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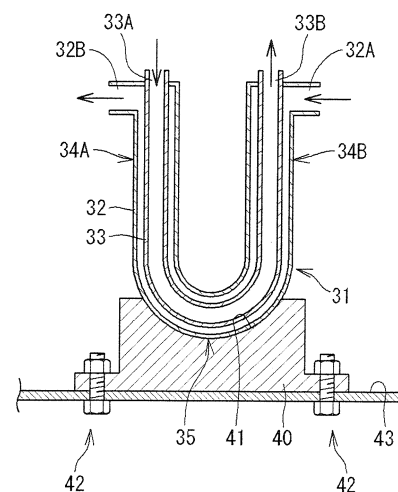
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(54) **DOUBLE-PIPE HEAT EXCHANGER AND AIR CONDITIONER USING SAME**

(57) A double-pipe heat exchanger capable of achieving a compact configuration and suppressing a liquid refrigerant contained in a gas-liquid two-phase refrigerant from flowing out from an inner pipe so as to prevent generation of a liquid-back phenomenon is provided. A double-pipe heat exchanger (31) includes an outer pipe (32) through which a high pressure liquid refrigerant flows, and an inner pipe (33) having an inlet side end (33A) into which a low pressure gas-liquid two-phase refrigerant obtained by reducing pressure of the high pressure liquid refrigerant flows, and an outlet side end (33B) connected to a suction side part of a compressor. The double-pipe heat exchanger (31) includes a plurality of vertical pipes (34A, 34B) arranged in the up and down direction, and a curve pipe (35) connecting ends of the plurality of vertical pipes (34A, 34B), the outlet side end (33B) of the inner pipe (33) is provided in an upper end of one vertical pipe (34B), and the inlet side end (33A) of the inner pipe (33) is provided in an upper end of the other vertical pipe (34A).

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a double-pipe heat exchanger and an air conditioner using same.

BACKGROUND ART

[0002] There is a known refrigerant circuit including a supercooling heat exchanger for supercooling a high pressure liquid refrigerant before flowing into an expansion valve in an air conditioner. As this supercooling heat exchanger, as disclosed in Patent Literature 1 below, there is a double-pipe heat exchanger including an outer pipe through which a high pressure liquid refrigerant flows, and an inner pipe through which a low pressure gas-liquid two-phase refrigerant obtained by reducing pressure of the high pressure liquid refrigerant flows. Specifically, Patent Literature 1 discloses a double-pipe heat exchanger of a vertical pipe shape arranged in the up and down direction, and a double-pipe heat exchanger of an inverted U shape.

CITATION LIST

[PATENT LITERATURE]

[0003] Patent Literature 1: Japanese Unexamined Patent Publication No. 2003-75026

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] In the double-pipe heat exchanger of the vertical pipe shape, there is a need for ensuring an arrangement space which is wide in the up and down direction in a casing of an outdoor unit in an air conditioner, and a refrigerant pipe has to be connected to each of an upper end and a lower end of the double-pipe heat exchanger. Thus, at the time of a task of connecting this refrigerant pipe, there is a need for a step of inverting the double-pipe heat exchanger upside down. Thus, there is a disadvantage that the task becomes troublesome.

[0005] Meanwhile, the double-pipe heat exchanger of the inverted U shape can be arranged compactly in the up and down direction, and both ends are arranged on the same side (lower side). Thus, there is an advantage that a task of connecting a refrigerant pipe is easily performed. However, a gas-liquid two-phase refrigerant flowing in from one end (inlet side end) of an inner pipe flows upward and then flows downward through a U shape curved portion, and flows out from the other end (outlet side end). Thus, in a case where the gas-liquid two-phase refrigerant is not sufficiently evaporated inside the inner pipe, and when a liquid component (liquid refrigerant) contained in the gas-liquid two-phase refriger-

ant gets over the curved portion, there is a possibility that the liquid component flows downward in the inner pipe and easily flows out from the outlet side end, so as to flow into a compressor. Such a phenomenon is called as a "liquid-back phenomenon" which unfavorably causes a decrease in a performance of the compressor.

[0006] The present invention is achieved in consideration with the situation described above, and an object thereof is to provide a double-pipe heat exchanger and an air conditioner capable of achieving a compact configuration, and suppressing a liquid refrigerant contained in a gas-liquid two-phase refrigerant from flowing out from an inner pipe so as to prevent generation of a liquid-back phenomenon.

