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

(11) **EP 4 145 028 A1**

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

(43) Date of publication:
08.03.2023 Bulletin 2023/10

(21) Application number: **20933555.3**

(22) Date of filing: **30.04.2020**

(51) International Patent Classification (IPC):
F16K 11/07 *(2006.01)* ***F25B 13/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F16K 11/07; F25B 13/00

(86) International application number:
PCT/JP2020/018319

(87) International publication number:
WO 2021/220486 (04.11.2021 Gazette 2021/44)

(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

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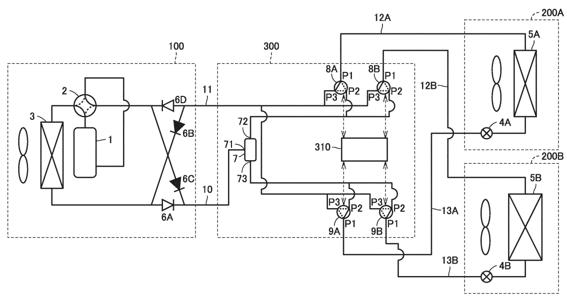
(54) **REFRIGERATION CYCLE DEVICE**

(57) A refrigeration cycle apparatus (1000) comprises a refrigerant circuit in which refrigerant circulates, the refrigerant circuit comprising a compressor (1), a flow path switching portion (2), an outdoor heat exchanger (3), a decompressing apparatus (4A, 4B), a first indoor heat exchanger (5A), a first connecting pipe (10), and a second connecting pipe (11). The refrigerant circuit further comprises: a first three-way valve (8A) arranged downstream of the first indoor heat exchanger in a cooling operation state and arranged upstream of the first indoor heat exchanger in a heating operation state; and a second three-way valve (9A) arranged upstream of the first indoor heat exchanger in the cooling operation state and arranged downstream of the first indoor heat exchanger in the heating operation state. A first aperture (P1) of each of the first three-way valve and the second three-way valve is connected to one end or the other end of the first indoor heat exchanger in the refrigerant circuit. A second aperture (P2) of each of the first three-way valve and the second three-way valve is connected to the first connecting pipe. A third aperture (P3) of each of the first three-way valve and the second three-way valve is connected to the second connecting pipe. Each of the first three-way valve and the second three-way valve is configured to be switched independently to one of a first state in which the valve body (15) is located at a first position, a second state in which the valve body is located at a second position, and a third state in which the valve body is located at a third position. In the first state, a first space (S1) is arranged in the valve chamber (16), the first space (S1) communicating with the first aperture and the second aperture and being separated from the third aperture. In the second state, a second space (S2) is arranged in the valve chamber, the second space (S2) communicating with the first aperture, the second aperture, and the third aperture. In the third state, a third space (S3) is arranged in the valve chamber, the third space (S3) communicating with the first aperture and the third aperture and being separated from the second aperture.

FIG.1



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a refrigeration cycle apparatus.

BACKGROUND ART

[0002] Conventionally, there has been known a refrigeration cycle apparatus including an outdoor unit, a plurality of indoor units, and a branch unit, wherein the outdoor unit and the plurality of indoor units are connected via the branch unit.

[0003] Japanese Patent Laying-Open No. 4-6361 discloses a refrigeration cycle apparatus in which an outdoor unit and a branch unit are connected via a first refrigerant pipe and a second refrigerant pipe. The refrigeration cycle apparatus includes: a first refrigerant flow path switching mechanism arranged in the outdoor unit; and a second refrigerant flow path switching mechanism arranged in the branch unit.

[0004] The first flow path switching mechanism includes one four-way valve and four check valves. The first refrigerant flow path mechanism switches between a cooling operation state in which the outdoor heat exchanger acts as a condenser and a heating operation state in which the outdoor heat exchanger acts as an evaporator, and a state in which the pressure of the refrigerant flowing through the first refrigerant pipe is lower than the pressure of the refrigerant flowing through the second refrigerant pipe is maintained irrespective of the switching between the cooling operation state and the heating operation state. The inner diameter of the first refrigerant pipe is larger than the inner diameter of the second refrigerant pipe. Thus, in the refrigeration cycle apparatus, pressure loss in the first refrigerant pipe and the second refrigerant pipe is suppressed from being increased due to the switching between the cooling operation state and the heating operation state, thereby suppressing decreased operation capability.

[0005] The second flow path switching mechanism includes a plurality of flow path switching valves. In the first operation state or the second operation state, the second refrigerant flow path mechanism switches between a full-cooling operation state or full-heating operation state in which all of the plurality of indoor units each act as an evaporator or condenser and a cooling-dominated operation state or heating-dominated operation in which part of the plurality of indoor units each act as a condenser and the other part of the plurality of indoor units each act as an evaporator.

CITATION LIST

PATENT LITERATURE

[0006] PTL 1: Japanese Patent Laying-Open No. 4-6361

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0007] In the above-described refrigeration cycle apparatus, when load of an indoor heat exchanger is decreased, an amount of circulation of the refrigerant needs to be decreased by decreasing the driving frequency of the compressor in order to prevent decreased comfortability.

[0008] However, in the refrigeration cycle apparatus, when the amount of circulation of the refrigerant is decreased, a differential pressure before and after a check valve included in the first flow path switching mechanism is decreased, thus resulting in occurrence of chattering.

[0009] It is a main object of the present disclosure to provide a refrigeration cycle apparatus so as to suppress occurrence of chattering while preventing decreased comfortability when load of an indoor heat exchanger is decreased.

SOLUTION TO PROBLEM

[0010] A refrigeration cycle apparatus according to the present disclosure comprises a refrigerant circuit in which refrigerant circulates, the refrigerant circuit comprising a compressor, a flow path switching portion, an outdoor heat exchanger, a decompressing apparatus, a first indoor heat exchanger, a first connecting pipe through which the refrigerant flows into the first indoor heat exchanger, and a second connecting pipe through which the refrigerant flows from the first indoor heat exchanger. The flow path switching portion is configured to switch between a cooling operation state in which the outdoor heat exchanger acts as a condenser and a heating operation state in which the outdoor heat exchanger acts as an evaporator. The refrigerant circuit further comprises: a first three-way valve arranged downstream of the first indoor heat exchanger in the cooling operation state and arranged upstream of the first indoor heat exchanger in the heating operation state; and a second three-way valve arranged upstream of the first indoor heat exchanger in the cooling operation state and arranged downstream of the first indoor heat exchanger in the heating operation state. Each of the first three-way valve and the second three-way valve comprises: a valve seat having a valve chamber and provided with a first aperture, a second aperture and a third aperture, the first aperture, the second aperture, and the third aperture being connected to the valve chamber; and a valve body configured to move among a first position, a second position, and a third position in the valve chamber. The first aperture of each of the first three-way valve and the second three-way valve is connected to one end or the other end of the first indoor heat exchanger in the refrigerant circuit. The second aperture of each of the first three-way valve and the second three-way valve is connected to the first connecting pipe. The third aperture of each of the first three-way valve and the second three-way valve is connected to the second connecting pipe. Each of the first three-way valve and the second three-way valve is configured to be switched independently to one of a first state in which the valve body is located at the first position, a second state in which the valve body is located at the second position, and a third state in which the valve body is located at the third position. In each of the first three-way valve and the second three-way valve, in the first state, a first space is arranged in the valve chamber, the first space communicating with the first aperture and the second aperture and being separated from the third aperture, in the second state, a second space is arranged in the valve chamber, the second space communicating with the first aperture, the second aperture, and the third aperture, and in the third state, a third space is arranged in the valve chamber, the third space communicating with the first aperture and the third aperture and being separated from the second aperture.

ADVANTAGEOUS EFFECTS OF INVENTION

[0011] According to the present disclosure, a refrigeration cycle apparatus can be provided to suppress occurrence of chattering while preventing decreased comfortability when load of an indoor heat exchanger is decreased.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

Fig. 1 is a diagram showing a refrigerant circuit of a refrigeration cycle apparatus according to the present embodiment.

Fig. 2 is a cross sectional view showing a valve seat, a valve chamber, and a valve body when a first three-way valve according to the present embodiment is in a first state.

Fig. 3 is a cross sectional view when viewed from an arrow III-III shown in Fig. 2.

Fig. 4 is a cross sectional view showing the valve seat, the valve chamber, and the valve body when the first three-way valve according to the present embodiment is in a second state.

Fig. 5 is a cross sectional view when viewed from an arrow V-V shown in Fig. 4.

Fig. 6 is a cross sectional view showing the valve seat, the valve chamber, and the valve body when the first three-way valve according to the present embodiment is in a third state.

Fig. 7 is a cross sectional view when viewed from an arrow VII-VII shown in Fig. 6.

Fig. 8 is a diagram showing the refrigerant circuit when the refrigeration cycle apparatus according to the present embodiment is in a full-cooling operation state.

Fig. 9 is a diagram showing the refrigerant circuit when load of a first indoor heat exchanger is decreased to be lower than that in the state shown in Fig. 8 when the refrigeration cycle apparatus according to the present embodiment is in a full-cooling operation state.

Fig. 10 is a diagram showing the refrigerant circuit when the refrigeration cycle apparatus according to the present embodiment is in a full-heating operation state.

Fig. 11 is a diagram showing the refrigerant circuit when the load of the first indoor heat exchanger is decreased to be lower than that in the state shown in Fig. 10 when the refrigeration cycle apparatus according to the present embodiment is in the full-heating operation state.

Fig. 12 is a diagram showing the refrigerant circuit when the refrigeration cycle apparatus according to the present embodiment is in a first cooling-dominated operation state.

Fig. 13 is a diagram showing the refrigerant circuit when the refrigeration cycle apparatus according to the present embodiment is in a first heating-dominated operation state.

Fig. 14 is a cross sectional view showing a valve seat, a valve chamber, and a valve body when a modification of the first three-way valve shown in Fig. 2 is in the first state.

Fig. 15 is a cross sectional view showing the valve seat, the valve chamber, and the valve body when the modification of the first three-way valve shown in Fig. 2 is in the second state.

Fig. 16 is a cross sectional view showing the valve seat, the valve chamber, and the valve body when the modification of the first three-way valve shown in Fig. 2 is in the third state.

DESCRIPTION OF EMBODIMENTS

[0013] Hereinafter, embodiments will be described with reference to figures. It should be noted that in the below-described figures, the same or corresponding portions are denoted by the same reference characters, and will not be described repeatedly.

<Configuration of Refrigeration Cycle Apparatus>

[0014] As shown in Fig. 1, a refrigeration cycle apparatus 1000 according to the present embodiment includes a refrigerant circuit in which refrigerant circulates. The refrigerant circuit includes a compressor 1, a four-way valve 2 serving as a flow path switching portion, an outdoor heat exchanger 3, a first decompressing apparatus 4A, a second decompressing apparatus 4B, a first indoor heat exchanger 5A, a second indoor heat exchanger 5B, a first check valve 6A, a second check valve 6B, a third check valve 6C, a fourth check valve 6D, a gas-liquid separator 7, a first three-way valve 8A, a second three-way valve 9A, a third three-way valve 8B, a fourth three-way valve 9B, a first connecting pipe 10, a second connecting pipe 11, a third connecting pipe 12A, a fourth connecting pipe 13A, a fifth connecting pipe 12B, and a sixth connecting pipe 13B.

[0015] Compressor 1, four-way valve 2, outdoor heat exchanger 3, first check valve 6A, second check valve 6B, third check valve 6C, and fourth check valve 6D are accommodated in an outdoor unit 100. First decompressing apparatus 4A and first indoor heat exchanger 5A are accommodated in a first indoor unit 200A. Second decompressing apparatus 4B and second indoor heat exchanger 5B are accommodated in a second indoor unit 200B. Gas-liquid separator 7, first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B are accommodated in a branch unit 300.

[0016] First connecting pipe 10 and second connecting pipe 11 are arranged between outdoor unit 100 and branch unit 300 so as to connect outdoor unit 100 and branch unit 300 to each other. Third connecting pipe 12A and fourth connecting pipe 13A are arranged between first indoor unit 200A and branch unit 300 so as to connect first indoor unit 200A and branch unit 300 to each other. Fifth connecting pipe 12B and sixth connecting pipe 13B are arranged between second indoor unit 200B and branch unit 300 so as to connect second indoor unit 200B and branch unit 300 to each other.

[0017] Compressor 1 has a discharge port through which the refrigerant is discharged and a suction port through which the refrigerant is suctioned. Compressor 1 is, for example, a constant-speed compressor having a constant driving frequency. It should be noted that compressor 1 may be, for example, an inverter compressor having a driving frequency controlled by an inverter.

