US 20140326019A1

(19) United States
(12) Patent Application Publication
(10) Pub. No.: US 2014/0326019 A1
(43) Pub. Date: Nov. 6, 2014
Kagawa et al.

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

(71) Applicant: **DAIKIN INDUSTRIES, LTD.**, Osaka-shi, Osaka (JP)

(72) Inventors: **Mikio Kagawa**, Sakai-shi (JP); **Tadashi Sao**, Sakai-shi (JP); **Yuusuke Nakagawa**, Sakai-shi (JP); **Katsutoshi Sakurai**, Sakai-shi (JP)

(21) Appl. No.: **14/358,527**

(22) PCT Filed: **Nov. 6, 2012**

(86) PCT No.: **PCT/JP2012/078678**

§ 371 (c)(1), (2), (4) Date: **May 15, 2014**

(30) **Foreign Application Priority Data**

Nov. 30, 2011 (JP) 2011-262525

Publication Classification

(51) **Int. Cl.**

F25B 40/02	(2006.01)
F25B 1/00	(2006.01)
F25B 40/00	(2006.01)
F28D 7/10	(2006.01)

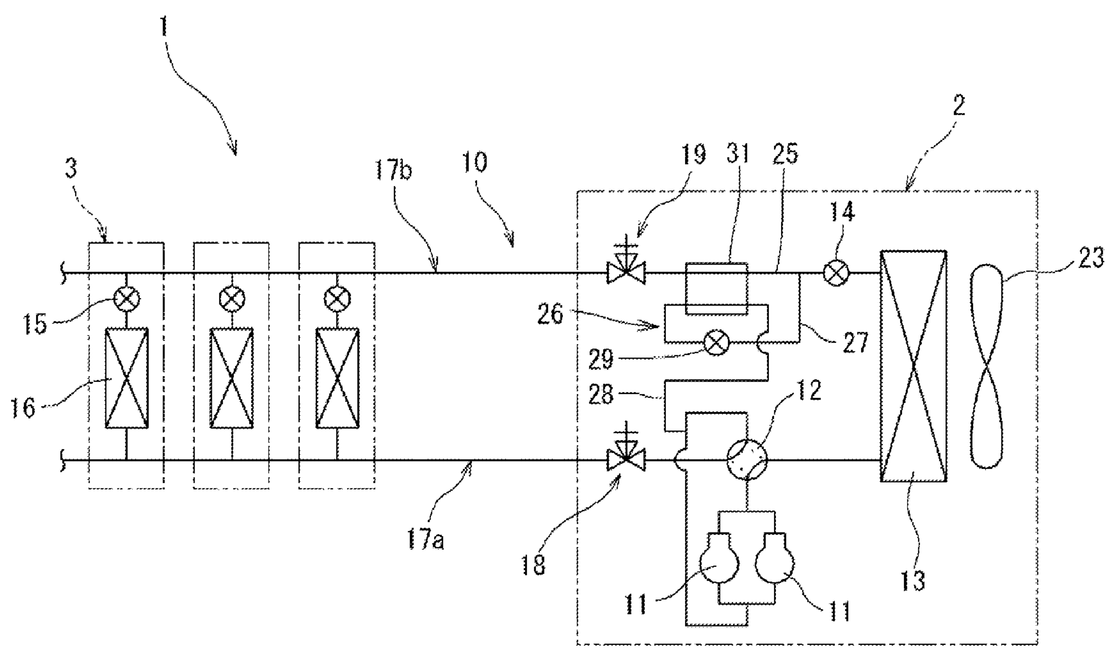
(52) **U.S. Cl.**

CPC . ***F25B 40/02*** (2013.01); ***F28D 7/10*** (2013.01); ***F25B 1/005*** (2013.01); ***F25B 40/00*** (2013.01)

USPC **62/511**; 165/154

(57) **ABSTRACT**

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 includes 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. 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 pipe), 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.



