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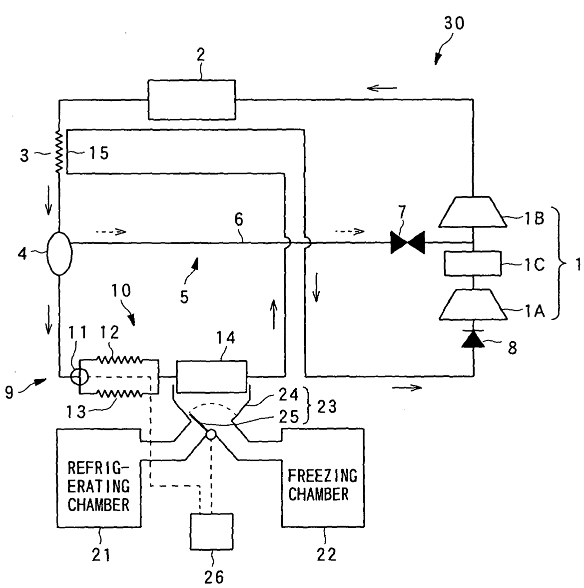
(54) **Refrigerating machine**

(57) A refrigerating machine having a compressor, a radiator, a pressure-reducing device, a gas-liquid separator, a unit for selectively introducing gas refrigerant separated in the gas-liquid separator into an intermediate pressure portion of the compressor, and a low pressure side circuit in which liquid refrigerant separated in the gas-liquid separator is circulated. The low pressure side circuit is provided with a heat absorbing unit functioning selectively in one of different temperature zones, and refrigerant passing through the selected heat absorbing unit is returned to a suction portion of the compressor.

FIG. 1



EP 1 577 620 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a refrigerating machine having a unit for selectively introducing gas refrigerant separated in a gas-liquid separator into an intermediate pressure portion of a compressor.

2.Description of the Related Art

[0002] In general, there is known a refrigerating machine having a compressor, a radiator, a pressure-reducing device, a gas-liquid separator and a unit which can introduce gas refrigerant separated in the gas-liquid separator into an intermediate pressure portion of the compressor as disclosed in JP-A-2003-106693 (hereinafter referred to as "Patent Document 1"). In this type of refrigerant machine, gas refrigerant separated in the gas-liquid separator is introduced into the intermediate pressure portion of the compressor while kept to a gas state, so that there is achieved an effect that the efficiency of the compressor can be enhanced.

[0003] In some cases, this type of refrigerating machine is equipped with a heat absorbing unit containing heat absorbers which selectively function in different temperature zone in a refrigerating cycle. For example, when this refrigerating machine is applied to a refrigerator (fridge) having a refrigerating chamber and a freezing chamber, heat absorbers functioning as a refrigerator and a freezer are disposed in the refrigerating cycle, and a refrigerating or freezing operation is carried out by using any one of the heat absorbers. In this case, it is important to carry out the refrigerating or freezing operation without reducing the efficiency under any operation.

SUMMARY OF THE INVENTION

[0004] Therefore, an object of the present invention is to provide a refrigerating machine in which when heat absorbing units selectively functioning in different temperature zones are provided in the refrigerating cycle, the high efficiency operation can be performed in any temperature zone without reducing the efficiency.

[0005] In order to attain the above object, according to the present invention, there is provided a refrigerating machine having a compressor, a radiator, a pressure-reducing device, a gas-liquid separator, a unit for selectively introducing gas refrigerant separated in the gas-liquid separator into an intermediate pressure portion of the compressor, and a low pressure side circuit in which liquid refrigerant separated in the gas-liquid separator is circulated, wherein the low pressure side circuit is provided with a heat absorbing unit functioning selectively in one of different temperature zones, and refrigerant passing through the selected heat absorbing unit is returned to a suction portion of the compressor.

[0006] In this case, it is preferable that the heat absorbing unit has plural heat absorbers which function in different temperature zones, the heat absorbers function selectively, and there is provided a unit for guiding cold air passing through the heat absorbers to chambers controlled to the corresponding temperature zones. Furthermore, the respective heat absorbers may be disposed in chambers which are respectively controlled to the corresponding temperature zones. Furthermore, the heat absorbing unit may be provided with one heat absorber which functions selectively in different temperature zones, and there is provided a unit for selectively guiding cold air passing through the heat absorber through a change-over dumper to plural chambers controlled to different temperature zones. In this case, the heat absorber may be disposed in a chamber controlled to a low temperature zone.

[0007] Furthermore, in all the cases described above, refrigerant such as carbon dioxide refrigerant or the like with which the high pressure side is set to supercritical pressure under operation may be filled.

[0008] According to the present invention, the low pressure side circuit for circulating liquid refrigerant separated in the gas-liquid separator is provided, and the low pressure side circuit is provided with the absorbing unit which selectively functions in different temperature zones. Therefore, high-efficiency operation can be performed in the respective temperature zones.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a refrigerant circuit diagram showing an embodiment of a refrigerating machine according to the present invention;
Fig. 2 is an enthalpy-pressure diagram of a refrigerating cycle;
Fig. 3 is an enthalpy-pressure diagram of a supercritical cycle;
Fig. 4 is a diagram showing an applied example to a refrigerator;
Fig. 5 is a diagram showing a cooling example;
Fig. 6 is a diagram showing a cooling example;
Fig. 7 is a diagram showing an applied example to a refrigerator;
Fig. 8 is a diagram showing an applied example to a refrigerator;
Fig. 9 is a refrigerant circuit diagram showing another embodiment;
Fig. 10 is a diagram showing an applied example to a refrigerator; and
Fig. 11 is a diagram showing an applied example to a refrigerator.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Preferred embodiments according to the present invention will be described hereunder with reference to the accompanying drawings.

[0011] Fig. 1 is a refrigerant circuit diagram showing an embodiment of the present invention.

[0012] A refrigerating machine 30 has a compressor 1, a radiator 2, a pressure-reducing device 3 and a gas-liquid separator 4. A refrigerant circuit extending from the compressor 1 through the radiator 2 to the inlet port of the pressure-reducing device 3 constitutes a high pressure side circuit. The pressure-reducing device 3 is designed so that the opening degree of the diaphragm thereof is variable. By varying the opening degree, the pressure of refrigerant is reduced until the refrigerant reaches the gas-liquid separator 4, and a lot of gas refrigerant occurs. Under this state, the refrigerant is input to the gas-liquid separator 4, whereby the separation efficiency in the gas-liquid separator 4 can be varied. The compressor 1 is a two-stage compressor, and it contains a first-stage compressing portion 1A, a second-stage compressing portion 1B and an intermediate cooler 1C between the first-stage compressing portion 1A and the second-stage compressing portion 1B. Reference numeral 8 represents a check valve.

[0013] The refrigerating machine 30 has an introducing unit 5 which can introduce gas refrigerant separated in the gas-liquid separator 4 to the intermediate portion of the compressor 1, that is, between the intermediate cooler 1C and the second-stage compressing portion 1B. The compressor is not limited to the two-stage compressor. For example, when the compressor is a one-stage compressor, the introducing unit 5 may return the refrigerant to the intermediate pressure portion of the one-stage compressor. The introducing unit 5 comprises a gas pipe 6 and an opening/closing valve 7 provided to the gas pipe 6. When the opening/closing valve 7 is opened, the gas refrigerant separated in the gas-liquid separator 4 is passed through the gas pipe 6, and introduced to the intermediate pressure portion of the compressor 1 as indicated by an arrow of a broken line due to the pressure difference in the gas pipe 6.

[0014] Furthermore, the refrigerating machine 30 is provided with a low pressure side circuit 9 for circulating liquid refrigerant separated in the gas-liquid separator 4, and the low pressure side circuit 9 is provided with a heat absorbing unit 10 which functions selectively in different temperature zones. The heat absorbing unit 10 comprises a three-way valve 11, a first capillary tube 12, a second capillary tube 13 provided in parallel to the first capillary tube 12, and one heat absorber 14.

