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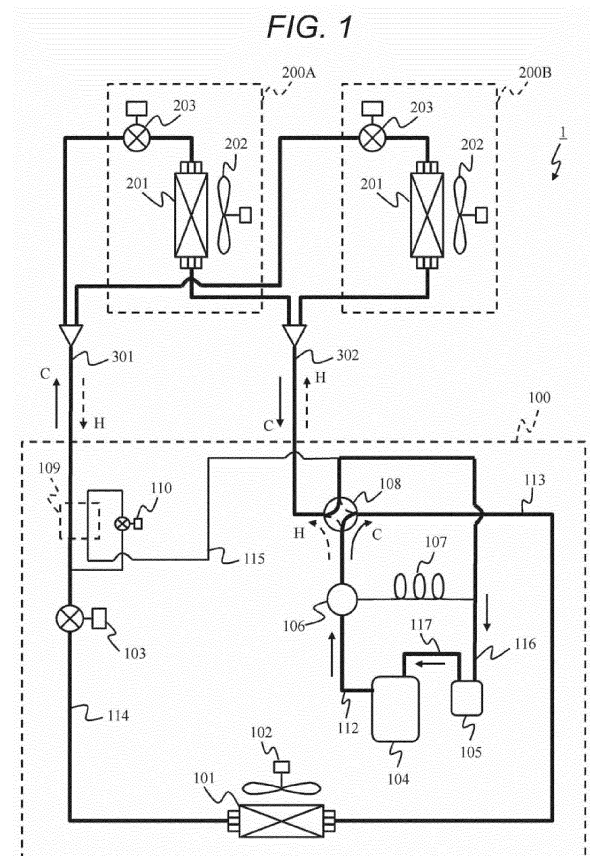
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(54) **Air conditioner**

(57) The separation between a liquid refrigerant and a lubricant inside an accumulator is prevented, and the amount of the lubricant supplied to a compressor is ensured. As a refrigerant, a refrigerant made of only R32 or a mixed refrigerant containing predetermined mass percent or more of the R32 is used. The refrigerant mixed with a predetermined level or more of the lubricant to prevent the occurrence of the two-layer separation between the liquid refrigerant and the lubricant is supplied to a compressor (104) of an outdoor unit (100). The lubricant separated by an oil separator (106) is returned to the accumulator (105) by an oil return capillary (107) to prevent the occurrence of a two-layer separation area in the accumulator. By the supply of a gas refrigerant containing an appropriate amount of the liquid refrigerant from the accumulator (105) to the compressor (104), the lubricant can be supplied to the compressor (104).



Description

Technical Field

[0001] The present invention relates to an air conditioner.

Background Art

[0002] A known technique uses an HFC (Hydro Fluorocarbon) refrigerant as a refrigerant for an air conditioner and PVE (Polyvinylether) oil compatible with the refrigerant as refrigerating machine oil (Patent Literature 1). In addition, considering the fact that the temperature of R32 serving as an HFC refrigerant discharged from a compressor becomes higher than a conventional refrigerant R410A by 10 to 15°C, a known technique sets refrigerant quality on the suction side of the compressor at 0.65 or more and 0.85 or less to reduce the discharge temperature (Patent Literature 2).

Citation List

Patent Literature

[0003]

Patent Literature 1: JP 11-325620 A

Patent Literature 2: JP 3956589 B2

Summary of Invention

[0004] Because of its low GWP (Global Warming Potential) level, R32 serving as an HFC refrigerant has been expected to be an environmentally-friendly refrigerant. However, as to the mixing characteristics of a refrigerant R32 and a lubricant, the compatibility of the refrigerant R32 reduces with a low lubricant mixing ratio, which causes an area where the mixture of the refrigerant R32 and the lubricant is separated into the two layers of the lubricant and a liquid refrigerant.

[0005] In addition, a refrigerant R32 is controlled to have less refrigerant quality on the suction side of a compressor than a conventional refrigerant R410A. Accordingly, when the R32 is used, a lubricant mixing ratio in the mixture of a liquid refrigerant and a lubricant inside an accumulator provided on the suction side of the compressor becomes low. For this reason, two-layer separation is likely to occur between the liquid refrigerant and the lubricant inside the accumulator, which makes it difficult to return the lubricant to the compressor. Thus, due to a shortage of the lubricant in the compressor, a problem such as improper lubrication is caused. As a result, reliability is decreased.

[0006] Accordingly, it is an object of the present invention to provide an air conditioner capable of preventing the two-layer separation between a liquid refrigerant and a lubricant and reducing the occurrence of improper lu-

brication.