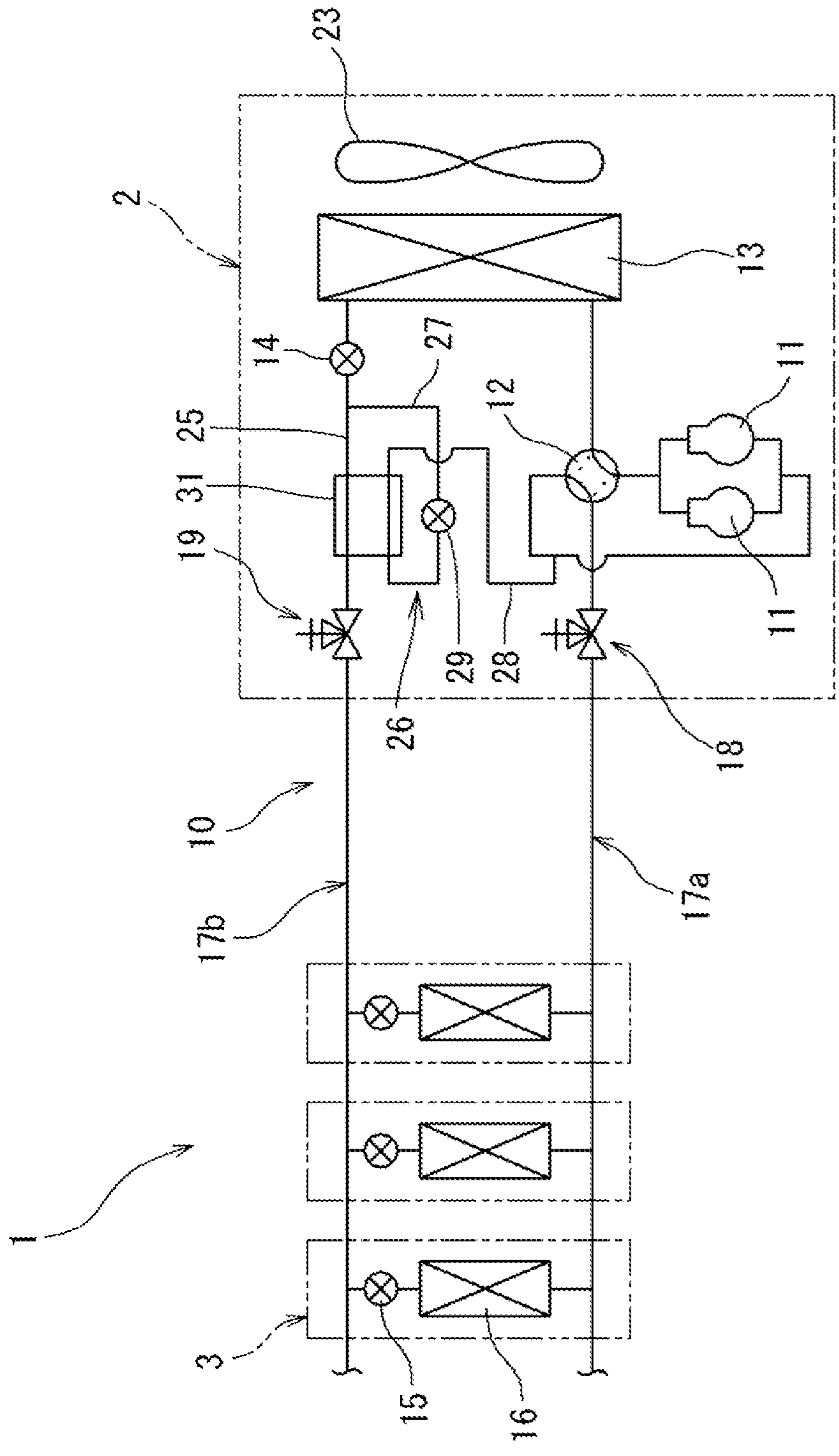


FIG. 1

FIG. 2

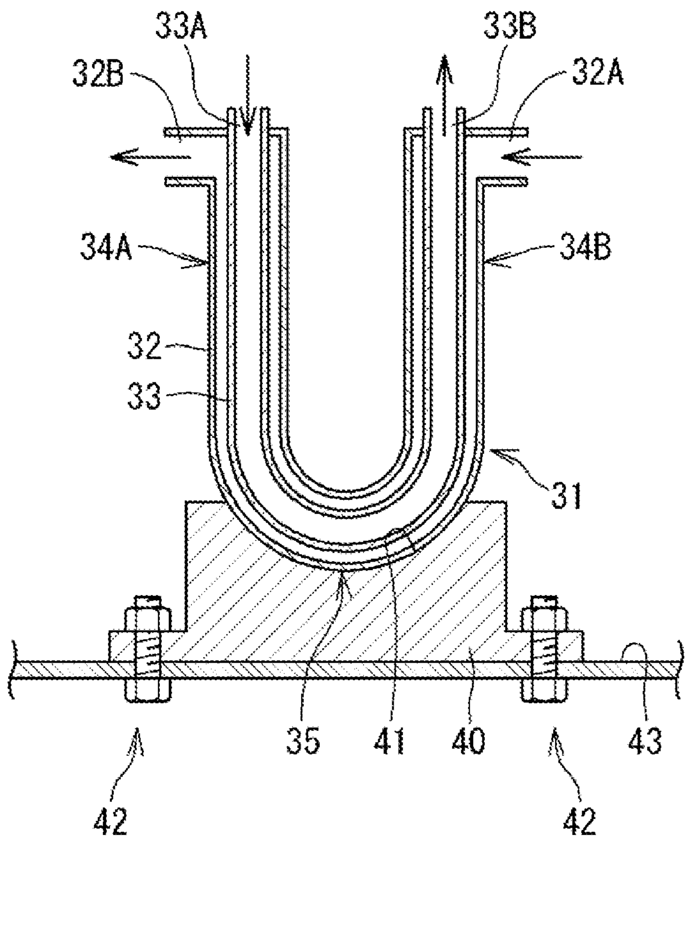


FIG. 3

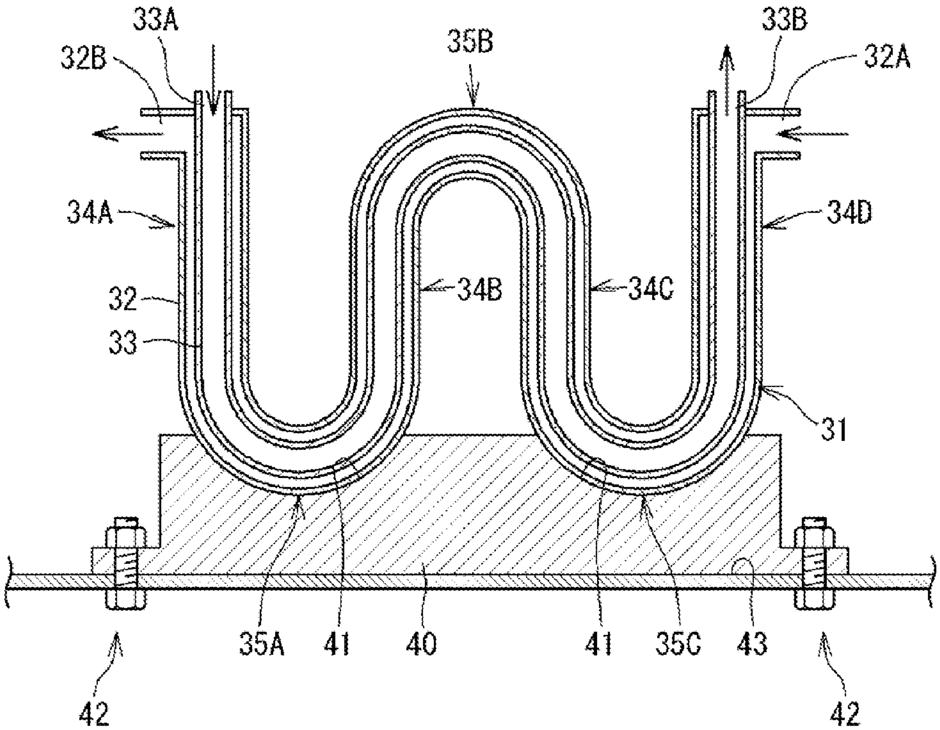
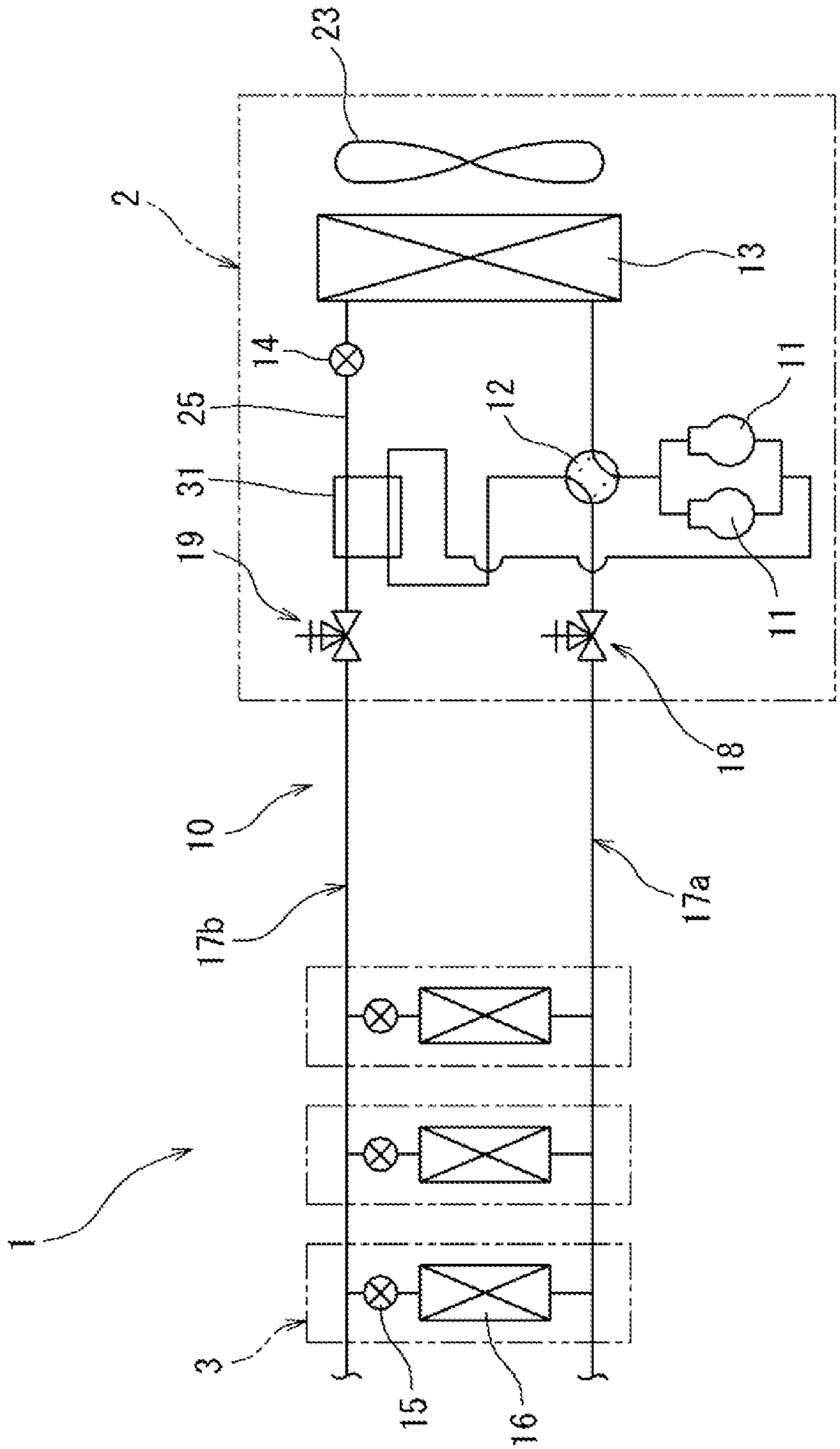

33A
32B
35B
33B
32A
34A
34D
34B
34C
32
33
31
35A
41
40
41
35C
43
42
42

FIG. 4



DOUBLE-PIPE HEAT EXCHANGER AND AIR CONDITIONER USING SAME

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 refrigerant 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 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** is a pattern diagram showing a refrigerant circuit of an air conditioner according to a first embodiment of the present invention.

[0017] 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**.

[0018] 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.

[0019] FIG. **4** is a pattern diagram showing a modified example of the refrigerant circuit of the air conditioner.

DESCRIPTION OF EMBODIMENTS

[0020] FIG. **1** is a pattern diagram showing a refrigerant circuit of an air conditioner according to a first embodiment of the present invention.

[0021] 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.

