

DESCRIPTION

Title of Invention

REFRIGERATOR

Technical Field

[0001]

The present disclosure relates to a refrigerator provided with a storage compartment that is configured to be set in a soft-freezing temperature zone.

Background Art

[0002]

In normal freezing performed in a related-art refrigerator, needle-like ice crystals are gradually generated from the surface of a food toward the center thereof. As a result, cells of the food are broken and the quality of the food is affected, such as deterioration of the texture and outflow of taste components after thawing. To solve such problems, a refrigerator that performs freezing to improve freezing quality has been proposed (see Patent Literature 1, for example).

[0003]

In the freezing described in Patent Literature 1, after a food is placed in a compartment and the door is closed, the food is once brought into a supercooling state in which the food is not frozen at the temperature below its freezing point, and then a physical or thermal stimulus is applied to the food being in the supercooling state. Here, the supercooling state is a state in which a food is not frozen even when the food is cooled below the freezing temperature of the food. When the stimulus is applied, the supercooling state is released and the food is quickly frozen. When a food is frozen in such a manner, ice nucleation occurs throughout the food and homogeneous fine ice crystals can be formed. Consequently, destruction of food cells is prevented, and thus deterioration of the texture is suppressed and taste components are maintained after thawing. As a result, the food can be stored at high quality even when the food is frozen.

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2001-4260

Summary of Invention

Technical Problem

[0005]

To freeze a food by bringing the food into the supercooling state without fail in a storage compartment whose temperature is set to a soft-freezing temperature zone (e.g., about -7 degrees C), it is necessary to increase the compartment temperature to near the freezing point of the food once, and after the food is placed in the compartment and the door is closed, and then decrease the compartment temperature below the freezing point of the food to promote freezing of the food. However, in the related-art refrigerator of Patent Literature 1, after a food is placed in a compartment and the door is closed, the compartment temperature is decreased below the freezing point of the food without being increased to near the freezing point. As a result, the food may be frozen without being brought into the supercooling state, and thus the food may not be stored at high quality.

[0006]

The present disclosure has been made to overcome the abovementioned problem, and an object thereof is to provide a refrigerator capable of properly storing food at high quality.

Solution to Problem

[0007]

A refrigerator of one embodiment of the present disclosure includes a heat insulating box body having therein a plurality of storage compartments including a first storage compartment whose temperature can be set at a soft-freezing temperature zone, a door that opens and closes an opening provided at the front side

of the first storage compartment, a door opening/closing detection unit configured to detect opening and closing of the door, a temperature detection unit configured to detect a temperature in the first storage compartment, a temperature control unit configured to control the temperature in the first storage compartment, and a controller configured to control the temperature control unit based on the temperature detected by the temperature detection unit. When opening and closing of the door is detected during a normal temperature control that maintains the compartment temperature of the first storage compartment at a predetermined normal set temperature, the controller executes a special temperature control that shifts the compartment temperature of the first storage compartment to a first set temperature being higher than the normal set temperature and maintains the compartment temperature at the first set temperature for a first time period, and then shifts the compartment temperature to a second set temperature being lower than the normal set temperature and maintains the compartment temperature at the second set temperature for a second time period.

Advantageous Effects of Invention

[0008]

According to the refrigerator of one embodiment of the present disclosure, when opening and closing of the door is detected during the normal temperature control, which maintains the compartment temperature of the first storage compartment, whose temperature can be set at the soft-freezing temperature zone, at a predetermined normal set temperature, the special temperature control is executed to maintain the compartment temperature of the first storage compartment at the first set temperature, which is lower than the normal temperature, for the first time period, and then maintain the compartment temperature at the second set temperature, which is lower than the normal set temperature, for the second time period. Consequently, even when a food is placed in the first storage compartment and the door is closed, the food can be frozen after being brought into the

supercooling state in a more reliable manner and thus the food can be properly stored at high quality.

Brief Description of Drawings

[0009]

[Fig. 1] Fig. 1 is an elevation view of a refrigerator according to Embodiment 1 of the present disclosure.

[Fig. 2] Fig. 2 is a schematic longitudinal sectional view around a versatile compartment of the refrigerator according to Embodiment 1 of the present disclosure.

[Fig. 3] Fig. 3 is a diagram showing a temporal transition of the compartment temperature of the versatile compartment when a door of the versatile compartment of the refrigerator according to Embodiment 1 of the present disclosure is opened and closed during a normal temperature control.

[Fig. 4] Fig. 4 is a diagram showing a temporal transition of the compartment temperature of the versatile compartment when the door of the versatile compartment of the refrigerator according to Embodiment 1 of the present disclosure is opened and closed during a special temperature control.

[Fig. 5] Fig. 5 is a diagram showing a temporal transition of the compartment temperature of a versatile compartment when a door of the versatile compartment of a refrigerator according to Embodiment 2 of the present disclosure is opened and closed while the special temperature control maintains the compartment temperature at a first set temperature.

[Fig. 6] Fig. 6 is a temporal transition of the compartment temperature of a versatile compartment when a door of the versatile compartment of a refrigerator according to Embodiment 3 of the present disclosure is opened and closed.

