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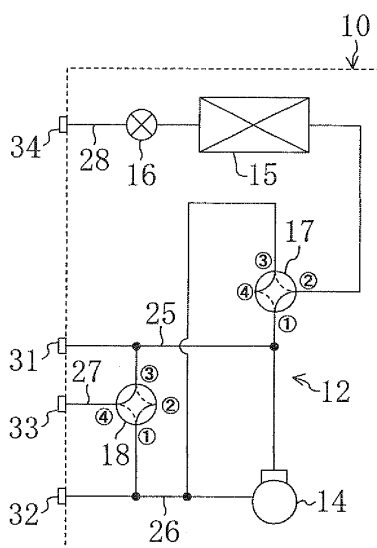
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(54) **HEAT SOURCE UNIT FOR REFRIGERATING APPARATUS, AND REFRIGERATING APPARATUS**

(57) A heat source circuit (12) includes: a first gas port (31) constantly communicating with a discharge side of a compressor (14); a second gas port (32) constantly communicating with a suction side of the compressor (14); a third gas port (33) selectively communicating with one of a first gas line (25) and a second gas line (26); a

liquid port (34) constantly communicating with a liquid inlet/outlet end of a heat-source heat exchanger (15); a first switching mechanism (17) which switches a state of communication of a gas inlet/outlet end of the heat-source heat exchanger (15); and a second switching mechanism (18) which switches a state of communication of a third gas line (27).

FIG. 1



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat source unit of a refrigeration system connected to a heat using unit through a connecting pipe, and a refrigeration system including the heat source unit.

BACKGROUND ART

[0002] Conventionally, heat source units of refrigeration systems including a compressor and a heat-source heat exchanger have been known. The heat source unit constitutes a refrigeration system, together with a heat using unit connected to the heat source unit through a connecting pipe. The heat source unit of this kind has been described in Patent Documents 1 and 2.

[0003] Specifically, as a heat source unit of this kind, Patent Document 1 discloses an outdoor unit of an air conditioner. The outdoor unit includes a single gas port and a single liquid port. The gas port is connected to a four-way switching valve connected to a discharge side and a suction side of a compressor. The liquid port is connected to a liquid inlet/outlet end of an outdoor heat exchanger. This air conditioner is switchable between air cooling operation and air heating operation by operating the four-way switching valve.

[0004] FIG. 3 of Patent Document 2 describes an outdoor unit including two gas ports and a single liquid port. In this outdoor unit, one of the gas ports is constantly connected to a discharge side of a compressor through a discharge line, and the other gas port is constantly connected to a suction side of the compressor through a suction line. The liquid port is constantly connected to a liquid inlet/outlet end of an outdoor heat exchanger. A gas inlet/outlet end of the outdoor heat exchanger is connected to a four-way switching valve connected to the discharge side and the suction side of the compressor.

[0005] Patent Document 2 further describes an air conditioner to which the outdoor unit is applied. The air conditioner includes a plurality of indoor units, and BS units for selecting the operation states of the indoor units, respectively. The BS unit switches a gas pipe of the corresponding indoor unit into communication with the discharge line or communication with the suction line. In this air conditioner, when the BS unit allows the gas pipe of the indoor unit to communicate with the discharge line of the outdoor unit, air heating operation is performed in which a heat-using heat exchanger of the indoor unit functions as a condenser. When the BS unit allows the gas pipe of the indoor unit to communicate with the suction line of the outdoor unit, air cooling operation is performed in which the heat-using heat exchanger of the indoor unit functions as an evaporator. The air conditioner is a so-called individually controllable air conditioner capable of individually selecting the air cooling operation or the air heating operation as the operation state of each

of the indoor units.

[0006] In the refrigeration system described in Patent Document 1, the operation state of the heat using unit is switched by a switching mechanism (e.g., a four-way switching valve) provided in the heat source unit. In the refrigeration system described in Patent Document 2, the operation states of the heat using units are switched by switching mechanisms provided in the heat using units, respectively. Since the heat source unit of Patent Document 1 has only a single gas port, it cannot be applied to the latter refrigeration system. Further, as the heat source unit of Patent Document 2 does not have the switching mechanism for changing the operation state of the heat using unit in the heat-source circuit, it cannot be applied to the former refrigeration system.

[0007] A heat source unit applicable to both of the former and latter refrigeration systems can be configured, for example, as shown in FIG. 13. A heat-source circuit (12) of a heat source unit (10) shown in FIG. 13 includes two gas ports (32, 33) and a single liquid port (34). One of the gas ports (32) constantly communicates with a suction side of a compressor (14), and the other gas port (33) selectively communicates with a discharge side or the suction side of the compressor (14). The liquid port (34) constantly communicates with a liquid inlet/outlet end of an outdoor heat exchanger (15). A gas inlet/outlet end of the outdoor heat exchanger (15) selectively communicates with the discharge side or the suction side of the compressor (14). The former refrigeration system (5) is constituted by connecting a heat using unit (7) to the heat source unit (10) as shown in FIG. 13(A). Further, the latter refrigeration system (5) is constituted by connecting the heat using unit (7) to the heat source unit (10) as shown in FIG. 13(B).

[0008] In a refrigeration system using this heat source unit, when a relatively high cooling or heating capacity is required by the heat using unit, e.g., when a large number of the indoor units are connected, the amount of heat exchange required by the heat-using heat exchanger of the heat using unit cannot be supplied by only the heat-source heat exchanger of the heat source unit. In this case, an appropriate refrigeration cycle cannot be performed, and a coefficient of performance (COP) becomes relatively low. This problem can be solved by connecting an auxiliary unit including an auxiliary heat exchanger to the refrigerant circuit. When a high heating capacity is required by the heat using units (7), the auxiliary unit (50) is connected as shown in FIG. 14 so that the auxiliary heat exchanger (52) functions as an evaporator together with the heat-source heat exchanger (15) in the heating operation. Further, when a high cooling capacity is required by the heat using units (7), the auxiliary unit (50) is connected as shown in FIG. 15 so that the auxiliary heat exchanger (52) functions as a condenser together with the heat-source heat exchanger (15) in the cooling operation.

Patent Document 1: Published Japanese Patent Ap-

plication No. 2006-078087
 Patent Document 2: Published Japanese Patent Ap-
 plication No. H11-241844

DISCLOSURE OF THE INVENTION

PROBLEM THAT THE INVENTION IS TO SOLVE

[0009] However, it has been impossible to configure the auxiliary unit so as to use it for both of the heating and cooling operations in the refrigeration system including the conventional heat source unit. More specifically, when the auxiliary unit is configured for use in the heating operation, a refrigerant discharged from the compressor in the cooling operation cannot be supplied to the auxiliary heat exchanger of the auxiliary unit. As a result, the auxiliary heat exchanger does not function as a condenser. On the other hand, when the auxiliary unit is configured for use in the cooling operation, a refrigerant evaporated in the auxiliary heat exchanger of the auxiliary unit in the heating operation cannot be guided to the suction side of the compressor. As a result, the auxiliary heat exchanger does not function as an evaporator.

[0010] In view of the foregoing, the present invention was developed. The present invention relates to the structure of a heat source unit which is applicable to both a refrigeration system in which the operation state of the heat using unit is switched by a switching mechanism provided in the heat source unit, and a refrigeration system in which the operation states of the heat using units are switched by switching mechanisms included in switching units corresponding to the heat using units, respectively. An object of the invention is to configure the heat source unit so that an auxiliary unit including an auxiliary heat exchanger can be used in both of the cooling and heating operations.

MEANS OF SOLVING THE PROBLEM

[0011] A first aspect of the invention is directed to a heat source unit (10) of a refrigeration system including a heat source circuit (12) including a compressor (14) and a heat-source heat exchanger (15) connected to each other. The heat source circuit (12) of the heat source unit (10) includes a first gas port (31) which is provided at an end of a first gas line (25) constantly communicating with a discharge side of the compressor (14), a second gas port (32) which is provided at an end of a second gas line (26) constantly communicating with a suction side of the compressor (14), a third gas port (33) which is provided at an end of a third gas line (27) selectively communicating with one of the first gas line (25) and the second gas line (26), a liquid port (34) which is provided at an end of a liquid line (28) constantly communicating with a liquid inlet/outlet end of the heat-source heat exchanger (15), a first switching mechanism (17) which switches a gas inlet/outlet end of the heat-source heat exchanger (15) into communication with the discharge

side of the compressor (14) or communication with the suction side of the compressor (14), and a second switching mechanism (18) which switches the third gas line (27) into communication with the first gas line (25) or communication with the second gas line (26).

[0012] According to a second aspect of the present invention, a refrigeration system (5) includes: the heat source unit (10) of the refrigeration system (5) according to the first aspect of the invention; and a heat using unit (7) having a heat-using circuit (8) including a decompression mechanism (41) and a heat-using heat exchanger (40) connected to each other to be arranged in this order from a liquid inlet/outlet end of the heat-using circuit (8), wherein a refrigerant circuit (9) is constituted by connecting the third gas port (33) of the heat source circuit (12) of the heat source unit (10) and a gas inlet/outlet end of the heat-using circuit (8), and connecting the liquid port (34) of the heat source circuit (12) and the liquid inlet/outlet end of the heat-using circuit (8), the refrigerant circuit (9) performing a vapor compression refrigeration cycle.

[0013] According to a third aspect of the invention, the refrigeration system according to the second aspect further includes: an auxiliary unit (50) having an auxiliary heat exchanger (52), a first connection port (56) constantly communicating with a liquid inlet/outlet end of the auxiliary heat exchanger (52), a second connection port (57) and a third connection port (58) with which a gas inlet/outlet end of the auxiliary heat exchanger (52) selectively communicates, and an auxiliary switching mechanism (54) which switches the gas inlet/outlet end of the auxiliary heat exchanger (52) into communication with the second connection port (57) or communication with the third connection port (58), wherein in the refrigerant circuit (9), the first connection port (56) is connected to the liquid port (34) of the heat source circuit (12), the second connection port (57) is connected to the first gas port (31) of the heat source circuit (12), and the third connection port (58) is connected to the second gas port (32) of the heat source circuit (12).

[0014] According to a fourth aspect of the invention, in the refrigeration system according to the second or third aspect, a plurality of heat using units (7) are provided, and in the refrigerant circuit (9), a plurality of heat-using circuits (8) connected to the heat source circuit (12) are parallel to each other.

[0015] According to a fifth aspect of the invention, the refrigeration system according to the fourth aspect further includes: switching units (60) corresponding to the plurality of the heat using units (7), respectively, each of which including operation state switching mechanisms (63, 64) which switch a gas inlet/outlet end of the heat-using circuit (8) of the heat using unit (7) into communication with the second gas port (32) or communication with the third gas port (33).

-Operation-

[0016] According to the first aspect of the invention, the heat source circuit (12) of the heat source unit (10) includes three gas ports (31, 32, 33) and a single liquid port (34). The first gas port (31) constantly communicates with a discharge side of the compressor (14). The second gas port (32) constantly communicates with a suction side of the compressor (14). The third gas port (33) is switched into communication with the first gas line (25) or the second gas line by switching of the second switching mechanism (18). The liquid port (34) constantly communicates with the liquid inlet/outlet end of the heat-source heat exchanger (15). The gas inlet/outlet end of the heat-source heat exchanger (15) is switched into communication with the discharge side of the compressor (14) or communication with the suction side of the compressor (14) by switching of the first switching mechanism (17). Thus, the heat source unit (10), e.g., the heat source unit (10) shown in FIG. 13, which is applicable to both a refrigeration system (5) in which the operation state of the heat using unit (7) is switched by the switching mechanism (17) provided in the heat source unit (10), and a refrigeration system (5) in which the operation states of the heat using units (7) are switched by the switching mechanisms (63, 64) included in switching units (60) corresponding to the heat using units (7), respectively, is provided with a first gas port (31) constantly communicating with the discharge side of the compressor (14).

[0017] According to the second aspect of the invention, in the refrigerant circuit (9) of the refrigeration system (5), the third gas port (33) of the heat source circuit (12) of the heat source unit (10) is connected to the gas inlet/outlet end of the heat-using circuit (8), and the liquid port (34) of the heat source circuit (12) is connected to the liquid inlet/outlet end of the heat-using circuit (8). In this refrigeration system (5), when the switching units (60) described later are not connected, the first switching mechanism (17) and the second switching mechanism (18) switch the operation state of the heat using unit (7). Specifically, when the first switching mechanism (17) allows the gas inlet/outlet end of the heat-source heat exchanger (15) to communicate with the discharge side of the compressor (14), and the second switching mechanism (18) allows the third gas line (27) to communicate with the second gas line (26), the cooling operation is performed in which the heat-source heat exchanger (15) functions as a condenser, and the heat-using heat exchanger (40) functions as an evaporator. Further, when the first switching mechanism (17) allows the gas inlet/outlet end of the heat-source heat exchanger (15) to communicate with the suction side of the compressor (14), and the second switching mechanism (18) allows the third gas line (27) to communicate with the first gas line (25), the heating operation is performed in which the heat-using heat exchanger (40) functions as a condenser, and the heat-source heat exchanger (15) functions as an

evaporator.

