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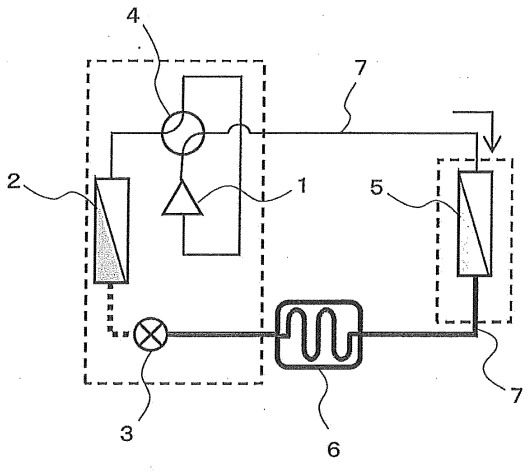
(54) REFRIGERATION CYCLE DEVICE

(57) A refrigeration cycle apparatus includes a compressor 1, a use-side heat exchanger 5, a heat source-side flow control valve 3, and a heat source-side heat exchanger 2. The refrigeration cycle apparatus is configured to circulate refrigerant through in an order of the compressor 1, the use-side heat exchanger 5, the heat source-side flow control valve 3, and the heat source-side heat exchanger 2 in a heating operation. The refrigeration cycle apparatus further includes a heat storage device 6 connected between the use-side heat exchanger 5 and the heat source-side flow control valve 3. The heat storage device 6 is configured to store heat through heat exchange with the circulating refrigerant.

F I G. 1



EP 3 006 865 A1

Description

Technical Field

[0001] The present invention relates to a refrigeration cycle apparatus including a heat storage device in a refrigerant circuit.

Background Art

[0002] As the related art, there is known a refrigeration cycle apparatus having a heat storage device arranged in a refrigerant circuit, and using heat stored in the heat storage device to quickly start a heating operation or shorten a defrosting operation period when heating is started or when an outdoor heat exchanger is defrosted in a low outside air temperature environment.

[0003] To store the heat in the heat storage device of the refrigeration cycle apparatus as described above, the refrigeration cycle apparatus has, for example, a system having a heating unit, for example, additionally arranged in the heat storage device as a heat source for the heat storage to drive the heating unit in the heat storing operation, a configuration of transferring exhaust heat from a shell of a compressor to a heat storage material to perform the heat storing operation, or a configuration of using refrigerant discharged from the compressor as a heat source (see, for example, Patent Literatures 1 and 2).

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2000-291985
Patent Literature 2: Japanese Patent No. 2503637

Summary of Invention

Technical Problem

[0005] The related-art heat storage device has problems in that the heating unit that is an external heat source prepared for the heat storage device requires additional equipment and electric power, that using the exhaust heat from the shell of the compressor for the heat storage device deteriorates starting performance of the heating, and that using the heat, to be stored, from the refrigerant discharged from the compressor also deteriorates the starting performance of the heating.

[0006] The present invention has been made to solve the above-mentioned problems, and has an object to provide a refrigeration cycle apparatus that requires no external heat source, uses necessary heat from a refrigeration cycle as a heat-storage heat source, stores heat in a heat storage device without adversely affecting starting performance of heating, shortens a defrosting operation period, and improves the comfort in a room.

Solution to Problem

[0007] A refrigeration cycle apparatus according to the present invention includes a compressor, a use-side heat exchanger, a heat source-side flow control valve, and a heat source-side heat exchanger. The refrigeration cycle apparatus is configured to circulate refrigerant through in an order of the compressor, the use-side heat exchanger, the heat source-side flow control valve, and the heat source-side heat exchanger in a heating operation. The refrigeration cycle apparatus further includes a heat storage device connected between the use-side heat exchanger and the heat source-side flow control valve. The heat storage device is configured to store heat through heat exchange with the circulating refrigerant.

Advantageous Effects of Invention

[0008] According to the refrigeration cycle apparatus of the present invention, to heat the heat storage device, a liquid refrigerant transferred heat to the use-side heat exchanger to contribute to a heating operation is used as a heat source. Consequently, the heat storage device can be heated without providing another heat source for heating the heat storage device. Further, exhaust heat from a shell of the compressor in the refrigeration cycle or heat of refrigerant discharged from the compressor is not used as a heat source. Consequently, a refrigeration cycle apparatus capable of quickly starting a heating operation can be provided.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a structural diagram of a refrigeration cycle apparatus according to Embodiment 1 of the present invention.
[Fig. 2] Fig. 2 is a Mollier chart in a heating and heat storing operation of the refrigeration cycle apparatus according to Embodiment 1.
[Fig. 3] Fig. 3 is a graph showing a heating capacity of the refrigeration cycle apparatus in a defrosting operation according to Embodiment 1.
[Fig. 4] Fig. 4 is a structural diagram of a refrigeration cycle apparatus according to Embodiment 2 of the present invention.
[Fig. 5] Fig. 5 is a Mollier chart in a heating and heat storing operation of the refrigeration cycle apparatus according to Embodiment 2 and Embodiment 3 of the present invention.
[Fig. 6] Fig. 6 is a structural diagram of the refrigeration cycle apparatus according to Embodiment 3.
[Fig. 7] Fig. 7 is a Mollier chart in a heating and defrosting operation of the refrigeration cycle appara-

tus according to Embodiment 3.

[Fig. 8] Fig. 8 is a graph showing a heating capacity of the refrigeration cycle apparatus in the heating and defrosting operation according to Embodiment 3.

[Fig. 9] Fig. 9 is a structural diagram of a refrigeration cycle apparatus according to Embodiment 4 of the present invention.

Description of Embodiments

[0010] Embodiments of the present invention are described below with reference to the drawings. Note that, the present invention is not limited to the embodiments described below.

