

(12)

(87) International publication number:
WO 2007/020885 (22.02.2007 Gazette 2007/08)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

an operation state where the circulation path is formed in which the refrigerant sent out from compression mechanism (11D, 11E) flows from a second user side unit (20) to first user side units (30, 40) and is then returned to the compression mechanisms (11D, 11E).

Description

Technical Field

[0001] The present invention relates to refrigerating apparatuses and particularly relates to a refrigerating apparatus including a plurality of user side heat exchangers for refrigeration/freezing and air conditioning capable of performing a 100% heat recovery operation therebetween.

Background Art

[0002] Conventionally, refrigerating apparatuses performing a refrigeration cycle have been known. The refrigerating apparatuses are widely utilized as air conditioners for cooling/heating indoors and coolers, such as showcases for refrigerating, or freezing food and the like. Of the refrigerating apparatuses, some perform both air conditioning and refrigeration/freezing (see Patent Document 1, for example). Installation of only a single refrigerating apparatus of this type in, for example, a convenience store attains indoor air conditioning and cooling of showcases and the like.

[0003] In the above refrigerating apparatus, a plurality of user side heat exchangers (refrigerating and freezing heat exchangers, an air conditioning heat exchanger, and the like) provided in user side units, such as refrigerating and frozen showcases, an air conditioning indoor unit, and the like are connected in parallel to a heat source side heat exchanger (an outdoor heat exchanger) of a heat source side unit (an outdoor unit) installed outdoors through liquid side communication pipes and gas side communication pipes.

[0004] Herein, in the case where a refrigerant circuit includes two system circuits of a first system circuit for refrigeration/freezing and a second system circuit for air conditioning, two communication pipes are used for each of a liquid line and a gas line in general. While in some refrigerating apparatuses, the two system circuits share one liquid side communication pipe to reduce the number of communication pipes (see Patent Document 2).

[0005] Specifically, the refrigerant circuit of this apparatus is composed as shown in FIG. 13. In the drawing, reference numeral (101) denotes an outdoor unit, (102) denotes an indoor unit, (103) denotes a refrigerated showcase (a refrigerating unit), and (104) denotes a frozen showcase (a freezing unit). The outdoor unit (101) includes compression mechanisms (105, 106), an outdoor heat exchanger (107), an outdoor expansion valve (108), and a receiver (109), while the indoor unit (102) includes an indoor heat exchanger (an air conditioning heat exchanger) (110) and an indoor expansion valve (111). The refrigerated showcase (103) includes a refrigerating heat exchanger (112) and a refrigerating expansion valve (113) while the frozen showcase (104) includes a freezing heat exchanger (114), a freezing expansion valve (115), and a booster compressor (116).

[0006] The refrigerant circuit (120) of this refrigerating apparatus includes a first system circuit for refrigeration/freezing and a second system circuit for air conditioning, wherein the first system circuit is so composed to circulate refrigerant in one direction between the outdoor heat exchanger (107) and the refrigerating and freezing heat exchangers (112, 114) while the second system circuit is so composed that the refrigerant circulates in two directions between the outdoor heat exchanger (107) and the indoor heat exchanger (110). The system circuits share a single liquid side communication pipe (121) as a liquid line for both the system circuits.

[0007] In addition to indoor air conditioning and cooling of each showcase with the use of the outdoor heat exchanger (107) installed outdoor as a heat source, the refrigerating apparatus can perform, heating and refrigeration/freezing at 100% heat recovery using the indoor heat exchanger (110) as a condenser and the refrigerating and freezing heat exchangers (112, 114) as evaporators without using the outdoor heat exchanger (107).

[0008] When the 100% heat recovery operation is performed in the refrigerant circuit (120) using the single liquid side communication pipe (121), a refrigerant circulation path is formed in the refrigerant circuit (120) in which the refrigerant discharged from the compression mechanisms (105, 106) is condensed in the indoor heat exchanger (110), evaporates in the refrigerating and freezing heat exchangers (112, 114), and is then returned again to the compression mechanisms (105, 106). In other words, in performing the 100% heat recovery operation, the liquid refrigerant condensed in the indoor heat exchanger (110) is introduced into the refrigerating and freezing heat exchangers (112, 114) without allowing it to flow from the receiver (109) into the heat source side heat exchanger (107).

[0009] For example, when the outdoor air temperature is low, however, the pressure in the receiver (109) lowers to lower the inner pressure of the liquid side communication pipe (121), so that the liquid refrigerant flowing out from the indoor heat exchanger (110) is liable to flow into the receiver (109) through the liquid side communication pipe (121). This invites shortage of the refrigerant flowing in the refrigerating and freezing heat exchangers (112, 114). When the refrigerant flowing in the refrigerating and freezing heat exchangers (112, 114) is short, the cooling capacity for cooling each inside of the showcases (103, 104) lowers.

[0010] To tackling this problem, a relief valve (117) is provided in the middle of the refrigerant path from the liquid side communication pipe (121) to the receiver (109). Though the relief valve (117) opens when the refrigerant pressure in the liquid side communication pipe (121) is increased to be equal to or higher than a predetermined value, it is closed until the pressure reaches the predetermined value. When the operation pressure of the relief valve (117) is set at a pressure higher than the pressure of the liquid side communication pipe (121) at the 100% heat recovery operation, the liquid refrigerant

is prevented from flowing into the receiver (109) in the 100% heat recovery operation. Further, even when the outdoor air temperature is low, the refrigerant flow in the refrigerant circuit (120) can be stabilized to prevent the freezing capacity from lowering.

[0011] The above refrigerating apparatus can perform a heating operation of the refrigeration cycle with the use of the outdoor heat exchanger (107) as an evaporator. In this operation, however, the relief valve (117) receives the suction pressure of the compressor (106) to be opened. In a cooling operation, the refrigerant does not flow in a path in which the relief valve (117) is provided.

Patent Document 1: Japanese Patent Application Laid-Open Publication No. 2001-280749

Patent Document 2: Japanese Patent Application Laid-Open Publication No. 2005-134103

Summary of the Invention

Problems that the Invention is to Solve

[0012] In the above apparatus, the refrigerant may not be prevented completely from flowing into the receiver when the relief valve is closed in some cases, namely, the cases where refrigerant leakage occurs at the relief valve. In these cases, the refrigerant gradually flows into the receiver, and less or no refrigerant flowing therein flows out from the receiver during the 100% heat recovery operation. Accordingly, the refrigerant in the receiver increases while the refrigerant in the refrigerating and freezing heat exchangers as the user side units is short. This lowers the capacity of cooling each inside of the showcases. Such a problem occurs in a case with a valve mechanism different from the relief valve, for example, a solenoid valve, as well. In any valve mechanisms, it is difficult to prevent refrigerant leakage completely when comparatively high-pressure refrigerant works.

[0013] Even in the case where the refrigerant should be prevented from flowing into the receiver, the refrigerant pressure working on the relief valve may be increased excessively to open the relief valve. In this case, also, excessive refrigerant flowing in the receiver causes refrigerant shortage similarly to the foregoing to lower the capacity of cooling each inside of the showcases.

[0014] The present invention has been made in view of the foregoing and has its object of preventing, in a refrigerating apparatus which includes a plurality of system user side heat exchangers and in which a plurality of liquid lines share a single liquid side communication pipe, refrigerant shortage in a user side unit which is caused due to an increase in refrigerant in a receiver.

Means for Solving the Problems

[0015] A first aspect of the present invention is directed to a refrigerating apparatus including: a heat source side unit (10) including a compression mechanism (11D,

11E), a heat source side heat exchanger (15), and a receiver (17); a first user side unit (30, 40) including a first user side heat exchanger (31, 41); a second user side unit (20) including a second user side heat exchanger (21); and gas side communication pipes (51, 52) and liquid side communication pipes (53, 54, 55) which connect each unit (10, 20, 30, 40) to form a refrigerant circuit (50), the gas side communication pipes (51, 52) including a first gas side communication pipe (51) connected to the heat source side unit (10) and the first user side unit (30, 40) and a second gas side communication pipe (53) connected to the heat source side unit (10) and the second user side unit (20), and the liquid side communication pipes (53, 54, 55) including a collection liquid pipe (53) connected to the heat source side unit (10), a first branch liquid pipe (54) branching from the collection liquid pipe (53) and connected to the first user side unit (30, 40), and a second branch liquid pipe (55) branching from the collection liquid pipe (53) and connected to the second user side unit (20). Wherein the refrigerant circuit (50) is capable of forming a refrigerant circulation path in which refrigerant sent out from the compression mechanisms (11D, 11E) flows from the second user side unit (20) to the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), and a refrigerant return mechanism (5) is provided for returning liquid refrigerant in the receiver (17) to the circulation path.

[0016] Referring to a second aspect of the present invention, in the first aspect, the refrigerant return mechanism (5) includes an introduction pipe (71) for introducing high-pressure refrigerant discharged from the compression mechanism (11D, 11E) into the receiver (17), and the liquid refrigerant in the receiver (17) is returned to the circulation path through the collection liquid pipe (53) in such a manner that the high-pressure refrigerant from the introduction pipe (71) is introduced into the receiver (17) to increase an inner pressure of the receiver (17).

[0017] Referring to a third aspect of the present invention, in the first aspect, the refrigerant return mechanism (5) includes a communication pipe (67) for allowing the receiver (17) to communicate with a suction side of the compression mechanism (11D, 11E), and the liquid refrigerant in the receiver (17) is returned to the circulation path in such a manner that the compression mechanism (11D, 11E) sucks the liquid refrigerant through the communication pipe (67).

[0018] Referring to a fourth aspect of the present invention, in the first aspect, the refrigerant return mechanism (5) includes a communication mechanism (13) for allowing the receiver (17) to communicate with a discharge side of the compression mechanism (11D, 11E) through the heat source side heat exchanger (15), and the liquid refrigerant in the receiver (17) is returned to the circulation path through the collection liquid pipe (53) in such a manner that the communication mechanism (13) allows the receiver (17) to communicate with the discharge side of the compression mechanism (11D, 11E) to cause high-pressure refrigerant discharged from the

compression mechanism (11D, 11E) to flow into the receiver (17).

[0019] Referring to a fifth aspect of the present invention, the refrigerating apparatus in any one of the first to fourth aspects further includes: suction side superheat detection means (79, 81) for detecting a degree of superheat of refrigerant flowing from the first user side heat exchanger (31, 41) toward a suction side of the compression mechanism (11D, 11E); and control means (95) for controlling the refrigerant return mechanism (5) so that the refrigerant in the receiver (17) is returned to the circulation path when a detection value of the suction side superheat detection means (79, 81) is equal to or larger than a predetermined value.

[0020] Referring to a sixth aspect of the present invention, the refrigerating apparatus in any one of the first to fourth aspects further includes: discharge side superheat detection means (75, 76) for detecting a degree of superheat of refrigerant discharged from the compression mechanism (11D, 11E); and control means (95) for controlling the refrigerant return mechanism (5) so that the refrigerant in the receiver (17) is returned to the circulation path when a detection value of the discharge side superheat detection means (75, 76) is equal to or larger than a predetermined value.

[0021] Referring to a seventh aspect of the present invention, the refrigerating apparatus in any one of first to fourth aspect further includes: discharge side refrigerant temperature detection means (76) for detecting a temperature of refrigerant discharged from the compression mechanism (11D, 11E); and control means (95) for controlling the refrigerant return mechanism (5) so that the refrigerant in the receiver (17) is returned to the circulation path when a detection value of the discharge side refrigerant temperature detection means (76) is equal to or larger than a predetermined value.

[0022] An eight aspect of the present invention is directed to a refrigerating apparatus including: a heat source side unit (10) including a compression mechanism (11D, 11E), a heat source side heat exchanger (15), and a receiver (17); a first user side unit (30, 40) including a first user side heat exchanger (31, 41); a second user side unit (20) including a second user side heat exchanger (21); and gas side communication pipes (51, 52) and liquid side communication pipes (53, 54, 55) which connect each unit (10, 20, 30, 40) to form a refrigerant circuit (50), the gas side communication pipes (51, 52) including a first gas side communication pipe (51) connected to the heat source side unit (10) and the first user side unit (30, 40) and a second gas side communication pipe (53) connected to the heat source side unit (10) and the second user side unit (20), and the liquid side communication pipes (53, 54, 55) including a collection liquid pipe (53) connected to the heat source side unit (10), a first branch liquid pipe (54) branching from the collection liquid pipe (53) and connected to the first user side unit (30, 40), and a second branch liquid pipe (55) branching from the collection liquid pipe (53) and connected to the second

user side unit (20). Wherein, the refrigerant circuit (50) includes a switching mechanism (12) which switches between a first operation mode and a second operation mode, the first operation mode being a mode in which refrigerant sent out from the compression mechanism (11D, 11E) flows from the second user side unit (20) to the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), and the second operation mode being a mode in which the refrigerant sent out from the compression mechanism (11D, 11E) flows from the heat source side heat exchanger (15) into the receiver (17) and into the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), and the liquid refrigerant retained in the receiver (17) in the first operation mode is returned to the first user side unit (30, 40) through the collection liquid pipe (53) by switching the switching mechanism (12) from the first operation mode to the second operation mode.

-Operation-

[0023] In the first aspect of the present invention, in an operation state where the circulation path is formed in which the refrigerant sent out from the compression mechanism (11D, 11E) flows from the second user side unit (20) to the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), the liquid refrigerant in the receiver (17) can be forcibly returned to the circulation path by the refrigerant return mechanism (5). In some cases, as described above, the refrigerant will flow into the receiver (17) even through the refrigerant is inhibited from flowing into the receiver (17), thereby reducing the refrigerant in the circulation path. In the first aspect, however, the refrigerant return mechanism (5) returns the liquid refrigerant in the receiver (17) to the circulation path.

[0024] In the second aspect of the present invention, when the liquid refrigerant in the receiver (17) is returned to the circulation path, the high-pressure gas refrigerant discharged from the compression mechanism (11D, 11E) is introduced into the receiver (17) through the introduction pipe (71). When the high-pressure gas refrigerant is introduced, the inner pressure of the receiver (17) increases to push out the liquid refrigerant therein, so that the liquid refrigerant thus pushed out from the receiver (17) is returned to the circulation path through the collection liquid pipe (53). This increases the rate of the gas refrigerant having a small density while decreasing the rate of the liquid refrigerant having a large density. As a result, the refrigerant in the receiver (17) decreases while increasing the refrigerant in the circulation path.

[0025] In the third aspect of the present invention, when the liquid refrigerant in the receiver (17) is returned to the circulation path, the communication pipe (67) allows the receiver (17) to communicate with the suction side of the compression mechanism (11D, 11E). When the receiver (17) communicates with the suction side of the compression mechanism (11D, 11E), the liquid re-

refrigerant therein is sucked into the compression mechanism (11D, 11E) to return the liquid refrigerant in the receiver (17) forcedly to the circulation path. This decreases the refrigerant in the receiver (17) while increasing the refrigerant in the circulation path.

[0026] In the fourth aspect of the present invention, when the liquid refrigerant in the receiver (17) is returned to the circulation path, the communication mechanism (13) allows the receiver (17) to communicate with the discharge side of the compression mechanism (11D, 11E) through the heat source side heat exchanger (15) to cause the high-pressure refrigerant discharged from the compression mechanism (11D, 11E) to flow into the receiver (17). When the high-pressure gas refrigerant flows into the receiver (17), the inner pressure of the receiver (17) increases to push out the liquid refrigerant therein, similarly to the second aspect. The liquid refrigerant pushed out from the receiver (17) is returned to the circulation path through the collection liquid pipe (53). This decrease the refrigerant in the receiver (17) while increasing the refrigerant in the circulation path.

[0027] Further, the high-pressure gas refrigerant discharged from the compression mechanism (11D, 11E) is introduced into the receiver (17) via the heat source side heat exchanger (15). In the fourth aspect, the heat source side heat exchanger (15) is utilized as a flow path for introducing the high-pressure gas refrigerant discharged from the compression mechanism (11D, 11E) into the receiver (17).

[0028] In the fifth aspect of the present invention, when the degree of superheat of the refrigerant flowing from the first user side heat exchanger (31, 41) to the suction side of the compression mechanism (11D, 11E) is equal to or larger than the predetermined value, the refrigerant return mechanism (5) returns the liquid refrigerant in the receiver (17) to the circulation path. In the first user side heat exchanger (31, 41), the less the flow rate of the refrigerant is, the more the region where the refrigerant in a liquid-vapor two-phase state flows decreases and the more the region where the single-phase gas refrigerant flows expands. As a result, the degree of superheat of the refrigerant flowing out from the first user side heat exchanger (31, 41) increases. In other words, the degree of superheat of the refrigerant flowing out from the first user side heat exchanger (31, 41) reflects the flow rate of the refrigerant flowing in the first user side heat exchanger (31, 41). Accordingly, with the use of the detection value of the suction side superheat detection means (79, 81), appropriate judgment can be performed as to whether or not the refrigerant is short in the first user side heat exchanger (31, 41).

[0029] In the sixth aspect of the present invention, when the degree of superheat of the refrigerant discharged from the compression mechanism (11D, 11E) is equal to or larger than the predetermined value, the refrigerant return mechanism (5) returns the liquid refrigerant in the receiver (17) to the circulation path. As described above, the less the flow rate of the refrigerant in

the first user side heat exchanger (31, 41) is, the more the degree of superheat of the refrigerant flowing out from the first user side heat exchanger (31, 41) and sucked to the compression mechanism (11D, 11E) increases.

Further, the larger the degree of superheat of the refrigerant sucked to the compression mechanism (31, 41) is, the larger the degree of superheat of the refrigerant discharged from the compression mechanism (31, 41) is. In other words, since the degree of superheat of the refrigerant discharged from the compression mechanism (11D, 11E) reflects the flow rate of the refrigerant in the first user side heat exchanger (31, 41), appropriate judgment can be performed with the use of the detection value of the discharge side superheat detection means (75, 76) as to whether or not the refrigerant is short in the first user side heat exchanger (31, 41).