[0018] According to the third aspect of the invention, the refrigeration system (5) includes an auxiliary unit (50). In the auxiliary unit (50), the gas inlet/outlet end of the auxiliary heat exchanger (52) is switched into communication with the second connection port (57) or communication with the third connection port (58) by the operation of the auxiliary switching mechanism (54). Thus, in the refrigeration system (5) according to the third aspect of the invention, the gas inlet/outlet end of the auxiliary heat exchanger (52) is switched into communication with the first gas port (31) connected to the second connection port (57) or communication with the second gas port (32) connected to the third connection port (58) by the operation of the auxiliary switching mechanism (54).

[0019] According to the fourth aspect of the invention, the refrigeration system (5) includes a plurality of heat using units (7). The heat-using circuits (8) of the heat using units (7) connected to the heat source circuit (12) are parallel to each other. The gas inlet/outlet end of each of the heat using units (7) is connected to the third gas port (33), and the liquid inlet/outlet end of each of the heat using units (7) is connected to the liquid port (34).

[0020] According to the fifth aspect of the invention, the operation state switching mechanisms (63, 64) provided in each of the switching units (60) corresponding to the heat using units (7), respectively, switch the gas inlet/outlet end of the heat-using circuit (8) of the heat using unit (7) into communication with the second gas port (32) or communication with the third gas port (33). When the operation state switching mechanisms (63, 64) allow the gas inlet/outlet end of the heat-using circuit (8) to communicate with the second gas port (32), the cooling operation is performed in which the heat-using circuit (8) functions as an evaporator. Specifically, the refrigerant condensed in the heat-source heat exchanger (15) is supplied to the heat-using circuit (8) through the liquid port (34). The refrigerant supplied to the heat-using circuit (8) evaporates in the heat-using heat exchanger (40), and then returns to the suction side of the compressor (14) through the second gas port (32). When the operation state switching mechanisms (63, 64) allow the gas inlet/outlet end of the heat-using circuit (8) to communicate with the third gas port (33), the heating operation is performed in which the heat-using circuit (8) functions as a condenser. Specifically, the refrigerant discharged from the compressor (14) is supplied to the heat-using circuit (8) through the third gas port (33). The refrigerant supplied to the heat-using circuit (8) condenses in the heat-using heat exchanger (40), is supplied to the heat-source heat exchanger (15) through the liquid port (34) and evaporates therein, and then is sucked into the compressor (14). According to the fifth aspect of the invention, the heat source unit (10) according to the first aspect of the invention is applied to the refrigeration system (5) in which the operation state of each of the heat using units (7) is switched by the operation state switching mechanisms (63, 64) included in the switching units (60) corre-

sponding to the heat using units (7), respectively.

EFFECT OF THE INVENTION

[0021] According to the present invention, in the heat source unit (10), which is applicable to both the refrigeration system (5) in which the operation state of the heat using unit (7) is switched by the switching mechanism (17) provided in the heat source unit (10), and the refrigeration system (5) in which the operation states of the heat using units (7) are switched by the switching mechanisms (63, 64) included in the switching units (60) corresponding to the heat using units (7), respectively, the first gas port (31) constantly communicating with the discharge side of the compressor (14) is provided. In this heat source unit (10), when the second switching mechanism (18) allows the third gas port (33) to communicate with the first gas line (25), the third gas port (33) functions as a port through which the compressed refrigerant discharged from the compressor (14) flows out, the liquid port (34) functions as a port through which the condensed liquid refrigerant to be evaporated in the heat-source heat exchanger (15) flows in, and the second gas port (32) functions as a port through which the evaporated refrigerant to be sucked into the compressor (14) flows in. On the other hand, when the second switching mechanism (18) allows the third gas port (33) to communicate with the second gas line (26), the liquid port (34) functions as a port through which the liquid refrigerant condensed in the heat-source heat exchanger (15) flows out, the second gas port (32) functions as a port through which the evaporated refrigerant to be sucked into the compressor (14) flows in, and the first gas port (31) functions as a port through which the compressed refrigerant discharged from the compressor (14) flows out.

[0022] For example, as shown in FIG. 5, in the state where the second switching mechanism (18) allows the third gas port (33) to communicate with the first gas line (25), with the gas inlet/outlet end of the heat-using circuit (8) connected to the third gas port (33), the liquid inlet/outlet end of the heat-using circuit (8) connected to the liquid port (34), the liquid inlet/outlet end of the auxiliary heat exchanger (52) of the auxiliary unit (50) connected to the liquid port (34), and the gas inlet/outlet end of the auxiliary heat exchanger (52) selectively connected to the first gas port (31) or the second gas port (32), the heating operation is performed in which the heat-using heat exchanger (40), to which a high pressure refrigerant discharged from the compressor (14) is supplied through the third gas port (33), functions as a condenser. In the heating operation, when the refrigerant condensed in the heat-using heat exchanger (40) is supplied to the auxiliary heat exchanger (52), the supplied refrigerant evaporates in the auxiliary heat exchanger (52), flows into the heat source circuit (12) through the second gas port (32), and is sucked into the compressor (14). Further, in the state where the second switching mechanism (18) allows the third gas port (33) to communicate with the second

gas line (26), the cooling operation is performed in which the heat-using heat exchanger (40), to which a liquid refrigerant condensed in the heat-source heat exchanger (15) is supplied through the liquid port (34), functions as an evaporator. In the cooling operation, when the refrigerant discharged from the compressor (14) is supplied to the auxiliary heat exchanger (52) through the first gas port (31), the supplied refrigerant condenses in the auxiliary heat exchanger (52), and is supplied to the heat-using heat exchanger (40) together with the liquid refrigerant condensed in the heat-source heat exchanger (15). The refrigerant supplied to the heat-using heat exchanger (40) evaporates in the heat-using heat exchanger (40), and the evaporated low-pressure refrigerant flows into the heat source circuit (12) through the third gas port (33), and is sucked into the compressor (14).

[0023] In this way, by selectively connecting the gas inlet/outlet end of the auxiliary heat exchanger (52) of the auxiliary unit (50) to the first gas port (31) or the second gas port (32), the low-pressure gaseous refrigerant from the auxiliary heat exchanger (52) serving as an evaporator in the heating operation can be supplied to the compressor (14) through the second gas port (32), and the high-pressure gaseous refrigerant can be supplied to the auxiliary heat exchanger (52) serving as a condenser in the cooling operation through the first gas port (31). Therefore, the auxiliary unit (50) can be used for both of the cooling operation and the heating operation. The outdoor unit (10) of the present invention makes it possible to connect the auxiliary unit (50) to the outdoor unit (10) so that the auxiliary unit (50) can be used for both of the cooling operation and the heating operation.

[0024] According to the third aspect of the invention, the gas inlet/outlet end of the auxiliary heat exchanger (52) is selectively connected to the first gas port (31) or the second gas port (32). Therefore, as described above, the low-pressure gaseous refrigerant from the auxiliary heat exchanger (52) serving as an evaporator in the heating operation can be supplied to the compressor (14) through the second gas port (32), and the high-pressure gaseous refrigerant can be supplied to the auxiliary heat exchanger (52) serving as a condenser in the cooling operation through the first gas port (31). The auxiliary unit (50) according to the third aspect of the invention can be connected to the refrigeration system (5) so as to make up the lack of the amount of heat exchange in the heat-source heat exchanger (15) both in the cooling operation and the heating operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a schematic block diagram of an outdoor unit according to an embodiment.

FIG. 2 is a schematic block diagram of a first example air conditioner including the outdoor unit according

to the embodiment.

FIG. 3 is a schematic block diagram illustrating air cooling operation performed in the first example air conditioner including the outdoor unit according to the embodiment.

FIG. 4 is a schematic block diagram illustrating air heating operation performed in the first example air conditioner including the outdoor unit according to the embodiment.

FIG. 5 is a schematic block diagram of a second example air conditioner including the outdoor unit according to the embodiment.

FIG. 6 is a schematic block diagram illustrating air cooling operation performed in the second example air conditioner including the outdoor unit according to the embodiment.

FIG. 7 is a schematic block diagram illustrating air heating operation performed in the second example air conditioner including the outdoor unit according to the embodiment.

FIG. 8 is a schematic block diagram of a third example air conditioner including the outdoor unit according to the embodiment.

FIG. 9 is a schematic block diagram illustrating air cooling operation performed in the third example air conditioner combined with the outdoor unit according to the embodiment.

FIG. 10 is a schematic block diagram illustrating air heating operation performed in the third example air conditioner including the outdoor unit according to the embodiment.

FIG. 11 is a schematic block diagram illustrating air cooling/heating operation performed in the third example air conditioner including the outdoor unit according to the embodiment.

FIG. 12 is a schematic block diagram of an air conditioner according to another embodiment.

FIGS. 13(A) and (B) are schematic block diagrams of a refrigeration system including a conventional heat source unit, FIG. 13(A) is a schematic block diagram of the former refrigeration system described in the section of Background Art, and FIG. 13(B) is a schematic block diagram of the latter refrigeration system described in the section of

Background Art.

[0026] FIG. 14 is a schematic block diagram of the refrigeration system including the conventional heat source unit, to which an auxiliary unit is connected for use in heating operation.

[0027] FIG. 15 is a schematic block diagram of the refrigeration system including the conventional heat source unit, to which the auxiliary unit is connected for use in cooling operation.

EXPLANATION OF REFERENCE NUMERALS

[0028]

- 5 Air conditioner (refrigeration system)
- 7 Indoor unit (heat using unit)
- 8 Indoor circuit (heat-using circuit)
- 9 Refrigerant circuit
- 10 Outdoor unit (heat source unit)
- 12 Outdoor circuit (heat source circuit)
- 14 Compressor
- 15 Outdoor heat exchanger (heat-source heat exchanger)
- 17 First four-way switching valve (first switching mechanism)
- 18 Second four-way switching valve (second switching mechanism)
- 25 First gas line
- 26 Second gas line
- 27 Third gas line
- 28 Liquid line
- 31 First gas port
- 32 Second gas port
- 33 Third gas port
- 34 Liquid port
- 40 Indoor heat exchanger (heat-using heat exchanger)
- 41 Decompression mechanism (indoor expansion valve)
- 50 Auxiliary unit
- 52 Auxiliary heat exchanger
- 54 Auxiliary switching mechanism
- 56 First connection port
- 57 Second connection port
- 58 Third connection port
- 63 First solenoid valve (operation state switching mechanism)
- 64 Second solenoid valve (operation state switching mechanism)

BEST MODE FOR CARRYING OUT THE INVENTION

[0029] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[Structure of Outdoor Unit]

[0030] An outdoor unit (10) of the present embodiment constitutes a heat source unit of a refrigeration system of the present invention. The outdoor unit (10) is connected to a heat using unit (7) through a gas connecting pipe (20) and a liquid connecting pipe (21).

[0031] As shown in FIG. 1, the outdoor unit (10) includes an outdoor circuit (12) as a heat source circuit. To the outdoor circuit (12), a compressor (14), an outdoor heat exchanger (15), an outdoor expansion valve (16), a first four-way switching valve (17), and a second four-way switching valve (18) are connected. The first four-way switching valve (17) constitutes a first switching mechanism, and the second four-way switching valve (18) constitutes a second switching mechanism. The outdoor unit (10) is provided with a first gas port (31), a second gas port (32), a third gas port (33), and a liquid port (34).

[0032] The compressor (14) is configured as a variable-volume compressor. A discharge side of the compressor (14) is connected to the first gas port (31) through a first gas line (25). A first port of the first four-way switching valve (17) is connected to the first gas line (25). A suction side of the compressor (14) is connected to the second gas port (32) through a second gas line (26). A third port of the first four-way switching valve (17) is connected to the second gas line (26).

[0033] The outdoor heat exchanger (15) is a cross fin/tube heat exchanger and constitutes a heat-source heat exchanger. A liquid inlet/outlet end of the outdoor heat exchanger (15) is connected to a liquid port (34) through a liquid line (28). A gas inlet/outlet end of the outdoor heat exchanger (15) is connected to a second port of the first four-way switching valve (17). A fourth port of the first four-way switching valve (17) is closed. The outdoor expansion valve (16) is configured as an electronic expansion valve and arranged on the liquid line (28).

[0034] A first port of the second four-way switching valve (18) is connected to the second gas line (26). A second port of the second four-way switching valve (18) is closed. A third port of the second four-way switching valve (18) is connected to the first gas line (25). A fourth port of the second four-way switching valve (18) is connected to the third gas port (33) through a third gas line (27).

[0035] Each of the first four-way switching valve (17) and the second four-way switching valve (18) is switchable between a first state in which the first and second ports communicate with each other, and the third and fourth ports communicate with each other (a state depicted by a solid line in FIG. 1), and a second state in which the first and fourth ports communicate with each other, and the second and third ports communicate with each other (a state depicted by a broken line in FIG. 1). Instead of the four-way switching valves (17, 18), three-way switching valves may be used to constitute the first switching mechanism (17) and a second switching mechanism (18), or two solenoid valves may be used to constitute the first switching mechanism (17) and a second switching mechanism (18).

5 (Structure and Operation of Refrigeration System)

[0036] Hereinafter, three example refrigeration systems (5) including the outdoor unit (10) of the present invention, respectively, will be described.

