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(54) **REFRIGERATOR**

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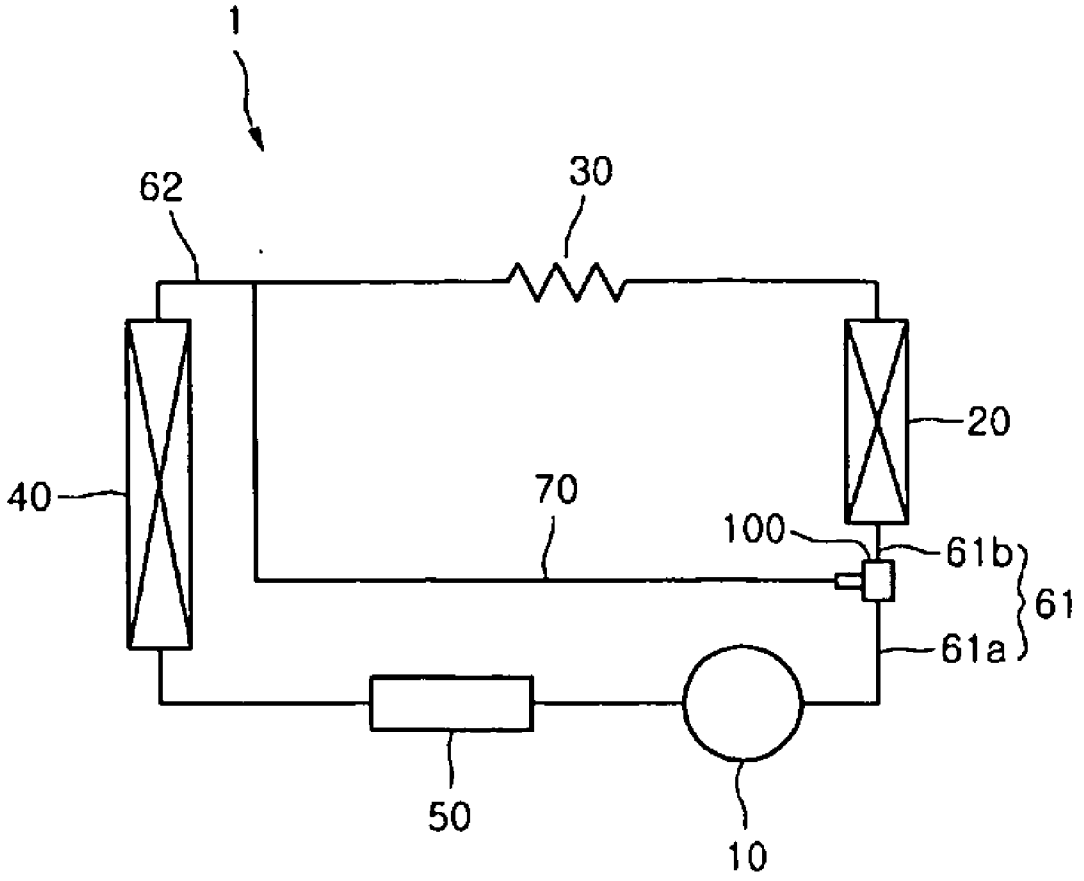
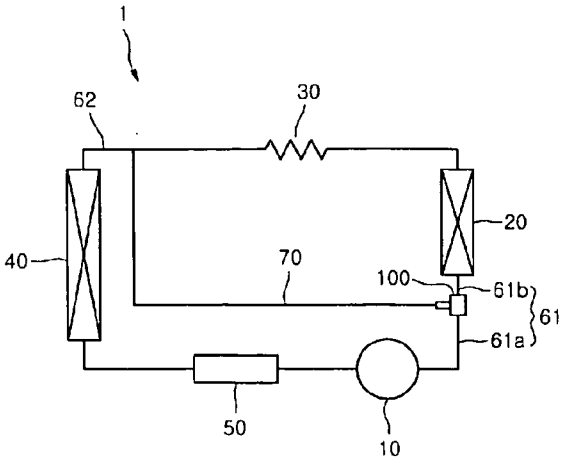
(57) **ABSTRACT**