SOLUTION TO PROBLEM

[0007] (1) The present invention is a double-pipe heat exchanger including an outer pipe through which a high pressure liquid refrigerant flows, and an inner pipe having an inlet side end into which a low pressure gas-liquid two-phase refrigerant obtained by reducing pressure of the high pressure liquid refrigerant flows, and an outlet side end connected to a suction side part of a compressor, wherein the double-pipe heat exchanger includes a plurality of vertical pipes arranged in the up and down direction, and a curve pipe connecting ends of the plurality of vertical pipes, the outlet side end of the inner pipe is provided in an upper end of one vertical pipe, and the inlet side end of the inner pipe is provided in an upper end of the other vertical pipe.

[0008] With this configuration, while flowing through the inner pipe, the gas-liquid two-phase refrigerant flowing in from the inlet side end of the inner pipe performs heat exchange with the high pressure liquid refrigerant flowing through the outer pipe, and is evaporated to become a gas refrigerant, and then flows out from the outlet side end of the inner pipe. At this time, the outlet side end of the inner pipe is provided in the upper end of the one vertical pipe. Thus, even in a case where the gas-liquid two-phase refrigerant is not sufficiently evaporated and a liquid component (liquid refrigerant) remains, this liquid component does not easily go up in the inner pipe of the one vertical pipe, and hence does not easily flow out from the outlet side end. Therefore, a "liquid-back phenomenon" in which the liquid refrigerant comes into a compressor can be prevented.

[0009] Both the inlet side end and the outlet side end of the inner pipe are provided in the upper ends of the vertical pipes. Thus, without inverting the double-pipe heat exchanger, the refrigerant pipe can be connected, so that a pipe connecting task can be easily performed.

[0010] (2) Preferably, in the above configuration, the two vertical pipes are provided, and lower ends of the vertical pipes are connected by the curve pipe.

[0011] With such a configuration, the double-pipe heat exchanger can achieve a simple configuration, and by reducing a curve pipe part, a pressure loss of the refrigerant

erant can be decreased.

[0012] (3) An air conditioner of the present invention includes a compressor, a condenser for condensing a high pressure gas refrigerant compressed by the compressor, a pressure reduction mechanism for reducing pressure of the condensed high pressure liquid refrigerant, an evaporator for evaporating the low pressure refrigerant after pressure reduction, and the double-pipe heat exchanger according to (1) or (2) described above, the double-pipe heat exchanger for supercooling the high pressure liquid refrigerant condensed by the condenser before reducing the pressure of the refrigerant by the pressure reduction mechanism.

[0013] (4) Preferably, in the above air conditioner, the curve pipe connected to lower ends of the plurality of vertical pipes in the double-pipe heat exchanger is supported on a bottom frame of a casing in the air conditioner via a support member.

[0014] With such a configuration, in a part of the curve pipe where strength is relatively high, the double-pipe heat exchanger can be stably supported.

ADVANTAGEOUS EFFECTS OF INVENTION

[0015] According to the present invention, while the double-pipe heat exchanger can achieve a compact configuration, the liquid refrigerant contained in the gas-liquid two-phase refrigerant can be suppressed from flowing out from the inner pipe so as to prevent generation of the liquid-back phenomenon.

BRIEF DESCRIPTION OF DRAWINGS

[0016]

[FIG. 1] FIG. 1 is a pattern diagram showing a refrigerant circuit of an air conditioner according to a first embodiment of the present invention.

[FIG. 2] FIG. 2 is a schematic view of a double-pipe heat exchanger provided in the refrigerant circuit of the air conditioner shown in FIG. 1.

[FIG. 3] FIG. 3 is a schematic view showing a modified example of a double-pipe heat exchanger according to a second embodiment of the present invention.

[FIG. 4] FIG. 4 is a pattern diagram showing a modified example of the refrigerant circuit of the air conditioner.

DESCRIPTION OF EMBODIMENTS

[0017] FIG. 1 is a pattern diagram showing a refrigerant circuit of an air conditioner according to a first embodiment of the present invention.

[0018] An air conditioner 1 is for example a multiple type air conditioner for a building in which a refrigerant circuit 10 is formed in such a manner that a plurality of indoor units 3 is connected in parallel to one or a plurality

of outdoor unit 2 so as to circulate a refrigerant.

[0019] In the outdoor unit 2, compressors 11, a four way valve 12, an outdoor heat exchanger 13, an outdoor expansion valve 14, a supercooling heat exchanger 31, and the like are provided. These parts are connected by a refrigerant pipe so as to form the refrigerant circuit. A fan 23 is provided in the outdoor unit 2. In the indoor unit 3, an indoor expansion valve 15, an indoor heat exchanger 16, and the like are provided. The four way valve 12 and the indoor heat exchanger 16 are connected by a gas side refrigerant communication pipe 17a, and the outdoor expansion valve 14 and the indoor expansion valve 15 are connected by a liquid side refrigerant communication pipe 17b. A gas side stop valve 18 and a liquid side stop valve 19 are provided in terminal portions of the inside refrigerant circuit of the outdoor unit 2. The gas side stop valve 18 is arranged on the side of the four way valve 12, and the liquid side stop valve 19 is arranged on the side of the outdoor expansion valve 14. The gas side refrigerant communication pipe 17a is connected to the gas side stop valve 18, and the liquid side refrigerant communication pipe 17b is connected to the liquid side stop valve 19.

