(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 089 344 A1

(12) # EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
16.11.2022 Bulletin 2022/46

(21) Application number: **20912685.3**

(22) Date of filing: **09.01.2020**

(51) International Patent Classification (IPC):
F25B 1/00 $^{(2006.01)}$ ***F25B 13/00*** $^{(2006.01)}$

(52) Cooperative Patent Classification (CPC):
F25B 1/00; F25B 13/00

(86) International application number:
PCT/JP2020/000494

(87) International publication number:
WO 2021/140622 (15.07.2021 Gazette 2021/28)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

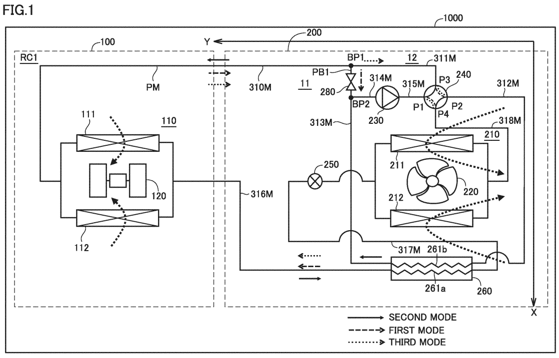
(72) Inventors:
- **SATO, Masanori**
  Tokyo 100-8310 (JP)
- **SHINGU, Wahei**
  Tokyo 100-8310 (JP)

(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Joachimsthaler Straße 10-12
10719 Berlin (DE)

(54) **AIR CONDITIONING APPARATUS**

(57) A flow path switch (240) is provided with a first opening (P1) to a fourth opening (P4). An inner heat exchanger (260) is provided with a first inner flow path (261a) and a second inner flow path (261b). A discharge side of a compressor (230) is connected to the first opening (P1). A first end of a first heat exchange unit (210) is connected to the fourth opening (P4). A first end of the second inner flow path (261b) is connected to the second opening (P2). A first branching portion (BP1) is connected to a first end of the second valve (280) and the third opening (P3). A second end of the second valve (280) is connected to a second branching portion (BP2). The second branching portion (BP2) is connected to a suction side of the compressor (230) and a second end of the second inner flow path (261b). When an operation mode of an air conditioning apparatus (1000) is a first mode, the second valve (280) is open, the first opening (P1) is connected to the fourth opening (P4), and the second opening (P2) is connected to the third opening (P3). When the operation mode of the air conditioning apparatus (1000) is a second mode, the second valve (280) is closed, the first opening (P1) is connected to the third opening (P3), and the second opening (P2) is connected to the fourth opening (P4).

FIG.1



Processed by Luminess, 75001 PARIS (FR)

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an air conditioning apparatus.

BACKGROUND ART

[0002] European regulations on refrigerant require the use of carbon dioxide (CO_2), which is natural refrigerant, also as refrigerant for use in a refrigeration cycle of an air conditioning apparatus. When the CO_2 refrigerant is used, performance is reduced more due to its lower theoretical efficiency than when common refrigerant, such as R407c, is used. In order to reduce a performance decrease, in a known technique, an inner heat exchanger is used to increase a difference in evaporator enthalpy for improved performance.

[0003] For example, a refrigeration cycle apparatus of Japanese Patent Laying-Open No. 2003-194432 (PTL 1) operates as follows. In a cooling operation mode, high-temperature, high-pressure refrigerant discharged from a compressor is cooled in a heat-source-side heat exchanger and is further cooled in an inner heat exchanger. On the other hand, in a heating operation mode, high-temperature, high-pressure refrigerant discharged from the compressor is cooled in a use-side heat exchanger and is further decompressed in a decompressor, and is then flowed into the inner heat exchanger. In the heating operation mode, the inner heat exchanger is seldom used due to a small difference between the temperature of refrigerant flowing through a low-pressure-side flow path and the temperature of refrigerant flowing through a high-pressure-side flow path. Such a configuration allows the refrigerant to circulate in both of the cooling operation mode and the heating operation mode without a four-way valve newly provided.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: Japanese Patent Laying-Open No. 2003-194432

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] The apparatus disclosed in PTL 1, however, has a problem as described below.

[0006] In the cooling operation mode, since the temperature of an external fluid subjected to heat exchange with CO_2 refrigerant in an outdoor heat exchanger is equal to an outdoor air temperature (approximately 30°C to 40°C) in summertime, the refrigerant discharged from the compressor has an extremely high temperature. When the inner heat exchanger is used in the cooling operation mode, the discharge temperature of the compressor may rise further to exceed a limit value at which the compressor operates normally. In such a case, a compressor motor is damaged and refrigeration machine oil degrades, and accordingly, protection control, such as lowering the frequency of the compressor, is performed. As a result, the operating performance of the air conditioning apparatus decreases.

[0007] Moreover, in the cooling operation mode, the CO_2 refrigerant is supercritical within the outdoor heat exchanger. Consequently, the operating performance of the air conditioning apparatus decreases more than when the CO_2 refrigerant is used in a two-phase region. To compensate for such a decrease, the heat transfer area of the outdoor heat exchanger needs to be larger than the heat transfer area of an indoor heat exchanger, which causes a problem as described below. When the inner heat exchanger is used in the cooling operation mode, an amount of refrigerant required increases, increasing a cost and also increasing a risk in case of CO_2 refrigerant leakage. In the heating operation mode, no inner heat exchanger is used, and accordingly, the amount of the refrigerant within the indoor heat exchanger increases. This increases a high pressure in the air conditioning apparatus, decreasing the performance of the air conditioning apparatus.

[0008] An object of the present disclosure is therefore to provide an air conditioning apparatus that has two operation modes and that can achieve high performance even when CO_2 refrigerant is used.

SOLUTION TO PROBLEM

[0009] An air conditioning apparatus of the present disclosure includes a refrigerant circuit which has a compressor, a flow path switch, a first heat exchange unit, a second heat exchange unit, an inner heat exchanger, a first valve, and a second valve, and in which refrigerant flows. The flow path switch is provided with a first opening, a second opening, a third opening, and a fourth opening. The inner heat exchanger is provided with a first inner flow path and a second inner flow path. A discharge side of the compressor is connected to the first opening of the flow path switch. A first end of the first heat exchange unit is connected to the fourth opening of the flow path switch. A second end of the first heat exchange unit is connected to a first end of the first valve. A second end of the first valve is connected to a first end of the first inner flow path of the inner heat exchanger. A second end of the first inner flow path of the inner heat exchanger is connected to a first end of the second heat exchange unit. A first end of the second inner flow path of the inner heat exchanger is connected to the second opening of the flow path switch. A second end of the second heat exchange unit is connected to a first branching portion. The first branching portion is connected to a first end of the second valve and the third opening of the flow path switch. A second end of the second valve is connected to a second branching portion. The second branching portion is connected to a suction side of the compressor and a second end of the second inner flow path of the inner heat exchanger. When an operation mode of the air conditioning apparatus is a first mode, the second valve is configured to open, the first opening is connected to the fourth opening, and the second opening is connected to the third opening. When the operation mode of the air conditioning apparatus is a second mode, the second valve is configured to close, the first opening is connected to the third opening, and the second opening is connected to the fourth opening.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010] In the air conditioning apparatus of the present disclosure, when the operation mode of the air conditioning apparatus is the first mode, the second valve is open, the first opening is connected to the fourth opening, and the second opening is connected to the third opening. When the operation mode of the air conditioning apparatus is the second mode, the second valve is closed, the first opening is connected to the third opening, and the second opening is connected to the fourth opening.

[0011] Therefore, the air conditioning apparatus of the present disclosure has two operation modes and can achieve high performance even when CO_2 refrigerant is used.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

Fig. 1 shows a configuration of an air conditioning apparatus 1000 of Embodiment 1.
Fig. 2 shows a configuration of an air conditioning apparatus 1100 of a reference example.
Fig. 3 is a side view of an outdoor unit 200.
Fig. 4 is another side view of outdoor unit 200.
Fig. 5 shows a configuration of an air conditioning apparatus 1001 of Embodiment 2.
Fig. 6 shows a configuration of an air conditioning apparatus 1002 of Embodiment 3.

DESCRIPTION OF EMBODIMENTS

[0013] Embodiments will now be described with reference to the drawings.

Embodiment 1

[0014] Fig. 1 shows a configuration of an air conditioning apparatus 1000 of Embodiment 1.

