

DESCRIPTION

Title of Invention

REFRIGERATOR

Technical Field

5 [0001]

The present invention relates to a refrigerator capable of performing supercooling storage.

Background Art

[0002]

10 Conventional refrigerators including a plurality of temperature zone chambers have been disclosed to meet increasing need for storage of foods at an optimum temperature for each food (refer to Patent Literatures 1 and 2). In refrigerators of Patent Literatures 1 and 2, the amount of cool air can be individually set for an upper low-temperature container and a lower low-temperature container in a refrigerator
15 compartment, and different temperatures thus can be set for air in the upper low-temperature container and air in the lower low-temperature container. In addition, there has been disclosed another refrigerator in which a heater configured to control temperature is embedded in a boundary wall to perform supercooling storage (refer to Patent Literature 3).

20 Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2001-330361

25 Patent Literature 2: Japanese Patent No. 3571549

Patent Literature 3: Japanese Patent No. 5847235

Summary of Invention

Technical Problem

[0004]

30 In the refrigerators disclosed in Patent Literatures 1 and 2, cool air is caused to

flow to cool the two low-temperature containers in the refrigerator compartment.

With this configuration, however, air temperature variation is large between the containers, and no temperature increasing process is performed. Consequently, the supercooling storage cannot be achieved in some cases.

5 [0005]

In the refrigerator disclosed in Patent Literature 3, a freezer compartment is disposed below a supercooling insulation compartment, and thus the heater embedded in the boundary wall has such a size that the entire case is covered by the heater to prevent the supercooling insulation compartment from being cooled too much through heat transfer. This configuration leads to increase in the amount of electric power consumption, increase in the cost of the heater, and inefficient use of heat from the heater in some cases.

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[0006]

The present invention is intended to solve the above-described problems and provide a refrigerator including a heater having reduced energization rate and size, and capable of efficiently performing supercooling storage of a cooling target object.

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Solution to Problem

[0007]

A refrigerator according to an embodiment of the present invention includes a refrigerator compartment having a set temperature within a refrigerating temperature zone and configured to house a cooling target object, a supercooling insulation compartment provided in the refrigerator compartment and configured to insulate a cooling target object at a supercooling temperature equal to or lower than a freezing temperature of the cooling target object, a vegetable compartment provided below the refrigerator compartment and close to the supercooling insulation compartment and having a set temperature higher than the set temperature of the refrigerator compartment, a boundary wall provided between the vegetable compartment and the supercooling insulation compartment, and a heater installed at the boundary wall below the supercooling insulation compartment and configured to heat the cooling target object in the supercooling insulation compartment.

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Advantageous Effects of Invention

[0008]

In a refrigerator according to an embodiment of the present invention, a supercooling insulation compartment is disposed close to a vegetable compartment having a set temperature higher than that of a refrigerator compartment, and thus is not cooled through heat transfer from the vegetable compartment. Consequently, the supercooling insulation compartment does not suffer from such temperature influence observed with a conventional technology in which the supercooling insulation compartment is close to a freezer compartment. As a result, the supercooling insulation compartment is not cooled too much, a heater used in the supercooling storage can have reduced energization rate and size, and efficient supercooling storage thus can be achieved.

Brief Description of Drawings

[0009]

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

[Fig. 2] Fig. 2 is a cross-sectional view of the refrigerator according to Embodiment 1 of the present invention taken along line A-A in Fig. 1.

[Fig. 3] Fig. 3 is a cross-sectional view of the refrigerator according to Embodiment 1 of the present invention taken along line B-B in Fig. 1.

[Fig. 4] Fig. 4 is an enlarged view of the refrigerator according to Embodiment 1 of the present invention at part E in Fig. 3.

[Fig. 5] Fig. 5 is a cross-sectional view taken along line C-C in Fig. 4.

[Fig. 6] Fig. 6 is an enlarged view of part F in Fig. 2.

[Fig. 7] Fig. 7 is an enlarged view of part G in Fig. 1.

[Fig. 8] Fig. 8 is a cross-sectional view taken along line D-D in Fig. 7.

Description of Embodiments

[0010]

The following describes a refrigerator 1 according to embodiments of the present invention in detail with reference to the accompanying drawings. In the

drawings described below, the dimensional relation between components is different from that in reality in some cases. In the drawings described below, components denoted by an identical reference sign are identical or similar to each other, and this notation applies in the entire specification. Component configurations described in the entire specification are merely exemplary, and the present invention is not limited to those described.