10 [First Example Refrigeration System]

[0037] A first example refrigeration system (5) is an air conditioner (5) capable of performing air cooling operation as cooling operation and air heating operation as heating operation. As shown in FIG. 2, the air conditioner (5) includes a plurality of indoor units (7a, 7b, ...) connected to an outdoor unit (10) to be parallel to each other. The number of the indoor units (7) may be reduced to 1.

[0038] Each of the indoor units (7) includes an indoor circuit (8). The indoor circuit (8) includes an indoor heat exchanger (40) and an indoor expansion valve (41) connected in this order from a gas inlet/outlet end of the indoor circuit (8). The indoor heat exchanger (40) is configured as a cross fin/tube heat exchanger. The indoor expansion valve (41) is configured as an electronic expansion valve.

[0039] The gas inlet/outlet end of each indoor circuit (8) is connected to the third gas port (33) of the outdoor unit (10) through the gas connecting pipe (20). A liquid inlet/outlet end of each indoor circuit (8) is connected to the liquid port (34) of the outdoor unit (10) through the liquid connecting pipe (21). In the air conditioner (5), the outdoor circuit (12) and the indoor circuits (8a, 8b, ...) are connected through the gas connecting pipe (20) and the liquid connecting pipe (21) to constitute a refrigerant circuit (9) which performs a vapor compression refrigeration cycle.

40 -Operation Mechanism-

[0040] Hereinafter, the operation mechanism of the first example air conditioner (5) will be described. In this air conditioner (5), whether air cooling operation or air heating operation is performed is controlled by the first four-way switching valve (17) and the second four-way switching valve (18) of the outdoor unit (10). When the first four-way switching valve (17) and the second four-way switching valve (18) are set to the state of the air cooling operation, every working indoor unit (7) performs the air cooling operation. On the other hand, when the first four-way switching valve (17) and the second four-way switching valve (18) are set to the state of the air heating operation, every working indoor unit (7) performs the air heating operation.

(Air Cooling Operation)

[0041] In the air cooling operation, as shown in FIG. 3, the first four-way switching valve (17) is set to the first state, and the second four-way switching valve (18) is set to the second state. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the outdoor heat exchanger (15) functions as a condenser, and the indoor heat exchanger (40) functions as an evaporator.

[0042] More specifically, a refrigerant discharged from the compressor (14) condenses as it exchanges heat with outdoor air in the outdoor heat exchanger (15). The refrigerant condensed in the outdoor heat exchanger (15) is distributed to each of the indoor circuits (8a, 8b, ...). The refrigerant flowed into each of the indoor circuits (8) is reduced in pressure by the indoor expansion valve (41), and then evaporates as it exchanges heat with indoor air in the indoor heat exchanger (40). The refrigerant evaporated in the indoor heat exchanger (40) and flowed into the outdoor circuit (12) is sucked into the compressor (14) and compressed.

(Air Heating Operation)

[0043] In the air heating operation, as shown in FIG. 4, the first four-way switching valve (17) is set to the second state, and the second four-way switching valve (18) is set to the first state. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the indoor heat exchanger (40) functions as a condenser, and the outdoor heat exchanger (15) functions as an evaporator.

[0044] More specifically, a refrigerant discharged from the compressor (14) is distributed to each of the indoor circuits (8a, 8b, ...). The refrigerant flowed into each of the indoor circuits (8) condenses as it exchanges heat with indoor air in the indoor heat exchanger (40). The refrigerant condensed in the indoor heat exchanger (40) flows into the outdoor circuit (12). The refrigerant flowed into the outdoor circuit (12) is reduced in pressure by the outdoor expansion valve (16), and then evaporates as it exchanges heat with outdoor air in the outdoor heat exchanger (15). The refrigerant evaporated in the outdoor heat exchanger (15) is sucked into the compressor (14) and compressed.

[Second Example Refrigeration System]

[0045] As shown in FIG. 5, a second example air conditioner (5) includes an auxiliary unit (50), in addition to the structure of the first example air conditioner (5). The auxiliary unit (50) is placed outside together with the outdoor unit (10). Two or more auxiliary units (50) may be used.

[0046] The auxiliary unit (50) includes an auxiliary unit

circuit (51). The auxiliary unit circuit (51) includes an auxiliary heat exchanger (52), an expansion valve (53), and a four-way switching valve (54). The auxiliary unit (50) further includes a first connection port (56), a second connection port (57), and a third connection port (58).

[0047] The auxiliary heat exchanger (52) is configured as a cross fin/tube heat exchanger. A liquid inlet/outlet end of the auxiliary heat exchanger (52) is connected to the first connection port (56). A gas inlet/outlet end of the auxiliary heat exchanger (52) is connected to a second port of the four-way switching valve (54). A first port of the four-way switching valve (54) is connected to the third connection port (58). A third port of the four-way switching valve (54) is connected to the second connection port (57). A fourth port of the four-way switching valve (54) is closed. The expansion valve (53) is configured as an electronic expansion valve, and arranged between the auxiliary heat exchanger (52) and the first connection port (56).

[0048] The four-way switching valve (54) is switchable between a first state in which the first and second ports communicate with each other, and the third and fourth ports communicate with each other (a state depicted by a solid line in FIG. 5), and a second state in which the first and fourth ports communicate with each other, and the second and third ports communicate with each other (a state depicted by a broken line in FIG. 5). When the four-way switching valve (54) is set to the first state, the gas inlet/outlet end of the auxiliary heat exchanger (52) communicates with the third connection port (58). When the four-way switching valve (54) is set to the second state, the gas inlet/outlet end of the auxiliary heat exchanger (52) communicates with the second connection port (57). In this way, the four-way switching valve (54) constitutes an auxiliary switching mechanism. Instead of the four-way switching valve (54), a three-way switching valve may be used to constitute the auxiliary switching mechanism, or two solenoid valves may be used to constitute the auxiliary switching mechanism.

[0049] The first connection port (56) of the auxiliary unit (50) is connected to the liquid connecting pipe (21). The second connection port (57) is connected to the first gas port (31) of the outdoor unit (10). The third connection port (58) is connected to the second gas port (32) of the outdoor unit (10).

-Operation Mechanism-

[0050] Hereinafter, the operation mechanism of the second example air conditioner (5) will be described. In the air conditioner (5), in the same manner as in the first example air conditioner (5), every working indoor unit (7) performs the air cooling operation when the first four-way switching valve (17) and the second four-way switching valve (18) are set to the state of the air cooling operation. On the other hand, when the first four-way switching valve (17) and the second four-way switching valve (18) are set to the state of the air heating operation, every working

indoor unit (7) performs the air heating operation.

(Air Cooling Operation)

[0051] In the air cooling operation, as shown in FIG. 6, the first four-way switching valve (17) is set to the first state, and the second four-way switching valve (18) is set to the second state. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the outdoor heat exchanger (15) functions as a condenser, and the indoor heat exchanger (40) functions as an evaporator.

[0052] When a relatively high air cooling capacity is required, e.g., when a large number of the indoor units (7) that perform the air cooling operation are connected, the four-way switching valve (54) of the auxiliary unit (50) is set to the second state. In this state, the auxiliary heat exchanger (52) of the auxiliary unit (50) functions as a condenser together with the outdoor heat exchanger (15). On the other hand, the four-way switching valve (54) of the auxiliary unit (50) is set to the first state when the required air cooling capacity is relatively low. In this case, the expansion valve (53) is closed, and the refrigerant does not flow into the auxiliary heat exchanger (52) of the auxiliary unit (50). The air conditioner (5) is able to perform a refrigeration cycle which is always appropriate to the required air cooling capacity by using or not using the auxiliary heat exchanger (52) of the auxiliary unit (50). Thus, the air conditioner (5) can be operated with a high coefficient of performance (COP) at all times.

[0053] Hereinafter, the flow of the refrigerant when the auxiliary heat exchanger (52) of the auxiliary unit (50) is used as a condenser will be described. The flow of the refrigerant in the outdoor unit (10) and the indoor unit (7) is omitted because it is the same as that in the air cooling operation of the first example air conditioner (5).

[0054] In the air cooling operation, part of the refrigerant discharged from the compressor (14) flows into the auxiliary unit circuit (51). The refrigerant flowed into the auxiliary unit circuit (51) condenses as it exchanges heat with outdoor air in the auxiliary heat exchanger (52). The refrigerant condensed in the auxiliary heat exchanger (52) flows together with the refrigerant condensed in the outdoor heat exchanger (15) to be distributed to the indoor circuits (8).

(Air Heating Operation)

[0055] In the air heating operation, as shown in FIG. 7, the first four-way switching valve (17) is set to the second state, and the second four-way switching valve (18) is set to the first state. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the indoor heat exchanger (40) functions as a condenser, and the outdoor heat exchanger (15) functions as an evaporator.

[0056] When a relatively high air heating capacity is required, e.g., when a large number of the indoor units (7) that perform the air heating operation are connected, the four-way switching valve (54) of the auxiliary unit (50) is set to the first state. In this state, the auxiliary heat exchanger (52) of the auxiliary unit (50) functions as an evaporator together with the outdoor heat exchanger (15). The four-way switching valve (54) of the auxiliary unit (50) is set to the second state when the required air heating capacity is relatively low. In this case, the expansion valve (53) is closed, and the refrigerant does not flow into the auxiliary heat exchanger (52) of the auxiliary unit (50). The air conditioner (5) is able to perform a refrigeration cycle which is always appropriate to the required air heating capacity by using or not using the auxiliary heat exchanger (52) of the auxiliary unit (50). Thus, the air conditioner (5) can be operated with a high coefficient of performance (COP) at all times.

[0057] Hereinafter, the flow of the refrigerant when the auxiliary heat exchanger (52) of the auxiliary unit (50) is used as an evaporator will be described. The flow of the refrigerant in the outdoor unit (10) and the indoor unit (7) is omitted because it is the same as that in the air heating operation of the first example air conditioner (5).

[0058] In the air heating operation, part of the refrigerant condensed in the indoor heat exchanger (40) flows into the auxiliary unit circuit (51). The refrigerant flowed into the auxiliary unit circuit (51) is reduced in pressure by the expansion valve (53), and then evaporates as it exchanges heat with outdoor air in the auxiliary heat exchanger (52). The refrigerant evaporated in the auxiliary heat exchanger (52) flows into the outdoor circuit (12), and flows together with the refrigerant evaporated in the outdoor heat exchanger (15) to be sucked into the compressor (14).

[Third Example Refrigeration System]

[0059] A third example air conditioner (5) is a so-called individually controllable air conditioner (5) capable of individually selecting the cooling operation or the heating operation for each of the indoor units (7a, 7b, ...). In this air conditioner (5), as shown in FIG. 8, a plurality of indoor units (7a, 7b, ...) are connected to the outdoor unit (10) to be parallel to each other, and BS units (60a, 60b, ...) corresponding to the indoor units (7a, 7b, ...), respectively, are provided. Each of the BS units (60a, 60b, ...) constitutes a switching unit. In FIG. 8, other indoor units than a first indoor unit (7a) and a second indoor unit (7b) are omitted.

[0060] Each of the BS units (60) includes a liquid circuit (61) and a gas circuit (62). An end of the liquid circuit (61) is connected to the liquid connecting pipe (21) extending from the liquid port (34) of the outdoor unit (10). The other end of the liquid circuit (61) is connected to a refrigerant pipe connected to the liquid inlet/outlet end of the indoor circuit (8).

[0061] The gas circuit (62) includes a first pipe provid-

ed with a first solenoid valve (63) and a second pipe provided with a second solenoid valve (64). An end of the first pipe and an end of the second pipe are connected to each other. A refrigerant pipe extending from a junction of the ends of the first and second pipes is connected to a gas inlet/outlet end of the indoor circuit (8). The other end of the first pipe is connected to a first gas connecting pipe (20a) extending from a third gas port (33) of the outdoor unit (10). The other end of the second pipe is connected to a second gas connecting pipe (20b) extending from a second gas port (32) of the outdoor unit (10). The first solenoid valve (63) and the second solenoid valve (64) constitute operation state switching mechanisms.

[0062] This air conditioner (5) includes the same auxiliary unit (50) as that used in the second example air conditioner (5). The first connection port (56) of the auxiliary unit (50) is connected to the liquid connecting pipe (21). The second connection port (57) is connected to a first gas port (31) of the outdoor unit (10). The third connection port (58) is connected to the second gas connecting pipe (20b).

-Operation Mechanism-

[0063] Hereinafter, the operation mechanism of the third example air conditioner (5) will be described. In addition to the air cooling operation and the air heating operation, this air conditioner (5) performs air cooling/heating operation in which an indoor unit (7) performs the air cooling operation, and simultaneously, the other indoor unit (7) performs the air heating operation.

(Air cooling operation)

[0064] In the air cooling operation, as shown in FIG. 9, the second four-way switching valve (18) of the outdoor unit (10) is set to the second state. The four-way switching valve (54) of the auxiliary unit (50) is set to the second state. In each of the BS units (60), the first solenoid valve (63) is closed, and the second solenoid valve (64) is opened. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the auxiliary heat exchanger (52) of the auxiliary unit (50) functions as a condenser, and the indoor heat exchanger (40) functions as an evaporator.