[0020] In a case where a cooling operation is performed in the air conditioner 1 with the above configuration, the four way valve 12 is retained in a state shown by solid lines in FIG. 1. A high temperature and high pressure gas refrigerant discharged from the compressors 11 flows into the outdoor heat exchanger (condenser) 13 via the four way valve 12, and performs heat exchange with the outdoor air by actuation of the fan 23 so as to be condensed and liquefied. The liquefied refrigerant passes through the outdoor expansion valve 14 in a fully open state, and flows into the indoor units 3 through the liquid side refrigerant communication pipe 17b. In the indoor unit 3, pressure of the refrigerant is reduced to predetermined low pressure by the indoor expansion valve (pressure reduction mechanism) 15, and further, the refrigerant performs the heat exchange with the indoor air in the indoor heat exchanger (evaporator) 16 so as to be evaporated. The indoor air cooled by evaporation of the refrigerant is blown out to an interior by an indoor fan (not shown) so as to cool the interior. The refrigerant evaporated in the indoor heat exchanger 16 is returned to the outdoor unit 2 through the gas side refrigerant communication pipe 17a, and suctioned into the compressors 11 via the four way valve 12.

[0021] On the other hand, in a case where a heating operation is performed, the four way valve 12 is retained in a state shown by broken lines in FIG. 1. A high temperature and high pressure gas refrigerant discharged from the compressors 11 flows into the indoor heat exchanger (condenser) 16 of the indoor unit 3 via the four way valve 12, and performs the heat exchange with the indoor air so as to be condensed and liquefied. The indoor air heated by condensation of the refrigerant is blown out to the interior by the indoor fan so as to heat the interior. The refrigerant liquefied in the indoor heat exchanger 16

is returned to the outdoor unit 2 from the indoor expansion valve 15 in a fully open state through the liquid side refrigerant communication pipe 17b. The pressure of the refrigerant returned to the outdoor unit 2 is reduced to predetermined low pressure by the outdoor expansion valve (pressure reduction mechanism) 14, and further, the refrigerant performs the heat exchange with the outdoor air in the outdoor heat exchanger (evaporator) 13 so as to be evaporated. The refrigerant evaporated in the outdoor heat exchanger 13 is suctioned into the compressors 11 via the four way valve 12.

[0022] The supercooling heat exchanger 31 of the present embodiment is used for supercooling the high pressure liquid refrigerant flowing out from the outdoor heat exchanger 13 before reducing the pressure by the indoor expansion valve 15 at the time of the cooling operation as described above. In the present embodiment, the supercooling heat exchanger 31 is provided in a part of the refrigerant pipe (called as a main refrigerant pipe 25) between the outdoor expansion valve 14 and the liquid side stop valve 19.

[0023] The refrigerant circuit has a bypass refrigerant circuit 26 in which a part of the refrigerant condensed in the outdoor heat exchanger 13 (high pressure liquid refrigerant) is diverted from the main refrigerant pipe 25, the cooling refrigerant serving as a cooling source is supplied to the supercooling heat exchanger 31, and then the cooling refrigerant is returned to a suction side part of the compressors 11. Specifically, the bypass refrigerant circuit 26 has a diverting pipe 27 by which the refrigerant is diverted from a part of the main refrigerant pipe 25 between the outdoor expansion valve 14 and the supercooling heat exchanger 31, the diverting pipe 27 being connected to an inlet of the cooling refrigerant in the supercooling heat exchanger 31, and a joining pipe 28 extending from an outlet of the cooling refrigerant in the supercooling heat exchanger 31 and joining a pipe of the suction side part of the compressors 11.

[0024] A bypass expansion valve 29 for reducing the pressure of the refrigerant is provided in the diverting pipe 27. The bypass expansion valve 29 is formed by an electric valve or the like for reducing the pressure of the high pressure liquid refrigerant flowing through the diverting pipe 27 so as to make the refrigerant a low pressure gas-liquid two-phase refrigerant. The high pressure liquid refrigerant flowing from the outdoor heat exchanger 13 toward the indoor expansion valve 15 is supercooled by the low pressure gas-liquid two-phase refrigerant in the supercooling heat exchanger 31. A liquid component (liquid refrigerant) contained in the gas-liquid two-phase refrigerant is evaporated by the heat exchange with the high pressure liquid refrigerant to become a gas refrigerant, and suctioned by the compressors 11.