[0018] Four-way valve 2 has first to fourth ports. The first port is connected to the discharge port of compressor 1. The second port is connected to the suction port of compressor 1. The third port is connected to first connecting pipe 10 via outdoor heat exchanger 3 and first check valve 6A, and is connected to second connecting pipe 11 via outdoor heat exchanger 3 and second check valve 6B. The fourth port is connected to first connecting pipe 10 via third check valve 6C, and is connected to second connecting pipe 11 via fourth check valve 6D. Four-way valve 2 switches between a cooling operation state in which the first port communicates with the third port and the second port communicates with the fourth port and a heating operation state in which the first port communicates with the fourth port and the second port communicates with the third port.

[0019] In outdoor heat exchanger 3, heat is exchanged between the refrigerant circulating in the refrigerant circuit and outdoor air. First decompressing apparatus 4A and second decompressing apparatus 4B are, for example, expansion valves. In each of first decompressing apparatus 4A and second decompressing apparatus 4B, the refrigerant is expanded. In each of first indoor heat exchanger 5A and second indoor heat exchanger 5B, heat is exchanged between the refrigerant circulating in the refrigerant circuit and indoor air. First indoor unit 200A and second indoor unit 200B are installed, for example, in different rooms.

[0020] Outdoor unit 100 is provided with: a refrigerant flow path that connects between outdoor heat exchanger 3 and first connecting pipe 10; a refrigerant flow path that connects between outdoor heat exchanger 3 and second connecting pipe 11; a refrigerant flow path that connects between the fourth port of four-way valve 2 and first connecting pipe 10; and a refrigerant flow path that connects between the fourth port of four-way valve 2 and second connecting pipe 11.

[0021] First check valve 6A is arranged in the refrigerant flow path between outdoor heat exchanger 3 and first connecting pipe 10, and permits only the flow of the refrigerant from outdoor heat exchanger 3 to first connecting pipe 10. First check valve 6A blocks the flow of the refrigerant from first connecting pipe 10 to outdoor heat exchanger 3.

[0022] Second check valve 6B is arranged in the refrigerant flow path between outdoor heat exchanger 3 and second connecting pipe 11, and permits only the flow of the refrigerant from second connecting pipe 11 to the outdoor heat exchanger. Second check valve 6B blocks the flow of the refrigerant from second connecting pipe 11 to outdoor heat exchanger 3.

[0023] Third check valve 6C is arranged in the refrigerant flow path between the fourth port of four-way valve 2 and first connecting pipe 10, and permits only the flow of the refrigerant from the fourth port of four-way valve 2 to the second connecting pipe. Third check valve 6C blocks the flow of the refrigerant from first connecting pipe 10 to the fourth port of four-way valve 2.

[0024] Fourth check valve 6D is arranged in the refrigerant flow path between the fourth port of four-way valve 2 and second connecting pipe 11, and permits only the flow of the refrigerant from second connecting pipe 11 to the fourth port of four-way valve 2. Fourth check valve 6D blocks the flow of the refrigerant from the fourth port of four-way valve 2 to second connecting pipe 11.

[0025] Gas-liquid separator 7 is connected to first connecting pipe 10 and has an flow inlet 71 via which the refrigerant flows in, a first flow outlet 72 via which the gas-phase refrigerant flows out, and a second flow outlet 73 via which the liquid-phase refrigerant flows out.

[0026] First three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B have the same configuration. As shown in Figs. 2 to 7, each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B includes a valve seat 14 and a valve body 15.

[0027] Each of valve seats 14 of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B includes a valve chamber 16 and is provided with a first aperture P1, a second aperture P2, and a third aperture P3, first aperture P1, second aperture P2, and third aperture P3 communicating with valve chamber 16.

[0028] Valve seat 14 has a first surface 14A facing valve chamber 16 and provided with one end of each of first aperture P1 and third aperture P3, and a second surface 14B provided with one end of second aperture P2. First aperture P1 is arranged beside third apertures P3 with an interval being interposed therebetween in a peripheral direction serving as a first direction. The aperture area of third aperture P3 is equal to, for example, the aperture area of first aperture P1. Second surface 14B faces first surface 14A with valve body 15 being interposed therebetween in a Z direction serving as a second direction, for example. Second aperture P2 is arranged to overlap with the rotation axis of valve body 15 when viewed in the Z direction, for example. When viewed in the Z direction, the shortest distance between the respective centers of second aperture P2 and first aperture P1 is equal to, for example, the shortest distance between the respective centers of second aperture P2 and third aperture P3.

[0029] First aperture P1 of first three-way valve 8A is connected to first indoor heat exchanger 5A via third connecting pipe 12A. Second aperture P2 of first three-way valve 8A is connected to first flow outlet 72 of gas-liquid separator 7. That is, second aperture P2 of first three-way valve 8A is connected to first connecting pipe 10 via gas-liquid separator 7. Third aperture P3 of first three-way valve 8A is connected to second connecting pipe 11.

[0030] First aperture P1 of second three-way valve 9A is connected to first indoor heat exchanger 5A via fourth connecting pipe 13A. Second aperture P2 of second three-way valve 9A is connected to second flow outlet 73 of gas-liquid separator 7. That is, second aperture P2 of second three-way valve 9A is connected to first connecting pipe 10 via gas-liquid separator 7. Third aperture P3 of second three-way valve 9A is connected to second connecting pipe 11.

[0031] First aperture P1 of third three-way valve 8B is connected to second indoor heat exchanger 5B via fifth connecting pipe 12B. Second aperture P2 of third three-way valve 8B is connected to first flow outlet 72 of gas-liquid separator 7. That is, second aperture P2 of third three-way valve 8B is connected to first connecting pipe 10 via gas-liquid separator 7. Third aperture P3 of third three-way valve 8B is connected to second connecting pipe 11.

[0032] First aperture P1 of fourth three-way valve 9B is connected to second indoor heat exchanger 5B via sixth connecting pipe 13B. Second aperture P2 of fourth three-way valve 9B is connected to second flow outlet 73 of gas-liquid separator 7. That is, second aperture P2 of fourth three-way valve 9B is connected to first connecting pipe 10 via gas-liquid separator 7. Third aperture P3 of fourth three-way valve 9B is connected to second connecting pipe 11.

[0033] Second aperture P2 of first three-way valve 8A and second aperture P2 of third three-way valve 8B are connected to first flow outlet 72 of gas-liquid separator 7 and first connecting pipe 10 in parallel with each other. Third aperture P3 of first three-way valve 8A and third aperture P3 of third three-way valve 8B are connected to second connecting pipe 11 in parallel with each other.

[0034] Second aperture P2 of second three-way valve 9A and second aperture P2 of fourth three-way valve 9B are connected to second flow outlet 73 of gas-liquid separator 7 and first connecting pipe 10 in parallel with each other. Third aperture P3 of second three-way valve 9A and third aperture P3 of fourth three-way valve 9B are connected to second connecting pipe 11 in parallel with each other.

[0035] Each of valve bodies 15 of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B moves among a first position, a second position, and a third position in valve chamber 16. Valve body 15 is provided to rotate about, for example, a rotation axis extending along the Z direction. Valve body 15 rotates, for example, in a peripheral direction from third aperture P3 toward first aperture P1 and in a direction opposite thereto. Valve body 15 is connected to a rotation shaft of a motor (not shown) via, for example, a gear 17. Valve body 15 has a third surface 18 slidable on first surface 14A, and is provided with a recess 19 arranged beside third surface 18 in the peripheral direction serving as the first direction and recessed with respect to third surface 18, and has a fourth surface 20 located opposite to third surface 18 and facing second surface 14B of valve seat 14 with an interval being interposed therebetween in the Z direction.

[0036] Valve body 15 has: a first end portion 151 in the peripheral direction; and a second end portion 152 located opposite to first end portion 151 in the peripheral direction. First end portion 151 is an end portion arranged on the front side with respect to second end portion 152 when valve body 15 rotates in the peripheral direction from third aperture P3 toward first aperture P1. Second end portion 152 is an end portion arranged on the front side with respect to first end portion 151 when valve body 15 rotates in the peripheral direction from first aperture P1 toward third aperture P3.

[0037] Recess 19 has: a third end portion 191 in the peripheral direction; and a fourth end portion 192 located opposite to third end portion 191 in the peripheral direction. Third end portion 191 is an end portion arranged on the rear side with respect to first end portion 151 and on the front side with respect to fourth end portion 192 when valve body 15 rotates in the peripheral direction from third aperture P3 toward first aperture P1. Fourth end portion 192 is an end portion arranged on the rear side with respect to second end portion 152 and on the front side with respect to third end portion 191 when valve body 15 rotates in the peripheral direction from first aperture P1 toward third aperture P3.

[0038] An interval between first end portion 151 and third end portion 191 in the peripheral direction is wider than an interval between second end portion 152 and fourth end portion 192 in the peripheral direction. Third surface 18 is arranged at least between first end portion 151 and third end portion 191 and around the entire periphery of recess 19 in the peripheral direction.

[0039] As shown in Fig. 4, when valve body 15 is located at the second position, valve body 15 is provided not to overlap with at least a portion of each of first aperture P1 and third aperture P3 when viewed from the second aperture P2 side. As indicated by a dotted line in Fig. 4, when valve body 15 is located at the second position, valve body 15 is provided not to overlap with, for example, first aperture P1 and third aperture P3 when viewed from the second aperture P2 side. Valve body 15 is provided to allow second space S2 to be continuous to a whole of each of first aperture P1 and third aperture P3. When viewed from the second aperture P2 side, an angle $\theta 1$ formed with respect to the rotation axis by first end portion 151 and second end portion 152 of valve body 15 outside valve body 15 is equal to, for example, an angle $\theta 2$ formed with respect to the rotation axis by a first imaginary line L1 passing through the rotation axis of valve body 15 and tangent to first aperture P1 and a second imaginary line L2 passing through the rotation axis of valve body 15 and tangent to third aperture P3.

[0040] As shown in Fig. 6, when viewed from the second aperture P2 side, recess 19 is provided to overlap with a whole of each of first aperture P1 and third aperture P3 when valve body 15 is located at the third position. An angle $\theta 3$ formed with respect to the rotation axis by third end portion 191 and fourth end portion 192 of recess 19 is equal to, for example, angle $\theta 2$ described above.

[0041] Each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B can be in the following three states: a first state in which valve body 15 is located at the first position; a second state in which valve body 15 is located at the second position; and a third state in which valve body 15 is located at the third position. Each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B is switchable independently to one of the above-described three states.

[0042] As shown in Figs. 2 and 3, in the first state, a first space S1 communicating with first aperture P1 and second aperture P2 and separated from third aperture P3 by valve body 15 is arranged in each valve chamber 16. In the first state, valve body 15 does not overlap with first aperture P1 in the Z direction. Third surface 18 of valve body 15 overlaps with a whole of third aperture P3, and closes third aperture P3. Recess 19 of valve body 15 does not overlap with first aperture P1 and third aperture P3. Third surface 18 is arranged to overlap with a whole of third aperture P3 when viewed from the second aperture P2 side. First end portion 151 and third end portion 191 of valve body 15 are arranged to sandwich third aperture P3 therebetween in the peripheral direction when viewed from the second aperture P2 side. Recess 19 is arranged not to overlap with first aperture P1 and third aperture P3 when viewed from the second aperture P2 side.

[0043] As shown in Figs. 4 and 5, in the second state, second space S2 communicating with first aperture P1, second aperture P2, and third aperture P3 is arranged in valve chamber 16. The second space forms a branched flow path or a merged flow path.

[0044] In the second state, valve body 15 does not overlap with first aperture P1 in the Z direction. Valve body 15 does not overlap with at least a portion of third aperture P3 in the Z direction. Valve body 15 is arranged, for example, at a second position indicated by a solid line in Fig. 4. In this case, for example, third surface 18 is arranged to overlap with only a portion of third aperture P3 when viewed from the second aperture P2 side. When viewed from the second aperture P2 side, the aperture area of the region of third aperture P3 which does not overlap with valve body 15 is smaller than the aperture area of first aperture P1, for example.

[0045] Valve body 15 may be arranged, for example, at the second position indicated by a dotted line in Fig. 4. In this case, for example, third surface 18 is arranged not to overlap with third aperture P3 when viewed from the second aperture P2 side.

[0046] As shown in Figs. 6 and 7, in the third state, a third space S3 communicating with first aperture P1 and third aperture P3 and separated from second aperture P2 is arranged in recess 19 of valve body 15. In the third state, recess 19 of valve body 15 is arranged to overlap with first aperture P1 and third aperture P3 in the Z direction.

<Operation of Refrigeration Cycle Apparatus>

[0047] Refrigeration cycle apparatus 1000 is switched by four-way valve 2 between a cooling operation state in which outdoor heat exchanger 3 acts as a condenser and a heating operation state in which outdoor heat exchanger 3 acts as an evaporator. Further, refrigeration cycle apparatus 1000 is switched by first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B to a full-cooling operation state, a cooling-dominated operation state, a full-heating operation state, or a heating-dominated operation.