[0065] When a relatively high air cooling capacity is required, e.g., when a large number of the indoor units (7) that perform the air cooling operation are connected, the first four-way switching valve (17) of the outdoor unit (10) is set to the first state. In this state, the outdoor heat exchanger (15) functions as a condenser together with the auxiliary heat exchanger (52) of the auxiliary unit (50). The first four-way switching valve (17) is set to the second state when the required air cooling capacity is relatively low. In this case, the outdoor expansion valve (16) is closed, and the refrigerant does not flow into the outdoor

heat exchanger (15). The air conditioner (5) is able to perform a refrigeration cycle which is always appropriate to the required air cooling capacity by using or not using the outdoor heat exchanger (15). Thus, the air conditioner (5) can be operated with a high coefficient of performance (COP) at all times.

[0066] Hereinafter, the flow of the refrigerant when the outdoor heat exchanger (15) is used as a condenser will be described.

[0067] In the air cooling operation, part of the refrigerant discharged from the compressor (14) flows into the auxiliary unit circuit (51) through the second connection port (57) of the auxiliary unit (50). The refrigerant flowed into the auxiliary unit circuit (51) condenses as it exchanges heat with outdoor air in the auxiliary heat exchanger (52). The rest of the refrigerant discharged from the compressor (14) condenses as it exchanges heat with outdoor air in the outdoor heat exchanger (15). The refrigerant condensed in the outdoor heat exchanger (15) flows together with the refrigerant condensed in the auxiliary heat exchanger (52) of the auxiliary unit (50).

[0068] The co-flowing condensed refrigerants are distributed to each of the indoor circuits (8). The distributed refrigerant passes through the liquid circuit (61) of the BS unit (60) and flows into the indoor circuit (8). The refrigerant flowed into the indoor circuit (8) is reduced in pressure by the indoor expansion valve (41), and evaporates as it exchanges heat with outdoor air in the indoor heat exchanger (40). The refrigerant evaporated in the indoor heat exchanger (40) flows into the outdoor circuit (12) through the second pipe of the gas circuit (62) of the BS unit (60) and other pipes, and is sucked into the compressor (14).

(Air Heating Operation)

[0069] In the air heating operation, as shown in FIG. 10, the second four-way switching valve (18) of the outdoor unit (10) is set to the first state. The four-way switching valve (54) of the auxiliary unit (50) is set to the first state. In each of the BS units (60), the first solenoid valve (63) is opened, and the second solenoid valve (64) is closed. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the indoor heat exchanger (40) functions as a condenser, and the auxiliary heat exchanger (52) of the auxiliary unit (50) functions as an evaporator.

[0070] When a relatively high air heating capacity is required, e.g., when a large number of the indoor units (7) that perform the air heating operation are connected, the first four-way switching valve (17) of the outdoor unit (10) is set to the second state. In this state, the outdoor heat exchanger (15) functions as an evaporator together with the auxiliary heat exchanger (52) of the auxiliary unit (50). The first four-way switching valve (17) is set to the first state when the required heating capacity is relatively low. In this case, the outdoor expansion valve (16) is

closed, and the refrigerant does not flow into the outdoor heat exchanger (15). The air conditioner (5) is able to perform a refrigeration cycle which is always appropriate to the required air heating capacity by using or not using the outdoor heat exchanger (15). Thus, the air conditioner (5) can be operated with a high coefficient of performance (COP) at all times.

[0071] Hereinafter, the flow of the refrigerant when the outdoor heat exchanger (15) is used as an evaporator will be described.

[0072] In the air heating operation, the refrigerant discharged from the compressor (14) is distributed to each of the indoor circuits (8). The distributed refrigerant passes through the first pipe of the gas circuit (62) of the BS unit (60), and flows into the indoor circuit (8). The refrigerant flowed into the indoor circuit (8) condenses as it exchanges heat with outdoor air in the indoor heat exchanger (40).

[0073] Part of the refrigerant condensed in the indoor heat exchanger (40) flows into the auxiliary unit circuit (51). The refrigerant flowed into the auxiliary unit circuit (51) is reduced in pressure by the expansion valve (53), and then evaporates as it exchanges heat with outdoor air in the auxiliary heat exchanger (52). The rest of the refrigerant condensed in the indoor heat exchanger (40) flows into the outdoor circuit (12). The refrigerant flowed into the outdoor circuit (12) is reduced in pressure by the outdoor expansion valve (16), and then evaporates as it exchanges heat with outdoor air in the outdoor heat exchanger (15). The refrigerant evaporated in the outdoor heat exchanger (15) flows together with the refrigerant evaporated in the auxiliary heat exchanger (52) of the auxiliary unit (50) to be sucked into the compressor (14).

(Air Cooling/heating Operation)

[0074] The air cooling/heating operation will be described. Specifically, the case where only the first indoor unit (7a) performs the air cooling operation, and the other indoor units (7b, ...) perform the air heating operation will be described. In the air cooling/heating operation, as shown in FIG. 11, the second four-way switching valve (18) of the outdoor unit (10) is set to the first state. In the BS unit (60a) of the first indoor unit (7a), the first solenoid valve (63b) is closed, and the second solenoid valve (64b) is opened. In the BS units (60b, ...) corresponding to the indoor units other than the first indoor unit (7a), the first solenoid valves (63b, ...) are opened, and the second solenoid valves (64b, ...) are closed. Then, when the compressor (14) is actuated in this state, the refrigerant circuit (9) performs the vapor compression refrigeration cycle in which the indoor heat exchangers (40b, ...) of the indoor units (7b, ...) other than the first indoor unit (7a) function as condensers, and the indoor heat exchanger (40a) of the first indoor unit (7a) functions as an evaporator.

[0075] The first four-way switching valve (17) and the outdoor expansion valve (16) allow the outdoor heat ex-

changer (15) to function as a condenser or an evaporator, or stop the distribution of the refrigerant to the outdoor heat exchanger (15). More specifically, when the outdoor expansion valve (16) is opened, and the first four-way switching valve (17) is set to the first state, the outdoor heat exchanger (15) functions as a condenser. When the outdoor expansion valve (16) is opened, and the first four-way switching valve (17) is set to the second state, the outdoor heat exchanger (15) functions as an evaporator. Further, when the outdoor expansion valve (16) is closed, the distribution of the refrigerant to the outdoor heat exchanger (15) is stopped.

[0076] The expansion valve (53) and the four-way switching valve (54) allow the auxiliary heat exchanger (52) of the auxiliary unit (50) to function as a condenser or an evaporator, or stop the distribution of the refrigerant to the auxiliary heat exchanger (52). More specifically, when the expansion valve (53) is opened, and the four-way switching valve (54) is set to the second state, the auxiliary heat exchanger (52) functions as a condenser. When the expansion valve (53) is opened, and the four-way switching valve (54) is set to the first state, the auxiliary heat exchanger (52) functions as an evaporator. Further, when the expansion valve (53) is closed, the distribution of the refrigerant to the auxiliary heat exchanger (52) is stopped.

[0077] In this air conditioner (5), the first four-way switching valve (17), the outdoor expansion valve (16), and the four-way switching valve (54) and the expansion valve (53) of the auxiliary unit (50) are appropriately controlled in response to the required air cooling capacity and air heating capacity. As a result, the functions of the outdoor heat exchanger (15) and the auxiliary heat exchanger (52) of the auxiliary unit (50) are determined. Thus, the air conditioner (5) can perform a suitable refrigeration cycle, and maintain high coefficient of performance (COP) at all times.

[0078] Hereinafter, the flow of the refrigerant when the outdoor heat exchanger (15) and the auxiliary heat exchanger (52) of the auxiliary unit (50) function as condensers will be described.

[0079] In the air cooling/heating operation, the refrigerant discharged from the compressor (14) is distributed to the indoor circuits (8b, ...) other than the indoor circuit (8a) of the first indoor unit (7a). The refrigerant flowed into the indoor circuits (8b, ...) condenses as it exchanges heat with indoor air in the indoor heat exchangers (40b, ...). The refrigerant condensed in the indoor heat exchangers (40b, ...) is distributed to the outdoor circuit (12), the auxiliary unit circuit (51), and the indoor circuit (8a) of the first indoor unit (7a).

[0080] The refrigerant flowed into the outdoor circuit (12) is reduced in pressure by the outdoor expansion valve (16), and then evaporates as it exchanges heat with outdoor air in the outdoor heat exchanger (15). The refrigerant flowed into the auxiliary unit circuit (51) is reduced in pressure by the expansion valve (53), and then evaporates as it exchanges heat with outdoor air in the

auxiliary heat exchanger (52). The refrigerant flowed into the indoor circuit (8a) of the first indoor unit (7a) is reduced in pressure by the indoor expansion valve (41a), and then evaporates as it exchanges heat with indoor air in the indoor heat exchanger (40a). Then, the refrigerant evaporated in the outdoor heat exchanger (15), the refrigerant evaporated in the auxiliary heat exchanger (52) of the auxiliary unit (50), and the refrigerant evaporated in the indoor heat exchanger (40a) of the first indoor unit (7a) flow together to be sucked into the compressor (14).

-Effect of the Embodiment-

[0081] According to the embodiment, the outdoor unit (10), which is applicable to both the refrigeration system (5) in which the operation state of the heat using unit (7) is switched by the switching mechanism (17) provided in the heat source unit (10), and the refrigeration system (7) in which the operation states of the heat using units (7) are switched by switching mechanisms (63, 64) included in switching units (60) corresponding to the heat using units (7), respectively, is provided with the first gas port (31) constantly communicating with the discharge side of the compressor (14).

[0082] Like in the second example refrigeration system (5) or the third example refrigeration system (5), the second switching mechanism (18) allows the third gas port (33) to communicate with the first gas line (25), with the gas inlet/outlet end of the indoor circuit (8) connected to the third gas port (33), the liquid inlet/outlet end of the indoor circuit (8) connected to the liquid port (34), the liquid inlet/outlet end of the auxiliary heat exchanger (52) of the auxiliary unit (50) connected to the liquid port (34), and the gas inlet/outlet end of the auxiliary heat exchanger (52) selectively connected to the first gas port (31) or the second gas port (32). Then, the air heating operation is performed in which the indoor heat exchanger (40), to which a high pressure refrigerant discharged from the compressor (14) is supplied through the third gas port (33), functions as a condenser. In the air heating operation, when the refrigerant condensed in the indoor heat exchanger (40) is supplied to the auxiliary heat exchanger (52), the supplied refrigerant evaporates in the auxiliary heat exchanger (52), flows into the outdoor circuit (12) through the second gas port (32), and is sucked into the compressor (14). Further, when the second switching mechanism (18) allows the third gas port (33) to communicate with the second gas line (26), the air cooling operation is performed in which the indoor heat exchanger (40), to which a liquid refrigerant condensed in the outdoor heat exchanger (15) is supplied through the liquid port (34), functions as an evaporator. In the air cooling operation, when the refrigerant discharged from the compressor (14) through the first gas port (31) is supplied to the auxiliary heat exchanger (52), the supplied refrigerant condenses in the auxiliary heat exchanger (52), and is supplied to the indoor heat exchanger (40) together with the liquid refrigerant condensed in the outdoor heat ex-

changer (15). The refrigerant supplied to the indoor heat exchanger (40) evaporates in the indoor heat exchanger (40), and the evaporated low-pressure refrigerant flows into the outdoor circuit (12) through the third gas port (33), and is sucked into the compressor (14).

[0083] In this way, by connecting the gas inlet/outlet end of the auxiliary heat exchanger (52) of the auxiliary unit (50) selectively to the first gas port (31) or the second gas port (32), the low-pressure gaseous refrigerant from the auxiliary heat exchanger (52) serving as an evaporator in the air heating operation can be supplied to the compressor (14) through the second gas port (32), and the high-pressure gaseous refrigerant can be supplied to the auxiliary heat exchanger (52) serving as a condenser in the air cooling operation through the first gas port (31). Therefore, the auxiliary unit (50) can be used for both of the air cooling operation and the air heating operation. Thus, the outdoor unit (10) of the present embodiment makes it possible to connect the auxiliary unit (50) to the outdoor unit (10) so that the auxiliary unit (50) can be used for both of the air cooling operation and the air heating operation. The auxiliary unit (50) of the present embodiment is configured so that the auxiliary heat exchanger (52) can make up the lack of the amount of heat exchange in the outdoor heat exchanger (15) both in the cooling operation and the heating operation.

[Other Embodiments]

[0084] Regarding the above-described embodiments, the air conditioner (5) may include a plurality of outdoor units (10, 10, ...) connected in parallel to each other as shown in FIG. 12.

[0085] The above embodiments are merely preferred embodiments in nature, and are not intended to limit the scope, applications and use of the invention.

INDUSTRIAL APPLICABILITY

[0086] As described above, the present invention is useful for a heat source unit of a refrigeration system connected to a heat using unit through a connecting pipe, and a refrigeration system including the heat source unit.

Claims

1. A heat source unit of a refrigeration system comprising: a heat source circuit (12) including a compressor (14) and a heat-source heat exchanger (15) connected to each other, wherein the heat source circuit (12) includes

a first gas port (31) which is provided at an end of a first gas line (25) constantly communicating with a discharge side of the compressor (14), a second gas port (32) which is provided at an end of a second gas line (26) constantly com-

communicating with a suction side of the compressor (14),

a third gas port (33) which is provided at an end of a third gas line (27) selectively communicating with one of the first gas line (25) and the second gas line (26),

a liquid port (34) which is provided at an end of a liquid line (28) constantly communicating with a liquid inlet/outlet end of the heat-source heat exchanger (15),

a first switching mechanism (17) which switches a gas inlet/outlet end of the heat-source heat exchanger (15) into communication with the discharge side of the compressor (14) or communication with the suction side of the compressor (14), and

a second switching mechanism (18) which switches the third gas line (27) into communication with the first gas line (25) or communication with the second gas line (26).

