamber upstream region to communicate with the first chamber downstream region is formed in a portion of the first chamber vertical partition plate, which has a vertical position different from that of the first horizontal through-hole, and

a fourth horizontal through-hole that allows the second chamber upstream region to communicate with the second chamber downstream region is formed in a portion of the second chamber vertical partition plate, which has a vertical position different from that of the second horizontal through-hole.

5. The heat exchanger according to any one of Claims 1 to 4, further comprising:

a first chamber horizontal partition plate that partitions the first chamber into a first chamber lower region connected to the flow passage and a first chamber upper region disposed above the first chamber lower region; and

a second chamber horizontal partition plate that partitions the second chamber into a second chamber lower region connected to the flow passage and a second chamber upper region disposed above the second chamber lower region, wherein a vertical through-hole that allows the upper and lower regions to communicate with each other is formed in at least one of the first chamber horizontal partition plate and the second chamber horizontal partition plate.

6. The heat exchanger according to any one of Claims 1 to 5,

wherein a connection portion of the flow passage to the header part straddles the first chamber and the

second chamber by making the circumferential position of the connection portion of the flow passage to the header part be the same point as the inflow-side vertical partition plate.

7. The heat exchanger according to any one of Claims 1 to 5,
wherein the flow passage has

a first flow passage connected to the first chamber in the header part in a communicating state, and

a second flow passage connected to the second chamber in the header part in a communicating state.

8. An air conditioner comprising the heat exchanger according to any one of Claims 1 to 7.

Amended claims under Art. 19.1 PCT

1. (Amended) A heat exchanger comprising:

a plurality of heat-transfer pipes that extend in a horizontal direction to allow a refrigerant to flow therein, and are arranged at intervals in a vertical direction;

a header part that has a tubular shape extending in the vertical direction and has an internal space connected to one end of each of the plurality of heat-transfer pipes in a communicating state;

a flow passage that is connected to an inside of the header part in a communicating state and allows the refrigerant to flow therein;

a main vertical partition plate that partitions the inside of the header part into an outflow-side region connected to each of the heat-transfer pipes and an inflow-side region connected to the flow passage, in horizontal sectional view; and an inflow-side vertical partition plate that partitions the inflow-side region into a first chamber and a second chamber, which are adjacent to each other in a circumferential direction of the header part and each of which communicates with the flow passage, in horizontal sectional view,

wherein a first horizontal through-hole that allows the first chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the first chamber,

a second horizontal through-hole that allows the second chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the second chamber, the portion having a vertical position different from that of the first horizontal through-hole,

the heat exchanger further comprises

a first chamber vertical partition plate that partitions the first chamber into a first chamber upstream region connected to the flow passage and a first chamber downstream region facing the main vertical partition plate, in horizontal sectional view; and
 a second chamber vertical partition plate that partitions the second chamber into a second chamber upstream region connected to the flow passage and a second chamber downstream region facing the main vertical partition plate, in horizontal sectional view,

a third horizontal through-hole that allows the first chamber upstream region to communicate with the first chamber downstream region is formed in a portion of the first chamber vertical partition plate, which has a vertical position different from that of the first horizontal through-hole, and

a fourth horizontal through-hole that allows the second chamber upstream region to communicate with the second chamber downstream region is formed in a portion of the second chamber vertical partition plate, which has a vertical position different from that of the second horizontal through-hole.

2. (Amended) A heat exchanger comprising:

a plurality of heat-transfer pipes that extend in a horizontal direction to allow a refrigerant to flow therein, and are arranged at intervals in a vertical direction;

a header part that has a tubular shape extending in the vertical direction and has an internal space connected to one end of each of the plurality of heat-transfer pipes in a communicating state;

a flow passage that is connected to an inside of the header part in a communicating state and allows the refrigerant to flow therein;

a main vertical partition plate that partitions the inside of the header part into an outflow-side region connected to each of the heat-transfer pipes and an inflow-side region connected to the flow passage, in horizontal sectional view; and
 an inflow-side vertical partition plate that partitions the inflow-side region into a first chamber and a second chamber, which are adjacent to each other in a circumferential direction of the header part and each of which communicates with the flow passage, in horizontal sectional view,