[0007] In order to solve the above-described problems, an air conditioner according to the present invention is the air conditioner in which an indoor unit and an outdoor unit are connected to each other via a pipe to circulate a refrigerant, characterized in that a refrigerant made of only R32 or a mixed refrigerant containing a predetermined mass percent or more of the R32 is used as the refrigerant, and the refrigerant mixed with a predetermined level or more of a lubricant to prevent an occurrence of two-layer separation between a liquid refrigerant and the lubricant is supplied to a compressor of the outdoor unit.

[0008] The outdoor unit may include the compressor, an oil separator connected to a discharge side of the compressor and configured to separate and collect oil from the refrigerant discharged from the compressor, an accumulator connected to an inflow side of the compressor, configured to separate the liquid refrigerant from the refrigerant and accumulate the same, and configured to supply a gas refrigerant to the compressor, and a supply oil amount control unit configured to return the lubricant separated by the oil separator to the accumulator to control a lubricant mixing ratio in a mixture of the liquid refrigerant and the lubricant accumulated in the accumulator to a predetermined level or more.

[0009] According to an embodiment of the present invention, it is possible to prevent the occurrence of the two-layer separation between a liquid refrigerant and a lubricant and reduce improper lubrication to enhance reliability.

Brief Description of Drawings

[0010]

FIG. 1 is a circuit configuration diagram of an air conditioner.

FIG. 2 is a vertical cross-sectional view of an accumulator.

FIG. 3 is a graph showing the mixing characteristics of a refrigerant R32 and a lubricant.

Description of Embodiment

[0011] Hereinafter, a description will be given of an embodiment of the present invention with reference to the drawings. In the embodiment, as will be described in detail below, a refrigerant mixed with a predetermined level or more of a lubricant is supplied to a compressor in a case in which the refrigerant containing at least predetermined mass percent or more of R32 serving as an HFC refrigerant is used. Specifically, in a mixture (mixture of a liquid refrigerant and the lubricant) accumulated in an accumulator connected to the inflow side of the compressor, the mixing ratio of the lubricant is set at the predetermined level or more. In order to control the mixing ratio of the lubricant in the mixture inside the accumulator,

the lubricant separated by an oil separator connected to the discharge side of the compressor is returned to the accumulator so as to satisfy a predetermined condition. Here, in the embodiment, the mixed refrigerant containing 70 mass percent or more of the R32 is used. This is because the mixed refrigerant with a ratio of 70 mass percent or more of the R32 becomes equal to the R32 in characteristics such as GWP levels, suction wetness, and compatibility with the oil.

[0012] According to the embodiment, with the control of the mixing ratio of the lubricant in the mixture of the refrigerant R32 and the lubricant inside the accumulator, it is possible to prevent the two-layer separation between the liquid refrigerant and the lubricant inside the accumulator. This results in an increase in the amount of the lubricant contained in the refrigerant supplied from the accumulator to the compressor, which makes it possible to reduce the shortage of the lubricant inside the compressor and improve the reliability of the compressor and an air conditioner.

(First Embodiment)

[0013] The embodiment will be described with reference to FIGS. 1 to 3. FIG. 1 shows a configuration example of the refrigeration cycle of an air conditioner 1 according to the embodiment.

[0014] The refrigeration cycle of the air conditioner 1 includes at least one outdoor unit 100 and at least one indoor unit 200. A plurality of indoor units 200A and 200B are shown in FIG. 1, but they are called the indoor units 200 unless otherwise classified. FIG. 1 shows a case in which one outdoor unit 100 and two indoor units 200 are connected to each other. However, without being limited to this, the refrigerant cycle may include two or more outdoor units 100 and three or more indoor units 200 connected to each other.

[0015] The outdoor unit 100 includes, for example, an outdoor heat exchanger 101, an outdoor fan 102, an outdoor expansion valve 103, a compressor 104, an accumulator 105, an oil separator 106, an oil return capillary 107, a four-way valve 108, a supercooling heat exchanger 109, a supercooling bypass expansion valve 110, and pipes 112 to 117.

[0016] Each of the indoor units 200 includes, for example, an indoor heat exchanger 201, an indoor fan 202, and an indoor expansion valve 203. The outdoor unit 100 and the indoor units 200 are connected to each other by a liquid pipe 121 and a gas pipe 302.

[0017] Here, in the embodiment, a refrigerant made of only R32 or a mixed refrigerant containing 70 mass percent or more of the R32 is used. Next, the operations will be described.

[0018] The compressor 104 includes, for example, a crankcase and a compressor main body (both not shown) provided inside the crankcase, and a lubricant is accumulated at the bottom of the crankcase. During the compressing operation of the compressor main body, the lu-

bricant inside the crankcase is pumped up by the pumping action and supplied to a part where lubrication is required. Some of the lubricant is discharged to the discharge pipe 112 together with the refrigerant.

