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

(11) EP 1 983 277 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
31.05.2017 Bulletin 2017/22

(21) Application number: **08153996.7**

(22) Date of filing: **03.04.2008**

(51) Int Cl.:
F25B 13/00 *(2006.01)* ***F25B 47/02*** *(2006.01)*

(54) Refrigeration cycle apparatus

Kältekreislaufvorrichtung

Appareil de circuit de réfrigération

(84) Designated Contracting States:
DE

(30) Priority: **19.04.2007 JP 2007110243**
21.11.2007 JP 2007301512

(43) Date of publication of application:
22.10.2008 Bulletin 2008/43

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Printed by Jouve, 75001 PARIS (FR)

Description

Field of the Invention

[0001] The present invention relates to a refrigeration cycle apparatus including a bypass circuit for melting frost deposited on an evaporator, by means of the discharge gas refrigerant of a compressor.

Background of the Invention

[0002] Conventionally, in such a refrigeration cycle apparatus, frost deposits on an evaporator and reduces the capability of the evaporator in some operational states. To be specific, a discharge gas refrigerant compressed at a high temperature and pressure by a compressor flows into a condenser through a four-way valve and the refrigerant is condensed by heat exchange. The condensed refrigerant is decompressed by a throttling device, flows into the evaporator in a gas-liquid two phase state, is evaporated by heat exchange, and is sucked back into the compressor through the four-way valve. In this case, when the ambient temperature of the evaporator is low, frost gradually deposits on the evaporator and the capability of the evaporator decreases with an increasing amount of deposited frost.

[0003] After that, an operation for melting frost deposited on the evaporator is performed as needed. As a method of melting frost, the actions of heat exchangers are reversed by switching a four-way valve to perform a reverse cycle operation. However, this method reduces a temperature on a condenser.

[0004] As a method not using a reverse cycle operation, the following defrosting method is available: a discharge pipe for flowing a refrigerant discharged from a compressor is provided with a branch pipe which flows a part of the refrigerant into a condenser and the other part of the refrigerant into an evaporator through a refrigerant controller such as a solenoid valve to melt frost deposited on the evaporator (e.g., see Japanese Utility Model Laid-Open No. 60-10178).

[0005] FIG. 3 shows the refrigeration cycle apparatus of a conventional air conditioner described in the publication. A solid line arrow indicates a heating cycle and a broken line arrow indicates a defrosting cycle. In FIG. 3, a refrigeration cycle during a heating operation is made up of an outdoor unit B including a compressor 1, a four-way valve 11, a throttling device 3, and an evaporator 4, and an indoor unit A including a condenser 2. Further, a discharge gas bypass 30 is formed from a discharge pipe 1a to a pipe line between the throttling device 3 and the evaporator 4, through a branch pipe 5 and a solenoid valve 6. In this configuration, frost deposits on the evaporator 4 after a continuous heating operation. Thus a defrosting operation is performed such that the actions of the heat exchangers of the condenser 2 and the evaporator 4 are kept as in the heating operation and the solenoid valve 6 of the discharge gas bypass 30 is opened in this state to directly flow a discharge gas refrigerant into the evaporator 4, so that the evaporator 4 is defrosted. The evaporator 4 can be defrosted during the heating operation.

[0006] In the conventional configuration, however, the branch pipe is generally provided in a direction in which the main stream of the refrigerant discharged from the compressor flows through the condenser, a larger amount of refrigerant basically flows into the condenser as compared with the discharge gas bypass, and the amount of discharge gas refrigerant flowing into the evaporator while bypassing the condenser further decreases when the discharge pressure is low, so that the effect of the discharge gas bypass diminishes and the defrosting time increases. Further, in order to increase the amount of flow of the discharge gas refrigerant while bypassing the condenser, a refrigerant controller such as a solenoid valve provided on the discharge gas bypass has to have a quite low path resistance, thereby increasing the cost.

[0007] The present invention is devised to solve the problem of the prior art. An object of the present invention is to provide a refrigeration cycle apparatus which can shorten a defrosting time, can improve the flexibility of design by expanding the scope of selection of a refrigerant controller such as a solenoid valve provided on a discharge gas bypass, and can reduce the cost, and a refrigeration cycle apparatus usable for an air conditioner for improving comfort with the refrigeration cycle apparatus during a heating operation.

Disclosure of the Invention

[0008] In order to solve the problem of the prior art, a refrigeration cycle apparatus according to the present invention is configured such that the discharge refrigerant of a compressor flows into a discharge gas bypass with a larger flow rate than the discharge refrigerant flowing into a four-way valve during defrosting. Since a larger amount of discharge refrigerant flows into the bypass, it is possible to increase the temperature of an evaporator, the degree of superheat of the compressor, and the temperature of the discharge refrigerant, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of a condenser.

[0009] A refrigeration cycle apparatus according to the present invention is defined in claim 1.

[0010] With this configuration, a larger amount of discharge refrigerant flows into the discharge gas bypass. Thus it is possible to increase the temperature of the evaporator or increase the degree of superheat of the compressor and the temperature of the discharge refrigerant. Accordingly, it is possible to further increase the temperature of the evaporator, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser. Moreover, since the influence of the path resistance of the refrigerant controller provided on the discharge gas bypass is reduced, the design flexibility improves and thus a cost

reduction is achieved.

[0011] In the present invention, the discharge gas bypass has a lower path resistance than the condenser, so that the flow rate of the refrigerant flowing into the discharge gas bypass can be larger than the flow rate of the refrigerant flowing into the four-way valve on the side of the condenser.

[0012] Further, in the present invention, since the dynamic pressure component of the discharge refrigerant greatly acts on the bypass, the ratio of the refrigerant diverted at the branch pipe to the discharge gas bypass is larger than the ratio of the refrigerant diverted to the four-way valve, thereby increasing the flow rate of the refrigerant to the discharge gas bypass. Even when the refrigerant controller is provided on the discharge gas bypass, it is possible to keep an amount of circulation, that is, it is possible to reduce the influence of the path resistance of the refrigerant controller.

[0013] Moreover, in the present invention, the path resistance of the discharge gas bypass can be smaller than the path resistance of the condenser, and the discharge refrigerant of the compressor can have the dynamic pressure component acting more greatly in the direction of the discharge gas bypass than in the direction of the four-way valve.

[0014] Further, in the present invention, the discharge refrigerant from the bypass flows in a straight line through a pipe tee, on a point where the exit of the discharge gas bypass joins with the pipe of a refrigeration cycle. Thus the path resistance of the discharge gas bypass can be smaller than the path resistance of the condenser and the flow rate of the refrigerant to the bypass can be increased.

[0015] Moreover, in the present invention, each of the discharge gas bypasses to the evaporator pipe and the suction pipe is smaller in pipe length than the pipe of the condenser. Thus the path resistance of the discharge gas bypass can be smaller than the path resistance of the condenser and the flow rate of the refrigerant to the bypass can be increased.

[0016] Further, in the present invention, the discharge gas bypasses are not smaller in pipe diameter than the pipe of the condenser. Thus the path resistance of the discharge gas bypass can be smaller than the path resistance of the condenser and the flow rate of the refrigerant to the bypass can be increased.