[0011]

Embodiment 1

Fig. 1 is a front view of a refrigerator according to Embodiment 1 of the present invention. Illustration of a door of a refrigerator compartment 2 is omitted from Fig. 1 for description of the internal structure of the refrigerator compartment 2. Fig. 2 is a cross-sectional view of the refrigerator according to Embodiment 1 of the present invention taken along line A-A in Fig. 1. Fig. 3 is a cross-sectional view of the refrigerator according to Embodiment 1 of the present invention taken along line B-B in Fig. 1. The following describes an outline configuration of the refrigerator 1 with reference to Figs. 1 to 3. In Figs. 1 to 3, the X axis represents the width direction of the refrigerator 1, the Y axis represents the depth direction of the refrigerator 1, and the Z axis represents the height direction of the refrigerator 1. More specifically, in description of the refrigerator 1, X1 direction on the X axis is defined to be the left direction, X2 direction on the X axis is defined to be the right direction, Y1 direction on the Y axis is defined to be the front direction, Y2 direction on the Y axis is defined to be the back direction, Z1 direction on the Z axis is defined to be the upper direction, and Z2 direction on the Z axis is defined to be the lower direction. The positional relation (such as vertical relation) between components in the specification is a positional relation at a time when the refrigerator 1 is installed in a usable state, in principle.

[0012]

[Configuration of refrigerator 1]

The refrigerator 1 includes a substantially cuboid housing 50 that has an opening at the front of the housing 50 and a plurality of storage compartments in the

housing 50. The housing 50 includes a steel outer box, a resin inner box, and a heat insulation material filling a space between the outer box and the inner box. A storage space defined inside the housing 50 is partitioned, by a plurality of partition parts, into a plurality of storage compartments in each of which a cooling target object such as food is to be stored. As illustrated in Fig. 1, the refrigerator 1 includes, as the plurality of storage compartments partitioned from each other, the refrigerator compartment 2 disposed at an uppermost part, a vegetable compartment 3 disposed below the refrigerator compartment 2, and a freezer compartment 4 disposed at a lowermost part below the vegetable compartment 3. In a structure in which the vegetable compartment is installed in a lower region of the refrigerator compartment, the kind and number of storage compartments included in the refrigerator 1 are not limited to these described above. For example, the freezer compartment 4 may be provided as a plurality of rooms, for example, vertically or horizontally partitioned.

[0013]

As illustrated in Fig. 2, a compressor 30 configured to compress and discharge refrigerant, as an exemplary cooling unit configured to cool inside of the storage compartments, a cooler 8 configured to act as an evaporator, and an air-sending fan 9 configured to move cool air generated by the cooler 8 are provided in a portion facing the back surface of the refrigerator 1. The refrigerator 1 further includes a first air path 10 through which cool air flows and on which, for example, the cooler 8 and the air-sending fan 9 are installed. The compressor 30 has a refrigerant discharging portion connected with a condenser (not illustrated), and a refrigerant suction portion connected with the cooler 8. The cooler 8 acts as an evaporator, and generates cool air through heat exchange between refrigerant flowing through the cooler 8 and air in the first air path 10. The air-sending fan 9 supplies cool air from the first air path 10 to the refrigerator compartment 2, the vegetable compartment 3, and the freezer compartment 4. The first air path 10 extends from a lower part to an upper part in the refrigerator 1 and is vertically provided in a portion facing an inner wall panel 17 of the housing 50. More specifically, the first air path 10 is provided in a portion facing the back surfaces of the refrigerator compartment 2, the vegetable compartment 3,

and the freezer compartment 4. The first air path 10 is divided into a first air path 10a through which cool air is sent to a second housing container 5c, and a first air path 10b through which cool air is sent to the refrigerator compartment 2 and a first housing container 5b. The first air path 10a is provided with a damper 11a, and the first air path 10b is provided with a damper 11b. The dampers 11a and 11b are used to adjust the flow rate of cool air supplied to the second housing container 5c, the refrigerator compartment 2, and the first housing container 5b. The dampers 11a and 11b may be replaced with a twin damper. Air outlets 17a for cool air are formed in the inner wall panel 17 of the refrigerator compartment 2 as illustrated in Fig. 1.