[0019] A low-pressure gaseous refrigerant flows in the compressor 104 from the accumulator 105 via the pipe 117. The compressor 104 compresses the refrigerant to discharge a high-temperature and high-pressure gaseous refrigerant from the discharge port. The high-pressure gaseous refrigerant discharged from the discharge port of the compressor 104 into the pipe 112 flows in the oil separator 106 via the pipe 112. The high-temperature and high-pressure gaseous refrigerant discharged from the compressor 104 contains the lubricant.

[0020] The oil separator 106 collects the lubricant contained in the high-pressure gaseous refrigerant and returns the collected lubricant to the accumulator 105 via the oil return capillary 107 and the pipe 116. The pipe 116 is a pipe used to connect the port on the compressor inflow port side of the four-way valve 108 and the inflow port of the accumulator 105 to each other. The oil return capillary 107 as an example of a "supply oil amount control unit" is a unit used to control the flow and pressure of the lubricant returned from the oil separator 106 to the accumulator 105.

[0021] The four-way valve 108 is a direction switch valve used to select whether the high-pressure gaseous refrigerant is introduced into the outdoor heat exchanger 101 or the indoor heat exchangers 201 inside the indoor units 200. During a cooling operation, the four-way valve 108 causes the high-pressure gaseous refrigerant to flow in a direction as indicated by an arrow C in FIG. 1. The high-pressure gaseous refrigerant flows in the outdoor heat exchanger 101 serving as a condenser via the pipe 113 that connects the port on the outdoor heat exchanger side of the four-way valve 108 and the suction side of the outdoor heat exchanger 101 to each other.

[0022] When passing through the outdoor heat exchanger 101, the high-temperature and high-pressure gaseous refrigerant is heat-exchanged with outdoor air supplied by the outdoor fan 102 for condensation and converted to a high-temperature and high-pressure liquid refrigerant (liquid refrigerant). The high-temperature and high-pressure liquid refrigerant flows in the outdoor expansion valve 103 via the pipe 114 connected to the exit side of the outdoor heat exchanger 101. A low-pressure liquid refrigerant flowing out from the outdoor expansion valve 103 is branched off. Among the branched liquid refrigerant, some flows in the supercooling bypass expansion valve 110 while other flows in a pipe 301 after being further cooled via the supercooling heat exchanger 109. The pipe 301 is a pipe used to connect the heat exchanger 101 of the outdoor unit 100 and the heat exchangers 201 of the indoor units 200 to each other.

[0023] The liquid refrigerant flowing in the supercooling bypass expansion valve 110 is depressurized by the supercooling bypass expansion valve 110 and flows in the supercooling heat exchanger 109. When passing

through the supercooling heat exchanger 109, the liquid refrigerant flowing in the supercooling heat exchanger 109 is heat-exchanged with another liquid refrigerant for evaporation and converted to a low-pressure gaseous refrigerant. The low-pressure gaseous refrigerant flows in the accumulator 105 via the return pipe 115 connected to the pipe 116.

[0024] The low-pressure liquid refrigerant supplied to the indoor units 200 is depressurized by the indoor expansion valves 203 and flows in the indoor heat exchangers 201. When passing through the indoor heat exchangers 201, the low-pressure liquid refrigerant flowing in the indoor heat exchangers 201 is heat-exchanged with indoor air supplied by the indoor fans 202 for evaporation and converted to a gaseous refrigerant (gas refrigerant).

[0025] When the low-pressure liquid refrigerant is evaporated inside the indoor heat exchangers 201, air inside a room is refrigerated to cool the room. The gas refrigerant flowing out from the indoor heat exchangers 201 is supplied to the outdoor unit 100 via the gas pipe 302.

[0026] The gas refrigerant flowing in the outdoor unit 100 flows in the accumulator 105 via the four-way valve 108 and the pipe 116. The accumulator 105 accumulates a non-evaporated liquid refrigerant to prevent the liquid refrigerant from flowing in the compressor 104. This is because there is a likelihood of damage or the like to the parts of the compressor 104 when the compressor 104 compresses the liquid refrigerant.

[0027] The gaseous refrigerant, the liquid refrigerant, and the lubricant returned from the oil separator 106 flow in the accumulator 105. The gas refrigerant and the lubricant are mixed together inside the accumulator 105 and supplied to the compressor 104. The liquid refrigerant remains in the accumulator 105.

[0028] Next, a heating operation will be described. The flow of a refrigerant at the heating operation is indicated by an arrow H. After the separation of a lubricant by the oil separator 106, a high-temperature and high-pressure gas refrigerant discharged from the compressor 104 is supplied to the gas pipe 302 via the four-way valve 108. The lubricant separated by the oil separator 106 is supplied to the accumulator 105 via the oil return capillary 107.