Embodiment 1

[0011] Fig. 1 is a structural diagram of a refrigeration cycle apparatus according to Embodiment 1. A compressor 1, a heat source-side heat exchanger 2, a heat source-side flow control valve 3, a four-way valve 4, a use-side heat exchanger 5, and a heat storage device 6 are connected via refrigerant pipes 7 to construct a refrigeration cycle apparatus. The heat storage device 6 of the refrigeration cycle apparatus is connected between the use-side heat exchanger 5 and the heat source-side flow control valve 3.

[0012] Next, a heating and heat storing operation and a defrosting operation according to Embodiment 1 are described.

[Heating and Heat Storing Operation]

[0013] When the refrigeration cycle apparatus according to Embodiment 1 performs a heating operation, gas refrigerant discharged from the compressor 1 is condensed by the use-side heat exchanger 5 to become liquid refrigerant. The high-pressure liquid refrigerant discharged from the use-side heat exchanger 5 passes through the heat storage device 6. At this time, the heat storage device 6 stores heat from the high-pressure liquid refrigerant. The high-pressure liquid refrigerant transfers heat to the heat storage device 6 to be subcooled, passes through the heat source-side flow control valve 3, and is evaporated by the heat source-side heat exchanger 2, followed by being sucked into the compressor 1.

[0014] Fig. 2 is a Mollier chart in the heating and heat storing operation. As shown in Fig. 2, the high-pressure liquid refrigerant condensed by the use-side heat exchanger 5 subsequently passes through the heat storage device 6 and is subcooled. Further, the opening degree of the heat source-side flow control valve 3 is controlled based on the degree of subcooling of the refrigerant at an outlet of the use-side heat exchanger 5 or the degree of superheat of the refrigerant at an outlet of the heat source-side heat exchanger 2.

[0015] In this manner, to heat the heat storage device 6, the high-pressure liquid refrigerant that has transferred heat to the use-side heat exchanger 5 to contribute to the heating operation is used as a heat source. Consequently, the heat storage device 6 can be heated without providing another heat source for heating the heat storage device 6. Further, exhaust heat from a shell of the compressor in the refrigeration cycle or heat of the refrigerant discharged from the compressor is not used, and hence starting performance of the heating operation is not deteriorated.

[Defrosting Operation]

[0016] Next, an operation of defrosting the heat source-side heat exchanger 2 is described. The four-way valve 4 is switched from the heating and heat storing operation to the defrosting operation so that the gas refrigerant discharged from the compressor 1 is sent to the heat source-side heat exchanger 2 and condensed, to thereby defrost the heat source-side heat exchanger 2. The condensed liquid refrigerant is sent to the heat storage device 6 via the heat source-side flow control valve 3, and is evaporated due to the heat stored in the heating and heat storing operation. The evaporated gas refrigerant passes through the use-side heat exchanger 5 and is sucked into the compressor 1. The opening degree of the heat source-side flow control valve 3 in the defrosting operation is at the maximum.

[0017] Fig. 3 shows a change in heating capacity in comparison between the case where the defrosting operation of the heat source-side heat exchanger 2 is performed with the heat stored in the heat storage device 6 as described above and the case where the defrosting operation is performed with a refrigeration cycle without the heat storage device 6.

[0018] As shown in Fig. 3, the defrosting operation by the refrigeration cycle with the heat storage device 6 has a shorter defrosting period than the defrosting operation by the refrigeration cycle without the heat storage device 6, and the heating operation is resumed in a shorter period of time from the start of the defrosting operation.

[0019] Consequently, the comfort in the room in the heating operation is improved.

[0020] The types of the heat storage device 6 include a type in which the heat storage device 6 is incorporated into an outdoor unit and a type in which the heat storage device 6 is interposed in the middle of the refrigerant pipe outside the outdoor unit. When the heat storage device 6 is installed outside, if the heat storage device 6 is installed at a lower part of the outdoor unit, defrosting capacity can be enhanced without increasing the installation area in a plan view. Further, when the heat storage device 6 is arranged outside the outdoor unit, the heat storage device 6 can be employed in an existing outdoor unit.

[0021] As a heat storage material to be incorporated into the heat storage device 6, any one of a sensible heat storage material and a latent heat storage material can

be employed. The latent heat storage material is preferred in terms of heat capacity. For example, a latent heat storage material having a melting point of 0 degrees C or higher, such as paraffin and polyethyleneglycol, is suitable. The use of a latent heat storage material having a melting point of 0 degrees C or higher can secure a sufficient heat amount in the defrosting operation.

[0022] A refrigerant passage in the heat storage device 6 may have any shape as long as the refrigerant passage can be brought into contact with the heat storage material with a large area to transfer heat. For example, a heat transfer tube having a spiral shape and a plate type heat exchanger shape are conceivable.

Embodiment 2

[0023] A refrigeration cycle apparatus according to Embodiment 2 differs from the refrigeration cycle apparatus according to Embodiment 1 in that the refrigeration cycle apparatus according to Embodiment 2 includes a plurality of use-side heat exchangers 5 and use-side flow control valves 8 corresponding to the plurality of use-side heat exchangers 5.

[0024] Fig. 4 is a structural diagram of the refrigeration cycle apparatus according to Embodiment 2. The compressor 1, the heat source-side heat exchanger 2, the heat source-side flow control valve 3, the four-way valve 4, the use-side heat exchangers 5, the use-side flow control valves 8, and the heat storage device 6 are connected via the refrigerant pipes 7 to construct a refrigeration cycle apparatus. The heat storage device 6 of the refrigeration cycle apparatus is connected between the use-side flow control valves 8 and the heat source-side flow control valve 3.

[0025] Next, a heating and heat storing operation and a defrosting operation according to Embodiment 2 are described.