[0017] A method of operating a refrigeration cycle apparatus is defined in claim 8.

[0018] Moreover, in the present invention, 50% to 90% of the discharge refrigerant flows into the discharge gas bypasses. With this configuration, a larger amount of discharge refrigerant flows into the bypasses. Thus it is possible to increase the temperature of the evaporator or increase the degree of superheat of the compressor and the temperature of the discharge refrigerant. Accordingly, it is possible to further increase the temperature of the evaporator, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser.

[0019] The present invention is a refrigeration cycle apparatus further including a blower for the condenser and a blower for the evaporator, wherein the blower for the evaporator is operated during defrosting. Thus the evaporator can exchange heat with the outside air, thereby further shortening the defrosting time of the evaporator and suppressing a reduction in the capability of the condenser.

[0020] Further, the present invention is a refrigeration cycle apparatus including an outside-air temperature detector for detecting the temperature of air passing through the evaporator, wherein the operation of the blower for the evaporator is controlled according to an air temperature detected by the outside-air temperature detector during defrosting. With this configuration, when the air temperature is not lower than a predetermined temperature, heat can be exchanged between the outside air and the evaporator. Thus it is possible to perform defrosting by efficiently using the thermal energy of the outside air, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser.

[0021] Moreover, the present invention is a refrigeration cycle apparatus further including an evaporation temperature detector for detecting the temperature of the evaporator, wherein the operation of the blower for the evaporator is controlled according to a temperature detected by the evaporation temperature detector during defrosting. With this configuration, only when the outside air temperature is higher than the evaporator temperature, heat can be exchanged between the outside air and the evaporator. Thus it is possible to expand the range of defrosting using the thermal energy of the outside air, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser.

[0022] Further, the present invention is a refrigeration cycle apparatus, in which the operation of the blower for the evaporator is controlled by time during defrosting. With this configuration, when the detectors erroneously detect an outside air temperature or an evaporator temperature, it is possible to prevent the outdoor blower from being operated more than necessary and interfering with defrosting, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser. Moreover, the devices can be more reliable.

[0023] Moreover, the present invention is a refrigeration cycle apparatus in which the operating time of the blower for the evaporator is controlled during defrosting by the operating time of the compressor in a normal operation. With this configuration, it is possible to eliminate a mode in which an outdoor blower is operated more than necessary by the variations of the detectors and interferes with defrosting, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser. Moreover, the devices

can be more reliable.

[0024] Further, the present invention is a refrigeration cycle apparatus in which the operation of the blower for the evaporator is controlled during defrosting by a time when the evaporator has a temperature not higher than a predetermined temperature in a normal operation. With this configuration, it is possible to eliminate a mode in which the outdoor blower is operated more than necessary by the variations of the detectors and interferes with defrosting, thereby shortening the defrosting time of the evaporator while suppressing a reduction in the capability of the condenser. Moreover, the devices can be more reliable.

[0025] Moreover, the present invention is a refrigeration cycle apparatus used for an air conditioner made up of an indoor unit and an outdoor unit. The refrigeration cycle apparatus capable of shortening a defrosting time is used for the air conditioner, so that a reduction in room temperature can be suppressed during defrosting in a heating operation and the comfort can be improved.

[0026] Further, the present invention is a refrigeration cycle apparatus used for an air conditioner made up of an indoor unit having an auxiliary heater and an outdoor unit. By compensating for a reduction in heating capacity during defrosting in a heating operation, a reduction in room temperature can be further suppressed and the comfort can be further improved.

[0027] In the refrigeration cycle apparatus of the present invention, a larger amount of discharge refrigerant flows into the discharge gas bypass, so that the temperature of the evaporator is further increased and the defrosting time can be shortened. Further, since the influence of the path resistance of the refrigerant controller provided on the discharge gas bypass is reduced, the design flexibility improves and thus a cost reduction is achieved. By using the refrigeration cycle apparatus for an air conditioner, it is possible to suppress a reduction in room temperature during defrosting in a heating operation and improve the comfort.

[0028] As described above, in the refrigeration cycle apparatus of the present invention, the dynamic pressure component of the discharge refrigerant acts on the bypass pipe. Thus the ratio of the discharge refrigerant diverted at the branch pipe to the bypass pipe is quite large. Since the influence of the path resistance of the refrigerant controller provided on the bypass pipe is reduced, the design flexibility improves and thus a cost reduction is achieved. Further, a larger amount of discharge refrigerant flows into the bypass pipe, so that the defrosting time can be shortened. Thus the present invention is applicable to not only an air conditioner but also to a refrigerator, a vending machine, a heat pump water heater, and so on.

Brief Description of the Drawings

[0029]

FIG. 1 is a refrigeration system diagram of a refrigeration cycle apparatus according to a first embodiment of the present invention;

FIG. 2 is a refrigeration system diagram of a refrigeration cycle apparatus according to a second embodiment of the present invention; and

FIG. 3 is a refrigeration system diagram of a conventional air conditioner.

Description of the Embodiment(s)

[0030] The following will describe embodiments of a refrigeration cycle apparatus of the present invention with reference to the accompanying drawings, as examples of a refrigeration cycle apparatus installed in an air conditioner. The present invention is not limited to these embodiments.

(First Embodiment)

[0031] FIG. 1 is a refrigerant system diagram of a refrigeration cycle apparatus according to a first embodiment of the present invention. FIG. 1 illustrates the flow of a refrigerant in an air conditioner (the refrigerant flows along a solid line arrow during a heating operation and flows along a broken line arrow during a defrosting operation). In FIG. 1, a compressor 1 for compressing the refrigerant, a four-way valve 11 for changing the flow of the refrigerant, a condenser 2 for condensing the high-pressure, high-temperature refrigerant, a throttling device 3 for decompressing the condensed refrigerant, and an evaporator 4 for evaporating the decompressed refrigerant are serially connected via pipes and compose a typical refrigeration cycle. In this configuration, the condenser 2 is provided in an indoor unit A and the other devices are provided in an outdoor unit B. The indoor unit A further includes an indoor blower 7 acting as a blower for the condenser and an electric heater 9, and the outdoor unit B further includes an outdoor blower 8 acting as a blower for the evaporator.

[0032] In the first embodiment, a first discharge gas bypass 31 is provided for branching a discharge gas refrigerant from the compressor 1, on a discharge pipe 1a upstream from the four-way valve 11. Further, a second discharge gas bypass 32 is provided which branches from the first discharge gas bypass 31 as a bypass to an evaporator pipe 4a between the throttling device 3 and the evaporator 4, and a third discharge gas bypass 33 is provided which is a bypass to a suction pipe 1b of the compressor 1. In other words, a discharge gas bypass is made up of the first discharge gas bypass 31, the second discharge gas bypass 32, and the third discharge gas bypass 33.

[0033] The first discharge gas bypass 31 includes a refrigerant controller 40 for optionally flowing the discharge gas refrigerant. The refrigerant controller 40 controls the flow of the refrigerant as needed. Further, the second discharge gas bypass 32 includes an evaporator

bypass flow-rate adjusting pipe 32a and a check valve 32b. Moreover, the third discharge gas bypass 33 includes a suction bypass flow-rate adjusting pipe 33a which adjusts the balance of the flow rates of the second discharge gas bypass 32 and the third discharge gas bypass 33.

