

DESCRIPTION

Title of Invention

REFRIGERATOR

Technical Field

5 [0001]

The present invention relates to a refrigerator provided with a switching chamber.

Background Art

[0002]

10 To date, there have been produced refrigerators provided with a plurality of storage chambers. One such refrigerator is provided with a refrigeration chamber, a freezing chamber, and a vegetable chamber that have large capacities and with an ice-making chamber that has a small capacity. Furthermore, Patent Literature 1 and Patent Literature 2 disclose refrigerators
15 each provided with a switching chamber that has a small capacity and is capable of switching an internal temperature thereof from a refrigeration temperature range to a freezing temperature range, in addition to the refrigeration chamber, the freezing chamber and the vegetable chamber having large capacities and the ice-making chamber having a small capacity.

20 Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent No. 3212954 (Page 5)

Patent Literature 2: Japanese Unexamined Patent Application Publication

25 No. 2001-33144 (Page 2)

Summary of Invention

Technical Problem

[0004]

However, in recent years, since lifestyles vary for each user and especially during summer, foods and other products are stored in freezing chambers very often, the number of households concerned with the limited capacity of freezing chambers during the hot season, such as in summer, has increased.

Furthermore, needs of refrigerator change depending on the environment of the residential area. Moreover, even when a switching chamber is used to compensate for a limited capacity of the freezing chamber by setting the switching chamber to a freezing temperature range, the capacity of the switching chamber of the refrigerator as disclosed in Patent Literature 1 or Patent Literature 2 is too small to compensate for such a limited capacity of the freezing chamber.

[0005]

Furthermore, in the refrigerator of Patent Literature 1 or Patent Literature 2, the capacity of the switching chamber is small and variation in the temperature in the switching chamber is small, and therefore strict temperature control is not required. However, if the capacity of the switching chamber is increased, variation in the temperature in the switching chamber increases accordingly, and therefore precise temperature control is required.

[0006]

To overcome the abovementioned problem, the present invention provides a refrigerator that can appropriately control the internal temperature of a switching chamber even if the capacity of the switching chamber is increased.

Solution to Problem

[0007]

The refrigerator according the present invention includes a refrigerant circuit formed by connecting, by pipes, a compressor, a condenser, an expansion

device, and a cooler to allow refrigerant to flow therethrough; a refrigeration
chamber configured to have an internal temperature therein set within a
refrigeration temperature range; a freezing chamber provided below the
refrigeration chamber, and configured to have an internal temperature therein set
5 within a freezing temperature range lower than the refrigeration temperature
range; and a switching chamber provided below the freezing chamber, and
configured to have an internal temperature therein changeable within the
refrigeration temperature range and the freezing temperature range.

Advantageous Effects of Invention

10 [0008]

According to the present invention, the control unit controls the internal
temperature of the switching chamber to be a predetermined temperature.
Therefore, even if the capacity of the switching chamber is increased, the internal
temperature of the switching chamber can be appropriately controlled.

15 Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is a front view of a refrigerator 1 according to Embodiment 1.

[Fig. 2] Fig. 2 is a sectional front view of a freezing chamber 30 in
Embodiment 1.

20 [Fig. 3] Fig. 3 is a sectional front view of a switching chamber 40 in
Embodiment 1.

[Fig. 4] Fig. 4 is a sectional side view of the refrigerator 1 according to
Embodiment 1, being a cross section taken along the line A-A in Fig. 1.

[Fig. 5] Fig. 5 is a sectional side view of the freezing chamber 30 and the
25 switching chamber 40 according to Embodiment 1.

[Fig. 6] Fig. 6 is a block diagram illustrating a control unit 10 in
Embodiment 1.

[Fig. 7] Fig. 7 is a flowchart of operation of the refrigerator 1 according to Embodiment 1.

[Fig. 8] Fig. 8 is a block diagram illustrating a control unit 110 in Embodiment 2.

5 [Fig. 9] Fig. 9 is a flowchart of operation of a refrigerator 100 according to Embodiment 2.

[Fig. 10] Fig. 10 is a block diagram illustrating a control unit 210 in Embodiment 3.

10 [Fig. 11] Fig. 11 is a flowchart of operation of a refrigerator 200 according to Embodiment 3.