[0015] The resistance value of the first capillary tube 12 is set to be larger than the resistance value of the second capillary tube 13. Therefore, when the refrigerant is made to flow to the first capillary tube 12 by switching the three-way valve 11 and also the driving frequency of the compressor 1 is reduced, the flow amount of the refrigerant flowing into the heat absorber 14 is reduced, the evaporation temperature is increased and thus refrigerating operation is carried out. When the driving frequency is fixed and only the resistance value of the capillary tube is increased, the evaporation temperature is lowered. Furthermore, when the refrigerant is made to flow to the second capillary tube 13 and the driving frequency of the compressor 1 is increased, the flow amount of the refrigerant flowing into the heat absorber 14 is increased, the evaporation temperature is lowered and the freezing operation is carried out. The refrigerant passed through the heat absorber 14 is passed through a heat exchanger 15 disposed near to the pressure-reducing device 3, heat-exchanged by the heat exchanger 15 to be heated. The refrigerant thus heated is passed through a check valve 8, and then returned to the suction portion of the compressor 1.

[0016] The above construction is equipped with a unit 23 for selectively guiding cold air passed through the heat absorber 14 to plural chambers (refrigerating chamber 21, freezing chamber 22) controlled to different temperature zones. The unit 23 contains an air blowing duct 24 and a change-over dumper 25. A controller 26 is connected to the change-over dumper 25. The controller 26 is connected to the three-way valve 11. For example when the load of the freezing chamber 22 is increased, by switching the three valve 11, the refrigerant is made to successively flow through the second capillary tube 13 having the small resistance value and the heat absorbing unit in this order. The evaporation temperature in the heat absorber 14 is reduced, and the change-over dumper 25 is tilted to the position shown in Fig. 1 to guide cold air to the freezing chamber 22. When the load of the refrigerating chamber 21 is increased, by switching the three-way valve 11, the refrigerant is made to successively flow through the first capillary tube 12 having a large resistance value and the heat absorber 14 in this order, and the evaporator temperature in the heat absorber 14 is increased. Then, the change-over dumper 25 is titled to the opposite side to the position shown in Fig 1 to guide cold air to the refrigerating chamber 21 .

[0017] The refrigerant with which the high pressure side is set to supercritical pressure during operation, for example, carbon dioxide refrigerant is filled in the refrigerant circuit described above.

[0018] Fig. 2 is an enthalpy-pressure (ph) diagram of the refrigerating cycle containing the two-stage compressor of this embodiment. In this embodiment, under such a condition that the outside air temperature is increased to 30° or more in summer or the load is increased, the high pressure side circuit is driven at supercritical pressure during operation as indicated by the enthalpy-pressure (ph) diagram of Fig. 3. The refrigerant with which the high pressure circuit is driven at supercritical pressure may contain ethylene, diborane, ethane, nitride oxide or the like.

[0019] Next, the refrigerating cycle of the two-stage compressor 1 will be described with reference to Figs. 2 and 3.

[0020] In Figs. 2 and 3, "a" represents a ph value at the suction port of the first-stage compressing portion 1A, "b" represents a ph value at the discharge port of the first-stage compressing portion 1A, "c" represents a ph value at the outlet port of the intermediate cooler 1C, "d" represents a ph value at the suction port of the second-stage compressing portion 1B, and "e" represents the discharge port of the second-stage compressing portion 1A. The refrigerant discharge from the compressor 1 is passed through the radiator 2 and circulated and cooled. "f" represents a ph value at the outlet port of the radiator 2, "g" represents a ph value at the inlet port of the pressure-reducing device 3, and "h" represents a ph value at the outlet port of the pressure-reducing device 3. Under this state, the refrigerant becomes a two-phase mixture of gas/liquid. The ratio of gas and liquid corresponds to the ratio of the length of a line segment (gas) h-i and the length of a line segment (liquid) h-n. The refrigerant enters the gas-liquid separator 4 under the two-phase mixture. The gas refrigerant separated in the gas-liquid separator 4 is introduced to the intermediate pressure portion of the compressor 1, that is, introduced between the intermediate cooler 1C and the second-stage compressing portion 1B. "n" represents a ph value at the outlet port of the gas-liquid separator 4. The refrigerant passed through the outlet port of the gas-liquid separator 4 reaches the suction port of the second-stage compressing portion 1B of "d", and is compressed in the second-stage compressing portion 1A. On the other hand, the liquid refrigerant separated in the gas-liquid separator 4 is circulated in the low pressure side circuit 9. "i" represents a ph value at the outlet port of the gas-liquid separator 4, "i" represents a ph value at the inlet port of one of the first capillary tube 12 and the second capillary tube 13, "k" represents a ph value at the outlet port of one of the first and second capillary tubes 12 and 13, and "1" represents a ph value at the outlet port of the heat absorber 14. The refrigerant of gas phase is passed through the check valve 8 and returned to the suction port of the first-stage compressing portion 1A of "a".

[0021] In the above construction, the gas refrigerant separated in the gas-liquid separator 4 is not usable for cooling even when it is circulated to the low pressure side circuit 9, and returning of this gas refrigerant to the suction port of the first-stage compressing portion 1A reduces the compression efficiency of the compressor 1.

[0022] In this construction, the gas refrigerant separated in the gas-liquid separator 4 is introduced to the intermediate pressure portion of the compressor 1, that is, between the intermediate cooler 1C and the second-stage compressing portion 1B, and thus the compression efficiency of the compressor 1 can be enhanced. In this embodiment, particularly carbon dioxide refrigerant is filled in the refrigerant circuit, and thus with respect to the ratio of gas and liquid which are separated from each other in the gas-liquid separator 4, the gas amount (the line segment h-i) is larger as compared with chlorofluorocarbon refrigerant, and the large amount of gas refrigerant is introduced to the intermediate pressure portion of the compressor 1 to thereby enhance the efficiency.

[0023] In this embodiment, all the constituent elements of the heat absorbing unit 10 functioning selectively in different temperature zones, that is, the three-way valve 11, the first and second capillary tubes 12 and 13 and the heat absorber 14 are provided in the low pressure side circuit 9 in which the liquid refrigerant separated in the gas-liquid separator 4 is circulated. Therefore, for example in both the cases where refrigerating operation is carried out and where freezing operation is carried out, the high-efficiency operation can be performed without reducing the efficiency.

[0024] Fig. 4 shows an example in which the above embodiment is applied to a refrigerator.

[0025] A refrigerator 40 has a refrigerating chamber 41 at the upper stage, and a freezing chamber 42 at a lower stage. A refrigerator partition wall 43 is provided at an inner back side of the freezing chamber 42, and the heat absorber 14 is disposed in an air flow path 44 partitioned by the refrigerator partition wall 43. A first change-over dumper 45 is disposed at the inlet port of the air flow path 44, and the first change-over duper 45 is switched between a closing position (broken-line position) at which the inlet port A of the air flow path 44 is closed and an opening position (solid-line position) at which the inlet port A of the air flow path 44 is opened. Furthermore, a back-side air flow path 46 is formed in the back wall 47 of the refrigerator 40, and when the first change-over dumper 45 is switched to the broken-line position, the inlet port A of the air flow path 44 and the refrigerating chamber 41 intercommunicate with each other through the back-side air flow path 46. A fan 48 and a second change-over dumper 49 are disposed at the outlet port B of the air flow path 44, and the second change-over dumper 49 is switched between a closing position (broken-line position) at which the outlet port B of the air blow path 44 is closed and an opening position (solid-line position) at which the outlet port B of the air blow path 44 is opened. At the solid-line position, the second change-over dumper 49 closes an opening 51 of an intermediate partition wall 50.

[0026] Fig. 5 shows an cooling example 1.

[0027] The area from the initial point to the point a corresponds to the freezing operation. Referring to Fig. 4 (the dumpers 45 and 49 are located at the solid-line positions), cold air cooled by the heat absorber 14 is circulated in the air flow path 44, and fed to the freezing chamber 42, whereby the temperature of the freezing chamber 42 is gradually reduced. On the other hand, the temperature of the refrigerating chamber 41 to which no cold air is fed is gradually increased. During this period, the compressor 1 is turned on, the fan 48 is turned on, and each of the dumpers 45 and 49 is switched to the solid-line position. By switching the three-way valve 11, refrigerant is made to flow into the second capillary tube 13, and the opening/closing valve 7 is opened. From a point to b point, the operation is stopped. During this period, no cold air is fed to both the refrigerating chamber 41 and the freezing chamber 42, and the temperature of each of the chambers 41 and 42 is gradually increased. That is, the compressor 1 is turned off and the fan 48 is turned off. In addition, each of the dumpers 45 and 49 is kept to the solid-line position and the three-way valve 11 is fully closed while the opening/closing valve 7 is closed. From b point to c point, the refrigerating operation is carried out. Referring to Fig. 4 (the dumpers 45 and 49 are set to the broken-line positions), air in the refrigerating chamber 41 is circulated through the back-side air flow path 46, and cold air cooled by the heat absorber 14 is fed through the opening 51 of the intermediate partition wall 50 to the refrigerating chamber 41. Accordingly, the temperature of the refrigerating chamber 41 turns into reduction, however, the temperature of the freezing chamber 42 to which no cold air is fed keeps increase. During this period, the compressor 1 is turned on, the fan 48 is turned on, each of the dumpers 45 and 49 is switched to the broken-line position, and the three-way valve 11 is switched, so that the refrigerant flows into the first capillary tube 12. When the refrigerating operation is started, the opening/closing valve 7 is opened with a predetermined time delay in order to prevent short-cut of the refrigerant passing through the opening/closing valve 7 at the start time of the operation of the compressor 1. Subsequently, this control is repeated from d point to i point.