The compressor 30 and the cooler 8 together with a condenser and an expansion unit (both not illustrated) form a refrigeration cycle. Cool air generated at the cooler 8 through operation of the refrigeration cycle is sent by the air-sending fan 9 and supplied to the storage compartments such as the refrigerator compartment 2 and the freezer compartment 4 through the first air path 10 provided in the portion facing the back surface of the refrigerator 1. The cool air supplied to the refrigerator compartment 2 is returned to the cooler 8 through a second air path 12 illustrated in Fig. 3.

[0014]

The refrigerator 1 includes a controller (not illustrated) configured to control various instruments. The temperature of each compartment is measured by a thermistor (not illustrated) installed at the compartment, and the controller controls the opening degree of the damper 11a provided in the first air path 10a and the opening degree of the damper 11b provided in the first air path 10b, the output of the compressor 30, the output of a heater 15, and the air-sending flow rate of the air-sending fan 9 so that the temperature of each compartment is equal to a temperature set in advance.

[0015]

(Refrigerator compartment 2)

The refrigerator compartment 2 is a storage compartment having a set temperature within a refrigerating temperature zone (for example, approximately 3 to

5 degrees C) and configured to house a cooling target object such as food. As illustrated in Fig. 2, the refrigerator compartment 2 includes shelves 21 on which, for example, food is to be stored. A rotational (for example, double) door 2c is provided at an opening opened at the front of the refrigerator compartment 2 to open and close the opening. The door 2c of the refrigerator compartment 2 may be a rotational single door instead of a double door. The refrigerator compartment 2 is provided with the inner wall panel 17. The inner wall panel 17 is disposed at a position opposite to the door 2c of the refrigerator compartment 2, and corresponds to a back wall in the refrigerator compartment 2. As illustrated in Figs. 1 and 2, a top plate 18 is provided at a lower part in the refrigerator compartment 2 to partition inside of the refrigerator compartment 2, and partly defines a chilling compartment 5a as one of storage compartments. The chilling compartment 5a will be described below in detail with reference to Fig. 4.

[0016]

Fig. 4 is an enlarged view of the refrigerator according to Embodiment 1 of the present invention at part E in Fig. 3. In the chilling compartment 5a, the first housing container 5b capable of maintaining a temperature lower than that of the refrigerator compartment 2 is disposed in an upper space, the second housing container 5c capable of performing supercooling storage is disposed in a lower space. A partition plate 6 is provided between the first housing container 5b and the second housing container 5c to partition the upper and lower spaces. In other words, the top plate 18 is provided above the second housing container 5c, and the first housing container 5b is provided between the top plate 18 and the second housing container 5c.

[0017]

The first housing container 5b and the second housing container 5c are drawer containers movable in the front-back direction along rails (not illustrated) provided on the inner surfaces of sidewalls of the chilling compartment 5a. The rails may be provided on the bottom wall of the chilling compartment 5a and the partition plate 6, or no rails may be provided. As illustrated in Fig. 4, the first housing container 5b is a substantially box-shaped part including a front wall 5b1, sidewalls 5b2, a back wall

5b3, and a top opening, and allows food to be brought in and out through the top opening when the first housing container 5b is pulled out. The second housing container 5c is a substantially box-shaped part including a front wall 5c1, sidewalls 5c2, a back wall 5c3, and a top opening, and allows food to be brought in and out through the top opening when the second housing container 5c is pulled out. The material of the first housing container 5b and the second housing container 5c is, for example, polystyrene, similarly to a housing container of a typical refrigerator, but is not limited to such a material. In Figs. 1 to 4, the two housing containers, which are the first housing container 5b and the second housing container 5c, are vertically disposed, but may be disposed, for example, on the right and left in the width direction. Alternatively, only one housing container may be provided.

[0018]

As illustrated in Fig. 4, a space in the first housing container 5b provided in the refrigerator compartment 2 is a cold insulation compartment 5a1 having a temperature set to be lower than that of the refrigerator compartment 2 and higher than that of the second housing container 5c and set to be approximately 0 degrees C, similarly to a chilling compartment of a typical refrigerator. Thus, food such as cheese and yogurt, the quality of which can be maintained by cold insulation at approximately 0 degrees C, is to be housed in the first housing container 5b. A space in the second housing container 5c provided in the refrigerator compartment 2 is a supercooling insulation compartment 5a2 in which cold insulation is achieved at a temperature (for example, a supercooling temperature equal to or lower than the freezing point (freezing temperature) of a cooling target object) lower than that of the space in the first housing container 5b. Thus, for example, meat, fish, and their processed products, which are desirably insulated in a supercooling state, are to be housed in the second housing container 5c. The temperature of the cold insulation compartment 5a1 is adjusted through adjustment of the air flow rate by the damper 11b, and the temperature of the supercooling insulation compartment 5a2 is adjusted through adjustment of the air flow rate by the damper 11a and the output of the heater 15.