[Fig. 12] Fig. 12 is a front view of a refrigerator 300 according to a modification.

Description of Embodiments

[0010]

15 The embodiments of a refrigerator according to the present invention will be explained with reference to the drawings. Note that the present invention is not limited by the embodiments explained below. In the drawings including Fig. 1, the relations among the sizes of component members may differ from actual relations.

20 [0011]

Embodiment 1

Fig. 1 is a front view of a refrigerator 1 according to Embodiment 1. The refrigerator 1 will be explained based on Fig. 1. As illustrated in Fig. 1, the refrigerator 1 is provided with a refrigeration chamber 20, a freezing chamber 30, a switching chamber 40, an ice-making chamber 50, and a sub-switching chamber 60. The refrigeration chamber 20 is installed at an uppermost part of the storage chambers of the refrigerator 1, and the internal temperature of the

25

refrigeration chamber 20 is set to a refrigeration temperature range. The refrigeration temperature range is 0 degrees Celsius (C) or higher, for example.

[0012]

At a lower part of the refrigeration chamber 20, the ice-making chamber 50 and the sub-switching chamber 60 are installed side by side in a width direction (X-arrow direction) of the refrigerator 1. The ice-making chamber 50 is for storing ice and is provided with a drawer door. The internal temperature of the sub-switching chamber 60 is changeable to a temperature within a freezing temperature range (-18 degrees C or lower), which is a temperature range lower than the refrigeration temperature range, a soft-freezing temperature (-7 degrees C), a chilling temperature (0 degrees C), a refrigeration temperature (5 degrees C), or another temperature. The sub-switching chamber 60 is provided with a drawer door, as is with the ice-making chamber 50.

[0013]

The freezing chamber 30 is installed below the ice-making chamber 50 and the sub-switching chamber 60, and the internal temperature thereof is set to a freezing temperature range (-18 degrees C or lower). Fig. 2 is a sectional front view of the freezing chamber 30 in Embodiment 1. As illustrated in Fig. 2, the freezing chamber 30 has a freezing temperature detection unit 31 installed on, for example, an inner wall thereof. The freezing temperature detection unit 31 includes a thermistor, for example, and detects the internal temperature of the freezing chamber 30.

[0014]

In addition, a freezing chamber opening section 32 is provided close to the freezing temperature detection unit 31 and introduces cold air from an air passage 2 provided behind the freezing chamber 30. In the freezing chamber 30, the freezing temperature detection unit 31 is installed at a position where the

freezing temperature detection unit 31 is not directly exposed to the cold air introduced from the freezing chamber opening section 32. For example, the freezing temperature detection unit 31 is not directly adjacent to the freezing chamber opening section 32 in the width direction (X-arrow direction) and in a height direction (Z-arrow direction) of the refrigerator 1. That is, the freezing chamber opening section 32 is provided with, for example, a partition plate, and the freezing temperature detection unit 31 is adjacent to the freezing chamber opening section 32 via the partition plate. Furthermore, a plurality of freezing chamber opening sections 32 may be provided.

[0015]

As illustrated in Fig. 1, the switching chamber 40 is provided below the freezing chamber 30, that is, at the lowermost part of the storage chambers of the refrigerator 1. The internal temperature of the switching chamber 40 is changeable to a temperature within the freezing temperature range (-18 degrees C or lower), the soft-freezing temperature (-7 degrees C), or the refrigeration temperature (5 degrees C). The capacity of the switching chamber 40 is larger than that of the sub-switching chamber 60. Fig. 3 is a sectional front view of the switching chamber 40 in Embodiment 1. As illustrated in Fig. 3, the switching chamber 40 has a switching temperature detection unit 41 installed on, for example, an inner wall thereof. The switching temperature detection unit 41 includes a thermistor, for example, and detects the internal temperature of the switching chamber 40.

[0016]

In addition, two switching chamber opening sections 42 are provided close to the switching temperature detection unit 41 and introduce cold air from the air passage 2 provided behind the switching chamber 40. The switching chamber 40 allows not only the freezing temperature range but also the refrigeration

temperature range, which is higher than the freezing temperature range, and therefore requires less cold air than the freezing chamber 30 requires to be introduced thereto. Thus, the total opening area of the two switching chamber opening sections 42 is smaller than the opening area of the freezing chamber opening section 32.