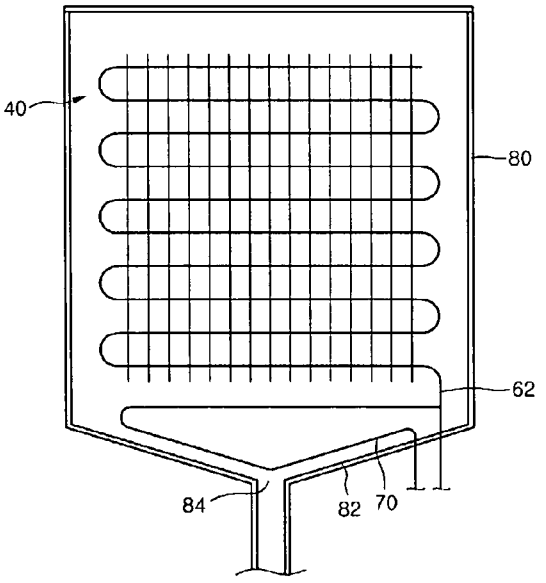
A refrigerator is provided. The refrigerator includes a compressor, a condenser, an expansion valve, an evaporator, a bypass pipe, and a valve device. The condenser condenses refrigerant discharged from the compressor, and the expansion valve expands the refrigerant condensed in the condenser. The evaporator evaporates the refrigerant expanded in the expansion valve, and the bypass pipe allows the refrigerant discharged from the compressor to move toward an inlet of the evaporator. The valve device allows the refrigerant discharged from the compressor to selectively move toward the bypass pipe or the condenser. The valve device comprises an inlet, a first outlet, and a second outlet. The refrigerant discharged from the compressor flows into the inlet. The refrigerant is discharged toward the condenser through the first outlet, and is discharged toward the bypass pipe through the second outlet. The first outlet has a diameter larger than that of the second outlet.



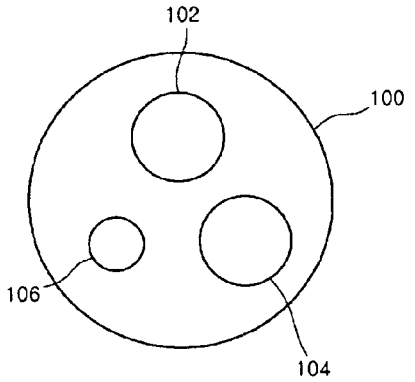
[Fig. 1]



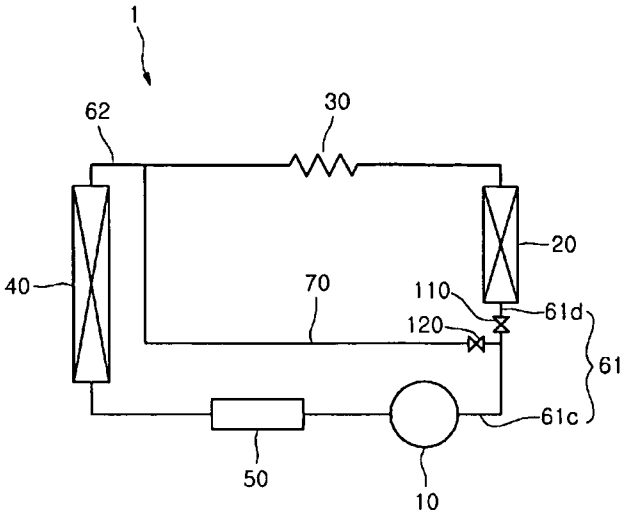
[Fig. 2]



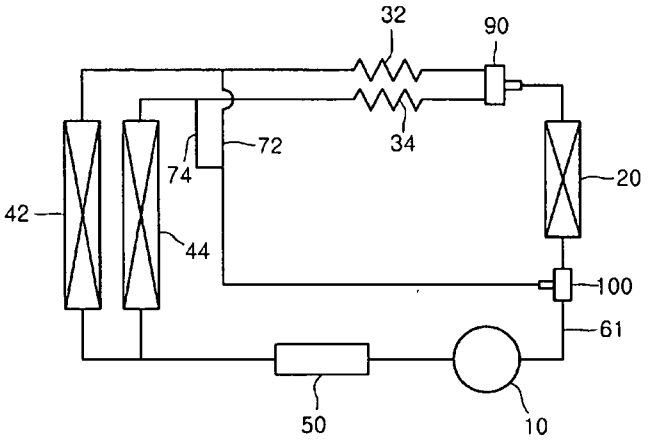
[Fig. 3]