[0025] FIG. 2 is a schematic view of the supercooling heat exchanger (double-pipe heat exchanger) provided in the refrigerant circuit of the air conditioner shown in FIG. 1. The supercooling heat exchanger 31 of the present embodiment is a double-pipe heat exchanger.

That is, as shown in FIGS. 1 and 2, the supercooling heat exchanger 31 is formed by double pipes including an outer pipe 32 connected to the main refrigerant pipe 25 of the refrigerant circuit, the outer pipe 32 through which the high temperature and high pressure liquid refrigerant flowing out from the outdoor heat exchanger 13 flows, and an inner pipe 33 connected to the bypass refrigerant circuit 26, the inner pipe 33 through which the cooling refrigerant after pressure reduction by the bypass expansion valve 29 flows. More specifically, the inner pipe 33 has one end (inlet side end) 33A connected to the diverting pipe 27, and the other end (outlet side end) 33B connected to the joining pipe 28. By the heat exchange between the high pressure liquid refrigerant flowing through the outer pipe 32 and the gas-liquid two-phase refrigerant flowing through the inner pipe 33, the high pressure liquid refrigerant is supercooled, and the gas-liquid two-phase refrigerant becomes the gas refrigerant by evaporation of the liquid component.

[0026] The supercooling heat exchanger 31 is formed in a U curved structure. Specifically, the supercooling heat exchanger 31 includes two vertical pipes 34A and 34B, and a curve pipe 35 connecting ends of the two vertical pipes 34A and 34B. The curve pipe 35 connects lower ends of the two vertical pipes 34A and 34B. Therefore, inlet side ends 32A and 33A and outlet side ends 32B and 33B of the refrigerant are provided in upper ends of the two vertical pipes 34A and 34B.

[0027] The gas-liquid two-phase cooling refrigerant after the pressure reduction by the bypass expansion valve 29 flows into the inner pipe 33 of the supercooling heat exchanger 31 from the inlet side end 33A, performs the heat exchange with the high pressure liquid refrigerant flowing through the outer pipe 32 while flowing through the inner pipe 33 to become the gas refrigerant, and flows out from the outlet side end 33B. However, in a case where the liquid component of the gas-liquid two-phase refrigerant is not completely evaporated by the heat exchange with the high pressure liquid refrigerant, and when the liquid component flows out from the outlet side end 33B, the liquid component is suctioned by the compressors 11 and a liquid-back phenomenon is generated, so as to cause a decrease in a performance of the compressors 11.

[0028] In the present embodiment, the outlet side end 33B of the inner pipe 33 is provided in the upper end of the vertical pipe 34B. Thus, even when the liquid component of the gas-liquid two-phase refrigerant remains unevaporated, the liquid component does not easily go up toward the outlet side end 33B of the inner pipe 33, and does not easily flow out from the end 33B. Therefore, the liquid-back phenomenon to the compressors 11 can be suppressed. The liquid component of the gas-liquid two-phase refrigerant performs the heat exchange with the high pressure liquid refrigerant in the outer pipe 32 while remaining in the curve pipe 35 to become the gas refrigerant, and then flows out from the outlet side end 33B. Meanwhile, since the two vertical pipes 34A and

34B are connected by the curve pipe 35 having no horizontal part, drift (up-down separation of the liquid component and a gas component) of the gas-liquid two-phase refrigerant between the two vertical pipes 34A and 34B can be suppressed as far as possible.

[0029] Both the inlet side end 32A and the outlet side end 32B of the outer pipe 32, and the inlet side end 33A and the outlet side end 33B of the inner pipe 33 in the supercooling heat exchanger 31 are provided on the same side (upper side) in the up and down direction. Thus, the refrigerant pipe can be connected to these parts without inverting the supercooling heat exchanger 31 upside down. Therefore, a task of connecting the refrigerant pipe to the supercooling heat exchanger 31 can be performed with favorable workability.

[0030] The supercooling heat exchanger 31 is attached onto a bottom frame 43 in a casing of the outdoor unit 2 via a support member 40. This support member 40 is made of rubber, synthetic resin, or the like, and fixed to the bottom frame 43 by fixing tools 42 including bolts, nuts, and the like. A fitting recessed portion 41 recessed in a curved shape is formed on an upper surface of the support member 40. The supercooling heat exchanger 31 is supported by the support member 40 by fitting the curve pipe 35 into the fitting recessed portion 41 and fixing the support member 40 and the curve pipe 35 by a fastening band or the like. The supercooling heat exchanger 31 has relatively high strength in a part of the curve pipe 35. Thus, the supercooling heat exchanger 31 can be stably supported by the support member 40.

[0031] FIG. 3 is a schematic view showing a supercooling heat exchanger (double-pipe heat exchanger) according to a second embodiment.