[0029] The high-temperature and high-pressure gas refrigerant from the outdoor unit 100 is supplied to the indoor units 200 via the gas pipe 302. When flowing through the indoor heat exchangers 201, the high-temperature gas refrigerant supplied to the indoor units 200 is heat-exchanged with indoor air supplied by the indoor fans 202 for condensation and converted to a liquid refrigerant. The liquid refrigerant flows out from the indoor units 200 via the indoor expansion valves 203. The high-temperature and high-pressure gas refrigerant is heat-exchanged with the indoor air at the indoor heat exchangers 201 to perform the heating operation.

[0030] The liquid refrigerant flowing out from the indoor units 200 flows in the outdoor unit 100 via the liquid pipe

301. After passing through the outdoor expansion valve 103, the liquid refrigerant flowing in the outdoor unit 100 is branched off into two liquid refrigerants. Among the branched liquid refrigerants, some flows in the supercooling bypass expansion valve 110 and is supplied to the accumulator 105 via the pipes 115 and 116.

[0031] While, other liquid refrigerant is depressurized by the outdoor expansion valve 103 and then flows in the outdoor heat exchanger 101. When flowing through the outdoor heat exchanger 101, the liquid refrigerant is heat-exchanged with outdoor air supplied by the outdoor fan 102 for evaporation and converted to a gas refrigerant. The gas refrigerant flows in the accumulator 105 via the four-way valve 108 and the pipe 116. As described above, the gas refrigerant and the lubricant flow in the accumulator 105 to be mixed together, and the gas refrigerant containing the lubricant is supplied to the compressor 104.

[0032] FIG. 2 shows the accumulator 105 inside the outdoor unit 100 of the refrigeration cycle in FIG. 1.

[0033] Inside the accumulator 105, the pipe 116 for introduction (introduction pipe) and the pipe 117 for delivery (delivery pipe) are inserted and attached. The introduction pipe 116 is a pipe used to introduce the gas refrigerant and/or the lubricant into the accumulator 105.

[0034] The delivery pipe 117 has a substantially U-shape on the tip end side thereof and is a pipe used to supply the gas refrigerant mixed with the lubricant from the accumulator 105 to the compressor 104. The delivery pipe 117 is attached to the accumulator 105 with the U-shaped curve thereof positioned on the bottom side of the accumulator 105. Thus, the U-shaped curve of the delivery pipe 117 is soaked in the liquid refrigerant accumulated in the accumulator 105.

[0035] The delivery pipe 117 has a first liquid return port 121A at the U-shaped curve thereof. In addition, the delivery pipe 117 has a second liquid return port 121B positioned on an upper side than the first liquid return port 121A. Moreover, the delivery pipe 117 has, on the upper side thereof, a pressure equalization hole 122 positioned on the upper side of the accumulator 105 and used to control pressure inside the delivery pipe 117.

[0036] The refrigerant and lubricant flowing in the accumulator 105 via the introduction pipe 116 are separated into the liquid and gas. The gas refrigerant is supplied to the compressor 104 via the delivery pipe 117. With the circulation of the gas refrigerant, the liquid is sucked in the delivery pipe 117 from the first liquid return port 121A and supplied from the accumulator 105 to the compressor 104 at a predetermined liquid mixing ratio.

[0037] If the liquid level of the accumulator 105 is above the second liquid return port 121B, the liquid is also sucked from the second liquid return port 121B, which increases the liquid mixing ratio. The liquid mixing ratio is controlled by the hole diameters of the two liquid return ports 121A and 121B and the hole diameter of the pressure equalization hole 122.

[0038] Here, in the embodiment, a conventional refrigerant

erant R410A is replaced with the refrigerant R32 having a lower GWP. The use of the R32 as a refrigerant results in an increase in the discharge temperature of the compressor 104 by 10 to 15°C. In the embodiment, the suction quality of the compressor 104 is kept at a lower level than in the past to prevent the increase in the discharge temperature.

[0039] To this end, the accumulator 105 of the embodiment accumulates a greater amount of the liquid refrigerant than the conventional refrigerant R410A. When the accumulator 105 accumulates a greater amount of the liquid refrigerant than in the past, the lubricant mixing ratio in the mixture accumulated at the lower part of the accumulator 105 becomes low.

[0040] FIG. 3 shows the mixing characteristics of the refrigerant and the lubricant in a case in which the R32 is used as a refrigerant. If the lubricant mixing ratio becomes 40% or less in the refrigerant R32, a two-layer separation area including the layers of the liquid refrigerant and the lubricant occurs at low temperature. That is, the liquid refrigerant is accumulated on the lower side of the accumulator 105, and the layer of the lubricant is formed on the layer of the liquid refrigerant.