[0030] In the seventh aspect of the present invention, when the temperature of the refrigerant discharged from the compression mechanism (11D, 11D) is equal to or higher than the predetermined temperature, the refrigerant return mechanism (5) returns the refrigerant in the receiver (17) to the circulation path. As described above, the less the flow rate of the refrigerant in the first user side heat exchanger (31, 41) is, the larger the degree of superheat of the refrigerant discharged from the compression mechanism (11D, 11E) becomes. The larger degree of superheat of the refrigerant means high temperature thereof. Namely, the temperature of the refrigerant discharged from the compression mechanism (11D, 11E) reflects the flow rate of the refrigerant in the first user side heat exchanger (31, 41), and accordingly, appropriate judgment can be performed with the use of the detection value of the discharge side temperature detection means (76) as to whether or not the refrigerant is short in the first user side heat exchanger (31, 41).

[0031] In the eighth aspect of the present invention, when the liquid refrigerant is retained much in the receiver (17) in the first operation mode, the switching mechanism (12) switches the operation mode from the first operation mode to the second operation mode. In the second operation mode, similarly to the fourth aspect, the high-pressure gas refrigerant discharged from the compression mechanism (11D, 11E) flows into the receiver (17) to increase the inner pressure thereof, thereby pushing out the liquid refrigerant retained in the first operation mode. Then, the liquid refrigerant pushed out from the receiver (17) is returned to the first user side unit (30, 40) through the collection liquid pipe (53).

Effects of the Invention

[0032] In the present invention, in the operation state where the circulate path in which the refrigerant decreases when the refrigerant flows into the receiver (17) is formed, the refrigerant return mechanism (5) returns the liquid refrigerant in the receiver (17) to the circulation path. When the liquid refrigerant in the receiver (17) is returned to the circulation path, the refrigerant flowing in

each user side unit (20, 30, 40) increases. Accordingly, when the liquid refrigerant in the receiver (17) is returned to the circulation path by the refrigerant return mechanism (5) before the refrigerant is short in the user side units (20, 30, 40), refrigerant shortage can be prevented in each user side unit (20, 30, 40) to avoid lowering of the capacity of temperature adjustment in each user side unit (20, 30, 40).

[0033] In the third aspect of the present invention, during the time when the liquid refrigerant in the receiver (17) is returned to the circulation path, the compression mechanism (11D, 11E) sucks the liquid refrigerant in the receiver (17) to lower the degree of superheat on the suction side of the compression mechanism (11D, 11E). As a result, the refrigerant is returned to the circulation path to obviate refrigerant shortage, and the degree of superheat on the suction side is suppressed to reduce the required input of the compression mechanism (11D, 11E).

[0034] In the fourth aspect of the present invention, the heat source side heat exchanger (15) serving as an evaporator or a condenser in the refrigeration cycle of the refrigerant circuit (50) is utilized as a flow path for introducing the high-pressure gas refrigerant discharged from the compression mechanism (11D, 11E) into the receiver (17). In other words, a part of the refrigerating apparatus (1) is utilized as the refrigerant return mechanism (5). This simplifies the refrigerating apparatus (1) including the refrigerant return mechanism (5).

[0035] In the fifth aspect of the present invention, in view of the fact that whether or not the refrigerant is short in the first user side heat exchanger (31, 41) can be judged from the degree of superheat of the refrigerant flowing from the first user side heat exchanger (31, 41) to the suction side of the compression mechanism (11D, 11E), the refrigerant return mechanism (5) is controlled on the basis of the detection value of the suction side superheat detection means (79, 81). Accordingly, the liquid refrigerant in the receiver (17) can be returned to the circulation path at an appropriate timing before the refrigerant is short in the first user side heat exchanger (31, 41) to avoid the cooling capacity of the first user side heat exchanger (31, 41) from lowering definitely.

[0036] In the sixth aspect of the present invention, in view of the fact that whether or not the refrigerant is short in the first user side heat exchanger (31, 41) can be judged from the degree of superheat of the refrigerant discharged from the compression mechanism (11D, 11E), the refrigerant return mechanism (5) is controlled on the basis of the detection value of the discharge side superheat detection means (75, 76). Accordingly, the liquid refrigerant in the receiver (17) can be returned to the circulation path at an appropriate timing before the refrigerant is short in the first user side heat exchanger (31, 41) to avoid the cooling capacity of the first user side heat exchanger (31, 41) from lowering definitely.

[0037] In the seventh aspect of the present invention, in view of the fact that whether or not the refrigerant is

short in the first user side heat exchanger (31, 41) can be judged from the temperature of the refrigerant discharged from the compression mechanism (11D, 11E), the refrigerant return mechanism (5) is controlled on the basis of the detection value of the discharge side temperature detection means (76). Accordingly, the liquid refrigerant in the receiver (17) can be returned to the circulation path at an appropriate timing before the refrigerant is short in the first user side heat exchanger (31, 41) to avoid the cooling capacity of the first user side heat exchanger (31, 41) from lowering definitely.

[0038] In the eighth aspect of the present invention, switching from the first operation mode to the second operation mode causes the liquid refrigerant retained in the receiver (17) in the first operation mode to be returned to the first user side unit (30, 40). Accordingly, in the eighth aspect, the refrigerant circulating between the user side units (20, 30, 40) and the compression mechanism (11D, 11E) is prevented from being short in the first operation mode to avoid lowering of the capacity of temperature adjustment in the user side units (20, 30, 40).

Brief Description of the Drawings

[0039]

[FIG. 1] FIG. 1 is diagram showing a refrigerant circuit of a refrigerating apparatus in accordance with Embodiment 1 of the present invention.

[FIG. 2] FIG. 2 is a diagram showing the refrigerant circuit in a cooling operation in Embodiment 1.

[FIG. 3] FIG. 3 is a diagram showing the refrigerant circuit in a freezing operation in Embodiment 1.

[FIG. 4] FIG. 4 is a diagram showing the refrigerant circuit in a first cooling/freezing operation in Embodiment 1.

[FIG. 5] FIG. 5 is a diagram showing the refrigerant circuit in a second cooling/freezing operation in Embodiment 1.

[FIG. 6] FIG. 6 is a diagram showing the refrigerant circuit in a heating operation in Embodiment 1.

[FIG. 7] FIG. 7 is a diagram showing the refrigerant circuit in a state where a solenoid valve of a hot gas bypass pipe is closed in a first heating/freezing operation in Embodiment 1.

[FIG. 8] FIG. 8 is a diagram showing the refrigerant circuit in a state where the solenoid valve of the hot gas bypass pipe is opened in the first heating/freezing operation in Embodiment 1.

[FIG. 9] FIG. 9 is a diagram showing the refrigerant circuit in a second heating/freezing operation in Embodiment 1.

[FIG. 10] FIG. 10 is a diagram showing the refrigerant circuit in a third heating/freezing operation in Embodiment 1.

[FIG. 11] FIG. 11 is a diagram showing a refrigerant circuit of a refrigerating apparatus in accordance with Embodiment 2 of the present invention.

[FIG. 12] FIG. 12 is a diagram showing a refrigerant circuit of a refrigerating apparatus in accordance with Embodiment 3 of the present invention.

[FIG. 13] FIG. 13 is a diagram showing a refrigerant circuit of a conventional refrigerating apparatus.

Explanation of Reference Numerals

[0040]

1	refrigerating apparatus
5	refrigerant return mechanism
10	outdoor unit (heat source side unit)
11D	compression mechanism
11E	compression mechanism
13	second four-way switching valve (communication mechanism)
15	outdoor heat exchanger (heat source side heat exchanger)
17	receiver
20	indoor unit (second user side unit)
21	indoor heat exchanger (second user side heat exchanger)
30	refrigerating unit (first user side unit)
31	refrigerating heat exchanger (first user side heat exchanger)
40	freezing unit (first user side unit)
41	freezing heat exchanger (first user side heat exchanger)
50	refrigerant circuit
50A	first system circuit
50B	second system circuit
51	first gas side communication pipe (gas side communication pipe)
52	second gas side communication pipe (gas side communication pipe)
53	collection liquid pipe (liquid side communication pipe)
54	first branch liquid pipe (liquid side communication pipe)
55	second branch liquid pipe (liquid side communication pipe)
67	liquid injection pipe (communication pipe)
71	hot gas bypass pipe (introduction pipe)
75	high-pressure pressure sensor (discharge side superheat detection means)
76	discharge side temperature sensor (discharge side superheat detection means, discharge side refrigerant temperature detection means)
79	low-pressure pressure sensor (suction side superheat detection means)
81	suction side temperature sensor (suction side degree of superheat detection means)
95	controller (control means)

Best Mode for Carrying out the Invention

[0041] Embodiments of the present invention will be

described below in detail with reference to the accompanying drawings.

<Embodiment 1>

[0042] Embodiment 1 of the present invention will be described. A refrigerant circuit of a refrigerating apparatus (1) in accordance with Embodiment 1 is shown in FIG. 1. The refrigerating apparatus (1) is installed in a convenience store and performs cooling of a refrigerated showcase and a frozen showcase and cooling/heating of the store.

[0043] The refrigerating apparatus (1) includes an outdoor unit (a heat source side unit) (10), an indoor unit (a second user side unit) (20), a refrigerating unit (a first user side unit) (30), and a freezing unit (a first user side unit) (40). The units (10, 20, 30, 40) are connected to each other by means of gas side communication pipes (51, 52) and liquid side communication pipes (53, 54, 55) to form a refrigerant circuit (50) that performs a vapor compression refrigeration cycle.

[0044] The gas side communication pipes (51, 52) are a first gas side communication pipe (low-pressure gas pipe) (51) connected to the outdoor unit (10), the refrigerating unit (30), and the freezing unit (40) and a second gas side communication pipe (52) connected to the outdoor unit (10) and the indoor unit (20). The liquid side communication pipes (53, 54, 55) are a collection liquid pipe (53) connected to the outdoor unit (10), a first branch liquid pipe (54) branching from the collection liquid pipe (53) and connected to the refrigerating unit (30) and the freezing unit (40), and a second branch liquid pipe (55) branching from the collection liquid pipe (53) and connected to the indoor unit (20). The first branch liquid pipe (54) includes a refrigerating side first branch liquid pipe (54a) on the refrigerating unit (30) side and a freezing side first branch liquid pipe (54b) on the freezing unit (40) side. In Embodiment 1, the indoor unit (20) and the refrigerating and freezing units (30, 40) share the collection liquid pipe (53), which is a part of the liquid side communication pipes (53, 54, 55) on the outdoor unit (10) side, to form three-pipe communication pipe structure.

[0045] The indoor unit (20) is switchable between a cooling operation and a heating operation and is installed in a sales room, for example. The refrigerating unit (30) is installed in the refrigerated showcase to cool the air inside the showcase. The freezing unit (40) is installed in the frozen showcase to cool the air inside the showcase. Though the drawing shows only one indoor unit (20), one refrigerating unit (30), and one freezing unit (40), Embodiment 1 supposes that two indoor units (20) are connected in parallel, eight refrigerating units (30) are connected in parallel, and one freezing unit (40) is connected.

[0046] The refrigerant circuit (50) includes a refrigerating/freezing first system side circuit (50A) which is composed of the outdoor unit (10) as the heat source side unit and the refrigerating unit (30) and the freezing unit

(40) as the first user side units and in which refrigerant circulates in one direction and an air conditioning second system side circuit (50B) which is composed of the outdoor unit (10) as the heat source side unit and the indoor unit (20) as the second user side unit and in which the refrigerant circulates in two directions.

<Outdoor unit>

[0047] The outdoor unit (10) includes an inverter compressor (11A) as a first compressor, a first non-inverter compressor (11B) as a second compressor, a second non-inverter compressor (11C) as a third compressor, a first four-way switching valve (12), a second four-way switching valve (13), a third four-way switching valve (14), and an indoor heat exchanger (51) as a heat source side heat exchanger. The outdoor heat exchanger (15) is a fin and tube heat exchanger of cross fin type, for example, and an outdoor fan (16) as a heat source fan is provided in the vicinity thereof.

[0048] Each compressor (11A, 11B, 11C) is a hermetic high-pressure dome type scroll compressor, for example. The inverter compressor (11A) is a variable capacity compressor stepwisely or continuously variable in capacity having a motor under inverter control. The first non-inverter compressor (11B) and the second non-inverter compressor (11C) are fixed capacity compressors each of which motor drives at a given speed of rotation all the time.

[0049] The inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) compose compression mechanisms (11D, 11E) of the refrigerating apparatus (1), wherein the compression mechanisms (11D, 11E) are a first system compression mechanism (11D) and a second system compression mechanism (11E). Specifically, the compression mechanisms (11D, 11E) fall in either of two states in operation. One is that: the inverter compressor (11A) and the first non-inverter compressor (11B) serve as the first system compression mechanism (11D) while the second non-inverter compressor (11C) serves as the second system compression mechanism (11E). The other one is that: the inverter compressor (11A) serves as the first system compression mechanism (11D) while the first non-inverter compressor (11B) and the second non-inverter compressor (11C) serve as the second system compression mechanism (11E). In other words, the inverter compressor (11A) is used for the refrigerating/freezing first system side circuit (50A) fixedly while the second non-inverter compressor (11C) is used for the air conditioning second system side circuit (50B) fixedly, and the first non-inverter compressor (11B) is used for the first system side circuit (50A) and the second system side circuit (50B) by switching.

[0050] Respective discharge pipes (56a, 56b, 56c) of the inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) are connected to one high-pressure gas pipe (dis-

charge pipe) (57). To the discharge pipe (56b) of the first non-inverter compressor (11B) and the discharge pipe (56c) of the second non-inverter compressor (11C), check valves (CV1, CV2) are provided, respectively.

[0051] The high-pressure gas pipe (57) is connected to the first port (P1) of the first four-way switching valve (12). The gas side end of the indoor heat exchanger (15) is connected to the second port (P2) of the first four-way switching valve (12) through an outdoor first gas pipe (58a). The third port (P3) of the first four-way switching valve (12) is connected to the second gas side communication pipe (52) through an outdoor second gas pipe (58b). The fourth port (P4) of the first four-way switching valve (12) is connected to the second four-way switching valve (13).

[0052] The first port (P1) of the second four-way switching valve (13) is connected to the discharge pipe (56c) of the second non-inverter compressor (11C) through an auxiliary gas pipe (59). The second port (P2) of the second four-way switching valve (13) is a closed port. The third port (P3) of the second four-way switching valve (13) is connected to the fourth port (P4) of the first four-way switching valve (12) through a connection pipe (60). The fourth port (P4) of the second four-way switching valve (13) is connected to a suction pipe (61c) of the second non-inverter compressor (11C). The second four-way switching valve (13) includes the closed port as the second port (P2), and therefore, a three-way switching valve may be replaced.

[0053] The first four-way switching valve (12) is switchable between a first state indicated by the solid lines in FIG. 1 and a second state indicated by the broken lines in FIG. 1, wherein the first state is a state in which the first port (P1) communicates with the second port (P2) while the third port (P3) communicates with the fourth port (P4), and the second state is a state in which the first port (P1) communicates with the third port (P3) while the second port (P2) communicates with the fourth port (P4).

[0054] As well, the second four-way switching valve (13) is switchable between a first state indicated by the solid lines in FIG. 1 and a second state indicated by the broken lines in FIG. 1, wherein the first state is a state in which the first port (P1) communicates with the second port (P2) while the third port (P3) communicates with the fourth port (P4), and the second state is a state in which the first port (P1) communicates with the third port (P3) while the second port (P2) communicates with the fourth port (P4).

[0055] The liquid side end of the outdoor heat exchanger (15) is connected to one end of an outdoor liquid pipe (62) as a liquid line. In the middle of the outdoor liquid pipe (62), a receiver (17) is provided for storing liquid refrigerant. The other end of the outdoor liquid pipe (62) is connected to the collection liquid pipe (53) of the liquid side communication pipes (53, 54, 55).

[0056] The receiver (17) is connected to the heat source side heat exchanger (15) and the liquid side com-

munication pipes (53, 54, 55) through a first inflow pipe (63a) allowing the refrigerant from the heat source side heat exchanger (15) to flow therein, a first outflow pipe (63b) allowing the refrigerant to flow out to the liquid side communication pipes (53, 54, 55), a second inflow pipe (63c) allowing the refrigerant from the liquid side communication pipes (53, 54, 55) to flow therein, and a second outflow pipe (63d) allowing the refrigerant to flow out to the outdoor heat exchanger (15)

[0057] A suction pipe (61a) of the inverter compressor (11A) is connected to the first gas side communication pipe (51) through a low-pressure gas pipe (64) of the first system side circuit (50A). A suction pipe (61c) of the second non-inverter compressor (11C) is connected to a low-pressure gas pipe (an outdoor first gas pipe (58a) or an outdoor second gas pipe (58b)) of the second system side circuit (50B) via the first and second four-ways switching valves (12, 13). A suction pipe (61b) of the first non-inverter compressor (11B) is connected to the suction pipe (61a) of the inverter compressor (11A) or the suction pipe (61c) of the second non-inverter compressor (11C) via the third four-way switching valve (14).

[0058] Specifically, a branch pipe (61d) is connected to the suction pipe (61a) of the inverter compressor (11A), and a branch pipe (61e) is connected to the suction pipe (61c) of the second non-inverter compressor (11C). A branch pipe (61d) of the suction pipe (61a) of the inverter compressor (11A) is connected to the first port (P1) of the third four-way switching valve (14) via a check valve (CV3); the suction pipe (61b) of the first non-inverter compressor (11B) is connected to the second port (P2) of the third four-way switching valve (14); and the branch pipe (61e) of the suction pipe (61c) of the second non-inverter compressor (11C) is connected to the third port (P3) of the third four-way switching valve (14) via a check valve (CV4). The check valves (CV3, CV4) respectively provided in the branch pipes (61d, 61e) allows the refrigerant flowing toward the third four-way switching valve (14) to flow while inhibiting the refrigerant from flowing in the reverse direction. The fourth port (P4) of the third four-way switching valve (14) is connected to a high-pressure introduction pipe for introducing high pressure for the refrigerant circuit (50), though not shown.

[0059] The third four-way switching valve (14) is switchable between a first state indicated by the solid lines in FIG. 1 and a second state indicated by the broken lines in FIG. 1, wherein the first state is a state in which the first port (P1) communicates with the second port (P2) while the third port (P3) communicates with the fourth port (P4), and the second state is a state in which the first port (P1) communicates with the fourth port (P4) while the second port (P2) communicates with the third port (P3).