[0015] Air conditioning apparatus 1000 includes an outdoor unit 200 and an indoor unit 100. Outdoor unit 200 includes a compressor 230, a first heat exchange unit 210, a flow path switch 240, a first valve 250, a second valve 280, an inner heat exchanger 260, and an outdoor blower 220. First heat exchange unit 210 includes a first outdoor heat exchanger 211 and a second outdoor heat exchanger 212.

[0016] Indoor unit 100 includes a second heat exchange unit 110 and an indoor blower 120. Second heat exchange unit 110 includes a first indoor heat exchanger 111 and a second indoor heat exchanger 112.

[0017] A refrigerant circuit RC1 includes compressor 230, flow path switch 240, first heat exchange unit 210, second heat exchange unit 110, inner heat exchanger 260, first valve 250, and second valve 280. Refrigerant enclosed in refrigerant circuit RC1 is CO_2 refrigerant.

[0018] Flow path switch 240 is formed of a four-way valve. Flow path switch 240 is provided with a first opening P1, a second opening P2, a third opening P3, and a fourth opening P4. A first flow path, which connects first opening P1 to third opening P3 or fourth opening P4, and a second flow path, which connects second opening P2 to fourth opening P4 or third opening P3, are arranged in flow path switch 240.

[0019] Inner heat exchanger 260 is provided with a first inner flow path 261a and a second inner flow path 261b. Refrigerant flowing through first inner flow path 261a and refrigerant flowing through second inner flow path 261b are subjected to heat exchange. First inner flow path 261a is parallel to second inner flow path 261b. A first end of first inner flow path 261a is arranged near a first end of second inner flow path 261b, and a second end of first inner flow path 261a is arranged near a second end of second inner flow path 261b.

[0020] A discharge side of compressor 230 is connected to first opening P1 of flow path switch 240 by a pipe 315M. A first end of first heat exchange unit 210 is connected to fourth opening P4 of flow path switch 240 by a pipe 318M. A second end of first heat exchange unit 210 is connected to a first end of first valve 250 by a pipe 317M. A second end of first valve 250 is connected to the first end of first inner flow path 261a of inner heat exchanger 260 by a pipe 317M. The second end of first inner flow path 261a of inner heat exchanger 260 is connected to a first end of second heat exchange unit 110 by a pipe 316M. The first end of second inner flow path 261b of inner heat exchanger 260 is connected to second opening P2 of flow path switch 240 by a pipe 312M. A second end of second heat exchange unit 110 is connected to a first branching portion BP1 by a pipe 310M. First branching portion BP1 is connected to a first end of second valve 280 by a first bypass pipe PB1. First branching portion BP1 is connected to third opening P3 of flow path switch 240 by a pipe 311M. A second end of second valve 280 is connected to a second branching portion BP2 by first bypass pipe PB1. Second branching portion BP2 is connected to a suction side of compressor 230 by a pipe 314M. Second branching portion BP2 is connected to the second end of second inner flow path 261b of inner heat exchanger 260 by a pipe 313M.

[0021] Pipe 318M, pipe 317M, pipe 313M, pipe 314M, pipe 315M, pipe 316M, pipe 310M, pipe 311M, and pipe 312M constitute a main pipe PM.

[0022] Operation modes of air conditioning apparatus 1000 include a first mode, a second mode, and a third mode. The first mode is, for example, a cooling operation mode. The second mode is, for example, a heating operation mode. The third mode is, for example, a high-load cooling operation mode.

[0023] When the operation mode of air conditioning apparatus 1000 is the first mode and when an outside air temperature exceeds a specified value, the operation mode of air conditioning apparatus 1000 changes to the third mode. In this case, the frequency of compressor 230 remains unchanged. In the present embodiment, a high-load cooling operation is enabled without changing the frequency of compressor 230.

[0024] Compressor 230 compresses sucked refrigerant and discharges the compressed refrigerant.

[0025] Flow path switch 240 switches a flow path of the refrigerant in accordance with the operation mode of air conditioning apparatus 1000.

[0026] When the operation mode of air conditioning apparatus 1000 is the first mode or the third mode, first opening P1 is connected to fourth opening P4, and second opening P2 is connected to third opening P3. Thus, when the operation mode of air conditioning apparatus 1000 is the first mode or the third mode, compressor 230 is connected to first heat exchange unit 210, and inner heat exchanger 260 is connected to second heat exchange unit 110 and second valve 280.

[0027] When the operation mode of air conditioning apparatus 1000 is the second mode, first opening P1 is connected to third opening P3, and second opening P2 is connected to fourth opening P4. Thus, when the operation mode of air conditioning apparatus 1000 is the second mode, compressor 230 is connected to second heat exchange unit 110 and second valve 280, and inner heat exchanger 260 is connected to first heat exchange unit 210.

[0028] First heat exchange unit 210 operates as a condenser in the first mode and the third mode. First heat exchange unit 210 operates as an evaporator in the second mode.

[0029] Second heat exchange unit 110 operates as an evaporator in the first mode and the third mode. Second heat exchange unit 110 operates as a condenser in the second mode.

[0030] In the first mode and the third mode, inner heat exchanger 260 performs heat exchange between the refrigerant flowing from flow path switch 240 to compressor 230 and the refrigerant flowing from first valve 250 to second heat exchange unit 110. In the second mode, inner heat exchanger 260 performs heat exchange between the refrigerant flowing from flow path switch 240 to compressor 230, the refrigerant flowing from second heat exchange unit 110 to first valve 250, and the refrigerant from first valve 250.

[0031] First valve 250 is an electronic expansion valve.

[0032] Second valve 280 is a solenoid valve. Second valve 280 opens in the first mode. Second valve 280 closes in the second mode and the third mode.

[0033] Outdoor blower 220 blows the outdoor air to first outdoor heat exchanger 211 and second outdoor heat exchanger 212. Indoor blower 120 blows the indoor air to first indoor heat exchanger 111 and second indoor heat exchanger 112.

[0034] Description will be given of a flow of the refrigerant when the operation mode of the air conditioning apparatus is the first mode. As indicated by the broken line in Fig. 1, the refrigerant flows in order of compressor 230, flow path switch 240, first heat exchange unit 210, first valve 250, inner heat exchanger 260, second heat exchange unit 110, and first branching portion BP1.

[0035] After first branching portion BP1, part of the refrigerant flows in order of second valve 280, second branching portion BP2, and compressor 230. The rest of the refrigerant flows in order of flow path switch 240, inner heat exchanger 260, second branching portion BP2, and compressor 230.

[0036] Description will be given of a flow of the refrigerant when the operation mode of the air conditioning apparatus is the second mode. As indicated by the solid line in Fig. 1, the refrigerant flows in order of compressor 230, flow path switch 240, second heat exchange unit 110, inner heat exchanger 260, first valve 250, first heat exchange unit 210, flow path switch 240, inner heat exchanger 260, second branching portion BP2, and compressor 230.

[0037] Description will be given of a flow of the refrigerant when the operation mode of the air conditioning apparatus is the third mode. As indicated by the dotted line in Fig. 1, all the refrigerant flows in order of compressor 230, flow path switch 240, first heat exchange unit 210, first valve 250, inner heat exchanger 260, second heat exchange unit 110, first branching portion BP1, flow path switch 240, inner heat exchanger 260, second branching portion BP2, and compressor 230.

[0038] Fig. 2 shows a configuration of an air conditioning apparatus 1100 of a reference example.

[0039] Air conditioning apparatus 1100 of the reference example is different from air conditioning apparatus 1000 of Embodiment 1 in that air conditioning apparatus 1100 of the reference example includes two compressors 230A, 230B, two flow path switches 240A, 240B, and two first valves 250A, 250B.

[0040] Air conditioning apparatus 1100 of the reference example is used, for example, in a train. Air conditioning apparatus 1100 of the reference example uses R407c, which is general refrigerant. Air conditioning apparatus 1100 of the reference example uses two compressors 230A, 230B to achieve the required performance.

[0041] When refrigerant is changed from R407c to CO_2 refrigerant without changing a casing of air conditioning apparatus 1100 of the reference example, the theoretical efficiency of the air conditioning apparatus decreases.

Accordingly, the air conditioning apparatus needs to include an inner heat exchanger.

[0042] When the air conditioning apparatus using the CO_2 refrigerant includes two compressors as in the reference example, the air conditioning apparatus needs to include two inner heat exchangers in correspondence with the two compressors or include one inner heat exchanger and a complicated control mechanism. As a result, the cost of the air conditioning apparatus using the CO_2 refrigerant increases.