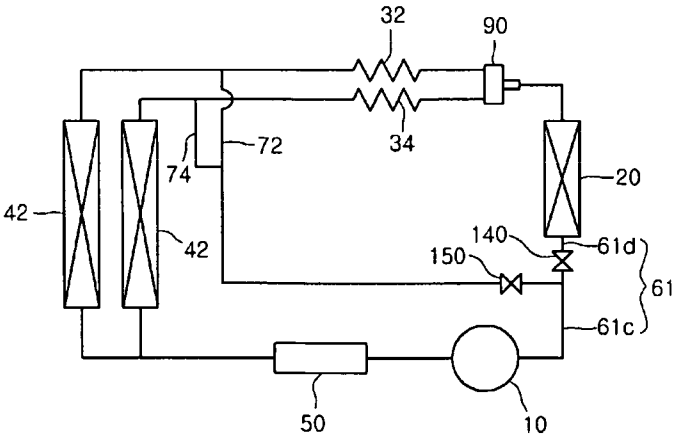
[Fig. 4]



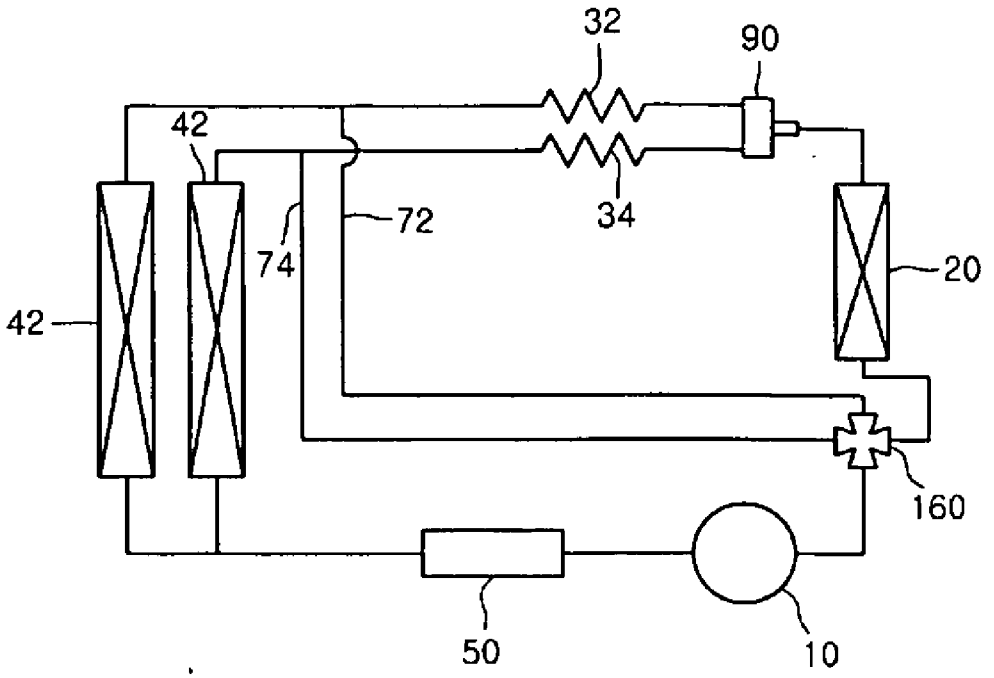
[Fig. 5]



[Fig. 6]



[Fig. 7]



REFRIGERATOR

TECHNICAL FIELD

[0001] The present disclosure relates to a refrigerator.

BACKGROUND ART

[0002] A refrigerator supplies cold air to a freezer compartment and a refrigeration compartment through a refrigerant system so as to store foods at a low temperature.

[0003] The refrigerant system includes a compressor, a condenser, an expansion unit, and an evaporator. Air is cooled while passing through the evaporator, and then is supplied to the freezer compartment and the refrigeration compartment.