[Heating and Heat Storing Operation]

[0026] When the refrigeration cycle apparatus according to Embodiment 2 performs a heating operation, gas refrigerant discharged from the compressor 1 is condensed by the use-side heat exchangers 5 to become liquid refrigerant. The high-pressure liquid refrigerant discharged from the use-side heat exchangers 5 passes through the heat storage device 6 via the use-side flow control valves 8. At this time, the heat storage device 6 stores heat from the high-pressure liquid refrigerant. The high-pressure liquid refrigerant transfers heat to the heat storage device 6 to be subcooled, passes through the heat source-side flow control valve 3, and is evaporated by the heat source-side heat exchanger 2, followed by being sucked into the compressor 1.

[0027] Fig. 5 is a Mollier chart in the heating and heat storing operation. As shown in Fig. 5, the high-pressure liquid refrigerant condensed by the use-side heat exchangers 5 is reduced in pressure by the use-side flow control valves 8 for the first stage, and thereafter has an intermediate pressure between a condensing pressure and an evaporating pressure, followed by passing through the heat storage device 6 to be subcooled. Then, the refrigerant is reduced in pressure by the heat source-side flow control valve 3 for the second stage, and is evaporated by the heat source-side heat exchanger 2. At this time, the opening degree of the use-side flow control valve 8 is controlled based on the degree of subcooling of the refrigerant at the outlet of the use-side heat exchanger 5 or the degree of superheat of the refrigerant at the outlet of the heat source-side heat exchanger 2. Further, the opening degree of the heat source-side flow control valve 3 is controlled so that the refrigerant that transfers heat to the heat storage device 6 arranged on the upstream side of the heat source-side flow control valve 3 has the intermediate pressure between the condensing pressure and the evaporating pressure.

[0028] In this manner, to heat the heat storage device 6, the high-pressure liquid refrigerant that has transferred heat to the plurality of use-side heat exchangers 5 to contribute to the heating operation and is reduced in pressure by the use-side flow control valves 8 to have the intermediate pressure is used as a heat source. Consequently, the heat storage device 6 can be heated without providing another heat source for heating the heat storage device 6. Further, similarly to Embodiment 1, exhaust heat from a shell of the compressor in the refrigeration cycle or heat of the refrigerant discharged from the compressor is not used, and hence starting performance of the heating operation is not deteriorated.

[Defrosting Operation]

[0029] Next, an operation of defrosting the heat source-side heat exchanger 2 is described.

[0030] The flow of the refrigerant is the same as in Embodiment 1. In Embodiment 2, however, both the opening degrees of the heat source-side flow control valve 3 and the use-side flow control valves 8 are controlled to be at the maximum to perform the defrosting operation.

[0031] Then, a change in heating capacity in comparison between the case where the defrosting operation of the heat source-side heat exchanger 2 is performed with the heat stored in the heat storage device 6 and the case where the defrosting operation is performed with a refrigeration cycle without the heat storage device 6 is as shown in Fig. 3 similarly to Embodiment 1.

Embodiment 3

[0032] In Embodiment 3, a bypass refrigerant circuit is provided in the refrigeration cycle apparatus according to Embodiment 2, to thereby enable the heating operation and the defrosting operation to be performed simultaneously.

[0033] Fig. 6 is a structural diagram of the refrigeration cycle apparatus according to Embodiment 3. The com-

pressor 1, the heat source-side heat exchanger 2, the heat source-side flow control valve 3, the four-way valve 4, the use-side heat exchangers 5, the use-side flow control valves 8, and the heat storage device 6 incorporating a heat-storage heat exchanger 6a and a heat-transfer heat exchanger 6b are connected via the refrigerant pipes 7 to construct a refrigeration cycle apparatus. This refrigeration cycle apparatus further includes a first bypass circuit 9 connected from the discharge side of the compressor 1 to the refrigerant inlet side of the heat source-side heat exchanger 2, a first bypass flow control valve 10 provided to the first bypass circuit 9, a second bypass circuit 11 that branches from the refrigerant pipe 7 between the use-side flow control valves 8 and the heat storage device 6, passes through the heat-transfer heat exchanger 6b, and is connected to a suction refrigerant pipe of the compressor 1, and a second bypass flow control valve 12 provided to the second bypass circuit 11.

[0034] Next, a heating and heat storing operation and a heating and defrosting operation according to Embodiment 3 are described.

[Heating and Heat Storing Operation]

[0035] When the refrigeration cycle apparatus according to Embodiment 3 performs a heating operation, the first bypass flow control valve 10 and the second bypass flow control valve 12 are fully closed and the refrigeration cycle apparatus operates in the same manner as in Embodiment 2.

[0036] Gas refrigerant discharged from the compressor 1 is condensed by the use-side heat exchangers 5 to become liquid refrigerant. The high-pressure liquid refrigerant discharged from the use-side heat exchangers 5 passes through the heat-storage heat exchanger 6a in the heat storage device 6 via the use-side flow control valves 8. At this time, the heat storage device 6 stores heat from the high-pressure liquid refrigerant. The high-pressure liquid refrigerant transfers heat to the heat storage device 6 to be subcooled, passes through the heat source-side flow control valve 3, and is evaporated by the heat source-side heat exchanger 2, followed by being sucked into the compressor 1.

[0037] A Mollier chart in the heating and heat storing operation according to Embodiment 3 is as shown in Fig. 5 similarly to Embodiment 2. In other words, the high-pressure liquid refrigerant condensed by the use-side heat exchangers 5 is reduced in pressure by the use-side flow control valves 8 for the first stage, and thereafter has an intermediate pressure between a condensing pressure and an evaporating pressure, followed by passing through the heat storage device 6 to be subcooled. Then, the refrigerant is reduced in pressure by the heat source-side flow control valve 3 for the second stage, and is evaporated by the heat source-side heat exchanger 2. At this time, the opening degree of the use-side flow control valve 8 is controlled based on the degree of subcooling of the refrigerant at the outlet of the use-side heat exchanger 5 or the degree of superheat of the refrigerant at the outlet of the heat source-side heat exchanger 2. Further, the opening degree of the heat source-side flow control valve 3 is controlled so that the refrigerant that transfers heat to the heat storage device 6 arranged on the upstream side of the heat source-side flow control valve 3 has the intermediate pressure between the condensing pressure and the evaporating pressure.