[Fig. 7] Fig. 7 is a temporal transition of the compartment temperature of a versatile compartment when a door of the versatile compartment of a refrigerator according to Embodiment 4 of the present disclosure is opened and closed.

Description of Embodiments

[0010]

Embodiments of the present disclosure will be explained below with reference to the drawings. It should be noted that the present disclosure is not limited by the embodiments described below. Further, there is a case where the relationship of sizes of the components in the drawings may differ from that of actual ones.

[0011]

Embodiment 1

Fig. 1 is an elevation view of a refrigerator 1 according to Embodiment 1 of the present disclosure. Fig. 2 is a schematic longitudinal sectional view around a versatile compartment of the refrigerator 1 according to Embodiment 1 of the present disclosure.

[0012]

The refrigerator 1 according to Embodiment 1 of the present disclosure includes a heat insulating box body 2 having a front opening and a storage space therein. The heat insulating box body 2 includes an outer box 2a that is made of a steel plate and forms an outer frame, an inner box 2b that has a thin hard wall made of resin, such as acrylonitrile butadiene styrene (ABS), and is placed inside the outer box 2a, and an insulation material 2c, such as a rigid urethane foam, filled between the outer box 2a and the inner box 2b.

[0013]

The storage space formed inside the heat insulating box body 2 is divided into a plurality of storage compartments for storing food, by a plurality of partition members (not shown). The refrigerator 1 according to Embodiment 1 includes, as the plurality of storage compartments, a refrigerator compartment 100 arranged at the top, a versatile compartment 200 arranged under the refrigerator compartment 100, and an ice-making compartment 300 arranged adjacent to a side of the versatile compartment 200, in parallel to the versatile compartment 200. In addition, the refrigerator 1 includes a vegetable compartment 400 arranged under the versatile compartment 200 and the ice-making compartment 300, and a freezer compartment 500 arranged at the bottom, under the vegetable compartment 400.

[0014]

An opening provided at the front side of the refrigerator compartment 100 is provided with a refrigerator compartment door 11 that is of double door type and is configured to open and close the opening. Similarly, openings formed at the front sides of the versatile compartment 200, the ice-making compartment 300, the vegetable compartment 400, and the freezer compartment 500 are respectively provided with a versatile compartment door 12, an ice-making compartment door 13, a vegetable compartment door 14, and a freezer compartment door 15 that are of drawer type and are configured to open and close the openings. Furthermore, the refrigerator compartment door 11 is provided with a setting operation unit 10 with which a user can perform operations, such as setting temperatures of the storage compartments.

[0015]

The refrigerator compartment 100 is set at a refrigerator temperature zone (e.g., about 3 degrees C). The versatile compartment 200 is set at a refrigeration temperature zone (e.g., about -18 degrees C) or a soft-freezing temperature zone (e.g., about -7 degrees C) by switching between the temperature zones. The ice-making compartment 300 is set at a refrigeration temperature zone (e.g., about -18 degrees C). The vegetable compartment 400 is set at a refrigerator temperature zone (e.g., about -6 degrees). The freezer compartment 500 is set at a refrigeration temperature zone (e.g., -18 degrees C). The soft-freezing temperature zone may be in the range of -10 to -4 degrees C.

[0016]

Note that the arrangement of each storage compartments is not limited to that of Embodiment 1, and may be any arrangement other than above. The number of the storage compartments is not limited to that of Embodiment 1, and may be any number as long as at least a storage compartment whose temperature can be set at the soft-freezing temperature zone is provided.

[0017]

Each storage compartment is provided with a food storage case 18 for storing food. In addition, each door is provided with a door opening/closing detection unit 19 for detecting opening and closing of the door.

[0018]

In the heat insulating box body 2, a cooling chamber (not shown) is formed at the rear side of the heat insulating box body 2, and the storage compartments and the cooling chamber are divided by a partition plate (not shown). A fan (not shown), a cooler (not shown), and other devices are provided in the cooling chamber, and a cold air cooled by the cooler is supplied from the cooling chamber to each storage compartment by the fan, thereby cooling each storage compartment.

[0019]

A damper device 17 is provided in an air duct 20 through which the cold air cooled by the cooler passes when the cold air is supplied from the cooling chamber to each storage compartment. Each storage compartment is provided with a temperature detection unit 16, such as a thermistor. To maintain each storage compartment at a set temperature, a controller 50 controls an opening degree of the damper device 17, output of a compressor (not shown), and an amount of air supplied by the fan, based on the temperature detected by the temperature detection unit 16. Note that the damper device 17, the compressor, and the fan correspond to a temperature control unit.

[0020]

In the refrigerator 1, the controller 50 and a storage device 51 are provided. The controller 50 controls the temperature control unit based on a detected temperature of the temperature detection unit 16. The controller 50 includes, for example, a dedicated hardware or a central processing unit (CPU, also referred to as a central processor, a processing device, an arithmetic device, a microprocessor, or a processor) that executes a program stored in a memory. The storage device 51 stores various kinds of information. The storage device 51 includes, for example, an

electrically erasable programmable read-only memory (EEPROM), a flash memory, or a similar device.

[0021]

Next, control of the compartment temperature of the versatile compartment 200, in which the compartment temperature is set at the soft-freezing temperature zone (-7 degrees C) by switching of the temperature zones, will be explained.