[0060] The first gas side communication pipe (51), the second gas side communication pipe (52), and the collection liquid pipe (53) of the liquid side communication pipes (53, 54, 55) extend from the outdoor unit (10) to the outside, and closing valves (18a, 18b, 18c) are pro-

vided correspondingly thereto in the outdoor unit (10).

[0061] To the outdoor liquid pipe (62), there are connected an auxiliary liquid pipe (65) (the second outflow pipe (63d)) and a liquid branch pipe (66) (the second inflow pipe (63c)) which bypass the receiver (17). Refrigerant flows in the auxiliary liquid pipe (65) mainly in a heating operation, and an outdoor expansion valve (19) is provided therein as an expansion mechanism. The auxiliary liquid pipe (65) is connected at one end thereof between the outdoor heat exchanger (15) and the receiver (17) (in the first inflow pipe (63a)) and is connected at the other end thereof between the receiver (17) and the closing valve (18c). A check valve (CV5) allowing only the refrigerant flowing toward the receiver (17) to flow is provided between the receiver (17) and a connection point of the outdoor liquid pipe (62) to the auxiliary liquid pipe (65) which is located on the outdoor heat exchanger (15) side.

[0062] The liquid branch pipe (66) is provided with, from the closing valve (18c) side in this order, a check valve (CV6) and a relief valve (117). The check valve (CV6) allows only the refrigerant flowing from the closing valve (18c) toward the receiver (17) to flow. The relief valve (117) automatically opens when the refrigerant pressure working thereon becomes a predetermined pressure (1.5 MPa, for example) while on the other hand maintaining the state in which the liquid branch pipe (66) is closed until it exceeds the predetermined pressure. The liquid branch pipe (66) is connected at one end thereof between the check valve (CV5) and the receiver (17) and is connected at the other end thereof between the closing valve (18c) and a connection point of the outdoor liquid pipe (62) to the auxiliary liquid pipe (65) which is located on the closing valve (18c) side.

[0063] In the outdoor liquid pipe (62), a check valve (CV7) is provided in the first outflow pipe (63b) between a connection point to the auxiliary liquid pipe (65) which is located on the closing valve (18c) side and a connection point to the liquid branch pipe (66) which is located on the closing valve (18c) side. The check valve (CV7) allows only the refrigerant flowing from the receiver (17) toward the closing valve (18c) to flow.

[0064] Between the receiver (17) and the check valve (CV5) in the outdoor liquid pipe (62), one end of a hot gas bypass pipe (71) as an introduction pipe is connected. The hot gas bypass pipe (71) is connected at the other end thereof between the closing valve (18b) of the outdoor second gas pipe (58b) and the first four-way switching valve (12), and a solenoid valve (SV1) is provided in the middle thereof. The hot gas bypass pipe (71) and the solenoid valve (SV1) compose a refrigerant return mechanism (5) in the present invention.

[0065] To the liquid branch pipe (66), a liquid injection pipe (67) is connected of which one end is connected to a connection part between the suction pipe (61a) and the low-reassure gas pipe (64). The other end of the injection pipe (67) is connected between the check valve (CV6) and the relief valve (117). The liquid injection pipe (67)

is provided with a motor-operated expansion valve (67a) for flow rate adjustment.

<Indoor unit>

[0066] The indoor unit (20) includes an indoor heat exchanger (an air conditioning heat exchanger) (21) as a second user side heat exchanger and an indoor expansion valve (22) as an expansion mechanism. On the gas side of the indoor heat exchanger (21), the second gas side communication pipe (52) is connected. On the other hand, on the liquid side thereof, the second branch liquid pipe (55) of the liquid side communication pipes (53, 54, 55) is connected via the indoor expansion valve (22). The indoor heat exchanger (21) is a fin and tube heat exchanger of cross fin type, for example, and an indoor fan (23) as a user side fan is provided in the vicinity thereof. The indoor expansion valve (22) is a motor-operated expansion valve.

<Refrigerating unit>

[0067] The refrigerating unit (30) includes a refrigerating heat exchanger (31) as a first user side heat exchanger and a refrigerating expansion valve (32) as an expansion mechanism. On the liquid side of the refrigerating heat exchanger (31), the first branch liquid pipe (54) (the refrigerating side first branch liquid pipe (54a)) of the liquid side communication pipes (53, 54, 55) is connected via a solenoid valve (SV2) and the refrigerating expansion valve (32). The solenoid valve (SV2) is used for stopping refrigerant flow in a thermo-off operation (operation stop). On the other hand, the refrigerating heat exchanger (31) is connected on the gas side thereof to a refrigerating side branch gas pipe (51a) branching from the first gas side communication pipe (51).

[0068] The refrigerating heat exchanger (31) communicates with the suction side of the inverter compressor (11A), and the indoor heat exchanger (21) communicates with the suction side of the second non-inverter compressor (11C) in a cooling operation. The refrigerant pressure (evaporation pressure) in the refrigerating heat exchanger (31) is lower than the refrigerant pressure (evaporation pressure) in the indoor heat exchanger (21). Specifically, the refrigerant evaporation temperature in the refrigerating heat exchanger (31) is -10°C, for example, while the refrigerant evaporation temperature in the indoor heat exchanger (21) is +5°C, for example so that the refrigerant circuit (50) serves as a plural-evaporation-temperature circuit.

[0069] The refrigerating expansion valve (32) is a temperature sensing expansion valve and includes a temperature sensing cylinder mounted on the gas side of the refrigerating heat exchanger (31). Accordingly, the opening of the refrigerating expansion valve (32) is adjusted on the basis of the temperature of the refrigerant at the outlet of the refrigerating heat exchanger (31). The refrigerating heat exchanger (31) is a fin and tube heat

exchanger of cross fin type, and a refrigerating fan (33) as a cooling fan is provided in the vicinity thereof.

<Freezing unit>

[0070] The freezing unit (40) includes a freezing heat exchanger (41) as a first user side heat exchanger, a freezing expansion valve (424) as an expansion mechanism, and a booster compressor (43) as a freezing compressor. The liquid side of the freezing heat exchanger (41) is connected to the first branch liquid pipe (54) (the freezing side first branch liquid pipe (54b)) of the liquid side communication pipes (53, 54, 55) via a solenoid valve (SV3) and the freezing expansion valve (42).

[0071] The gas side of the freezing heat exchanger (41) and the suction side of the booster compressor (43) are connected to each other by means of a connection gas pipe (68). The discharge side of the booster compressor (43) is connected to a freezing side branch gas pipe (51b) branching from the first gas side communication pipe (51). The freezing side branch gas pipe (51b) is provided with a check valve (CV8) and an oil separator (44). An oil return pipe (69) including a capillary tube (45) is connected between the oil separator (44) and the connection gas pipe (68).

[0072] The booster compressor (43) compresses the refrigerant in two stages in combination with the first system compression mechanism (11D) so that the refrigerant evaporation temperature in the freezing heat exchanger (41) is lower than that in the refrigerating heat exchanger (31). The refrigerant evaporation temperature of the freezing heat exchanger (41) is set at -35 °C, for example.

[0073] The freezing expansion valve (42) is a temperature sensing expansion valve and includes a temperature sensing cylinder mounted on the gas side of the refrigerating heat exchanger (31). The freezing heat exchanger (41) is a fin and tube type heat exchanger of cross fin type, for example, and a freezing fan (46) as a cooling fan is provided in the vicinity thereof.

[0074] A bypass pipe (70) including a check valve (CV9) is connected between the connection gas pipe (68) located on the suction side of the booster compressor (43) and a part of the freezing side branch gas pipe (51b) between the oil separator (44) and the check valve (CV8). The bypass pipe (70) is so composed that the refrigerant bypasses the booster compressor (43) when the booster compressor (43) is sopped due to disorder or the like.

<Control system>

[0075] The refrigerant circuit (50) is provided with various kinds of sensors and switches. The high-pressure gas pipe (57) of the outdoor unit (10) is provided with a high-pressure pressure sensor (75) for detecting the pressure of high-pressure refrigerant and a discharge side temperature sensor (76) for detecting the temperature of the high-pressure refrigerant.

The discharge pipe (56c) of the second non-inverter compressor (11C) is provided with a discharge side temperature sensor (77) for detecting the temperature of the high-pressure refrigerant. Pressure switches (78) for high pressure protection which open when the pressure of the high-pressure refrigerant becomes a predetermined value to stop the corresponding compressors (11A, 11B, 11C) are provided at the inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C).

[0076] In the suction pipes (61a, 61c) of the inverter compressor (11A) and the second non-inverter compressor (11C), there are provided respective low-pressure sensors (79, 80) for detecting the pressure of low-pressure refrigerant and respective suction side temperature sensors (81, 82) for detecting the temperature of the low-pressure refrigerant. The low-pressure pressure sensor (79) and the suction side temperature sensor (81) of the inverter compressor (11A) compose suction side superheat detection means in the present invention.

[0077] The outdoor heat exchanger (15) is provided with an outdoor heat exchange sensor (83) for detecting the evaporation temperature or the condensation temperature of the refrigerant as the refrigerant temperature in the outdoor heat exchanger (15). The outdoor unit (10) is provided with an outdoor air temperature sensor (84) for detecting the outdoor air temperature.

[0078] The indoor heat exchanger (21) is provided with an indoor heat exchange sensor (85) for detecting the condensation temperature or the evaporation temperature of the refrigerant as the refrigerant temperature in the indoor heat exchanger (21) and a gas temperature sensor (86) on the gas side for detecting the temperature of the gas refrigerant. The indoor unit (20) is provided with a room temperature sensor (87) for detecting the indoor air temperature.

[0079] The refrigerating unit (30) is provided with a refrigeration temperature sensor (88) for detecting the inside temperature of the refrigerated showcase. The freezing unit (40) is provided with a freezing temperature sensor (89) for detecting the inside temperature of the frozen showcase. On the discharge side of the booster compressor (43), a pressure switch (90) for high pressure protection is provided which opens when the pressure of the discharged refrigerant becomes a predetermined value to stop the compressor (43).

[0080] Output signals from each sensor and each switch are input to a controller (95) as control means. The controller (95) controls the operation of the refrigerant circuit (50) by switching eight kinds of operation modes, which will be described later. The controller (95) performs, in operation, control for activation, stop, and capacity adjustment of the inverter compressor (11A), control for activation and stop of the first non-inverter compressor (11B) and the second non-inverter compressor (11C), and control for opening adjustment of the outdoor expansion valve (19) and the indoor expansion valve (22), and performs, in addition, control for switching

of each four-way switching valve (12, 13, 14) and control for opening adjustment of the liquid injection pie (67) and the motor-operated expansion valve (67a).

[0081] Further, the controller (95) controls opening/closing of the solenoid valve (SV1) of the hot gas bypass pipe (71) in a first heating/freezing operation, which will be described later. Specifically, the following control is performed in the first heating/freezing operation where a refrigerant circulation path is formed in which the refrigerant sent out from the compression mechanism (11D) flows from the indoor unit (20) as the second user side unit to the refrigerating unit (30) and the freezing unit (40) as the first user side units and is then returned to the compression mechanism (11D).

[0082] First, the controller (95) detects the degree of superheat of the refrigerant flowing from the refrigerating heat exchanger (31) and the freezing heat exchanger (41) as the first user side heat exchangers toward the suction side of the compression mechanism (11D) with the use of the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81). When the detected degree of superheat is equal to or larger than a predetermined value, the controller (95) opens the solenoid valve (SV1). Or, when the detected degree thereof is smaller than a predetermined value, it closes the solenoid valve (SV1).

[0083] The controller (95) judges from the degree of superheat of the refrigerant sucked to the compression mechanism (11D) whether or not the refrigerant is short in the refrigerating heat exchanger (31) and the freezing heat exchanger (41) as the first user side heat exchangers. When the controller (95) judges that the refrigerant is short in the refrigerating heat exchanger (31) and the freezing heat exchanger (41), the controller (95) opens the solenoid valve (SV1) for returning the refrigerant in the receiver (17) to the circulation path.

-Driving operation-

[0084] Each driving operation that the refrigerating apparatus (1) performs will be described next. In Embodiment 1, eight operation modes can be set. Specifically, the apparatus (1) can be set to: (i) a cooling operation for performing only cooling by the indoor unit (20); (ii) a freezing operation for performing only cooling by the refrigerating unit (30) and the freezing unit (40); (iii) a first cooling/freezing operation for simultaneously performing cooling by the indoor unit (20) and cooling by the refrigerating unit (30) and the freezing unit (40); (iv) a second cooling/freezing operation as an operation performed when the cooling capacity of the indoor unit (20) is short in the first cooling/freezing operation; (v) a heating operation for performing only heating by the indoor unit (20); (vi) a first heating/freezing operation for performing heating by the indoor unit (20) and cooling by the refrigerating unit (30) and the freezing unit (40) through a 100% heat recovery operation without using the outdoor heat exchanger (15); (vii) a second heating/freezing operation

performed when the heating capacity of the indoor unit (20) is surplus in the first heating/freezing operation; and (viii) a third heating/freezing operation performed when the heating capacity of the indoor unit (20) is short in the first heating/freezing operation.

[0085] Each driving operation will be described below specifically.

<Cooling operation>

[0086] The cooling operation is an operation for performing only cooling by the indoor unit (20). In the cooling operation, as shown in FIG. 2, the inverter compressor (11A) serves as the first system compressor mechanism (11D) while the first non-inverter compressor (11B) and the second non-inverter compressor (11C) serve as the second system compression mechanism (11E). Only the first non-inverter compressor (11B) and the second non-inverter compressor (11C) as the second system compression mechanism (11E) are driven.

[0087] Further, as indicated by the solid lines in FIG. 2, the first four-way switching valve (12) and the second four-way switching valve (13) are switched to the first state while the third four-way switching valve (14) is switched to the second state. All of the outdoor expansion valve (19), the motor-operated expansion valve (67a) of the liquid injection pipe (67), the solenoid valve (SV1) of the hot gas bypass pipe (71), the solenoid valve (SV2) of the refrigerating unit (30), and the solenoid valve (SV3) of the freezing unit (40) are closed.

[0088] In this state, the refrigerant discharged from the first non-inverter compressor (11B) and the second non-inverter compressor (11C) flows from the first four-way switching valve (12) through the outdoor first gas pipe (58a) into the outdoor heat exchanger (15) to be condensed. The thus condensed refrigerant flows through the outdoor liquid pipe (62), the receiver (17), the collection liquid pipe (53), and the second branch pipe (55) of the liquid side communication pipes (53, 54, 55), and then flows via the indoor expansion valve (22) into the indoor heat exchanger (21) to be evaporated. The thus evaporated gas refrigerant flows from the second gas side communication pipe (52) through the outdoor second gas pipe (58b), the first four-way switching valve (12), and the second four-way switching valve (13) into the suction pipe (61c) of the second non-inverter compressor (11C). Part of this low-pressure gas refrigerant is returned to the second non-inverter compressor (11C). On the other hand, the other gas refrigerant branches from the suction pipe (61c) of the second non-inverter compressor (11C) into the branch pipe (61e) and flows via the third four-way switching valve (14) to be returned to the first non-inverter compressor (11B). Repetition of this refrigerant circulation cools the inside of the store.

[0089] Under this driving operation, activation and stop of the first non-inverter compressor (11B) and the second non-inverter compressor (11C) and the opening of the indoor expansion valve (22) and the like are controlled

according to the indoor cooling load. Only one of the compressors (11B, 11C) may be driven.

<Freezing operation>

[0090] The freezing operation is an operation for performing only cooling by the refrigerating unit (30) and the freezing unit (40). In the freezing operation, as shown in FIG. 3, the inverter compressor (11A) and the first non-inverter compressor (11B) serve as the first system compression mechanism (11D) while the second non-inverter compressor (11C) serves as the second system compression mechanism (11E). The inverter compressor (11A) and the first non-inverter compressor (11B) as the first system compression mechanism (11D) are driven, and the booster compressor (43) is driven in addition with the second non-inverter compressor (11C) stopped.

[0091] The first four-way switching valve (12), the second four-way switching valve (13), and the third four-way switching valve (14) are switched to the first state, as indicated by the solid lines in FIG. 3. Further, the solenoid valve (SV2) of the refrigerating unit (30) and the solenoid valve (SV3) of the freezing unit (40) are opened while the solenoid valve (SV1) of the hot gas bypass pipe (71), the outdoor expansion valve (19), and the indoor expansion valve (22) are closed. The motor-operated expansion valve (67a) of the liquid injection pipe (67) is set to be closed fully or set at a predetermined opening so as to allow the liquid refrigerant to flow at a predetermined flow rate according to the driving condition.

[0092] In this state, the refrigerant discharged from the inverter compressor (11A) and the first non-inverter compressor (11B) flows from the first four-way switching valve (12) through the outdoor first gas pipe (58a) into the outdoor heat exchanger (15) to be condensed. The thus condensed refrigerant flows through the outdoor liquid pipe (62), the receiver (17), and the collection liquid pipe (53) of the liquid side communication pipes (53, 54, 55) and then branches into the refrigerating side first branch liquid pipe (54a) and the freezing side first branch liquid pipe (54b).

[0093] The liquid refrigerant flowing in the refrigerating side first branch liquid pipe (54a) flows via the refrigerating expansion valve (32) into the refrigerating heat exchanger (31) to be evaporated and then flows into the refrigerating side branch gas pipe (51a). On the other hand, the refrigerant flowing in the freezing side first branch liquid pipe (54b) flows via the freezing expansion valve (42) into the freezing heat exchanger (41) to be evaporated. The gas refrigerant thus evaporated in the freezing heat exchanger (41) is sucked into and compressed in the booster compressor (43) and is then discharged to the freezing side branch gas pipe (51b).

[0094] The gas refrigerant evaporated in the refrigerating heat exchanger (31) and the gas refrigerant discharged from the booster compressor (43) interflow in the first gas side communication pipe (51), flow through the low-pressure gas pipe (64), and is then returned to

the inverter compressor (11A) and the first non-inverter compressor (11B). Repetition of the above refrigerant circulation cools each inside of the refrigerated showcase and the frozen showcase.