[0019]

A door is provided at an opening opened at the front of the upper space of the chilling compartment 5a. The door includes a lid 13 fixed to the top plate 18 in such a manner that the lid 13 is allowed to pivotally move. When the first housing
5 container 5b is pulled out, the lid 13 rotates and the door opens. The front wall 5c1 of the second housing container 5c provided with a pull is provided as a pull-out door at an opening opened at the front of the lower space of the chilling compartment 5a. The chilling compartment 5a may have an optional door configuration, and for example, the lid 13 may be provided as a lower door, and the front wall 5b1 of the first
10 housing container 5b may be provided as an upper door. As illustrated in Fig. 2, an air outlet 17b is formed at the inner wall panel 17 at a back of the first housing container 5b so that the upper space of the chilling compartment 5a is communicated and connected with the first air path 10b. Similarly, an air outlet 17c is formed at the inner wall panel 17 at a back of the second housing container 5c so that the lower
15 space of the chilling compartment 5a is communicated and connected with the first air path 10a.

[0020]

As illustrated in Fig. 4, a chilling-compartment air inlet 14 through which cool air in the first housing container 5b flows toward the second housing container 5c is
20 formed at the partition plate 6 provided between the first housing container 5b and the second housing container 5c. The chilling-compartment air inlet 14 is formed between the back wall 5b3 of the first housing container 5b and the inner wall panel 17 of the refrigerator compartment 2. The chilling-compartment air inlet 14 is a through-hole allowing the upper and lower spaces of the chilling compartment 5a to
25 communicate with each other.

[0021]

(Vegetable compartment 3)

In Figs. 2 and 3, the vegetable compartment 3 is provided below the refrigerator compartment 2 and close to the second housing container 5c in the
30 refrigerator compartment 2 with a boundary wall 7 interposed between the vegetable

compartment 3 and the second housing container 5c. In other words, the vegetable compartment 3 is close to the supercooling insulation compartment 5a2. The vegetable compartment 3 has a space for housing a storage item, and is suitable for refrigeration of vegetable, in particular. The vegetable compartment 3 is a storage compartment having a set temperature within a refrigerating temperature zone (for example, approximately 3 to 7 degrees C) higher than that of the refrigerator compartment 2. The vegetable compartment 3 is provided with a pull-out door 3c. The vegetable compartment 3 is opened to or closed from the outside of the refrigerator 1 by opening or closing the door 3c.

[0022]

(Boundary wall 7)

As illustrated in Fig. 2, the boundary wall 7 is provided between the vegetable compartment 3 and the second housing container 5c. In a configuration in which the vegetable compartment 3 is provided below the boundary wall 7, the second housing container 5c is not cooled through heat transfer. Thus, the boundary wall 7 does not need to contain a heat insulation material. As illustrated in Fig. 4, a refrigerator-compartment air inlet 24 through which cool air in the refrigerator compartment 2 is sucked is formed at the boundary wall 7. The refrigerator-compartment air inlet 24 is formed between the back wall 5c3 of the second housing container 5c and the inner wall panel 17. At least a part of the refrigerator-compartment air inlet 24 and at least a part of the chilling-compartment air inlet 14 overlap with each other in plan view. As illustrated in Fig. 3, the refrigerator-compartment air inlet 24 is communicated and connected with the second air path 12.

[0023]

(Heater 15)

As illustrated in Fig. 4, the heater 15 as a heating mechanism (heating unit) configured to increase the temperature of a cooling target object such as food in the second housing container 5c by heating is installed at the boundary wall 7 below the second housing container 5c. The heater 15 is used to heat the cooling target object and used for a temperature increasing process of supercooling storage. In the

supercooling storage, the cooling target object needs to be prevented from being frozen through too much cooling. The heater 15 is used to heat the cooling target object cooled too much. When the heater 15 is installed below the second housing container 5c, the temperature of the cooling target object in the second housing container 5c can be efficiently increased.