[Heating and Defrosting Operation]

[0038] Next, the heating and defrosting operation for performing the heating operation while defrosting the heat source-side heat exchanger 2 is described.

[0039] In the heating and defrosting operation, the heat source-side flow control valve 3 is fully closed and the first bypass flow control valve 10 and the second bypass flow control valve 12 are opened so that the refrigerant circuit branches to a heating circuit for circulating the gas refrigerant discharged from the compressor 1 to the use-side heat exchangers 5, the second bypass circuit 11, and the compressor 1, and a defrosting circuit for circulating the gas refrigerant discharged from the compressor 1 to the first bypass circuit 9, the heat source-side heat exchanger 2, and the compressor 1, to thereby perform the heating operation and the defrosting operation simultaneously.

[0040] Fig. 7 is a Mollier chart in the heating and defrosting operation. The gas refrigerant discharged from the compressor 1 is separated into two refrigerants. One refrigerant is condensed by the use-side heat exchangers 5, reduced in pressure by the use-side flow control valves 8 and the second bypass flow control valve 12, evaporated by the heat-transfer heat exchanger 6b of the heat storage device 6, and sucked into the compressor 1. Further, the other refrigerant separated from the gas refrigerant discharged from the compressor 1 is reduced in pressure by the first bypass flow control valve 10, and thereafter condensed by the heat source-side heat exchanger 2, to thereby defrost the heat source-side heat exchanger 2.

[0041] Fig. 8 shows a change in heating capacity in comparison between the case where the defrosting operation is performed with the refrigeration cycle apparatus including the bypass circuit for the heating and defrosting operation and the heat storage device 6 as described above and the case where the defrosting operation is performed with a refrigeration cycle without the heat storage device 6.

[0042] As shown in Fig. 8, the defrosting operation by the refrigeration cycle including the bypass circuit for the heating and defrosting operation and the heat storage device 6 can enable the heating operation to be performed even during the defrosting operation, unlike the refrigeration cycle without the heat storage device 6. Consequently, the comfort in the room in the defrosting operation is improved.

Embodiment 4

[0043] Embodiments 1 to 3 are the embodiments in which the heating operation or the defrosting operation is assumed. However, when the heat storage device 6 is caused to function in a cooling operation, low-temperature low-pressure refrigerant passes through the heat storage device 6 to store cooling energy in the heat storage material, and hence starting performance of the cooling operation is deteriorated.

[0044] A refrigeration cycle apparatus according to Embodiment 4 is provided with a heat storage device bypass circuit 13 for bypassing the low-temperature low-pressure refrigerant arranged for the heat storage device 6 to control a reduction in capacity at the start of the cooling operation.

[0045] Fig. 9 is an illustration of the refrigeration cycle apparatus according to Embodiment 4. In this refrigeration cycle apparatus, the heat storage device bypass circuit 13 for allowing the refrigerant to flow from the heat source-side heat exchanger 2 to the use-side heat exchanger 5 is provided for the heat storage device 6. In the heat storage device bypass circuit 13, a check valve 14 is arranged to regulate the flow of the refrigerant. Further, in the refrigerant pipe 7 of the refrigeration cycle apparatus, a check valve 15 for preventing the refrigerant from flowing from the heat source-side heat exchanger 2 toward the heat storage device 6 is arranged to regulate the flow of the refrigerant.

[0046] When the refrigeration cycle apparatus performs a cooling operation, the refrigerant flows from the heat source-side heat exchanger 2 to the use-side heat exchanger 5 so that the low-temperature low-pressure refrigerant bypasses the heat storage device 6, and hence the reduction in capacity at the start of the cooling operation can be controlled.

[0047] Note that, the heat storage device bypass circuit 13 of Embodiment 4 can be applied for the heat storage device 6 of Embodiments 1 to 3.

[0048] The refrigerant to be employed in the refrigeration cycle apparatus is not particularly limited. For example, any one of natural refrigerants such as carbon dioxide, hydrocarbons, and helium, and refrigerants such as R410A, R32, R407C, R404A, and HFO1234yf may be employed.

Reference Signs List

[0049] 1 compressor 2 heat source-side heat exchanger 3 heat source-side flow control valve 4 four-way valve 5 use-side heat exchanger 6 heat storage device 6a heat-storage heat exchanger 6b heat-transfer heat exchanger 7 refrigerant pipe 8 use-side flow control valve 9 first bypass circuit 10 first bypass flow control valve 11 second bypass circuit 12 second bypass flow control valve 13 heat storage device bypass circuit 14 check valve 15 check valve

Claims

1. A refrigeration cycle apparatus, comprising;
a compressor;
a use-side heat exchanger;
a heat source-side flow control valve;
a heat source-side heat exchanger,

the refrigeration cycle apparatus being configured to circulate refrigerant through in an order of the compressor, the use-side heat exchanger, the heat source-side flow control valve, and the heat source-side heat exchanger in a heating operation; and

a heat storage device connected between the use-side heat exchanger and the heat source-side flow control valve, the heat storage device being configured to store heat through heat exchange with the circulating refrigerant.

2. The refrigeration cycle apparatus of claim 1, further comprising:

one or a plurality of the use-side heat exchangers; and
one or a plurality of use-side flow control valves corresponding to the one or the plurality of the use-side heat exchangers,
wherein the heat storage device is connected between the one or the plurality of use-side flow control valves and the heat source-side flow control valve.

3. The refrigeration cycle apparatus of claim 2, further comprising:

a first bypass circuit connected from a discharge side of the compressor to a refrigerant inlet side of the heat source-side heat exchanger;
a first bypass flow control valve provided to the first bypass circuit;
a second bypass circuit branching from a part between the use-side flow control valve and the heat storage device, the second bypass circuit passing through the heat storage device, and connected to a refrigerant suction side of the compressor; and
a second bypass flow control valve provided to the second bypass circuit.