[0043] The air conditioning apparatus using the CO_2 refrigerant has a higher operating pressure, and thus, the thickness of each of a heat exchanger and a pipe needs to be increased. Accordingly, the weight of the air conditioning apparatus using the CO_2 refrigerant is greater than the weight of air conditioning apparatus 1100 of the reference example.

[0044] The volume capacity (= evaporation latent heat $\times$ gaseous density) of CO_2 reaches four to five times that of R407c which is general refrigerant, and accordingly, the stroke volume of the compressor (the internal volume of the compression chamber) can be reduced greatly. The compressor of the air conditioning apparatus using the CO_2 refrigerant can thus be much smaller in size than the compressor for general refrigerant. Accordingly, the air conditioning apparatus using the CO_2 refrigerant can include only a single compressor.

[0045] Thus, in terms of performance, cost, and weight, the air conditioning apparatus using the CO_2 refrigerant according to the present embodiment includes one compressor and one inner heat exchanger, as shown in Fig. 1.

[0046] Figs. 3 and 4 are side views of outdoor unit 200.

[0047] An upper surface US of outdoor unit 200 has an arc shape in an X-axis direction, as shown in Fig. 3. Outdoor unit 200 is highest in the central portion in the X-axis direction. In order to improve the performance of air conditioning apparatus 1000, first outdoor heat exchanger 211 and second outdoor heat exchanger 212 need to have a maximum possible size. In order to improve the efficiency of heat exchange by blowing the air to first outdoor heat exchanger 211 and second outdoor heat exchanger 212 by outdoor blower 220, outdoor blower 220 needs to be arranged between first outdoor heat exchanger 211 and second outdoor heat exchanger 212.

[0048] Outdoor blower 220 is arranged at the center of outdoor unit 200 in the X-axis direction. In the X-axis direction, first outdoor heat exchanger 211 is arranged on a first side of outdoor blower 220, and second outdoor heat exchanger 212 is arranged on a second side of outdoor blower 220. In the X-axis direction, compressor 230 is arranged between a first end E1 of outdoor unit 200 and first outdoor heat exchanger 211. In the X-axis direction, inner heat exchanger 260 is arranged between a second end E2 of outdoor unit 200 and second outdoor heat exchanger 212. As a result, compressor 230 and inner heat exchanger 260 are remote from each other in the X-axis direction.

[0049] As shown in Fig. 4, in pipe 310M, a portion between an outlet of indoor unit 100 and first branching portion BP1 is arranged in a Y-axis direction. First bypass pipe PB1 is arranged in the X-axis direction. As compressor 230 and pipe 310M are arranged to provide a minimum possible distance between pipe 310M and compressor 230, first bypass pipe PB1 can have a length smaller than the length of pipe 312M and the length of pipe 313M. For example, in the X-axis direction, first bypass pipe PB1 is arranged between compressor 230 and first end E1 of the outdoor unit, as shown in Fig. 4. It is premised here that the thickness of first bypass pipe PB1, the thickness of pipe 312M, and the thickness of pipe 313M are equal to each other.

[0050] Description will be given of an operation of air conditioning apparatus 1000 when the operation mode of air conditioning apparatus 1000 is the first mode.

[0051] High-temperature, high-pressure refrigerant discharged from compressor 230 flows through flow path switch 240 into first outdoor heat exchanger 211 and second outdoor heat exchanger 212.

[0052] In first outdoor heat exchanger 211 and second outdoor heat exchanger 212, the refrigerant dissipates heat through heat exchange with the outdoor air blown by outdoor blower 220.

[0053] Subsequently, the refrigerant is decompressed in first valve 250 to enter a gas-liquid two-phase state. The refrigerant in the gas-liquid two-phase state flows through inner heat exchanger 260 into first indoor heat exchanger 111 and second indoor heat exchanger 112.

[0054] In first indoor heat exchanger 111 and second indoor heat exchanger 112, the refrigerant absorbs heat through heat exchange with the outside air blown by indoor blower 120, thereby entering the gas state.

[0055] The gaseous refrigerant reaches first branching portion BP1. In the first mode, second valve 280 is open, and accordingly, flow paths from first branching portion BP1 to second branching portion BP2 on the suction side of compressor 230 are a first flow path 11 and a second flow path 12.

[0056] First flow path 11 is a flow path via first bypass pipe PB1 and second valve 280. Second flow path 12 is a flow path via pipe 311M, flow path switch 240, pipe 312M, inner heat exchanger 260, and pipe 313M.

[0057] As the length of first bypass pipe PB1 is made smaller than the length of pipe 312M and the length of pipe 313M as shown in Fig. 4, a flow path resistance LR2 of second flow path 12 is greater than a flow path resistance LR1 of first flow path 11.

[0058] Thus, the flow rate of the refrigerant flowing through first flow path 11 is F1 $\times$ a1, and the flow rate of the refrigerant flowing through second flow path 12 is F1 $\times$ a2, where F1 represents the flow rate of the gaseous refrigerant that has reached first branching portion BP1, and a1 > a2.

$$a1 = LR2/(LR1 + LR2) \ldots (1)$$

$$a2 = LR1/(LR1 + LR2) \ldots (2)$$

[0059] At second branching portion BP2, the refrigerant that has flowed through first flow path 11 and the refrigerant that has flowed through second flow path 12 merge and are sucked by compressor 230. Since a larger amount of refrigerant flows through first flow path 11 having a smaller flow path resistance, an amount of the decrease in the pressure of second branching portion BP2 from the pressure of first branching portion BP1 can be reduced. As a result, the performance of air conditioning apparatus 1000 can be improved.

[0060] In the first mode, the refrigerant (refrigerant A) in the gas-liquid two-phase state from first valve 250 and the refrigerant (refrigerant B) that has flowed from second heat exchange unit 110 to second flow path 12 flow into inner heat exchanger 260. Refrigerant B has a smaller flow rate, and each of refrigerant A and refrigerant B is decompressed refrigerant. Thus, refrigerant A and refrigerant B are seldom subjected to heat exchange in inner heat exchanger 260. In the first mode, accordingly, inner heat exchanger 260 is not used.

[0061] Next, description will be given of an operation when the operation mode of air conditioning apparatus 1000 is the second mode.

[0062] High-temperature, high-pressure refrigerant discharged from compressor 230 flows through flow path switch 240 to first branching portion BP1. In the second mode, second valve 280 is closed, and accordingly, the refrigerant does not flow through first flow path 11 and flows into first indoor heat exchanger 111 and second indoor heat exchanger 112. Liquid refrigerant, the heat of which has been dissipated in first indoor heat exchanger 111 and second indoor heat exchanger 112, is cooled further in inner heat exchanger 260.

[0063] Subsequently, the refrigerant is decompressed in first valve 250 to enter the gas-liquid two-phase state, and then, flows into first outdoor heat exchanger 211 and second outdoor heat exchanger 212. The refrigerant, the heat of which has been absorbed in first outdoor heat exchanger 211 and second outdoor heat exchanger 212, flows through flow path switch 240 into inner heat exchanger 260. The refrigerant is heated in inner heat exchanger 260 to be gas refrigerant. The refrigerant then flows through second branching portion BP2 and is sucked by compressor 230.

[0064] In the second mode, in inner heat exchanger 260, the liquid refrigerant (refrigerant C) from first indoor heat exchanger 111 and second indoor heat exchanger 112 and the refrigerant (refrigerant D) from first outdoor heat exchanger 211 and second outdoor heat exchanger 212 are subjected to heat exchange. Refrigerant C is cooled through heat dissipation to refrigerant D. Refrigerant D is heated through heat absorption from refrigerant C. In the second mode, thus, inner heat exchanger 260 is effectively used.

[0065] Next, description will be given of an operation of air conditioning apparatus 1000 when the operation mode of air conditioning apparatus 1000 is the third mode.

[0066] High-temperature, high-pressure refrigerant discharged from compressor 230 flows through flow path switch 240 into first outdoor heat exchanger 211 and second outdoor heat exchanger 212.

[0067] In first outdoor heat exchanger 211 and second outdoor heat exchanger 212, the refrigerant dissipates heat through heat exchange with the outdoor air blown by outdoor blower 220.

[0068] Subsequently, the refrigerant is decompressed in first valve 250 to enter the gas-liquid two-phase state. The refrigerant in the gas-liquid two-phase state flows through inner heat exchanger 260 into first indoor heat exchanger 111 and second indoor heat exchanger 112.

[0069] In first indoor heat exchanger 111 and second indoor heat exchanger 112, the refrigerant absorbs heat through heat exchange with the outside air blown by indoor blower 120, thereby entering the gas state.