[0032] A supercooling heat exchanger 31 shown in FIG. 3 includes four vertical pipes 34A to 34D, and three curve pipes 35A to 35C. Ends of the adjacent vertical pipes 34A to 34D are respectively connected by the curve pipes 35A to 35C, so as to be formed in a substantially W form as a whole. Inlet side ends 32A and 33A and outlet side ends 32B and 33B of an outer pipe 32 and an inner pipe 33 are provided in upper ends of the vertical pipes 34A and 34D. The curve pipes 35A and 35C are arranged on the lower part side of the supercooling heat exchanger 31 and are supported by a bottom frame 43 of a casing via a support member 40. Therefore, the supercooling heat exchanger 31 of the present embodiment exerts the same operations and effects as the supercooling heat exchanger 31 shown in FIG. 2. Further, in comparison to the supercooling heat exchanger 31 of the first embodiment, the supercooling heat exchanger 31 of the present embodiment can be formed more compactly in the up and down direction in a case where pipe length is the same. However, since the number of the curve pipes 35A to 35C is higher in the present embodiment, a pressure loss of the refrigerant is more easily generated. Thus, in this point, the first embodiment is more advantageous.

[0033] The present invention is not limited to the above

embodiments but can be appropriately changed within the scope of the invention described in the claims.

[0034] For example, the supercooling heat exchanger (double-pipe heat exchanger) 31 of the present invention can also be applied to a refrigerant circuit shown in FIG. 4. In this refrigerant circuit, the supercooling heat exchanger 31 performs the heat exchange between the high pressure liquid refrigerant flowing out from the outdoor heat exchanger 13 and the gas-liquid two-phase refrigerant after the pressure reduction by the indoor expansion valve 15, a part of the gas-liquid two-phase refrigerant being evaporated in the indoor heat exchanger 16. It should be noted that in this refrigerant circuit, the high pressure liquid refrigerant can be favorably supercooled by the supercooling heat exchanger 31 even at the time of the heating operation.

[0035] In the supercooling heat exchanger 31 shown in FIG. 3, the pluralities of vertical pipes 34A to 34D and curve pipes 35A to 35C are arranged on one straight line in a plan view. However, for example, the pipes may be arranged in a square form or a substantially Z form in a plan view. The supercooling heat exchanger 31 may include six or more vertical pipes (and five or more curve pipes).

REFERENCE SIGNS LIST

[0036]

- 1: AIR CONDITIONER
- 2: OUTDOOR UNIT
- 10: REFRIGERANT CIRCUIT
- 11: COMPRESSOR
- 12: FOUR WAY VALVE
- 13: OUTDOOR HEAT EXCHANGER
- 14: OUTDOOR EXPANSION VALVE
- 15: INDOOR EXPANSION VALVE
- 16: INDOOR HEAT EXCHANGER
- 31: SUPERCOOLING HEAT EXCHANGER (DOUBLE-PIPE HEAT EXCHANGER)
- 32: OUTER PIPE
- 33: INNER PIPE
- 33A: INLET SIDE END
- 33B: OUTLET SIDE END
- 34A to 34D: VERTICAL PIPE
- 35: CURVE PIPE
- 35A to 35C: CURVE PIPE
- 40: SUPPORT MEMBER
- 43: BOTTOM FRAME

Claims

1. A double-pipe heat exchanger (31) comprising:

an outer pipe (32) through which a high pressure liquid refrigerant flows; and
an inner pipe (33) having an inlet side end (33A)

into which a low pressure gas-liquid two-phase refrigerant obtained by reducing pressure of the high pressure liquid refrigerant flows, and an outlet side end (33B) connected to a suction side part of a compressor, wherein 5
the double-pipe heat exchanger includes a plurality of vertical pipes (34A, 34B, 34C, 34D) arranged in the up and down direction, and a curve pipe (35, 35A, 35B, 35C) connecting ends of the plurality of vertical pipes (34A, 34B, 34C, 34D), 10
the outlet side end (33B) of the inner pipe (33) is provided in an upper end of one vertical pipe (34B, 34D), and
the inlet side end (33A) of the inner pipe (33) is provided in an upper end of the other vertical pipe (34A). 15

2. The double-pipe heat exchanger according to claim 1, wherein 20
the two vertical pipes (34A, 34B) are provided, and lower ends of the vertical pipes (34A, 34B) are connected by the curve pipe (35).
3. An air conditioner comprising: 25
a compressor (11);
a condenser (13, 16) for condensing a high pressure gas refrigerant compressed by the compressor (11);
a pressure reduction mechanism (15, 14) for reducing pressure of the condensed high pressure liquid refrigerant; 30
an evaporator (16, 13) for evaporating the low pressure refrigerant after pressure reduction; and
the double-pipe heat exchanger (31) according to claim 1 or 2, the double-pipe heat exchanger (31) for supercooling the high pressure liquid refrigerant condensed by the condenser (13, 16) before reducing the pressure of the refrigerant by the pressure reduction mechanism (15, 14). 35 40
4. The air conditioner according to claim 3, wherein 45
the curve pipe (35) connected to lower ends of the plurality of vertical pipes (34A, 34B, 34C, 34D) in the double-pipe heat exchanger (31) is supported on a bottom frame (43) of a casing in the air conditioner via a support member (40). 50