[0028] Fig. 6 shows a cooling example 2.

[0029] The time period from 1 point to m point corresponds to the freezing operation. Referring to Fig. 4 (the dumpers 45 and 49 are set to the solid-line position), and cold air cooled by the heat absorber 14 is circulated in the air flow path 44 and fed to the freezing chamber 42. Accordingly, the temperature of the freezing chamber 42 is gradually reduced. On the other hand, the temperature of the refrigerating chamber 41 to which no cold air is fed is gradually increased. During this time period, the compressor 1 is turned on, the fan 48 is turned on, each of the dumpers 45 and 49 is switched to the solid-line position and the three-way valve 11 is switched, so that the refrigerant is made to flow in the second capillary tube 13 and the opening/closing valve 7 is opened. From the time period from m point to n point, the refrigerating operation is carried out. Referring to Fig. 4 (the dumpers 45 and 49 are set to the broken-line positions), air in the refrigerating chamber 41 is circulated through the back-side air blow path 46, and cold air cooled by the heat absorber 14 is passed through the opening 51 of the intermediate partition wall 50 to the refrigerating chamber 41. Accordingly, the temperature of the refrigerating chamber 41 turns into reduction, however, the temperature of the freezing chamber 42 to which no cold air is fed turns into increase. During this period, the compressor 1 and the fan 48 are kept to ON-state, each of the dumpers 45 and 49 is switched to the broken-line position, and the three-way valve 11 is switched, so that the refrigerant is made to flow into the first capillary tube 12. From the time period from n point to o point, the operation is stopped. During this period, no cold air is fed to both the refrigerating chamber 41 and the freezing chamber 42, and the temperature of each of the chambers 41 and 42 is gradually increased. That is, the compressor 1 is turned off and the fan 48 is turned off. Both the dumpers 45 and 49 are not switched, and kept to the broken-line positions. The three-way valve 11 is fully closed, and the opening valve 7 is closed. Subsequently, this control is repeated during the time period from p point to s point.

[0030] Fig. 7 shows another embodiment. This embodiment is different from the embodiment shown in Fig. 4 in the dumper construction at the outlet and inlet ports of the air flow path 44. The dumper at the inlet port A is constructed by two dumpers 145A and 145B, and the dumper at the outlet port B is constructed by two dumpers 149A and 149B.

[0031] Fig. 8 shows another embodiment. This embodiment is different from the embodiment of Fig. 4 in the construction of the heat absorbing unit 10. That is, the heat absorbing unit 10 comprises a fourth capillary tube 55 and an electric motor operated valve 56 connected t the fourth capillary tube 55 in series. Reference numeral 54 represents an electric motor operated valve. The fourth capillary tube 55 has a fixed resistance value, and the overall resistance value can be varied by adjusting the resistance value of the fourth capillary tube 55 and the valve opening degree of the electric motor operated valve 56, so that the refrigeration or freezing operation can be performed. Substantially the same effect as the above embodiment can be achieved.

[0032] Fig. 9 shows the construction of another refrigerant circuit.

[0033] This construction is different from the construction shown in Fig. 1 in the construction of the heat absorbing unit 10. The heating unit of this embodiment comprises a three-way valve 11, a first capillary tube 12, a heat absorber for refrigeration which is connected to the first capillary tube 12 in series, a second capillary tube 13 which is provided in parallel to the above elements, and a heat absorber 58 for freezing which is connected to the second capillary tube 13. Reference numeral 59 represents a check valve.

[0034] Fig. 10 shows an applied example to a refrigerator. The refrigerator 40 has a refrigerating chamber 41 at the upper stage and a freezing chamber 42 at the lower stage. Inner partition walls 61 and 62 are provided at the inner back sides of the respective chambers 41 and 42, and the heat absorbers 57 and 58 and fans 63 and 64 are provided in the air flow paths 44 partitioned by the inner partition walls 61 and 62, respectively. In this construction, the three-way valve 11 is switched in accordance with the thermo-on, thermo-off of the refrigerating operation and the freezing operation so that refrigerant is made to flow into any one of the heat absorbers 57 and 58, and the corresponding fan 62 or 63 is operated.

[0035] Fig. 11 shows another construction.

[0036] This construction is different from the construction of Fig. 10 in the construction of the heat absorbing unit 10. The three-way valve is eliminated from the heat absorbing unit 10, however, electric motor operated valves 65 and 66 are connected to the capillary tubes 12 and 13, respectively. Reference numeral 67 represents an electric motor operated valve. In this construction, the electric motor operated valves 65 and 66 are turned on or off in accordance with the thermo-on or thermo-off of the refrigerating operation and the freezing operation so that refrigerant is made to selectively flow into any one of the heat absorbers 57 and d58, and also the corresponding fan 62 or 63 is driven. In these embodiments, the same effect as the embodiment described above can be achieved.

[0037] The present invention is not limited to the above embodiments, and various modifications may be made without departing from the subject matter of the present invention. In the above embodiments, carbon dioxide refrigerant is filled in the refrigerant circuit, however, the refrigerant used in the present invention is not limited to carbon dioxide. For example, chlorofluorocarbon (Freon) type refrigerant or the like may be used.

Claims

1. A refrigerating machine comprising a compressor, a radiator, a pressure-reducing device, a gas-liquid separator, a unit for selectively introducing gas refrigerant separated in the gas-liquid separator into an intermediate pressure portion of the compressor, and a low pressure side circuit in which liquid refrigerant separated in the gas-liquid separator is circulated, wherein the low pressure side circuit is provided with a heat absorbing unit functioning selectively in one of different temperature zones, and refrigerant passing through the selected heat absorbing unit is returned to a suction portion of the compressor.

2. The refrigerating machine according to claim 1, wherein the heat absorbing unit has plural heat absorbers functioning in different temperature zones, the heat absorbers selectively function, and the refrigerating machine further comprises a unit for guiding cold air passing through the heat absorbers to chambers controlled to the corresponding temperature zones.

3. The refrigerating machine according to claim 2, wherein the respective heat absorbers are disposed in the chambers controlled to the corresponding temperature zones.

