

DESCRIPTION

Title of Invention

REFRIGERATOR

5 Technical Field

[0001]

The present disclosure relates to a refrigerator having a storage compartment in which temperatures are switchable.

Background Art

10 [0002]

In recent years, the tendency of buying a large amount of food at a time and storing the food in a refrigerator has been increased by changes in lifestyles due to, for example, the increasing number of double-income households and single-person households. Under such a tendency, there is a demand for refrigerators having increased capacities and refrigerators in which temperature can be finely regulated and various foods can be preserved at suited temperatures. As one of refrigerators that meet such a demand, there is a known refrigerator including, separately from a refrigerator compartment and a freezer compartment, a storage compartment (versatile compartment, temperature switchable compartment) in which temperature zones are switchable.

20

[0003]

As temperature zones for preservation of a cooling target in a refrigerator, the following three temperature zones are known.

The first temperature zone is a temperature zone of higher than or equal to 0 degrees C and less than 3 degrees C and is, for example, a temperature zone of about 1 degree C. It is known that, when food, such as meat and fish, that has been frozen in a storage compartment in the first temperature zone is defrosted, frozen moisture in the food is gradually melted and the food can be defrosted without considerably losing the taste of the food.

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In addition, there is a usage example of the second temperature zone, in which the temperature in a storage compartment is maintained at around 0 degrees C and in which a minus temperature zone in which the temperature inside the compartment is about -3 degrees C is set for the purpose of prolonging, while avoiding freezing of the moisture in food, the preservation period of the food compared with preservation in a normal refrigerator compartment.

Further, as a use of the third temperature zone, setting the temperature in a storage compartment to about -7 degrees C has been proposed.

There is proposed a versatile compartment that is a storage compartment in which the first temperature zone, the second temperature zone, and the third temperature zone described above can be set by a user. The wider the width of the temperature zones settable for a versatile compartment, the more the time and labor of a user to take out food from a storage compartment and move the food to another storage compartment in a different temperature zone suited for the food can be reduced.

[0004]

As one example of a refrigerator including a versatile compartment in the related art, there is disclosed a refrigerator provided with a freezer compartment and a refrigerator compartment in an upper portion and a lower portion of the refrigerator, respectively. In an upper portion inside the refrigerator compartment, a storage compartment partitioned from the refrigerator compartment by a wall is provided. The ceiling of the refrigerator compartment is provided with a cool-air return passage through which cool air in the refrigerator compartment is returned to a cool-air introduction passage, and a passage through which cool air in the storage compartment is returned to the cool-air introduction passage. The cool-air return passage and the passage are in communication with each other. Cool air that has flowed into the refrigerator compartment returns to the cool-air introduction passage through the cool-air return passage. Cool air that has flowed into the storage compartment returns to the cool-air introduction passage through the passage and the cool-air return passage.

There has been such a refrigerator in which food stored inside the storage compartment is rapidly cooled (Refer to, for example, Patent Literature 1).

Citation List

Patent Literature

5 [0005]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 5-187756

Summary of Invention

Technical Problem

10 [0006]

In the aforementioned method in the related art, however, since the cool-air return passage through which the cool air in the refrigerator compartment is returned to the cool-air introduction passage and the passage through which the cool air in the storage compartment is returned to the cool-air introduction passage are connected to each other, a sudden temperature change in the cool air is generated when the cool air that flows in the cool-air return passage and the cool air that flows in the passage merge together during rapid cooling in the storage compartment, and frost is easily generated at a merging portion of the cool air. There has been a problem in that, when the cool-air return passage or the passage is narrowed in width or closed due to such generation of frost, circulation of the cool air inside the refrigerator is obstructed and the entirety of the refrigerator is thus not cooled.

[0007]

The present disclosure has been made to solve the above problem, and an object of the present disclosure is to provide a refrigerator that includes a storage compartment to be set to a refrigerating temperature zone and in which a cooling target is to be preserved and a storage compartment settable to a minus temperature zone, and that performs stable temperature control by preventing formation of frost in a cool-air return passage connecting the storage compartment to be set to a refrigerating temperature zone and a cooler chamber to each other and a cool-air return passage connecting the storage compartment settable to a minus temperature zone and the

cooler chamber to each other and by preventing clogging of the cool-air return passages by formed frost.