[0095] The pressure of the refrigerant in the freezing heat exchanger (41), which is sucked to the booster compressor (43), is lower than the that in the refrigerating heat exchanger (31). As a result, for example, the refrigerant temperature (evaporation temperature) in the freezing heat exchanger (41) is -35°C while the refrigerant temperature (evaporation temperature) in the refrigerating heat exchanger (31) is -10 °C.

[0096] In the freezing operation, activation and stop of the first non-inverter compressor (11B) and activation and stop or capacity control of the inverter compressor (11A) are performed on the basis of the low-pressure refrigerant pressure (LP) that the low-pressure pressure sensor (79) detects to perform the operation according to the freezing load.

[0097] For example, in order to perform control for increasing the capacity of the compression mechanism (11D), the inverter compressor (11A) is driven first with the first non-inverter compressor (11B) stopped. When the load of the inverter compressor (11A) is further increased after the load reaches the maximum capacity, the first non-inverter compressor (11B) is driven and the capacity of the inverter compressor (11A) is reduced to the minimum capacity. When the load is further increased thereafter, the capacity of the inverter compressor (11A) is increased with the first non-inverter compressor (11B) driven. Control for decreasing the capacities of the compressors are performed in the reverse operation to this capacity increasing control.

[0098] Each opening of the refrigerating expansion valve (32) and the freezing expansion valve (42) is under superheat control by a temperature sensitive cylinder. This is applied to each of the following operations.

<First cooling/freezing operation>

[0099] The first cooling/freezing operation is an operation for simultaneously performing cooling by the indoor unit (20) and cooling by the refrigerating unit (30) and the freezing unit (40). In the first cooling/freezing operation, as shown in FIG. 4, the inverter compressor (11A) and the first non-inverter compressor (11B) serve as the first system compression mechanism (11D) while the second non-inverter compressor (11C) serves as the second system compression mechanism (11E). The inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) are driven, and the booster compressor (43) is driven in addition.

[0100] The first four-way switching valve (12), the second four-way switching valve (13), and the third four-way switching valve (14) are switched to the first state, as indicated by the solid lines in FIG. 4. The solenoid valve (SV2) of the refrigerating unit (30) and the solenoid valve

(SV3) of the freezing unit (40) are opened while the solenoid valve (SV1) of the hot gas bypass pipe (71) and the outdoor expansion valve (19) are closed. The motor-operated expansion valve (67a) of the liquid injection pipe (67) is set to be closed fully or set at a predetermined opening so as to allow the liquid refrigerant to flow at a predetermined flow rate to the suction side of the compression mechanism (11D) according to the driving condition.

[0101] In this state, the refrigerant discharged from the inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) interflows in the high-pressure gas pipe (57), flows from the first four-way switching valve (12) through the outdoor first gas pipe (58a) into the outdoor heat exchanger (15) to be condensed. The thus condensed refrigerant flows through the outdoor liquid pipe (62) and the receiver (17) into the collection liquid pipe (53) of the liquid side communication pipes (53, 54, 55).

[0102] Part of the liquid refrigerant flowing in the collection liquid pipe (53) of the liquid side communication pipes (53, 54, 55) branches into the second branch liquid pipe (55) and flows via the indoor expansion valve (22) into the indoor heat exchanger (21) to be evaporated.

The thus evaporated gas refrigerant flows from the second gas side communication pipe (52) through the outdoor second gas pipe (58b), the first four-way switching valve (12), and the second four-way switching valve (13) into the suction pipe (61c) and is then returned to the second non-inverter compressor (11C).

[0103] On the other hand, the liquid refrigerant flowing in the collection liquid pipe (53) of the liquid side communication pipes (53, 54, 55) branches into the refrigerating side first branch liquid pipe (54a) and the freezing side first branch liquid pipe (54b). The liquid refrigerant flowing in the refrigerating side first branch liquid pipe (54a) flows via the refrigerating expansion valve (32) into the refrigerating heat exchanger (31) to be evaporated and then flows into the refrigerating side branch gas pipe (51a).

The liquid refrigerant flowing in the freezing side first branch liquid pipe (54b) flows via the freezing expansion valve (42) into the freezing heat exchanger (41) to be evaporated. The gas refrigerant thus evaporated in the freezing heat exchanger (41) is sucked into and compressed in the booster compressor (43) and is then discharged to the freezing side branch gas pipe (51b).

[0104] The gas refrigerant evaporated in the refrigerating heat exchanger (31) and the gas refrigerant discharged from the booster compressor (43) interflow in the first gas side communication pipe (51), flows through the low-pressure gas pipe (64), and is then returned to the inverter compressor (11A) and the first non-inverter compressor (11B).

[0105] Repetition of the above refrigerant circulation cools the inside of the store and cools each inside of the refrigerated showcase and the frozen showcase.

<Second cooling/freezing operation>

[0106] The second cooling/freezing operation is an operation performed in the case where the cooling capacity of the indoor unit (20) is short in the first cooling/freezing operation and an operation in which the first non-inverter compressor (11B) is switched for air conditioning. The state in the second cooling/freezing operation is basically the same as that in the first cooling/freezing operation, as shown in FIG. 5, wherein the third four-way switching valve (14) is switched to the second state unlike the first cooling/freezing operation.

[0107] Accordingly, in the second cooling/freezing operation, the refrigerant discharged from the inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) is condensed in the outdoor heat exchanger (15) while being evaporated in the indoor heat exchanger (21), the refrigerating heat exchanger (31), and the freezing heat exchanger (41), similarly to that in the first cooling/freezing operation.

[0108] Then, the refrigerant evaporated in the indoor heat exchanger (21) is returned to the first non-inverter compressor (11B) and the second non-inverter compressor (11C) while the refrigerant evaporated in the refrigerating heat exchanger (31) and the freezing heat exchanger (41) is returned to the inverter compressor (11A). With the use of the two compressors (11B, 11C) for air conditioning, the shortage of the cooling capacity is supplemented.

<Heating operation>

[0109] The heating operation is an operation for performing only heating by the indoor unit (20). In the heating operation, as shown in FIG. 6, the inverter compressor (11A) serves as the first system compression mechanism (11D) while the first non-inverter compressor (11B) and the second non-inverter compressor (11C) serve as the second system compression mechanism (11E). Only the first non-inverter compressor (11B) and the second non-inverter compressor (11C) as the second system compression mechanism (11E) are driven.

[0110] Further, as indicated by the solid lines in FIG. 6, the first four-way switching valve (12) is switched to the second state, the second four-way switching valve (13) is switched to the first state, and third four-way switching valve (14) is switched to the second state. The motor-operated expansion valve (67a) of the liquid injection pipe (67), the solenoid valve (SV1) of the hot gas bypass pipe (71), the solenoid valve (SV2) of the refrigerating unit (30), and the solenoid valve (SV3) of the freezing unit (40) are closed. The indoor expansion valve (22) is opened fully while the outdoor expansion valve (19) is controlled to be opened at a predetermined opening.

[0111] In this state, the refrigerant discharged from the first non-inverter compressor (11B) and the second non-

inverter compressor (11C) flows from the first four-way switching valve (12) through the outdoor second gas pipe (58b) and the second gas side communication pipe (52) into the indoor heat exchanger (21) to be condensed. The thus condensed liquid refrigerant flows from the second branch liquid pipe (55) of the liquid side communication pipes (53, 54, 55) into the collection liquid pipe (53), passes through the liquid branch pipe (66), and then flows into the receiver (17). Thereafter, the liquid refrigerant flows via the outdoor expansion valve (19) of the auxiliary liquid pipe (65) into the outdoor heat exchanger (15) to be evaporated. The thus evaporated gas refrigerant flows from the outdoor first gas pipe (58a) via the first four-way switching valve (12) and the second four-way switching valve (13) into the suction pipe (61c) of the second non-inverter compressor (11C) and is then returned to the first non-inverter compressor (11B) and the second non-inverter compressor (11C). Repetition of the above refrigerant circulation heats indoors.

[0112] Similarly to the cooling operation, the above operation can be performed by only one compressor (11B, 11C).

<First heating/freezing operation>

[0113] The first heating/freezing operation is a 100% heat recovery operation for performing heating by the indoor unit (20) and cooling by the refrigerating unit (30) and the freezing unit (40) without using the outdoor heat exchanger (15). In the first heating/freezing operation, as shown in FIG. 7, the inverter compressor (11A) and the first non-inverter compressor (11B) serve as the first system compression mechanism (11D) while the second non-inverter compressor (11C) serves as the second system compression mechanism (11E). The inverter compressor (11A) and the first non-inverter compressor (11B) are driven, and the booster compressor (43) is driven in addition with the second non-inverter compressor (11C) stopped.

[0114] Further, as indicated by the solid lines in FIG. 7, the first four-way switching valve (12) is switched to the second state while the second four-way switching valve (13) and the third four-way switching valve (14) are switched to the first state. The solenoid valve (SV2) of the refrigerating unit (30) and the solenoid valve (SV3) of the freezing unit (40) are opened while the outdoor expansion valve (19) is closed. Opening/closing of the solenoid valve (SV1) of the hot gas bypass pipe (71) is controlled on the basis of the degree of superheat of the refrigerant flowing in the suction pipe (61a) which is detected from the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81). Opening/closing of the motor-operated expansion valve (67a) of the liquid injection pipe (67) is controlled on the basis of the above degree of superheat and the detection value of the discharge side temperature sensor (76).

[0115] In this state, the refrigerant discharged from the

inverter compressor (11A) and the first non-inverter compressor (11B) flows from the first four-way switching valve (12) through the outdoor second gas pipe (58b) and the second gas side communication pipe (52) into the indoor heat exchanger (21) to be condensed. The thus condensed liquid refrigerant flows from the second branch liquid pipe (55) of the liquid side communication pipe (53, 54, 55) and branches into the refrigerating side first branch liquid pipe (54a) and the freezing side first branch liquid pipe (54b) at a point before the collection liquid pipe (53).

[0116] The liquid refrigerant flowing in the refrigerating side first branch liquid pipe (54a) flows via the refrigerating expansion valve (32) into the refrigerating heat exchanger (31) to be evaporated and then flows into the refrigerating side branch gas pipe (51a). On the other hand, the liquid refrigerant flowing in the freezing side first branch liquid pipe (54b) flows via the freezing expansion valve (42) into the freezing heat exchanger (41) to be evaporated. The gas refrigerant thus evaporated in the freezing heat exchanger (41) is sucked into and compressed in the booster compressor (43) and is then discharged to the freezing side branch gas pipe (51b).

[0117] The gas refrigerant evaporated in the refrigerating heat exchanger (31) and the gas refrigerant discharged from the booster compressor (43) interflow in the first gas side communication pipe (51), flow through the low-pressure gas pipe (64), and is then returned to the inverter compressor (11A) and the first non-inverter compressor (11B). Repetition of the above refrigerant circulation heats the inside of the store while cooling each inside of the refrigerated showcase and the frozen showcase. During the first heating/freezing operation, the 100% heat recovery is performed in such a manner that the cooling capacities (evaporation heat) of the refrigerating unit (30) and the freezing unit (40) balance the heating capacity (condensation heat) of the indoor unit (20). In this first heating/freezing operation, the refrigerant circulation path is formed in which the refrigerant sent out from the compression mechanisms (11D) flows from the indoor unit (20) to the refrigerating unit (30) and the freezing unit (40) and is then returned to the compression mechanism (11D). In this circulation path, the refrigerant condensed in the indoor unit (20) flows directly into the refrigerating unit (30) and the freezing unit (40) without being returned to the outdoor unit (10).

[0118] During the first heating/freezing operation, the relief valve (117) is closed. In so doing, the pressure in the liquid side communication pipes (53, 54, 55) may be increased so high that the refrigerant pressure working on the relieve valve (117) exceeds a predetermined pressure (1.5 MPa, for example) to open the relief valve (117). Even if the relief valve (117) is closed, refrigerant leakage may occur. In these cases, the refrigerant in the circulation path flows from the collection liquid pipe (53) through the liquid branch pipe (66) into the receiver (17) to decrease the refrigerant in the circulation path. When the refrigerant in the circulation path is decreased, the flow

rate of the refrigerant decreases gradually in the refrigerating heat exchanger (31) and the freezing heat exchanger (41), so that the region where the refrigerant in a liquid-vapor two-phase state flows decreases while the region where the single-phase gas refrigerant flows increases. Hence, the degree of superheat of the refrigerant flowing out from the refrigerating heat exchanger (31) and the freezing heat exchanger (41) toward the compression mechanism (11D) increases gradually.

[0119] The controller (95) opens the solenoid valve (SV1) when the degree of superheat of the refrigerant flowing in the suction pipe (61a) which is detected on the basis of the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81) is equal to or larger than a predetermined value. When the solenoid valve (SV1) is opened, the high-pressure gas refrigerant discharged from the compression mechanism (11D) is introduced into the receiver (17) through the hot gas bypass pipe (71), as shown in FIG. 8, to increase the inner pressure of the receiver (17). This pushes out the liquid refrigerant in the receiver (17) forcedly to return the liquid refrigerant to the circulation path through the collection liquid pipe (53). The gas refrigerant is supplied from the circulation path to the receiver (17), from which the liquid refrigerant is pushed out. As a result, the refrigerant in the receiver (17) decreases while the refrigerant in the circulation path increases. This prevents refrigerant shortage in the refrigerating unit (30) and the freezing unit (40) to avoid lowering of the cooling capacities of the refrigerating unit (30) and the freezing unit (40).

[0120] Further, when the liquid refrigerant in the receiver (17) is returned to the circulation path to increase the refrigerant in the circulation path, the degree of superheat of the refrigerant flowing in the suction pipe (61a) decreases gradually. The controller (95) closes the solenoid valve (SB1) when the degree of superheat of the refrigerant which is detected on the basis of the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81) is lower than a predetermined value.

<Second heating/freezing operation>

[0121] The second cooling/freezing operation is an operation performed when the heating capacity of the indoor unit (20) is surplus in the first heating/freezing operation. In the second heating/freezing operation, as shown in FIG. 9, the inverter compressor (11A) and the first non-inverter compressor (11B) serve as the first system compression mechanism (11D) while the second non-inverter compressor (11C) serves as the second system compression mechanism (11E). The inverter compressor (11A) and the first non-inverter compressor (11B) are driven, and the booster compressor (43) is driven in addition with the second non-inverter compressor (11C) stopped.

[0122] The second heating/freezing operation is the

same as the first heating/freezing operation in setting of the valves and the like except that the second four-way switching valve (13A) is switched to the second state, as indicated by the solid lines in FIG. 9.

[0123] Accordingly, part of the refrigerant discharged from the inverter compressor (11A) and the first non-inverter compressor (11B) flows into the indoor heat exchanger (21) to be condensed, similarly to that in the first heating/freezing operation. The thus condensed liquid refrigerant flows from the second branch liquid pipe (55) of the liquid side communication pipes (53, 54, 55) into the first branch liquid pipe (54) (the refrigerating side first branch liquid pipe (54a) and the freezing side first branch liquid pipe (54b)) at a point before the collection liquid pipe (53).

[0124] On the other hand, the other refrigerant discharged from the inverter compressor (11A) and the first non-inverter compressor (11B) flows from the auxiliary gas pipe (59) via the second four-way switching valve (13) and the first four-way switching valve (12) to the outdoor first gas pipe (58a) and flows into the outdoor heat exchanger (15) to be condensed. The thus condensed liquid refrigerant passes through the receiver (17) when flowing into the outdoor liquid pipe (62), flows through the collection liquid pipe (62) of the liquid side communication pipes (51, 54, 55) into the first branch liquid pipe (54) (the refrigerating side first branch liquid pipe (54a) and the freezing side first branch liquid pipe (54b)), and then interflows with the refrigerant from the second branch liquid pipe (55).

[0125] Thereafter, the liquid refrigerant flowing in the refrigerating side first branch liquid pipe (54a) flows into the refrigerating heat exchanger (31) to be evaporated and then flows into the refrigerating side branch gas pipe (51a). The liquid refrigerant flowing in the freezing side first branch liquid pipe (54b) flows into the freezing heat exchanger (41) to be evaporated, is sucked into and compressed in the booster compressor (43), and is then discharged to the freezing side branch gas pipe (51b). The gas refrigerant evaporated in the refrigerating heat exchanger (31) and the gas refrigerant discharged from the booster compressor (43) interflow in the first gas side communication pipe (51), flows through the low-pressure gas pipe (64), and is then returned to the inverter compressor (11A) and the first non-inverter compressor (11B).

[0126] In the second heating/freezing operation, repetition of the above refrigerant circulation heats the inside of the store while cooling each inside of the refrigerated showcase and the frozen showcase. In this operation, the cooling capacities (evaporation heat) of the refrigerating unit (30) and the freezing unit (40) do not balance the heating capacity (condensation heat) of the indoor unit (20), so that the surplus condensation heat is released outdoors in the outdoor heat exchanger (15).

<Third heating/freezing operation>

[0127] The third heating/freezing operation is an operation performed when the heating capacity of the indoor unit (20) is short in the first heating/freezing operation. In the third heating/freezing operation, as shown in FIG. 10, the inverter compressor (11A) and the first non-inverter compressor (11B) serve as the first system compression mechanism (11D) while the second non-inverter compressor (11C) serves as the second system compression mechanism (11E). The inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) are driven, and the booster compressor (43) is driven in addition.

[0128] The third heating/freezing operation is the same in setting as the first heating/freezing operation except that: the opening of the outdoor expansion valve (19) is controlled; the solenoid valve (SV1) is closed under no opening/closing control; and the second non-inverter compressor (11C) is driven.

[0129] Accordingly, the refrigerant discharged from the inverter compressor (11A), the first non-inverter compressor (11B), and the second non-inverter compressor (11C) flows through the second gas side communication pipe (52) into the indoor heat exchanger (21) to be condensed, similarly to that in the first heating/freezing operation. The thus condensed liquid refrigerant branches from the second branch liquid pipe (55) of the liquid side communication pipes (53, 54, 55) into the first branch liquid pipe (54) (the refrigerating side first branch liquid pipe (54a) and the freezing side first branch liquid pipe (54b)) and the collection liquid pipe (53).