[0022]

Fig. 3 is a diagram showing a temporal transition of the compartment temperature of the versatile compartment 200 when the versatile compartment door 12 of the refrigerator 1 according to Embodiment 1 of the present disclosure is opened and closed during a normal temperature control.

First, control of the compartment temperature of the versatile compartment 200 to be executed when the versatile compartment door 12 is opened and closed during the normal temperature control will be explained. Here, the normal temperature control is control that maintains the compartment temperature of the versatile compartment 200 at the normal set temperature (e.g., about -7 degrees C). In addition, opening and closing of the versatile compartment door 12 is a sequence of actions in which the versatile compartment door 12 is opened and closed again.

[0023]

When detecting opening and closing of the versatile compartment door 12 during the normal temperature control, the controller 50 shifts the compartment temperature of the versatile compartment 200 to a first set temperature (e.g., about -4 degrees C), which is higher than the normal set temperature and is set for a case where no opening and closing of the versatile compartment door 12 is performed. After shifting to the first set temperature, the controller 50 maintains the compartment temperature at the first set temperature for a first time period (e.g., about 1.5 hours). Then, the controller 50 shifts the compartment temperature of the versatile compartment 200 to a second set temperature (about -12 degrees C), which is lower than the normal set temperature. After shifting to the second set temperature, the

controller 50 maintains the compartment temperature at the second set temperature for a second time period (e.g., about 2 hours). In a transition from the first set temperature to the second set temperature, it takes 2.5 hours to shift the compartment temperature from the first set temperature to the normal set temperature. That is, the versatile compartment 200 is slowly cooled during that period. Then, it takes 10 minutes to shift the compartment temperature from the normal set temperature to the second set temperature. That is, the versatile compartment 200 is quickly cooled during that period. Then, the controller 50 maintains the normal set temperature until detecting opening and closing of the versatile compartment door 12.

[0024]

As described above, when detecting opening and closing of the versatile compartment door 12, the controller 50 executes a special temperature control that maintains the compartment temperature of the versatile compartment 200 at the first set temperature for the first time period and then maintains the compartment temperature at the second set temperature for the second time period. Here, the normal set temperature, the first set temperature, and the second set temperature fall in a refrigeration temperature zone, which is at or below 0 degrees C. The first set temperature is higher than the upper limit of a hunting width of the normal set temperature and is in the range of -5 to 0 degrees C, which is higher than the temperature at which food starts freezing. The second set temperature is lower than the lower limit of the hunting width of the normal set temperature.

[0025]

Because the controller 50 executes the special temperature control when detecting opening and closing of the versatile compartment door 12, the special temperature control can be started at the timing of placing a food in the versatile compartment 200, which is performed with opening and closing the versatile compartment door 12. Consequently, the food is stored at the first set temperature immediately after being placed in the versatile compartment 200 and, as a result, the

food is cooled slowly compared with a case of storing food at the normal set temperature. In particular, because food is stored at the temperature range of -5 to 0 degrees C, which is higher than the temperature at which food starts freezing, the food can be properly brought into the supercooling state. Here, the supercooling state is a state in which a food is not frozen even when the food is cooled below the freezing temperature of the food.

[0026]

In addition, by storing the food at the second set temperature after storing at the first set temperature for the first time period, the supercooling state of the food is released and, and after the food starts freezing, the food is cooled quickly compared with a case of storing the food at the normal set temperature. By freezing food after bringing the food into the supercooling state as described above, homogeneous freezing can be attained and, by quickly cooling the food after the food starts freezing, the growth of the ice crystals can be prevented. As a result, adverse effects on food quality, such as deterioration of the texture and outflow of taste components after thawing caused by destruction of food cells due to freezing, can be reduced. That is, because destruction of food cells is prevented and thus deterioration of food texture is suppressed and taste components are maintained after thawing, a food can be stored at high quality even when the food is frozen.

[0027]

In addition, because the controller 50 can automatically starts the special temperature control when detecting opening and closing of the versatile compartment door 12 without requiring the user to enter an input indicating that the user has placed a food in the versatile compartment 200, from the setting operation unit 10 after the food is placed, the food can be stored at high quality without requiring any user operation. Furthermore, a risk where the special temperature control is not executed after a food is placed because the user forgot to enter an input indicating that the user has placed the food in the versatile compartment 200 from the setting operation unit 10, can be eliminated.

[0028]

Furthermore, in the transition from the first set temperature to the second set temperature, because the inside of the compartment is slowly cooled from the first set temperature to the normal set temperature, change in the temperature of food in the compartment can be reduced. Consequently, even a food that is not easily brought into the supercooling state, such as poultry, can be brought into the supercooling state in a more stable manner. In addition, because the inside of the compartment is quickly cooled from the normal set temperature to the second set temperature, change in the temperature of the food in the compartment is increased. Consequently, even a food that is not easily released from the supercooling state, that is, a food that is not easily frozen up, such as a food high in fat like a milk product, can be released from the supercooling state in a reliable manner.