[0024]

(Freezer compartment 4)

As illustrated in Fig. 2, the freezer compartment 4 is provided below the vegetable compartment 3, has a space for housing a storage item to freeze the storage item, in particular. The freezer compartment 4 is a storage compartment, the temperature of which is set to be within a freezing temperature zone (for example, equal to or lower than -18 degrees C) lower than 0 degrees C. The freezer compartment 4 is provided with a pull-out door 4c. The freezer compartment 4 is opened to or closed from the outside of the refrigerator 1 by opening or closing the door 4c.

[0025]

[Maintenance of supercooling state]

The following describes a temperature environment under which food in the second housing container 5c is maintained in the supercooling state. When water is to be changed into ice, a field is needed in which an ice crystal grows, which is an ice nucleus in a small molecule scale. It is thought that, in supercooled liquid, collection and separation of molecules are repeated due to fluctuation and molecular assemblies (clusters) in various sizes are thus generated. In an extremely small cluster, inner molecules are in an ice coupled state, but molecules on the surface cannot be in the coupled state and are unstable, and thus some of the molecules become separated from the cluster.

[0026]

A cluster cannot exist in a stable state and does not become an ice crystal unless the radius of the cluster exceeds a critical radius, and thus freezing still does not start even when the freezing point is reached. This state is referred to as the

supercooling state. When at least one cluster having a radius equal to or larger than the critical radius is generated, an ice crystal is generated with the cluster as a nucleus, and the supercooling state is resolved. The supercooling state is more likely to be resolved as the temperature decreases. In addition, the fluctuation in the liquid increases due to disturbance such as physical impact, so that a cluster having a radius equal to or larger than the critical radius is generated, and the supercooling state is resolved.

[0027]

As food is a composite of materials, ice crystals are mostly generated with the materials as nuclei. When food is stored at a temperature equal to or lower than the freezing point (for example, 0 degrees C), the supercooling state is potentially canceled due to impact or some causes, and ice crystals are generated in the food. Then, as the food is left to stand while the supercooling state is canceled, the freezing of the food proceeds, and the quality of the food degrades due to cell damage through the freezing. To avoid such a phenomenon, the temperature environment of a space in which the food is stored is adjusted by controlling a low temperature process in which a set compartment temperature is set to be a temperature lower than the freezing point of the food, and a temperature increasing process in which the set compartment temperature is set to be a temperature higher than the freezing point. In this manner, when the food is cooled without impulsion such as abrupt temperature decrease, the food can be maintained at the supercooling state. Specifically, to maintain the supercooling state, the second housing container 5c in which the supercooling storage is performed preferably has a "temperature range" of -3 to -1 degrees C. In addition, the second housing container 5c preferably has uniform "temperature distribution" to maintain the supercooling state.

[0028]

[Flow of cool air]

The following describes the flow of cool air generated at the cooler 8 with reference to Figs. 2 and 3. In Figs. 2 and 3, arrows show the flow of cool air. Cool air generated at the cooler 8 passes through the air-sending fan 9, and is divided into

cool air toward the refrigerator compartment 2 and cool air toward the freezer compartment 4. The cool air toward the refrigerator compartment 2 passes through the first air path 10, and is divided, through the dampers 11a and 11b, into cool air toward the refrigerator compartment 2 and the first housing container 5b and cool air toward the second housing container 5c. The cool air toward the refrigerator compartment 2 is blown out to the refrigerator compartment 2 through the air outlets 17a illustrated in Fig. 1. The cool air blown out to the refrigerator compartment 2 through the air outlets 17a passes through the shelves 21, and flows downward at a space in front of the refrigerator compartment 2 to a space 5d in front of the chilling compartment 5a illustrated in Fig. 4.

[0029]

The cool air toward the first housing container 5b and the second housing container 5c is blown out to the first housing container 5b through the air outlet 17b, and is also blown out to the second housing container 5c through the air outlet 17c. As illustrated in Fig. 4, part of the cool air blown out through the air outlet 17b flows into the space 5d in front of the chilling compartment 5a through a gap between the first housing container 5b and the lid 13 or a gap between the lid 13 and the top plate 18. Part of the cool air blown out through the air outlet 17c flows into the space 5d in front of the chilling compartment 5a through a gap between the second housing container 5c and the partition plate 6. The cool air flowing into the space 5d in front of the chilling compartment 5a from the first housing container 5b and the second housing container 5c joins with cool air flowing downward in the refrigerator compartment 2, and flows out to the second air path 12 from the refrigerator-compartment air inlet 24 through a space 5e below the second housing container 5c, as illustrated in Fig. 3.