[0048] In the full-cooling operation state, refrigeration cycle apparatus 1000 is switched among a first full-cooling operation state shown in Fig. 8, a second full-cooling operation state shown in Fig. 9, and a third full-cooling operation state not shown. Similarly, in the full-heating operation state, refrigeration cycle apparatus 1000 is switched among a first full-heating operation state shown in Fig. 10, a second full-heating operation state shown in Fig. 11, and a third full-heating operation state not shown.

[0049] The first full-cooling operation state shown in Fig. 8 is realized when each of loads of first indoor heat exchanger 5A and second indoor heat exchanger 5B is comparatively high. In the first full-cooling operation state shown in Fig. 8, each of first three-way valve 8A and third three-way valve 8B is in the third state, and each of second three-way valve 9A and fourth three-way valve 9B is in the first state. In the first full-cooling operation state shown in Fig. 8, the refrigerant flows in the refrigerant circuit along arrows in Fig. 8.

[0050] High-pressure gas-phase refrigerant discharged from compressor 1 is condensed in outdoor heat exchanger 3 into high-pressure liquid-phase refrigerant or gas-liquid two-phase refrigerant, and flows out to first connecting pipe 10. The high-pressure liquid-phase refrigerant or gas-liquid two-phase refrigerant having flowed through first connecting pipe 10 flows into gas-liquid separator 7 via flow inlet 71. The high-pressure liquid-phase refrigerant having flowed out from second flow outlet 73 is branched in branch unit 300, reaches each of second apertures P2 of second three-way valve 9A and fourth three-way valve 9B that are in the first state, flows through each of the first spaces, and flows out from each of first apertures P1 to fourth connecting pipe 13A or sixth connecting pipe 13B. The liquid-phase refrigerant having flowed through fourth connecting pipe 13A is decompressed by first decompressing apparatus 4A, is then evaporated in first indoor heat exchanger 5A, and flows out to third connecting pipe 12A as low-pressure gas-phase refrigerant. The liquid-phase refrigerant having flowed through sixth connecting pipe 13B is decompressed by second decompressing apparatus 4B, is then evaporated in second indoor heat exchanger 5B, and flows out to fifth connecting pipe 12B as low-pressure gas-phase refrigerant. The low-pressure gas-phase refrigerant having flowed through third connecting pipe 12A or fifth connecting pipe 12B reaches first apertures P1 of first three-way valve 8A and third three-way valve 8B that are in the third state, flows through each of the third spaces, and then flows out from third apertures P3. The flows of the gas-phase refrigerant from third apertures P3 are merged in branch unit 300 and the gas-phase refrigerant flows out to second connecting pipe 11.

[0051] Thus, in the first full-cooling operation state shown in Fig. 8, the refrigerant discharged from compressor 1 flows through one of first indoor heat exchanger 5A and second indoor heat exchanger 5B, and is then suctioned into compressor 1.

[0052] The second full-cooling operation state shown in Fig. 9 is realized when only the load of first indoor heat exchanger 5A becomes lower than a predetermined value, for example. It should be noted that the load of second indoor heat exchanger 5B in the second full-cooling operation state may be decreased to be lower than the load of second indoor heat exchanger 5B in the first full-cooling operation state.

[0053] In the second full-cooling operation state shown in Fig. 9, each of first three-way valve 8A and third three-way valve 8B is in the third state, fourth three-way valve 9B is in the first state, and second three-way valve 9A is in the second state. That is, the second full-cooling operation state shown in Fig. 9 is different from the first full-cooling operation state shown in Fig. 8 only in that second three-way valve 9A is in the second state. In the second full-cooling operation state shown in Fig. 9, the refrigerant flows in the refrigerant circuit along arrows in Fig. 9.

[0054] The high-pressure liquid-phase refrigerant having flowed out from second flow outlet 73 is branched in branch unit 300, and part of the high-pressure liquid-phase refrigerant reaches second aperture P2 of second three-way valve 9A that is in the second state. The high-pressure liquid-phase refrigerant having flowed into second aperture P2 of second three-way valve 9A flows through the second space and is accordingly further branched in valve chamber 16. The part of the high-pressure liquid-phase refrigerant having flowed into second aperture P2 of second three-way valve 9A flows out from third aperture P3. The liquid-phase refrigerant having flowed out from third aperture P3 of second three-way valve 9A is merged with the low-pressure gas-phase refrigerant having flowed out from each of third apertures P3 of first three-way valve 8A and third three-way valve 8B in branch unit 300, and flows out to second connecting pipe 11. The remainder of the high-pressure liquid-phase refrigerant having flowed into second aperture P2 flows out from first aperture P1 to fourth connecting pipe 13A, is decompressed by first decompressing apparatus 4A, and is then evaporated in first indoor heat exchanger 5A.

[0055] In the second full-cooling operation state shown in Fig. 9, an amount of refrigerant flowing through first indoor heat exchanger 5A is controlled as a ratio of the aperture areas of first aperture P1 and third aperture P3 when viewed from the second aperture P2 side of second three-way valve 9A. The ratio is controlled as a rotation angle of valve body 15 of second three-way valve 9A.

[0056] The switching between the first full-cooling operation state shown in Fig. 8 and the second full-cooling operation state shown in Fig. 9 and the control of the rotation angle of valve body 15 of second three-way valve 9A in the second full-cooling operation state shown in Fig. 9 are performed to bring the evaporation temperature in first indoor heat exchanger 5A into a target evaporation temperature, for example. When it is determined that the evaporation temperature in first indoor heat exchanger

5A is lower than the target evaporation temperature, valve body 15 of second three-way valve 9A rotates from the first position to the second position. The evaporation temperature is always or regularly measured by a temperature sensor (not shown) attached to first indoor heat exchanger 5A, for example. The determination of the evaporation temperature and the control of the rotation angle of valve body 15 are always or regularly performed by control unit 310, for example. When switching is made between the first full-cooling operation state and the second full-cooling operation state, the driving frequency of compressor 1 is constant, for example. Here, the expression "the driving frequency is constant" means that the maximum value and minimum value of the driving frequency fall within a range of 95% or more and 105% or less of the average value thereof.

[0057] Thus, in the second full-cooling operation state shown in Fig. 9, part of the refrigerant discharged from compressor 1 is suctioned into compressor 1 without flowing through one of first indoor heat exchanger 5A and second indoor heat exchanger 5B. Therefore, the flow rate of the refrigerant flowing in first indoor heat exchanger 5A in the second full-cooling operation state shown in Fig. 9 becomes lower than the flow rate of the refrigerant flowing in first indoor heat exchanger 5A in the first full-cooling operation state shown in Fig. 8 without decreasing the driving frequency of compressor 1.

[0058] It should be noted that the switching between the first full-cooling operation state shown in Fig. 8 and the second full-cooling operation state shown in Fig. 9 and the control of the rotation angle of valve body 15 of second three-way valve 9A in the second full-cooling operation state shown in Fig. 9 may be performed when a difference between the evaporation temperature of first indoor heat exchanger 5A and the target evaporation temperature falls out of a predetermined range.

[0059] The third full-cooling operation state is realized, for example, when only the load of second indoor heat exchanger 5B becomes lower than a predetermined value. In the third full-cooling operation state, each of first three-way valve 8A and third three-way valve 8B is in the third state, second three-way valve 9A is in the first state, and fourth three-way valve 9B is in the second state. The flow rate of the refrigerant flowing in second indoor heat exchanger 5B in the third full-cooling operation state becomes lower than the flow rate of the refrigerant flowing in second indoor heat exchanger 5B in the first full-cooling operation state shown in Fig. 8.

[0060] The first full-heating operation state shown in Fig. 10 is realized when each of loads of first indoor heat exchanger 5A and second indoor heat exchanger 5B is comparatively high. In the first full-heating operation state shown in Fig. 10, each of first three-way valve 8A and third three-way valve 8B is in the first state, and each of second three-way valve 9A and fourth three-way valve 9B is in the third state. In the first full-heating operation state shown in Fig. 10, the refrigerant flows in the refrigerant circuit along arrows in Fig. 10.

[0061] High-pressure gas-phase refrigerant discharged from compressor 1 flows out to first connecting pipe 10 through third check valve 6C. The high-pressure gas-phase refrigerant having flowed through first connecting pipe 10 flows into gas-liquid separator 7 via flow inlet 71. The high-pressure gas-phase refrigerant having flowed out from first flow outlet 72 is branched in branch unit 300, reaches each of second apertures P2 of first three-way valve 8A and third three-way valve 8B that are in the first state, flows through each of the first spaces, and flows out from each of first apertures P1 to third connecting pipe 12A or fifth connecting pipe 12B. The gas-phase refrigerant having flowed through third connecting pipe 12A is condensed in first indoor heat exchanger 5A, is then decompressed by first decompressing apparatus 4A, and flows out to fourth connecting pipe 13A as low-pressure gas-liquid two-phase refrigerant. The gas-phase refrigerant having flowed through fifth connecting pipe 12B is condensed in second indoor heat exchanger 5B, is then decompressed by second decompressing apparatus 4B, and flows out to sixth connecting pipe 13B as low-pressure gas-liquid two-phase refrigerant. The low-pressure gas-phase refrigerant having flowed through fourth connecting pipe 13A or sixth connecting pipe 13B reaches first apertures P1 of second three-way valve 9A and fourth three-way valve 9B that are in the third state, flows through each of the third spaces, and then flows out from third apertures P3. The flows of the gas-phase refrigerant from third apertures P3 are merged in branch unit 300 and the gas-phase refrigerant flows out to second connecting pipe 11.

[0062] Thus, in the first full-heating operation state shown in Fig. 10, the refrigerant discharged from compressor 1 flows through one of first indoor heat exchanger 5A and second indoor heat exchanger 5B, and is then suctioned into compressor 1.

[0063] The second full-heating operation state shown in Fig. 11 is realized, for example, when only the load of first indoor heat exchanger 5A becomes lower than a predetermined value. It should be noted that the load of second indoor heat exchanger 5B in the second full-heating operation state shown in Fig. 11 may be decreased to be lower than that in the first full-heating operation state.

[0064] In the second full-heating operation state shown in Fig. 11, each of second three-way valve 9A and fourth three-way valve 9B is in the third state, third three-way valve 8B is in the first state, and first three-way valve 8A is in the second state. That is, the second full-heating operation state shown in Fig. 11 is different from the first full-heating operation state shown in Fig. 10 only in that first three-way valve 8A is in the second state. In the second full-heating operation state shown in Fig. 11, the refrigerant flows in the refrigerant circuit along arrows in Fig. 11.

[0065] High-pressure gas-phase refrigerant having flowed out from first flow outlet 72 is branched in branch unit 300, and part of the high-pressure gas-phase refrigerant reaches second aperture P2 of first three-way valve 8A that is in the second state. The high-pressure gas-phase refrigerant having flowed into second aperture P2 of first three-way valve 8A flows through the second space and is accordingly further branched in valve chamber 16. Part of the high-pressure gas-phase refrigerant having flowed into second aperture P2 of first three-way valve 8A flows out from third aperture P3. The gas-phase refrigerant having flowed out from third aperture P3 of first three-way valve 8A is merged with the low-pressure gas-phase refrigerant having flowed out from each of third apertures P3 of second three-way valve 9A and fourth three-way valve 9B in branch unit 300, and flows out to second connecting pipe 11. The remainder of the high-pressure gas-phase refrigerant having flowed into second aperture P2 flows out from first aperture P1 to third connecting pipe 12A, and is condensed in first indoor heat exchanger 5A.

[0066] In the second full-heating operation state shown in Fig. 11, an amount of refrigerant flowing through first indoor heat exchanger 5A is controlled by first three-way valve 8A. The amount of refrigerant flowing through first indoor heat exchanger 5A becomes smaller as the ratio of the aperture area of third aperture P3 to the aperture area of first aperture P1 of first three-way valve 8A is higher. The ratio is controlled as a rotation angle of valve body 15 of first three-way valve 8A.

[0067] The switching between the first full-heating operation state shown in Fig. 10 and the second full-heating operation state shown in Fig. 11, and the control of the rotation angle of valve body 15 of first three-way valve 8A in the second full-heating operation state shown in Fig. 11 are performed to bring the condensation temperature in first indoor heat exchanger 5A into a target condensation temperature, for example. When it is determined that the condensation temperature in first indoor heat exchanger 5A is higher than the target condensation temperature, valve body 15 of first three-way valve 8A rotates from the first position to the second position. The condensation temperature is always or regularly measured by a temperature sensor (not shown) attached to first indoor heat exchanger 5A, for example. The determination of the condensation temperature and the control of the rotation angle of valve body 15 are always or regularly performed by control unit 310, for example. When switching is made between the first full-heating operation state and the second full-heating operation state, the driving frequency of compressor 1 is constant, for example.