[0004] Cold air, which has circulated inside the freezer compartment and the refrigeration compartment, moves to a heat exchange chamber including the evaporator through a predetermined path.

[0005] Here, moisture included in the air circulating inside the refrigerator becomes frost on a surface of the evaporator.

[0006] A large amount of frost greatly affects heat exchange efficiency of the evaporator and increases a flow resistance of air passing through the evaporator. Therefore, when frost of more than a predetermined amount is generated, a defrosting operation is performed using a defrost heater.

[0007] When power is applied to the defrost heater for a defrosting operation, the defrost heater radiates heat to melt frost generated on a surface of the evaporator adjacent to the defrost heater. Heat from the defrost heater is gradually transferred to an upper portion of the evaporator and removes the frost generated on the surface of the evaporator.

[0008] However, power should be additionally applied to the defrost heater, thereby leading to high power consumption. Also, the heat of the defrost heater causes a temperature increase in the refrigerator.

[0009] In addition, because the defrost heater is provided at one portion of the evaporator and heats only the portion of the evaporator, it takes a long time to defrost.

DISCLOSURE OF INVENTION

Technical Problem

[0010] Embodiments provide a refrigerator in which a defrost time is reduced and an internal temperature in the refrigerator is prevented from increasing during a defrosting operation.

[0011] Embodiments also provide a refrigerator in which frost removed from an evaporator is prevented from blocking an outlet formed in a tray.

Technical Solution

[0012] In one embodiment, a refrigerator includes a compressor; a condenser condensing refrigerant discharged from the compressor; an expansion valve expanding the refrigerant condensed in the condenser; an evaporator evaporating the refrigerant expanded in the expansion valve; a bypass pipe allowing the refrigerant discharged from the compressor to move toward an inlet of the evaporator; and a valve device allowing the refrigerant discharged from the compressor to selectively move toward the bypass pipe or the condenser, wherein the valve device comprises: an inlet into which the refrigerant discharged from the compressor flows; a first outlet through which the refrigerant is discharged toward the condenser; and a second outlet through which the refrigerant is discharged toward the bypass pipe, the first outlet having a diameter larger than that of the second outlet.

[0013] In another embodiment, a refrigerator includes a compressor; a condenser condensing refrigerant discharged from the compressor; an expansion valve expanding the refrigerant condensed in the condenser; a plurality of evaporators evaporating the refrigerant expanded in the expansion valve; a bypass pipe allowing the refrigerant discharged from the compressor to move toward an inlet of the evaporator; a valve device allowing the refrigerant discharged from the compressor to selectively move toward the bypass pipe or the condenser; and a condenser intake-side pipe allowing the refrigerant having passed through the valve device to move to the condenser, the condenser intake-side pipe having a diameter larger than that of the bypass pipe.

Advantageous Effects

[0014] According to the embodiments, since frost generated on an evaporator can be removed by high-temperature refrigerant discharged from a condenser without an additional defrost heater, power consumption can be reduced.

[0015] Also, since high-temperature refrigerant having passed through the compressor moves inside the evaporator, frost generated on an entire surface of the evaporator can be quickly removed.

[0016] In addition, a flow resistance of refrigerant can be minimized in a normal operation of a refrigerator by adjusting the size of an inlet and an outlet of a valve device.

[0017] Furthermore, since a portion of a bypass pipe is disposed adjacent to a tray for receiving water generated by defrosting, frost can be prevented from blocking an outlet formed in the tray.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** is a schematic view of a refrigerant system of a refrigerator according to a first embodiment.

[0019] FIG. **2** is a view illustrating a position of a bypass pipe.

[0020] FIG. **3** is a schematic view illustrating an internal structure of a valve device according to the first embodiment.

[0021] FIG. **4** is a schematic view of a refrigerant system according to a second embodiment.

[0022] FIG. **5** is a schematic view of a refrigerant system according to a third embodiment.

[0023] FIG. **6** is a schematic view of a refrigerant system according to a fourth embodiment.

[0024] FIG. **7** is a schematic view of a refrigerant system according to a fifth embodiment.