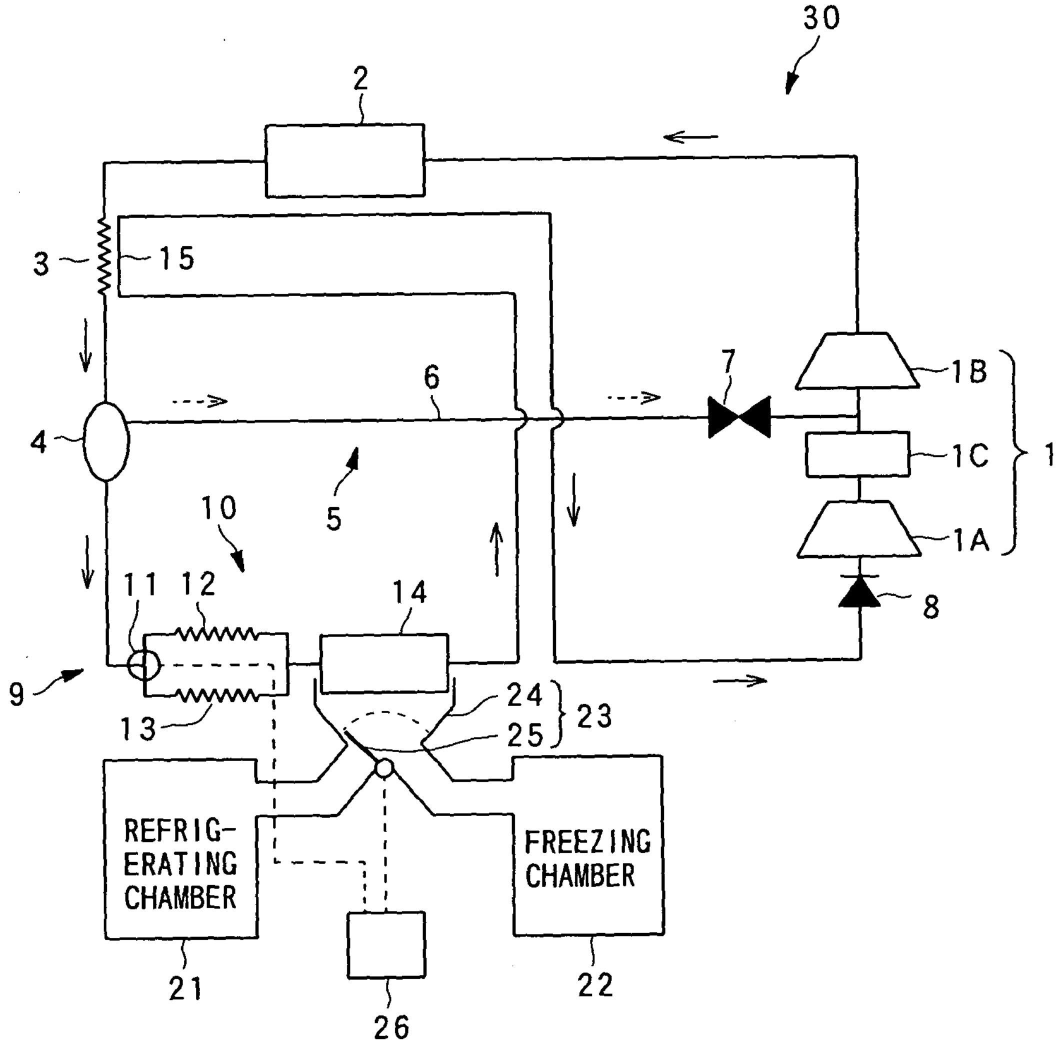
4. The refrigerating machine according to claim 1, wherein the heat absorbing unit is provided with one heat absorber which functions selectively in different temperature zones, and the refrigerating machine further comprises a unit for selectively guiding cold air passing through the heat absorber through a change-over dumper to plural chambers controlled to different temperature zones.

5. The refrigerating machine according to claim 4, wherein the heat absorber is disposed in a chamber controlled to a low temperature zone.

6. The refrigerating machine according to claim 1, wherein the refrigerant is formed of refrigerant with which the high pressure side is set to supercritical pressure under operation.

7. The refrigerating machine according to claim 6, wherein the refrigerant is formed of carbon dioxide.

FIG. 1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REFRIG-
ERATING
CHAMBER
FREEZING
CHAMBER
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FIG. 2