[0068] Thus, in the second full-heating operation state shown in Fig. 11, part of the refrigerant discharged from compressor 1 is suctioned into compressor 1 without flowing through one of first indoor heat exchanger 5A and second indoor heat exchanger 5B. Therefore, the flow rate of the refrigerant flowing in first indoor heat exchanger 5A in the second full-heating operation state shown in Fig. 11 is lower than the flow rate of the refrigerant flowing in first indoor heat exchanger 5A in the first full-heating operation state shown in Fig. 10 without decreasing the driving frequency of compressor 1.

[0069] It should be noted that the switching between the first full-heating operation state shown in Fig. 10 and the second full-heating operation state shown in Fig. 11 and the control of the rotation angle of valve body 15 of first three-way valve 8A in the second full-heating operation state shown in Fig. 11 may be performed when a difference between the condensation temperature of first indoor heat exchanger 5A and the target condensation temperature falls out of a predetermined range.

[0070] The third full-heating operation state is realized, for example, when only the load of second indoor heat exchanger 5B becomes lower than a predetermined value. In the third full-heating operation state, each of second three-way valve 9A and fourth three-way valve 9B is in the third state, first three-way valve 8A is in the first state, and third three-way valve 8B is in the second state. The flow rate of the refrigerant flowing in second indoor heat exchanger 5B in the third full-heating operation state becomes lower than the flow rate of the refrigerant flowing in second indoor heat exchanger 5B in the first full-heating operation state shown in Fig. 10.

[0071] Thus, in refrigeration cycle apparatus 1000, when the load of one of first indoor heat exchanger 5A and second indoor heat exchanger 5B is decreased in the first full-cooling operation state, the second full-cooling operation state or the third full-cooling operation state is realized. Similarly, in refrigeration cycle apparatus 1000, when the load of one of first indoor heat exchanger 5A and second indoor heat exchanger 5B is decreased in the first full-heating operation state, the second full-heating operation state or the third full-heating operation state is realized. As a result, in refrigeration cycle apparatus 1000, the flow rate of the refrigerant flowing in the indoor heat exchanger in which the load is decreased can be decreased without decreasing the driving frequency of compressor 1, thereby suppressing occurrence of chattering in first check valve 6A, second check valve 6B, third check valve 6C, and fourth check valve 6D while preventing decreased comfortability in the rooms in which the indoor units are arranged.

[0072] It should be noted that the switching among the full-cooling operation state, the cooling-dominated operation state, the full-heating operation state, and the heating-dominated operation state can be realized also when each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B is replaced with two or more electromagnetic valves (for example, eight electromagnetic valves). In this case, the control unit needs to control movement of each of the valve bodies of the eight electromagnetic valves for the purpose of the switching. On the other hand, in refrigeration cycle apparatus 1000, the switching can be performed by controlling, by control unit 310, only the movement of each of the valve bodies of the four three-way valves. Therefore, the number of ports of control unit 310 of refrigeration cycle apparatus 1000 is reduced as compared with that in the refrigeration cycle apparatus including the plurality of electromagnetic valves instead of the three-way valves.

[0073] In refrigeration cycle apparatus 1000, valve body 15 may be arranged not to overlap with first aperture P1 and third aperture P3 when viewed from the second aperture P2 side. In the case where valve body 15 is arranged not to overlap with first aperture P1 and third aperture P3 when viewed from the second aperture P2 side in the second state as indicated by a dotted line in Fig. 4, the flow rate of the refrigerant flowing through first indoor heat exchanger 5A is further reduced as compared with the case where valve body 15 is arranged to overlap with part of third aperture P3 when viewed from the second aperture P2 side in the second state as indicated by a solid line in Fig. 4. From a different viewpoint, it can be said that in the former case, a difference between the flow rate of the refrigerant flowing in first indoor heat exchanger 5A and the flow rate of the refrigerant flowing in second indoor heat exchanger 5B becomes larger than that in the latter case. Therefore, in the former case, even when each of the loads of first indoor heat exchanger 5A and second indoor heat exchanger 5B is comparatively large, the flow rate of the refrigerant flowing through each of first indoor heat exchanger 5A and second indoor heat exchanger 5B can be appropriately set in accordance with the load.

[0074] Refrigeration cycle apparatus 1000 is switched between a first cooling-dominated operation state shown in Fig. 12 and a second cooling-dominated operation state (not shown) in the cooling-dominated operation state. Similarly, refrigeration cycle apparatus 1000 is switched between a first heating-dominated operation state shown in Fig. 13 and a second heating-dominated operation state (not shown) in the heating-dominated operation.

[0075] The first cooling-dominated operation state shown in Fig. 12 is realized when the load of first indoor heat exchanger 5A acting as an evaporator is higher than the load of second indoor heat exchanger 5B acting as a condenser. In the first cooling-dominated operation state, each of first three-way valve 8A and fourth three-way valve 9B is in the third state, third three-way valve 8B is in the first state, and second three-way valve 9A is in the second state. The second cooling-dominated operation state is realized when the load of second indoor heat exchanger 5B acting as an evaporator is higher than the load of first indoor heat exchanger 5A acting as a condenser. In the second cooling-dominated operation state, each of second three-way valve 9A and third three-way valve 8B is in the third state, first three-way valve 8A is in the first state, and fourth three-way valve 9B is in the second state.

[0076] The first heating-dominated operation state shown in Fig. 13 is realized when the load of first indoor heat exchanger 5A acting as a condenser is higher than the load of second indoor heat exchanger 5B acting as an evaporator. In the first heating-dominated operation state, third three-way valve 8B is in the third state, first three-way valve 8A and fourth three-way valve 9B are in the first state, and second three-way valve 9A is in the second state. The second heating-dominated operation state is realized when the load of second indoor heat exchanger 5B acting as a condenser is higher than the load of first indoor heat exchanger 5A acting as an evaporator. In the second heating-dominated operation state, first three-way valve 8A is in the third state, each of second three-way valve 9A and third three-way valve 8B is in the first state, and fourth three-way valve 9B is in the second state.

<Modification>

[0077] Refrigeration cycle apparatus 1000 may include three or more indoor heat exchangers and three-way valves twice as large as the number of the indoor heat exchangers. For example, refrigeration cycle apparatus 1000 may further include: a third indoor heat exchanger connected in parallel with first indoor heat exchanger 5A and second indoor heat exchanger 5B; a fifth three-way valve arranged downstream of the third indoor heat exchanger in the cooling operation state and arranged upstream of the third indoor heat exchanger in the heating operation state; and a sixth three-way valve arranged upstream of the third indoor heat exchanger in the cooling operation state and arranged downstream of the third indoor heat exchanger in the heating operation state. The fifth three-way valve is connected in parallel with first three-way valve 8A and third three-way valve 8B. The sixth three-way valve is connected in parallel with second three-way valve 9A and fourth three-way valve 9B.

[0078] As shown in Figs. 14 to 16, in each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B, first aperture P1 may be arranged beside third aperture P3 with an interval being interposed therebetween in the X direction serving as the first direction. In this case, each of valve bodies 15 of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B is provided to move back and forth along the X direction. Third surface 18 of each valve body 15 is arranged beside recess 19 in the X direction. An interval between first end portion 151 and third end portion 191 in the X direction is larger than an interval between second end portion 152 and fourth end portion 192 in the X direction.

[0079] Fourth surface 20 of valve body 15 is provided to slide on second surface 14B of valve seat 14, for example. Second aperture P2 is arranged to face first aperture P1, for example. It should be noted that fourth surface 20 of valve body 15 may be provided to face second surface 14B of valve seat 14 with an interval being interposed therebetween, for example. In this case, each of valve seats 14 is provided with a holding portion for holding a state in which first surface 14A of valve seat 14 and third surface 18 of valve body 15 are in contact with each other.

[0080] As shown in Figs. 14 to 16, each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B described above can also be in the three states, i.e., the first state, the second state, and the third state as with each of first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B shown in Figs. 2 to 7. Therefore, refrigeration cycle apparatus 1000 including first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B shown in Figs. 14 to 16 can also exhibit the same effect as that of refrigeration cycle apparatus 1000 including first three-way valve 8A, second three-way valve 9A, third three-way valve 8B, and fourth three-way valve 9B shown in Figs. 2 to 7.

[0081] Refrigeration cycle apparatus 1000 may further include an apparatus configured to prevent liquid from returning to compressor 1. Examples of such an apparatus include an accumulator or a heat exchanger configured to exchange heat between the refrigerant discharged from compressor 1 and the refrigerant suctioned into compressor 1.

[0082] Although the embodiments of the present disclosure have been described as above, the above-described embodiments can be modified in various manners.

[0083] Further, the scope of the present disclosure is not limited to the above-described embodiments. The scope of the present disclosure is defined by the terms of the claims, and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

REFERENCE SIGNS LIST

[0084] 1: compressor; 2: four-way valve; 3: outdoor heat exchanger; 4A: first decompressing apparatus; 4B: second decompressing apparatus; 5A: first indoor heat exchanger; 5B: second indoor heat exchanger; 6A: first check valve; 6B: second check valve; 6C: third check valve; 6D: fourth check valve; 7: gas-liquid separator; 8A: first three-way valve; 8B: third three-way valve; 9A: second three-way valve; 9B: fourth three-way valve; 10: first connecting pipe; 11: second connecting pipe; 12A: third connecting pipe; 12B: fifth connecting pipe; 13A: fourth connecting pipe; 13B: sixth connecting pipe; 14: valve seat; 14A: first surface; 14B: second surface; 15: valve body; 16: valve chamber; 17: gear; 18: third surface; 19: recess; 20: fourth surface; 71: flow inlet; 72: first flow outlet; 73: second flow outlet; 100: outdoor unit; 151: first end portion; 152: second end portion; 191: third end portion; 192: fourth end portion; 200A: first indoor unit; 200B: second indoor unit; 300: branch unit; 310: control unit; 1000: refrigeration cycle apparatus; L1: first imaginary line; L2: second imaginary line; P1: first aperture; P2: second aperture; P3: third aperture; S1: first space; S3: second space; S3: third space.

Claims

1. A refrigeration cycle apparatus comprising a refrigerant circuit in which refrigerant circulates, the refrigerant circuit comprising a compressor, a flow path switching portion, an outdoor heat exchanger, a decompressing apparatus, a first indoor heat exchanger, a first connecting pipe through which the refrigerant flows into the first indoor heat exchanger, and a second connecting pipe through which the refrigerant flows from the first indoor heat exchanger,

the flow path switching portion being configured to switch between a cooling operation state in which the outdoor heat exchanger acts as a condenser and a heating operation state in which the outdoor heat exchanger acts as an evaporator,
the refrigerant circuit further comprising:

a first three-way valve arranged downstream of the first indoor heat exchanger in the cooling operation state and arranged upstream of the first indoor heat exchanger in the heating operation state; and
a second three-way valve arranged upstream of the first indoor heat exchanger in the cooling operation state and arranged downstream of the first indoor heat exchanger in the heating operation state,

each of the first three-way valve and the second three-way valve comprising:

a valve seat having a valve chamber and provided with a first aperture, a second aperture and a third aperture, the first aperture, the second aperture, and the third aperture being connected to the valve chamber; and
a valve body configured to move among a first position, a second position, and a third position in the valve chamber,

the first aperture of each of the first three-way valve and the second three-way valve being connected to one end or the other end of the first indoor heat exchanger in the refrigerant circuit,
the second aperture of each of the first three-way valve and the second three-way valve being connected to the first connecting pipe,
the third aperture of each of the first three-way valve and the second three-way valve being connected to the second connecting pipe,
each of the first three-way valve and the second three-way valve being configured to be switched independently to one of a first state in which the valve body is located at the first position, a sec-

ond state in which the valve body is located at the second position, and a third state in which the valve body is located at the third position,
in the first state, a first space being arranged in the valve chamber,
the first space communicating with the first aperture and the second aperture and being separated from the third aperture,
in the second state, a second space being arranged in the valve chamber,
the second space communicating with the first aperture, the second aperture, and the third aperture,
in the third state, a third space being arranged in the valve chamber,
the third space communicating with the first aperture and the third aperture and being separated from the second aperture.

2. The refrigeration cycle apparatus according to claim 1, wherein

the valve seat has a first surface facing the valve chamber and provided with the first aperture and the third aperture, and a second surface provided with the second aperture,
the first aperture is arranged beside the third aperture with an interval being interposed between the first aperture and the third aperture in a first direction.
the valve body has a third surface slidable on the first surface, and is provided with a recess arranged beside the third surface in the first direction and recessed with respect to the third surface,
in the first state, when viewed from the second aperture side, the third surface is arranged to overlap with the third aperture and the recess is arranged not to overlap with the first aperture and the third aperture, and
in the third state, the recess is arranged to overlap with the first aperture and the third aperture and the third space is formed in the recess.