2. A refrigeration system comprising:

the heat source unit (10) of the refrigeration system (5) of claim 1; and

a heat using unit (7) having a heat-using circuit (8) including a decompression mechanism (41) and a heat-using heat exchanger (40) connected to each other to be arranged in this order from a liquid inlet/outlet end of the heat-using circuit (8), wherein

a refrigerant circuit (9) is constituted by connecting the third gas port (33) of the heat source circuit (12) of the heat source unit (10) and a gas inlet/outlet end of the heat-using circuit (8), and connecting the liquid port (34) of the heat source circuit (12) and the liquid inlet/outlet end of the heat-using circuit (8), the refrigerant circuit (9) performing a vapor compression refrigeration cycle.

3. The refrigeration system of claim 2, further comprising:

an auxiliary unit (50) having an auxiliary heat exchanger (52), a first connection port (56) constantly communicating with a liquid inlet/outlet end of the auxiliary heat exchanger (52), a second connection port (57) and a third connection port (58) with which a gas inlet/outlet end of the auxiliary heat exchanger (52) selectively communicates, and an auxiliary switching mechanism (54) which switches the gas inlet/outlet end of the auxiliary heat exchanger (52) into communication with the second connection port (57) or communication with the third connection port (58), wherein in the refrigerant circuit (9), the first connection

port (56) is connected to the liquid port (34) of the heat source circuit (12), the second connection port (57) is connected to the first gas port (31) of the heat source circuit (12), and the third connection port (58) is connected to the second gas port (32) of the heat source circuit (12).

4. The refrigeration system of claim 2 or 3, wherein a plurality of heat using units (7) are provided, and in the refrigerant circuit (9), a plurality of heat-using circuits (8) connected to the heat source circuit (12) are parallel to each other.

5. The refrigeration system of claim 4, further comprising:

switching units (60) corresponding to the plurality of the heat using units (7), respectively, each of which including operation state switching mechanisms (63, 64) which switch a gas inlet/outlet end of the heat-using circuit (8) of the heat using unit (7) into communication with the second gas port (32) or communication with the third gas port (33).