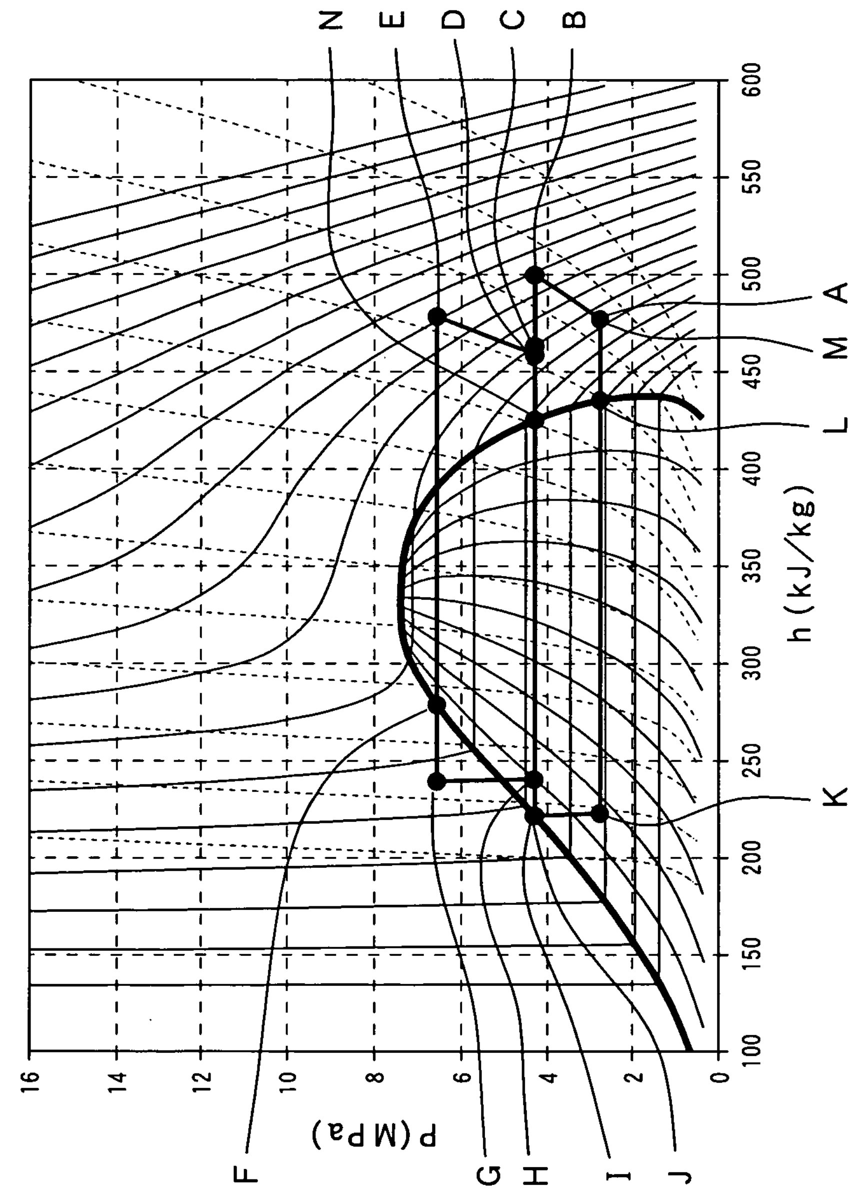
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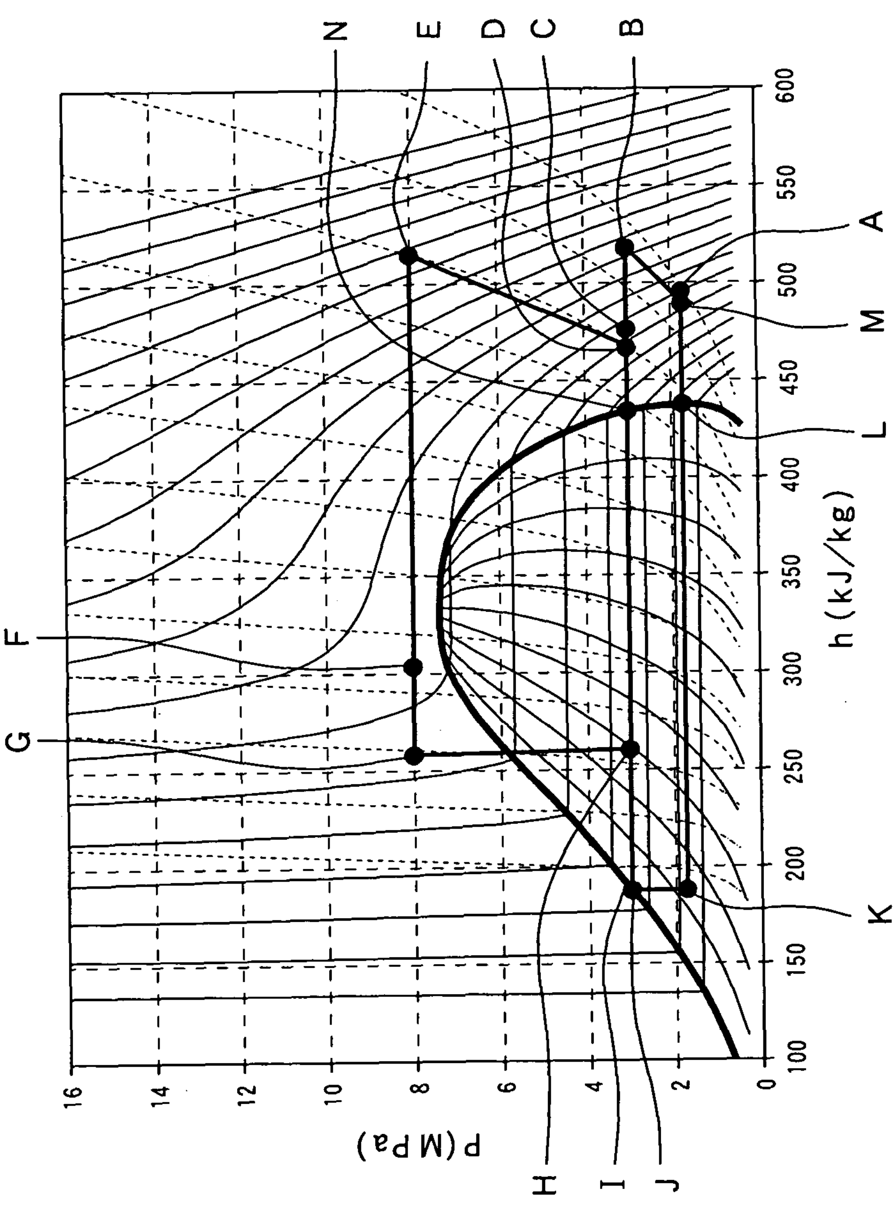
FIG. 3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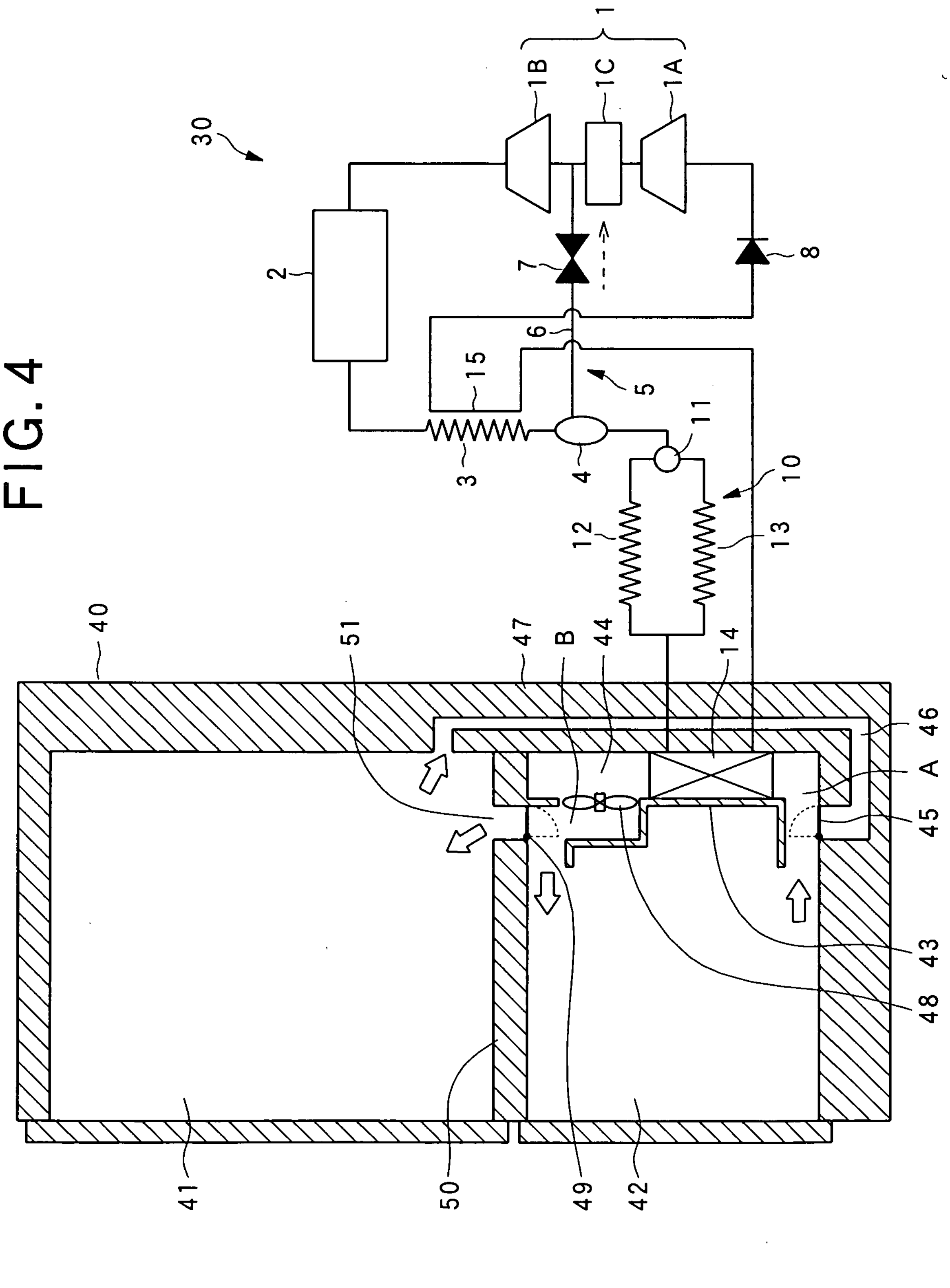
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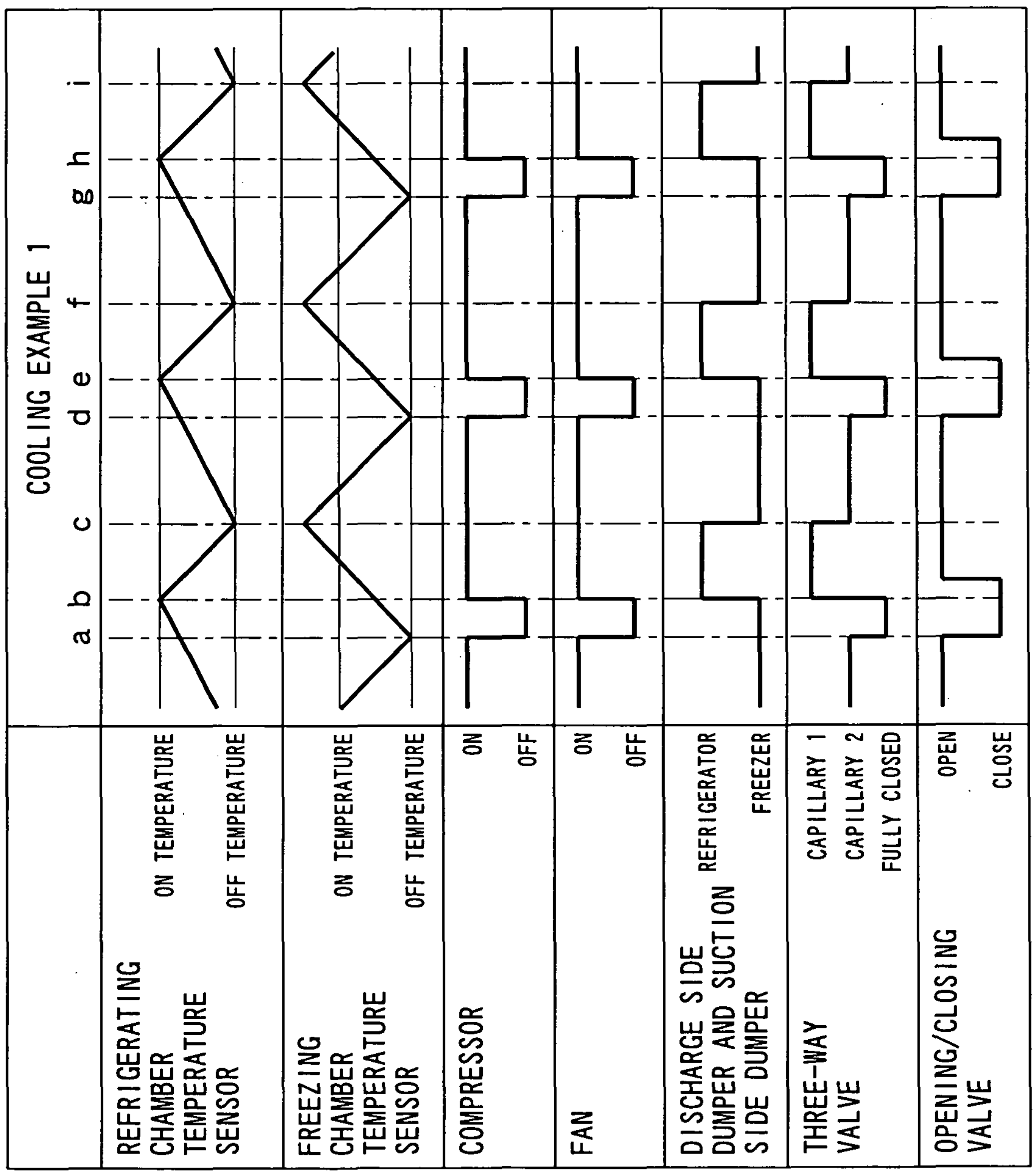
FIG. 4