[0070] The gaseous refrigerant reaches first branching portion BP1. In the third mode, second valve 280 is closed, and accordingly, the flow path from first branching portion BP1 to second branching portion BP2 on the suction side of compressor 230 is only second flow path 12. Second flow path 12 is a flow path via pipe 311M, flow path switch 240, pipe 312M, inner heat exchanger 260, and pipe 313M.

[0071] The refrigerant that has flowed to second branching portion BP2 is sucked by compressor 230.

[0072] In the third mode, the refrigerant (refrigerant A) in the gas-liquid two-phase state from first valve 250 and the refrigerant (refrigerant B) that has flowed from second heat exchange unit 110 to second flow path 12 flow into inner heat exchanger 260. Each of refrigerant A and refrigerant B is decompressed refrigerant. Thus, refrigerant A and refrigerant B are seldom subjected to heat exchange in inner heat exchanger 260. In the third mode, accordingly, inner heat exchanger 260 is not used.

[0073] In the third mode, the gaseous refrigerant, which has absorbed heat from the outside air in first indoor heat exchanger 111 and second indoor heat exchanger 112, flows through second flow path 12 having a large flow path resistance, and accordingly, a large pressure drop occurs on the suction side of compressor 230. As a result, the circulation flow rate of the refrigerant decreases, resulting in decreased cooling performance of air conditioning apparatus 1000. When the outside air temperature exceeds a specified value, thus, a high pressure discharged from compressor 230 can be reduced by setting air conditioning apparatus 1000 to the third mode. This can avoid the execution of a protective operation due to a high discharge pressure of compressor 230.

[0074] According to the present embodiment, in terms of cost, weight, and the like, the inner heat exchanger is used in the heating operation in an air conditioning apparatus including one compressor and using the CO_2 refrigerant. Thus, the performance of the air conditioning apparatus can be improved. In this air conditioning apparatus, a bypass path including a solenoid valve is provided at a portion through which low-pressure refrigerant flows in the cooling operation. As a result, a pressure loss at the low-pressure portion can be reduced, resulting in an increased efficiency of the air conditioning apparatus.

Embodiment 2

[0075] Fig. 5 shows a configuration of an air conditioning apparatus 1001 of Embodiment 2.

[0076] Air conditioning apparatus 1001 of Fig. 5 is different from air conditioning apparatus 1000 of the embodiment shown in Fig. 1 in the following point.

[0077] A refrigerant circuit RC2 of air conditioning apparatus 1001 of Fig. 5 includes a second bypass pipe 271 and a third valve 270.

[0078] A third branching portion BP3 between first valve 250 and inner heat exchanger 260 is connected to a fourth branching portion BP4 between inner heat exchanger 260 and second heat exchange unit 110 via third valve 270 by second bypass pipe 271.

[0079] Third valve 270 is formed of, for example, a check valve. The check valve causes the refrigerant to flow from third branching portion BP3 to fourth branching portion BP4, and interrupts a flow of the refrigerant from fourth branching portion BP4 to third branching portion BP3.

[0080] Third valve 270 causes the refrigerant to flow through second bypass pipe 271 when the operation mode of air conditioning apparatus 1001 is the first mode or the third mode, and causes the refrigerant not to flow through second bypass pipe 271 when the operation mode of air conditioning apparatus 1001 is the second mode.

[0081] Description will be given of an operation of air conditioning apparatus 1001 when the operation mode of air conditioning apparatus 1001 is the first mode.

[0082] High-temperature, high-pressure refrigerant discharged from compressor 230 flows through flow path switch 240 into first outdoor heat exchanger 211 and second outdoor heat exchanger 212.

[0083] In first outdoor heat exchanger 211 and second outdoor heat exchanger 212, the refrigerant dissipates heat through heat exchange with the outdoor air blown by outdoor blower 220.

[0084] Subsequently, the refrigerant is decompressed in first valve 250 to enter the gas-liquid two-phase state and reaches third branching portion BP3. Most of the refrigerant in the gas-liquid two-phase state which has reached third branching portion BP3 flows through second bypass pipe 271 and third valve 270 to fourth branching portion BP4. The rest of the refrigerant in the gas-liquid two-phase state which has reached third branching portion BP3 flows through inner heat exchanger 260 to fourth branching portion BP4. The refrigerant after merging at fourth branching portion BP4 from the two flow paths flows into first indoor heat exchanger 111 and second indoor heat exchanger 112.

[0085] Subsequently, in first indoor heat exchanger 111 and second indoor heat exchanger 112, the refrigerant absorbs heat through heat exchange with the outside air blown by indoor blower 120, thereby entering the gas state.

[0086] The gaseous refrigerant reaches first branching portion BP1. In the first mode, second valve 280 is open, and accordingly, the gaseous refrigerant flows from first branching portion BP1 through first flow path 11 and second flow path 12 to second branching portion BP2, as in Embodiment 1. Since the flow path resistance of first flow path 11 is smaller than the flow path resistance of second flow path 12, most of the gaseous refrigerant flows through first flow path 11. The refrigerant that has flowed through first flow path 11 and the refrigerant that has flowed through second flow path 12 merge at second branching portion BP2 and are sucked by compressor 230.

[0087] Next, description will be given of an operation of air conditioning apparatus 1001 when the operation mode of air conditioning apparatus 1001 is the second mode.

[0088] High-temperature, high-pressure refrigerant discharged from compressor 230 flows through flow path switch 240 to first branching portion BP1. In the second mode, second valve 280 is closed, and accordingly, the refrigerant does not flow through first flow path 11 and flows into first indoor heat exchanger 111 and second indoor heat exchanger 112. The liquid refrigerant, the heat of which has been dissipated in first indoor heat exchanger 111 and second indoor heat exchanger 112, does not flow through second bypass pipe 271 and third valve 270, and flows into inner heat exchanger 260 as in Embodiment 1. The refrigerant is cooled further in inner heat exchanger 260.

[0089] Subsequently, the refrigerant is decompressed in first valve 250 to enter the gas-liquid two-phase state, and flows into first outdoor heat exchanger 211 and second outdoor heat exchanger 212. The refrigerant, the heat of which has been absorbed in first outdoor heat exchanger 211 and second outdoor heat exchanger 212, flows through flow path switch 240 into inner heat exchanger 260. The refrigerant is heated in inner heat exchanger 260 to be gas refrigerant. The refrigerant then flows through second branching portion BP2 and is sucked by compressor 230.

[0090] Next, description will be given of an operation of air conditioning apparatus 1001 when the operation mode of air conditioning apparatus 1001 is the third mode.

[0091] High-temperature, high-pressure refrigerant discharged from compressor 230 flows through flow path switch 240 into first outdoor heat exchanger 211 and second outdoor heat exchanger 212.

[0092] In first outdoor heat exchanger 211 and second outdoor heat exchanger 212, the refrigerant dissipates heat through heat exchange with the outdoor air blown by outdoor blower 220.

[0093] Subsequently, the refrigerant is decompressed in first valve 250 to enter the gas-liquid two-phase state and reaches third branching portion BP3. Most of the refrigerant in the gas-liquid two-phase state which has reached third branching portion BP3 flows through second bypass pipe 271 and third valve 270 to fourth branching portion BP4. The rest of the refrigerant in the gas-liquid two-phase state which has reached third branching portion BP3 flows through inner heat exchanger 260 to fourth branching portion BP4. The refrigerant after merging at fourth branching portion BP4 from the two flow paths flows into first indoor heat exchanger 111 and second indoor heat exchanger 112.

[0094] In first indoor heat exchanger 111 and second indoor heat exchanger 112, the refrigerant absorbs heat through heat exchange with the outside air blown by indoor blower 120 to enter the gas state.

[0095] The gaseous refrigerant reaches first branching portion BP1. In the third mode, second valve 280 is closed, and accordingly, the refrigerant flows from first branching portion BP1 through second flow path 12 to second branching portion BP2. The refrigerant that has flowed to second branching portion BP2 is sucked by compressor 230.

[0096] In Embodiment 2, in the first mode and the third mode, most of the refrigerant discharged from first valve 250 flows into first indoor heat exchanger 111 and second indoor heat exchanger 112 without flowing through inner heat exchanger 260. This can reduce a pressure drop caused by the refrigerant flowing through inner heat exchanger 260.