[0034] The first discharge gas bypass 31 is branched from the discharge pipe 1a by means of a branch pipe 51 which is substantially T-shaped. The branch pipe 51 is configured such that the discharge refrigerant of the compressor 1 flows in a straight line (arrow D1) along the first discharge gas bypass 31 and the flow of the refrigerant to the four-way valve 11 is bent substantially at a right angle (arrow D2).

[0035] Moreover, pipe tees 52 and 53 shaped like the branch pipe 51 are respectively provided on a junction with the evaporator pipe 4a at the exit of the second discharge gas bypass 32 and a junction with the suction pipe 1b at the exit of the third discharge gas bypass 33. To be specific, on the junction of the pipe tee 52 on the side of the evaporator pipe 4a, a flow from the throttling device 3 to the evaporator pipe 4a is bent substantially at a right angle (arrow D3) and the refrigerant from the second discharge gas bypass 32 to the evaporator pipe 4a flows in a straight line (arrow D4). Further, on the junction of the pipe tee 53 on the side of the suction pipe 1b, the original flow from the four-way valve 11 to the suction pipe 1b is bent substantially at a right angle (arrow D5) and the refrigerant from the third discharge gas bypass 33 to the suction pipe 1b flows in a straight line (arrow D6).

[0036] The following will discuss the operations and action of the air conditioner including the refrigeration cycle apparatus configured thus. First, during a heating operation, as indicated by the solid line arrow, the discharge gas refrigerant compressed at a high temperature and pressure by the compressor 1 flows into the condenser 2 of the indoor unit A through the four-way valve 11 and is condensed by heat exchange, so that a room is heated. The condensed refrigerant flows into the outdoor unit B, is decompressed by the throttling device 3, flows into the evaporator 4 in a gas-liquid two phase state, and is evaporated by heat exchange to absorb heat outside the room. After that, the refrigerant is sucked back into the compressor 1 through the four-way valve 11. During this ordinary heating operation, the refrigerant controller 40 is closed. When the ambient temperature of the evaporator 4 is low, frost gradually deposits on the evaporator 4 and the heating capacity is reduced with an increasing amount of deposited frost.

[0037] During a defrosting operation which is performed when the amount of deposited frost increases to a predetermined amount, as indicated by the broken line arrow, the refrigerant controller 40 provided on the first discharge gas bypass 31 is opened to flow the discharge gas refrigerant to the second discharge gas bypass 32 and the third discharge gas bypass 33, so that the evaporator 4 is defrosted. The second discharge gas bypass 32 accelerates the melting of frost by increasing the temperature of the evaporator 4. The third discharge gas bypass 33 increases the dryness of the compressor 1 and raises the temperatures of the compressor 1 and the discharge gas refrigerant, so that the temperature of the evaporator 4 further increases. In this configuration, defrosting is performed in a heating state without switching the four-way valve 11. Although the heating capacity decreases, it is possible to reduce a temperature change in a heated room as compared with a defrosting system using a reverse cycle, thereby suppressing a reduction in comfort.

[0038] It is not always necessary to flow the discharge gas refrigerant to both of the second discharge gas bypass 32 and the third discharge gas bypass 33 from the first discharge gas bypass 31. Defrosting can be performed in a heating state only by a flow to one of the bypasses 32 and 33. In other words, instead of the refrigerant controller 40 of the aforementioned configuration, refrigerant controllers may be respectively provided on the second discharge gas bypass 32 and the third discharge gas bypass 33 to control the refrigerant according to an operational state and so on. Further, the discharge gas bypass may be a combination of the first discharge gas bypass 31 and the second discharge gas bypass 32 or a combination of the first discharge gas bypass 31 and the third discharge gas bypass 33.

[0039] Moreover, in the first embodiment, in order to flow the discharge gas refrigerant from the compressor 1 to the second discharge gas bypass 32 and the third discharge gas bypass 33 through the first discharge gas bypass 31 and circulate the discharge gas refrigerant, the T-shaped branch pipe 51 is further provided on the junction of the first discharge gas bypass 31 on the discharge pipe 1a of the compressor 1. Particularly, the branch pipe 51 is configured such that the discharge refrigerant of the compressor 1 flows in a straight line along the first discharge gas bypass 31 and the flow of the discharge refrigerant to the four-way valve 11 is bent at a right angle. With this configuration, the discharge gas refrigerant has a dynamic pressure component acting more greatly in the direction of the first discharge gas bypass 31 than in the direction of the four-way valve 11. The action of the dynamic pressure increases the ratio of the refrigerant diverted at the branch pipe 51 to the first discharge gas bypass 31, thereby increasing the flow rate of the discharge gas refrigerant to the first discharge gas bypass 31.

[0040] Thus frost deposited on the evaporator 4 can be melted in a shorter time and a temperature change in a room can be further reduced, so that a reduction in comfort can be further suppressed. Particularly, by flowing a larger amount of discharge gas refrigerant to the first discharge gas bypass 31 than the four-way valve 11, it is possible to produce the remarkable effect of suppressing a reduction in comfort by, even when the room temperature temporarily decreases because of a reduction in heating capacity, completing defrosting in a far

shorter time.

[0041] Further, the pipe tees 52 and 53 are used also on the junctions of the suction pipe 1b and the evaporator pipe 4a and are connected to flow the discharge gas refrigerant in straight lines on points where the exit of the second discharge gas bypass 32 and the exit of the third discharge gas bypass 33 join with the pipes of the refrigeration cycle, and a low path resistance is set to minimize interference with the flow, so that a flow rate from the discharge pipe 1a to the first discharge gas bypass 31 can be set larger. The T-shaped branch pipe 51 and pipe tees 52 and 53 do not always have to be perfect T shapes as long as a lower path resistance can be set on the discharge gas bypasses.

[0042] As described above, the dynamic pressure component of the discharge gas refrigerant acts on the first discharge gas bypass 31 and the path resistance is reduced on the junction to smoothly flow the discharge gas refrigerant. Thus the ratio of the refrigerant diverted at the branch pipe 51 to the first discharge gas bypass 31 is increased and the influence of the path resistance of the refrigerant controller 40 provided on the first discharge gas bypass 31 is reduced. Further, the design margin of the refrigerant controller 40 can be increased, thereby reducing the cost.

[0043] The flow rate from the discharge pipe 1a to the first discharge gas bypass 31 can be set larger also by making a path resistance on the discharge gas bypass smaller than a path resistance on the condenser 2. The flow rate on the discharge gas bypass is reduced by making shorter the refrigerant pipes of the path from the first discharge gas bypass 31 to the second discharge gas bypass 32 and the path from the first discharge gas bypass 31 to the third discharge gas bypass 33 than the pipe length of the condenser 2 or making the pipes of the bypasses larger in diameter than the pipe of the condenser 2.