[0017]

In the switching chamber 40, the switching temperature detection unit 41 is installed at a position where the switching temperature detection unit 41 is not directly exposed to the cold air introduced from the switching chamber opening sections 42. For example, the switching temperature detection unit 41 is not directly adjacent to the switching chamber opening sections 42 in the width direction (X-arrow direction) and in the height direction (Z-arrow direction) of the refrigerator 1. That is, the switching chamber opening sections 42 are provided with, for example, a partition plate, and the switching temperature detection unit 41 is adjacent to the switching chamber opening sections 42 via the partition plate. The internal temperature of the switching chamber 40 may be changeable within the refrigeration temperature range (0 degrees C or higher) and the freezing temperature range. Furthermore, one switching chamber opening section 42 or three or more switching chamber opening sections 42 may be provided.

[0018]

The chambers of the refrigerator 1 have respective capacities in the order of the refrigeration chamber 20, the freezing chamber 30, the switching chamber 40, the sub-switching chamber 60 and the ice-making chamber 50, from the largest to smallest. The width of the switching chamber 40 is the same as the widths of the freezing chamber 30 and the refrigeration chamber 20. Furthermore, in the refrigerator 1, the ice-making chamber 50 and the sub-

switching chamber 60 need not be provided. In such a case, the refrigerator 1 includes the refrigeration chamber 20, the freezing chamber 30 provided below the refrigeration chamber 20, and the switching chamber 40 provided below the freezing chamber 30.

5 [0019]

Fig. 4 is a sectional side view of the refrigerator 1 according to Embodiment 1 and is a cross-section taken along the line A-A (hereafter "A-A cross section") in Fig. 1. As illustrated in Fig. 4, a compressor 71 configured to compress refrigerant is installed at a position behind the refrigerator 1 and at the bottom thereof. The air passage 2 in which cold air flows is provided behind the refrigeration chamber 20, the sub-switching chamber 60, the freezing chamber 30, and the switching chamber 40. Below the air passage 2, a cooler 74 is provided. The cooler 74 is connected to the compressor 71, a condenser 72, and an expansion device 73 by pipes, and thereby a refrigerant circuit 70 through which refrigerant flows is provided.

15 [0020]

In the refrigerant circuit 70, refrigerant discharged from the compressor 71 flows into the condenser 72. In the condenser 72, the refrigerant is condensed by being subjected to heat exchange with air or other medium. The condensed refrigerant flows into the expansion device 73, and is expanded therein. Then, the expanded refrigerant flows into the cooler 74 and is subjected to heat exchange with the air in the air passage 2, and thereby the air in the air passage 2 is cooled and the refrigerant is evaporated. Then, the evaporated refrigerant is sucked into the compressor 71 again. The air cooled by the cooler 74 flows through the air passage 2 of the refrigerator 1 into each storage chamber.

25 [0021]

In the air passage 2, an air blower 90 is installed above the cooler 74. The air blower 90 blows air into the freezing chamber 30 and the switching chamber 40. The blowing direction of the air blower 90 is set toward the freezing chamber 30, for example. The refrigerator 1 is provided with the control unit 10. The control unit 10 controls the internal temperatures of the refrigeration chamber 20, the freezing chamber 30, the switching chamber 40, and other chambers to be predetermined temperatures.

[0022]

Fig. 5 is a sectional side view of the freezing chamber 30 and the switching chamber 40 according to Embodiment 1. As illustrated in Fig. 5, the switching chamber 40 and the air passage 2 are separated by a damper 91. By opening and closing the damper 91, the air volume of the cold air flowing from the air blower 90 into the switching chamber 40 is adjusted, and thereby the temperature of the switching chamber 40 is adjusted. Furthermore, an upper wall heater 80a and a lower wall heater 80b are respectively installed on a rear part of an upper wall of the switching chamber 40 and a rear part of a lower wall thereof. The upper wall heater 80a and the lower wall heater 80b adjust the temperature of the switching chamber 40.