[0097] When the outside air temperature is extremely high in the cooling operation, the circulation flow rate of the refrigerant is large, resulting in an extremely high temperature of the refrigerant discharged from second heat exchange unit 110. In order to avoid such a situation, the degree of opening of first valve 250 is controlled such that first valve 250 is open. When the degree of opening of first valve 250 reaches the fully open state, the temperature of the refrigerant discharged from second heat exchange unit 110 cannot be lowered. In Embodiment 2, most of the refrigerant discharged from first valve 250 flows into second heat exchange unit 110 without flowing through inner heat exchanger 260. Accordingly, even when first valve 250 has reached the fully-open state, the execution of the protective operation caused by the discharge temperature of compressor 230 exceeding a limit value can be avoided.

[0098] A solenoid valve may be used in place of a check valve as third valve 270.

Embodiment 3

[0099] Fig. 6 shows a configuration of an air conditioning apparatus 1002 of Embodiment 3.

[0100] Air conditioning apparatus 1002 of Fig. 6 is different from air conditioning apparatus 1000 of the embodiment shown in Fig. 1 in the following point.

[0101] A refrigerant circuit RC3 of air conditioning apparatus 1002 of Embodiment 3 includes a fourth valve 251 arranged in pipe 316M, which is part of main pipe PM, between inner heat exchanger 260 and second heat exchange unit 110.

[0102] Fourth valve 251 is formed of an electronic expansion valve.

[0103] When the operation mode of air conditioning apparatus 1002 is the first mode or the second mode, fourth valve 251 is fully open. Accordingly, air conditioning apparatus 1002 of Embodiment 3 operates as in Embodiment 1.

[0104] When the operation mode of air conditioning apparatus 1002 is the third mode, first valve 250 is fully open, and fourth valve 251 decompresses the refrigerant flowing through pipe 316M.

[0105] When the operation mode of air conditioning apparatus 1002 is the first mode (cooling operation mode), and when the outside air temperature exceeds a specified value, the operation mode of air conditioning apparatus 1002 is switched to the third mode (high-load cooling operation mode).

[0106] As air conditioning apparatus 1002 is switched to the high-load cooling operation mode when the outside air temperature is extremely high, the liquid refrigerant can be stored in inner heat exchanger 260. Accordingly, the high pressure discharged by compressor 230 can be reduced, thus avoiding the execution of the protective operation due to a high discharge pressure of compressor 230.

Variations

[0107] The present disclosure is not limited to the embodiments described above and includes, for example, the following variations.

(1) Although each of first heat exchange unit 210 and second heat exchange unit 110 includes two heat exchangers in the above embodiments, the present disclosure is not limited thereto. Each of first heat exchange unit 210 and second heat exchange unit 110 may include one heat exchanger.

(2) In place of the arrangement in which first bypass pipe PB1 is arranged between compressor 230 and first end E1 of the outdoor unit in the X-axis direction, first bypass pipe PB1 may be arranged between compressor 230 and first outdoor heat exchanger 211 in the X-axis direction.

(3) Although the frequency of the compressor remains unchanged when the operation mode of air

conditioning apparatus 1000, 1001, 1002 changes from the first mode to the third mode, the present disclosure is not limited thereto. When the operation mode of air conditioning apparatus 1000, 1001, 1002 changes from the first mode to the third mode, the frequency of the compressor may be changed, and control described in Embodiments 1 to 3 may be performed.

[0108] It is to be understood that the embodiments disclosed herein are presented for the purpose of illustration and non-restrictive in every respect. It is therefore intended that the scope of the present disclosure is defined by claims, not only by the embodiments described above, and encompasses all modifications and variations equivalent in meaning and scope to the claims.

REFERENCE SIGNS LIST

[0109] 11 first flow path; 12 second flow path; 100 indoor unit; 110 second heat exchange unit; 111 first indoor heat exchanger; 112 second indoor heat exchanger; 120 indoor blower; 200 outdoor unit; 210 first heat exchange unit; 211 first outdoor heat exchanger; 212 second outdoor heat exchanger; 220 outdoor blower; 230, 230A, 230B compressor; 240, 240A, 240B flow path switch; 250, 250A, 250B first valve; 251 fourth valve; 260 inner heat exchanger; 261a first inner flow path; 261b second inner flow path; 270 third valve; 271 second bypass pipe; 280 second valve; 310M, 311M, 312M, 313M, 314M, 315M, 316M, 317M, 318M pipe; 1000, 1001, 1002, 1100 air conditioning apparatus; BP1 first branching portion; BP2 second branching portion; BP3 third branching portion; BP4 fourth branching portion; E1 first end of outdoor unit; E2 second end of outdoor unit; P1 first opening; P2 second opening; P3 third opening; P4 fourth opening; PB1 first bypass pipe; RC1, RC2 refrigerant circuit; US upper surface.

Claims

1. An air conditioning apparatus comprising a refrigerant circuit in which refrigerant flows, the refrigerant circuit having a compressor, a flow path switch, a first heat exchange unit, a second heat exchange unit, an inner heat exchanger, a first valve, and a second valve,

   the flow path switch being provided with a first opening, a second opening, a third opening, and a fourth opening,
   the inner heat exchanger being provided with a first inner flow path and a second inner flow path,
   a discharge side of the compressor being connected to the first opening of the flow path switch,
   a first end of the first heat exchange unit being connected to the fourth opening of the flow path switch,
   a second end of the first heat exchange unit being connected to a first end of the first valve,
   a second end of the first valve is connected to a first end of the first inner flow path of the inner heat exchanger,
   a second end of the first inner flow path of the inner heat exchanger being connected to a first end of the second heat exchange unit,
   a first end of the second inner flow path of the inner heat exchanger being connected to the second opening of the flow path switch,
   a second end of the second heat exchange unit being connected to a first branching portion,
   the first branching portion being connected to a first end of the second valve and the third opening of the flow path switch,
   a second end of the second valve being connected to a second branching portion,
   the second branching portion being connected to a suction side of the compressor and a second end of the second inner flow path of the inner heat exchanger,
   when an operation mode of the air conditioning apparatus is a first mode, the second valve being configured to open, the first opening being connected to the fourth opening, and the second opening being connected to the third opening,
   when the operation mode of the air conditioning apparatus is a second mode, the second valve being configured to close, the first opening being connected to the third opening, and the second opening being connected to the fourth opening.

2. The air conditioning apparatus according to claim 1, wherein

   when the operation mode of the air conditioning apparatus is the first mode, the refrigerant flows in order of the compressor, the flow path switch, the first heat exchange unit, the first valve, the inner heat exchanger, the second heat exchange unit, and the first branching portion, and then, part of the refrigerant flows through a first flow path from the first branching portion via the second valve to the second branching portion, and rest of the refrigerant flows through a second flow path from the first branching portion via the flow path switch and the inner heat exchanger to the second branching portion, and then, the refrigerant in the first flow path and the refrigerant in the second flow path merge at the second branching portion and flow to the compressor, and
   when the operation mode of the air conditioning apparatus is the second mode, the refrigerant flows in order of the compressor, the flow path switch, the second heat exchange unit, the inner

heat exchanger, the first valve, the first heat exchange unit, the flow path switch, the inner heat exchanger, the second branching portion, and the compressor.

3. The air conditioning apparatus according to claim 2, wherein the first flow path has a flow path resistance smaller than a flow path resistance of the second flow path.

4. The air conditioning apparatus according to claim 3, wherein

the refrigerant circuit has a main pipe and a first bypass pipe, and
the main pipe is connected between the compressor and the flow path switch, between the flow path switch and the first heat exchange unit, between the first heat exchange unit and the inner heat exchanger via the first valve, between the inner heat exchanger and the second branching portion, between the second branching portion and the compressor, between the inner heat exchanger and the second heat exchange unit, between the second heat exchange unit and the first branching portion, between the first branching portion and the flow path switch, and between the flow path switch and the inner heat exchanger, and the first bypass pipe is connected between the first branching portion and the second branching portion via the second valve.

5. The air conditioning apparatus according to claim 4, wherein the first bypass pipe has a length smaller than a length of a pipe between the flow path switch and the inner heat exchanger and smaller than a length of a pipe between the inner heat exchanger and the second branching portion.

6. The air conditioning apparatus according to claim 5, wherein the first heat exchange unit has a first outdoor heat exchanger and a second outdoor heat exchanger.