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FIG. 1

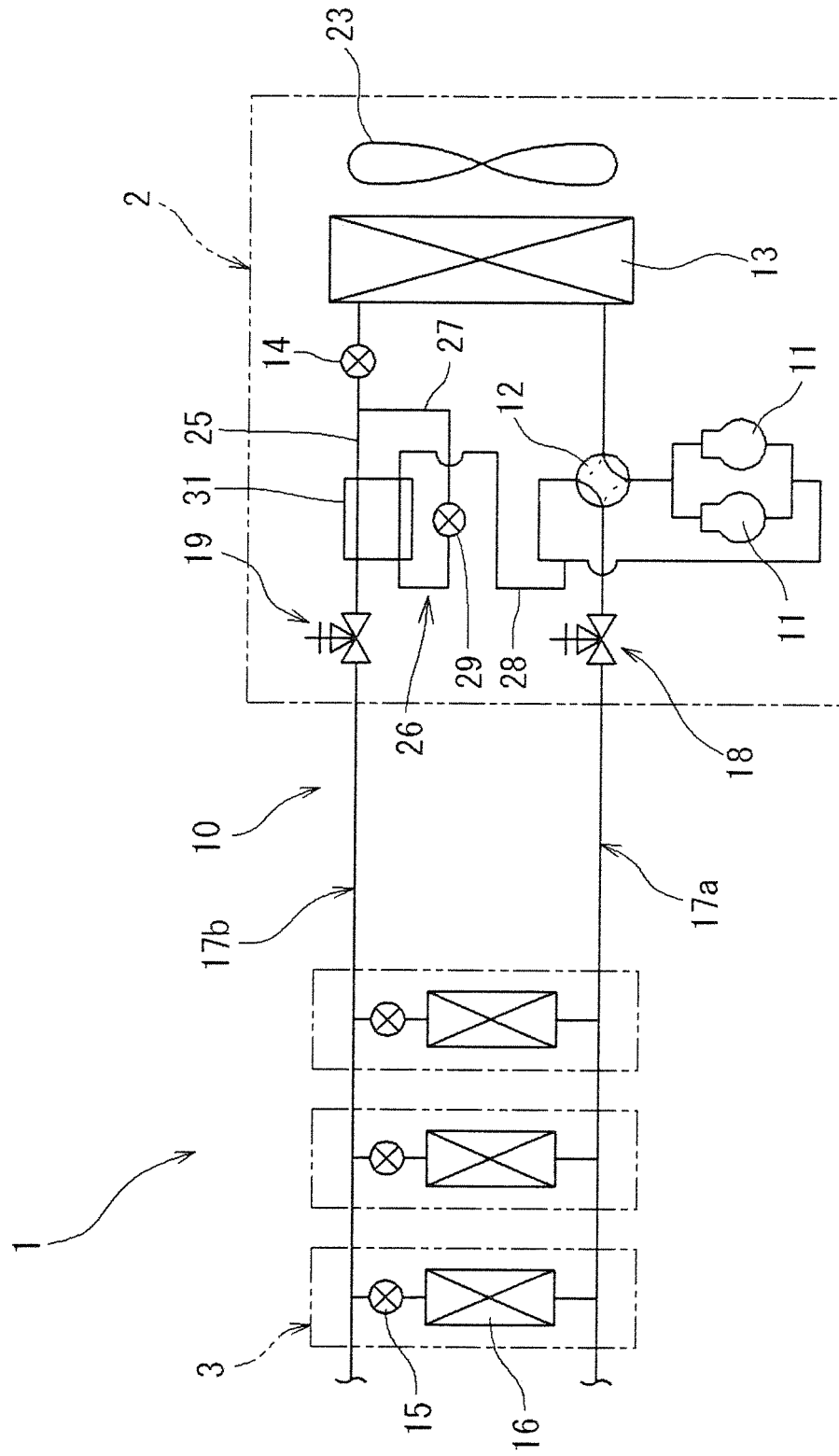


FIG. 2

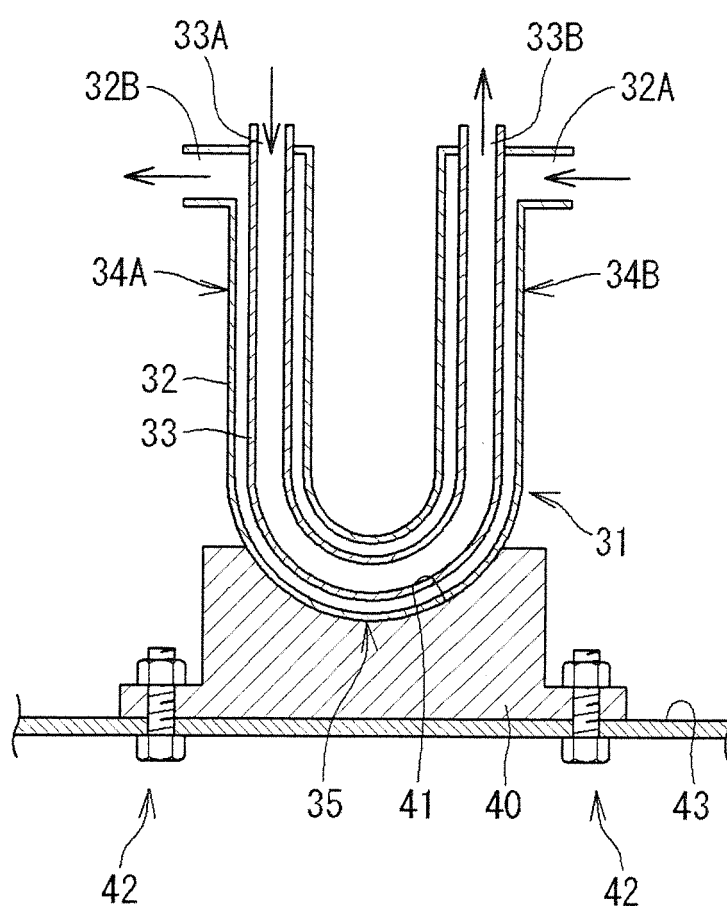


FIG. 3

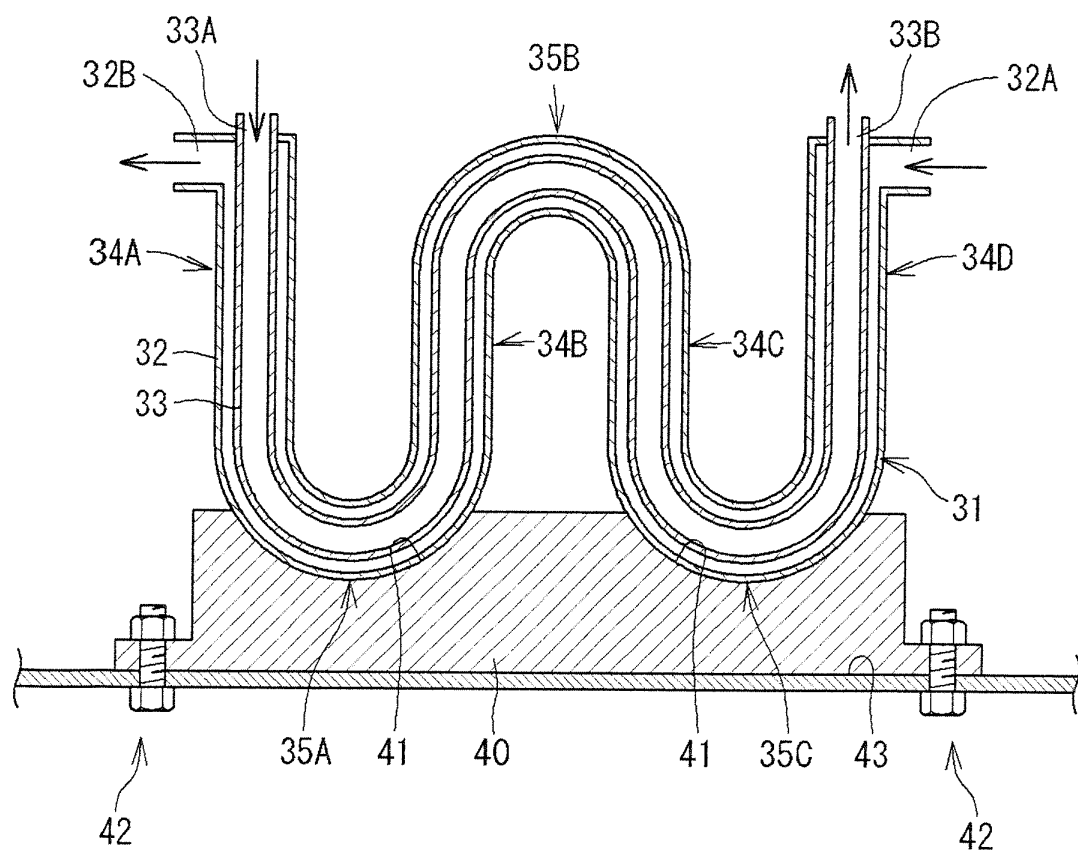
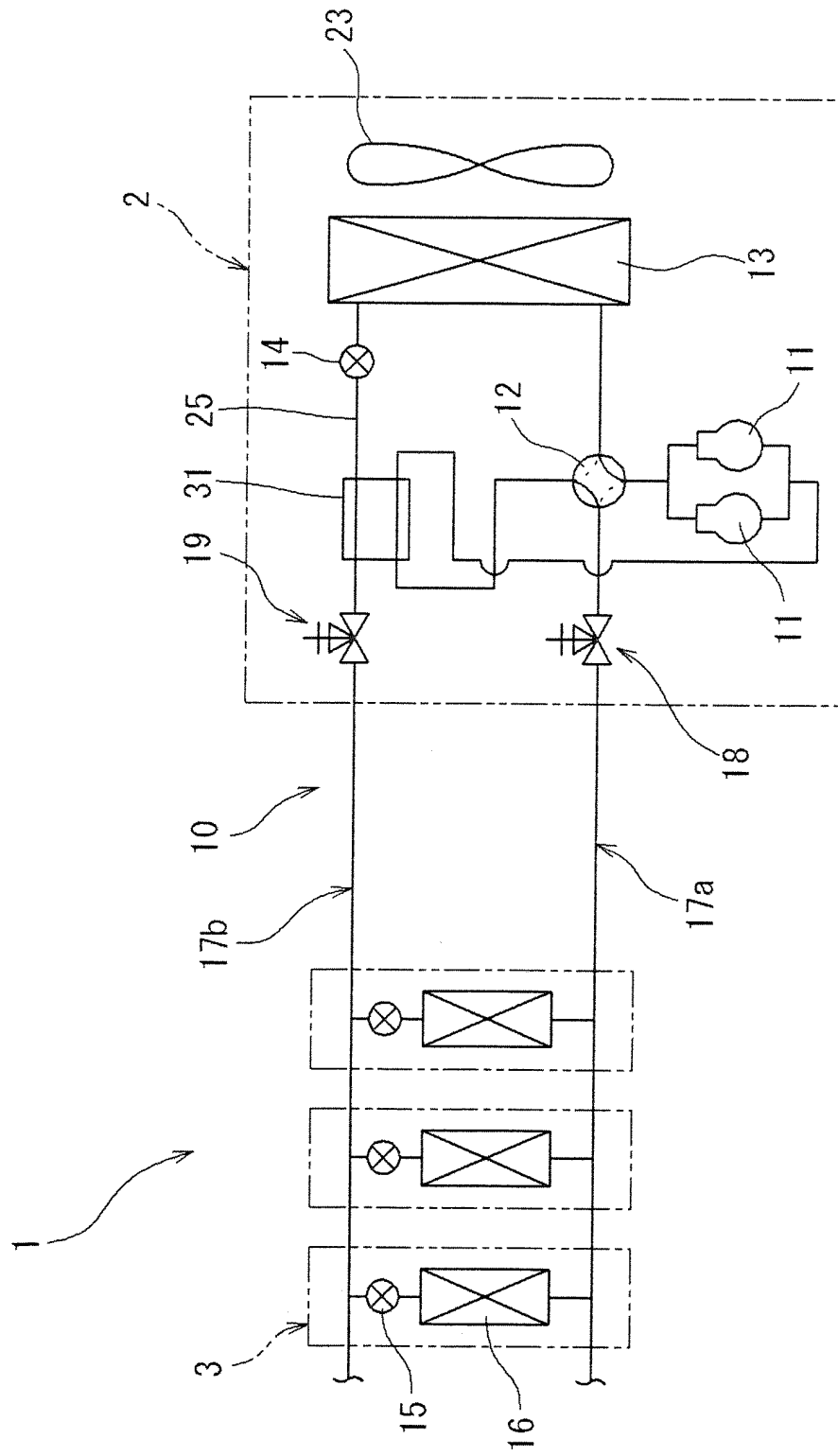


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/078678

5	A. CLASSIFICATION OF SUBJECT MATTER F28D7/06(2006.01)i, F25B1/00(2006.01)i, F25B40/00(2006.01)i, F25B13/00(2006.01)n	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F28D7/06, F25B1/00, F25B40/00, F25B13/00	
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 1996-2013 Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
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30	Y	JP 2008-2771 A (Denso Corp.), 10 January 2008 (10.01.2008), claim 2; fig. 3, 7 (Family: none)
35		
40	☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.	
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "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 "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 01 February, 2013 (01.02.13)	Date of mailing of the international search report 12 February, 2013 (12.02.13)
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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