[0041] When the occurrence condition of the two-layer separation area is met, the mixture is separated into the liquid refrigerant and the lubricant on the lower side of the accumulator 105. If the density of the lubricant is lower than that of the liquid refrigerant, the lubricant floats on the upper side. When floating on the upper side of the liquid refrigerant, the lubricant is not sucked in the delivery pipe 117 from the first liquid return port 121A, which reduces the amount of the lubricant supplied to the compressor 104. The reduction in the amount of the lubricant supplied to the compressor 104 causes a problem such as improper lubrication. As a result, reliability may be decreased.

[0042] In view of this, in the embodiment, the shape (such as the pipe area and pipe length) of the oil return capillary 107 is designed such that a predetermined amount or more of the lubricant collected by the oil separator 106 is returned to the accumulator 105. A method for setting the design is as follows.

[0043] The ratio of the liquid flowing from the accumulator 105 to the compressor 104 is expressed as R (= (the flow of the refrigerant liquid + the flow of the lubricant) / (the total flow of the refrigerant)). The lubricant mixing ratio at a two-layer separation limit (the boundary between a soluble area and a separation area in the mixture) in the mixture of the liquid refrigerant and the lubricant inside the accumulator 105 is expressed as n (= the amount of the lubricant/the amount of the refrigerant liquid). The oil return ratio of the lubricant flowing through the oil return capillary 107 is expressed as x (= the flow of the lubricant/the total flow of the refrigerant). The circulation ratio of the lubricant flowing from the oil separator 106 to the refrigeration cycle is expressed as y (= the flow of the lubricant/the total flow of the refrigerant) is expressed as y.

[0044] The oil return ratio x of the lubricant flowing through the oil return capillary 107 is found by the following formula (1).

$$x \geq n \times R - y \quad (1)$$

[0045] As to the characteristics shown in FIG. 3, it seems that the occurrence of the two-layer separation can be prevented if the lubricant mixing ratio is set at 40% (n = 0.4) or more and preferably 50% (n = 0.5) or more. Therefore, the following formula (2) is established.

$$x \geq 0.5 \times R - y \quad (2)$$

[0046] Note that the ratio R of the liquid flowing from the accumulator 105 to the compressor 104 is controlled by the hole diameters of the liquid return ports 121A and 121B and the hole diameter of the pressure equalization hole 122 of the delivery pipe 117 of the accumulator 105. In addition, the circulation ratio y of the lubricant flowing from the oil separator 106 to the refrigeration cycle depends on the characteristics of the compressor 104 and the oil separator 106.

[0047] Thus, the use of the R32 as a refrigerant requires an increase in the amount of the liquid refrigerant accumulated in the accumulator 105, which reduces the lubricant mixing ratio. However, in the embodiment, a greater amount of the lubricant collected by the oil separator 106 is returned to the accumulator 105 than in the past. Therefore, the lubricant mixing ratio in the accumulator 105 can be increased to a predetermined level (40% or more and preferably 50% or more). As a result, according to the embodiment, it is possible to hinder the occurrence condition of the two-layer separation area in the accumulator 105 from being met, prevent the separation between the liquid refrigerant and the lubricant, and supply a sufficient amount of the lubricant to the compressor 104.

[0048] Note that the present invention is not limited to the embodiment described above. Persons skilled in the art could make various additions, modifications, and the like, within the scope of the present invention. For example, means for returning the lubricant from the oil separator to the accumulator is not limited to the oil return capillary but may be replaced by other means. In addition, the present invention can be expressed as, for example, "the outdoor unit for the air conditioner that uses the refrigerant made of only the R32 or the mixed refrigerant containing a predetermined mass percent or more of the R32 as a refrigerant and supplies to the compressor the refrigerant mixed with a predetermined level or more of the lubricant to prevent the occurrence of the two-layer separation between the liquid refrigerant and the lubricant."

Reference Signs List

[0049]

1: Air conditioner
 100: Outdoor unit
 101: Heat exchanger
 103: Outdoor expansion valve
 104: Compressor
 105: Accumulator
 106: Oil separator
 107: Oil return capillary
 108: Four-way valve
 109: Supercooling heat exchanger

Claims

1. An air conditioner in which an indoor unit and an outdoor unit (100) are connected to each other via a pipe (301, 302) to circulate a refrigerant, **characterized in that** a refrigerant made of only R32 or a mixed refrigerant containing a predetermined mass percent or more of the R32 is used as the refrigerant, and the refrigerant mixed with a predetermined level or more of a lubricant to prevent an occurrence of two-layer separation between a liquid refrigerant and the lubricant is supplied to a compressor (104) of the outdoor unit (100).
2. The air conditioner according to claim 1, **characterized in that** the outdoor unit (100) includes the compressor (104), an oil separator (106) connected to a discharge side of the compressor (104) and configured to separate and collect oil from the refrigerant discharged from the compressor (104), an accumulator (105) connected to an inflow side of the compressor (104), configured to separate the liquid refrigerant from the refrigerant and accumulate the same, and configured to supply a gas refrigerant to the compressor (104), and a supply oil amount control unit configured to return the lubricant separated by the oil separator (106) to the accumulator (105) to control a lubricant mixing ratio in a mixture of the liquid refrigerant and the lubricant accumulated in the accumulator (105) to a predetermined level or more.
3. The air conditioner according to claim 2, **characterized in that** $x \geq n \times R - y$ is established when an oil return ratio of the lubricant returned from the oil separator (106) to the accumulator by the supply oil amount control unit is expressed as x (where x = a flow of the lubricant/a total flow of the refrigerant),