[0044] As described in the examples, the path resistance on the discharge gas bypass is set lower than the path resistance on the condenser 2, so that the flow rate from the discharge pipe 1a to the first discharge gas bypass 31 can be set larger than the flow rate to the four-way valve on the side of the condenser. Further, the flow rate of the discharge gas refrigerant from the compressor 1 to the first discharge gas bypass 31 is set larger than the flow rate to the four-way valve 11 during defrosting, so that the temperature of the evaporator 4 is increased. Moreover, the temperature of the evaporator 4 is further increased by increasing the degree of superheat of the compressor 1 and the temperature of the discharge gas refrigerant, thereby further reducing the defrosting time of the evaporator 4 while suppressing a reduction in the capability of the condenser 2. Further, since the influence of the path resistance of the refrigerant controller 40 provided on the first discharge gas bypass 31 is reduced, the design flexibility improves and thus a cost reduction is achieved. Furthermore, the refrigeration cycle apparatus configured thus makes it possible to provide an air conditioner with higher comfort.

[0045] The ratio of the refrigerant diverted to the first discharge gas bypass 31 is normally less than 50% and the defrosting time for melting frost is relatively long. In the first embodiment, 50% to 90% of the discharge refrigerant flows into the first discharge gas bypass 31, so that defrosting is completed in about five to seven minutes depending upon the ambient temperature condition. Although the amount of refrigerant circulating into the condenser 2 of the indoor unit A decreases, a reduction in heating capacity can be suppressed also by increasing the dryness of the compressor 1 and the temperature of the discharge gas refrigerant. Further, by providing, for example, the electric heater 9 as an auxiliary heater in the indoor unit A, it is possible to compensate for a reduction in heating capacity in a refrigeration cycle. Thus a reduction in room temperature is further suppressed and the comfort can be further improved.

(Second Embodiment)

[0046] FIG. 2 is a refrigeration system diagram of a refrigeration cycle apparatus according to a second embodiment of the present invention. A refrigeration cycle of FIG. 2 is identical to the refrigeration cycle of FIG. 1 but is different in that an outdoor unit B includes an outside-air temperature detector 101 for detecting the temperature of outside air sucked into an evaporator 4, an evaporation temperature detector 102 for detecting the temperature of the evaporator 4, and a controller 110 for processing the detected temperatures and detecting the operating time of a compressor 1 with a timer function.

[0047] Regarding an air conditioner including the refrigeration cycle apparatus configured thus, different points from the operations and action of the first embodiment will be mainly described below. In the second embodiment, when the value of the outside-air temperature detector 101 is not smaller than a predetermined value (for example, 1°C), an outdoor blower 8 is operated. During a heating operation, frost deposits on the evaporator 4 because the evaporation temperature of a refrigerant flowing through the evaporator 4 largely falls below 0°C and thus the temperature of the evaporator 4 falls below freezing. In this case, frost deposits even when the outside air temperature exceeds 0°C. Although frost is naturally melted when the outside air temperature exceeds 0°C during defrosting, a discharge refrigerant bypass is provided in a refrigeration cycle to shorten a defrosting time and the temperature of the evaporator 4 is increased. Further, the outdoor blower 8 is operated to expose the evaporator 4 to the outside air higher than 0°C, so that the thermal energy of the outside air can be efficiently used for defrosting and thus the defrosting time can be further shortened.

[0048] When the temperature of the evaporation temperature detector 102 is lower than the temperature of the outside-air temperature detector 101, the outdoor blower 8 is operated until the temperature of the evapo-

ration temperature detector 102 reaches the temperature of the outside-air temperature detector 101. Thus the thermal energy of the outside air can be further used for defrosting and increases the defrosting efficiency, achieving a shorter defrosting time.

[0049] Further, during defrosting, the operation of the outdoor blower 8 is stopped after a certain period of time. Thus even when an outside air temperature or an evaporator temperature is erroneously detected, it is possible to prevent the outdoor blower 8 from being operated more than necessary and interfering with defrosting, thereby shortening the defrosting time of the evaporator 4 while suppressing a reduction in the capability of the condenser 2. Moreover, the devices can be more reliable.

[0050] The amount of frost on the evaporator 4 is estimated based on the normal operation time of the compressor 1 from the completion of previous defrosting or a time when the detected temperature of the evaporation temperature detector 102 is not higher than a predetermined value, and then the operating time of the outdoor blower 8 during defrosting is determined, thereby eliminating a mode in which the variations of the detectors interfere with defrosting. Thus it is naturally possible to shorten the defrosting time of the evaporator 4 while suppressing a reduction in the capability of the condenser 2 and further improve the reliability of the devices.

Claims

1. A refrigeration cycle apparatus in which a compressor (1), a four-way valve (11), a condenser (2), a throttling device (3), and an evaporator (4) are connected via pipes, comprising:

discharge gas bypasses (31, 32, 33) for flowing a discharge refrigerant to at least one of a suction pipe (1b) of the compressor and an evaporator pipe (4a) for connecting the throttling device and the evaporator, from a discharge pipe (1a) for connecting the compressor and the four-way valve; and

a refrigerant controller (40) capable of optionally flowing the discharge refrigerant to the discharge gas bypasses,

wherein the discharge refrigerant of the compressor is partially passed through the discharge gas bypasses during defrosting in a heating operation, and

characterized in that

the apparatus further comprising a T-shaped branch pipe (51) on the discharge pipe (1a), wherein the discharge refrigerant of the compressor (1) flows in a straight line in a direction (D1) of the discharge gas bypass, and a flow of the discharge refrigerant is bent in a direction (D2) of the four-way valve, thereby a flow rate to the discharge gas bypasses is larger than a flow rate to the four-way valve (11),

wherein the branch pipe is connected such that the discharge refrigerant of the compressor (1) has a dynamic pressure component acting more greatly in the direction (D1) of the discharge gas bypass than in the direction (D2) of the four-way valve.

2. The refrigeration cycle apparatus according to claim 1, wherein the discharge gas bypass (31, 32, 33) has a lower path resistance than the condenser.

3. The refrigeration cycle apparatus according to claim 1, wherein the discharge refrigerant from the discharge gas bypass (32) flows in a straight line through a pipe tee (52), on a point where an exit of the discharge gas bypass (32) joins with the pipe (4a) of a refrigeration cycle.

4. The refrigeration cycle apparatus according to claim 1, wherein each of the discharge gas bypasses (31, 32, 33) to the evaporator pipe (4a) and the suction pipe (1b) is smaller in pipe length than a pipe of the condenser.

5. The refrigeration cycle apparatus according to claim 1, wherein the discharge gas bypasses are not smaller in pipe diameter than a pipe of the condenser.

6. The refrigeration cycle apparatus according to claim 1, wherein the refrigeration cycle apparatus is used for an air conditioner made up of an indoor unit (A) and an outdoor unit (B).

7. The refrigeration cycle apparatus according to claim 1, wherein the refrigeration cycle apparatus is used for an air conditioner made up of an indoor unit (A) having an auxiliary heater (9) and an outdoor unit (B).