[0023]

When the internal temperature of the switching chamber 40 is set to the refrigeration temperature range or a temperature range higher than the freezing temperature range, the internal temperature of the switching chamber 40 may be excessively reduced due to the cold air introduced from the air passage 2. The upper wall heater 80a and the lower wall heater 80b are used to raise and adjust the internal temperature of the switching chamber 40, which is excessively reduced, to an appropriate temperature. Since the air passage 2 is provided behind the switching chamber 40, the rear part of the switching chamber 40 is

easily excessively cooled compared with the front thereof. Therefore, the upper wall heater 80a and the lower wall heater 80b are installed at the rear part of the switching chamber 40. Note that the number of heaters to be installed may be one, or three or more.

5 [0024]

Furthermore, a temperature detection unit, a damper, and a heater may be installed in each storage chamber. In such a case, the temperature of each storage chamber is detected by the temperature detection unit installed therein, and the rotation speed and other parameters of the compressor 71, the air
10 blowing volume of the air blower 90, the opening degree of the damper, the energization rate of the heater, and the other parameters are adjusted to attain a target temperature set for each storage chamber.

[0025]

Fig. 6 is a block diagram illustrating the control unit 10 in Embodiment 1.
15 The control unit 10 usually controls the rotation speed of the compressor 71 or the operating frequency or another parameter thereof based on the internal temperature of the freezing chamber 30 detected by the freezing temperature detection unit 31. As illustrated in Fig. 6, the control unit 10 is provided with a switching determination unit 11 and an operation control unit 12.

20 [0026]

The switching determination unit 11 determines whether or not a target switching chamber temperature TS set for the switching chamber 40 is in the freezing temperature range. The operation control unit 12 controls the internal temperature of the switching chamber 40 to reach the target switching chamber
25 temperature TS and is provided with a target freezing chamber temperature reducing unit 12a. The target freezing chamber temperature reducing unit 12a reduces a target freezing chamber temperature TF set for the freezing chamber

30 if the switching determination unit 11 determines that the target switching chamber temperature TS is in the freezing temperature range. The target freezing chamber temperature reducing unit 12a then controls the compressor 71 in such a manner that the internal temperature of the freezing chamber 30 reaches the target freezing chamber temperature TF. For example, supposing that the target freezing chamber temperature TF of the freezing chamber 30 for normal operation is -18 degrees C, the freezing chamber temperature reducing unit 12a reduces the target freezing chamber temperature TF to -20 degrees C. As described above, in Embodiment 1, the target freezing chamber temperature reducing unit 12a performs a shift-down control.

[0027]

Next, the operation of the refrigerator 1 in Embodiment 1 will be explained. Fig. 7 is a flowchart of the operation of the refrigerator 1 according to Embodiment 1. As illustrated in Fig. 7, the control unit 10 controls the compressor 71 based on the temperature of the freezing chamber 30 (step S1). Specifically, the control unit 10 compares the temperature of the freezing chamber 30 with the target freezing chamber temperature TF, and controls the compressor 71 to eliminate the difference. Then, the switching determination unit 11 determines whether or not the target switching chamber temperature TS is in the freezing temperature range (step S2).

[0028]

In step S2, if it is determined that the target switching chamber temperature TS is in the refrigeration temperature range, for example, 5 degrees C, the process proceeds to step S3. If the internal temperature of the switching chamber 40 is higher than the target switching chamber temperature TS, the damper 91 is half-opened, and if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the

damper 91 is completely closed (step S3). Furthermore, if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the internal temperature is adjusted by using the upper wall heater 80a and the lower wall heater 80b (step S4) in addition to completely closing the damper 91. Then, the operation is continued.

[0029]

Meanwhile, in step S2, if it is determined that the target switching chamber temperature TS is in a soft-freezing temperature range that is a temperature range between the freezing temperature range and the refrigeration temperature range, for example, -7 degrees C, the process proceeds to step S5. If the internal temperature of the switching chamber 40 is higher than the target switching chamber temperature TS, the damper 91 is half-opened, and if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the damper 91 is completely closed (step S5). Furthermore, if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the internal temperature is adjusted by using the upper wall heater 80a and the lower wall heater 80b (step S6) in addition to completely closing the damper 91. Then, the operation is continued. Note that step S5 and step S6 are the same as step S3 and step S4, respectively.