4. The refrigeration cycle apparatus of claim 3, wherein the heat storage device incorporates
a heat-transfer heat exchanger configured to exchange heat with refrigerant flowing in the second bypass circuit, and
a heat-storage heat exchanger configured to exchange heat with refrigerant flowing between the

use-side flow control valve and the heat source-side flow control valve.

5. The refrigeration cycle apparatus of claim 1, wherein the refrigeration cycle apparatus has at least a heating and heat storing operation mode and a defrosting operation mode, and
wherein, in the defrosting operation mode, a flow of the refrigerant is changed from the heating and heat storing operation mode to form a refrigerant passage guiding refrigerant discharged from the compressor to the heat source-side heat exchanger, and an opening degree of the heat source-side flow control valve is controlled to be at a maximum.

6. The refrigeration cycle apparatus of claim 2, wherein the refrigeration cycle apparatus has at least a heating and heat storing operation mode and a defrosting operation mode, and
wherein, in the defrosting operation mode, a flow of the refrigerant is changed from the heating and heat storing operation mode to form a refrigerant passage guiding refrigerant discharged from the compressor to the heat source-side heat exchanger, and an opening degree of the heat source-side flow control valve and an opening degree of the use-side flow control valve are controlled to be at a maximum.

7. The refrigeration cycle apparatus of claim 2 or 3, wherein the refrigeration cycle apparatus has at least a heating and heat storing operation mode and a defrosting operation mode, and
wherein, in the heating and heat storing operation mode, a refrigerant passage is formed so that refrigerant discharged from the compressor passes through the use-side heat exchanger to the heat storage device, and an opening degree of the use-side flow control valve and an opening degree of the heat source-side flow control valve are set so that the refrigerant circulating through the heat storage device has an intermediate pressure between a condensing pressure of the use-side heat exchanger and an evaporating pressure of the heat source-side heat exchanger, to thereby store heat in the heat storage device.

8. The refrigeration cycle apparatus of claim 3, wherein the refrigeration cycle apparatus has at least a heating and heat storing operation mode and a heating and defrosting operation mode,
wherein, in the heating and defrosting operation mode, the heat source-side flow control valve is fully closed and the first bypass flow control valve and the second bypass flow control valve are opened to divide refrigerant discharged from the compressor into a heating circuit for circulating the refrigerant through the use-side heat exchanger, the second bypass circuit, and the compressor, and a defrosting circuit for circulating the refrigerant through the first bypass circuit, the heat source-side heat exchanger, and the compressor, to thereby perform the heating operation and a defrosting operation simultaneously.

9. The refrigeration cycle apparatus of any one of claims 1 to 8, wherein a heat storage device bypass circuit is provided for the heat storage device, and configured to allow the refrigerant to bypass the heat storage device in a cooling operation.

FIG. 1

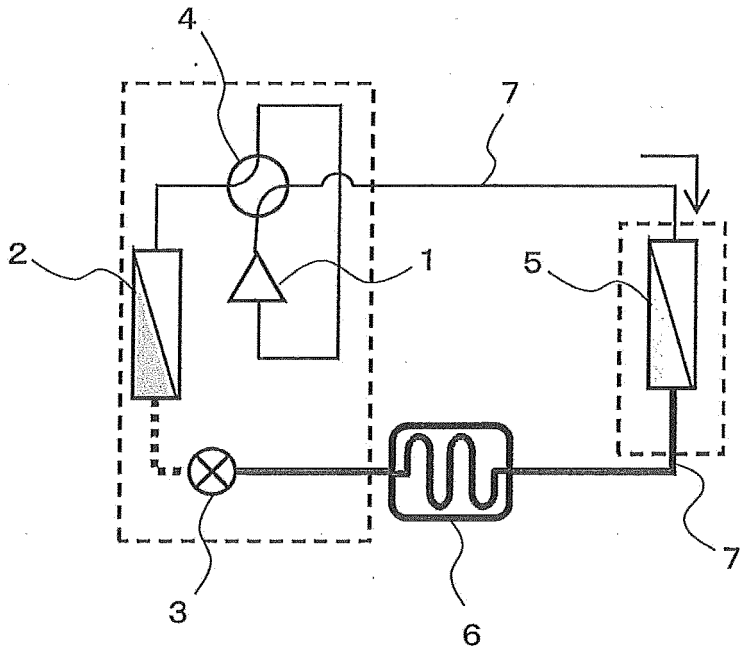
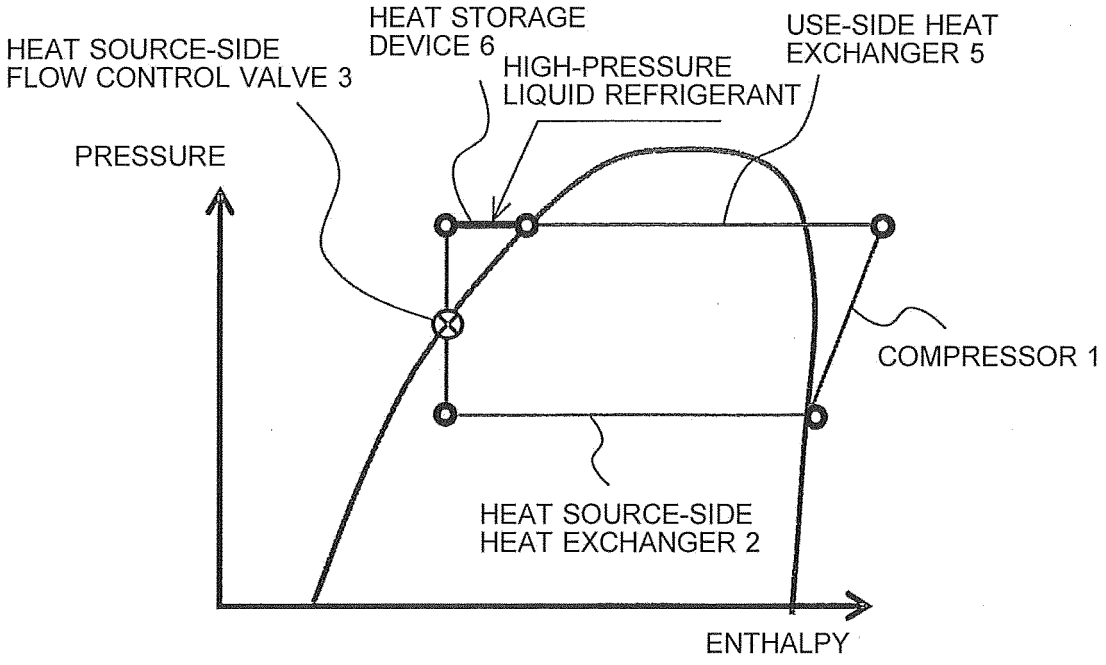