MODE FOR THE INVENTION

[0025] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

[0026] FIG. **1** is a schematic view of a refrigerant system of a refrigerator according to a first embodiment.

[0027] Referring to FIG. **1**, a refrigerator **1** including a refrigerant system according to the first embodiment includes a compressor **10**, a condenser **20**, an expansion valve **30**, an evaporator **40**, and a vapor-liquid separator **50**. The compressor **10** compresses refrigerant to high temperature and pressure, and the condenser **20** condenses the compressed refrigerant. The expansion valve **30** expands the condensed refrigerant. The evaporator **40** evaporates the refrigerant

expanded through the expansion valve **30**. The vapor-liquid separator **50** is disposed between the evaporator **40** and the compressor **10** to separate the liquid refrigerant and the vapor refrigerant having passed through the evaporator **40**.

[0028] In detail, the compressor **10** is connected with the condenser **20** through a first connecting pipe **61**. The expansion pipe **30** is connected with the evaporator **40** through a second connecting pipe **62**.

[0029] The first connecting pipe **61** is connected with the second connecting pipe **62** through a bypass pipe **70**. When it is necessary to defrost the evaporator **40**, the bypass pipe **70** provides a path that allows high-temperature refrigerant discharged from the compressor **10** to move toward an inlet of the evaporator **40**, i.e., toward the second connecting pipe **62**.

[0030] A valve device **100** is provided in the first connecting pipe **61** such that high-temperature refrigerant discharged from the compressor **10** selectively flows into the bypass pipe **70**. For example, a 3-way valve may be used as the valve device **100**.

[0031] The first connecting pipe **61** may be divided into a compressor discharge-side pipe **61***a* and a condenser intake-side pipe **61***b* by the valve device **100**. The compressor discharge-side pipe **61***a* may be connected with the condenser intake-side pipe **61***b* or the bypass pipe **70** by operation of the valve device **100**.

[0032] An operation of the refrigerator **1** having the above construction will now be described.

[0033] During a normal operation of the refrigerator **1**, the compressor discharge-side pipe **61***a* is connected with the condenser intake-side pipe **61***b* by the valve device **100**.

[0034] In such a connection state, refrigerant is compressed through the compressor **10**. The compressed refrigerant flows into the condenser **20** through the compressor discharge-side pipe **61***a* and the condenser intake-side pipe **61***b*. The refrigerant is condensed through the condenser **20**. The condensed refrigerant flows into the expansion valve **30** and then is expanded through the expansion valve **30**. The expanded refrigerant flows into the evaporator **40** and is evaporated through the evaporator **40**. The evaporated refrigerant is separated into liquid refrigerant and vapor refrigerant through the vapor-liquid separator **50**, and the vapor refrigerant flows into the compressor **10**.

[0035] Air blown by a blower fan (not shown) is cooled through heat exchange while passing through the evaporator **40**, and then is supplied to a freezer compartment and a refrigeration compartment.

[0036] Frost is generated on the evaporator **40** due to the heat exchange of air in the evaporator **40**. When more than a predetermined amount of frost is generated, the frost should be removed. In this case, the refrigerator **1** performs a defrosting operation.

[0037] When the refrigerator **1** performs a defrosting operation, the compressor discharge-side pipe **61***a* is connected with the bypass pipe **70** by the valve device **100**. Therefore, high-temperature refrigerant discharged from the compressor **10** does not flow into the condenser **20**, but flows into the second connecting pipe **62** through the bypass pipe **70**. Then, the high-temperature refrigerant flows into the evaporator **40**. Therefore, as the high-temperature refrigerant flows inside the evaporator **40**, the frost generated on the evaporator **40** is removed.

[0038] According to the first embodiment, the frost generated on the evaporator **40** can be removed without an additional defrost heater, thereby reducing power consumption. In addition, since the refrigerant from the compressor **10** flows inside the evaporator **40**, the frost generated on an entire surface of the evaporator **40** can be quickly removed.

[0039] FIG. **2** is a view illustrating a position of a bypass pipe.