FIG. 5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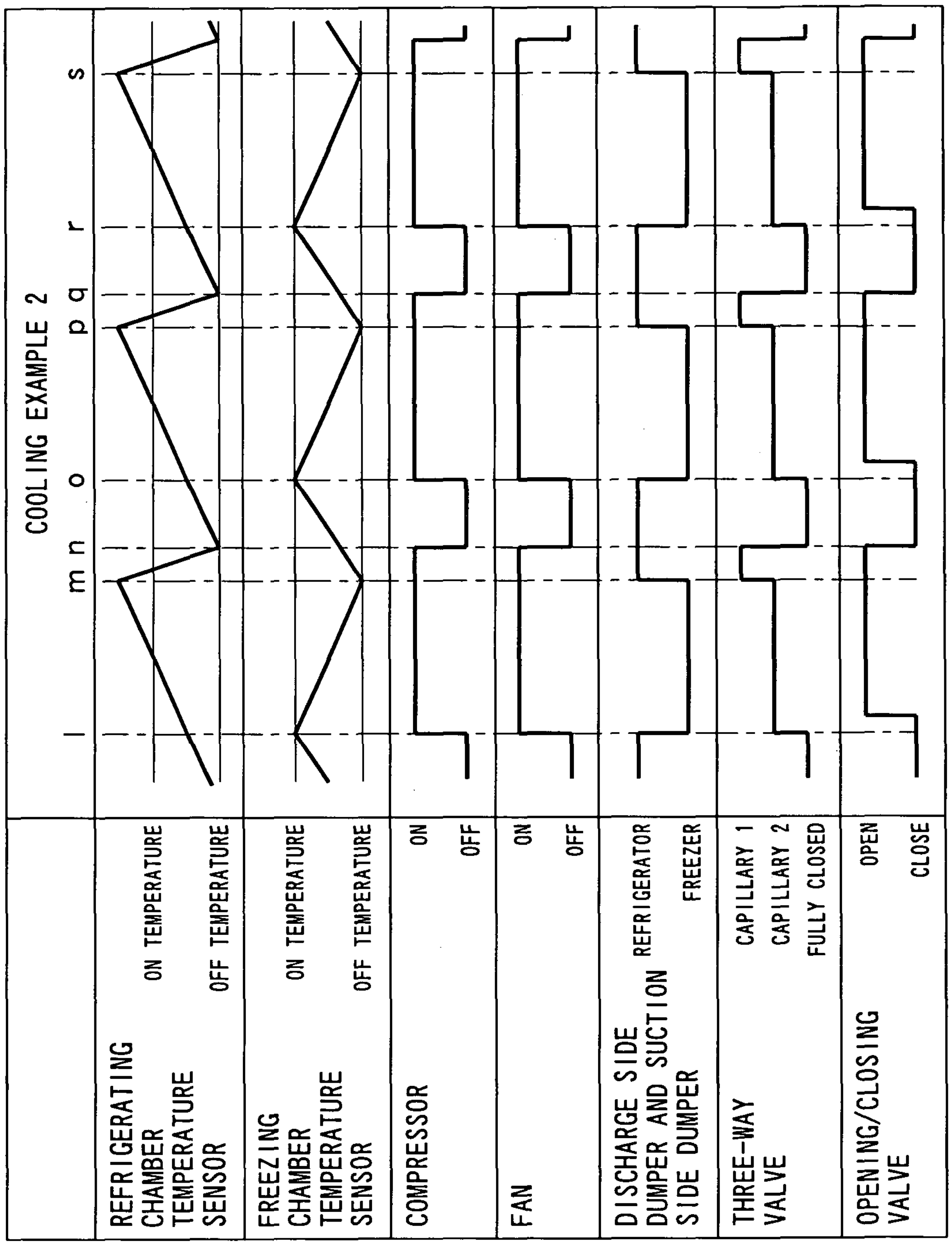
FREEZING CHAMBER TEMPERATURE SENSOR
ON TEMPERATURE
OFF TEMPERATURE
COMPRESSOR
ON
OFF
FAN
ON
OFF
DISCHARGE SIDE DUMPER AND SUCTION SIDE DUMPER
REFRIGERATOR
FREEZER
THREE-WAY VALVE
CAPILLARY 1
CAPILLARY 2
FULLY CLOSED
OPENING/CLOSING VALVE
OPEN
CLOSE

FIG. 6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DISCHARGE SIDE DUMPER AND SUCTION SIDE DUMPER
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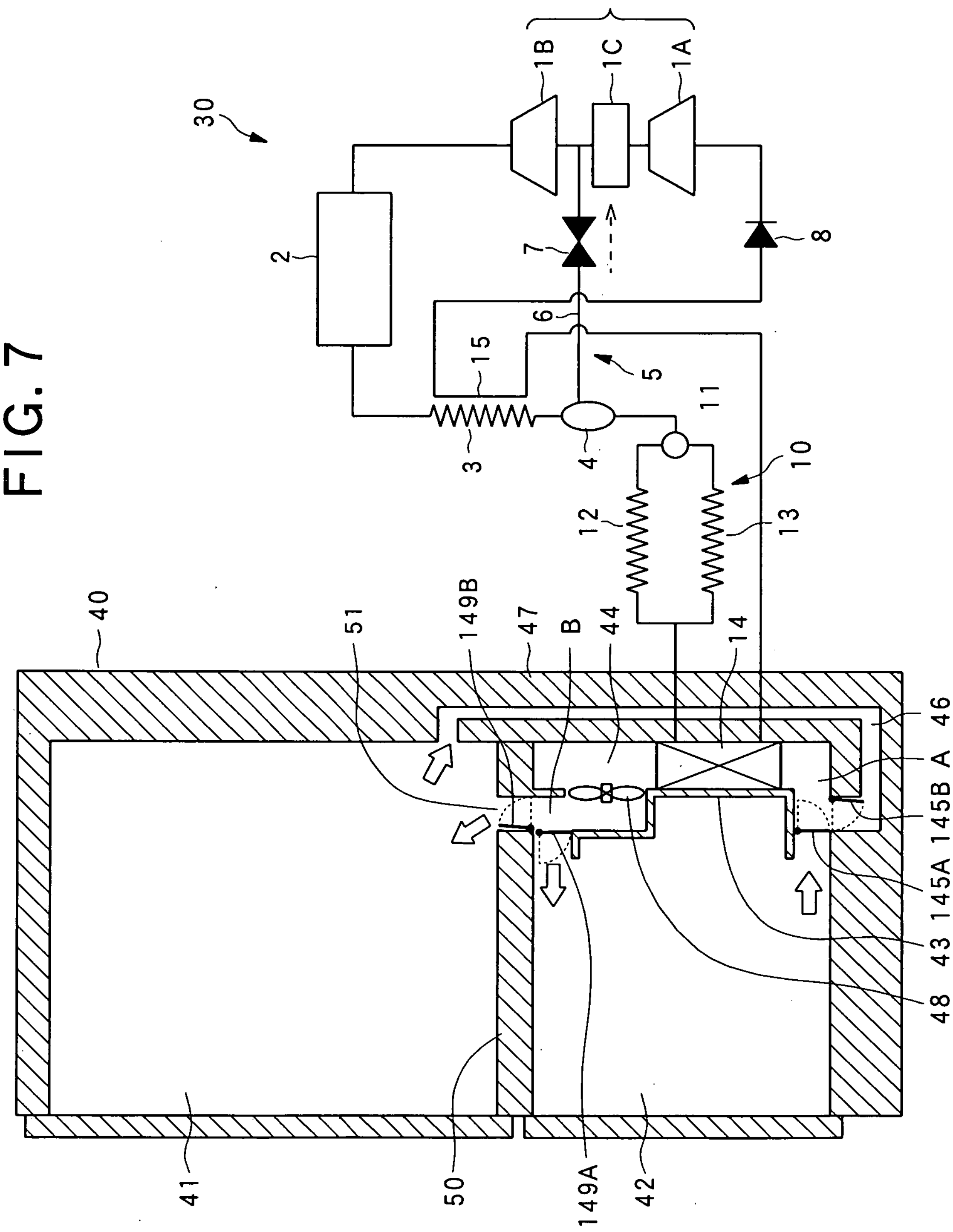
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FIG. 7