[0030]

In step S2, if it is determined that the target switching chamber temperature TS is in the freezing temperature range, for example, -18 degrees C, the process proceeds to step S7. In step S7, the target freezing chamber temperature reducing unit 12a reduces the target freezing chamber temperature TF set for the freezing chamber 30. Then, the damper 91 is fully opened, and

as much cold air as possible is introduced from the switching chamber opening sections 42 (step S8). Then, the operation is continued.

[0031]

As described above, the control unit 10 of Embodiment 1 controls the internal temperature of the refrigeration chamber 20, the freezing chamber 30, or the switching chamber 40 to be a predetermined temperature. Consequently, even if the capacity of the switching chamber 40 is increased, the internal temperature of the switching chamber 40 can be appropriately controlled. Thus, the refrigerator 1 suited to a lifestyle of the user can be realized.

[0032]

In addition, in Embodiment 1, the refrigeration chamber 20, the freezing chamber 30, and the switching chamber 40 are disposed in the named order from the upper side of the refrigerator 1, and the ice-making chamber 50 and the sub-switching chamber 60 are disposed between the refrigeration chamber 20 and the freezing chamber 30. Therefore, if the target switching chamber temperature T_S of the switching chamber 40 is in the freezing temperature range, all the storage chambers except the refrigeration chamber 20, which is located at the uppermost part, are set to have a temperature lower than the refrigeration temperature range. Consequently, if the target switching chamber temperature T_S of the switching chamber 40 is in the freezing temperature range, the refrigerator 1 is segmented as the refrigeration chamber 20 located at the upper part and the other storage chambers, the temperatures of which are lower than the temperature of the refrigeration chamber 20. Thus, a heat insulator used in the refrigerator 1 is substantially installed between the refrigeration chamber 20, and the ice-making chamber 50 and the sub-switching chamber 60, between which the temperature region is segmented, thereby reducing the amount of the heat insulator to be used in the entire refrigerator 1.

[0033]

Furthermore, if the target switching chamber temperature TS is in the freezing temperature range, the target freezing chamber temperature reducing unit 12a reduces the target freezing chamber temperature TF set for the freezing chamber 30. As described above, the switching chamber 40 allows not only the freezing temperature range but also the refrigeration temperature range, which is higher than the freezing temperature range, and therefore the switching chamber opening sections 42 are set to be small, and thereby, compared with the freezing chamber 30, cooling of the switching chamber 40 is less advanceable. As a result, if the target freezing chamber temperature TF of the freezing chamber 30 and the target switching chamber temperature TS of the switching chamber 40 are the same, there is a possibility that the temperature of the switching chamber 40 will not reach the target switching chamber temperature TS even when the temperature of the freezing chamber 30 reaches the target freezing chamber temperature TF.

[0034]

In contrast, in Embodiment 1, the target freezing chamber temperature reducing unit 12a reduces the target freezing chamber temperature TF set for the freezing chamber 30, and thereby the target freezing chamber temperature TF of the freezing chamber 30 is lower than the target switching chamber temperature TS of the switching chamber 40. Therefore, while the temperature of the freezing chamber 30 reaches the target freezing chamber temperature TF, the temperature of the switching chamber 40 reaches the target switching chamber temperature TS. As described above, in Embodiment 1, the internal temperature of the switching chamber 40 can be appropriately controlled. Note that, by reducing the target freezing chamber temperature TF, the internal temperature of the freezing chamber 30 decreases below the usual temperature,

however, there is no problem of reducing the internal temperature of the freezing chamber 30 in terms of freezing foods.

[0035]

Embodiment 2

5 Next, a refrigerator 100 according to Embodiment 2 will be explained.

Fig. 8 is a block diagram illustrating a control unit 110 in Embodiment 2.

Embodiment 2 differs from Embodiment 1 in that an operation control unit 112 is provided with a control target detection unit change unit 112a. In Embodiment 2, a description of parts common to Embodiment 1 is omitted by denoting with
10 the same reference numerals, and different points from Embodiment 1 will be mainly described.