[0040] Referring to FIG. **2**, a heat exchange chamber **80**, where the evaporator **40** is located, is provided at a rear side of the refrigerator **1**. A tray **82** is disposed under the evaporator **40**, and an outlet **84** is formed in a central portion of the tray **82**. Water generated by defrosting for the evaporator **40** falls down into the tray **82**, and the water having fallen into the tray **82** is discharged through the outlet **84**.

[0041] Here, the tray **82** and the outlet **84** may be formed integrally with the heat exchange chamber **80**. A water pan (not shown) may be further formed under the outlet **84** to receive the water generated by defrosting.

[0042] A portion of the bypass pipe **70** is disposed between the evaporator **40** and the tray **82**, and may be disposed adjacent to the tray **82**.

[0043] In detail, when high-temperature refrigerant bypassed by the bypass pipe **70** flows inside the evaporator **40**, frost generated on the evaporator **40** is melted by the high-temperature refrigerant. In this case, melted frost or lumped frost falls down into the tray **82**. Here, when the lumped frost falls down into the tray **82**, the outlet **84** may be blocked by the lumped frost.

[0044] In the first embodiment, a portion of the bypass pipe **70** is disposed adjacent to the tray **82** so that the frost falling down into the tray **82** can be melted by the high-temperature refrigerant that flows in the bypass pipe **70**. Accordingly, the outlet **84** can be prevented from being blocked.

[0045] FIG. **3** is a schematic view illustrating an internal structure of a valve device according to a first embodiment.

[0046] Referring to FIG. **3**, as described above, a 3-way valve may be used as the valve device **100**. The 3-way valve includes an inlet **102**, a first outlet **104**, and a second outlet **106**. The refrigerant discharged from the compressor **10** flows into the inlet **102**. The refrigerant flowing into the inlet **102** is discharged to the condenser intake-side pipe **61***b* through the first outlet **104**, and is discharged to the bypass pipe **70** through the second outlet **106**.

[0047] In detail, the inlet **102** has a diameter equal to that of the first outlet **104**. The second outlet **106** has a diameter smaller than that of the inlet **102** and the first outlet **104**.

[0048] In general, two outlets of a 3-way valve have the same diameter. However, in this case, a flow resistance becomes higher in a normal operation of the refrigerator compared with the refrigerator without having the 3-way valve. Therefore, the efficiency of a freezing cycle decreases, thereby increasing power consumption.

[0049] Therefore, in the first embodiment, the inlet **102** and the first outlet **104** have a diameter larger than that of the second outlet **106** so as to minimize the flow resistance of the refrigerant in a normal operation of the refrigerator.

[0050] Here, since the first outlet **104** has a diameter larger than that of the second outlet **106**, the condenser intake-side pipe **61***b* may be formed to a diameter larger than that of the bypass pipe **70**.

[0051] FIG. **4** is a schematic view of a refrigerant system according to a second embodiment.

[0052] Since the second embodiment is the same as the first embodiment except the structure of a valve device, detailed description will be omitted herein.

[0053] Referring to FIG. **4**, a valve device according to the second embodiment includes a first valve **110** and a second valve **120**. The first valve **110** is provided in a first connecting pipe **61** that connects the compressor **10** with the condenser **20**. The second valve **120** is provided in the bypass pipe **70**.

[0054] In detail, the bypass pipe **70** diverges from the first connecting pipe **61**. The first connecting pipe **61** may be divided into a compressor discharge-side pipe **61***c* and a condenser intake-side pipe **61***d* by the bypass pipe **70**. The first valve **110** is provided in the condenser intake-side pipe **61***d*.

[0055] The first valve **110** is opened and the second valve **120** is closed in a normal operation of the refrigerator. In this case, high-temperature refrigerant discharged from the compressor **10** flows into the condenser **20**.

[0056] On the other hand, the first valve **110** is closed and the second valve **120** is opened in a defrosting operation of the refrigerator. In this case, high-temperature refrigerant discharged from the compressor **10** flows into the evaporator **40** through the bypass pipe **70**. The high-temperature refrigerant removes frost generated on the evaporator **40**. When the defrosting operation is ended, the first valve **110** is opened and the second valve **120** is closed.

[0057] FIG. **5** is a schematic view of a refrigerant system according to a third embodiment.