FIG. 2



IN HEATING AND HEAT STORING OPERATION

FIG. 3

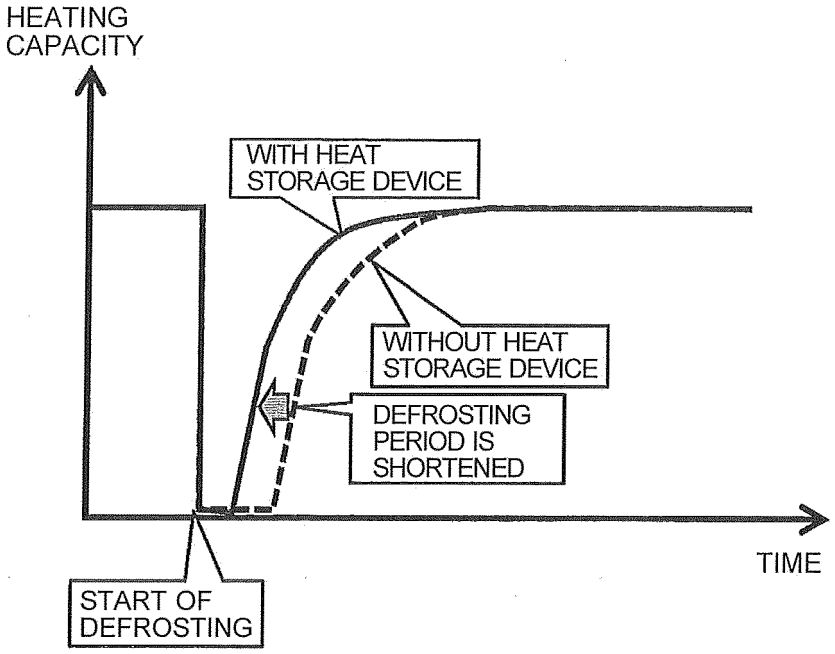

HEATING CAPACITY
WITH HEAT STORAGE DEVICE
WITHOUT HEAT STORAGE DEVICE
DEFROSTING PERIOD IS SHORTENED
TIME
START OF DEFROSTING