[0036]

As illustrated in Fig. 8, the operation control unit 112 is provided with the control target detection unit change unit 112a. The control target detection unit
15 change unit 112a controls the operation of a compressor 71 based on the internal temperature of a switching chamber 40 detected by a switching temperature detection unit 41, instead of the internal temperature of a freezing chamber 30 detected by a freezing temperature detection unit 31, if a switching determination unit 11 determines that a target switching chamber temperature TS is in the
20 freezing temperature range. As described above, the control target detection unit change unit 112a changes the temperature detection unit used in the control of the compressor 71 from the freezing temperature detection unit 31 to the switching temperature detection unit 41.

[0037]

25 Next, the operation of the refrigerator 100 in Embodiment 2 will be explained. Fig. 9 is a flowchart of the operation of the refrigerator 100 according to Embodiment 2. As illustrated in Fig. 9, the control unit 110 controls the

compressor 71 based on the temperature of the freezing chamber 30 (step S11). Specifically, the control unit 110 compares the temperature of the freezing chamber 30 with a target freezing chamber temperature T_F , and controls the compressor 71 to eliminate the difference. Then, the switching determination unit 11 determines whether or not the target switching chamber temperature T_S is in the freezing temperature range (step S12).

[0038]

In step S12, if it is determined that the target switching chamber temperature T_S is in the refrigeration temperature range, for example, 5 degrees C, the process proceeds to step S13. If the internal temperature of the switching chamber 40 is higher than the target switching chamber temperature T_S , a damper 91 is half-opened, and if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature T_S , the damper 91 is completely closed (step S13). Furthermore, if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature T_S , the internal temperature is adjusted by using an upper wall heater 80a and a lower wall heater 80b (step S14) in addition to completely closing the damper 91. Then, the operation is continued. Note that step S13 and step S14 are the same as step S3 and step S4 of Embodiment 1, respectively.

[0039]

Meanwhile, in step S12, if it is determined that the target switching chamber temperature T_S is in the soft-freezing temperature range, for example, -7 degrees C, the process proceeds to step S15. If the internal temperature of the switching chamber 40 is higher than the target switching chamber temperature T_S , the damper 91 is half-opened, and if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature

TS, the damper 91 is completely closed (step S15). Furthermore, if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the internal temperature is adjusted by using the upper wall heater 80a and the lower wall heater 80b (step S16) in addition to
5 completely closing the damper 91. Then, the operation is continued. Note that step S15 and step S16 are the same as step S13 and step S14, respectively.

[0040]

In step S12, if it is determined that the target switching chamber temperature TS is in the freezing temperature range, for example, -18 degrees C,
10 the process proceeds to step S17. In step S17, the control unit 110 suspends the control of the compressor 71, the control being based on the internal temperature of the freezing chamber 30 detected by the freezing temperature detection unit 31. Then, the control target detection unit change unit 112a controls the operation of the compressor 71 based on the internal temperature of
15 the switching chamber 40 detected by the switching temperature detection unit 41 (step S18). Then, the damper 91 is fully opened, and as much cold air as possible is introduced from switching chamber opening sections 42 (step S19). Then, the operation is continued.

[0041]

20 As described above, in Embodiment 2, the control target detection unit change unit 112a controls the operation of the compressor 71 based on the internal temperature of the switching chamber 40 detected by the switching temperature detection unit 41. As described in Embodiment 1, if the target freezing chamber temperature TF of the freezing chamber 30 and the target
25 switching chamber temperature TS of the switching chamber 40 are the same, there is a possibility that the temperature of the switching chamber 40 will not

reach the target switching chamber temperature TS even when the temperature of the freezing chamber 30 reaches the target freezing chamber temperature TF.
[0042]

In contrast, in Embodiment 2, the control target detection unit change unit
5 112a controls the operation of the compressor 71 based on the internal temperature of the switching chamber 40 detected by the switching temperature detection unit 41, and thereby the internal temperature of the switching chamber 40 can appropriately reach the target switching chamber temperature TS. Note that, by appropriately cooling the switching chamber 40 in such a manner, the
10 internal temperature of the freezing chamber 30 decreases to slightly below the target freezing chamber temperature TF, however, there is no problem of reducing the internal temperature of the freezing chamber 30 in terms of freezing foods.