[0058] Referring to FIG. **5**, the refrigerant system according to the third embodiment includes a compressor **10**, a condenser **20**, a plurality of evaporators, expansion valves of the same number as the evaporators, and a plurality of bypass pipes. The bypass pipes allow refrigerant discharged from the compressor **10** to flow into the evaporators.

[0059] In detail, the evaporators include an evaporator **42** for a freezing compartment and an evaporator **44** for a refrigeration compartment. The expansion valves include a first expansion valve **32** for expanding refrigerant to flow into the evaporator **42** a second expansion valve **34** for expanding refrigerant to flow into the evaporator **44**.

[0060] The bypass pipes include a first bypass pipe **72** and a second bypass pipe **74**. The first bypass pipe **72** allows high-temperature refrigerant discharged from the compressor **10** to move toward an inlet of the evaporator **42**. The second bypass pipe **74** diverges from the first bypass pipe **72** and allows high-temperature refrigerant to move toward an inlet of the evaporator **44**.

[0061] A 3-way valve **90** is disposed between the condenser **20** and the evaporators **42** and **44** and determines a flow direction of the condensed refrigerant. A valve device **100** is disposed between the compressor **10** and the condenser **20** such that high-temperature refrigerant discharged from the compressor **10** can selectively flow into the bypass pipes **72** and **74**. For example, a 3-way valve may be used as the valve device **100**.

[0062] According to the above-construction, when a freezing cycle operates, refrigerant compressed in the compressor **10** is condensed through the condenser **20**. The refrigerant discharged from the condenser **20** flows into the first expansion valve **32** by operation of the 3-way valve **90**.

[0063] The refrigerant is expanded through the first expansion valve **32** and flows into the evaporator **42** for a freezer compartment. The refrigerant evaporated in the evaporator **42** flows into the vapor-liquid separator **50**, and vapor refrigerant of the refrigerant flows into the compressor **10**.

[0064] On the other hand, when a refrigeration cycle operates, refrigerant compressed in the compressor **10** is condensed through the condenser **20**. The refrigerant discharged from the condenser **20** flows into the second expansion valve **34** by operation of the 3-way valve **90**.

[0065] The refrigerant is expanded through the second expansion valve **34** and flows into the evaporator **44** for a refrigeration compartment. The refrigerant evaporated in the evaporator **44** flows into the vapor-liquid separator **50**, and vapor refrigerant of the refrigerant flows into the compressor **10**.

[0066] Meanwhile, when the refrigerator performs a defrosting operation, high-temperature refrigerant compressed in the compressor **10** flows into the first and second bypass pipes **72** and **74** by operation of the valve device **100**, and then flows into the evaporators **42** and **44**. The high-temperature refrigerant removes frost generated on the evaporators **42** and **44**.

[0067] According to the second embodiment, the high-temperature refrigerant discharged from the compressor **10** can remove frost generated on the evaporators **42** and **44** at the same time.

[0068] Here, the first bypass pipe **72** provides a flow passage of high-temperature refrigerant toward the evaporator **42**, and the second bypass pipe **74** diverges from the first bypass pipe **72**, and vice-versa.

[0069] FIG. **6** is a schematic view of a refrigerant system according to a fourth embodiment.

[0070] Since the fourth embodiment is the same as the third embodiment except the structure of a valve device, detailed description will be omitted herein.

[0071] Referring to FIG. **6**, a valve device according to the fourth embodiment includes a first valve **140** and a second valve **150**. The first valve **140** is provided in a first connecting pipe **61** that connects the compressor **10** to the condenser **20**. The second valve **150** is provided in the first bypass pipe **72**.

[0072] In detail, the first bypass pipe **72** diverges from the first connecting pipe **61**. The first connecting pipe **61** may be divided into a compressor discharge-side pipe **61***c* and a condenser intake-side pipe **61***d* by the first bypass pipe **72**. The first valve **140** is provided in the condenser intake-side pipe **61***d*.

[0073] Therefore, the first valve **140** is opened and the second valve **150** is closed in a normal operation of the refrigerator. On the other hand, the first valve **140** is closed and the second valve **150** is opened in a defrosting operation of the refrigerator.

[0074] FIG. **7** is a schematic view of a refrigerant system according to a fifth embodiment.