3. The refrigeration cycle apparatus according to claim 2, wherein

the second surface faces the first surface with the valve body being interposed between the second surface and the first surface,
the valve body is provided to rotate about a rotation axis extending along a second direction, and
the first direction is a peripheral direction with respect to the rotation axis.

4. The refrigeration cycle apparatus according to claim 3, wherein the valve body is provided to allow the second space to be continuous to a whole of each of the first aperture and the third aperture.

5. The refrigeration cycle apparatus according to any one of claims 1 to 4, wherein

the refrigerant circuit further comprises:

a second indoor heat exchanger connected to the first connecting pipe and the second connecting pipe in parallel with the first indoor heat exchanger;
a third three-way valve arranged downstream of the first indoor heat exchanger in the cooling operation state and arranged upstream of the second indoor heat exchanger in the heating operation state; and
a fourth three-way valve arranged upstream of the first indoor heat exchanger in the cooling operation state and arranged downstream of the second indoor heat exchanger in the heating operation state,

the third three-way valve and the fourth three-way valve have the same configurations as configurations of the first three-way valve and the second three-way valve, each of the third three-way valve and the fourth three-way valve being configured to be switched independently to one of the first state, the second state, and the third state,
in the cooling operation state in which load of the first indoor heat exchanger is lower than load of the second indoor heat exchanger, each of the first three-way valve and the third three-way valve is in the third state, the second three-way valve is in the second state, and the fourth three-way valve is in the first state, and
in the heating operation state in which the load of the first indoor heat exchanger is lower than the load of the second indoor heat exchanger, each of the second three-way valve and the fourth three-way valve is in the third state, the first three-way valve is in the second state, and the third three-way valve is in the first state.

6. The refrigeration cycle apparatus according to any one of claims 1 to 5, wherein when switching is made between the first state and the second state, a driving frequency of the compressor is constant.

7. The refrigeration cycle apparatus according to any one of claims 1 to 6, wherein
the refrigerant circuit further comprises:

a first check valve arranged in a refrigerant flow path between the outdoor heat exchanger and the first connecting pipe, the first check valve

being configured to permit only flow of the refrigerant from the outdoor heat exchanger to the first connecting pipe;
a second check valve arranged in a refrigerant flow path between the outdoor heat exchanger and the second connecting pipe, the second check valve being configured to permit only flow of the refrigerant from the second connecting pipe to the outdoor heat exchanger;
a third check valve arranged in a refrigerant flow path between the flow path switching portion and the first connecting pipe, the third check valve being configured to permit only flow of the refrigerant from the flow path switching portion to the first connecting pipe; and
a fourth check valve arranged in a refrigerant flow path between the flow path switching portion and the second connecting pipe, the fourth check valve being configured to permit only flow of the refrigerant from the second connecting pipe to the flow path switching portion.

8. The refrigeration cycle apparatus according to any one of claims 1 to 7, wherein

the refrigerant circuit further comprises a gas-liquid separator, and
the gas-liquid separator has an flow inlet connected to the first connecting pipe, a first flow outlet which is connected to the second aperture of the first three-way valve and via which gas-phase refrigerant flows out, and a second flow outlet which is connected to the second aperture of the second three-way valve and via which liquid-phase refrigerant flows out.

9. The refrigeration cycle apparatus according to any one of claims 1 to 8, wherein the first connecting pipe and the second connecting pipe are arranged between an outdoor unit and a branch unit, the outdoor unit being configured to accommodate the compressor, the flow path switching portion, and the outdoor heat exchanger, the branch unit being configured to accommodate the first three-way valve and the second three-way valve.