FIG. 4

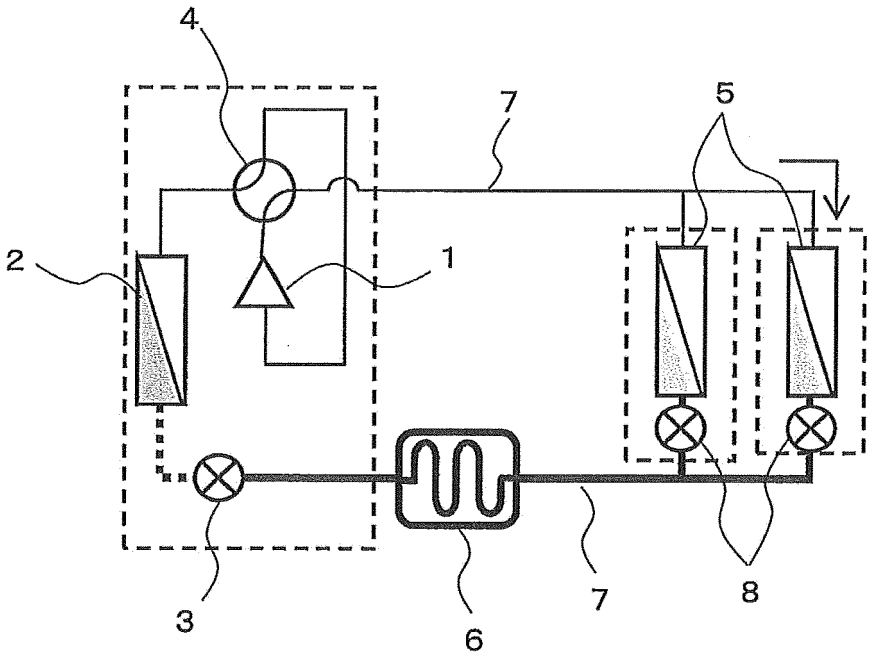

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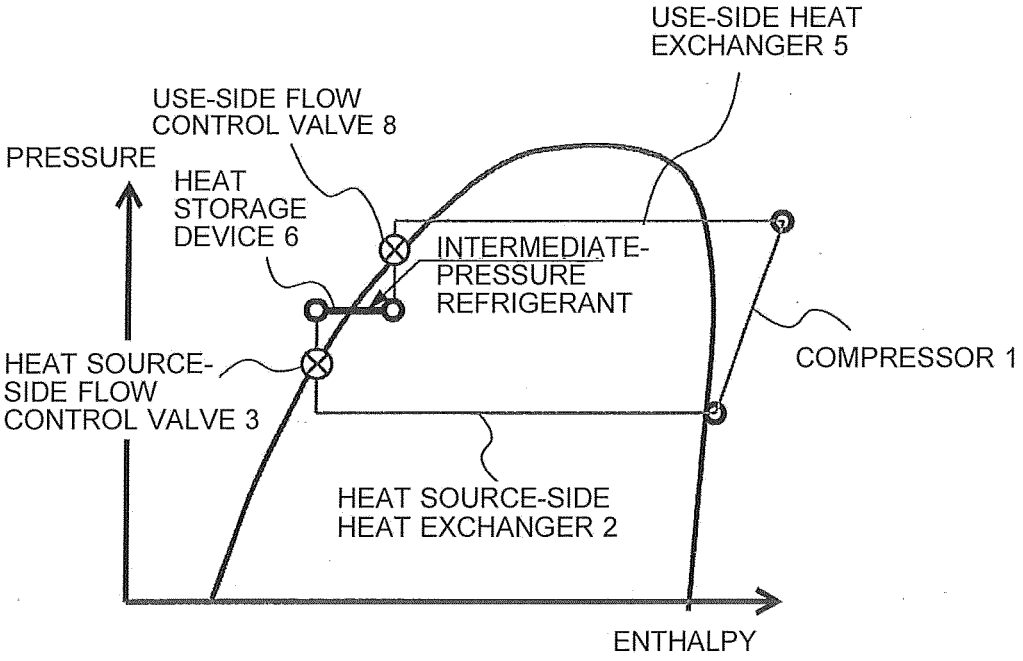
FIG. 5



IN HEATING AND HEAT STORING OPERATION

FIG. 6

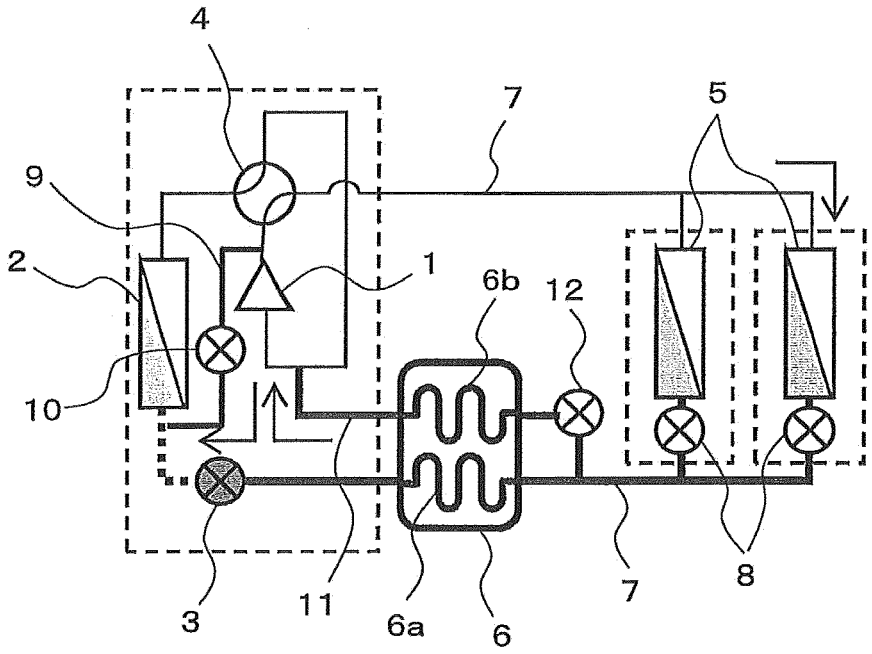
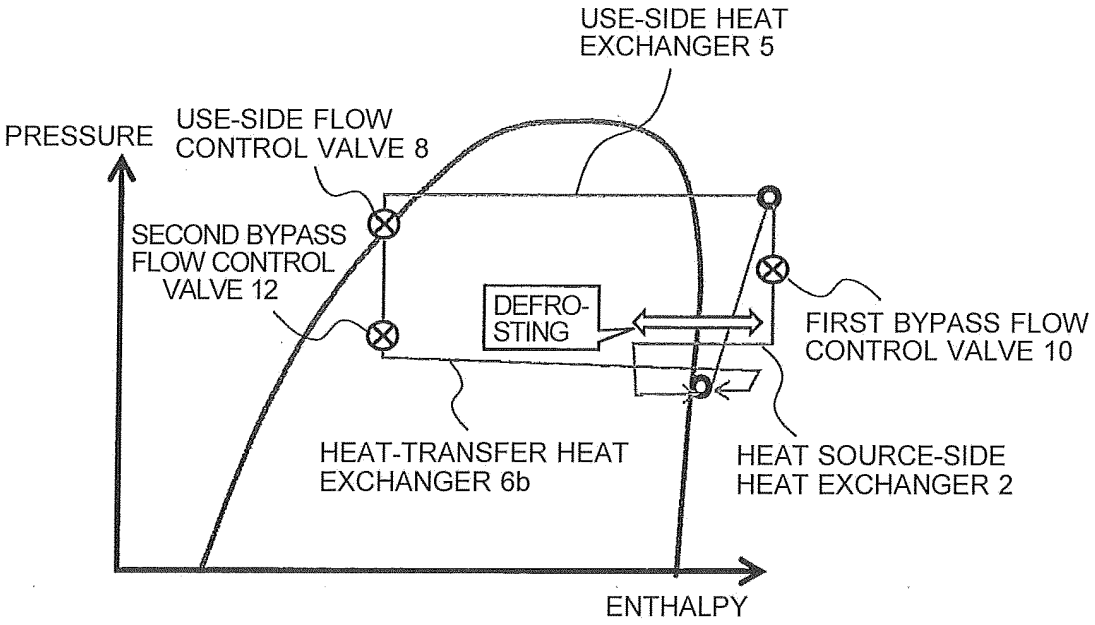