7. The air conditioning apparatus according to claim 6, wherein

the compressor, the first outdoor heat exchanger, the second outdoor heat exchanger, an outdoor blower, the inner heat exchanger, and the first valve are housed in an outdoor unit,
an upper surface of the outdoor unit has an arc shape in a first axial direction,
the outdoor blower is arranged at a center of the outdoor unit in the first axial direction,
the first outdoor heat exchanger is arranged on a first side of the outdoor blower in the first axial direction, and the second outdoor heat exchanger is arranged on a second side of the outdoor blower,
the compressor is arranged between a first end of the outdoor unit and the first outdoor heat exchanger in the first axial direction, and
the inner heat exchanger is arranged between a second end of the outdoor unit and the second outdoor heat exchanger in the first axial direction.

8. The air conditioning apparatus according to claim 7, wherein

the first bypass pipe is arranged parallel to a first axis, and
the first bypass pipe is arranged between the compressor and the first end of the outdoor unit in the first axial direction.

9. The air conditioning apparatus according to claim 8, wherein part of the main pipe connected to the first branching portion is arranged parallel to a second axis perpendicular to the first axis.

10. The air conditioning apparatus according to any one of claims 1 to 9, wherein the second heat exchange unit has a first indoor heat exchanger and a second indoor heat exchanger.

11. The air conditioning apparatus according to any one of claims 4 to 10, wherein

the refrigerant circuit has a second bypass pipe and a third valve,
a third branching portion between the first valve and the inner heat exchanger is connected to a fourth branching portion between the inner heat exchanger and the second heat exchange unit via the third valve by the second bypass pipe, and
the third valve is configured to cause the refrigerant to flow through the second bypass pipe when the operation mode of the air conditioning apparatus is the first mode and cause the refrigerant not to flow through the second bypass pipe when the operation mode of the air conditioning apparatus is the second mode.

12. The air conditioning apparatus according to any one of claims 1 to 11, wherein when the operation mode of the air conditioning apparatus is a third mode, the second valve is configured to be closed, the first opening is connected to the fourth opening, and the second opening is connected to the third opening.

13. The air conditioning apparatus according to claim 12, wherein when the operation mode of the air conditioning apparatus is the third mode, all the refrigerant flows in order of the compressor, the flow path switch, the first heat exchange unit, the first valve, the inner heat exchanger, the second heat exchange unit, the first branching portion, the flow path switch, the inner heat exchanger, the second branching portion, and the compressor.

14. The air conditioning apparatus according to any one of claims 4 to 9, comprising a fourth valve arranged in the main pipe between the inner heat exchanger and the second heat exchange unit, wherein

when the operation mode of the air conditioning apparatus is the first mode or the second mode, the fourth valve is configured to be fully open, and
when the operation mode of the air conditioning apparatus is the third mode, the first valve is configured to be fully open, and the fourth valve is configured to decompress the refrigerant.

15. The air conditioning apparatus according to any one of claims 12 to 14, wherein when an outside air temperature exceeds a specified value, the operation mode of the air conditioning apparatus changes from the first mode to the third mode.

16. The air conditioning apparatus according to claim 15, wherein when the outside air temperature exceeds the specified value, a frequency of the compressor remains unchanged.

17. The air conditioning apparatus according to any one of claims 1 to 16, wherein the refrigerant is CO_2 refrigerant.

FIG.1

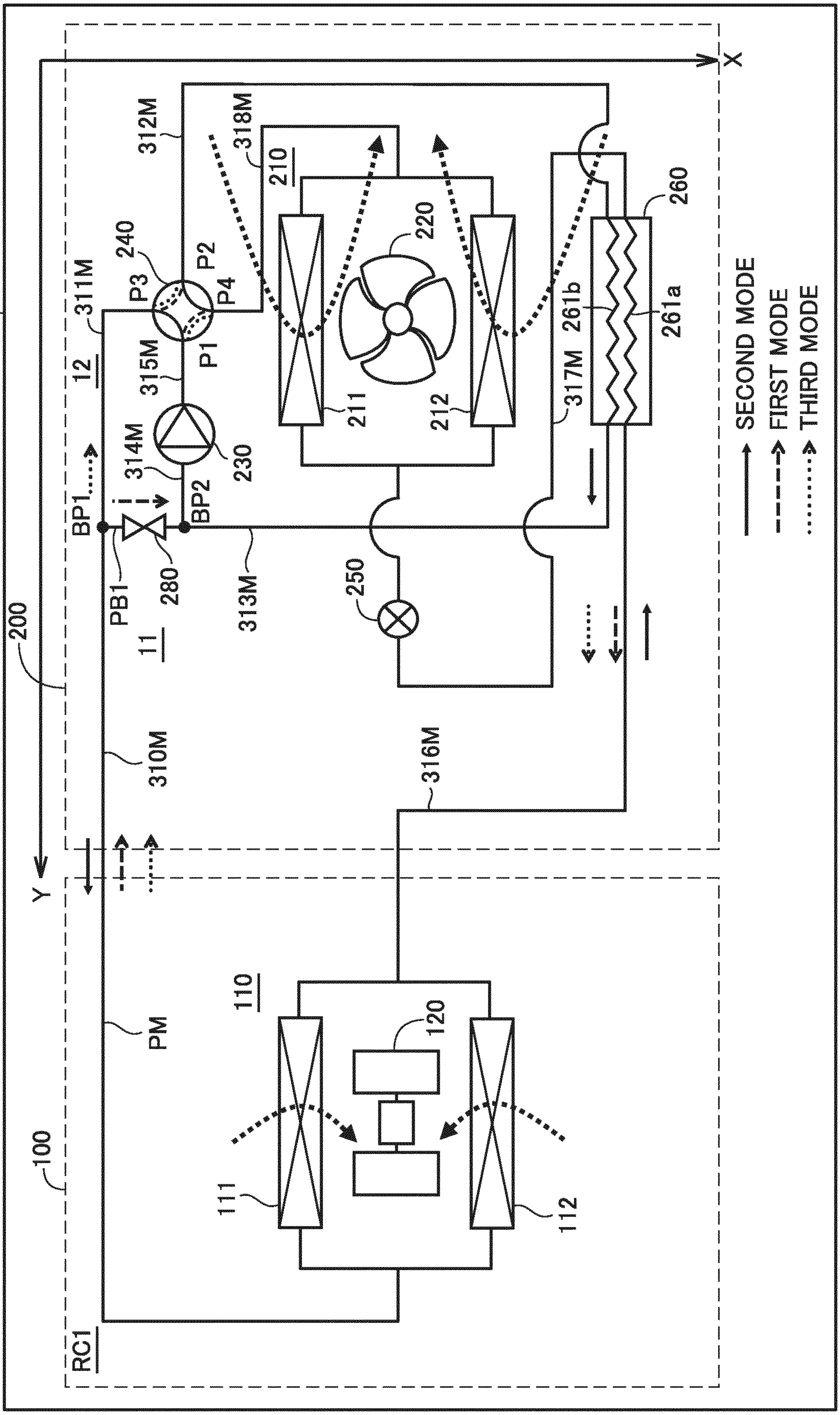

1000
200
100
RC1
11
12
110
111
112
120
PM
310M
311M
312M
313M
314M
315M
316M
317M
318M
210
211
212
220
230
240
250
260
261a
261b
280
P1
P2
P3
P4
BP1
BP2
PB1
X
Y
SECOND MODE
FIRST MODE
THIRD MODE