[0030]

As illustrated in Fig. 4, the cool air blown out through the air outlets 17b and 17c is bounced at a corresponding one of the lid 13 and the front wall 5c1 of the second housing container 5c, and flows toward a back portion of a corresponding one of the housing containers. The cool air bounced toward the back portion of the first

housing container 5b passes through the chilling-compartment air inlet 14, which is a through-hole opened at the partition plate 6, joins with the cool air bounced toward the back portion of the second housing container 5c, and flows out to the second air path 12 through the refrigerator-compartment air inlet 24. As illustrated in Fig. 3, the cool air having flowed through the second air path 12 returns to the cooler 8 through a back of the vegetable compartment 3. At this time, the cool air does not need to flow to the vegetable compartment 3.

[0031]

When the vegetable compartment 3 having a set temperature higher than that of the refrigerator compartment 2 is disposed close to the supercooling insulation compartment 5a2 as described above, the supercooling insulation compartment 5a2 is not cooled through heat transfer from the vegetable compartment 3, and thus does not suffer from such temperature influence observed with a conventional technology in which a freezer compartment is close to a supercooling insulation compartment. As a result, the supercooling insulation compartment 5a2 is not cooled too much, and thus the heater 15 used for the supercooling storage of a cooling target object in the supercooling insulation compartment 5a2 can have a reduced temperature-increasing capacity. As a result, the heater 15 can have reduced energization rate and size and efficient supercooling storage is thus achieved.

[0032]

Most of cool air in the first housing container 5b flows out to the second air path 12 through the chilling-compartment air inlet 14 opened on a back portion of the partition plate 6 and the refrigerator-compartment air inlet 24. As the chilling-compartment air inlet 14 is provided, the amount of cool air flowing through the space 5e between the second housing container 5c and the boundary wall 7 can be reduced. In addition, as the chilling-compartment air inlet 14 and the refrigerator-compartment air inlet 24 overlap with each other in plan view, the cool air is more likely to flow to the second air path 12, and thus the amount of cool air flowing through the space 5e can be reduced. When the amount of cool air flowing through the space 5e is reduced, heat from the heater 15 is unlikely to be absorbed by cool air

flowing through the space 5e, and thus the heater 15 can have a reduced temperature-increasing capacity. As a result, the heater 15 can have reduced energization rate and size and efficient supercooling storage is thus achieved.

[0033]

5 In the configuration in which the vegetable compartment 3 is close to the supercooling insulation compartment 5a2, the supercooling insulation compartment 5a2 is not cooled through heat transfer. Thus, the boundary wall 7 does not need to contain a heat insulation material for preventing heat transfer to the supercooling insulation compartment 5a2, and costs thus can be reduced.

10 [0034]

 In addition, the temperature of the boundary wall 7 does not become equal to or lower than the temperature of the second housing container 5c, and thus water does not potentially freeze. As heat insulation performance of the boundary wall 7 does not need to be considered and the boundary wall 7 contains no heat insulation material, the thickness of a part of the boundary wall 7 can be reduced. With these structural characteristics, for example, a water supply tank 19 for making ice can be disposed in the boundary wall 7 as illustrated in Fig. 4. Consequently, the water supply tank, which is conventionally disposed beside the chilling compartment 5a, can be disposed in the boundary wall 7, and thus the first housing container 5b and the second housing container 5c can have widths (the X axis) equal to the total inner-compartment width (the X axis) of the refrigerator compartment 2. As a result, the housing volumes of the first housing container 5b and the second housing container 5c are increased.

[0035]

25 In the configuration in which the widths of the first housing container 5b and the second housing container 5c are equal to the total inner-compartment width of the refrigerator compartment 2, the air outlets 17b and 17c can be positioned at portions relatively corresponding to centers of the first housing container 5b and the second housing container 5c as compared to a configuration in which the widths are not equal to the total inner-compartment width. Thus, cool air can equally flow into the

first housing container 5b and the second housing container 5c. As a result, variance in temperature distribution can be reduced in the second housing container 5c and efficient supercooling storage is thus achieved.