[0029]

Note that the first time period and the second time period may be determined so that the average temperature during one execution of the special temperature control becomes equal to the normal set temperature. With the time periods determined in such a manner, the average temperature becomes equal to the normal set temperature even when the special temperature control is executed repeatedly, and thus, a food storage period, which correlates with the compartment temperature, can be ensured.

[0030]

Fig. 4 is a diagram showing a temporal transition of the compartment temperature of the versatile compartment 200 when the versatile compartment door 12 of the refrigerator 1 according to Embodiment 1 of the present disclosure is opened and closed during the special temperature control.

Next, control of the compartment temperature of the versatile compartment 200 to be performed when the versatile compartment door 12 is opened and closed during the special temperature control, will be explained.

[0031]

When detecting opening and closing of the versatile compartment door 12 during the special temperature control, the controller 50 starts the special temperature control all over again. That is, the controller 50 shifts the compartment temperature of the versatile compartment 200 from the temperature at that time to the first set temperature, and, after shifting to the first set temperature, maintains the compartment temperature at the first set temperature for the first time period. Then, the controller 50 shifts the compartment temperature of the versatile compartment 200 to the second set temperature, and, after shifting to the second set temperature, maintains the compartment temperature at the second set temperature for the second time period. Then, the controller 50 maintains the compartment temperature of the versatile compartment 200 at the normal set temperature until detecting opening and closing of the versatile compartment door 12.

[0032]

Note that, when the controller 50 detects opening and closing of the versatile compartment door 12 while restarting the special temperature control from the beginning, the controller 50 once again restarts the special temperature control from the beginning.

[0033]

As described above, when detecting opening and closing of the versatile compartment door 12 during the special temperature control, the controller 50 starts the special temperature control all over again. Consequently, even when an additional food is placed in the compartment, foods can be brought into the supercooling state in a more reliable manner, and thus the foods can be properly stored at high quality.

[0034]

Note that, when the special temperature control is executed all over again, the predetermined values of the first time period and the second time period may be changed so that the average temperature during one sequential execution of the special temperature control becomes equal to the normal set temperature. That is,

when restarting the special temperature control from the beginning, the controller 50 may change the first time period and the second time period from the values, which have been set for a case in which the special temperature control is not restarted from the beginning, so that the average temperature during one sequential execution of special temperature control becomes equal to the normal set temperature. Consequently, the average temperature becomes equal to the normal set temperature even when the special temperature control is executed repeatedly, and thus, a food storage period, which correlates with the compartment temperature, can be ensured.

[0035]

Furthermore, the refrigerator compartment 100, which is set at the refrigerator temperature zone, is arranged above the versatile compartment 200, which is set at the soft-freezing temperature zone by switching, and the vegetable compartment 400, which is set at the refrigerator temperature zone, is arranged below the versatile compartment 200.

[0036]

When the versatile compartment 200 is surrounded by storage compartments having set temperatures lower than the normal set temperature, heat of the versatile compartment 200 is removed to the surrounding compartments. For this reason, to maintain the compartment temperature of the versatile compartment 200 at the first set temperature, which is higher than the normal set temperature, an additional component such as a heat input device or other device may be needed. To avoid such a situation, storage compartments that are set at the refrigerator temperature zone, which is higher than the first set temperature, are adjacently arranged at upper and lower positions of the versatile compartment 200. With this configuration, heat is entered from above and below the versatile compartment 200, and therefore, the compartment temperature of the versatile compartment 200 can be maintained at the first set temperature by only control of the opening degree of the damper device 17 without having any additional heat input device. Note that, even when a storage

compartment that are set at the refrigerator temperature zone, which is higher than the first set temperature, is arranged at only one of the upper and lower positions adjacent to the versatile compartment 200, the same effect as the above case can be attained, however greater effect can be attained when such storage compartments are arranged at the both sides

[0037]

As described above, the refrigerator 1 according to Embodiment 1 includes the heat insulating box body 2 in which a plurality of storage compartments including the versatile compartment 200 whose temperature can be set at the soft-freezing temperature zone are formed, and the versatile compartment door 12 that opens and closes the opening formed at the front side of the versatile compartment 200. The refrigerator 1 further includes the door opening/closing detection unit 19, which detects opening and closing of the versatile compartment door 12, the temperature detection unit 16, which detects the temperature of the versatile compartment 200, the temperature control unit, which controls the temperature of the versatile compartment 200, and the controller 50, which controls the temperature control unit based on the temperature detected by the temperature detection unit 16. When opening and closing of the versatile compartment door 12 is detected during the normal temperature control that maintains the compartment temperature of the versatile compartment 200 at the predetermined normal set temperature, the controller 50 executes the special temperature control to shift the compartment temperature of the versatile compartment 200 to the first set temperature, which is higher than the normal set temperature, maintain at the first set temperature for the first time period, then shift to the second set temperature, which is lower than the normal set temperature, and maintain at the second set temperature for the second time period.

[0038]

According to the refrigerator 1 of Embodiment 1, when opening and closing of the versatile compartment door 12 is detected during the normal temperature control,

which maintains the compartment temperature of the versatile compartment 200 being set at the soft-freezing temperature zone at the normal set temperature, the special temperature control is executed so that the compartment temperature of the versatile compartment 200 is maintained at the first set temperature, which is higher than the normal set temperature, for the first time period, and then maintained at the second set temperature, which is lower than the normal set temperature, for the second time period. Consequently, foods can be frozen by being brought into the supercooling state in a more reliable manner, and thus the foods can be properly stored at high quality.