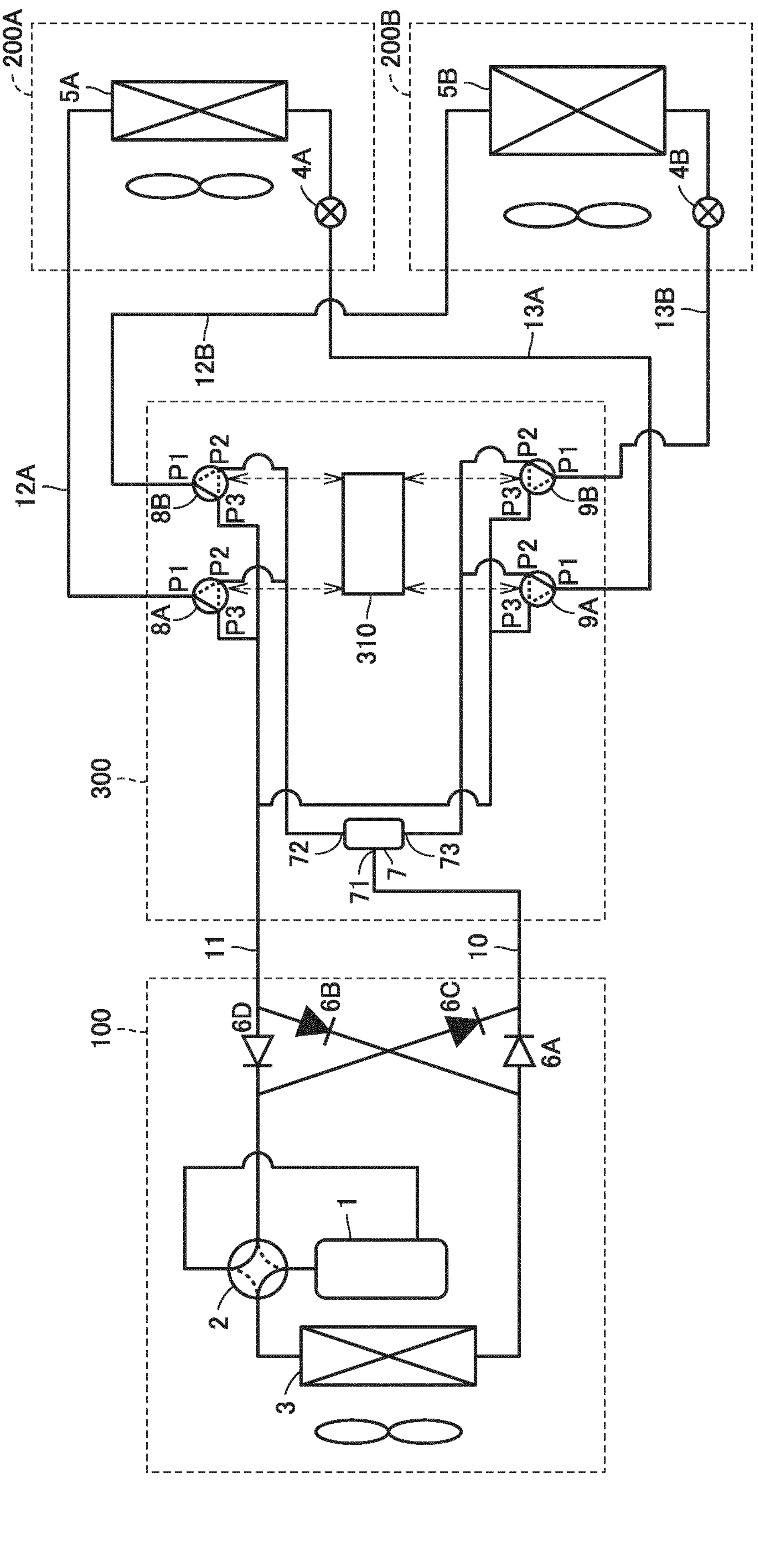

200A
200B
5A
5B
4A
4B
12A
12B
13A
13B
8A
8B
9A
9B
P1
P2
P3
310
300
7
71
72
73
11
10
100
6A
6B
6C
6D
1
2
3

FIG.1

FIG.2

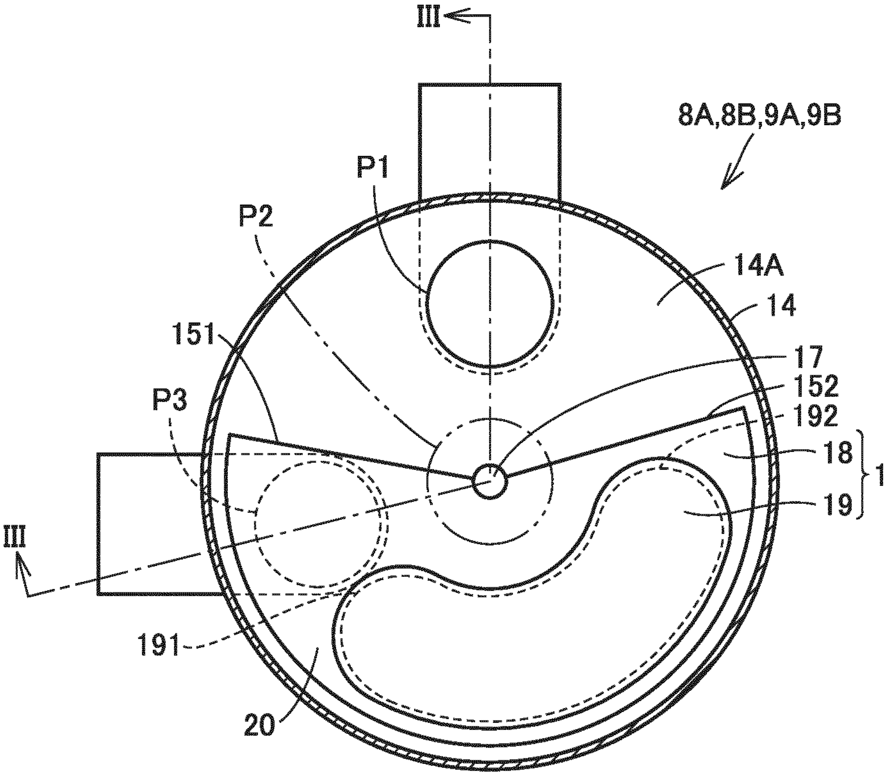

III
III
8A,8B,9A,9B
P1
P2
14A
14
151
17
152
P3
192
18
15
19
191
20

FIG.3

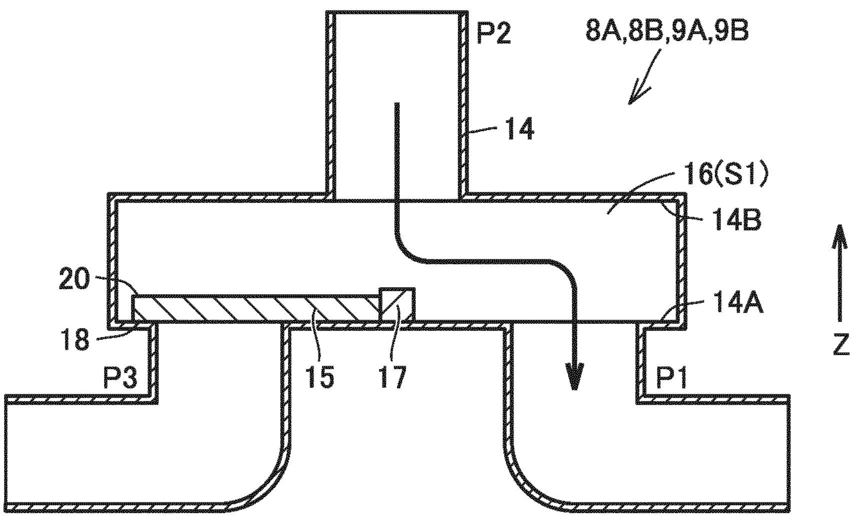

P2
8A,8B,9A,9B
14
16(S1)
14B
20
14A
Z
18
15
17
P3
P1

FIG.4

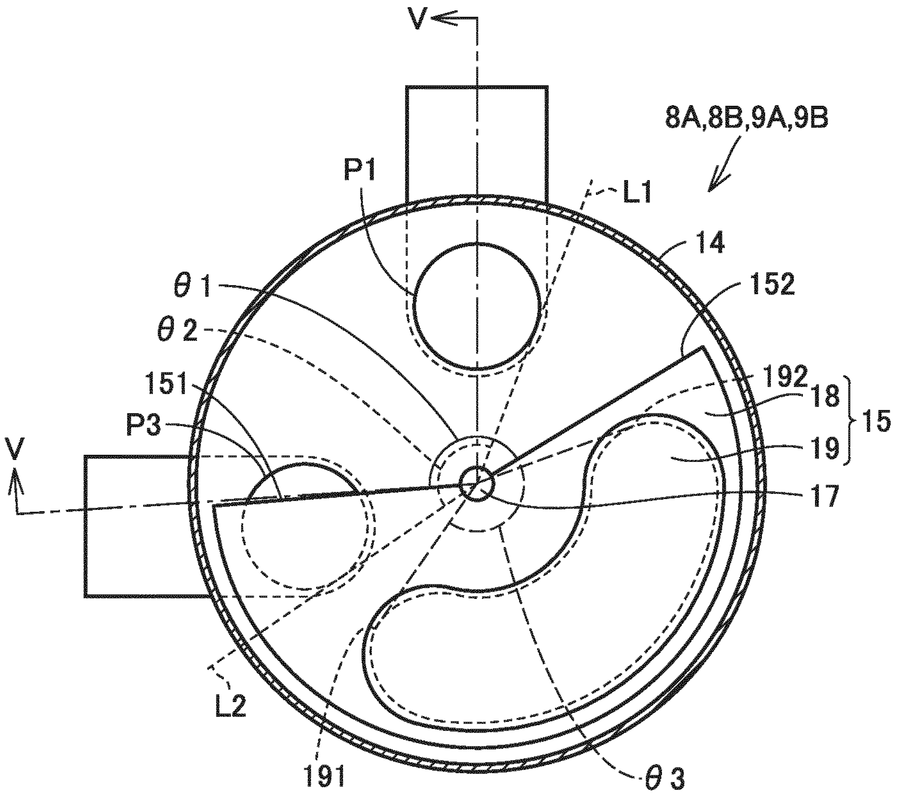

V
8A,8B,9A,9B
P1
L1
14
θ1
152
θ2
192
18
151
15
P3
19
V
17
L2
191
θ3

FIG.5

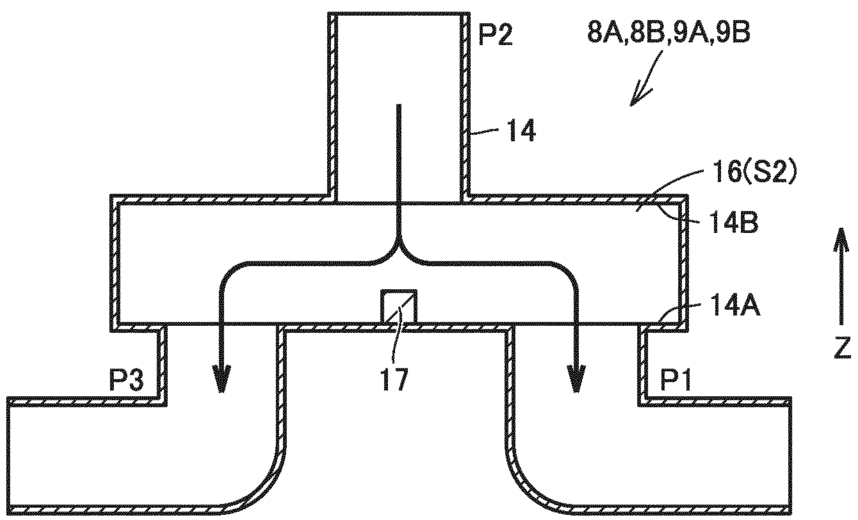

P2
8A,8B,9A,9B
14
16(S2)
14B
14A
Z
P3
17
P1

FIG.6

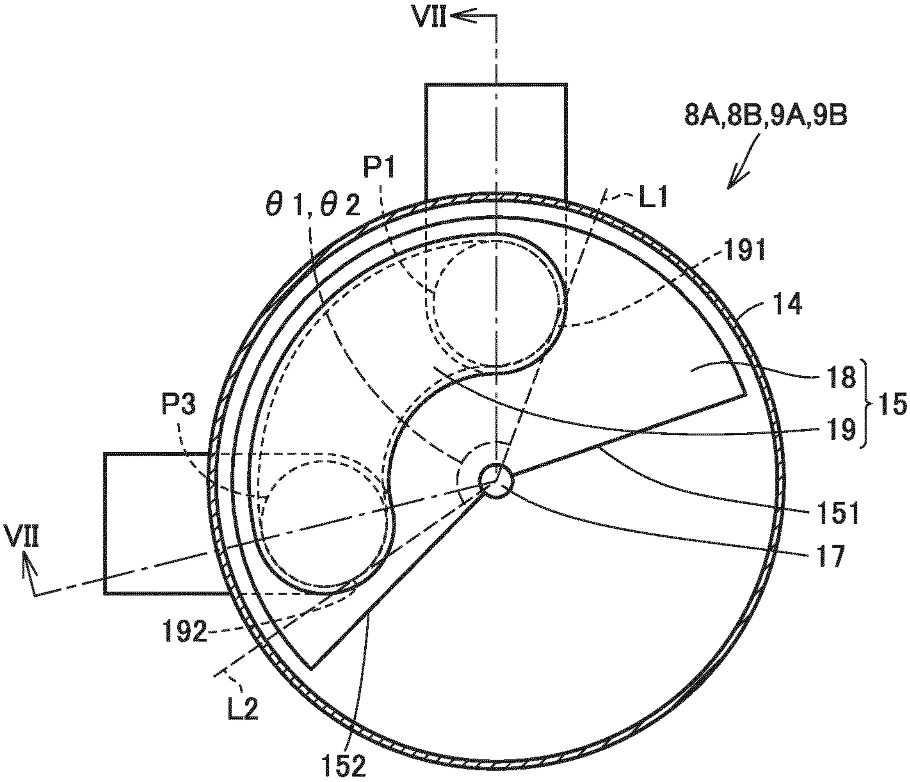
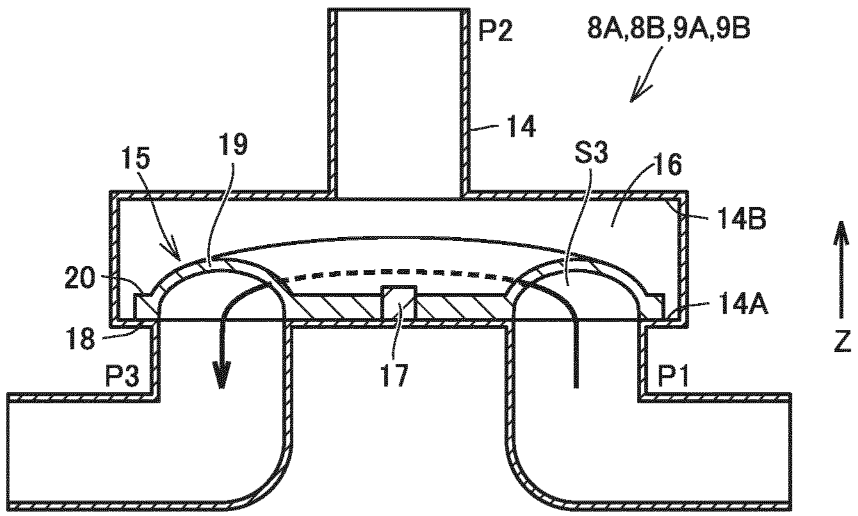

VII
8A,8B,9A,9B
P1
θ1, θ2
L1
191
14
18
15
19
P3
151
17
VII
192
L2
152

FIG.7


P2
8A,8B,9A,9B
14
15
19
S3
16
14B
20
14A
Z
18
P3
17
P1

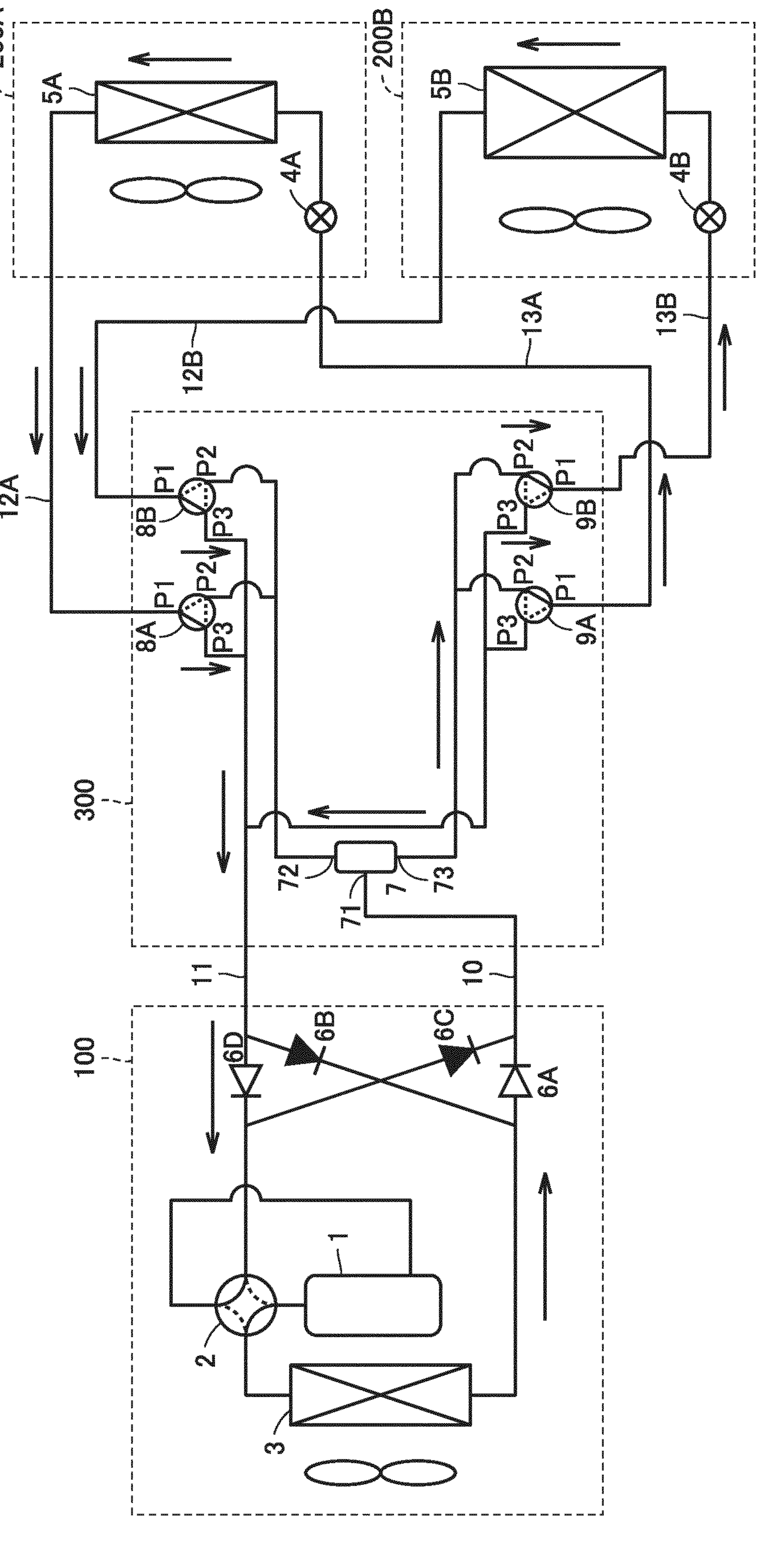
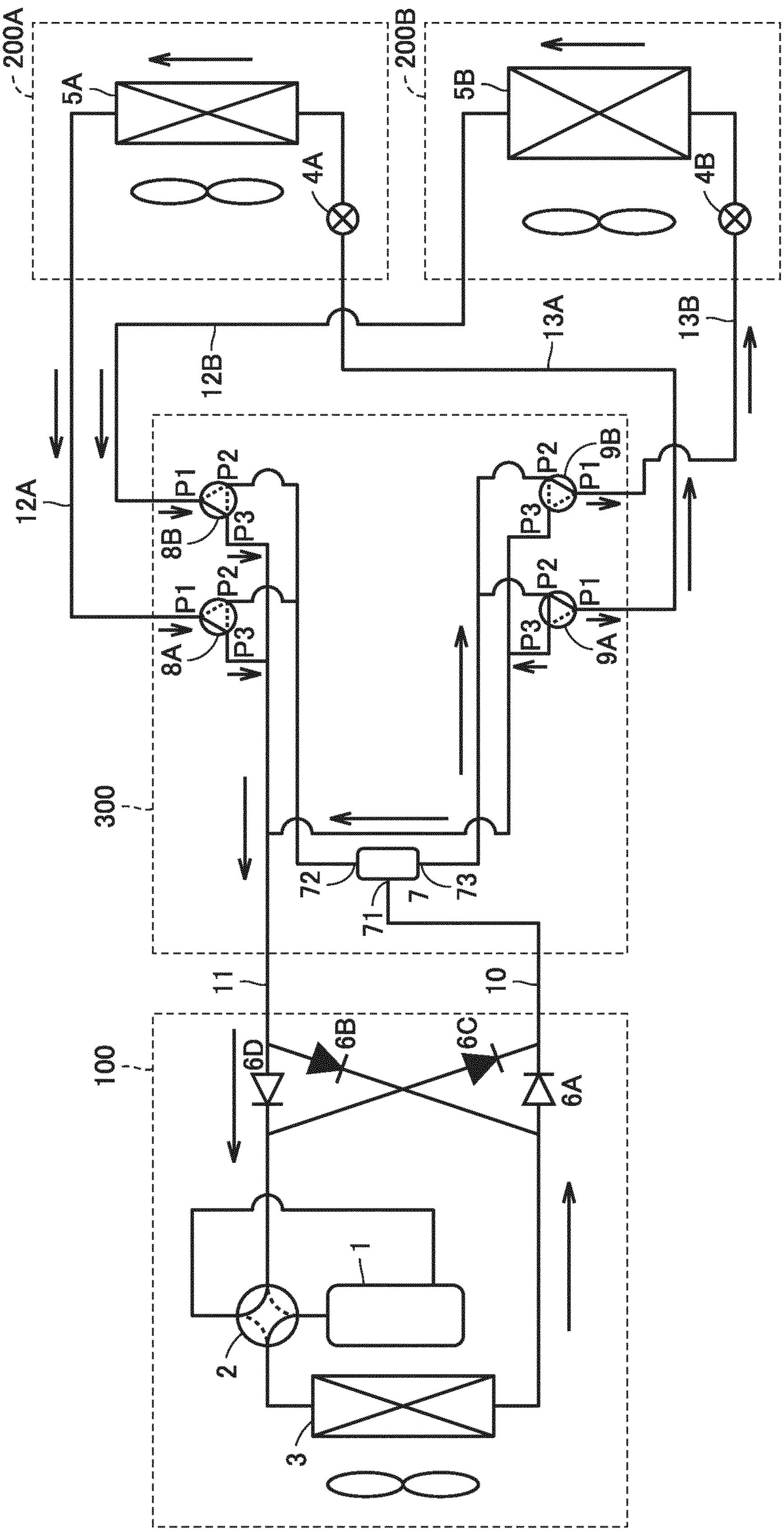