[0130] The liquid refrigerant flowing in the refrigerating side first branch liquid pipe (54a) flows into the refrigerating heat exchanger (31) to be evaporated and then flows into the refrigerating side branch gas pipe (51a). The refrigerant flowing in the freezing side first branch liquid pipe (54b) flows into the freezing heat exchanger (41) to be evaporated, is sucked into and compressed in the booster compressor (43), and is then discharged to the freezing side branch gas pipe (51b). The gas refrigerant evaporated in the refrigerating heat exchanger (31) and the gas refrigerant discharged from the booster compressor (43) interflow in the first gas side communication pipe (51), flow through the low-pressure gas pipe (64), and are then returned to the inverter compressor (11A) and the first non-inverter compressor (11B).

[0131] On the other hand, the liquid refrigerant having condensed in the indoor heat exchanger (21) and flowing in the collection liquid pipe (53) flows through the liquid branch pipe (66) into the receiver (17) and then flows via the outdoor expansion valve (19) into the outdoor heat exchanger (15) to be evaporated. The thus evaporated gas refrigerant flows into the outdoor first gas pipe (58a), flows via the first four-way switching valve (12) and the second four-way switching valve (13) into the suction pipe (61c) of the second non-inverter compressor (11C), and is then returned to the second non-inverter compressor (11C).

sor (11C).

[0132] In the third heating/freezing operation, repetition of the above refrigerant circulation heats the inside of the store while cooling each inside of the refrigerated showcase and the frozen showcase. In this operation, the cooling capacities (evaporation heat) of the refrigerating unit (30) and the freezing unit (40) do not balance the heating capacity (condensation heat) of the indoor unit (20), so that the short evaporation heat is obtained from the outdoor heat exchanger (15).

-Effects of Embodiment 1-

[0133] In Embodiment 1, in the first heating/freezing operation in which the circulation path of which the refrigerant decreases when the refrigerant flows into the receiver (17) is formed, the solenoid valve (SV1) of the hot gas bypass pipe (71) is opened to return the liquid refrigerant in the receiver (17) to the circulation path. When the liquid refrigerant in the receiver (17) is returned to the circulation path, the refrigerant flowing in the indoor unit (20), the refrigerating unit (30), and the freezing unit (40) as the user side units increases. Namely, the liquid refrigerant in the receiver (17) is returned to the circulation path by the refrigerant return mechanism (5) before the refrigerant is short in the user side units (20, 30, 40), thereby preventing the refrigerant in the user side units (20, 30, 40) from being short.

[0134] In addition, in Embodiment 1, in view of the fact that whether or not the refrigerant in the refrigerating unit (30) and the freezing unit (40) is short can be judged from the degree of superheat of the refrigerant flowing from the refrigerating heat exchanger (31) and the freezing heat exchanger (41) toward the suction side of compression mechanism (11D), the solenoid valve (SV1) of the hot gas bypass pipe (71) is controlled on the basis of the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81). Accordingly, the liquid refrigerant in the receiver (17) can be returned to the circulation path at an appropriate timing before the refrigerant is short in the refrigerating unit (30) and the freezing unit (40). This prevents the cooling capacities of the refrigerating unit (30) and the freezing unit (4) from lowering definitely.

<Embodiment 2 of the Invention>

[0135] Embodiment 2 of the present invention will be described. FIG. 11 is a diagram showing a refrigerant circuit of a refrigerating apparatus (1) in accordance with Embodiment 2. The refrigerating apparatus (1) of Embodiment 2 is different from that of Embodiment 1 in the point that neither the hot gas bypass pipe (71) nor the solenoid valve (SV1) is provided, wherein the second four-way switching valve (13) as a communication mechanism serves as the refrigerant return mechanism (5).

[0136] Description will given to an operation for returning the liquid refrigerant in the receiver (17) to the circu-

lation path in the first heating/freezing operation. In the refrigerating apparatus (1) of Embodiment 2, the controller (95) switches the second four-way switching valve (13) to the second state when the degree of superheat of the refrigerant flowing in the suction pipe (61a) which is detected from the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81) is equal to or larger than a predetermined value.

[0137] When the second four-way switching valve (18) is set to the second state, part of the high-pressure gas refrigerant discharged from the compression mechanism (11D) flows from the auxiliary gas pipe (59) via the second four-way switching valve (13) and the first four-way switching valve (12) into the outdoor first has pipe (58a) and further flows from the outdoor heat exchanger (15) through the outdoor liquid pipe (62) into the receiver (17). During this flow, the outdoor fan (16) remains being stopped. This increases the inner pressure of the receiver (17), so that the liquid refrigerant in the receiver (17) is pushed out forcibly to be returned to the circulation path through the collection liquid pipe (53).

[0138] It is noted that the state where the second four-way switching valve (13) is set to the second state in the first heating/freezing operation is the same as the state in the second heating/freezing operation in Embodiment 1. Wherein, the second heating/freezing operation in Embodiment 1 is performed for lowering the heating capacity of the indoor unit (20) while on the other hand the first heating/freezing operation in Embodiment 2 is performed for forcibly returning the liquid refrigerant in the receiver (17) to the circulation path. Further, the outdoor fan (16) is driven for condensing the refrigerant in the outdoor heat exchanger (15) in the second heating/freezing operation in Embodiment 1. While on the other hand, the outdoor heat exchanger (15) is only utilized as the flow path for introducing the high-pressure gas refrigerant discharged from the compression mechanism (11D) into the receiver (17) in the first heating/freezing operation in Embodiment 2, and therefore, the outdoor fan (16) is not driven because condensation of the refrigerant leads to introduction of the liquid refrigerant into the receiver (17) to cause the refrigerant in the receiver (17) to less decrease.

[0139] In Embodiment 2, the outdoor heat exchanger (15) is utilized as the flow path for introducing the high-pressure gas refrigerant into the receiver (17) to return the liquid refrigerant in the receiver (17) to the circulation path without providing an additional communication path for connecting the receiver (17) to the discharge side of the compression mechanism (11D). Thus, the refrigerating apparatus is simplified.

<Embodiment 3 of the Invention>

[0140] Embodiment 3 of the present invention will be described. FIG. 12 is a diagram showing a refrigerant circuit of a refrigerating apparatus (1) in accordance with

Embodiment 3. The refrigerating apparatus (1) in accordance with Embodiment 3 is different from that in accordance with Embodiment 1 in the point that neither the hot gas bypass pipe (71) nor the solenoid valve (SV1) is provided and the connection point of the liquid injection pipe (67) is different from that in Embodiment 1.

[0141] The liquid injection pipe (67) is connected at one end thereof to a connection point between the suction pipe (61a) and the low-pressure gas pipe (64) and is connected at the other end thereof between the receiver (17) and a connection point of the outdoor liquid pipe (62) to the auxiliary liquid pipe (65) which is located on the closing valve (18c) side. The liquid injection pipe (67) is a communication pipe for allowing the receiver (17) to communicate with the suction side of the compression mechanism (11D) and composes the refrigerant return mechanism (5) in combination with the motor-operated expansion valve (67a).

[0142] Description will be given to an operation for returning the liquid refrigerant in the receiver (17) to the circulation path in the first heating/freezing operation. In the refrigerating apparatus (1) of Embodiment 3, the controller (95) opens the motor-operated expansion valve (67a) when the degree of superheat of the refrigerant flowing in the suction pipe (61a) which is detected on the basis of the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81) is equal to or larger than a predetermined value. This allows the receiver (17) to communicate with the suction side of the compression mechanism (11D), so that the compression mechanism (11D) forcibly sucks up the liquid refrigerant in the receiver (17) to return it to the circulation path.

[0143] It is noted that in each refrigerating apparatus (1) of Embodiment 1 and Embodiment 2, since the inner pressure of the collection liquid pipe (53) is high even if the motor-operated expansion valve (67a) is opened in the first heating/freezing operation, the liquid refrigerant in the receiver (17) does not flow out from the receiver (17).

[0144] In contrast, in Embodiment 3, the compression mechanism (11D) sucks the liquid refrigerant in the receiver (17) when the liquid refrigerant in the receiver (17) is returned to the circulation path to lower the degree of superheat on the suction side of the compression mechanism (11D). Accordingly, the refrigerant is returned to the circulation path to prevent refrigerant shortage, and the degree of superheat on the suction side is suppressed to reduce the required input of the compression mechanism (11D).

<Other Embodiments>

[0145] The above embodiments may have any of the following constructions.

[0146] In the above embodiments, the controller (95) controls the refrigerant return mechanism (5) on the basis of the detection value of the low-pressure pressure sen-

sor (79) and the detection value of the suction side temperature sensor (81), but may control the refrigerant return mechanism (5) on the basis of the detection values of the high-pressure pressure sensor (75) and the discharge side temperature sensor (76). The controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the degree of superheat of the refrigerant discharged from the compression mechanism (11D) which is calculated on the basis of the detection value of the high-pressure pressure sensor (75) and the detection value of the discharge side temperature sensor (76) is equal to or higher larger than a predetermined value. The high-pressure pressure sensor (75) and the discharge side temperature sensor (76) compose discharge side superheat detection means.

[0147] Alternatively, the controller (95) may control the refrigerant return mechanism (5) on the basis of the detection value of the discharge side temperature sensor (76) that detects the temperature of the refrigerant discharged from the compression mechanism (11D). The controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the detection value of the discharge side temperature sensor (76) is equal to or larger than a predetermined value. The discharge side temperature sensor (76) composes discharge side refrigerant temperature detection means.

[0148] Or, the controller (95) may control the refrigerant return mechanism (5) on the basis of the opening of the motor-operated expansion valve (67a) of the liquid injection pipe (67). The controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the opening of the motor-operated expansion valve (67a) is equal to or larger than a predetermined opening (400 pulses or larger in a case using a 480-pulse motor-operated expansion valve, for example). Further, the controller (95) terminates the operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the opening of the motor-operated expansion valve (67a) is equal to or smaller than a predetermined opening (350 pulses or smaller in the case using the 480-pulse motor-operated expansion valve, for example).

[0149] It is noted that the opening of the motor-operated expansion valve (67a) is controlled on the basis of the detection value of the discharge side temperature sensor (76) and the degree of superheat of the refrigerant flowing in the suction pipe (61a) which is detected from the detection value of the low-pressure pressure sensor (79) and the detection value of the suction side temperature sensor (81). For example, the controller (95) increases the opening of the motor-operated expansion valve (67a) when either one of two conditions is satisfied, for example: one condition is that the detection value of the discharge side temperature sensor (76) is equal to or larger than 90 °C, and the other condition is that the degree of superheat of the refrigerant flowing in the suc-

tion pipe (61a) is equal to or larger than 5 °C.

[0150] Alternatively, the controller (95) may control the return mechanism (5) on the basis of the degrees of superheat of the outlets of the refrigerating heat exchanger (31) and the freezing heat exchanger (41) serving as evaporators. In this case, a temperature sensor and a pressure sensor are provided at the respective outlets of the refrigerating heat exchanger (31) and the freezing heat exchanger (41) for detecting the respective degrees of superheat. For example, the controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the state where the degree of superheat of the refrigerant at either one of the outlets of the refrigerating heat exchanger (31) and the freezing heat exchanger (41) is equal to or larger than 10 °C continues for a period longer than ten minutes. Further, the controller (95) terminates the operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the state where the degree of superheat of the refrigerant at the outlet of the evaporator, of which state where the degree of superheat of the refrigerant continues to be 10 °C or higher for the period longer than ten minutes, is equal to or lower than 7 °C continues for a period longer than one minute. The control of the refrigerant return mechanism (5) is not necessarily performed on the basis of the degree of superheat of the refrigerant at all of the outlets of the evaporators of the refrigerating unit (30) and the freezing unit (40) but is performed on the basis of the degree of superheat of the refrigerant at only the outlet of an evaporator of a unit in which the liquid refrigerant less flows (a unit installed at a high position in level, for example).

[0151] Moreover, the controller (95) may control the refrigerant return mechanism (5) on the basis of the detection value of the high-pressure pressure sensor (75). The high-pressure pressure in the refrigeration cycle varies depending on the temperature of the indoor space in which the indoor unit (20) is installed. Accordingly, in this case, the refrigerant return mechanism (5) is controlled on the basis of the saturation temperature of the pressure detected by the high-pressure pressure sensor (75). For example, the controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the state where the difference between the saturation temperature and the temperature of the indoor space is equal to or smaller than 15 °C continues for a period longer than ten minutes. Further, the controller (95) terminates the operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the state where the temperature difference is equal to or larger than 15 °C continues for a period longer than one minute.

[0152] Furthermore, the controller (95) may control the refrigerant return mechanism (5) on the basis of the detection value of the low-pressure pressure sensor (79). For example, the controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the state where the detection

value of the low-pressure pressure sensor (79) is equal to or lower than 0.15 MPa continues for a period longer than 10 minutes. Further, the controller (95) terminates the operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the state where the detection value of the low-pressure pressure sensor (79) is equal to or larger than 0.2 MPa continues for a period longer than one minute.

[0153] Alternatively, the controller (95) may control the refrigerant return mechanism (5) on the basis of some of conditions of: the degree of superheat of the refrigerant flowing from the refrigerating heat exchanger (31) and the freezing heat exchanger (41) toward the suction side of the compression mechanism (11D); the degree of superheat of the refrigerant discharged from the compression mechanism (11D); the temperature of the refrigerant discharged from the compression mechanism (11D); the opening of the motor-operated expansion valve (67a) of the liquid injection pipe (67); the degree of superheat of the refrigerant at the outlet of an evaporator; the detection value of the high-pressure pressure sensor (75); and the detection value of the low-pressure pressure sensor (79). In this case, the controller (95) performs an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when some of the conditions are satisfied.

[0154] Alternatively, the controller (95) may perform an operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the first heating/freezing operation for performing the 100% heat recovery continues for 30 minutes or longer. In the case where the outdoor air temperature is low (-10 °C or lower, for example), the inner pressure of the receiver (17) becomes low, so that the liquid refrigerant is liable to be retained. Accordingly, the refrigerant in the receiver (17) may be returned to the circulation path when the first heating/freezing operation continues for 20 minutes or longer.

[0155] Furthermore, the controller (95) may forcibly terminate the operation for returning the liquid refrigerant in the receiver (17) to the circulation path when the above operation continues for a period longer than ten minutes.

[0156] In the above embodiments, the controller (95) may switch the operation state by switching the first four-way switching valve (12) as a switching mechanism to the second state temporarily when much liquid refrigerant is retained in the receiver (17) in the first heating/freezing operation (first operation mode). During that time, the indoor expansion valve (22) is closed simultaneously. The condition for switching the first four-way switching valve (12) to the second state in this case is the same as the condition when the refrigerant return mechanism (5) performs the operation for returning the liquid refrigerant in the receiver (17) to the circulation path. When the first four-way switching valve (12) is set to the second state, the second operation mode is set in which the refrigerant circulates in the same direction as that in the freezing operation. Wherein, the outdoor fan (16) remains stopped unlike the case of the freezing operation.

Accordingly, the high-pressure gas refrigerant discharged from the compression mechanism (11D) flows through the outdoor heat exchanger (15) into the receiver (17) to increase the inner pressure of the receiver (17), so that the liquid refrigerant in the receiver (17) is pushed out forcedly to be returned through the collection liquid pipe (53) to the refrigerating unit (30) and the freezing unit (40).

[0157] In the above embodiments, the liquid branch pipe (66) may be provided with a solenoid valve rather than the relief valve (117).

[0158] The above embodiments refer to the case where two indoor units (20), eight refrigerating units (30), and one freezing unit (40) are provided for one outdoor unit (10), but the numbers of the user side units (20, 30, 40) may be changed as far as the 100% heat recovery operation is possible.

[0159] Further, the above embodiments refer to the case where the compression mechanisms (11D, 11E) are composed of three compressors (11A, 11B, 11C), but the number of the compressors may be changed appropriately, as well.

[0160] It should be noted that the above embodiments are mere essentially preferable examples and do not intend to limit the scopes of the present invention, the applicable subjects, and the use thereof.

Industrial Applicability

[0161] As described above, the present invention is useful for refrigerating apparatuses including a plurality of system user side heat exchangers capable of performing a 100% heat recovery operation therebetween:

Claims

1. A refrigerating apparatus comprising:

a heat source side unit (10) including a compression mechanism (11D, 11E), a heat source side heat exchanger (15), and a receiver (17);
a first user side unit (30, 40) including a first user side heat exchanger (31, 41);
a second user side unit (20) including a second user side heat exchanger (21); and
gas side communication pipes (51, 52) and liquid side communication pipes (53, 54, 55) which connect each unit (10, 20, 30, 40) to form a refrigerant circuit (50), the gas side communication pipes (51, 52) including a first gas side communication pipe (51) connected to the heat source side unit (10) and the first user side unit (30, 40) and a second gas side communication pipe (53) connected to the heat source side unit (10) and the second user side unit (20), and the liquid side communication pipes (53, 54, 55) including a collection liquid pipe (53) connected

to the heat source side unit (10), a first branch liquid pipe (54) branching from the collection liquid pipe (53) and connected to the first user side unit (30, 40), and a second branch liquid pipe (55) branching from the collection liquid pipe (53) and connected to the second user side unit (20),

wherein the refrigerant circuit (50) is capable of forming a refrigerant circulation path in which refrigerant sent out from the compression mechanisms (11D, 11E) flows from the second user side unit (20) to the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), and

a refrigerant return mechanism (5) is provided for returning liquid refrigerant in the receiver (17) to the circulation path.