a ratio of the mixture flowing from the accumulator (105) to the compressor (104) is expressed as R (where $R = (\text{a flow of the liquid refrigerant} + \text{the flow of the lubricant}) / \text{the total flow of the refrigerant}$), the lubricant mixing ratio at a limit at which the mixture of the liquid refrigerant and the lubricant inside the accumulator (105) is separated into two layers is expressed as n (where n = an amount of the lubricant/an amount of the liquid refrigerant), and a circulation ratio of the lubricant collected by the oil separator (106) and circulating in a refrigeration cycle is expressed as y (where y = the flow of the lubricant/the total flow of the refrigerant).

4. The air conditioner according to claim 3, **characterized in that** a value of the n is set at 0.4 or more.

FIG. 1

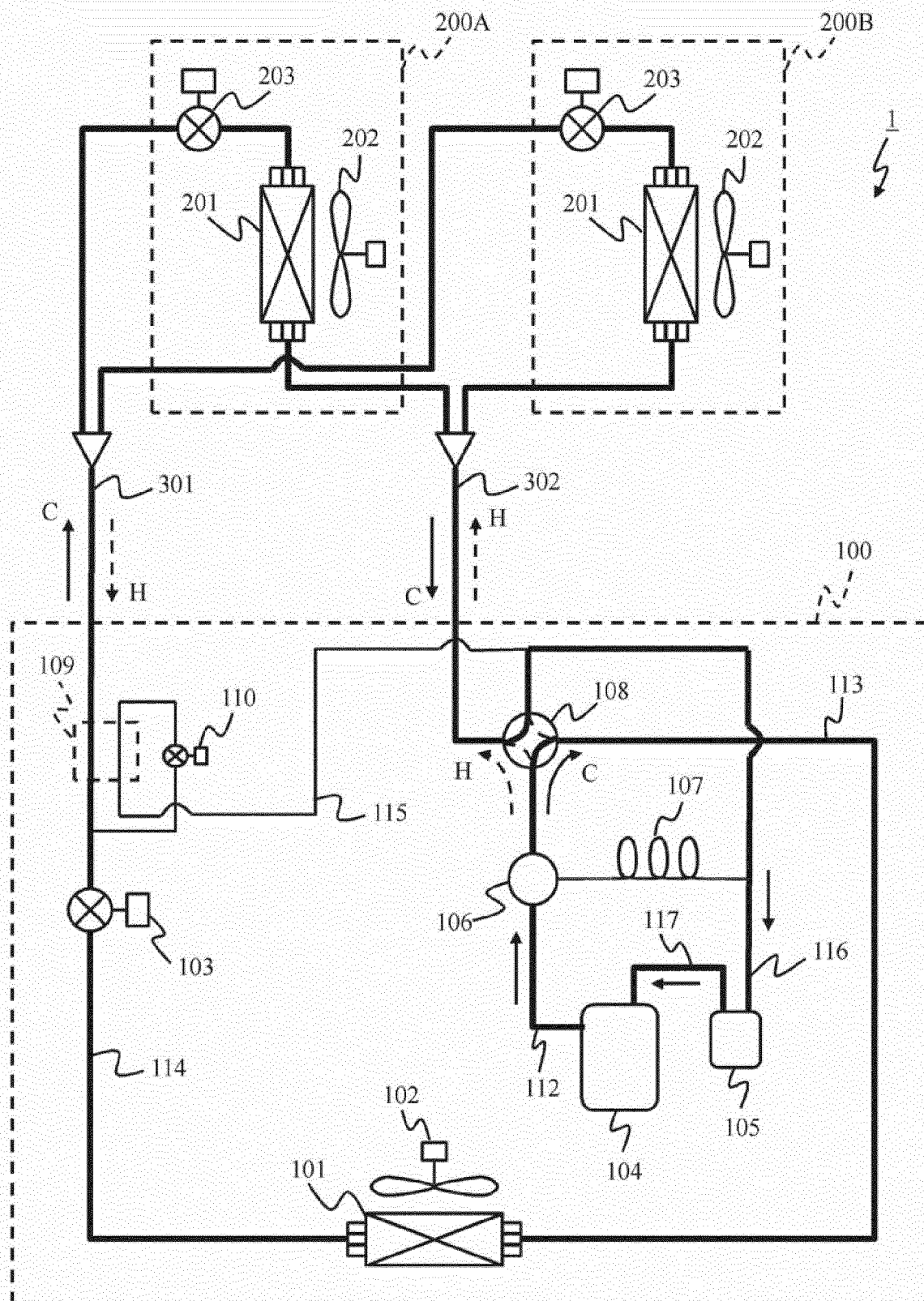


FIG. 2

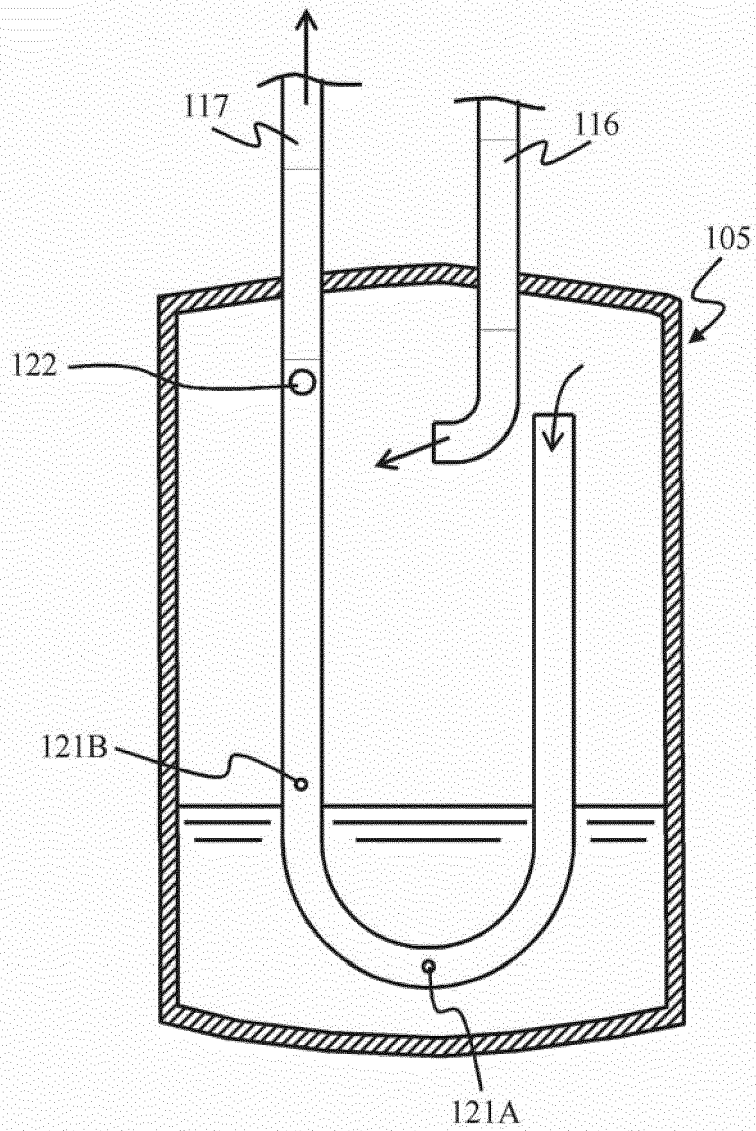
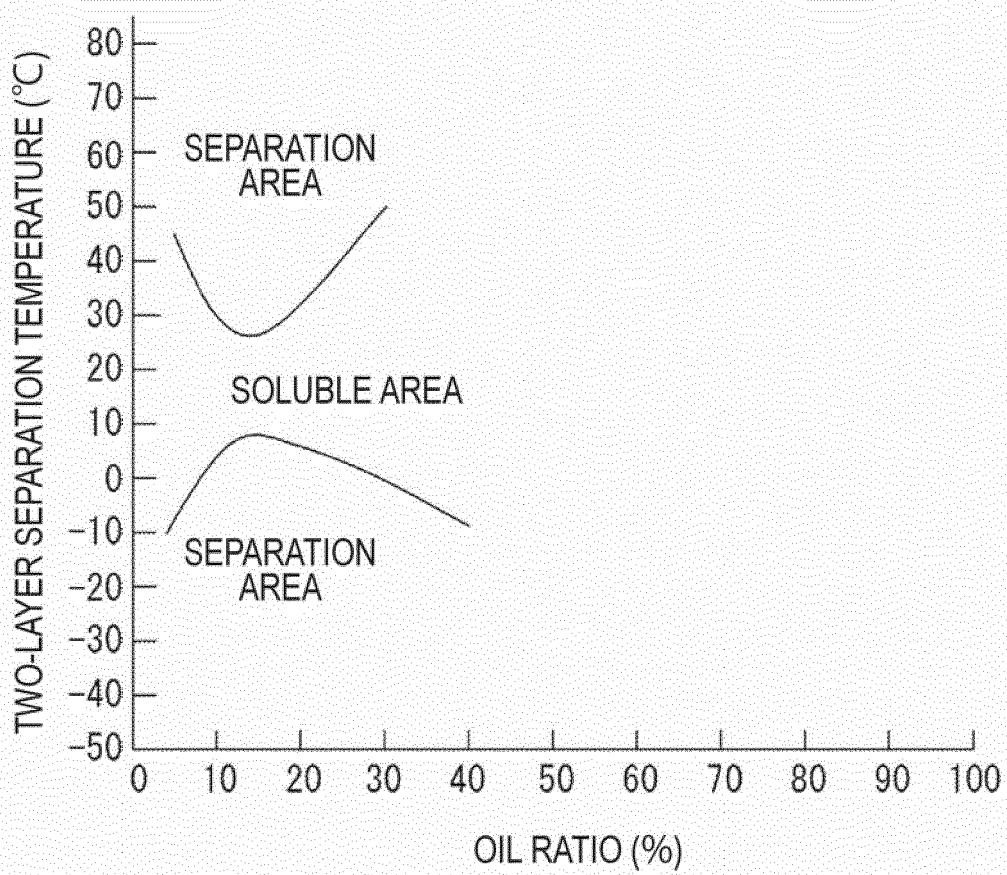