FIG. 8

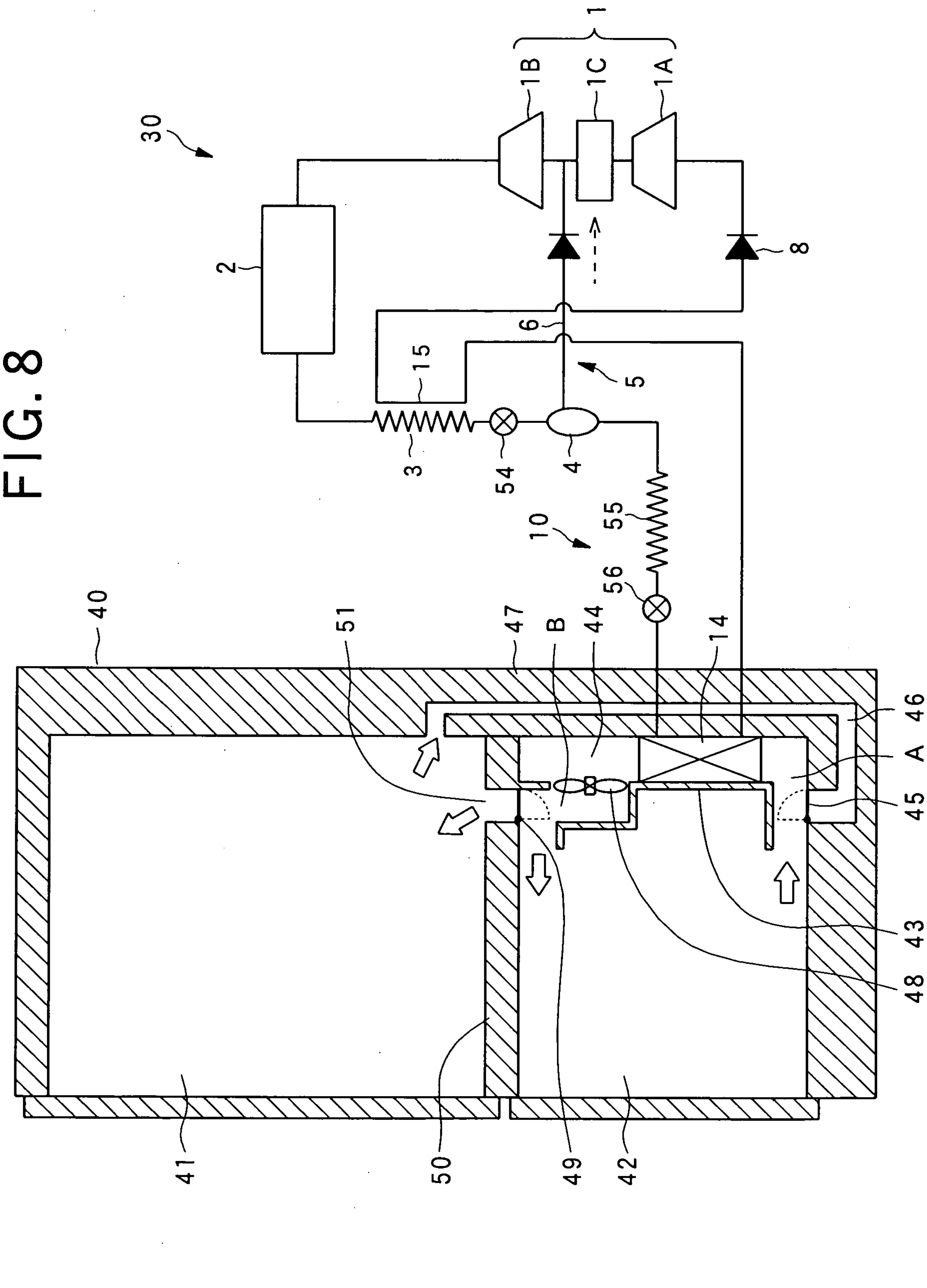

30
1
1B
1C
1A
2
8
6
15
5
3
54
4
10
55
56
40
51
47
B
44
14
46
A
45
43
48
41
50
49
42

FIG. 9

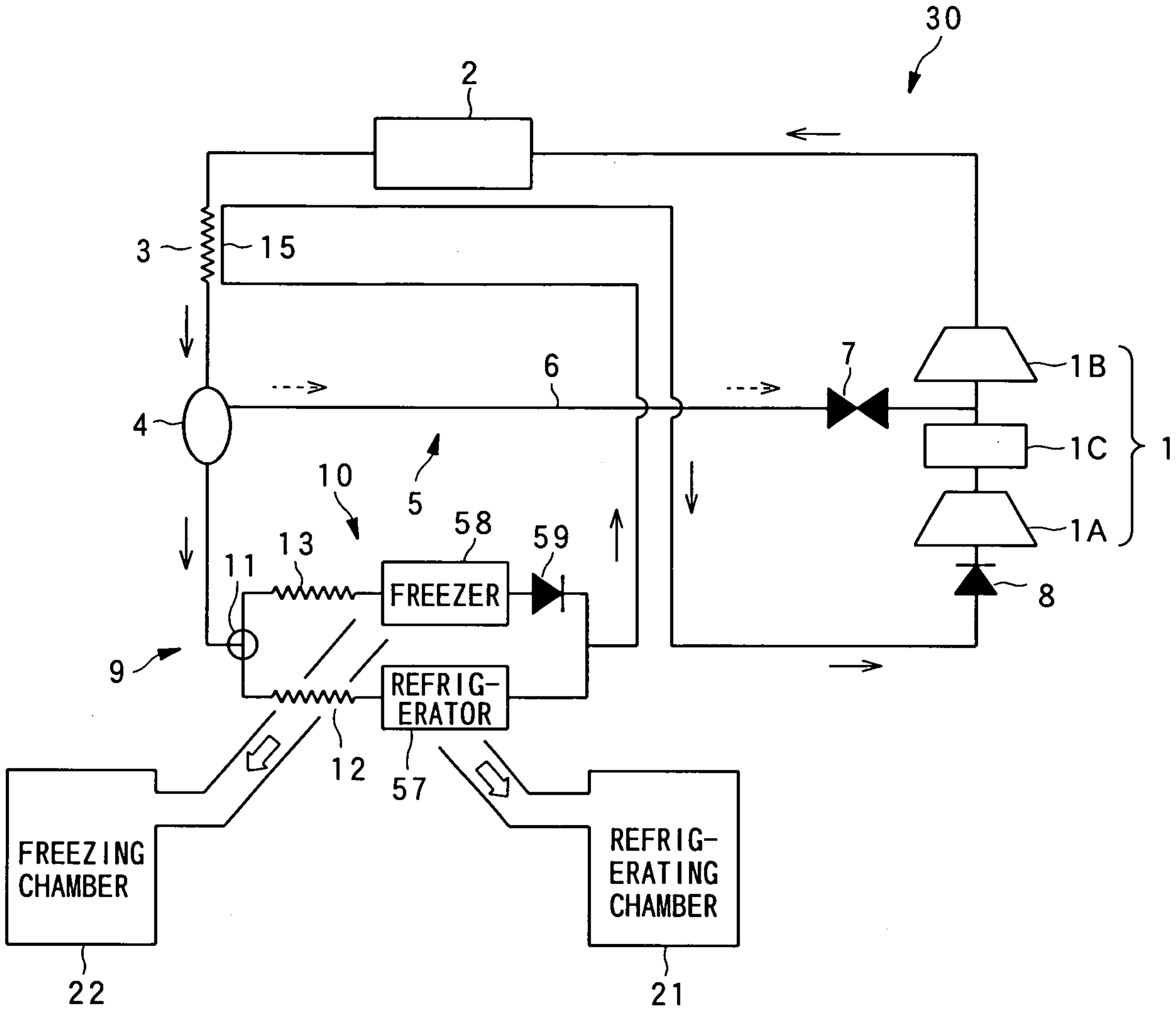
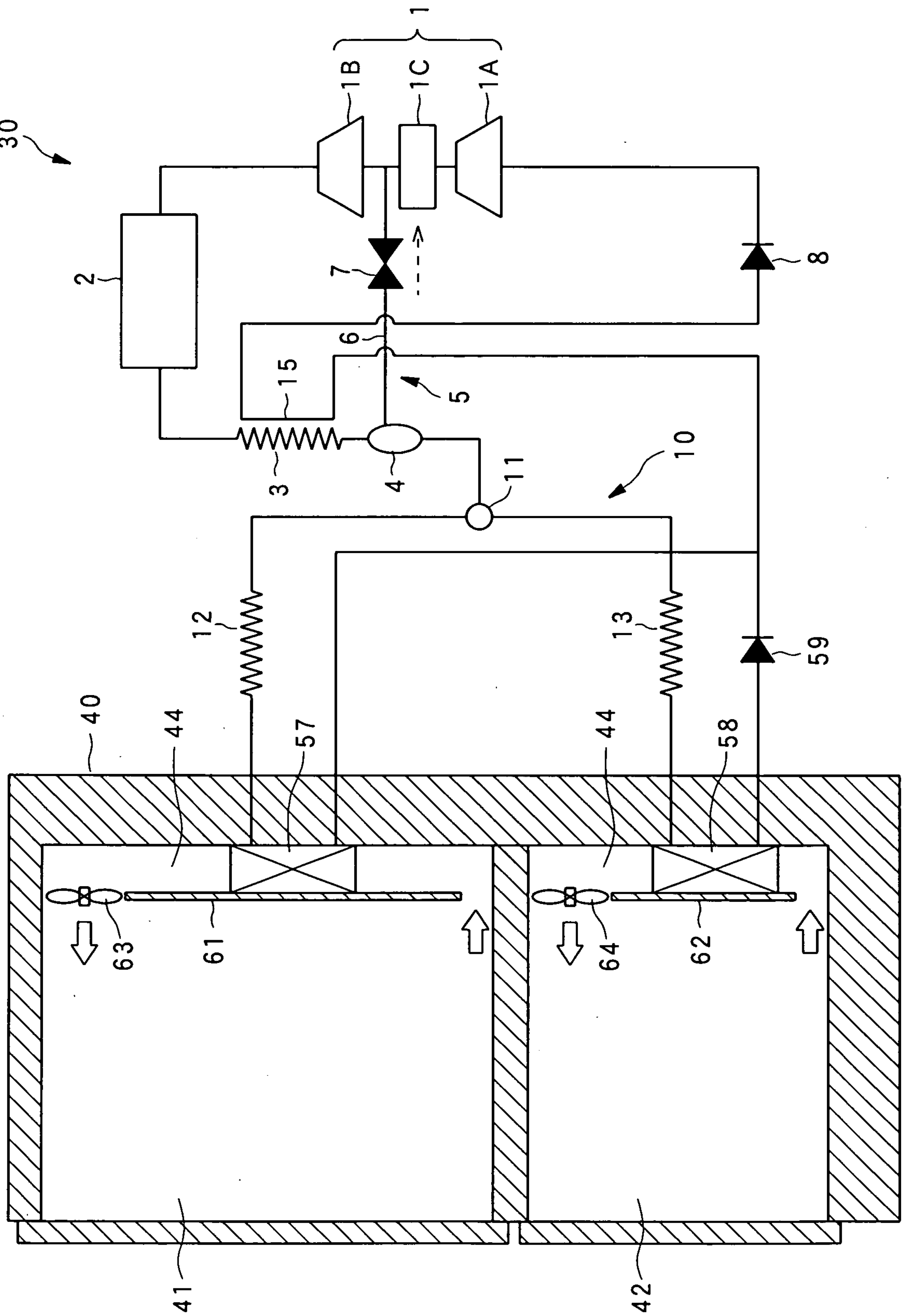

30
2
3
15
6
7
1B
4
1C
1
10
5
58
59
1A
13
11
FREEZER
8
9
REFRIG-
ERATOR
12
57
FREEZING
CHAMBER
REFRIG-
ERATING
CHAMBER
22
21

FIG.10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1