[0022] 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 **17***a,* and the outdoor expansion valve **14** and the indoor expansion valve **15** are connected by a liquid side refrigerant communication pipe **17***b*. 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 **17***a* is connected to the gas side stop valve **18**, and the liquid side refrigerant communication pipe **17***b* is connected to the liquid side stop valve **19**.

[0023] 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 **17***b*. 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 **17***a,* and suctioned into the compressors **11** via the four way valve **12**.

[0024] 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 **17***b*. 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 he evaporated. The refrigerant evaporated in the outdoor heat exchanger **13** is suctioned into the compressors **11** via the four way valve **12**.

[0025] 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**.

[0026] 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**.

[0027] 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**.

[0028] 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) **33**A connected to the diverting pipe **27**, and the other end (outlet side end) **33**B 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.

[0029] The supercooling heat exchanger **31** is formed in a U curved structure. Specifically, the supercooling heat exchanger **31** includes two vertical pipes **34**A and **34**B, and a curve pipe **35** connecting ends of the two vertical pipes **34**A and **34**B. The curve pipe **35** connects lower ends of the two vertical pipes **34**A and **34**B. Therefore, inlet side ends **32**A and **33**A and outlet side ends **32**B and **33**B of the refrigerant are provided in upper ends of the two vertical pipes **34**A and **34**B.

[0030] 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 **33**A, 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 **33**B. 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 **33**B, 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**.

[0031] In the present embodiment, the outlet side end **33**B of the inner pipe **33** is provided in the upper end of the vertical pipe **34**B. 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 **33**B of the inner pipe **33**, and does not easily flow out from the end **33**B. 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 **33**B. Meanwhile, since the two vertical pipes **34**A and **34**B 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 **34**A and **34**B can be suppressed as far as possible.

[0032] Both the inlet side end **32**A and the outlet side end **32**B of the outer pipe **32**, and the inlet side end **33**A and the outlet side end **33**B 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.

[0033] 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**.

[0034] FIG. **3** is a schematic view showing a supercooling heat exchanger (double-pipe heat exchanger) according to a second embodiment.

[0035] A supercooling heat exchanger **31** shown in FIG. **3** includes four vertical pipes **34**A to **34**D, and three curve pipes **35**A to **35**C. Ends of the adjacent vertical pipes **34**A to **34**D are respectively connected by the curve pipes **35**A to **35**C, so as to be formed in a substantially W form as a whole. Inlet side ends **32**A and **33**A and outlet side ends **32**B and **33**B of an outer pipe **32** and an inner pipe **33** are provided in upper ends of the vertical pipes **34**A and **34**D. The curve pipes **35**A and **35**C arranged on the lower part side of the supercooling heat exchanger **31** 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 **35**A to **35**C 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.

[0036] 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.

[0037] 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.

[0038] In the supercooling heat exchanger **31** shown in FIG. **3**, the pluralities of vertical pipes **34**A to **34**D and curve pipes **35**A to **35**C 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

[0039] **1**: AIR CONDITIONER
[0040] **2**: OUTDOOR UNIT
[0041] **10**: REFRIGERANT CIRCUIT
[0042] **11**: COMPRESSOR
[0043] **12**: FOUR WAY VALVE
[0044] **13**: OUTDOOR HEAT EXCHANGER
[0045] **14**: OUTDOOR EXPANSION VALVE
[0046] **15**: INDOOR EXPANSION VALVE
[0047] **16**: INDOOR HEAT EXCHANGER
[0048] **31**: SUPERCOOLING HEAT EXCHANGER (DOUBLE-PIPE HEAT EXCHANGER)
[0049] **32**: OUTER PIPE
[0050] **33**: INNER PIPE
[0051] **33**A: INLET SIDE END
[0052] **33**B: OUTLET SIDE END
[0053] **34**A to **34**D: VERTICAL PIPE
[0054] **35**: CURVE PIPE
[0055] **35**A to **35**C: CURVE PIPE
[0056] **40**: SUPPORT MEMBER
[0057] **43**: BOTTOM FRAME

1. A double-pipe heat exchanger comprising:
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.

2. The double-pipe heat exchanger according to claim **1**, wherein
the two vertical pipes are provided, and lower ends of the vertical pipes are connected by the curve pipe.

3. An air conditioner comprising:
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 claim **1**, 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.

4. The air conditioner according to claim **3**, wherein
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.

5. An air conditioner comprising:
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 claim **2**, 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.

* * * * *