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 13 19 1783

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 485 979 A2 (HITACHI LTD [JP]) 20 May 1992 (1992-05-20) * paragraphs [0016], [0029], [0061]; figures *	1-4	INV. F25B9/00 F25B31/00 F25B43/00
X	EP 1 174 665 A1 (DAIKIN IND LTD [JP]) 23 January 2002 (2002-01-23)	1	
Y	* paragraph [0028]; claim 1; figures *	2-4	
X	EP 1 275 912 A1 (DAIKIN IND LTD [JP]) 15 January 2003 (2003-01-15)	1	
Y	* the whole document *	2-4	
Y	GB 2 159 260 A (MITSUBISHI ELECTRIC CORP) 27 November 1985 (1985-11-27) * column 2, line 61 - column 3, line 77 *	2-4	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 January 2014	Examiner Ritter, Christoph
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 19 1783

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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15-01-2014

Patent document cited in search report		Publication date	Patent family member(s)	Publication date	
EP 0485979	A2	20-05-1992	CN	1063351 A	05-08-1992
			CN	1210961 A	17-03-1999
			DE	69118658 D1	15-05-1996
			DE	69118658 T2	09-01-1997
			DE	69132074 D1	27-04-2000
			DE	69132074 T2	14-12-2000
			DE	69133264 D1	26-06-2003
			DE	69133264 T2	25-03-2004
			EP	0485979 A2	20-05-1992
			EP	0688854 A1	27-12-1995
			EP	0688855 A1	27-12-1995
			ES	2085943 T3	16-06-1996
			ES	2143571 T3	16-05-2000
			ES	2194036 T3	16-11-2003
			JP	2967574 B2	25-10-1999
			JP	H04183788 A	30-06-1992
			SG	75085 A1	19-09-2000
			SG	102554 A1	26-03-2004
			US	5711165 A	27-01-1998
			US	5964581 A	12-10-1999
			US	6029459 A	29-02-2000
			US	6258293 B1	10-07-2001

EP 1174665	A1	23-01-2002	AU	756502 B2	16-01-2003
			AU	2882401 A	27-08-2001
			CN	1366599 A	28-08-2002
			EP	1174665 A1	23-01-2002
			JP	4836305 B2	14-12-2011
			JP	2001227827 A	24-08-2001
			US	2002134092 A1	26-09-2002
			WO	0161255 A1	23-08-2001

EP 1275912	A1	15-01-2003	AU	780335 B2	17-03-2005
			AU	4469401 A	30-10-2001
			BR	0110612 A	29-04-2003
			CA	2402391 A1	25-10-2001
			CA	2711674 A1	25-10-2001
			CA	2711729 A1	25-10-2001
			CN	1425122 A	18-06-2003
			EP	1275912 A1	15-01-2003
			EP	2051025 A1	22-04-2009
			JP	4815656 B2	16-11-2011
			JP	2001304116 A	31-10-2001
			KR	20030009441 A	29-01-2003
			US	2003089124 A1	15-05-2003
			WO	0179766 A1	25-10-2001

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 13 19 1783

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15-01-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2159260	A	27-11-1985	
		AU 557290 B2	18-12-1986
		AU 4257485 A	21-11-1985
		GB 2159260 A	27-11-1985
		JP H049982 B2	21-02-1992
		JP S60245960 A	05-12-1985
		KR 890006727 Y1	30-09-1989
		US 4586351 A	06-05-1986

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 11325620 A [0003]
- JP 3956589 B [0003]