2. The refrigerating apparatus of Claim 1, wherein the refrigerant return mechanism (5) includes an introduction pipe (71) for introducing high-pressure refrigerant discharged from the compression mechanism (11D, 11E) into the receiver (17), and the liquid refrigerant in the receiver (17) is returned to the circulation path through the collection liquid pipe (53) in such a manner that the high-pressure refrigerant from the introduction pipe (71) is introduced into the receiver (17) to increase an inner pressure of the receiver (17).
3. The refrigerating apparatus of Claim 1, wherein the refrigerant return mechanism (5) includes a communication pipe (67) for allowing the receiver (17) to communicate with a suction side of the compression mechanism (11D, 11E), and the liquid refrigerant in the receiver (17) is returned to the circulation path in such a manner that the compression mechanism (11D, 11E) sucks the liquid refrigerant through the communication pipe (67).
4. The refrigerating apparatus of Claim 1, wherein the refrigerant return mechanism (5) includes a communication mechanism (13) for allowing the receiver (17) to communicate with a discharge side of the compression mechanism (11D, 11E) through the heat source side heat exchanger (15), and the liquid refrigerant in the receiver (17) is returned to the circulation path through the collection liquid pipe (53) in such a manner that the communication mechanism (13) allows the receiver (17) to communicate with the discharge side of the compression mechanism (11D, 11E) to cause high-pressure refrigerant discharged from the compression mechanism (11D, 11E) to flow into the receiver (17).
5. The refrigerating apparatus of any one of Claims 1

to 4, further comprising:

suction side superheat detection means (79, 81) for detecting a degree of superheat of refrigerant flowing from the first user side heat exchanger (31, 41) toward a suction side of the compression mechanism (11D, 11E); and
control means (95) for controlling the refrigerant return mechanism (5) so that the refrigerant in the receiver (17) is returned to the circulation path when a detection value of the suction side superheat detection means (79, 81) is equal to or larger than a predetermined value.

6. The refrigerating apparatus of any one of Claims 1 to 4, further comprising:

discharge side superheat detection means (75, 76) for detecting a degree of superheat of refrigerant discharged from the compression mechanism (11D, 11E); and
control means (95) for controlling the refrigerant return mechanism (5) so that the refrigerant in the receiver (17) is returned to the circulation path when a detection value of the discharge side superheat detection means (75, 76) is equal to or larger than a predetermined value.

7. The refrigerating apparatus of any one of Claims 1 to 4, further comprising:

discharge side refrigerant temperature detection means (76) for detecting a temperature of refrigerant discharged from the compression mechanism (11D, 11E); and
control means (95) for controlling the refrigerant return mechanism (5) so that the refrigerant in the receiver (17) is returned to the circulation path when a detection value of the discharge side refrigerant temperature detection means (76) is equal to or larger than a predetermined value.

8. A refrigerating apparatus comprising:

a heat source side unit (10) including a compression mechanism (11D, 11E), a heat source side heat exchanger (15), and a receiver (17);
a first user side unit (30, 40) including a first user side heat exchanger (31, 41);
a second user side unit (20) including a second user side heat exchanger (21); and
gas side communication pipes (51, 52) and liquid side communication pipes (53, 54, 55) which connect each unit (10, 20, 30, 40) to form a refrigerant circuit (50), the gas side communication pipes (51, 52) including a first gas side communication pipe (51) connected to the heat

source side unit (10) and the first user side unit (30, 40) and a second gas side communication pipe (53) connected to the heat source side unit (10) and the second user side unit (20), and the liquid side communication pipes (53, 54, 55) including a collection liquid pipe (53) connected to the heat source side unit (10), a first branch liquid pipe (54) branching from the collection liquid pipe (53) and connected to the first user side unit (30, 40), and a second branch liquid pipe (55) branching from the collection liquid pipe (53) and connected to the second user side unit (20),

wherein the refrigerant circuit (50) includes a switching mechanism (12) which switches between a first operation mode and a second operation mode, the first operation mode being a mode in which refrigerant sent out from the compression mechanism (11D, 11E) flows from the second user side unit (20) to the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), and the second operation mode being a mode in which the refrigerant sent out from the compression mechanism (11D, 11E) flows from the heat source side heat exchanger (15) into the receiver (17) and into the first user side unit (30, 40) and is then returned to the compression mechanism (11D, 11E), and

the liquid refrigerant retained in the receiver (17) in the first operation mode is returned to the first user side unit (30, 40) through the collection liquid pipe (53) by switching the switching mechanism (12) from the first operation mode to the second operation mode.