8. A method of operating a refrigeration cycle apparatus in which a compressor (1), a four-way valve (11), a condenser (2), a throttling device (3), and an evaporator (4) are connected via pipes, the apparatus further comprising:

discharge gas bypasses (31, 32, 33) for flowing a discharge refrigerant to at least one of a suction pipe (1b) of the compressor and an evaporator pipe (4a) for connecting the throttling device and the evaporator, from a discharge pipe (1a) for connecting the compressor and the four-way valve; and

a refrigerant controller (40) capable of optionally flowing the discharge refrigerant to the discharge gas bypasses,

a T-shaped branch pipe (51) on the discharge pipe (1a),

wherein the discharge refrigerant of the com-

pressor is partially passed through the discharge gas bypasses during defrosting in a heating operation,
the discharge refrigerant of the compressor (1) flows in a straight line in a direction (D1) of the discharge gas bypass, and a flow of the discharge refrigerant is bent in a direction (D2) of the four-way valve, thereby a flow rate to the discharge gas bypasses is larger than a flow rate to the four-way valve (11), and
the branch pipe is connected such that the discharge refrigerant of the compressor (1) has a dynamic pressure component acting more greatly in the direction (D1) of the discharge gas bypass than in the direction (D2) of the four-way valve.

9. The method according to claim 8, wherein 50% to 90% of the discharge refrigerant flows into the discharge gas bypasses.

10. The method according to claim 8, the apparatus further comprising a blower (7) for the condenser and a blower (8) for the evaporator, wherein the blower (8) for the evaporator is operated during defrosting.

11. The method according to claim 10, the apparatus further comprising an outside-air temperature detector (101) for detecting a temperature of air passing through the evaporator (4),
wherein an operation of the blower (8) for the evaporator is controlled according to an air temperature detected by the outside-air temperature detector during defrosting.

12. The method according to claim 10, the apparatus further comprising an evaporation temperature detector (102) for detecting a temperature of the evaporator (4),
wherein an operation of the blower (8) for the evaporator is controlled according to a temperature detected by the evaporation temperature detector during defrosting.

13. The method according to claim 10, wherein an operation of the blower (8) for the evaporator is controlled by time during defrosting.

14. The method according to claim 10, wherein an operating time of the blower (8) for the evaporator is controlled during defrosting by an operating time of the compressor in a normal operation.

15. The method according to claim 10, wherein an operation of the blower (8) for the evaporator is controlled during defrosting by a time when the evaporator has a temperature not higher than a predetermined temperature in a normal operation.

Patentansprüche

1. Kältekreislaufvorrichtung, in der ein Verdichter (1), ein Vierwegeventil (11), ein Verflüssiger (2), eine Drosseleinrichtung (3) und ein Verdampfer (4) über Rohre verbunden sind, umfassend:

Auslassgas-Überbrückungen (31, 32, 33) zum Strömenlassen eines Auslasskältemittels zu einem Ansaugrohr (1 b) des Verdichters und/oder einem Verdampferrohr (4a) zum Verbinden der Drosseleinrichtung und des Verdampfers, aus einem Auslassrohr (1a) zum Verbinden des Verdichters und des Vierwegeventils; und
eine Kältemittel-Steuereinrichtung (40), geeignet zum wahlweisen Strömenlassen des Auslasskältemittels zu den Auslassgas-Überbrückungen,
wobei das Auslasskältemittel des Verdichters teilweise durch die Auslassgas-Überbrückungen während des Auftauens in einem Erwärmungsbetrieb geleitet wird, und
dadurch gekennzeichnet, dass
die Vorrichtung des Weiteren ein T-förmiges Abzweigrohr (51) auf dem Auslassrohr (1a) umfasst, wobei das Auslasskältemittel des Verdichters (1) in gerader Linie in eine Richtung (D1) der Auslassgas-Überbrückung fließt, und der Fluss des Auslasskältemittels in eine Richtung (D2) des Vierwegeventils umgebogen wird, wodurch die Durchflussgeschwindigkeit zu den Auslassgas-Überbrückungen größer als die Durchflussgeschwindigkeit zu dem Vierwegeventil (11) ist,
wobei das Abzweigrohr so verbunden ist, das das Auslasskältemittel des Verdichters (1) eine dynamische Druckkomponente aufweist, die stärker in Richtung (D1) der Auslassgas-Überbrückung als in Richtung (D2) des Vierwegeventils einwirkt.

2. Kältekreislaufvorrichtung nach Anspruch 1, wobei die Auslassgas-Überbrückung (31, 32, 33) einen geringeren Wegwiderstand als der Verflüssiger aufweist.

3. Kältekreislaufvorrichtung nach Anspruch 1, wobei das Auslasskältemittel von der Auslassgas-Überbrückung (32) in einer geraden Linie durch ein T-Stück (52) fließt, zu einem Punkt, an dem der Ausgang der Auslassgas-Überbrückung (32) sich mit dem Rohr (4a) des Kältekreislaufs vereinigt.

4. Kältekreislaufvorrichtung nach Anspruch 1, wobei jede der Auslassgas-Überbrückungen (31, 32, 33) zu dem Verdampferrohr (4a) und dem Absaugrohr (1b) in Bezug auf die Rohrlänge kleiner als das Rohr des Verflüssigers ist.

5. Kältekreislaufvorrichtung nach Anspruch 1, wobei die Auslassgas-Überbrückungen im Rohrdurchmesser nicht kleiner als das Rohr des Verflüssigers sind.

6. Kältekreislaufvorrichtung nach Anspruch 1, wobei die Kältekreislaufvorrichtung für eine aus einer Innengebäude-Einheit (A) und einer Freiluft-Einheit (B) gefertigte Klimaanlage verwendet wird.

7. Kältekreislaufvorrichtung nach Anspruch 1, wobei die Kältekreislaufvorrichtung für eine aus einer Innengebäude-Einheit (A) mit einer Zusatzheizung (9) und einer Freiluft-Einheit (B) gefertigte Klimaanlage verwendet wird.

8. Verfahren zum Betrieb einer Kältekreislaufvorrichtung, in der ein Verdichter (1), ein Vierwegeventil (11), ein Verflüssiger (2), eine Drosseleinrichtung (3) und ein Verdampfer (4) über Rohre verbunden sind, wobei die Vorrichtung des Weiteren umfasst:

Auslassgas-Überbrückungen (31, 32, 33) zum Strömenlassen eines Auslasskältemittels zu einem Ansaugrohr (1 b) des Verdichters und/oder einem Verdampferrohr (4a) zum Verbinden der Drosseleinrichtung und des Verdampfers, von einem Auslassrohr (1a) zum Verbinden des Verdichters und des Vierwegeventils; und
eine Kältemittel-Steuereinrichtung (40), geeignet zum wahlweisen Strömenlassen des Auslasskältemittels zu den Auslassgas-Überbrückungen,
ein T-förmiges Abzweigrohr (51) auf dem Auslassrohr (1a),
wobei das Auslasskältemittel des Verdichters teilweise durch die Auslassgas-Überbrückungen während des Auftauens in einem Erwärmungsbetrieb geleitet wird,
das Auslasskältemittel des Verdichters (1) in gerader Linie in eine Richtung (D1) der Auslassgas-Überbrückung fließt, und der Fluss des Auslasskältemittels in eine Richtung (D2) des Vierwegeventils umgebogen wird, wodurch die Durchflussgeschwindigkeit zu den Auslassgas-Überbrückungen größer als die Durchflussgeschwindigkeit zu dem Vierwegeventil (11) ist, und
wobei das Abzweigrohr so verbunden ist, das das Auslasskältemittel des Verdichters (1) eine dynamische Druckkomponente aufweist, die stärker in Richtung (D1) der Auslassgas-Überbrückung als in Richtung (D2) des Vierwegeventils einwirkt.