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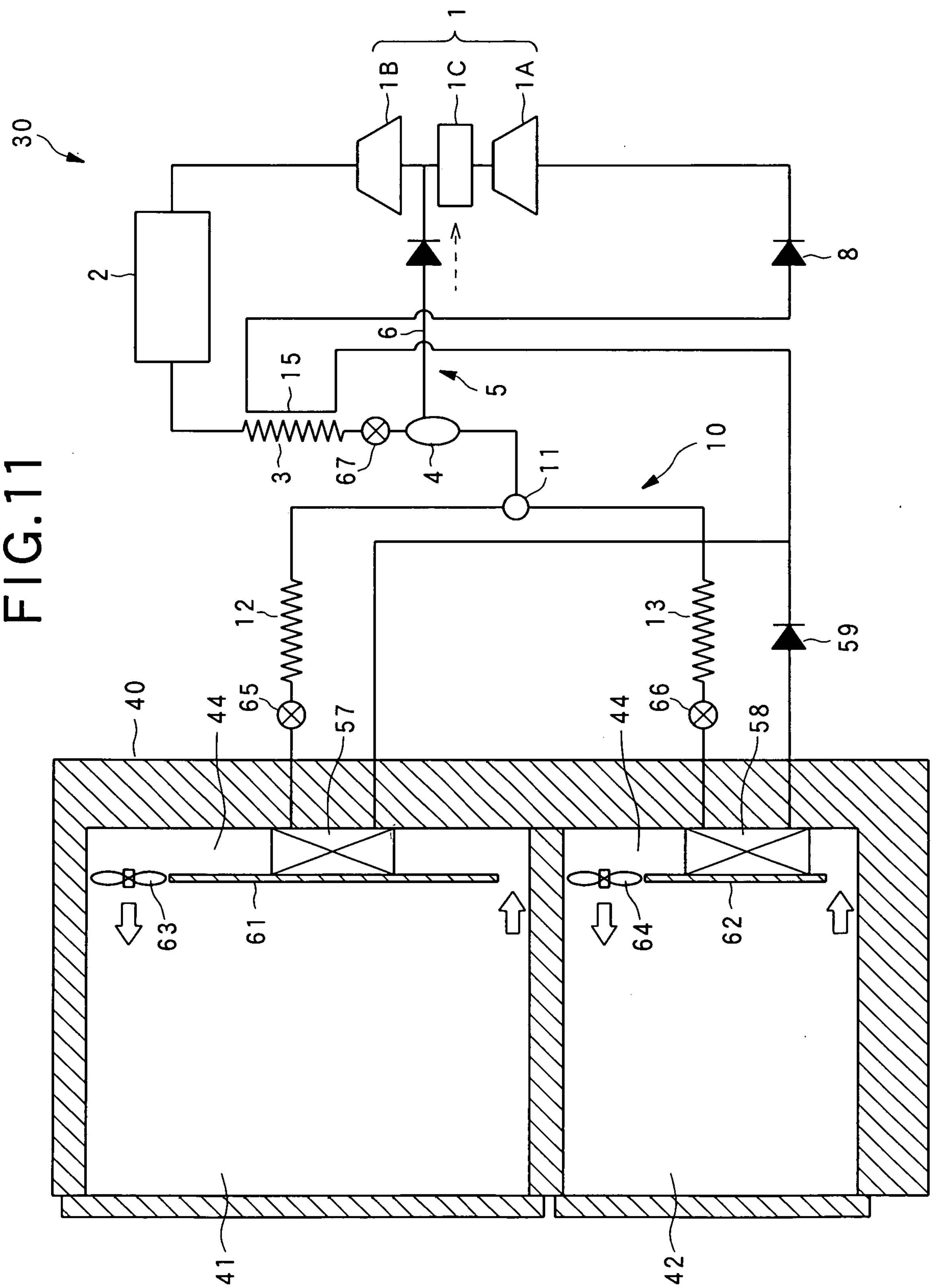
1C
1A
2
7
8
6
15
5
3
4
11
10
12
13
59
40
44
57
44
58
63
61
64
62
41
42

FIG.11


30
1
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1C
1A
2
8
6
15
5
10
3
67
4
11
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13
59
40
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65
57
44
66
58
63
61
64
62
41
42