[0036]

5 Embodiment 2

Fig. 5 is a cross-sectional view taken along line C-C in Fig. 4. The following describes a refrigerator according to Embodiment 2 of the present invention with reference to Fig. 5. An element having a configuration identical to that of the refrigerator illustrated in Figs. 1 to 4 is denoted by an identical reference sign, and description of the element will be omitted. In this refrigerator 1A according to Embodiment 2 of the present invention, a rib 16 is provided in the boundary wall 7. The rib 16 is a sidewall surrounding the heater 15 and having a height higher than that of the heater 15. In Fig. 5, the heater 15 is formed to have a rectangular shape in plan view, and thus the rib 16 is formed to have a rectangular shape in plan view, too. However, the rib 16 may have any shape surrounding the heater 15, and thus may be provided in various kinds of shapes corresponding to the shape of the heater 15.

[0037]

As described above, the refrigerator 1A according to Embodiment 2 of the present invention includes the rib 16 surrounding the heater 15 in the boundary wall 7 and having a height higher than that of the heater 15. Thus, any cool air flowing through the vicinity of the heater 15 is interrupted by the rib 16 and does not directly contact with the heater 15. As a result, a heat loss of the heater 15 can be reduced, and heat from the heater 15 can be prevented from being used in a place other than a necessary place. In addition, as warm air flows above cool air, the rib 16 can cause heat from the heater 15 to stay in the rib 16 of the boundary wall 7, so that heat at heat generation is effectively used, and thus the heater 15 can have reduced energization rate and size. Consequently, for example, the heater 15 does not need to be entirely provided at the boundary wall 7, but only needs to be disposed directly below a front portion of the second housing container 5c.

[0038]

Embodiment 3

Fig. 6 is an enlarged view of part F in Fig. 2. The following describes a refrigerator according to Embodiment 3 of the present invention with reference to Fig. 6. An element having a configuration identical to that of the refrigerator illustrated in Figs. 1 to 5 is denoted by an identical reference sign, and description of the element will be omitted. In this refrigerator 1B according to Embodiment 3 of the present invention, the air outlet 17c has an upper edge in contact with the lower surface of the partition plate 6. With this configuration, cool air having flowed from the air outlet 17c into the chilling compartment 5a flows along the partition plate 6 by the Coanda effect to the whole second housing container 5c and variance in temperature distribution thus can be reduced. As a result, the supercooling storage can be performed in a large part of the second housing container 5c.

[0039]

Embodiment 4

Fig. 7 is an enlarged view of part G in Fig. 1. Fig. 8 is a cross-sectional view taken along line D-D in Fig. 7. The following describes a refrigerator according to Embodiment 4 of the present invention with reference to Figs. 7 and 8. An element having a configuration identical to that of the refrigerator illustrated in Figs. 1 to 6 is denoted by an identical reference sign, and description of the element will be omitted. In this refrigerator 1C according to Embodiment 4 of the present invention, a thermistor 20 configured to measure the temperature of the second housing container 5c is further installed between the back wall 5c3 of the second housing container 5c and the inner wall panel 17. The temperature in the second housing container 5c is adjusted through adjustment of the output of the heater 15 and the cool air flow rate by the damper 11a, and the output of the heater 15 and the cool air flow rate by the damper 11a are controlled on the basis of a temperature measured by the thermistor 20 installed at a level lower than the lower edge of the air outlet 17c and equal to or higher than the back wall 5c3 of the second housing container 5c.

[0040]

When the supercooling storage is performed, it is desirable to measure a temperature as close to that of food as possible. However, the temperature of food does not abruptly vary unlike room temperature, but gradually varies depending on change of room temperature. Thus, the difference between the food temperature and a temperature measured by the thermistor 20 is large when the thermistor 20 is disposed at a place with which cool air is likely to contact, which is thus not suitable for the supercooling storage. To prevent cool air from contacting with the thermistor 20, the thermistor 20 is not disposed between the air outlet 17c and the refrigerator-compartment air inlet 24, but is disposed so that the air outlet 17c is formed between the installation position of the thermistor 20 and the refrigerator-compartment air inlet 24. As the air outlet 17c is disposed between the thermistor 20 and the refrigerator-compartment air inlet 24, cool air does not directly contact with the thermistor 20, and thus temperature measurement can be appropriately achieved, facilitating the supercooling storage.

[0041]

Embodiments of the present invention are not limited to the above-described Embodiments 1 to 4. For example, when cool air contacts with the thermistor 20 in a particular direction, a wall may be provided to a part of the periphery of the thermistor 20 so that the cool air is unlikely to contact. The heating unit is not limited to the heater 15, but may be a heat exchanger or a Peltier element.