[0043]

15 Embodiment 3

Next, a refrigerator 200 according to Embodiment 3 will be explained. Fig. 10 is a block diagram illustrating a control unit 210 in Embodiment 3. Embodiment 3 differs from Embodiment 1 in that an operation control unit 212 is provided with a compressor control unit 212a. In Embodiment 3, a description
20 of parts common to Embodiment 1 is omitted by denoting with the same reference numerals, and different points from Embodiment 1 will be mainly described.

[0044]

As illustrated in Fig. 10, the operation control unit 212 is provided with the
25 compressor control unit 212a. The compressor control unit 212a controls the operation of a compressor 71 based on the internal temperature of a freezing chamber 30 detected by a freezing temperature detection unit 31 and on a

temperature range of a target switching chamber temperature TS determined by a switching determination unit 11.

[0045]

Next, the operation of the refrigerator 200 in Embodiment 3 will be explained. Fig. 11 is a flowchart of the operation of the refrigerator 200 according to Embodiment 3. As illustrated in Fig. 11, the control unit 210 controls the compressor 71 based on the temperature of the freezing chamber 30 (step S21). Specifically, the control unit 210 compares the temperature of the freezing chamber 30 with a target freezing chamber temperature TF, and controls the compressor 71 to eliminate the difference. Then, the switching determination unit 11 determines whether the target switching chamber temperature TS is in the freezing temperature range, the refrigeration temperature range, or the soft-freezing temperature range (step S22).

[0046]

In step S22, if it is determined that the target switching chamber temperature TS is in the refrigeration temperature range, for example, 5 degrees C, the process proceeds to step S23. In step S23, the compressor control unit 212a controls the rotation speed of the compressor 71 or another parameter thereof based on the internal temperature of the freezing chamber 30 and further on a temperature range of the target switching chamber temperature TS determined by the switching determination unit 11, that is, the refrigeration temperature range.

[0047]

Then, if the internal temperature of the switching chamber 40 is higher than the target switching chamber temperature TS, a damper 91 is half-opened, and if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the damper 91 is completely closed

(step S24). Furthermore, if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the internal temperature is adjusted by using an upper wall heater 80a and a lower wall heater 80b (step S25) in addition to completely closing the damper 91. Then, the operation is continued. Note that step S24 and step S25 are the same as step S3 and step S4 of Embodiment 1, respectively.

[0048]

Meanwhile, in step S22, if it is determined that the target switching chamber temperature TS is in the soft-freezing temperature range, for example, -7 degrees C, the process proceeds to step S26. In step S26, the compressor control unit 212a controls the rotation speed of the compressor 71 or another parameter thereof based on the internal temperature of the freezing chamber 30 and further on a temperature range of the target switching chamber temperature TS determined by the switching determination unit 11, that is, the soft-freezing temperature range.

[0049]

Then, if the internal temperature of the switching chamber 40 is higher than the target switching chamber temperature TS, the damper 91 is half-opened, and if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the damper 91 is completely closed (step S27). Furthermore, if the internal temperature of the switching chamber 40 is lower than the target switching chamber temperature TS, the internal temperature is adjusted by using the upper wall heater 80a and the lower wall heater 80b (step S28) in addition to completely closing the damper 91. Then, the operation is continued. Note that step S27 and step S28 are the same as step S24 and step S25, respectively.

[0050]

In step S22, if it is determined that the target switching chamber temperature TS is in the freezing temperature range, for example, -18 degrees C, the process proceeds to step S29. In step S29, the compressor control unit 212a controls the rotation speed of the compressor 71 or another parameter thereof based on the internal temperature of the freezing chamber 30 and further on a temperature range of the target switching chamber temperature TS determined by the switching determination unit 11, that is, the freezing temperature range. Then, the damper 91 is fully opened, and as much cold air as possible is introduced from switching chamber opening sections 42 (step S30). Then, the operation is continued.

[0051]

As described above, in Embodiment 3, the compressor control unit 212a controls the operation of the compressor 71 based on the internal temperature of the freezing chamber 30 detected by the freezing temperature detection unit 31 and on the temperature range of the target switching chamber temperature TS determined by the switching determination unit 11. Therefore, even when the target switching chamber temperature TS of the switching chamber 40 is set to any temperature range, the internal temperature of the switching chamber 40 can be appropriately controlled to the corresponding temperature range.