9. Verfahren nach Anspruch 8, wobei 50% bis 90% des Auslasskältemittels in die Auslassgas-Überbrückungen fließen.

10. Verfahren nach Anspruch 8, wobei die Vorrichtung des Weiteren ein Gebläse (7) für den Verflüssiger und ein Gebläse (8) für den Verdampfer umfasst, wobei das Gebläse (8) für den Verdampfer während des Auftauens betrieben wird.

11. Verfahren nach Anspruch 10, wobei die Vorrichtung des Weiteren eine Außenlufttemperatur-Ermittlungseinrichtung (101) zur Ermittlung der Temperatur von Luft, die den Verdampfer (4) durchströmt, umfasst,
wobei der Betrieb des Gebläses (8) für den Verdampfer gemäß einer von der Außenlufttemperatur-Ermittlungseinrichtung ermittelten Lufttemperatur während des Auftauens gesteuert wird.

12. Verfahren nach Anspruch 10, wobei die Vorrichtung des Weiteren eine Verdampfungstemperatur-Ermittlungseinrichtung (102) zur Ermittlung der Temperatur des Verdampfers (4) umfasst,
wobei der Betrieb des Gebläses (8) für den Verdampfer gemäß der Temperatur gesteuert wird, die von der Verdampfungstemperatur-Ermittlungseinrichtung während des Auftauens ermittelt wird.

13. Verfahren nach Anspruch 10, wobei der Betrieb des Gebläses (8) für den Verdampfer durch die Zeit während des Auftauens gesteuert wird.

14. Verfahren nach Anspruch 10, wobei der Betrieb des Gebläses (8) für den Verdampfer während des Auftauens durch die Betriebsdauer des Verdichters in einem Normalbetrieb gesteuert wird.

15. Verfahren nach Anspruch 10, wobei der Betrieb des Gebläses (8) für den Verdampfer während des Auftauens durch die Zeit gesteuert wird, wenn der Verdampfer eine Temperatur aufweist, die nicht höher als eine vorgegebene Temperatur in einem Normalbetrieb ist.

Revendications

1. Appareil pour circuit de réfrigération dans lequel un compresseur (1), une soupape à quatre voies (11), un condenseur (2), un dispositif d'étranglement (3) et un évaporateur (4) sont raccordés par l'intermédiaire de canalisations, comprenant :

des dérivations de gaz de décharge (31, 32, 33) permettant de faire circuler un réfrigérant de décharge vers au moins l'un d'un tuyau d'aspiration (1b) du compresseur et d'un tuyau d'évaporateur (4a) destiné à raccorder le dispositif d'étranglement et l'évaporateur, à partir d'un tuyau de décharge (1a) destiné à raccorder le compresseur et la soupape à quatre voies, et

un contrôleur de réfrigérant (40) pouvant en option faire circuler le réfrigérant de décharge vers les dérivations de gaz de décharge,
dans lequel on fait partiellement traverser le réfrigérant de décharge du compresseur au travers des dérivations de gaz de décharge pendant le dégivrage dans une opération de chauffage, et
caractérisé en ce que
l'appareil comprend en outre un tuyau de branchement (51) en forme de T sur le tuyau de décharge (1a), le réfrigérant de décharge du compresseur (1) circulant en ligne droite dans la direction (D1) de la dérivation de gaz de décharge, et le flux du réfrigérant de décharge étant dévié dans la direction (D2) de la soupape à quatre voies, ce qui fait que le débit d'écoulement vers les dérivations de gaz de décharge est plus grand que le débit d'écoulement vers la soupape à quatre voies (11),
dans lequel le tuyau de branchement est raccordé de sorte à ce que le réfrigérant de décharge du compresseur (1) présente une composante de pression dynamique agissant plus fortement dans la direction (D1) de la dérivation de gaz de décharge que dans la direction (D2) de la soupape à quatre voies.

2. Appareil pour circuit de réfrigération selon la revendication 1, dans lequel la dérivation de gaz de décharge (31, 32, 33) présente une résistance à l'écoulement inférieure à celle du condenseur.

3. Appareil pour circuit de réfrigération selon la revendication 1, dans lequel le réfrigérant de décharge provenant de la dérivation de gaz de décharge (32) circule en ligne droite au travers d'un raccord en té de canalisation (52) sur un point où la sortie de la dérivation de gaz de décharge (32) rejoint le tuyau (4a) d'un circuit de réfrigération.

4. Appareil pour circuit de réfrigération selon la revendication 1, dans lequel chacune des dérivations de gaz de décharge (31, 32, 33) vers le tuyau d'évaporateur (4a) et le tuyau d'aspiration (1b) présente une longueur plus petite que celle du tuyau du condenseur.

5. Appareil pour circuit de réfrigération selon la revendication 1, dans lequel les dérivations de gaz de décharge ne présentent pas de diamètre plus petit que celui du tuyau du condenseur.

6. Appareil pour circuit de réfrigération selon la revendication 1, l'appareil pour circuit de réfrigération étant utilisé pour un climatiseur constitué d'une unité d'intérieur (A) et d'une unité extérieure (B).

7. Appareil pour circuit de réfrigération selon la revendication 1, l'appareil pour circuit de réfrigération étant utilisé pour un climatiseur constitué d'une unité d'intérieur (A) possédant un dispositif de chauffage auxiliaire (9) et d'une unité extérieure (B).

8. Procédé de mise en oeuvre d'un appareil pour circuit de réfrigération dans lequel un compresseur (1), une soupape à quatre voies (11), un condenseur (2), un dispositif d'étranglement (3) et un évaporateur (4) sont raccordés par l'intermédiaire de canalisations, l'appareil comprenant en outre :

des dérivations de gaz de décharge (31, 32, 33) permettant de faire circuler un réfrigérant de décharge vers au moins l'un d'un tuyau d'aspiration (1b) du compresseur et d'un tuyau d'évaporateur (4a) destiné à raccorder le dispositif d'étranglement et l'évaporateur, à partir d'un tuyau de décharge (1a) destiné à raccorder le compresseur et la soupape à quatre voies, et
un contrôleur de réfrigérant (40) pouvant en option faire circuler le réfrigérant de décharge vers les dérivations de gaz de décharge,
un tuyau de branchement (51) en forme de T sur le tuyau de décharge (1a),
dans lequel on fait partiellement traverser le réfrigérant de décharge du compresseur au travers des dérivations de gaz de décharge pendant le dégivrage dans une opération de chauffage,
le réfrigérant de décharge du compresseur (1) circule en ligne droite dans la direction (D1) de la dérivation de gaz de décharge, et le flux du réfrigérant de décharge est dévié dans la direction (D2) de la soupape à quatre voies, ce qui fait que le débit d'écoulement vers les dérivations de gaz de décharge est plus grand que le débit d'écoulement vers la soupape à quatre voies (11), et
le tuyau de branchement est raccordé de sorte à ce que le réfrigérant de décharge du compresseur (1) présente une composante de pression dynamique agissant plus fortement dans la direction (D1) de la dérivation de gaz de décharge que dans la direction (D2) de la soupape à quatre voies.