200A
200B
5A
5B
4A
4B
12A
12B
13A
13B
P1
P2
P3
8A
8B
9A
9B
300
7
71
72
73
11
10
100
6A
6B
6C
6D
1
2
3

FIG.8

FIG.9


200A
200B
5A
5B
4A
4B
12A
12B
13A
13B
300
8A
8B
9A
9B
P1
P2
P3
7
71
72
73
11
10
100
6A
6B
6C
6D
1
2
3

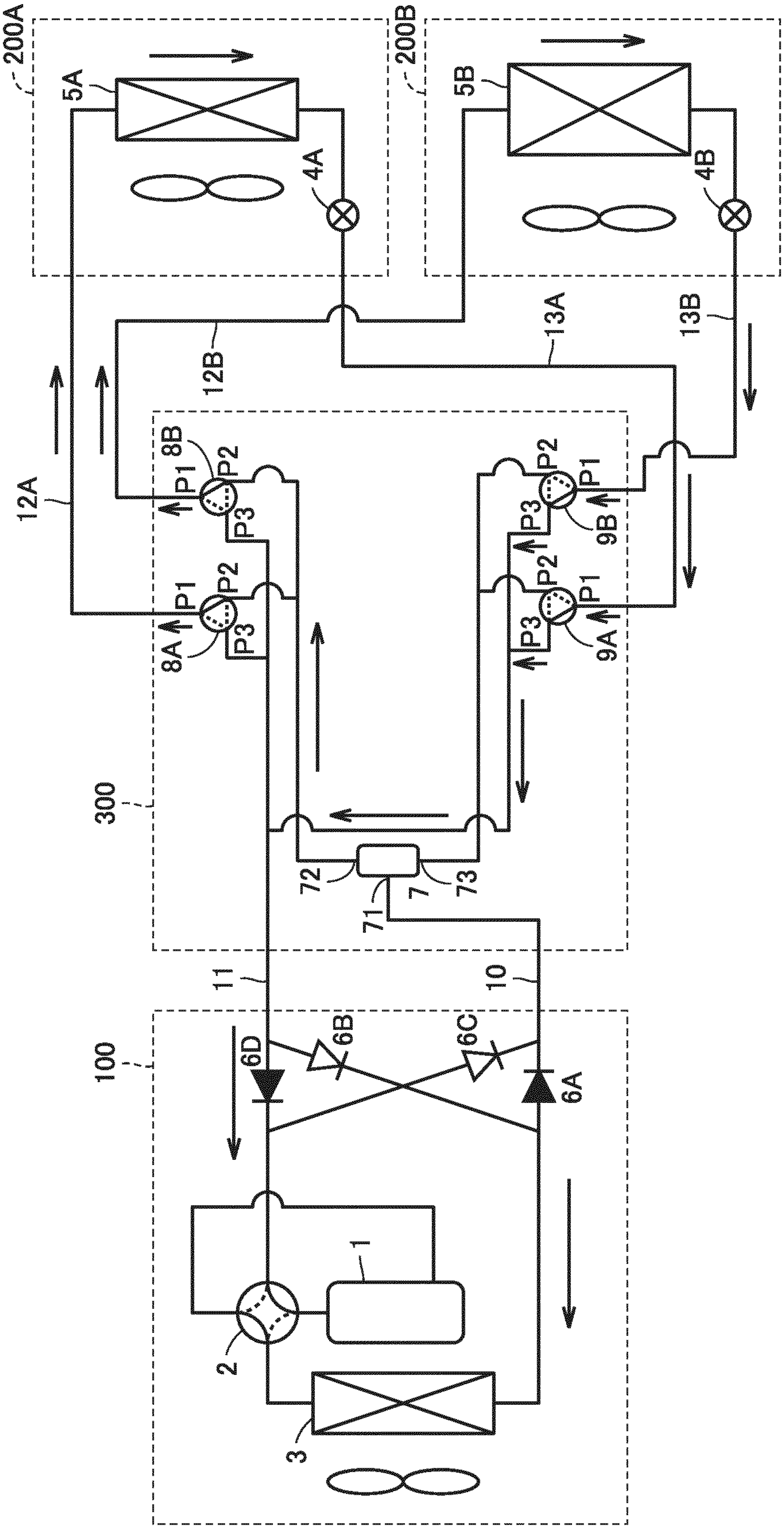

200A
200B
5A
5B
4A
4B
12A
12B
13A
13B
8A
8B
9A
9B
P1
P2
P3
300
7
71
72
73
11
10
100
6A
6B
6C
6D
1
2
3

FIG.10

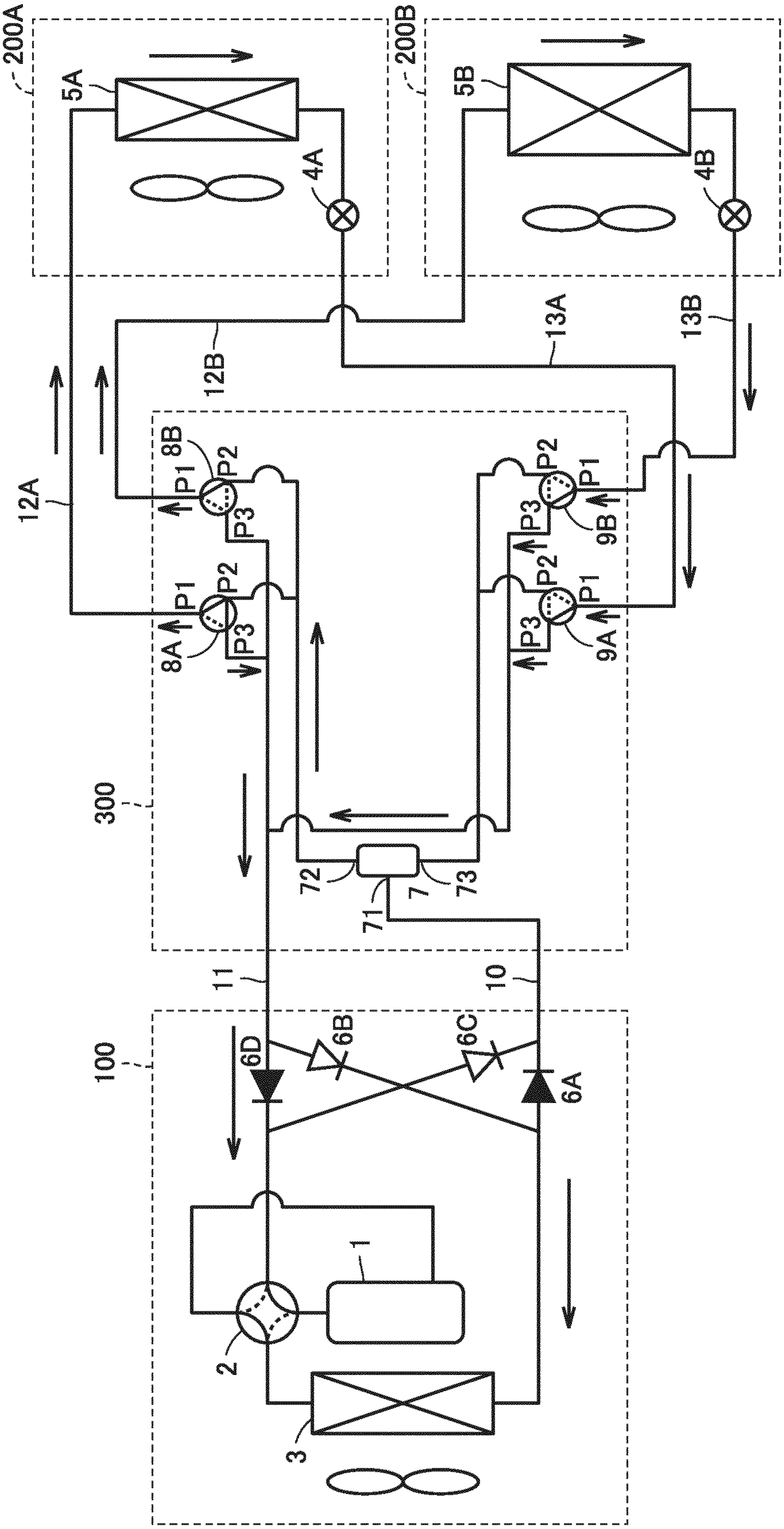

200A
200B
5A
5B
4A
4B
12A
12B
13A
13B
8A
8B
9A
9B
P1
P2
P3
300
7
71
72
73
11
10
100
6A
6B
6C
6D
1
2
3

FIG.11

FIG.12

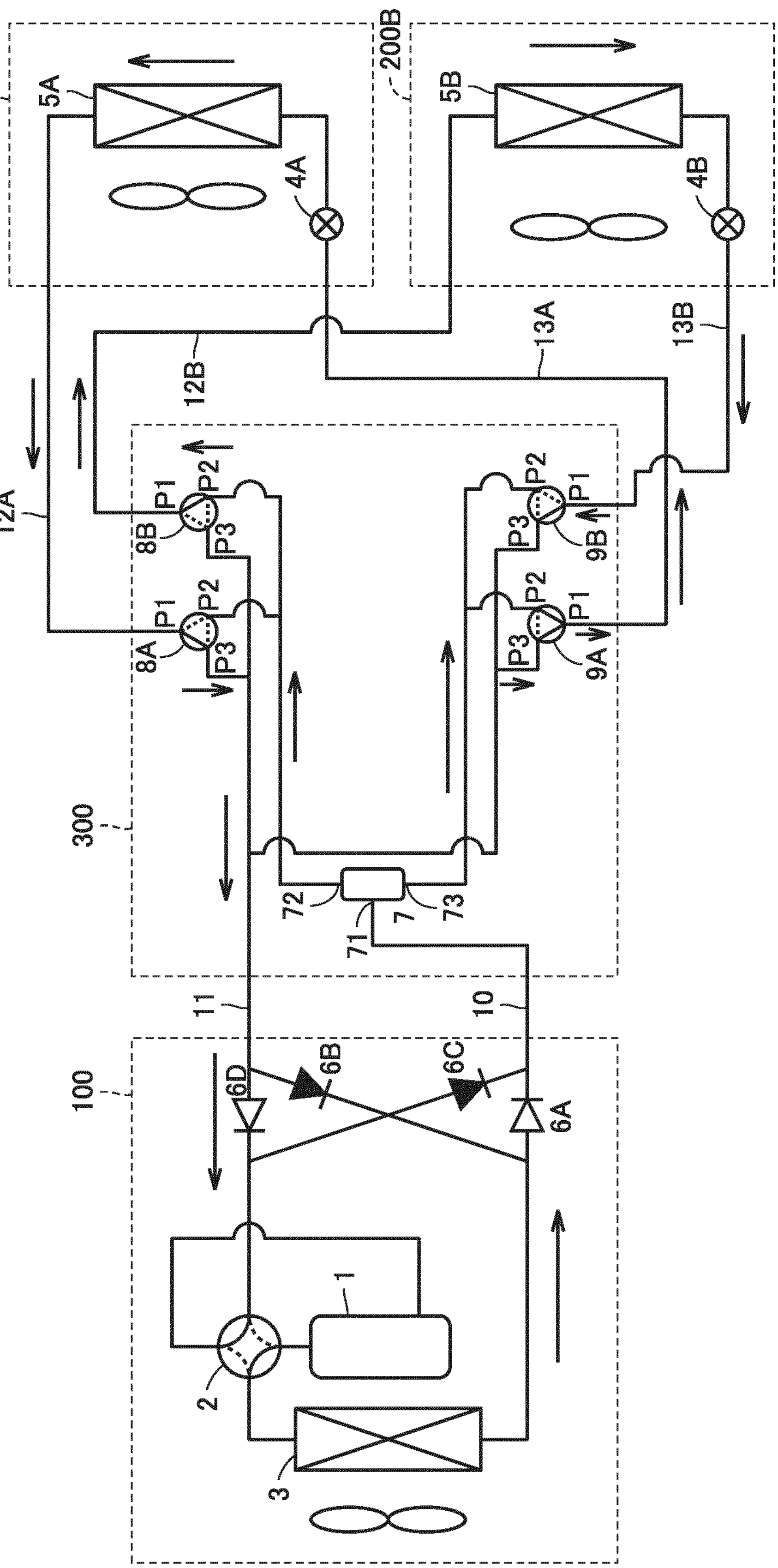

200A
5A
4A
200B
5B
4B
12A
12B
13A
13B
8A
8B
9A
9B
P1
P2
P3
300
72
71
7
73
11
10
100
6A
6B
6C
6D
1
2
3

FIG.13

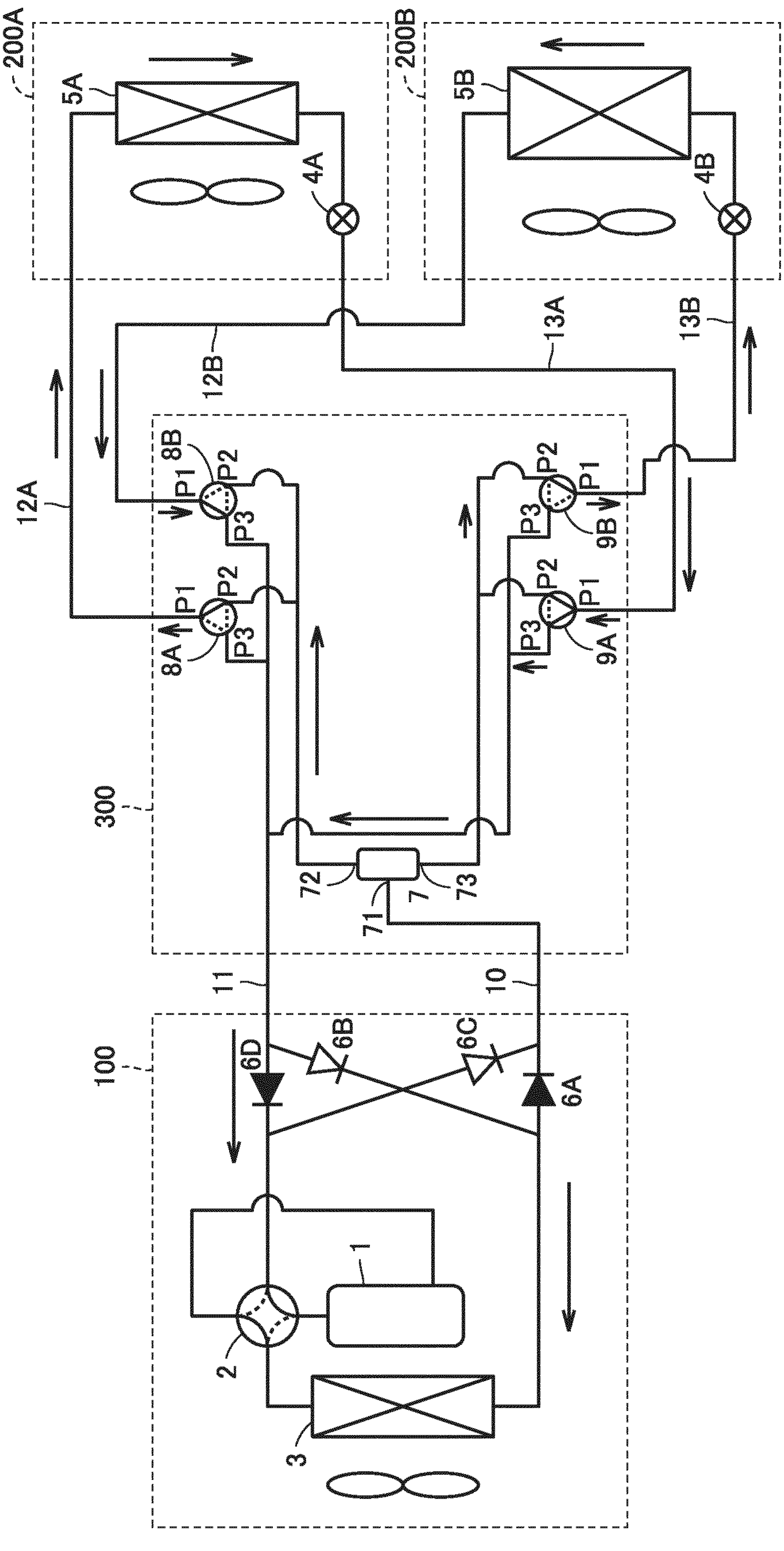

200A
200B
5A
5B
4A
4B
12A
12B
13A
13B
8A
8B
9A
9B
P1
P2
P3
300
7
71
72
73
11
10
100
6A
6B
6C
6D
1
2
3

FIG.14

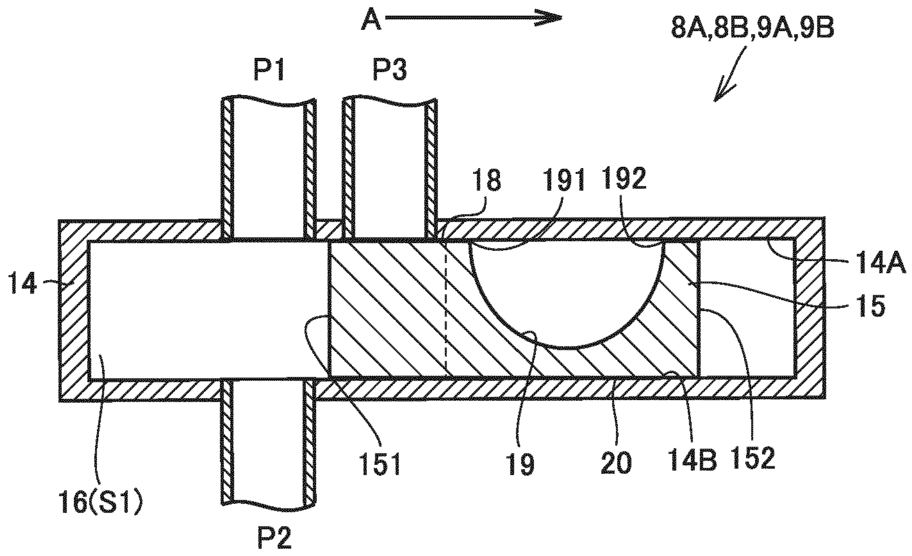

A
8A,8B,9A,9B
P1
P3
18
191
192
14
14A
15
151
19
20
14B
152
16(S1)
P2

FIG.15

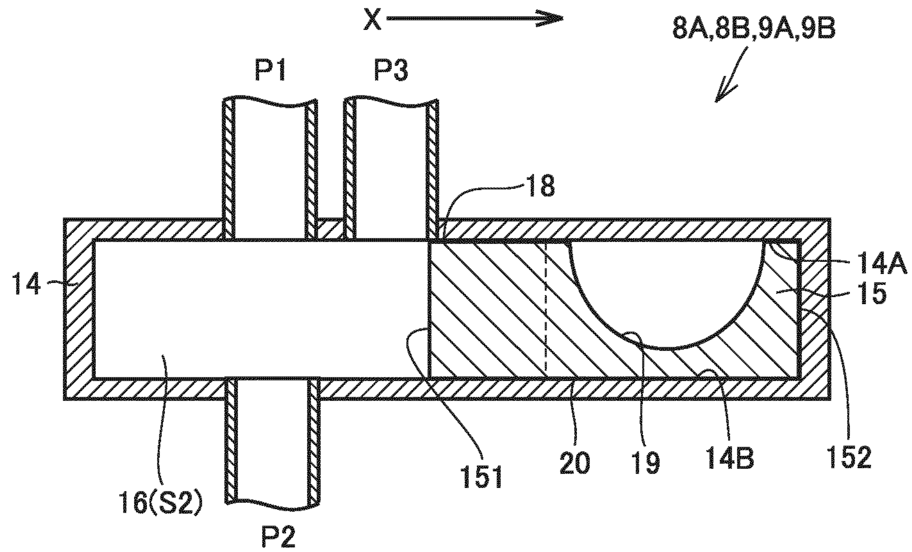
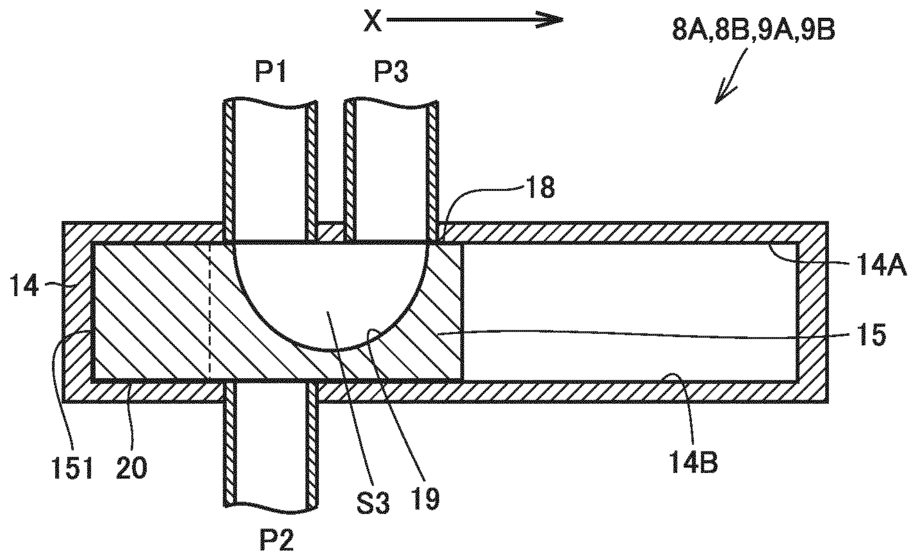

X
8A,8B,9A,9B
P1
P3
18
14
14A
15
151
20
19
14B
152
16(S2)
P2

FIG.16



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/018319

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F16K11/07(2006.01)i, F25B13/00(2006.01)i, F25B41/04(2006.01)i
FI: F25B13/00S, F25B41/04B, F16K11/07F
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. F16K11/07, F25B13/00, F25B41/04

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.
A	WO 2018/092186 A1 (MITSUBISHI ELECTRIC CORPORATION) 24 May 2018 (2018-05-24), paragraphs [0011]-[0099], fig. 1-6	1-9