FIG.2

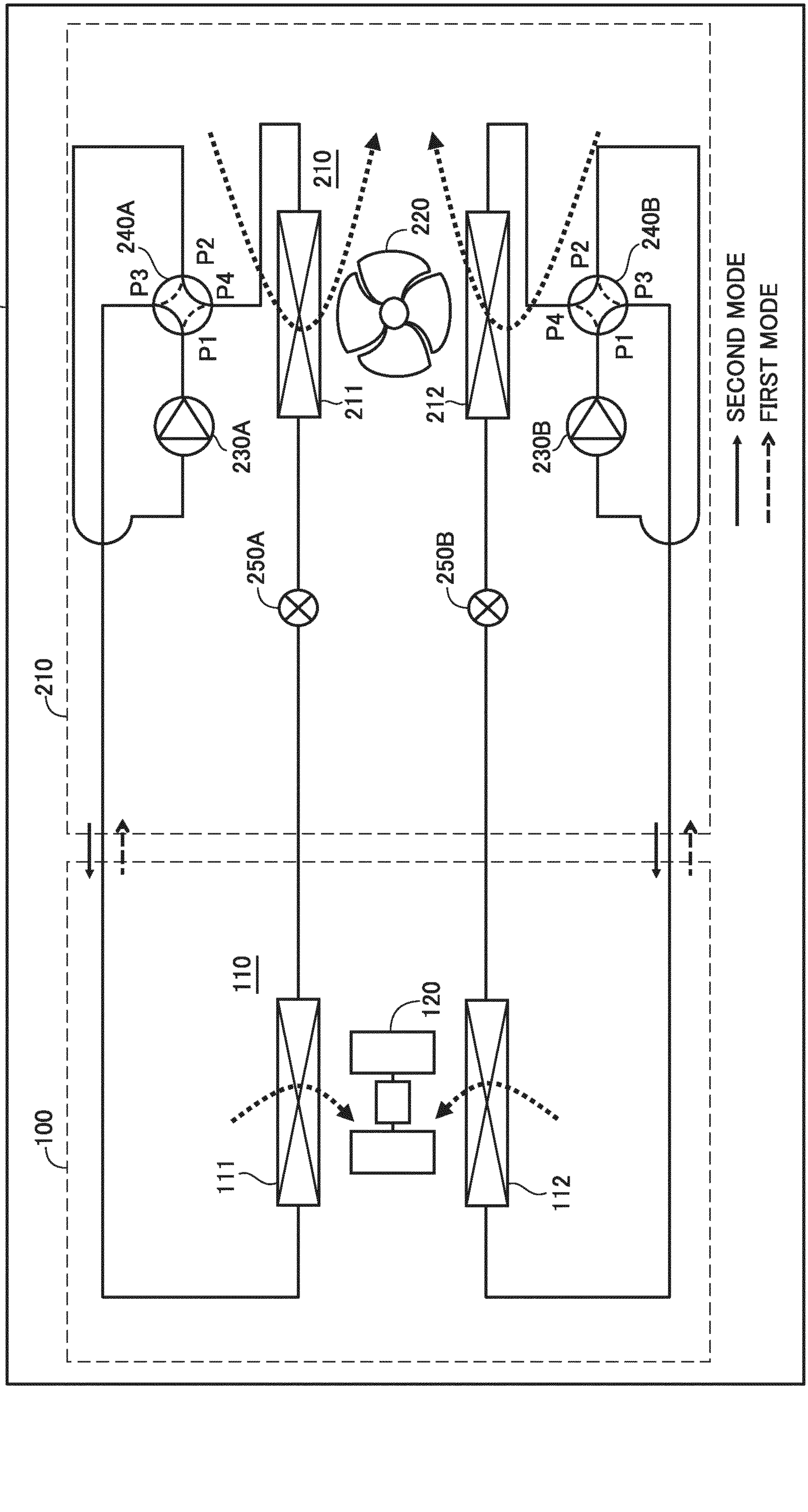

1100
210
210
220
240A
240B
P1
P2
P3
P4
P1
P2
P3
P4
211
212
230A
230B
250A
250B
110
120
100
111
112
SECOND MODE
FIRST MODE

FIG.3

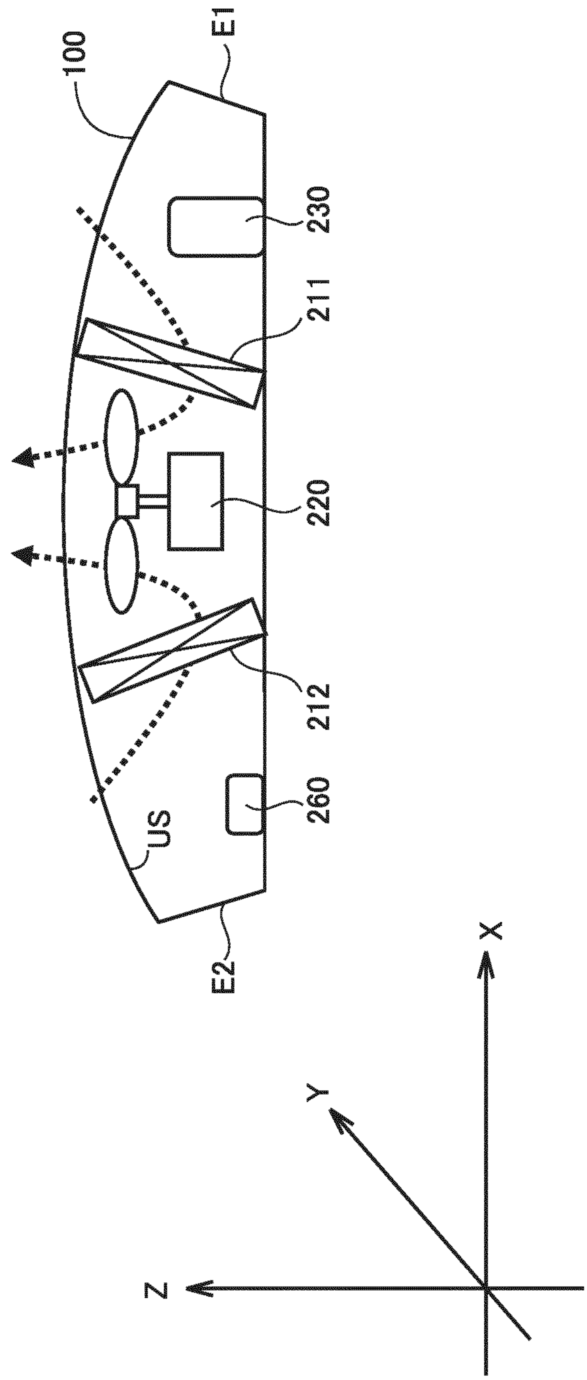


FIG.4

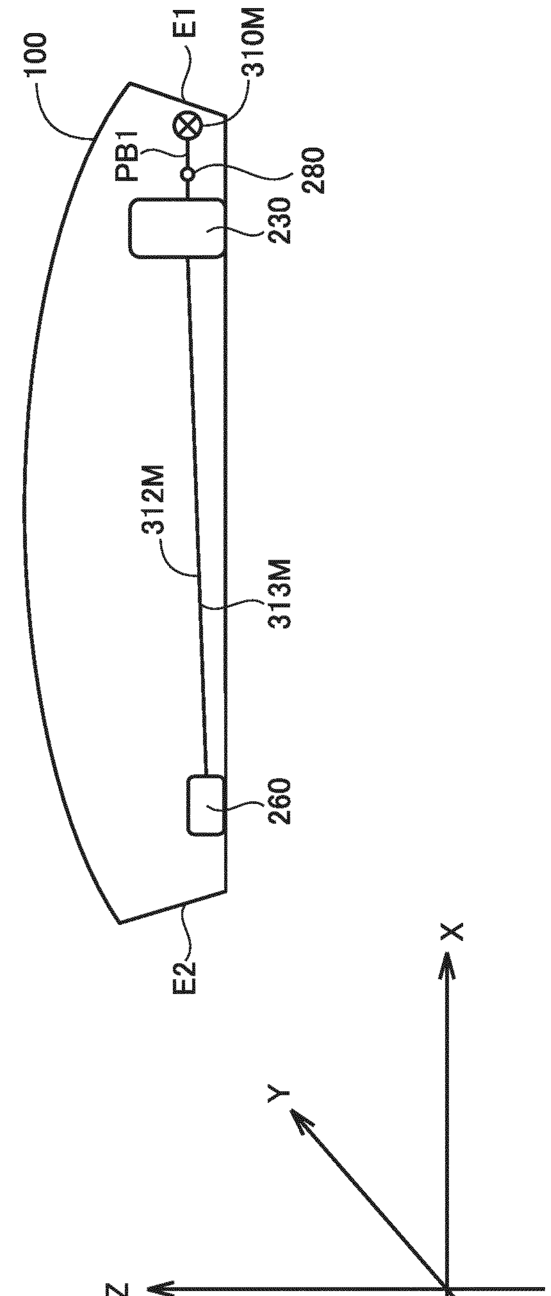
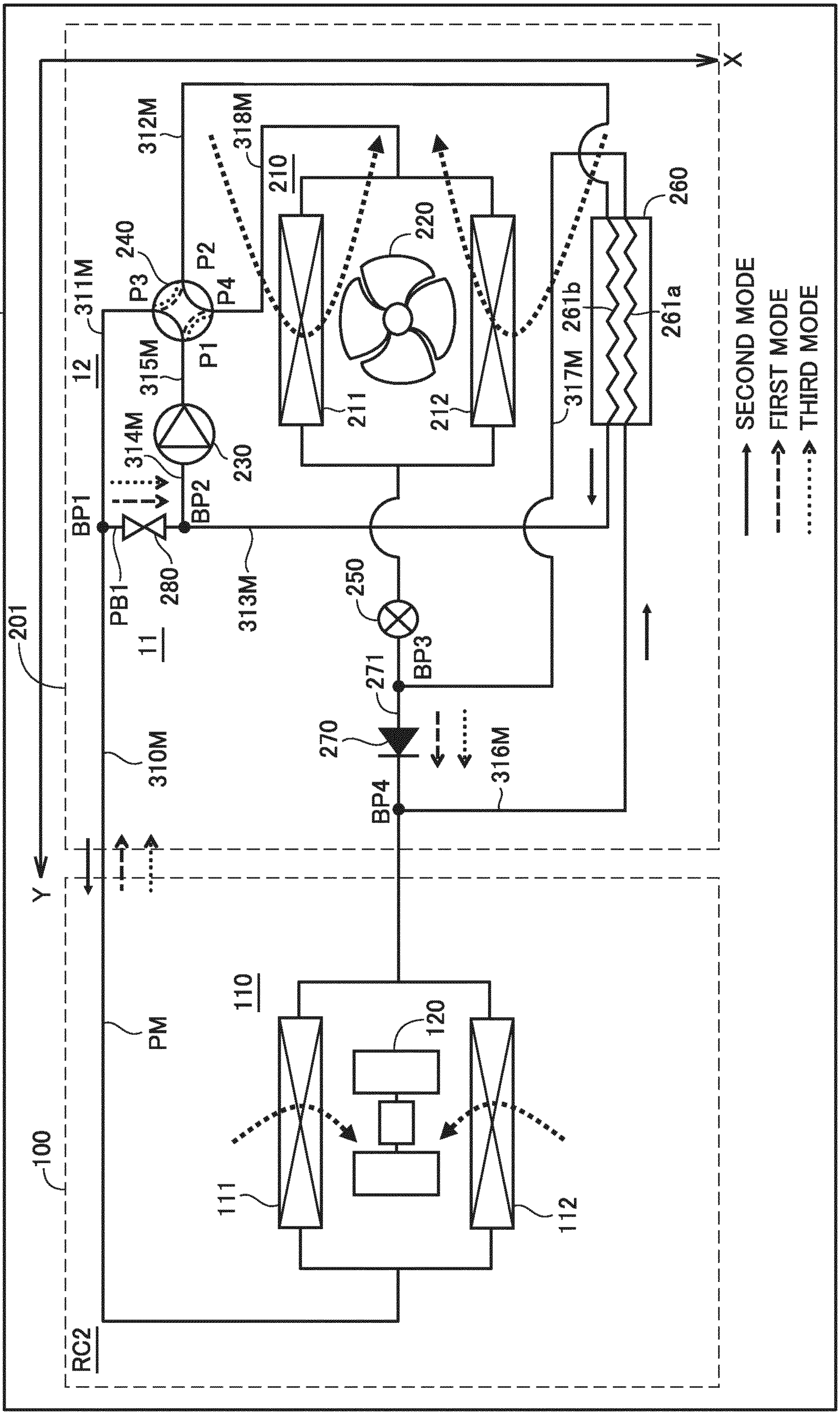