FIG. 1

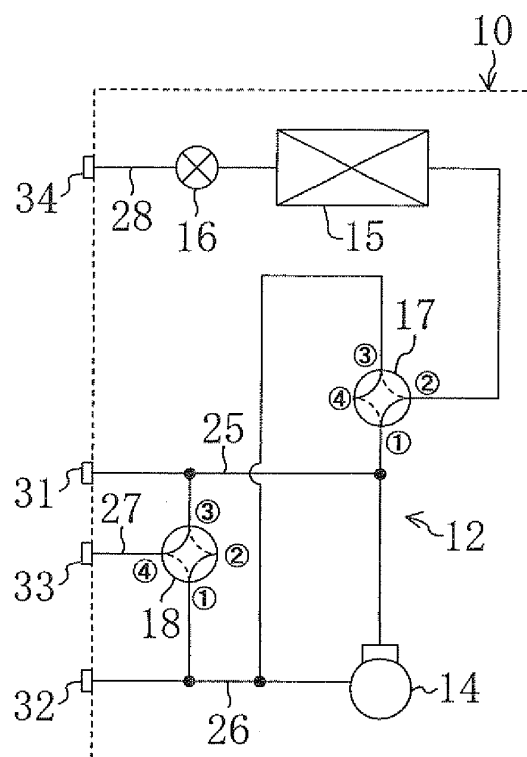


FIG. 2

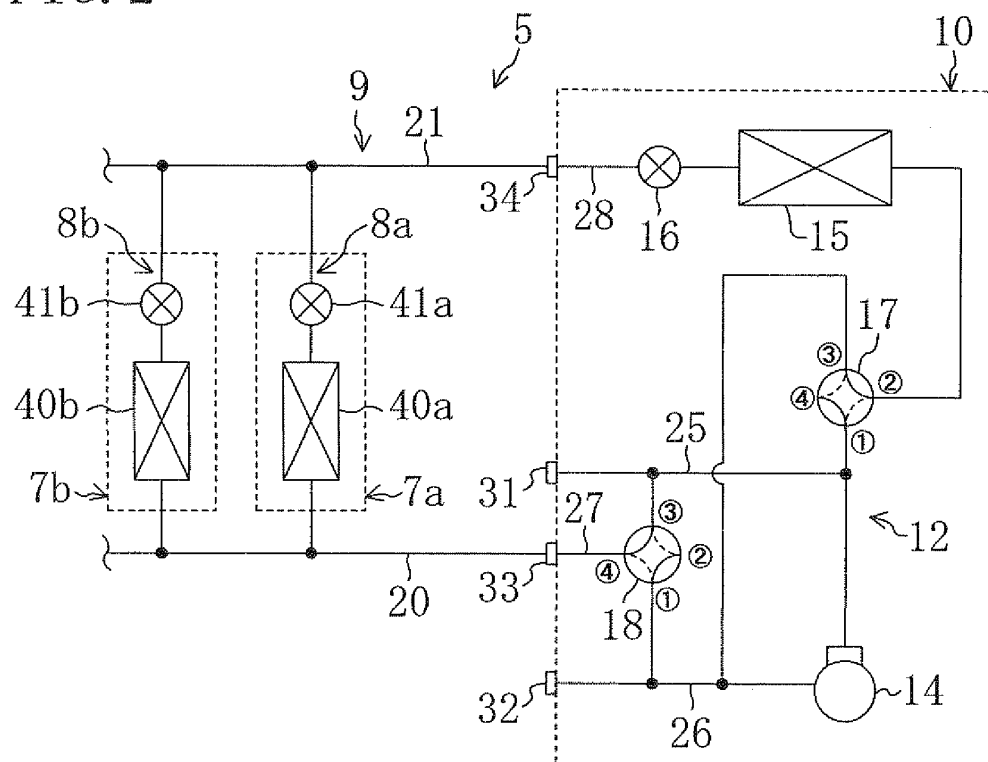


FIG. 3

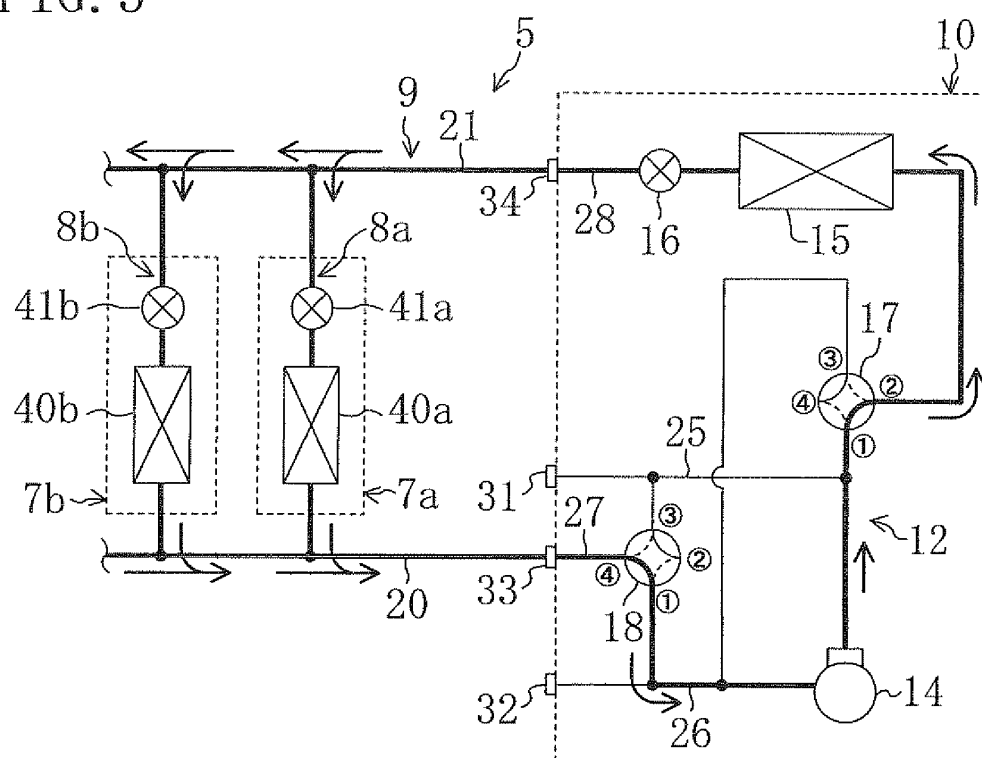


FIG. 4

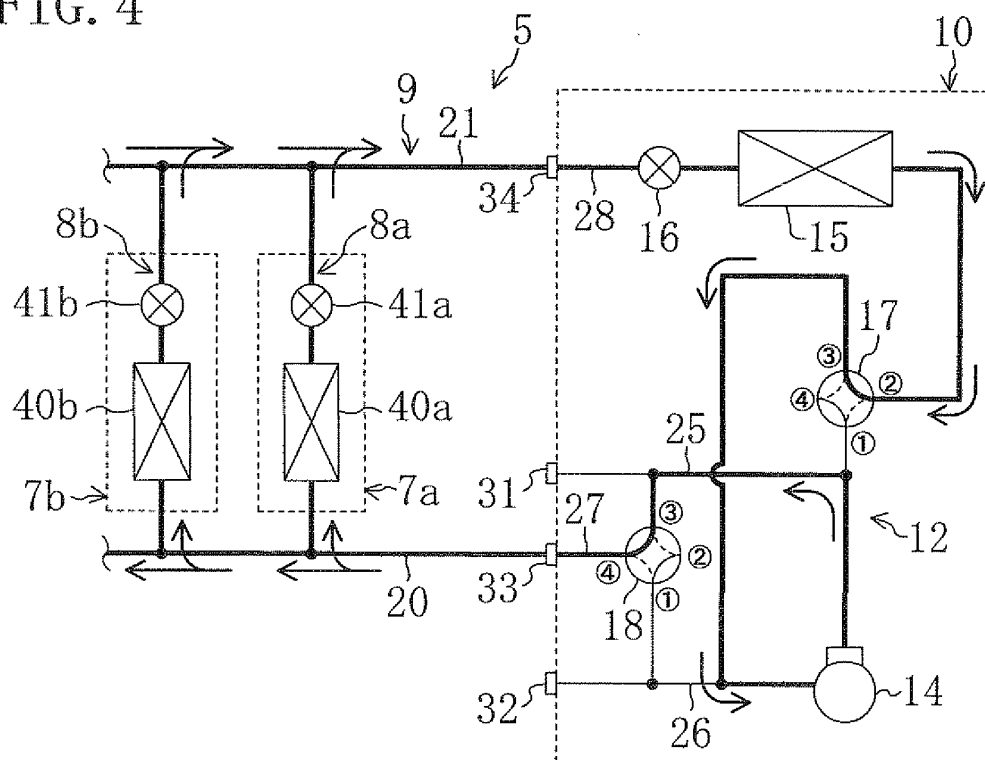


FIG. 5

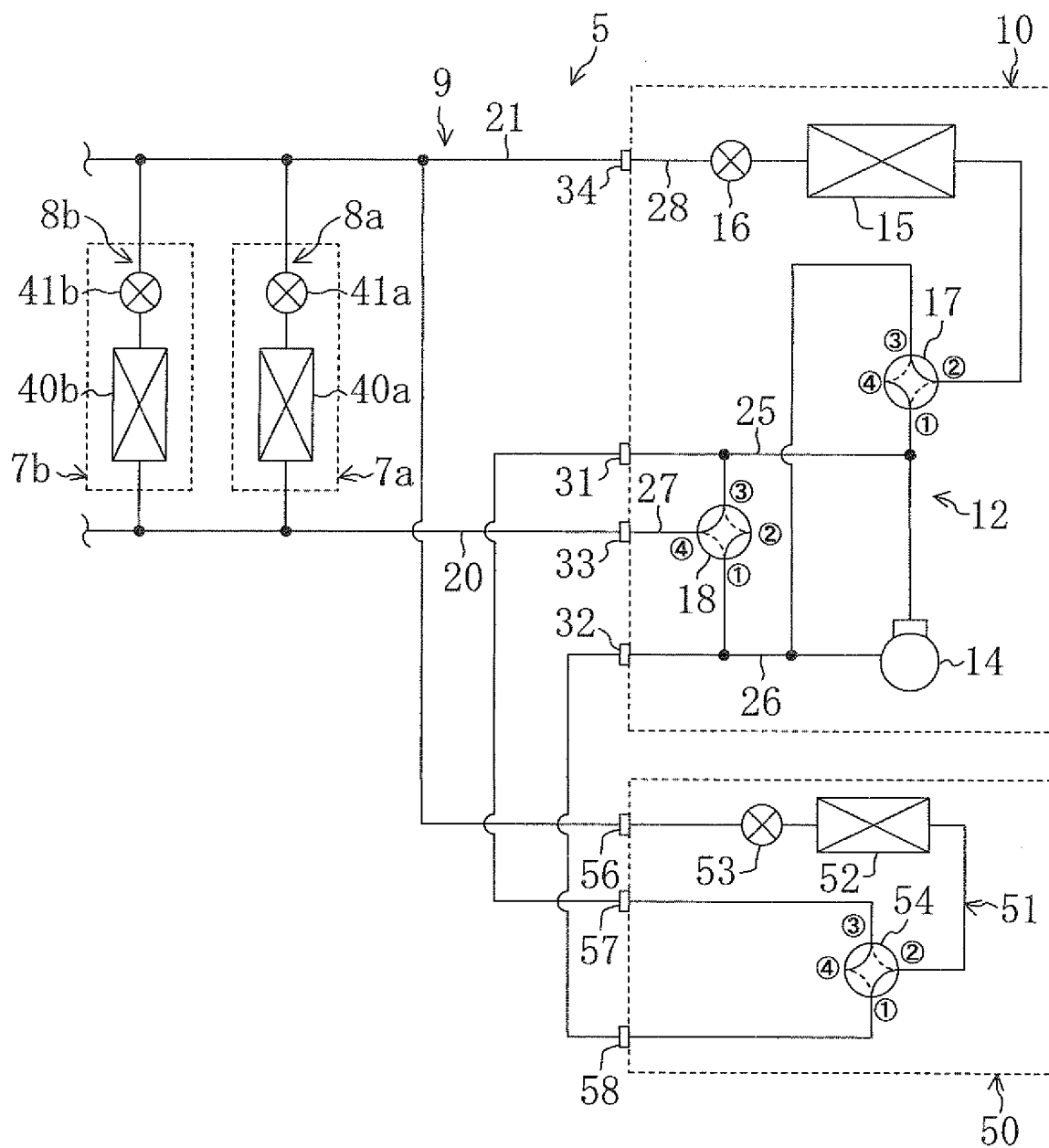


FIG. 6

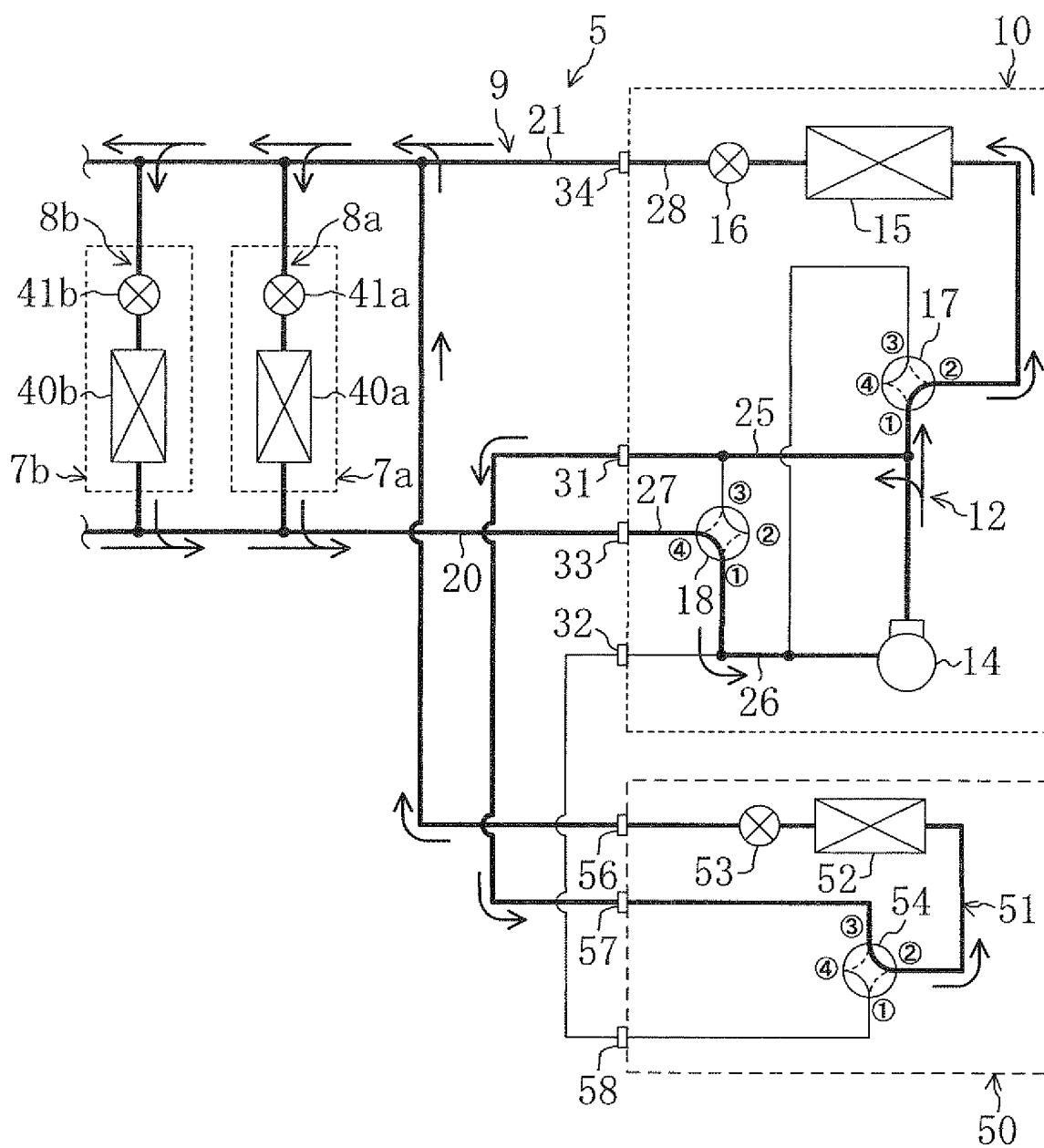


FIG. 7

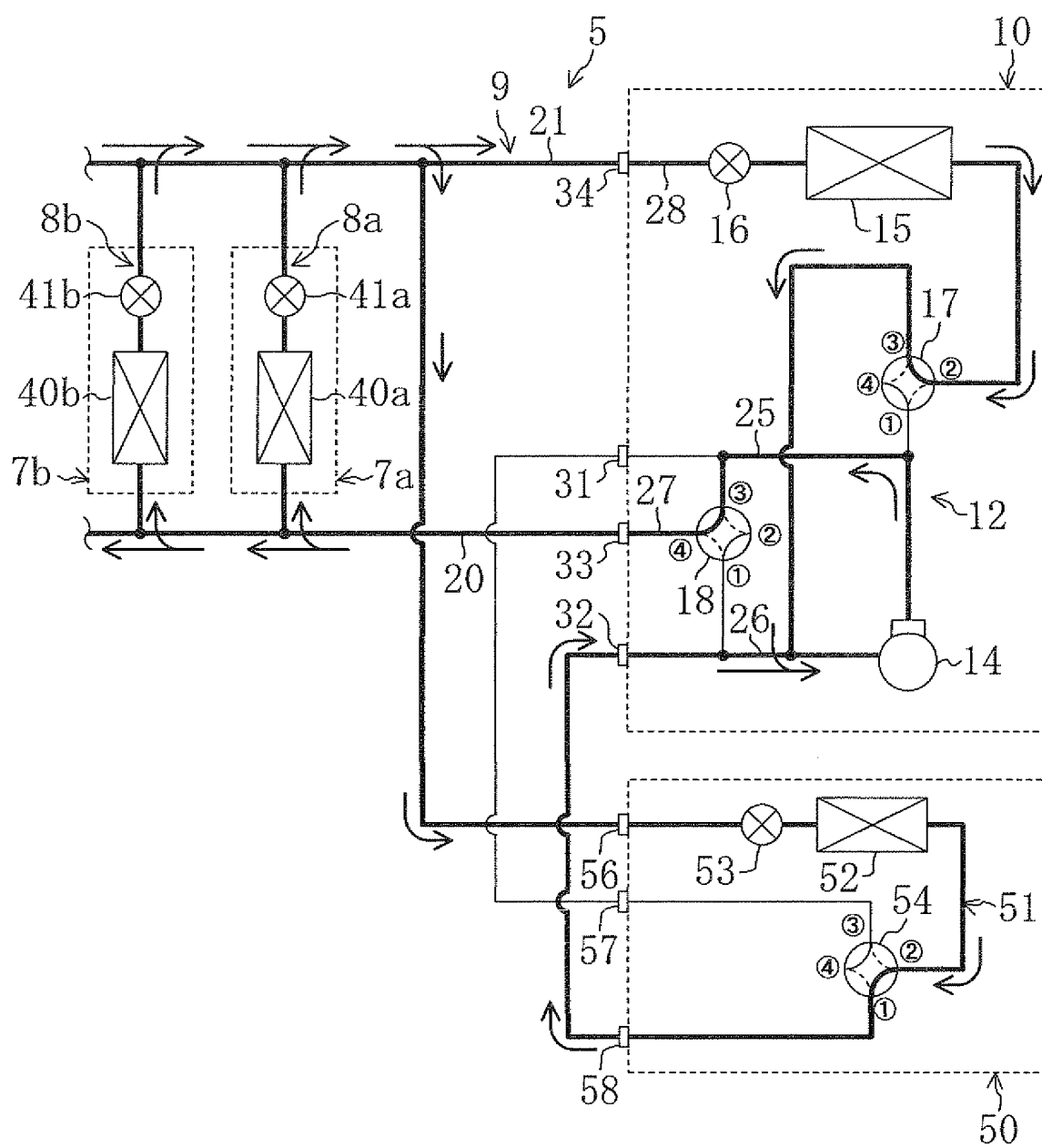


FIG. 8

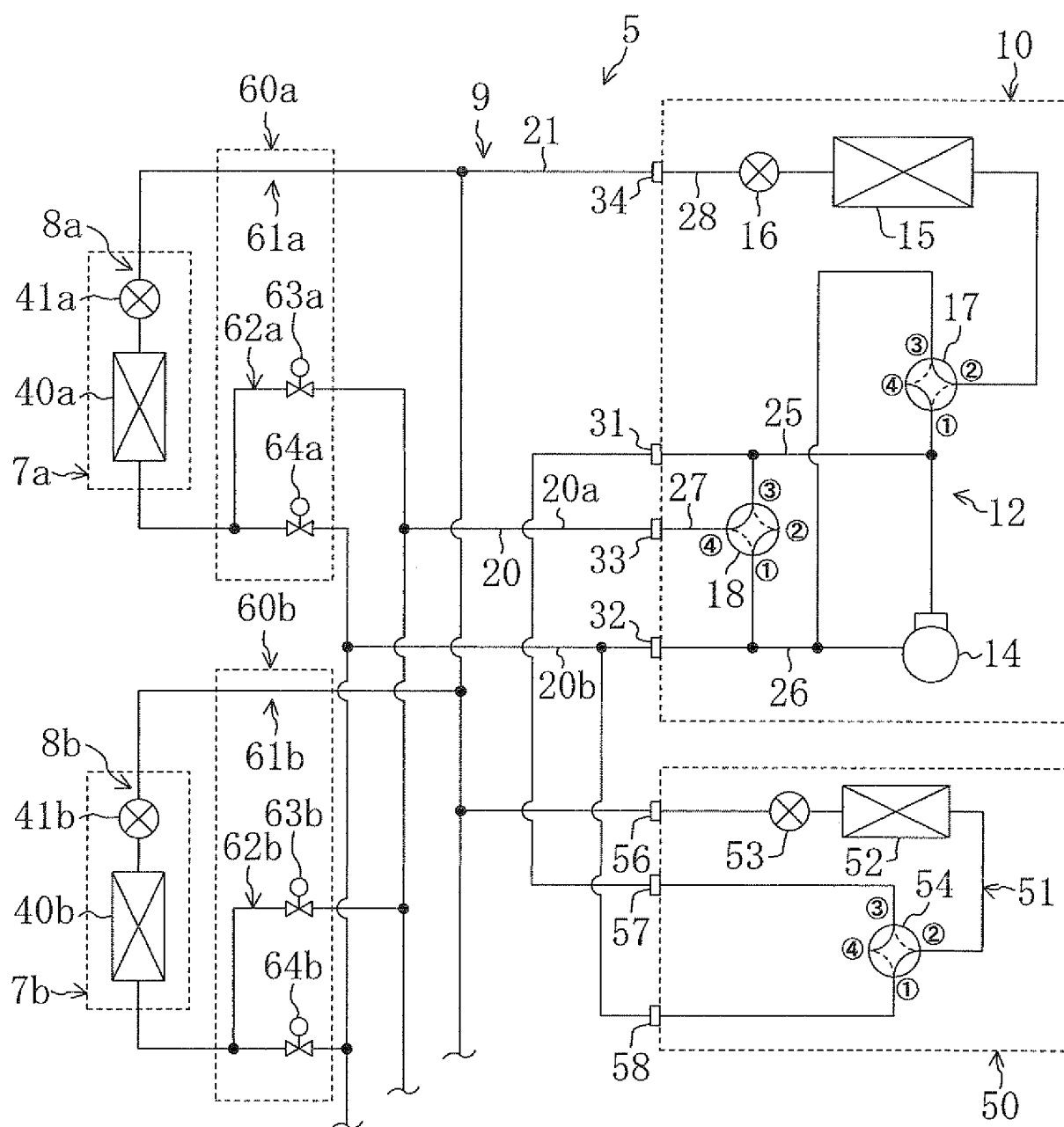


FIG. 9

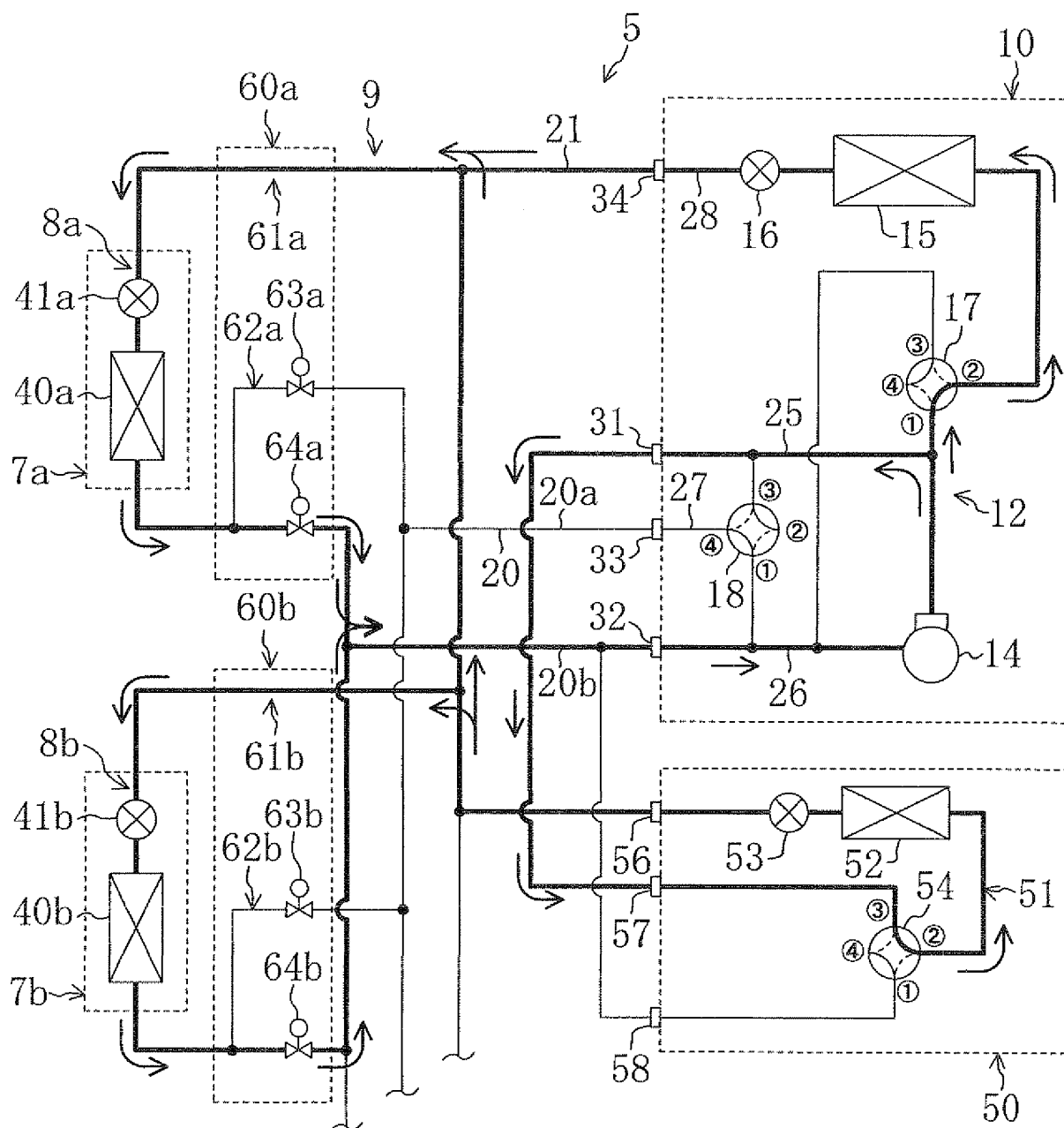


FIG. 10

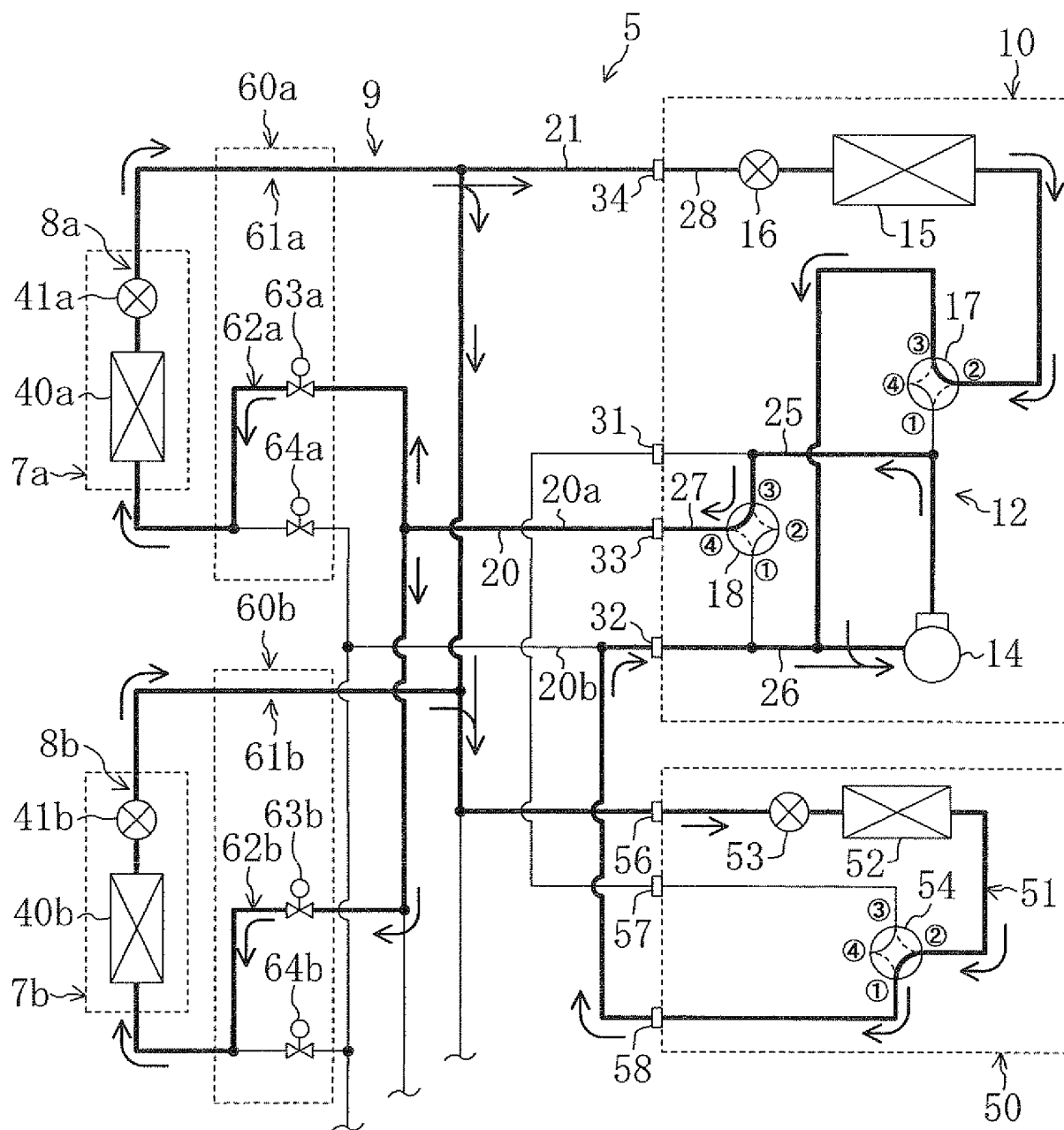


FIG. 11

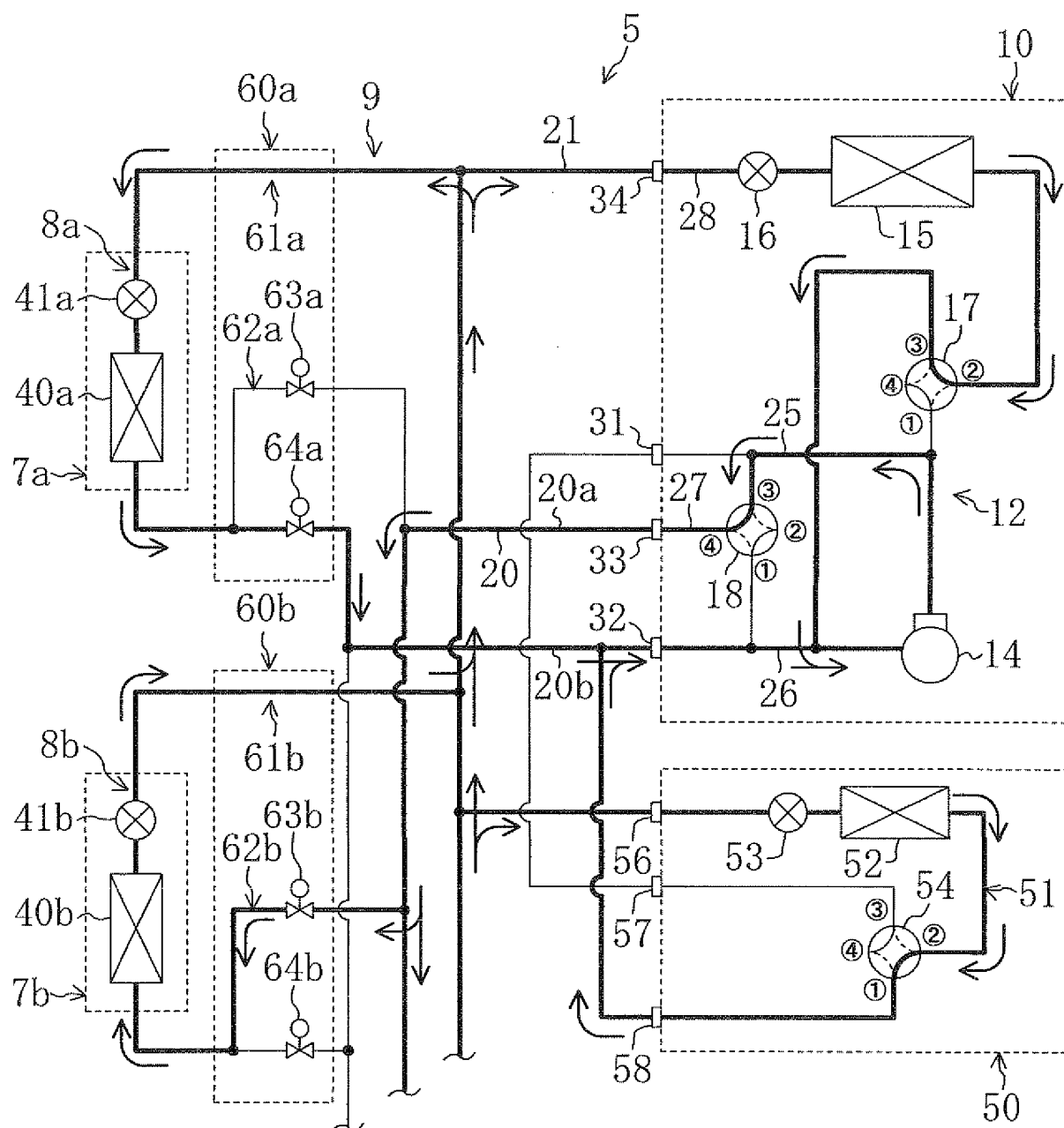


FIG. 12

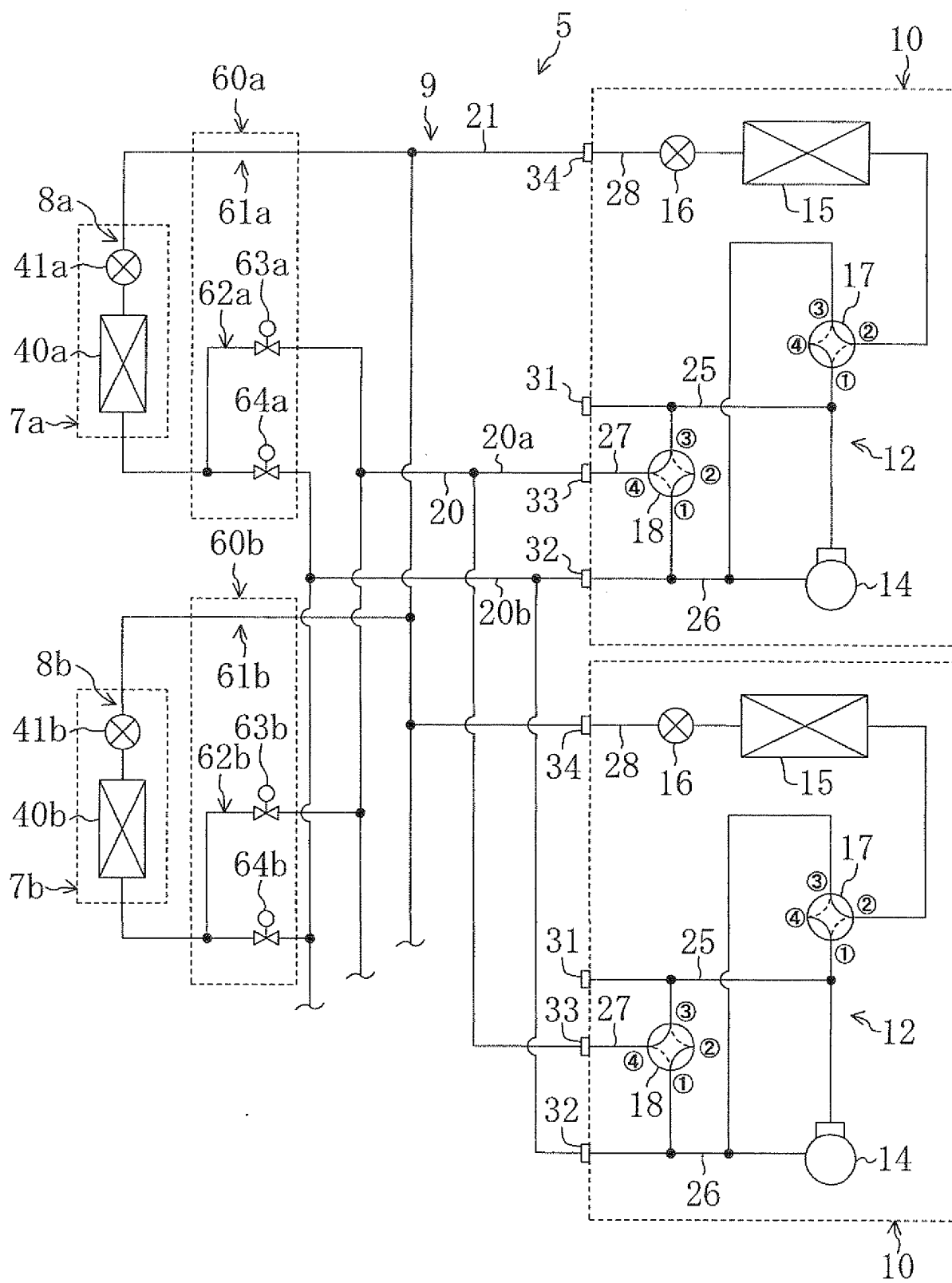


FIG. 13A

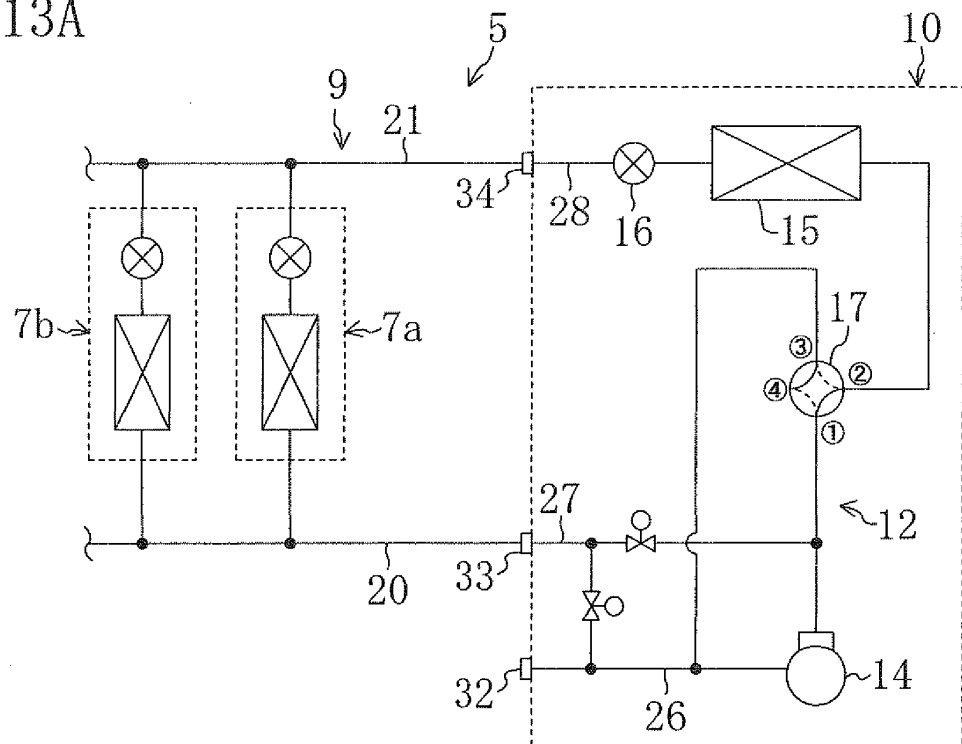


FIG. 13B

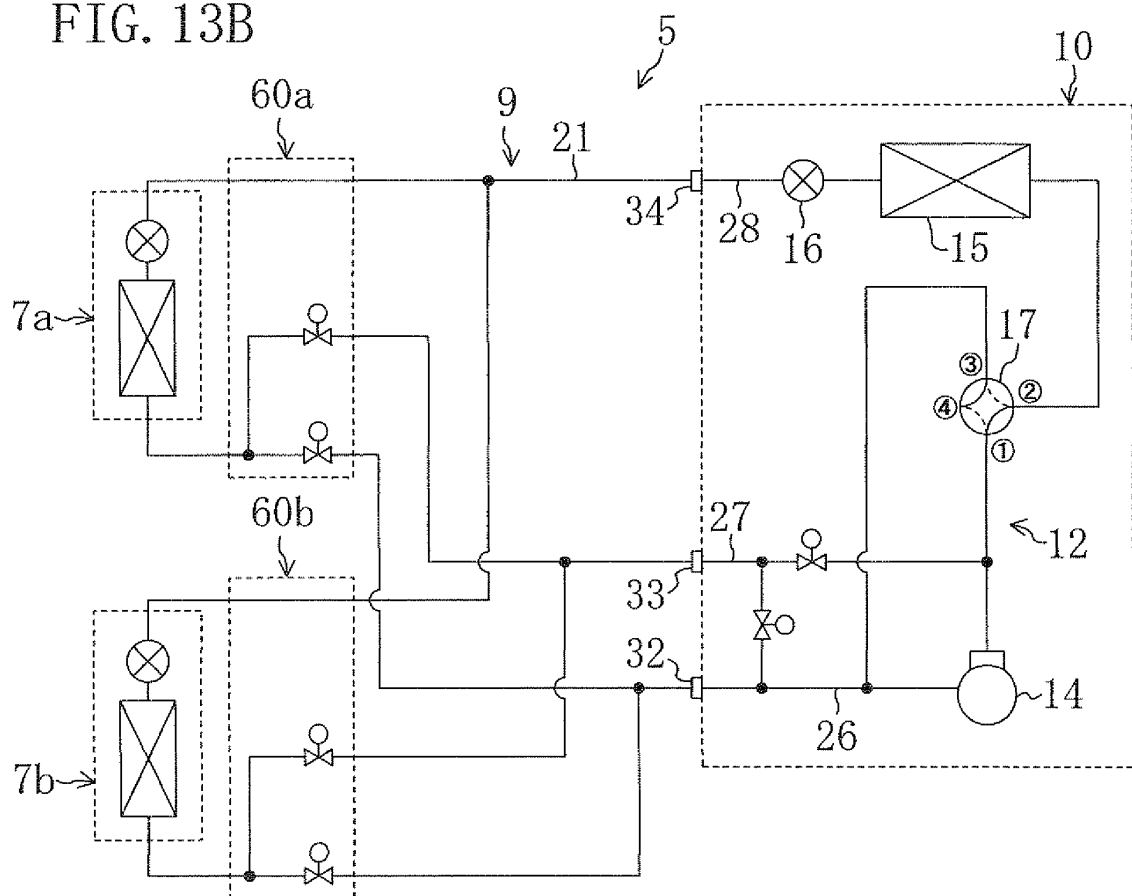


FIG. 14

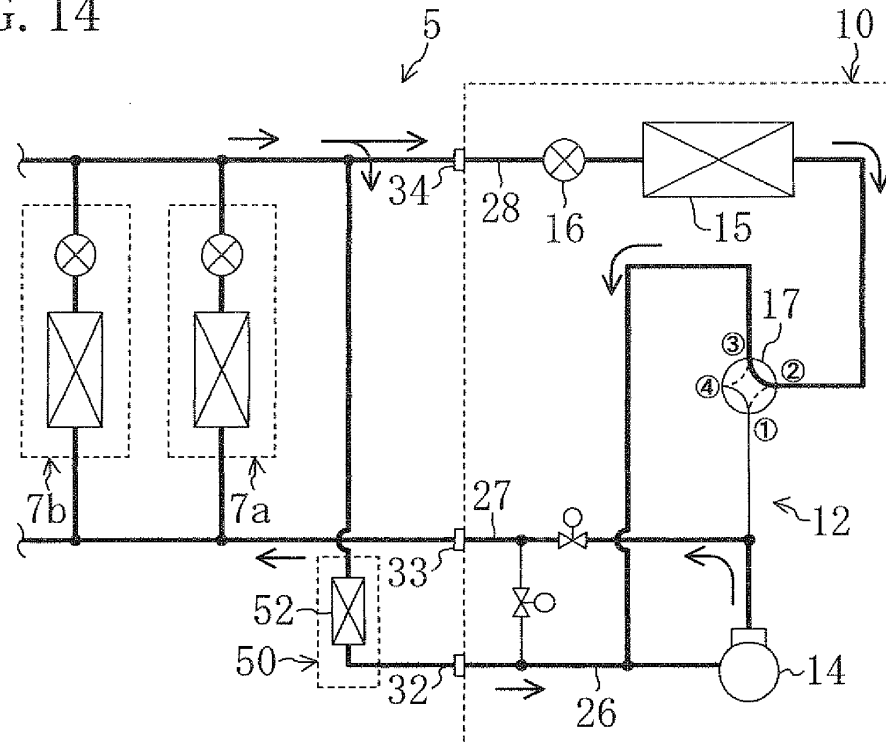