FIG. 7



IN HEATING AND DEFROSTING OPERATION

FIG. 8

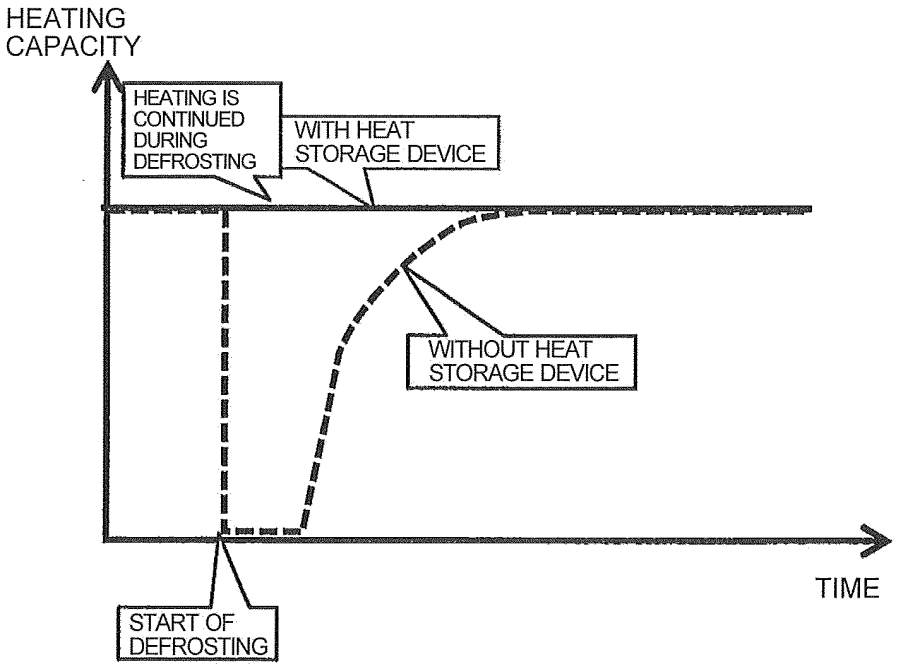
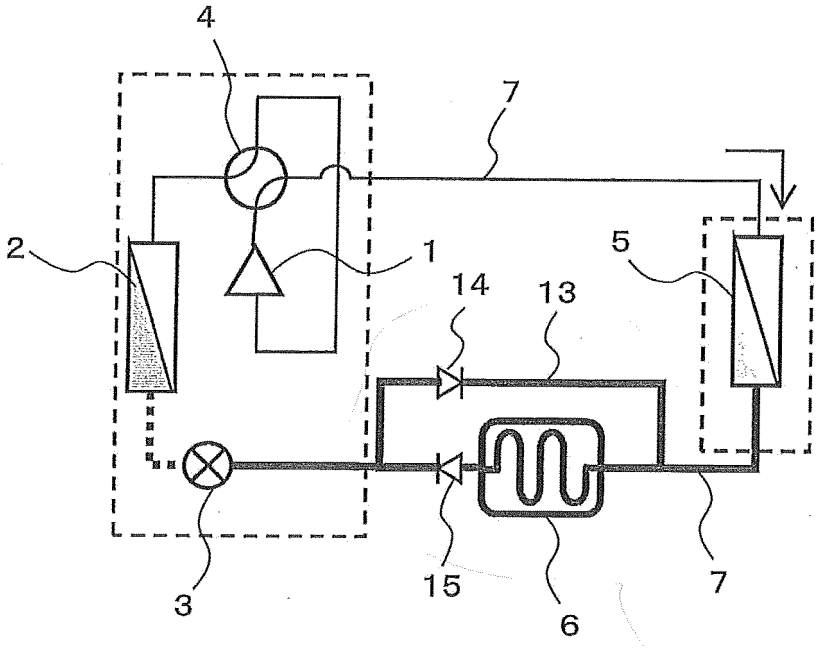


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/065207

A. CLASSIFICATION OF SUBJECT MATTER
F25B47/02(2006.01)i, *F24F11/02*(2006.01)i, *F25B1/00*(2006.01)i, *F25B13/00*(2006.01)i, *F25D21/06*(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)
F25B47/02, F24F11/02, F25B1/00, F25B13/00, F25D21/06

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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	JP 2009-287903 A (The Kansai Electric Power Co., Inc.), 10 December 2009 (10.12.2009), paragraphs [0012] to [0020]; fig. 1, 2 (Family: none)	1 2,5-7,9
X Y	JP 63-014061 A (Sanyo Electric Co., Ltd.), 21 January 1988 (21.01.1988), specification, page 2, upper right column, line 10 to page 4, upper left column, line 4; fig. 1, 2 (Family: none)	1,2 3-9
Y	JP 2002-147879 A (Hitachi, Ltd.), 22 May 2002 (22.05.2002), paragraphs [0002] to [0005]; fig. 2 (Family: none)	2,5-7

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

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Date of the actual completion of the international search	Date of mailing of the international search report
09 August, 2013 (09.08.13)	20 August, 2013 (20.08.13)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/065207

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 3-164668 A (Mitsubishi Electric Corp.), 16 July 1991 (16.07.1991), specification, page 3, lower right column, line 9 to page 5, lower left column, line 8; fig. 1 to 7 (Family: none)	3,4,8
Y	JP 2008-14576 A (Daikin Industries, Ltd.), 24 January 2008 (24.01.2008), paragraphs [0014], [0015], [0054] to [0058]; fig. 8 & US 2009/0282854 A1 & EP 2040009 A1 & KR 10-2009-0038889 A & CN 101479535 A & AU 2007270354 A & KR 10-1185257 B	9
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 190426/1985(Laid-open No. 119074/1986) (Mayekawa Mfg., Co., Ltd.), 26 July 1986 (26.07.1986), entire text; all drawings (Family: none)	1-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000291985 A **[0004]**
- JP 2503637 B **[0004]**