FIG.5


1001
X
Y
201
12
11
240
P1
P2
P3
P4
210
220
211
212
230
250
260
261a
261b
270
271
280
BP1
BP2
BP3
BP4
PB1
310M
311M
312M
313M
314M
315M
316M
317M
318M
100
110
111
112
120
PM
RC2
SECOND MODE
FIRST MODE
THIRD MODE

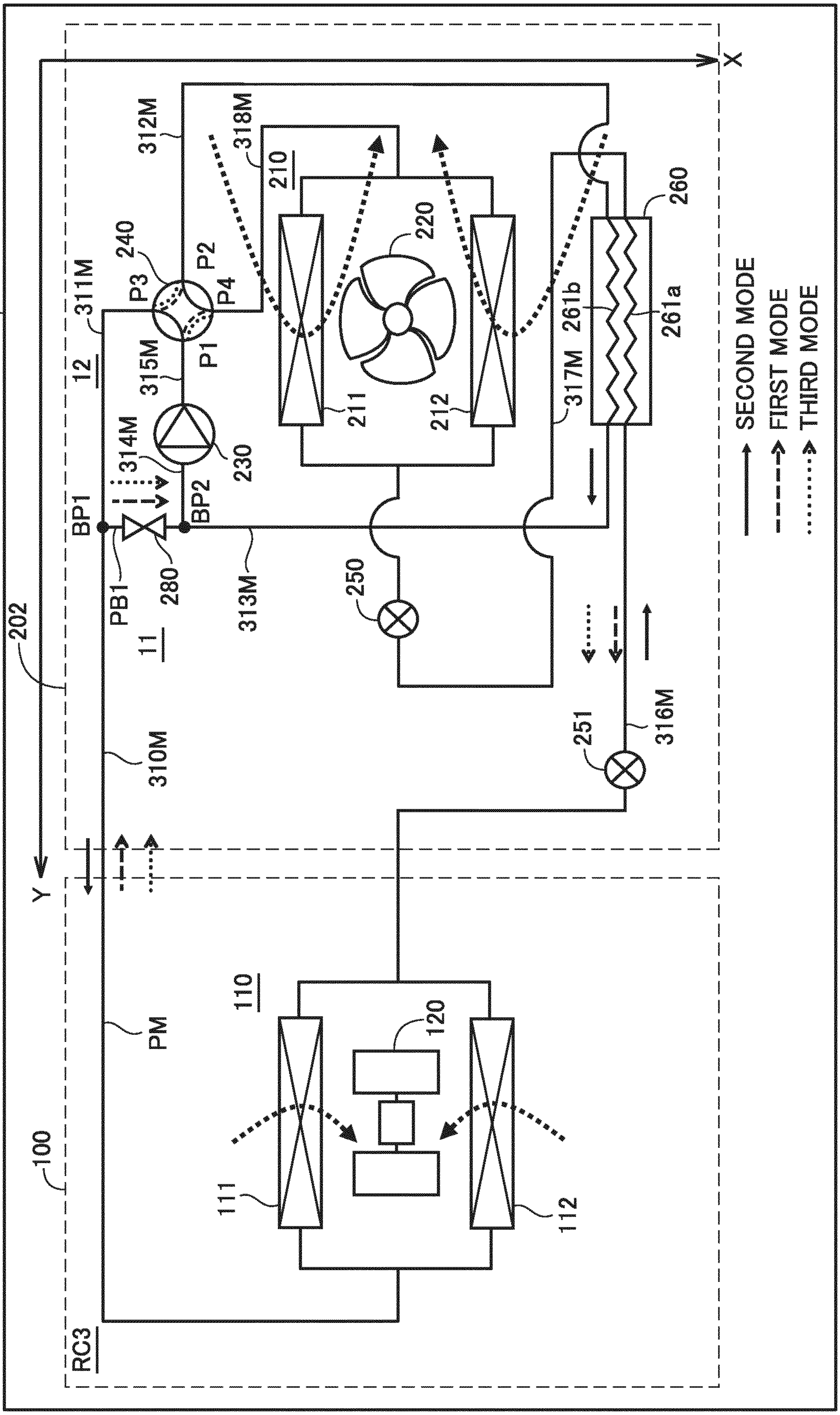

1002
X
Y
202
100
RC3
12
11
312M
318M
210
311M
240
P3
P2
P4
P1
315M
220
260
261b
261a
314M
230
211
212
317M
BP1
BP2
PB1
280
313M
250
251
316M
310M
PM
110
120
111
112
SECOND MODE
FIRST MODE
THIRD MODE

FIG.6

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2020/000494

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F25B1/00(2006.01)i, F25B13/00(2006.01)i
FI: F25B1/00 331Z, F25B1/00 101Z, F25B1/00 396D, F25B13/00 331B

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. F25B1/00, F25B13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2020
Registered utility model specifications of Japan 1996-2020
Published registered utility model applications of Japan 1994-2020

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 A	JP 2003-194432 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 09 July 2003, paragraphs [0019]-[0057], fig. 4-6	1-5, 11-14, 17 6-10, 15-16
A	WO 2013/038439 A1 (MITSUBISHI ELECTRIC CORP.) 21 March 2013, fig. 1, 2	7

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

* 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

Date of the actual completion of the international search	Date of mailing of the international search report
28.02.2020	10.03.2020

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/000494

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 2003-194432 A	09.07.2003	(Family: none)	
WO 2013/038439 A1	21.03.2013	US 2014/0345309 A1 fig. 1, 2 EP 2757326 A1 CN 103797309 A	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2003194432 A **[0003] [0004]**