9. Procédé selon la revendication 8, dans lequel de 50 % à 90 % du réfrigérant de décharge s'écoulent dans les dérivations de gaz de décharge.

10. Procédé selon la revendication 8, l'appareil comprenant en outre un ventilateur (7) pour le condenseur et un ventilateur (8) pour l'évaporateur, le ventilateur (8) pour l'évaporateur étant mis en oeuvre pendant le dégivrage.

11. Procédé selon la revendication 10, l'appareil comprenant en outre un détecteur de température de l'air extérieur (101) destiné à détecter la température de l'air traversant l'évaporateur (4),
dans lequel le fonctionnement du ventilateur (8) pour l'évaporateur est commandé en fonction de la température d'air détectée par le détecteur de température de l'air extérieur pendant le dégivrage.

12. Procédé selon la revendication 10, l'appareil comprenant en outre un détecteur de température d'évaporation (102) destiné à détecter la température de l'évaporateur (4),
dans lequel le fonctionnement du ventilateur (8) pour l'évaporateur est commandé en fonction de la température détectée par le détecteur de température d'évaporation pendant le dégivrage.

13. Procédé selon la revendication 10, dans lequel le fonctionnement du ventilateur (8) pour l'évaporateur est commandé par la durée pendant le dégivrage.

14. Procédé selon la revendication 10, dans lequel la durée de fonctionnement du ventilateur (8) pour l'évaporateur est commandée pendant le dégivrage grâce à la durée de fonctionnement du compresseur en fonctionnement normal.

15. Procédé selon la revendication 10, dans lequel le fonctionnement du ventilateur (8) pour l'évaporateur est commandé par une durée lorsque l'évaporateur présente une température qui n'est pas supérieure à une température prédéterminée en fonctionnement normal.