FIG. 1

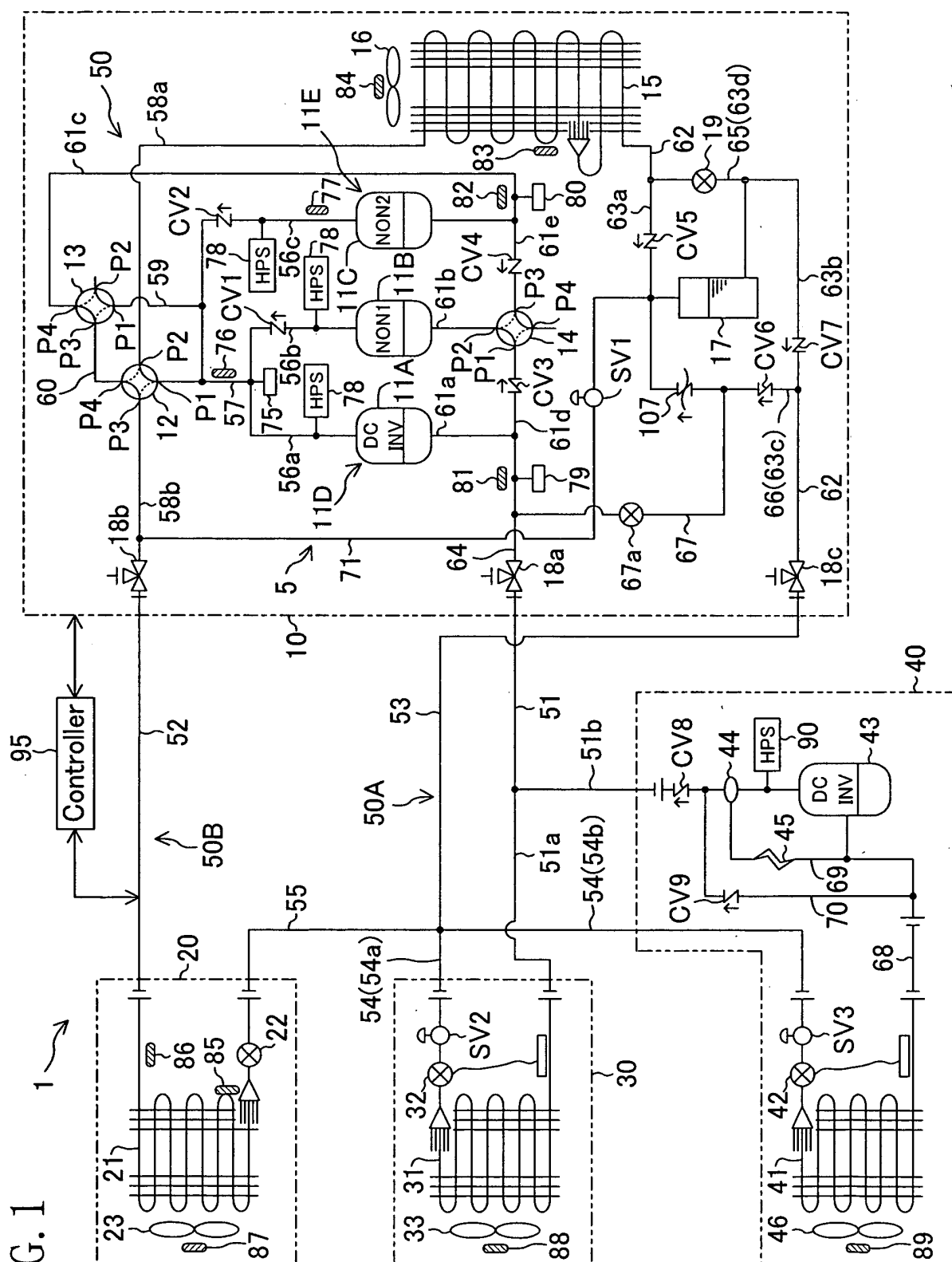


FIG. 2

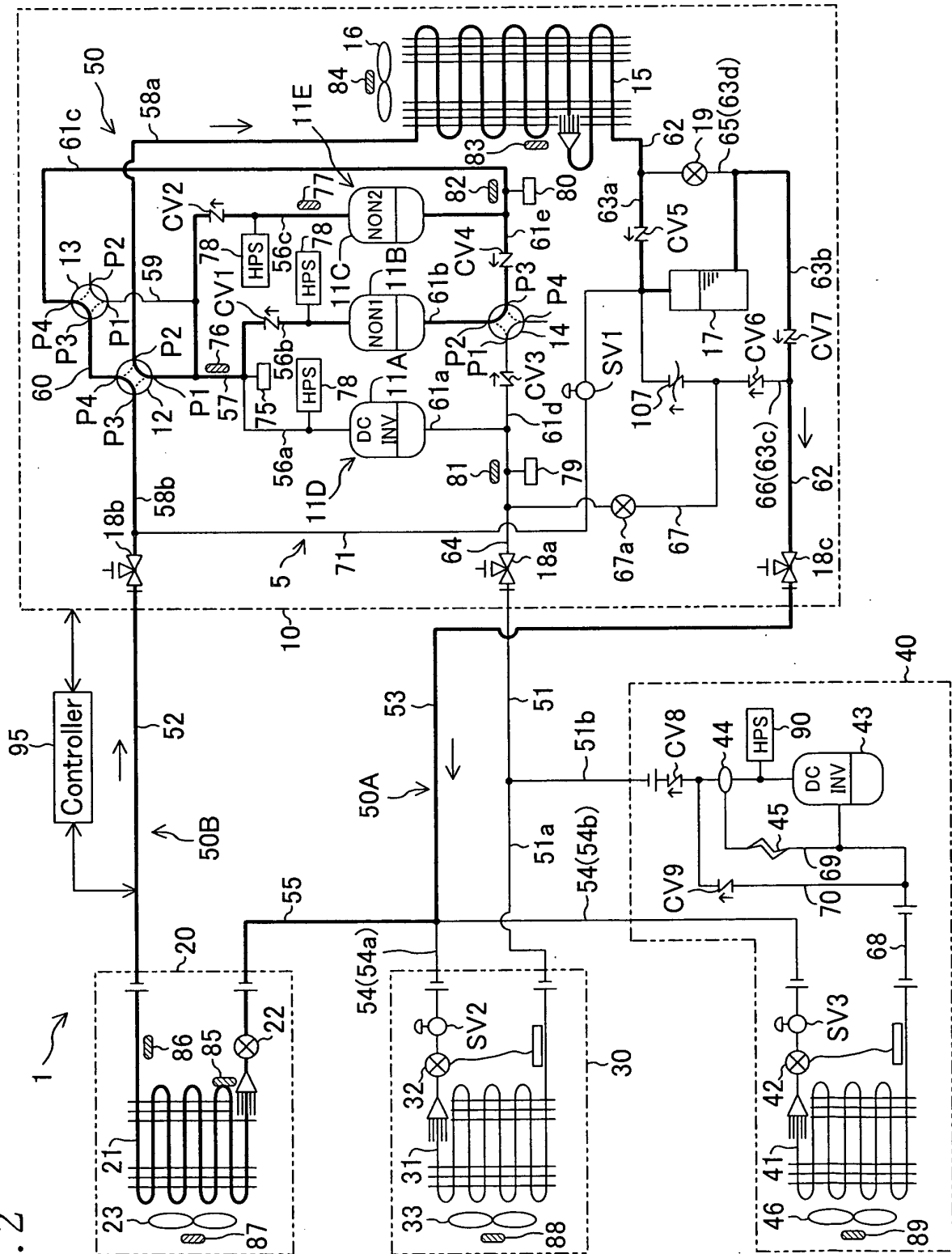


FIG. 3

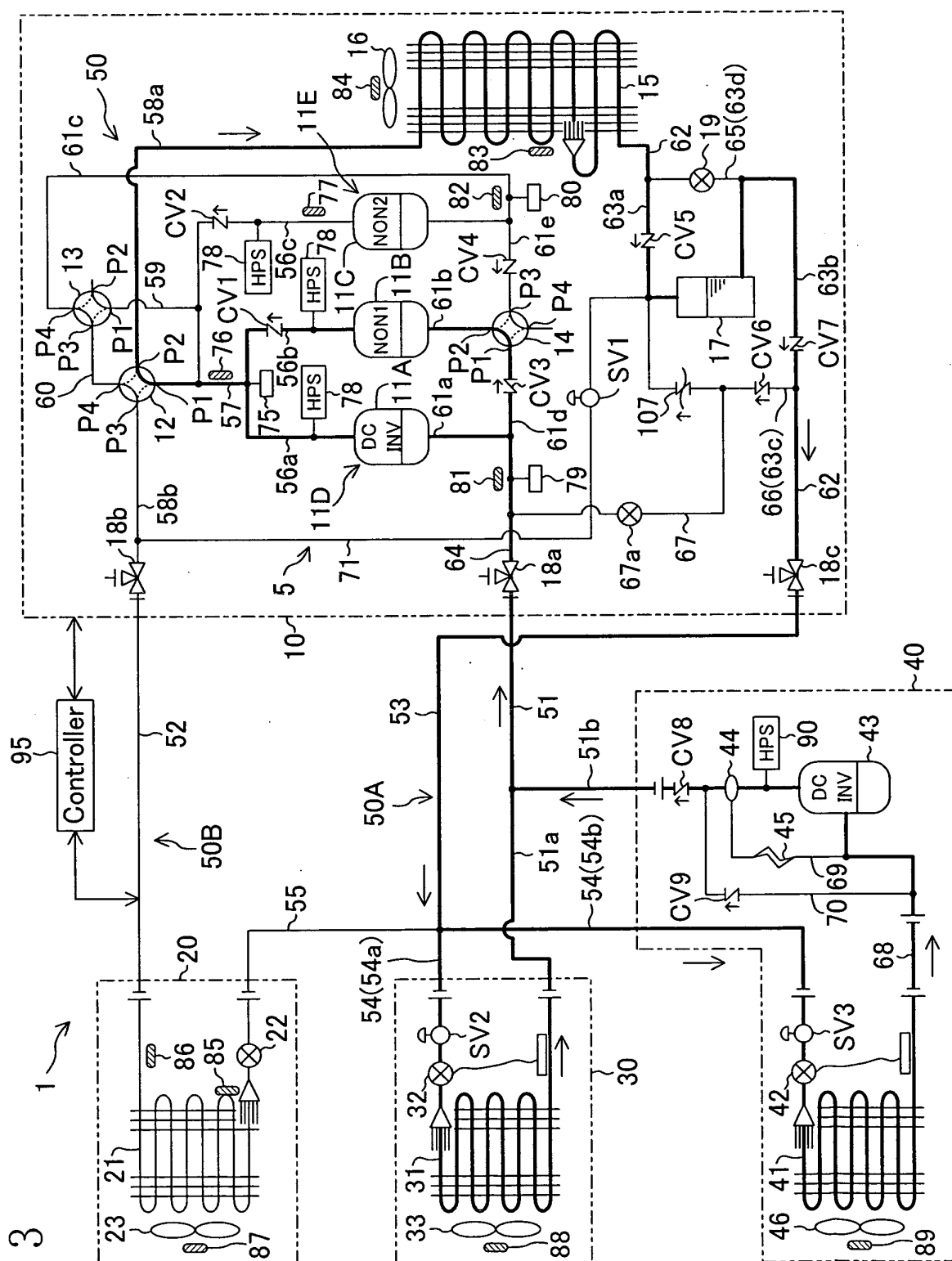


FIG. 4

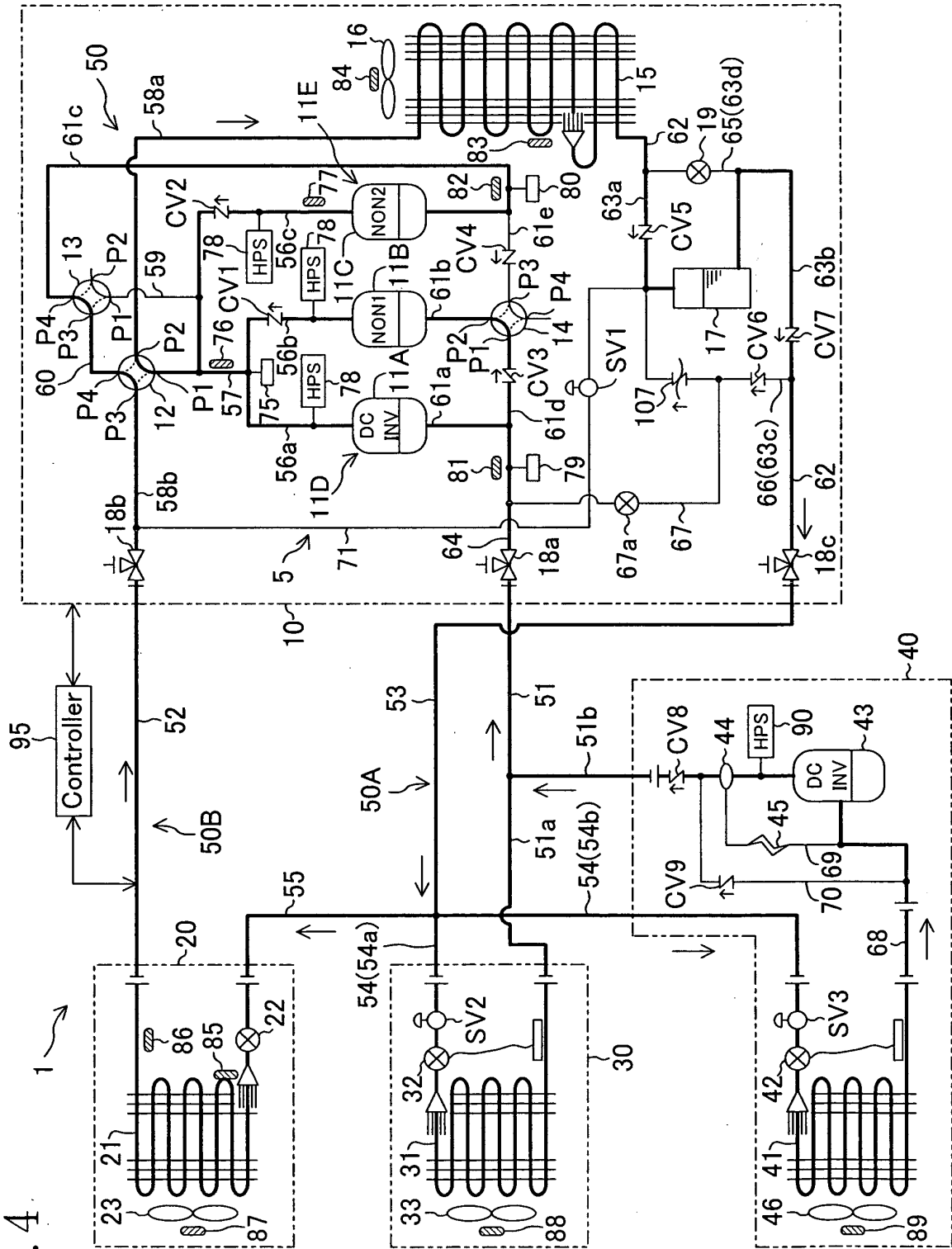


FIG. 5

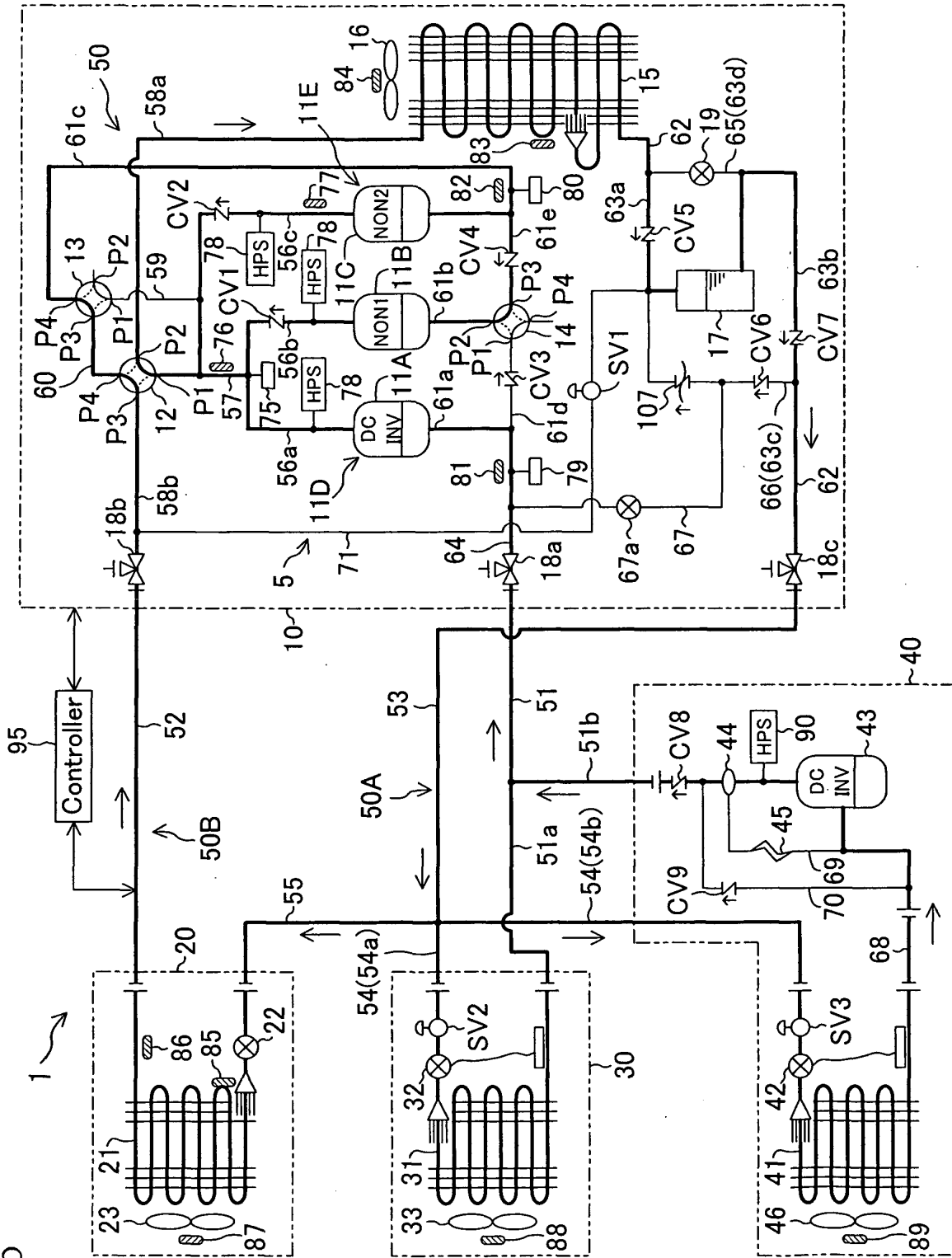


FIG. 6

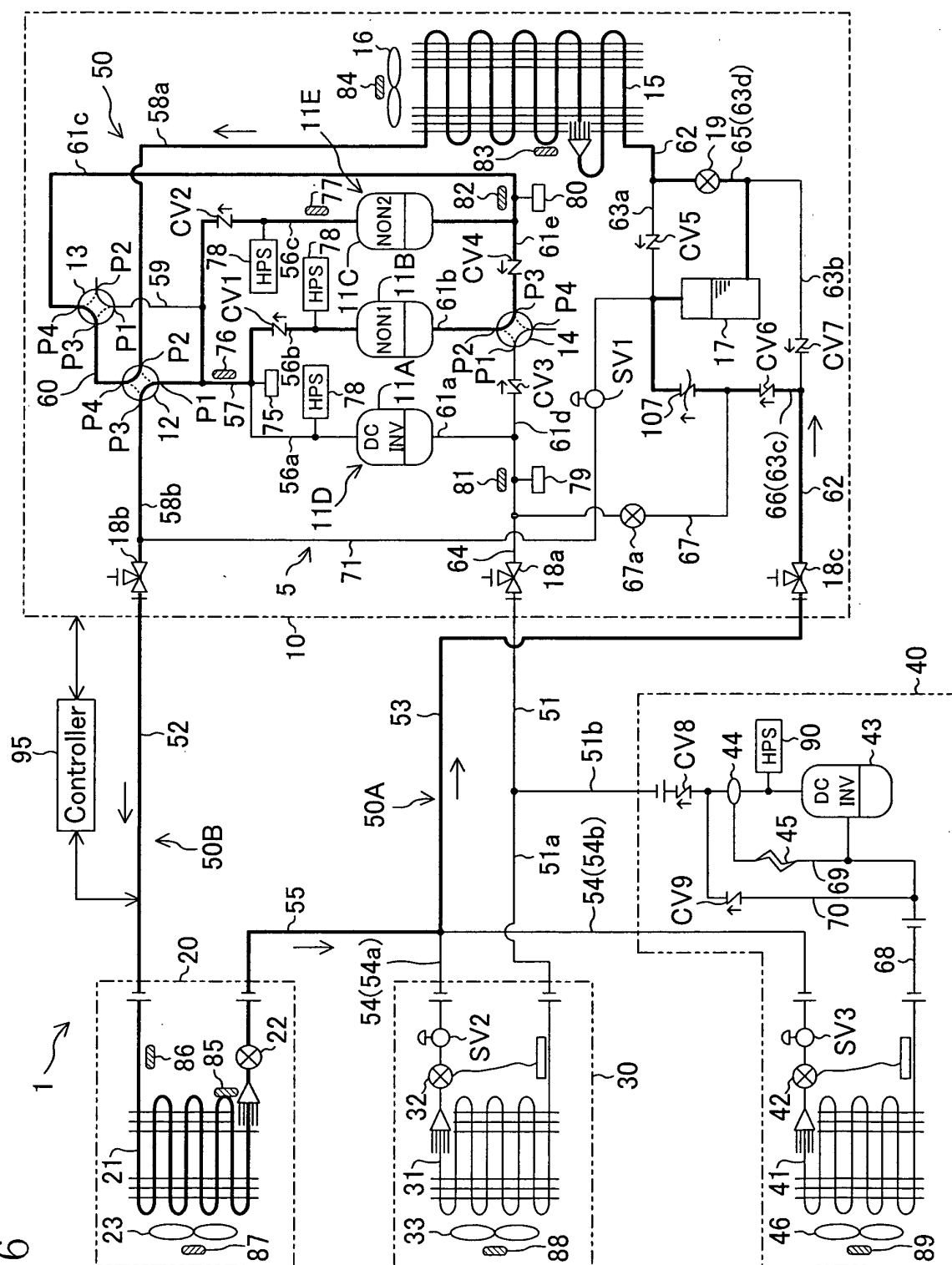


FIG. 7

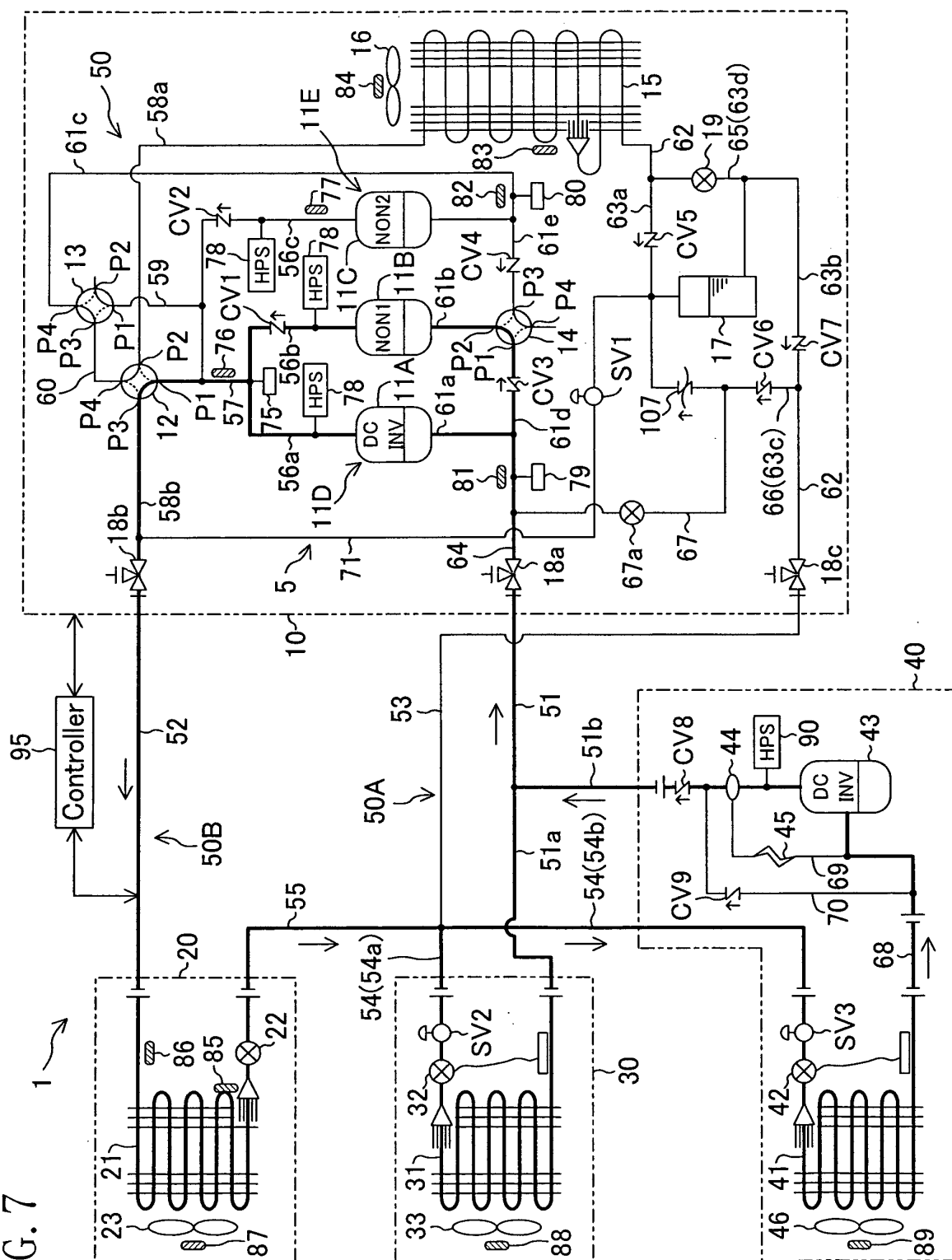


FIG. 8

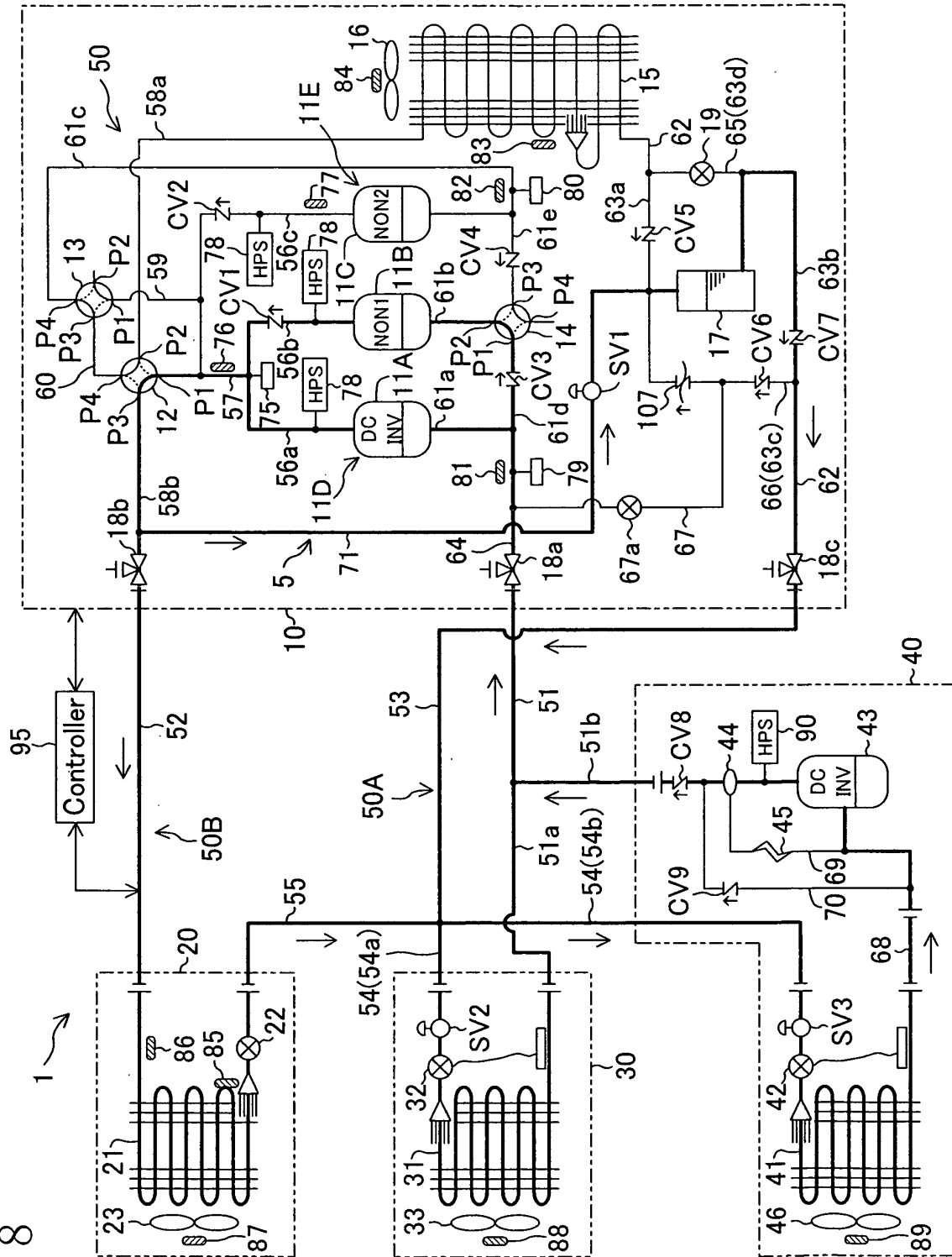


FIG. 9

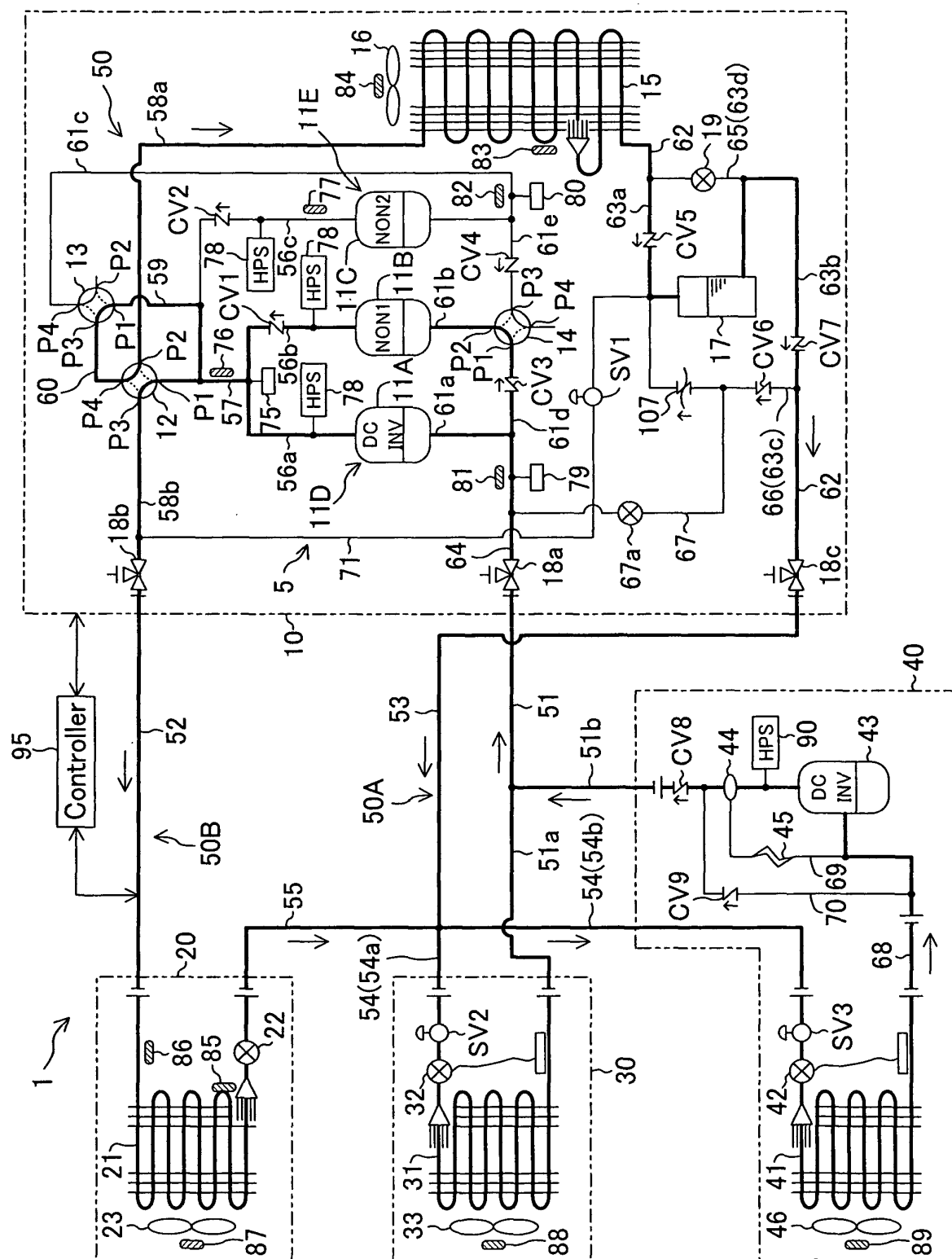


FIG. 10

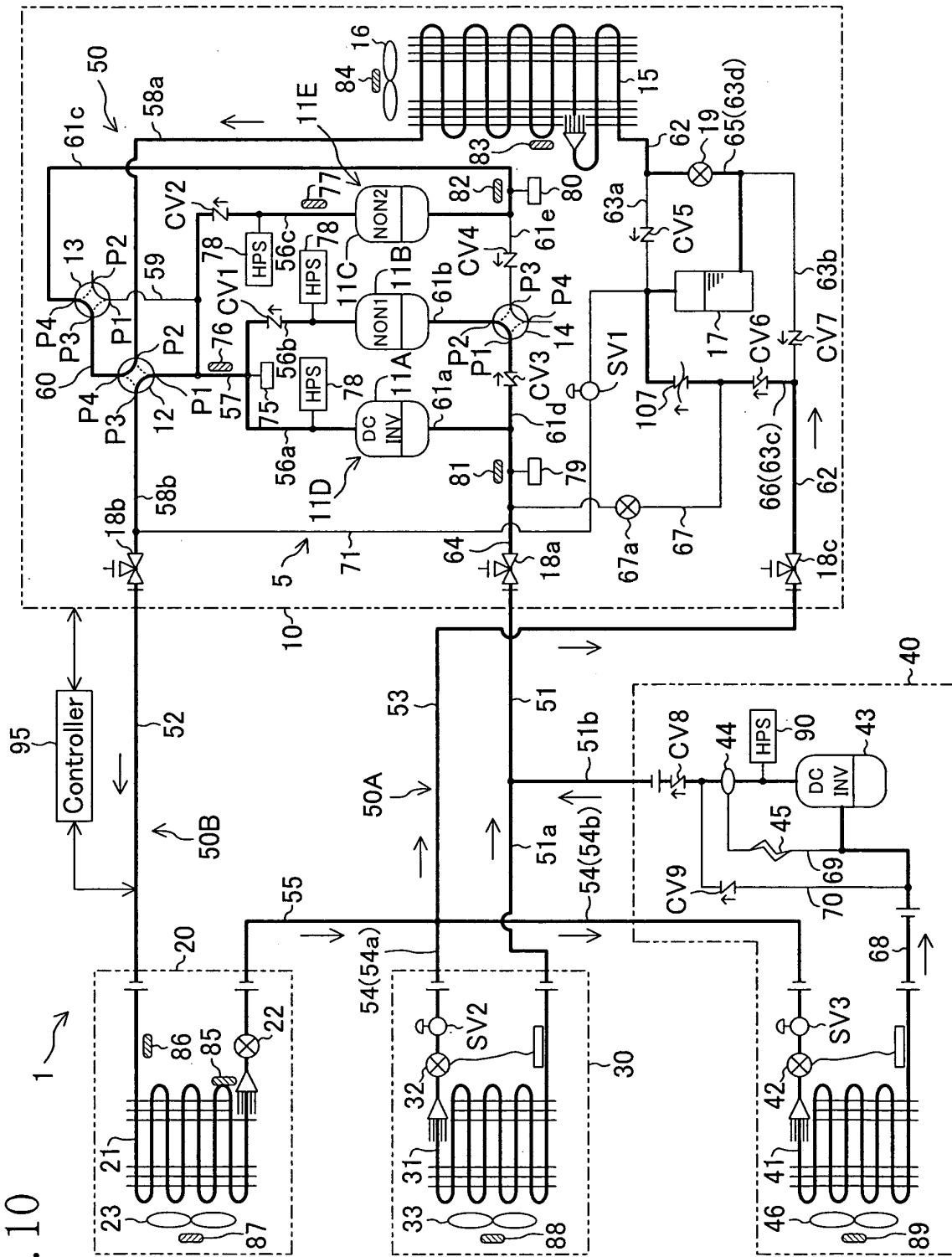


FIG. 11

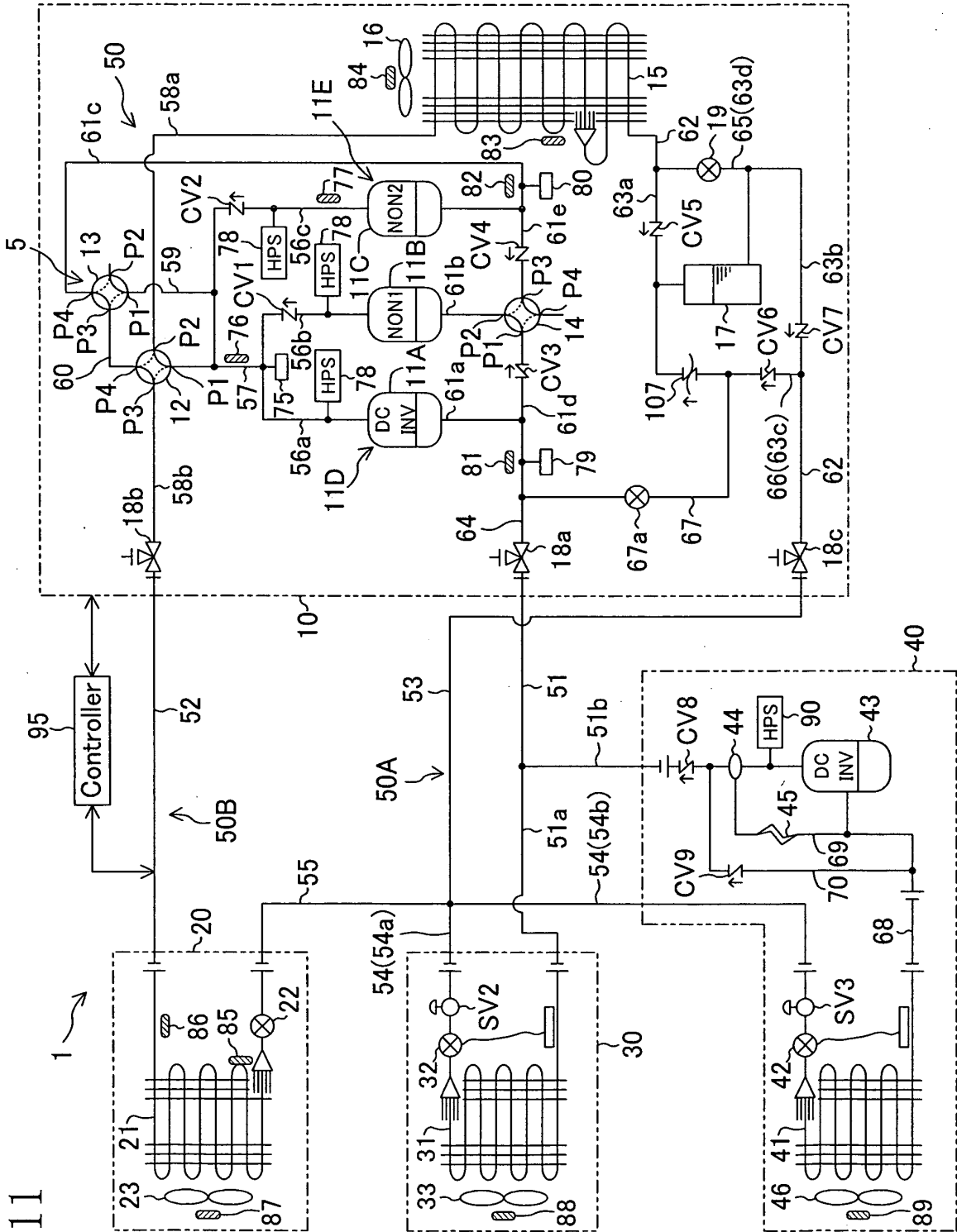


FIG. 12

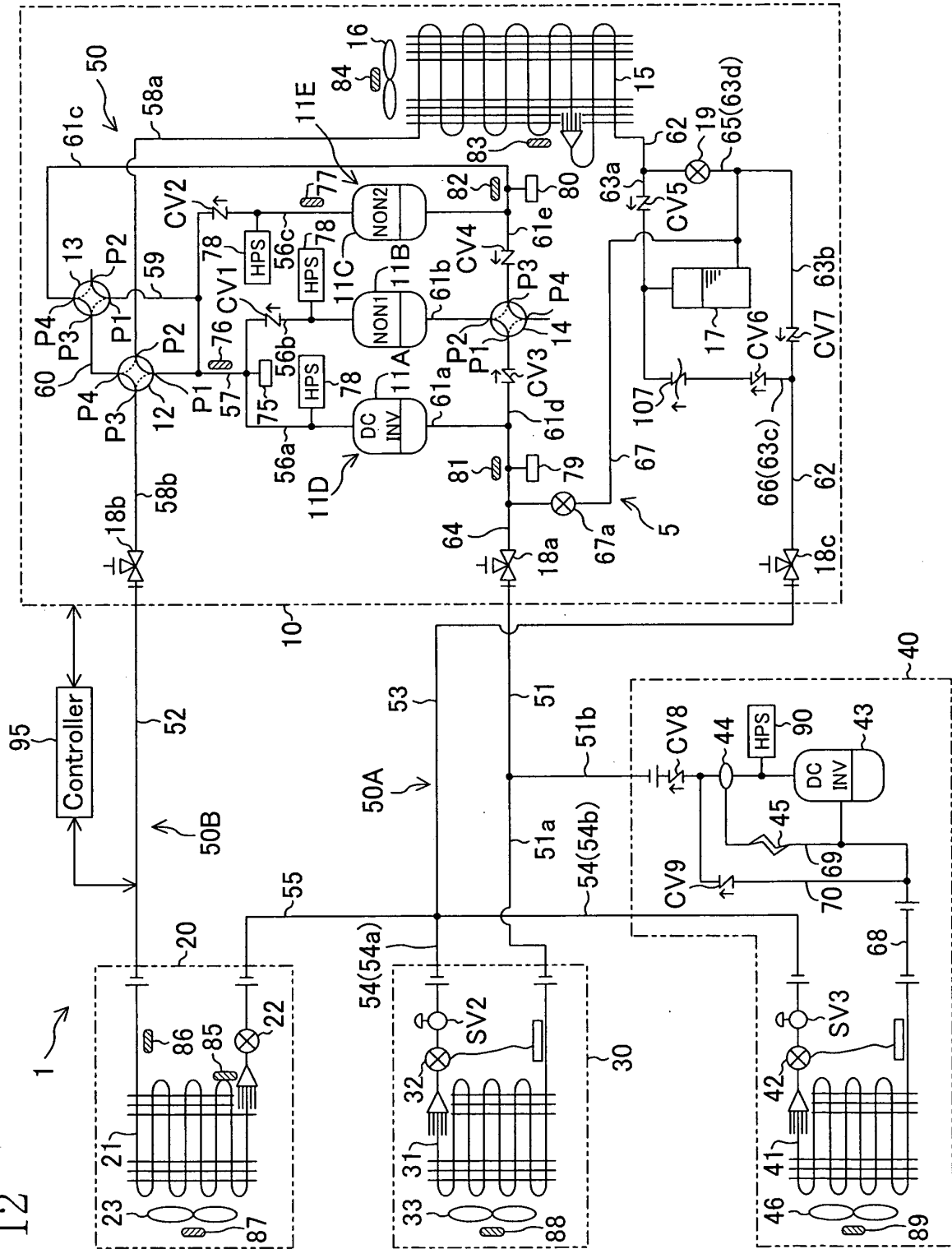
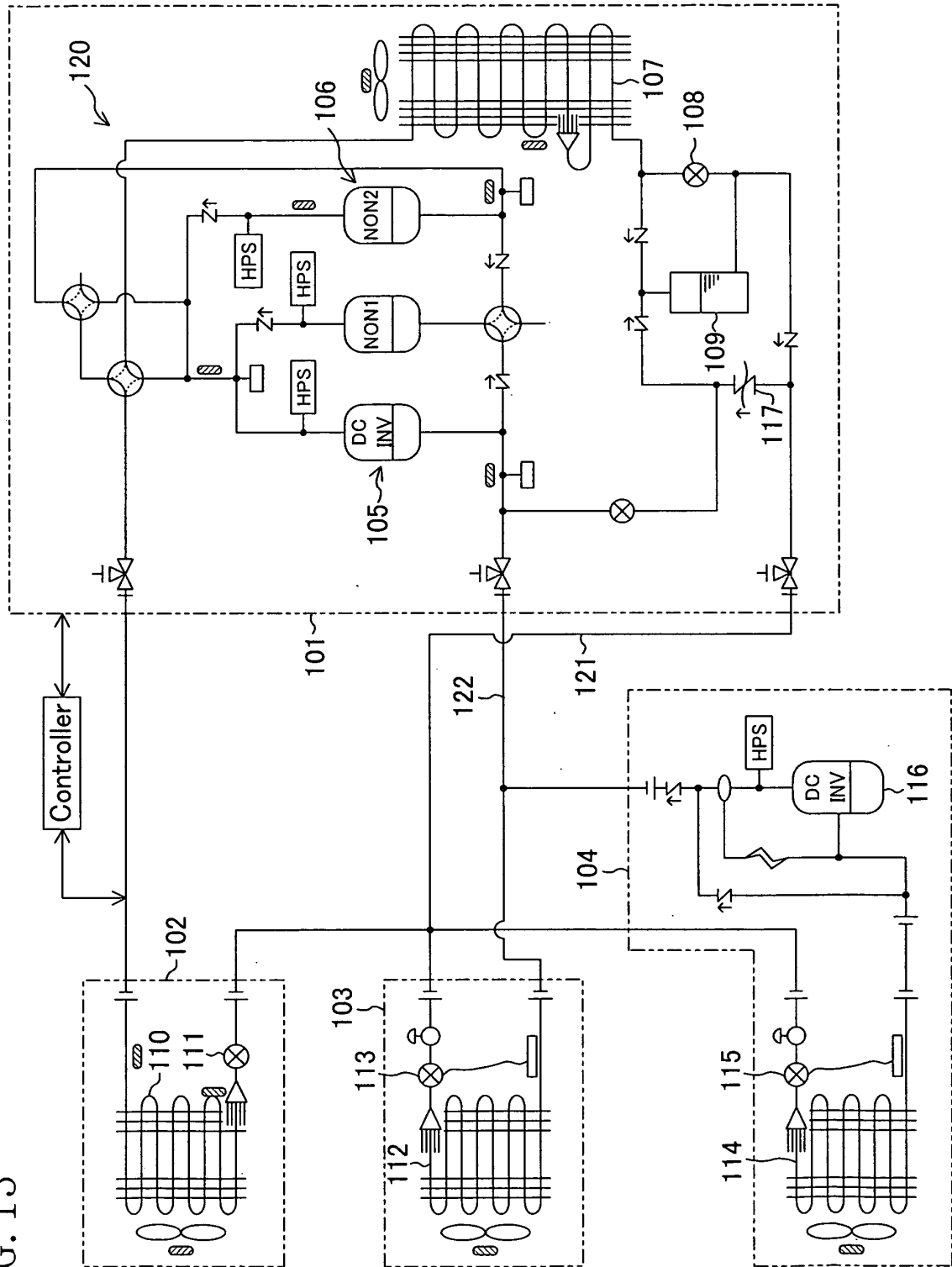


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/315914

A. CLASSIFICATION OF SUBJECT MATTER F25B1/00(2006.01)i, F25B5/02(2006.01)i, F25B43/00(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) F25B1/00, F25B5/02, F25B43/00		
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 1996-2006 Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2005-134103 A (Daikin Industries, Ltd.), 26 May, 2005 (26.05.05), Full text; Figs. 1 to 27 & WO 2005/033593 A1 & EP 1568951 A1 & US 2006-123835 A1	1, 3 2, 5-7 4, 8
Y	JP 7-305903 A (Hitachi, Ltd.), 21 November, 1995 (21.11.95), Par. No. [0011]; Fig. 1 (Family: none)	2
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 06 November, 2006 (06.11.06)		Date of mailing of the international search report 14 November, 2006 (14.11.06)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/315914

Claim 4 involves all refrigerating apparatuses having such specified characteristics that "the high-pressure refrigerant discharged from the compression mechanisms is allowed to flow to the receiver through the heat source side heat exchanger". However, since the refrigerating apparatus disclosed in the meaning of PCT Article 5 is only the refrigerating apparatus in which the refrigerant discharged from the compression mechanisms is led into the receiver without being condensed in the heat source side heat exchanger by stopping the outdoor fan of the heat source side heat exchanger, it is inadequately supported in the meaning of PCT Article 6.

There is the same defect in claim 8.

Accordingly, the search was performed within a scope where the refrigerating apparatus is supported by and disclosed in the description, namely, about a refrigerating apparatus in which the outdoor fan of the heat source side heat exchanger is stopped when the high-pressure refrigerant discharged from the compression mechanisms is allowed to flow to the receiver through the heat source side heat exchanger.

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2001280749 A [0011]
- JP 2005134103 A [0011]