A	WO 2018/193518 A1 (MITSUBISHI ELECTRIC CORPORATION) 25 October 2018 (2018-10-25), paragraphs [0009]-[0045], fig. 1-5	1-9
A	JP 2019-109044 A (MITSUBISHI ELECTRIC CORPORATION) 04 July 2019 (2019-07-04), paragraphs [0135]-[0141], fig. 28	1-9
A	JP 2013-204695 A (MITSUBISHI ELECTRIC CORPORATION) 07 October 2013 (2013-10-07), entire text, all drawings	1-9
A	WO 2017/085891 A1 (MITSUBISHI ELECTRIC CORPORATION) 26 May 2017 (2017-05-26), entire text, all drawings	1-9

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 July 2020	28 July 2020
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2020/018319

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2018-159507 A (OSAKA GAS CO., LTD.) 11 October 2018 (2018-10-11), entire text, all drawings	1-9
A	WO 2009/087733 A1 (MITSUBISHI ELECTRIC CORPORATION) 16 July 2009 (2009-07-16), fig. 28	2
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 176328/1975 (Laid-open No. 089738/1977) (SAGINOMIYA SEISAKUSHO INC.) 05 July 1977 (1977-07-05), fig. 1	2

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/018319

WO 2018/092186 A1	24 May 2018	(Family: none)
WO 2018/193518 A1	25 October 2018	CN 110494701 A
JP 2019-109044 A	04 July 2019	(Family: none)
JP 2013-204695 A	07 October 2013	(Family: none)
WO 2017/085891 A1	26 May 2017	US 2018/0283565 A1 entire text, all drawings EP 3379117 A1 CN 108291657 A
JP 2018-159507 A	11 October 2018	(Family: none)
WO 2009/087733 A1	16 July 2009	(Family: none)
JP 52-089738 U1	05 July 1977	(Family: none)

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

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Patent documents cited in the description

- JP 4006361 A **[0003] [0006]**