Reference Signs List

[0042]

1 refrigerator 1A refrigerator 1B refrigerator 1C refrigerator 2 refrigerator compartment 2c door 3 vegetable compartment 3c door 4 freezer compartment 4c door 5a chilling compartment 5a1 cold insulation compartment 5a2 supercooling insulation compartment 5b first housing container 5b1 front wall 5b2 sidewall 5b3 back wall 5c second housing container 5c1 front wall 5c2 sidewall 5c3 back wall 5d space 5e space 6 partition plate 7 boundary wall 8 cooler 9 air-sending fan 10 first air path 10a first air path 10b first air path 11a damper

11b damper 12 second air path 13 lid 14 chilling-
compartment air inlet 15 heater 16 rib 17 inner wall panel 17a air
outlet 17b air outlet 17c air outlet 18 top plate 19 water supply
tank 20 thermistor 21 shelf 24 refrigerator-compartment air inlet 30
5 compressor 50 housing

CLAIMS

[Claim 1]

A refrigerator, comprising:

5 a refrigerator compartment having a set temperature within a refrigerating temperature zone and configured to house a cooling target object;

a supercooling insulation compartment provided in the refrigerator compartment and configured to insulate a cooling target object at a supercooling temperature equal to or lower than a freezing temperature of the cooling target object;

10 a vegetable compartment provided below the refrigerator compartment and close to the supercooling insulation compartment and having a set temperature higher than the set temperature of the refrigerator compartment;

a boundary wall provided between the vegetable compartment and the supercooling insulation compartment; and

15 a heater installed at the boundary wall below the supercooling insulation compartment and configured to heat the cooling target object in the supercooling insulation compartment.

[Claim 2]

The refrigerator of claim 1, wherein

the refrigerator compartment includes

20 a top plate provided above the supercooling insulation compartment, and

a cold insulation compartment provided between the top plate and the supercooling insulation compartment and having a set temperature lower than the set temperature of the refrigerator compartment and higher than a set temperature of the supercooling insulation compartment,

25 a partition plate is provided between the supercooling insulation compartment and the cold insulation compartment, and

a chilling-compartment air inlet through which cool air in the cold insulation compartment flows toward the supercooling insulation compartment is formed in the partition plate.

[Claim 3]

The refrigerator of claim 2, wherein
a refrigerator-compartment air inlet through which cool air in the refrigerator
compartment is sucked is formed in the boundary wall, and
at least a part of the chilling-compartment air inlet and at least a part of the
5 refrigerator-compartment air inlet overlap with each other in plan view.

[Claim 4]

The refrigerator of claim 3, wherein
the cold insulation compartment comprises a first housing container having a
box shape including a front wall, sidewalls, a back wall, and a top opening,
10 the supercooling insulation compartment comprises a second housing
container having a box shape including a front wall, sidewalls, a back wall, and a top
opening,

the chilling-compartment air inlet is formed between the back wall of the first
housing container and an inner wall panel of the refrigerator compartment, the inner
15 wall panel being disposed opposite to a door of the refrigerator compartment, and
the refrigerator-compartment air inlet is formed between the back wall of the
second housing container and the inner wall panel.

[Claim 5]

The refrigerator of any one of claims 1 to 4, wherein the boundary wall further
20 houses a water supply tank for making ice.

[Claim 6]

The refrigerator of any one of claims 1 to 5, wherein the boundary wall is
provided with a sidewall surrounding the heater and having a height higher than a
height of the heater.

25 [Claim 7]

The refrigerator of any one of claims 2 to 6, wherein
in a portion facing the inner wall panel disposed opposite to a door of the
refrigerator compartment, an air path for cool air is vertically provided,
an air outlet for cool air allowing the air path and the supercooling insulation
30 compartment to communicate with each other is formed in the inner wall panel, and

a lower surface of the partition plate is in contact with an upper edge of the air outlet.

[Claim 8]

5 The refrigerator of claim 7, further comprising a thermistor configured to measure a temperature of the supercooling insulation compartment, wherein the thermistor is installed between the back wall of the second housing container and the inner wall panel and installed at a level lower than a lower edge of the air outlet and equal to or higher than the back wall of the second housing container.

[Claim 9]

10 The refrigerator of claim 8, wherein the air outlet is formed between an installation position of the thermistor and the refrigerator-compartment air inlet.