[0039]

In addition, in the refrigerator 1 according to Embodiment 1, when detecting opening and closing of the versatile compartment door 12 during the special temperature control, the controller 50 executes the special temperature control all over again.

[0040]

According to the refrigerator 1 of Embodiment 1, when opening and closing of the versatile compartment door 12 is detected during the special temperature control, the special temperature control is restarted from the beginning. Consequently, even when an additional food is placed in the versatile compartment 200, foods in the versatile compartment 200 can be frozen by being brought into the supercooling state in a more reliable manner, and thus the foods can be properly stored at high quality.

[0041]

Furthermore, in the refrigerator 1 according to Embodiment 1, in the transition from the first set temperature to the second set temperature during the special temperature control, the controller 50 takes a longer time to shift from the first set temperature to the normal set temperature than to shift from the normal set temperature to the second set temperature.

[0042]

According to the refrigerator 1 of Embodiment 1, because the inside of the compartment is slowly cooled from the first set temperature to the normal set temperature, change in the temperature of food in the compartment can be reduced. Consequently, even a food that is not easily brought into the supercooling state, such as poultry, can be brought into the supercooling state in a more stable manner. In addition, because the inside of the compartment is quickly cooled from the normal set temperature to the second set temperature, change in the temperature of the food in the compartment is increased. Consequently, even a food that is not easily released from the supercooling state, that is, a food that is not easily frozen up, such as a food high in fat like a milk product, can be released from the supercooling state in a reliable manner.

[0043]

Moreover, in the refrigerator 1 according to Embodiment 1, the first time period and the second time period are determined so that the average temperature during one sequential execution of the special temperature control becomes equal to the normal set temperature.

[0044]

According to the refrigerator 1 of Embodiment 1, because the average temperature becomes equal to the normal set temperature even when the special temperature control is repeated, a food storage period, which correlates with the compartment temperature, can be ensured.

[0045]

Furthermore, in the refrigerator 1 according to Embodiment 1, the compartment temperature of at least one of the storage compartments adjacent to the versatile compartment 200 is set at the refrigerator temperature zone. Alternatively, the refrigerator compartment 100, which is set at the refrigerator temperature zone, is arranged above the versatile compartment 200 and the vegetable compartment 400, which is set at the refrigerator temperature zone, is arranged below the versatile compartment 200.

[0046]

According to the refrigerator 1 of Embodiment 1, storage compartments that is set at the refrigerator temperature zone, which is higher than the first set temperature, are arranged at positions adjacent to the versatile compartment 200. Consequently, heat is entered from above and below the versatile compartment 200, and thus the compartment temperature of the versatile compartment 200 can be maintained at the first set temperature by only control of the opening degree of the damper device 17 without having any additional heat input device.

[0047]

Embodiment 2

Embodiment 2 of the present disclosure will be explained below. Description that has been given in Embodiment 1 is omitted. Elements that are the same as or equivalent to those described in Embodiment 1 are denoted by corresponding ones of the reference numerals. Note that, in Embodiment 2, the temperature control to be executed when opening and closing of the versatile compartment door 12 of the refrigerator 1 is performed during the special temperature control is different from that in Embodiment 1.

[0048]

Fig. 5 is a diagram showing a temporal transition of the compartment temperature of the versatile compartment 200 when versatile compartment door 12 of the refrigerator 1 according to Embodiment 2 of the present disclosure is opened and closed while the special temperature control maintains the compartment temperature at the first set temperature.

Described below is the control of the compartment temperature of the versatile compartment 200 to be executed when opening and closing of the versatile compartment door 12 is performed while the special temperature control maintains the compartment temperature at the first set temperature.

[0049]

When opening and closing of the versatile compartment door 12 is detected while the compartment temperature of the versatile compartment 200 is maintained at the first set temperature during the special temperature control, the controller 50 continues the special temperature control instead of restarting the special temperature control from the beginning. The controller 50 maintains the compartment temperature of the versatile compartment 200 at the first set temperature for the first time period. The controller 50 then shifts the compartment temperature of the versatile compartment 200 to the second set temperature and maintains the compartment temperature at the second set temperature for the second time period. After that, the controller 50 maintains the compartment temperature of the versatile compartment 200 at the normal set temperature until detecting opening and closing of the versatile compartment door 12.

[0050]

As described above, when opening and closing of the versatile compartment door 12 is detected while the compartment temperature of the versatile compartment 200 is maintained at the first set temperature during the special temperature control, the controller 50 continues the special temperature control instead of restarting the special temperature control from the beginning. When a food is placed in the versatile compartment 200 while the compartment temperature is maintained at the first set temperature, the food is going to be cooled gradually and is likely to be brought into the supercooling state. That is, the food can be stored at high quality even when the special temperature control is not restarted from the beginning, and the time required to maintain the first set temperature can be reduced because the special temperature control is not executed all over again. As a result, a time period in which the compartment temperature of the versatile compartment 200 is higher than the normal set temperature can be shortened. Consequently, a newly added food can be brought into the supercooling state without imparting the storage quality of the food, and influence of the temperature rise in the versatile compartment 200 on the storage quality of a previously placed food can be suppressed.