[0075] Since the fifth embodiment is the same as the third embodiment except the structure of a valve device, detailed description will be omitted herein.

[0076] Referring to FIG. **7**, a 4-way valve is used as a valve device **160** according to the fifth embodiment. A first bypass pipe **72** connected to an inlet of the evaporator **42** is separately formed a second bypass pipe **74** connected to an inlet of the evaporator **44**. One end of each of the bypass pipes **72** and **74** is connected to the valve device **160**.

[0077] Therefore, in a normal operation of the refrigerator, high-temperature refrigerant discharged from the compressor **10** flows into the condenser **20** by operation of the valve device **160**.

[0078] In order to defrost the evaporator **42** for a freezing compartment, high-temperature refrigerant discharged from the compressor **10** flows into the first bypass pipe **72** by operation of the valve device **160**. On the other hand, in order to defrost the evaporator **44** for a refrigeration compartment,

high-temperature refrigerant discharged from the compressor **10** flows into the second bypass pipe **74** by operation of the valve device **160**.

[0079] Therefore, according to the fifth embodiment, the evaporators **42** and **44** can be selectively defrosted.

[0080] A pair of evaporators are provided in the third to fifth embodiments, however, the number of the evaporators is not limited thereto. Even in the case where three or more evaporators are provided, the evaporators can be defrosted using the above-described structure.

1. A refrigerator comprising:
- a compressor;
- a condenser condensing refrigerant discharged from the compressor;
- an expansion valve expanding the refrigerant condensed in the condenser;
- an evaporator evaporating the refrigerant expanded in the expansion valve;
- a bypass pipe allowing the refrigerant discharged from the compressor to move toward an inlet of the evaporator; and
- a valve device allowing the refrigerant discharged from the compressor to selectively move toward the bypass pipe or the condenser,
- wherein the valve device comprises:
- an inlet into which the refrigerant discharged from the compressor flows;
- a first outlet through which the refrigerant is discharged toward the condenser; and
- a second outlet through which the refrigerant is discharged toward the bypass pipe, the first outlet having a diameter larger than that of the second outlet.

2. The refrigerator according to claim **1**, wherein the inlet has a diameter larger than that of the second outlet.

3. The refrigerator according to claim **1**, wherein water generated by defrosting falls down into a tray under the evaporator, and a portion of the bypass pipe is disposed between the tray and the evaporator.

4. A refrigerator comprising:
- a compressor;
- a condenser condensing refrigerant discharged from the compressor;
- an expansion valve expanding the refrigerant condensed in the condenser;
- a plurality of evaporators evaporating the refrigerant expanded in the expansion valve;
- a bypass pipe allowing the refrigerant discharged from the compressor to move toward an inlet of the evaporator;
- a valve device allowing the refrigerant discharged from the compressor to selectively move toward the bypass pipe or the condenser; and
- a condenser intake-side pipe allowing the refrigerant having passed through the valve device to move to the condenser, the condenser intake-side pipe having a diameter larger than that of the bypass pipe.

5. The refrigerator according to claim **4**, further comprising a compressor discharge-side pipe connecting the valve device with the compressor, the compressor discharge-side pipe having a diameter larger than that of the bypass pipe.

6. The refrigerator according to claim **4**, wherein the plurality of evaporators comprises a freezer compartment evaporator and a refrigeration compartment evaporator, and the bypass pipe comprises a first bypass pipe selectively connected with one of the plurality of evaporators and a second bypass pipe selectively connected with the other of the plurality of evaporators.

7. The refrigerator according to claim **6**, wherein the first bypass pipe is connected with the valve device and the second bypass pipe diverges from the first bypass pipe.

8. The refrigerator according to claim **6**, wherein the valve device comprises;
- a first valve provided in the a condenser intake-side pipe to selectively communicated the compressor with the condenser; and
- a second valve provided in the first bypass pipe to selectively connect the compressor with each of the evaporators, and
- the second bypass pipe diverges from the first bypass pipe.

9. The refrigerator according to claim **6**, wherein each of the bypass pipes is separately connected with the valve device such that refrigerant discharged from the compressor flows selectively to each of bypass pipes.

* * * * *