FIG. 1

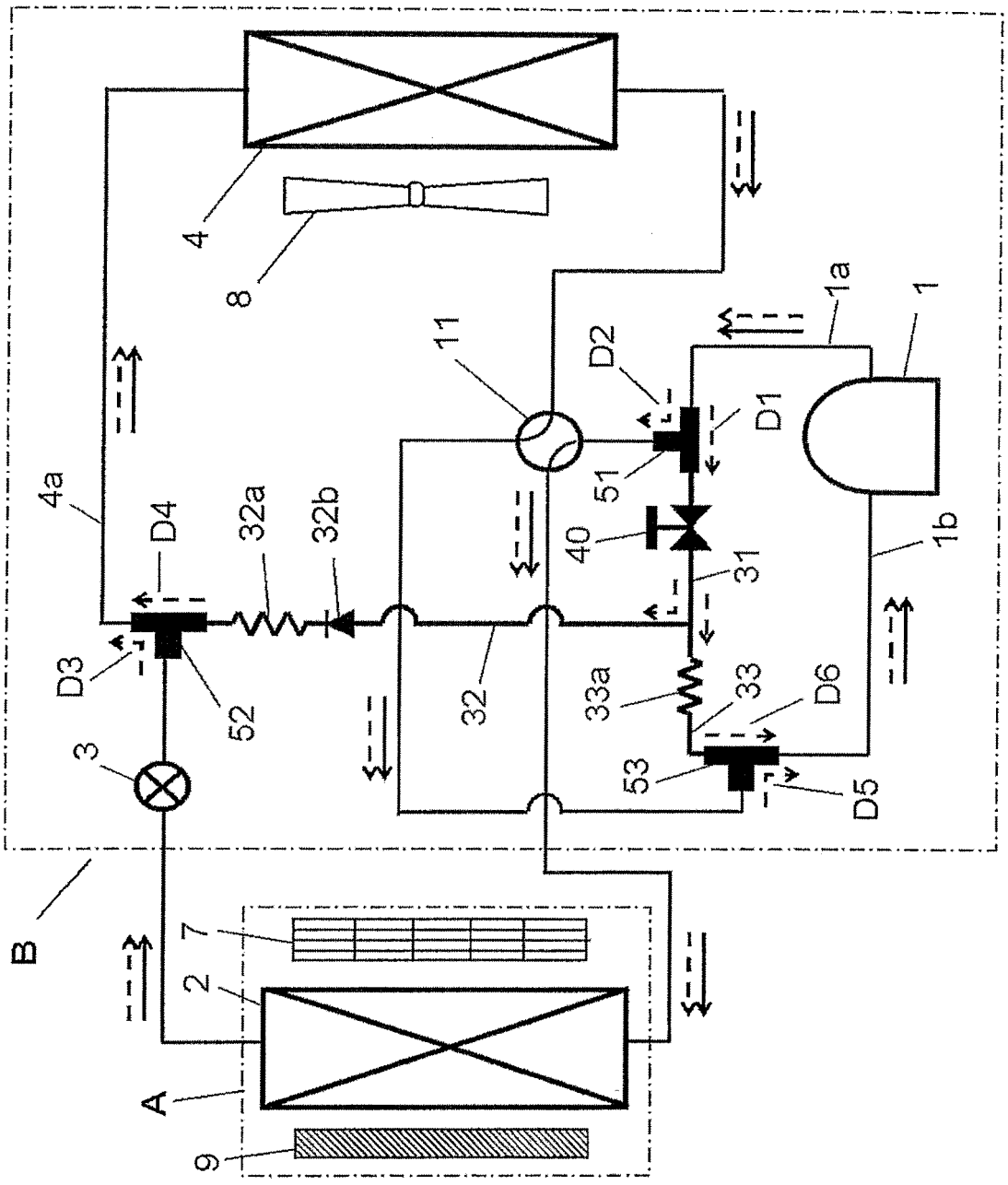

4
8
11
D2
D1
1a
1
51
40
31
1b
4a
D4
32a
32b
D3
52
32
33a
33
D6
53
D5
3
B
7
2
A
9

FIG. 2

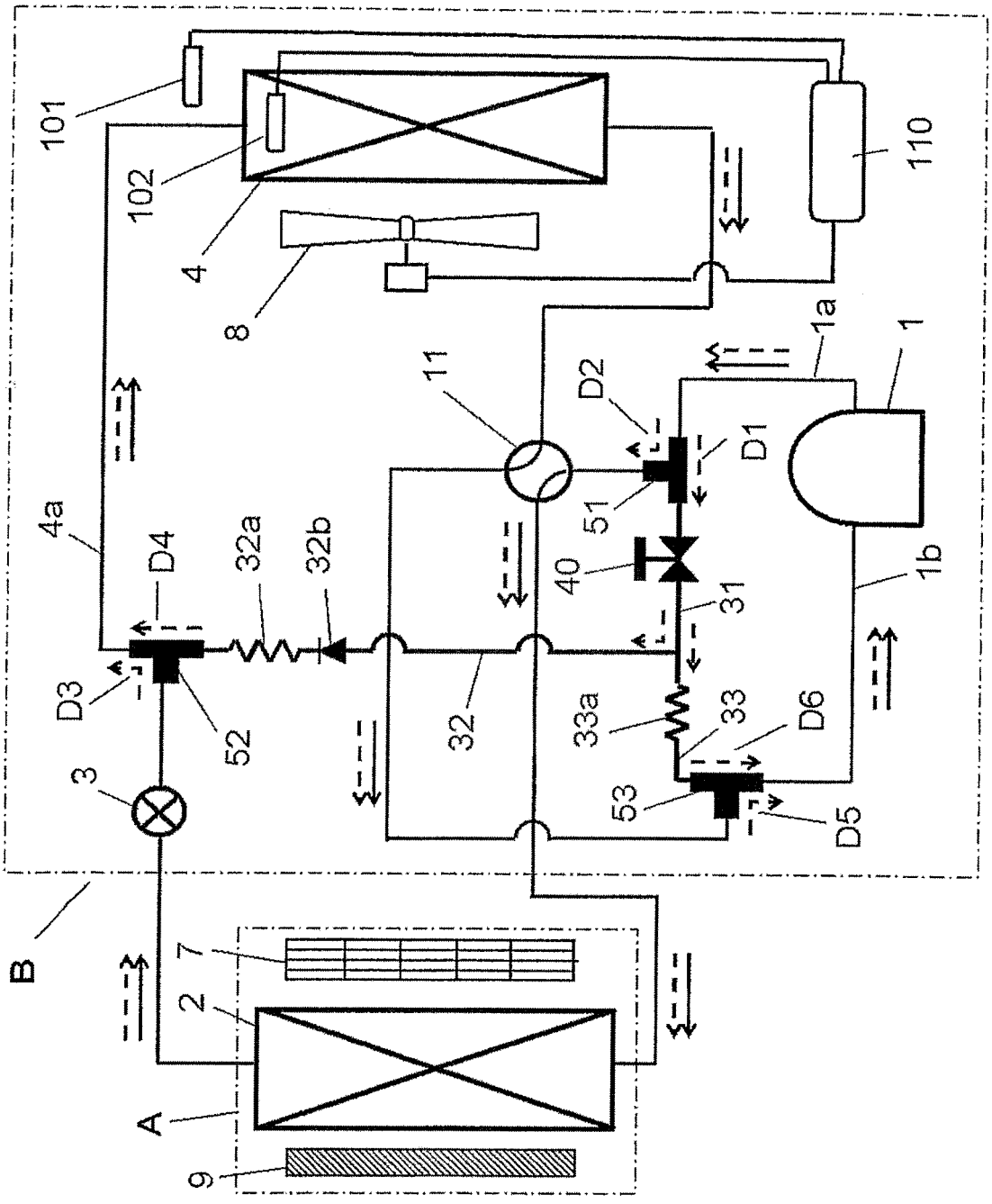
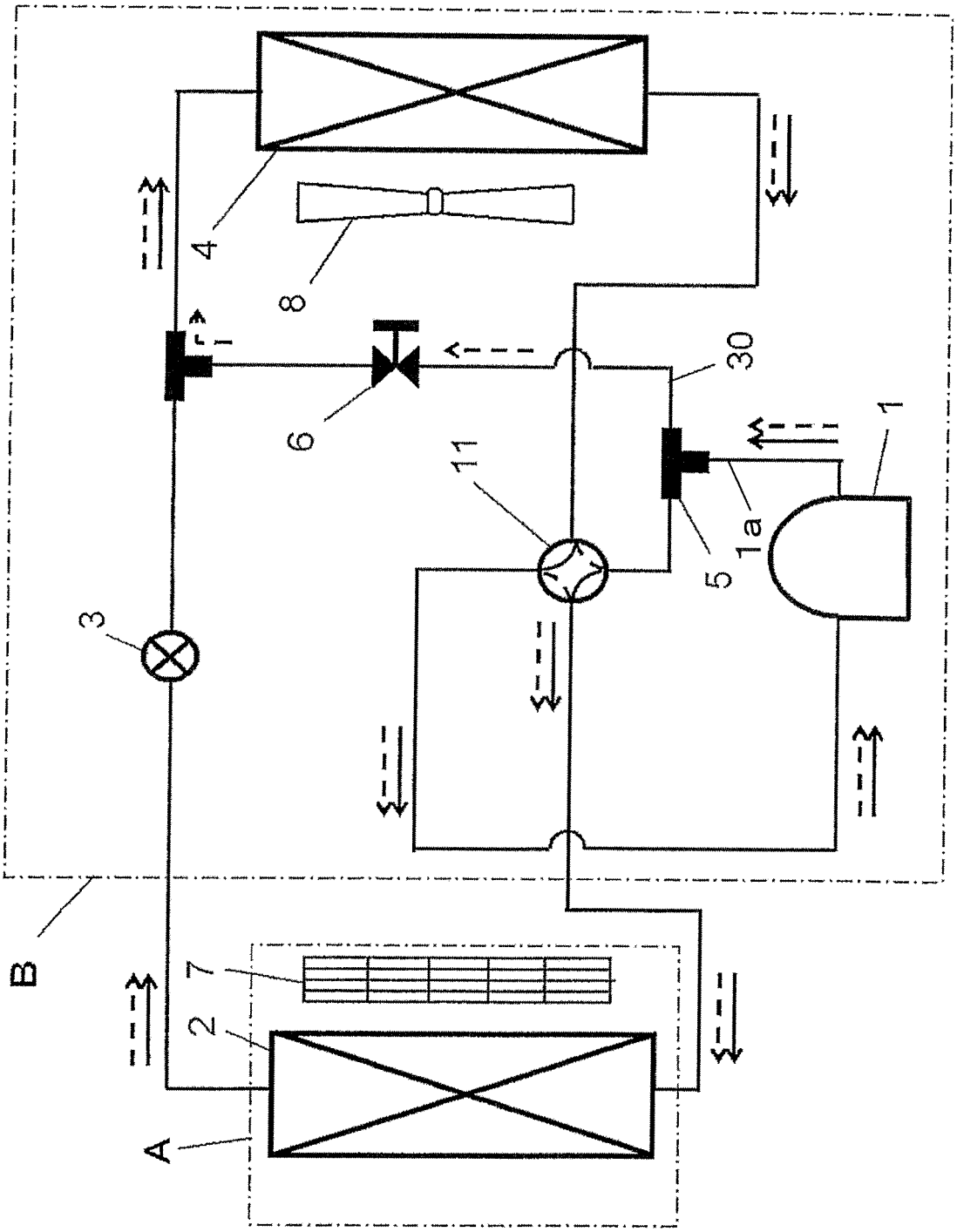

101
102
4
8
110
1a
1
11
D2
D1
51
40
31
1b
4a
D4
32a
32b
D3
52
32
33a
33
D6
53
D5
3
B
7
2
A
9

FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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