[0052]

Note that the present invention is not limited to the abovementioned embodiments. Fig. 12 is a front view of a refrigerator 300 according to a modification. As illustrated in Fig. 12, in storage chambers of the refrigerator 300, a soft-freezing chamber 360 may be installed, as an alternative to the sub-switching chamber 60. In such a case, a soft-freezing temperature of the soft-freezing chamber 360 is -7 degrees C, for example.

Reference Signs List

[0053]

1 refrigerator 2 air passage 10 control unit 11 switching
determination unit 12 operation control unit 12a target freezing chamber
temperature reducing unit 20 refrigeration chamber 30 freezing chamber
5 31 freezing temperature detection unit 32 freezing chamber opening section
40 switching chamber 41 switching temperature detection unit 42
switching chamber opening section 5 ice-making chamber 60 sub-
switching chamber 70 refrigerant circuit 71 compressor 72 condenser
73 expansion device 74 cooler 80a upper wall heater 80b lower wall
10 heater 90 air blower 91 damper 100 refrigerator 110 control unit
112 operation control unit 112a control target detection unit change unit
200 refrigerator 210 control unit 212 operation control unit 212a
compressor control unit 300 refrigerator 360 soft-freezing chamber TF
target freezing chamber temperature TS target switching chamber
15 temperature

CLAIMS

[Claim 1]

A refrigerator comprising:

a refrigerant circuit formed by connecting, by pipes, a compressor, a condenser, an expansion device, and a cooler to allow refrigerant to flow therethrough;

a refrigeration chamber configured to have an internal temperature therein set within a refrigeration temperature range;

a freezing chamber provided below the refrigeration chamber, and configured to have an internal temperature therein set within a freezing temperature range lower than the refrigeration temperature range, the freezing chamber being formed with a freezing chamber opening section for introducing air cooled by the cooler;

a switching chamber provided below the freezing chamber, and configured to have an internal temperature therein changeable within the refrigeration temperature range and the freezing temperature range, the switching chamber being formed with a switching chamber opening section for introducing the air cooled by the cooler,

a controller configured to control the internal temperature of the refrigeration chamber, the freezing chamber, or the switching chamber to reach a predetermined temperature, and

a freezing temperature detection unit configured to detect an internal temperature of the freezing chamber,

the controller including

a switching determination unit configured to determine whether or not a target switching chamber temperature set for the switching chamber is in the freezing temperature range, and

an operation control unit configured to control the internal temperature of the switching chamber to reach the target switching chamber temperature when the switching determination unit determines that the target switching chamber temperature is in the freezing temperature range,

wherein the switching determination unit is configured to determine whether the target switching chamber temperature is in the freezing temperature range, the refrigeration temperature range, or a soft-freezing temperature range, the soft-freezing temperature range being between the freezing temperature range and the refrigeration temperature range,

wherein the operation control unit includes

a compressor control unit configured to control operation of the compressor based on the internal temperature of the freezing chamber detected by the freezing temperature detection unit and on a temperature range of the target switching chamber temperature determined by the switching determination unit, and

wherein the switching chamber is provided with an upper wall heater and a lower wall heater for adjusting a temperature of the switching chamber.

[Claim 2]

The refrigerator of claim 1, further comprising
an air passage provided behind the refrigeration chamber, the freezing chamber, and the switching chamber for allowing cold air to flow through the air passage,
wherein the cooler is provided below the air passage, and
an air blower is installed above the cooler in the air passage in such a manner that a blowing direction of the air blower is set toward the freezing chamber.

[Claim 3]

The refrigerator of claim 1 or 2, further comprising:
an air blower configured to blow air into the refrigeration chamber, the freezing chamber, and the switching chamber; and
a damper configured to adjust an air volume of the air blower flowing into the switching chamber to adjust the temperature of the switching chamber.

[Claim 4]

The refrigerator of any one of claims 1 to 3, further comprising a sub-switching chamber having a capacity smaller than a capacity of the switching chamber, and in which an internal temperature thereof is changeable within the refrigeration temperature range and the freezing temperature range.

[Claim 5]

The refrigerator of any one of claims 1 to 4,
wherein a width of the switching chamber is same as a width of the freezing chamber.