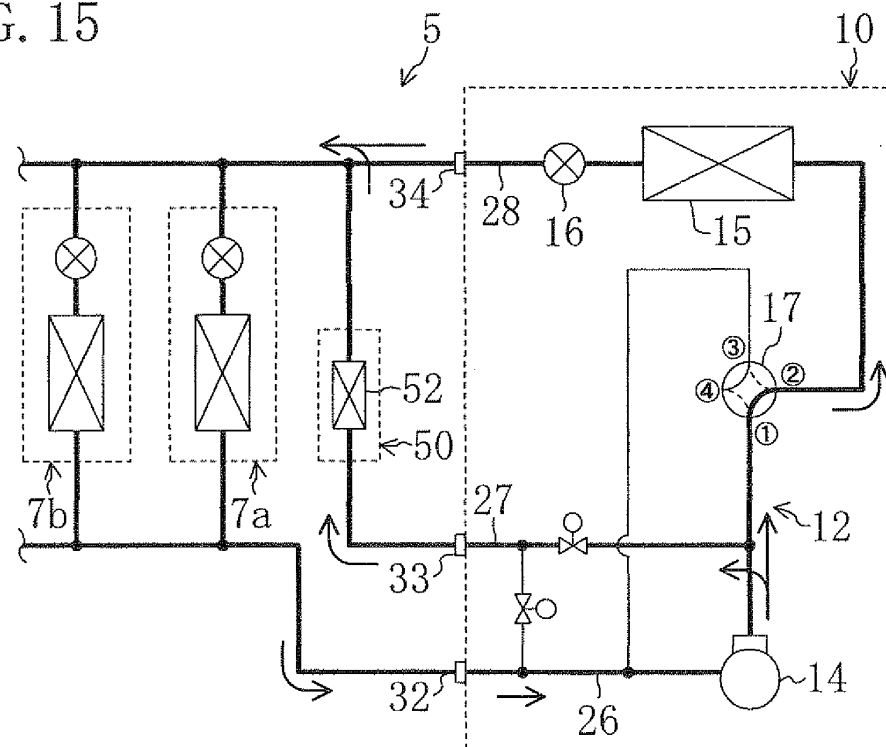


FIG. 15



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/070655

A. CLASSIFICATION OF SUBJECT MATTER

F25B29/00(2006.01)i, F24F11/02(2006.01)i, F25B13/00(2006.01)i

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)

F25B29/00, F24F11/02, F25B13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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	JP 2006-78087 A (Daikin Industries, Ltd.), 23 March, 2006 (23.03.06), Full text; all drawings & WO 2006/028218 A1	1-5
A	JP 11-241844 A (Daikin Industries, Ltd.), 07 September, 1999 (07.09.99), Full text; all drawings (Family: none)	1-5
A	JP 9-26219 A (Sanyo Electric Co., Ltd.), 28 January, 1997 (28.01.97), Full text; all drawings (Family: none)	1-5

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

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Date of the actual completion of the international search
08 January, 2008 (08.01.08)Date of mailing of the international search report
15 January, 2008 (15.01.08)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

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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 11-325636 A (Daikin Industries, Ltd.), 26 November, 1999 (26.11.99), Full text; all drawings (Family: none)	1-5
A	JP 2000-146345 A (Daikin Industries, Ltd.), 26 May, 2000 (26.05.00), Full text; all drawings (Family: none)	1-5

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2006078087 A [0008]
- JP H11241844 B [0008]