wherein a first horizontal through-hole that allows the first chamber to communicate with the

outflow-side region is formed in a portion of the main vertical partition plate facing the first chamber,

a second horizontal through-hole that allows the second chamber to communicate with the outflow-side region is formed in a portion of the main vertical partition plate facing the second chamber, the portion having a vertical position different from that of the first horizontal through-hole, the heat exchanger further comprises

a first chamber horizontal partition plate that partitions the first chamber into a first chamber lower region connected to the flow passage and a first chamber upper region disposed above the first chamber lower region; and

a second chamber horizontal partition plate that partitions the second chamber into a second chamber lower region connected to the flow passage and a second chamber upper region disposed above the second chamber lower region, and

a vertical through-hole that allows the upper and lower regions to communicate with each other is formed in at least one of the first chamber horizontal partition plate and the second chamber horizontal partition plate.

3. (Amended) The heat exchanger according to Claim 1 or 2, wherein the flow passage has

a first flow passage connected to the first chamber in the header part in a communicating state, and

a second flow passage connected to the second chamber in the header part in a communicating state.

4. (Amended) A heat exchanger comprising:

a plurality of heat-transfer pipes that extend in a horizontal direction to allow a refrigerant to flow therein, and are arranged at intervals in a vertical direction;

a header part that has a tubular shape extending in the vertical direction and has an internal space connected to one end of each of the plurality of heat-transfer pipes in a communicating state;

a flow passage that is connected to an inside of the header part in a communicating state and allows the refrigerant to flow therein;

a main vertical partition plate that partitions the inside of the header part into an outflow-side region connected to each of the heat-transfer pipes and an inflow-side region connected to the

flow passage, in horizontal sectional view; and
 an inflow-side vertical partition plate that parti-
 tions the inflow-side region into a first chamber
 and a second chamber, which are adjacent to
 each other in a circumferential direction of the
 header part and each of which communicates
 with the flow passage, in horizontal sectional
 view,
 wherein a first horizontal through-hole that al-
 lows the first chamber to communicate with the
 outflow-side region is formed in a portion of the
 main vertical partition plate facing the first cham-
 ber,
 a second horizontal through-hole that allows the
 second chamber to communicate with the out-
 flow-side region is formed in a portion of the main
 vertical partition plate facing the second cham-
 ber, the portion having a vertical position differ-
 ent from that of the first horizontal through-hole,
 and
 a connection portion of the flow passage to the
 header part straddles the first chamber and the
 second chamber by making the circumferential
 position of the connection portion of the flow pas-
 sage to the header part be the same point as
 the inflow-side vertical partition plate.

amended by adding matters described in Claim 1.
 Claim 5 corresponds to original Claim 2.
 Claim 6 corresponds to original Claim 3.
 Claim 7 corresponds to original Claim 8.

- 5. (Amended) The heat exchanger according to any
 one of Claims 1 to 4,
 wherein a plurality of the first horizontal through-
 holes are formed at vertical positions different from
 each other, and
 a plurality of the second horizontal through-holes are
 formed at vertical positions different from each other.
- 6. (Amended) The heat exchanger according to any
 one of Claims 1 to 5,
 wherein a plurality of the first horizontal through-
 holes are formed at horizontal positions different
 from each other, and
 a plurality of the second horizontal through-holes are
 formed at horizontal positions different from each
 other.
- 7. (Amended) An air conditioner comprising the heat
 exchanger according to any one of Claims 1 to 6.
- 8. (Cancelled)

Statement under Art. 19.1 PCT

Claim 1 is amended by adding matters described in
 original Claim 4.
 Claim 2 corresponds to original Claim 5, and is
 amended by adding matters described in Claim 1.
 Claim 3 corresponds to original Claim 7.
 Claim 4 corresponds to original Claim 6, and is