[0051]

As described above, in the refrigerator 1 according to Embodiment 2, when opening and closing of the versatile compartment door 12 is detected while the compartment temperature of the versatile compartment 200 is detected at the first set temperature during the special temperature control, the controller 50 continues the special temperature control instead of restarting the special temperature control from the beginning.

[0052]

According to the refrigerator 1 of Embodiment 2, when opening and closing of the versatile compartment door 12 is detected while the compartment temperature of the versatile compartment 200 is maintained at the first set temperature during the special temperature control, the special temperature control is continued without being restarted from the beginning. Therefore, the food can be stored at high quality even when the special temperature control is not restarted from the beginning, and the time required to maintain the first set temperature can be reduced because the special temperature control is not executed all over again. As a result, the time period in which the compartment temperature of the versatile compartment 200 is higher than the normal set temperature can be shortened. Consequently, a newly added food can be brought into the supercooling state without imparting the storage quality of the food, and influence of the temperature rise in the versatile compartment 200 on the storage quality of a previously placed food can be reduced.

[0053]

Embodiment 3

Embodiment 3 of the present disclosure will be explained below. Description that has been given in Embodiment 1 or 2 is omitted. Components that are the same as or equivalent to those described in Embodiment 1 or 2 are denoted by corresponding ones of the reference numerals. Note that, Embodiment 3 differs from Embodiments 1 and 2 in that the special temperature control is executed based on a previous record of opening and closing of the versatile compartment door 12.

[0054]

Fig. 6 is a temporal transition of the compartment temperature of the versatile compartment 200 when the versatile compartment door 12 of the refrigerator 1 according to Embodiment 3 of the present disclosure is opened and closed.

[0055]

In Embodiment 3, the number of times the versatile compartment door 12 is opened and closed, detected by the door opening/closing detection unit 19, is stored in storage device 51 for every hour for several days.

[0056]

The controller 50 calculates the average number of times the versatile compartment door 12 is opened and closed for each time period from information stored in the storage device 51. Then, the controller 50 sets, as a non-use time period, a time period in which the average number is equal to or less than a predetermined first threshold (e.g., 0.3 times), that is, a time period in which the number of times the versatile compartment door 12 is opened and closed is small. In this case, because there is a high possibility that the user is inactive in the house, such as sleeping or going out of the house, in the time period in which the number of times the versatile compartment door 12 is opened and closed is small, the special temperature control is not executed during the non-use time period even when opening and closing of the versatile compartment door 12 is performed. Consequently, when possibility of placing a food in the versatile compartment 200 is low in view of past usage of the refrigerator 1 by the user, the special temperature control, which may cause fluctuation of the compartment temperature, is not executed. As a result, an input of a food can be determined accurately and influence of the fluctuation of the compartment temperature on the food quality of a previously placed food can be reduced.

[0057]

Note that, not only the number of times the versatile compartment 200 is opened and closed, but also the number of times each storage compartment is

opened and closed, detected by the corresponding door opening/closing detection unit 19, may be stored in the storage device 51, and a non-use time period may be set based on information on the opening and closing of each storage compartment stored in the storage device 51.

[0058]

In addition, the average number of times the versatile compartment door 12 is opened and closed is calculated for each time period from the information stored in the storage device 51. Then, a time period in which the average number is equal to or more than a predetermined second threshold (e.g., 1.0 time), that is, a time period in which the number of times the versatile compartment door 12 is opened and closed is relatively large, is set as an active time period, and more than one active time period may be set. The special temperature control is executed only when opening and closing of the versatile compartment door 12 is detected first time in each active time period, and is not executed for the second and subsequent detections. In this case, because there is a high possibility that the user is cooking or just returned from shopping in a time period in which the number of times the versatile compartment door 12 is opened and closed is large, a food is likely to be input when the versatile compartment door 12 is opened and closed during the active time period. Therefore, the special temperature control is executed when the versatile compartment door 12 is opened and closed for the first time in each active time period, and is not executed when versatile compartment door 12 is opened and closed for the second and subsequent times because there is low possibility that the user is cooking or just returned from shopping and a food is input by the user.

[0059]

As described above, in view of past usage of the refrigerator 1 by the user, the special temperature control is executed when the possibility of food input is high, and the special temperature control is not executed when the possibility of food input is low. Consequently, food can be brought into the supercooling state efficiently and

influence of the fluctuation of the compartment temperature on the food quality of a previously placed food can be reduced.

[0060]

As described above, in the refrigerator 1 according to Embodiment 3, the controller 50 determines a time period of a day in which the average number of times the versatile compartment door 12 is opened and closed is equal to or less than the first threshold, from the information stored in the storage device 51 and sets the time period as a non-use time period. Then, when opening and closing of the versatile compartment door 12 is detected in the non-use time period, the special temperature control is not executed.

[0061]

According to the refrigerator 1 of Embodiment 3, when possibility of inputting a food in the versatile compartment 200 is low in view of past usage of the refrigerator 1 by the user, the special temperature control, which may cause fluctuation of the compartment temperature, is not executed. As a result, an input of a food can be determined accurately and influence of the fluctuation of the compartment temperature on the food quality of a previously placed food can be reduced.

[0062]

Moreover, in the refrigerator 1 according to Embodiment 3, the controller 50 determines a time period of a day in which the average number of times the versatile compartment door 12 is opened and closed is equal to or more than the second threshold, based on the information stored in the storage device 51 and sets the time period as an active time period. Then, when opening and closing of the versatile compartment door 12 is detected several times in the active time period, the special temperature control is executed only for the first detection and is not executed for the second and subsequent detections.

[0063]

Furthermore, in the refrigerator 1 according to Embodiment 3, the controller 50 sets more than one active time period. Then, when opening and closing of the

versatile compartment door 12 is detected several times in the same active time period, the special temperature control is executed only for the first detection and is not executed for the second and subsequent detections.

[0064]

According to the refrigerator 1 of Embodiment 3, in view of past usage of the refrigerator 1 by the user, the special temperature control is executed when the possibility of food input is high, and the special temperature control is not executed when the possibility of food input is low. Consequently, foods can be brought into the supercooling state efficiently and influence of the fluctuation of the compartment temperature on the food quality of a previously placed food can be reduced.

[0065]

Embodiment 4

Embodiment 4 of the present disclosure will be explained below. Description that has been given in Embodiment 1, 2 or 3 is omitted. Components that are the same as or equivalent to those described in Embodiment 1, 2 or 3 are denoted by corresponding ones of the reference numerals. Note that, Embodiment 4 differs from Embodiments 1, 2 and 3 in that a daily average compartment temperature is maintained at the normal set temperature even when the special temperature control is executed.

[0066]

Fig. 7 is a temporal transition of the compartment temperature of the versatile compartment 200 when the versatile compartment door 12 of the refrigerator 1 according to Embodiment 4 of the present disclosure is opened and closed.

[0067]

In Embodiment 4, the compartment temperature of the versatile compartment 200 is stored in the storage device 51 for a certain period (e.g., for one day).

[0068]

The controller 50 calculates the average temperature of the compartment temperature of the versatile compartment 200 for the active time periods of a day

from the information stored in the storage device 51. Then, when the calculated average temperature is higher than the normal set temperature, a temperature averaging control that maintains the compartment temperature of the versatile compartment 200 at the second set temperature, which is lower than the normal set temperature, for a third time period, is executed in the non-use time period to bring the average temperature to the normal set temperature.

[0069]

Consequently, even when the special temperature control is executed several times in a day, the compartment temperature of the versatile compartment 200 can be maintained at the normal set temperature, and thus, a food storage period, which correlates with the compartment temperature, can be ensured. In addition, because the lower the storage temperature of food is, the more freezing of the food progresses and thus the harder the food becomes, food stored at the second set temperature, which is lower than the normal set temperature, may need to be thawed before cooking. However, because the compartment temperature is maintained at the second set temperature in the non-use period and then returned to the normal set temperature before the active time period, a problem in which the food is too hard to cook for the user can be prevented from occurring.

[0070]

As described above, in the refrigerator 1 according to Embodiment 4, the controller 50 calculates the average temperature of the compartment temperature of the first storage compartment for a certain period from the information stored in the storage device 51. Then, when the calculated average temperature is higher than the normal set temperature, the temperature averaging control that maintains the compartment temperature of the first storage compartment at the second set temperature for the third time period is executed to bring the average temperature to the normal set temperature.

[0071]

According to the refrigerator 1 of Embodiment 4, even when the special temperature control is executed several times in a certain period, the compartment temperature of the versatile compartment 200 can be maintained at the normal set temperature. Consequently, a food storage period, which correlates with the compartment temperature, can be ensured.

[0072]

Furthermore, in the refrigerator 1 according to Embodiment 4, the controller 50 calculates the average temperature of the compartment temperature of the first storage compartment for the active time periods of a day from the information stored in the storage device 51. Then, when the average temperature for the active time periods is higher than the normal set temperature, the temperature averaging control is executed in the non-use time period to bring the average temperature of the active time periods to the normal set temperature.

[0073]

According to the refrigerator 1 of Embodiment 4, because the compartment temperature is maintained at the second set temperature in the non-use period and then returned to the normal set temperature before the active time periods, a problem in which the food is too hard to cook for the user can be prevented from occurring.

Reference Signs List

[0074]

1 refrigerator 2 heat insulating box body 2a outer box 2b inner box
2c insulation material 10 setting operation unit 11 refrigerator compartment
door 12 versatile compartment door 13 ice-making compartment door 14
vegetable compartment door 15 freezer compartment door 16 temperature
detection unit 17 damper device 18 food storage case 19 door
opening/closing detection unit 20 air duct 50 controller 51 storage device
100 refrigerator compartment 200 versatile compartment 300 ice-making
compartment 400 vegetable compartment 500 freezer compartment

CLAIMS

[Claim 1]

A refrigerator comprising:

a heat insulating box body having therein a plurality of storage compartments including a first storage compartment whose temperature is configured to set at a soft-freezing temperature zone;

a door that opens and closes an opening provided at a front side of the first storage compartment;

a door opening/closing detection unit configured to detect opening and closing of the door;

a temperature detection unit configured to detect a temperature in the first storage compartment;

a temperature control unit configured to control the temperature in the first storage compartment; and

a controller configured to control the temperature control unit based on a temperature detected by the temperature detection unit,

wherein, when opening and closing of the door is detected during a normal temperature control that maintains a compartment temperature of the first storage compartment at a predetermined normal set temperature, the controller executes a special temperature control that shifts the compartment temperature of the first storage compartment to a first set temperature being higher than the normal set temperature and maintains the compartment temperature at the first set temperature for a first time period, and then shifts the compartment temperature to a second set temperature being lower than the normal set temperature and maintains the compartment temperature at the second set temperature for a second time period.