FIG. 1

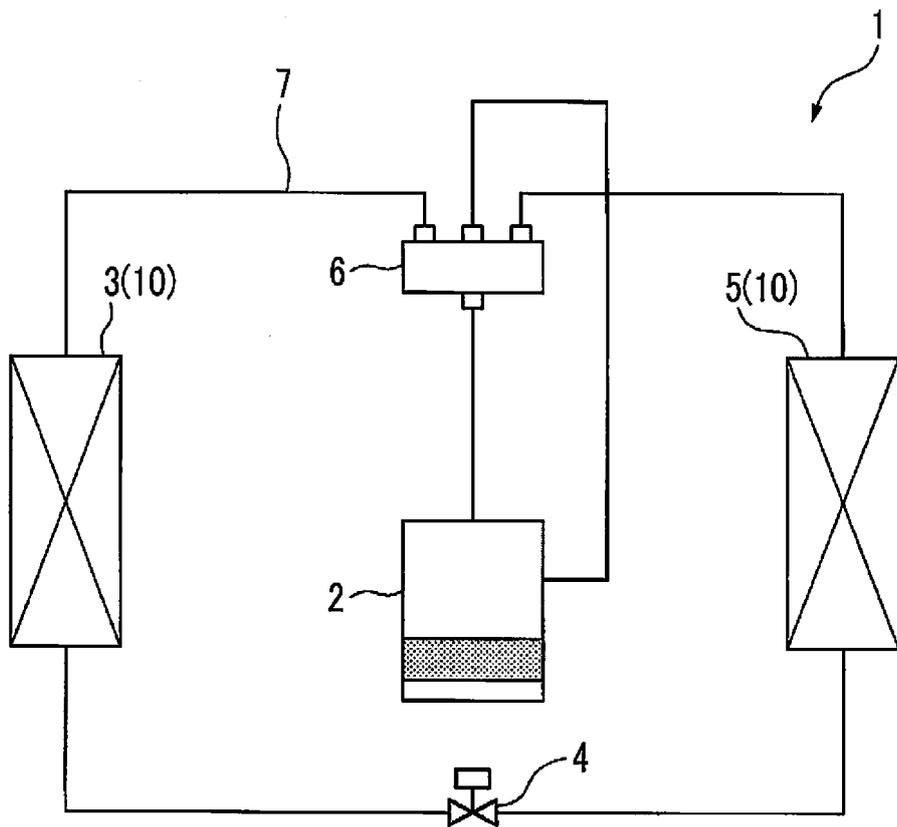


FIG. 2

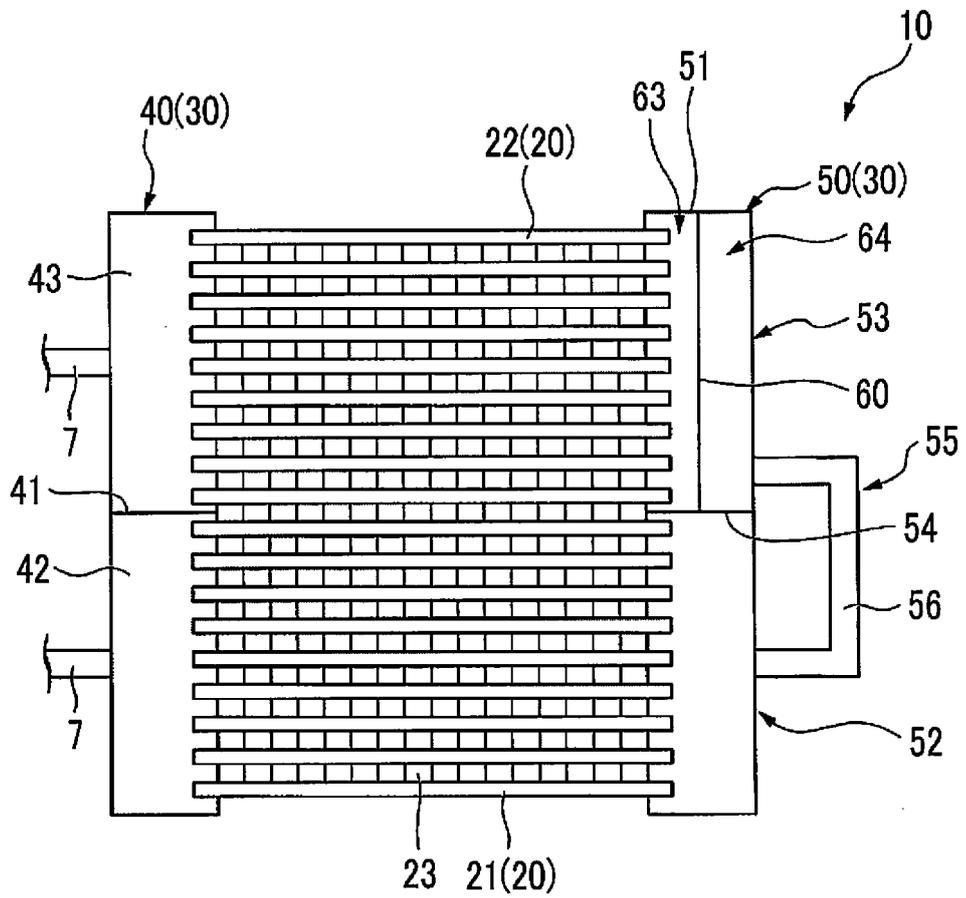


FIG. 3

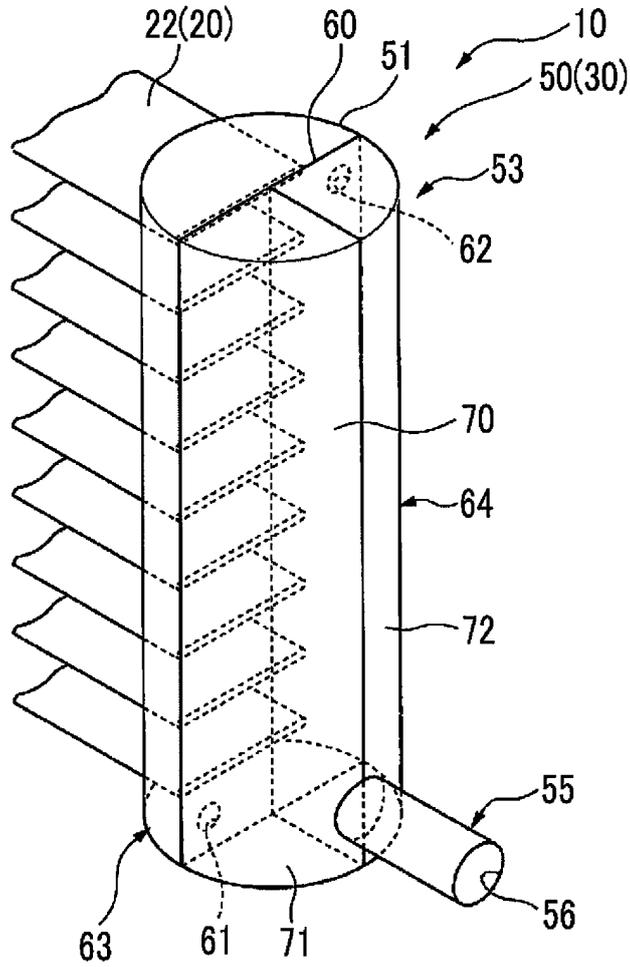


FIG. 4

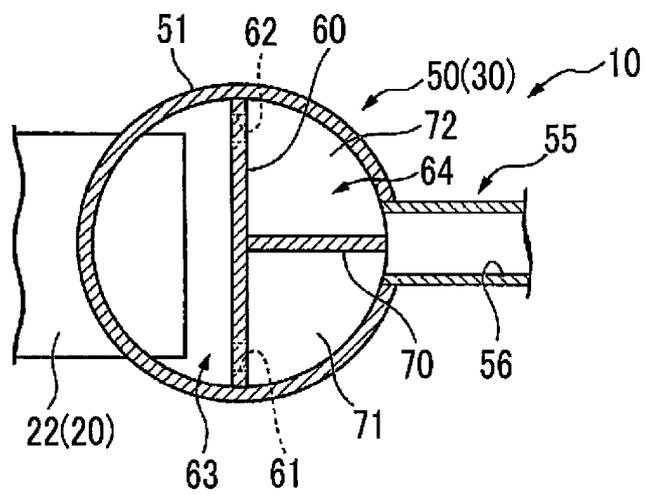


FIG. 7

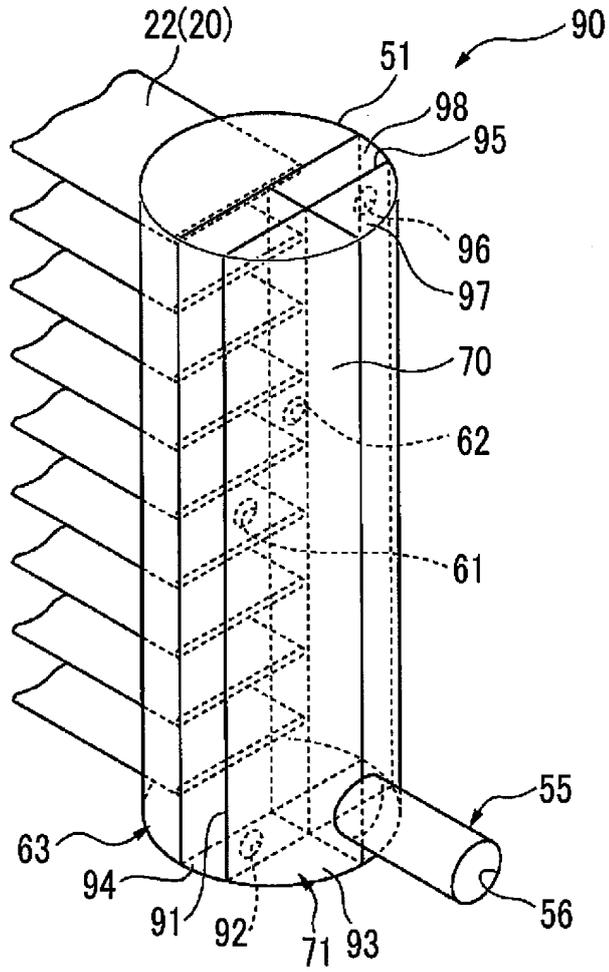


FIG. 8

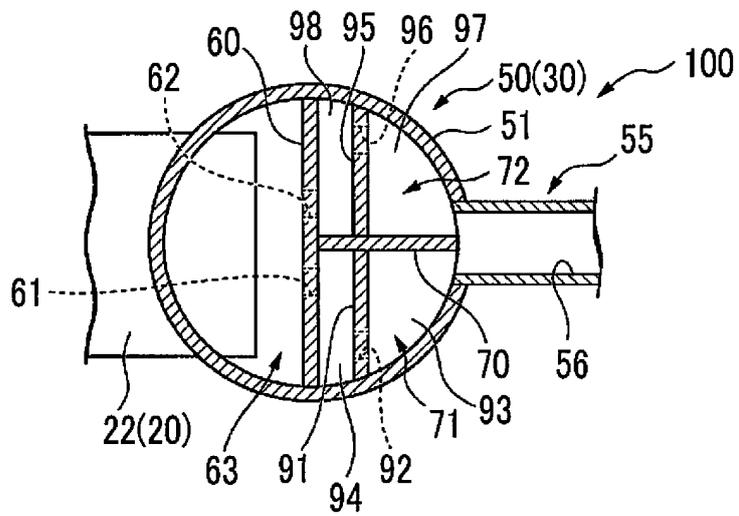


FIG. 9

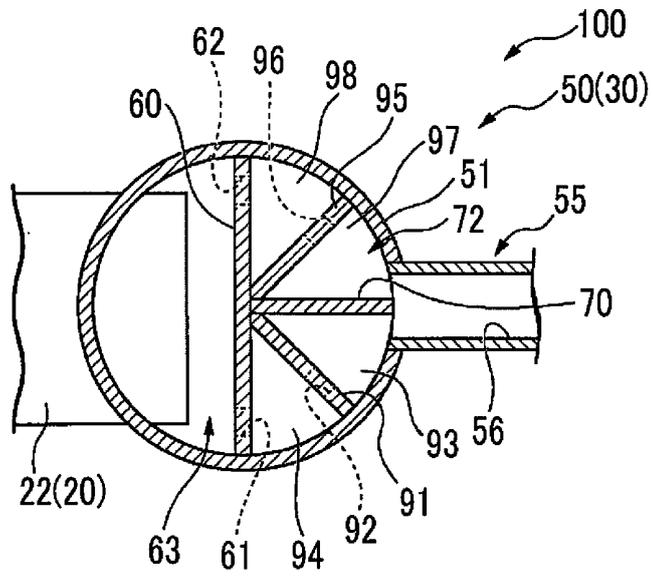


FIG. 10

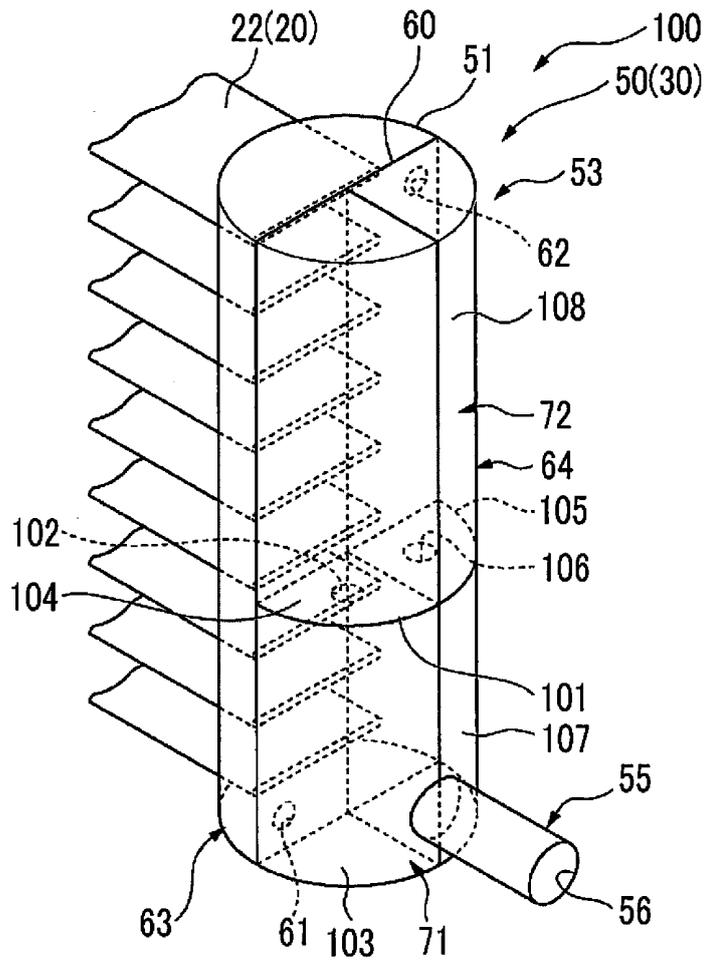


FIG. 11

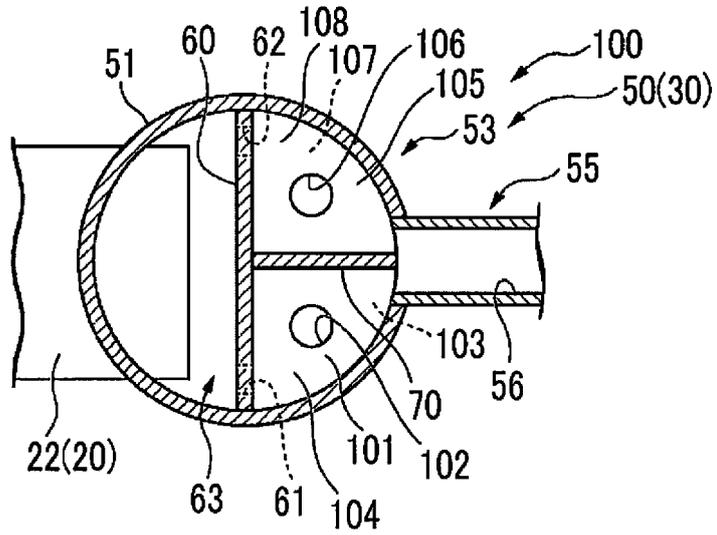
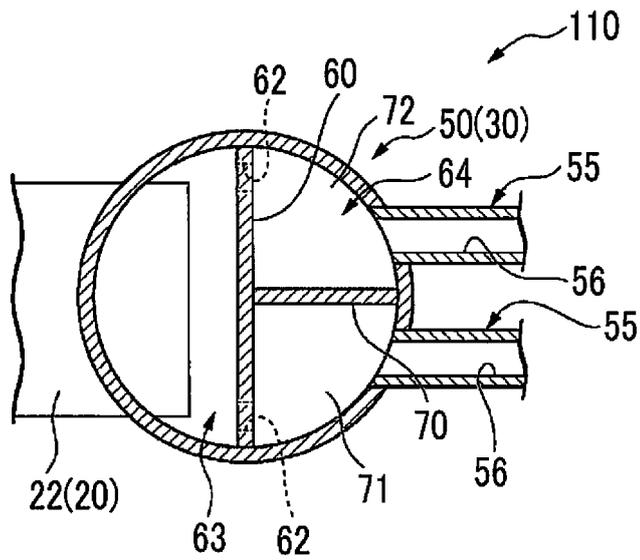


FIG. 12