[Claim 2]

The refrigerator of claim 1, wherein, when opening and closing of the door is detected during the special temperature control, the controller restarts the special temperature control from a beginning.

[Claim 3]

The refrigerator of claim 2, wherein, when opening and closing of the door is detected during the special temperature control while the compartment temperature of the first storage compartment is maintained at the first set temperature, the controller continues the special temperature control without restarting the special temperature control from a beginning.

[Claim 4]

The refrigerator of any one of claims 1 to 3, wherein, in a transition from the first set temperature to the second set temperature during the special temperature control, the controller takes a longer time to shift from the first set temperature to the normal set temperature than to shift from the normal set temperature to the second set temperature.

[Claim 5]

The refrigerator of any one of claims 1 to 4, wherein the first time period and the second time period are determined so that an average temperature during one execution of the special temperature control becomes equal to the normal set temperature.

[Claim 6]

The refrigerator of any one of claims 1 to 5, further comprising
a storage device that stores a number of times the door is opened and closed for each hour for several days.

[Claim 7]

The refrigerator of claim 6, wherein the controller determines a time period of a day in which an average number of times the door is opened and closed is equal to or less than a first threshold, from information stored in the storage device and sets the time period as a non-use time period, and, when opening and closing of the door is detected during the non-use time period, the controller does not execute the special temperature control.

[Claim 8]

The refrigerator of claim 6 or 7, wherein the controller determines a time period of a day in which an average number of times the door is opened and closed is equal to or more than a second threshold, from information stored in the storage device and sets the time period as an active time period, and, when opening and closing of the door is detected several times during the active time period, the controller executes the special temperature control for a first detection and does not execute the special temperature control for second and subsequent detections.

[Claim 9]

The refrigerator of claim 8, wherein the controller sets more than one active time period, and, when opening and closing of the door is detected several times during the same active time period, the controller executes the special temperature control for a first detection and does not execute the special temperature control for second and subsequent detections.

[Claim 10]

The refrigerator of any one of claims 6 to 9, wherein
the storage device stores the compartment temperature of the first storage compartment for a certain time period, and
the controller calculates an average temperature of the compartment temperature of the first storage compartment for the certain time period, from information stored in the storage device, and, when the average temperature is higher than the normal set temperature, the controller executes a temperature averaging control that maintains the compartment temperature of the first storage compartment at the second set temperature for a third time period to bring the average temperature to the normal set temperature.

[Claim 11]

The refrigerator of claim 10 as dependent on claim 7, wherein the controller calculates an average temperature of the compartment temperature of the first storage compartment for the active time periods of a day, from information stored in the storage device, and, when the average temperature of the active time periods is

higher than the normal set temperature, the controller executes the temperature averaging control during the non-use time period to bring the average temperature of the active time periods to the normal set temperature.

[Claim 12]

The refrigerator of any one of claims 1 to 11, wherein a compartment temperature of at least one of the storage compartments, the at least one being adjacent to the first storage compartment, is set at a refrigerator temperature zone.

[Claim 13]

The refrigerator of any one of claims 1 to 12, wherein the plurality of storage compartments include a freezer compartment and a vegetable compartment whose compartment temperatures are set at a refrigerator temperature zone, and the freezer compartment is arranged above the first storage compartment and the vegetable compartment is arranged below the first storage compartment.

[Claim 14]

A refrigerator comprising:

a heat insulating box body having therein a plurality of storage compartments including a first storage compartment whose temperature is set at a soft-freezing temperature zone;

a door that opens and closes an opening provided at a front side of the first storage compartment;

a door opening/closing detection unit configured to detect opening and closing of the door;

a temperature detection unit configured to detect a temperature in the first storage compartment;

a temperature control unit configured to control the temperature in the first storage compartment; and

a controller configured to control the temperature control unit based on a temperature detected by the temperature detection unit,

wherein, based on opening and closing of the door, the controller executes a normal temperature control that maintains a compartment temperature of the first storage compartment at a predetermined normal set temperature or a special temperature control that shifts the compartment temperature of the first storage compartment to a first set temperature being higher than the normal set temperature and maintains the compartment temperature at the first set temperature for a first time period, and then shifts the compartment temperature to a second set temperature being lower than the normal set temperature and maintains the compartment temperature at the second set temperature for a second time period, and

the plurality of storage compartments include a freezer compartment and a vegetable compartment whose compartment temperatures are set at a refrigerator temperature zone, and the freezer compartment is arranged above the first storage compartment and the vegetable compartment is arranged below the first storage compartment.