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/002082

A. CLASSIFICATION OF SUBJECT MATTER

5 F28F9/02(2006.01)i, F25B39/00(2006.01)i, F25B39/02(2006.01)i

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

B. FIELDS SEARCHED

10 Minimum documentation searched (classification system followed by classification symbols)

F28F9/02, F25B39/00, F25B39/02

15 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.
X	JP 04-174297 A (Zexel Corp.),	1-3, 7
Y	22 June 1992 (22.06.1992),	8
A	claims; page 4; fig. 1, 14, 17, 18	4-6
	& US 5203407 A	
	claims; columns 5 to 6; fig. 1, 14, 17, 18	
Y	JP 06-341736 A (Nippondenso Co., Ltd.),	8
	13 December 1994 (13.12.1994),	
	claims; paragraphs [0001] to [0002], [0012] to	
	[0018]; fig. 1 to 13	
	(Family: none)	
A	US 2044455 A (Ernest WITZEL),	1-8
	16 June 1936 (16.06.1936),	
	entire text; all drawings	
	(Family: none)	

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

* Special categories of cited documents:

45 "A" document defining the general state of the art which is not considered to be of particular relevance

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

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

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

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

50 Date of the actual completion of the international search
04 April 2017 (04.04.17)

Date of mailing of the international search report
18 April 2017 (18.04.17)

55 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/JP2017/002082

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4524823 A (Kari-Ernst HUMMEL), 25 June 1985 (25.06.1985), entire text; all drawings & EP 121079 A1 & DE 3311579 A	1-8
A	JP 2014-533819 A (LG Electronics Inc.), 15 December 2014 (15.12.2014), entire text; all drawings & US 2013/0126140 A1 & WO 2013/073842 A1 & EP 2597413 A1 & KR 10-2013-0055244 A & CN 103123186 A	1-8
A	US 2008/0023185 A1 (Henry Earl BEAMER), 31 January 2008 (31.01.2008), entire text; all drawings & EP 1884734 A1	1-8
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