Solution to Problem

[0008]

5 A refrigerator according to an embodiment of the present disclosure includes: a box body having an opening port in a front surface of the box body and including a first storage compartment to be set to a refrigerating temperature zone and a second storage compartment located higher than the first storage compartment, the second storage compartment being to be set to a freezing temperature zone; a door attached to
10 the front surface of the box body, the door opening or closing the opening port; a partition dividing the first storage compartment and the second storage compartment from each other vertically; a third storage compartment provided lower than the partition and provided in an uppermost portion inside the first storage compartment, the third storage compartment being settable to a minus temperature zone; a first return air
15 passage provided in the partition and through which return cool air in the first storage compartment is returned to a cooler chamber; and a second return air passage provided in the partition and through which return cool air in the third storage compartment is returned to the cooler chamber. The first return air passage and the second return air passage are air passages independent from each other, and the first return air passage
20 and the second return air passage are partitioned from each other by a heat insulator.

Advantageous Effects of Invention

[0009]

 When the refrigerator according to an embodiment of the present disclosure is used, a sudden temperature change due to merging of cool air, the sudden temperature
25 change occurring in the related art at a connection portion where a cool-air return passage connecting a storage compartment to be set to a refrigerating temperature zone and a cooler chamber to each other is connected to a cool-air return passage connecting a storage compartment settable to a minus temperature zone and the cooler chamber to each other, is prevented. Therefore, frost formation and clogging caused
30 by frost formation are prevented in the cool-air return passage connecting the storage

compartment to be set to a refrigerating temperature zone and the cooler chamber to each other and in the cool-air return passage connecting the storage compartment settable to a minus temperature zone and the cooler chamber to each other. It is thus possible to perform stable temperature control.

5 Brief Description of Drawings

[0010]

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

10 [Fig. 2] Fig. 2 is a perspective view of the refrigerator according to Embodiment 1 of the present disclosure, the perspective view illustrating an interior configuration with a state in which a freezer compartment door and a refrigerator compartment door are open.

15 [Fig. 3] Fig. 3 is a sectional view of the refrigerator according to Embodiment 1 of the present disclosure, the sectional view being taken along the line A-A in Fig. 1 and illustrating a freezer-compartment blowing air passage, a refrigerator-compartment blowing air passage, and a versatile-compartment blowing air passage.

20 [Fig. 4] Fig. 4 is a sectional view of the refrigerator according to Embodiment 1 of the present disclosure, the sectional view being taken along the line A-A in Fig. 1 and illustrating a freezer-compartment return air passage, a refrigerator-compartment return air passage, and a versatile-compartment return air passage.

[Fig. 5] Fig. 5 is a top view of a box body of the refrigerator according to Embodiment 1 of the present disclosure.

[Fig. 6] Fig. 6 is a sectional view of the refrigerator according to Embodiment 1 of the present disclosure, the sectional view being taken along the line B-B in Fig. 5.

25 [Fig. 7] Fig. 7 is a sectional view of the refrigerator according to Embodiment 1 of the present disclosure, the sectional view being taken along the line C-C in Fig. 5.

[Fig. 8] Fig. 8 includes sectional views of the refrigerator according to Embodiment 1 of the present disclosure, the sectional views being taken along the line C-C and the line D-D in Fig. 5.

[Fig. 9] Fig. 9 is a perspective view of an internal configuration of a partition according to Embodiment 2 of the present disclosure.

[Fig. 10] Fig. 10 is a top view of a box body of a refrigerator according to Embodiment 2 of the present disclosure.

5 [Fig. 11] Fig. 11 is a sectional view of the refrigerator according to Embodiment 2 of the present disclosure, the sectional view being taken along the line P-P.

[Fig. 12] Fig. 12 is a sectional view of the refrigerator according to Embodiment 2 of the present disclosure, the sectional view being taken along the line Q-Q.

10 [Fig. 13] Fig. 13 includes a front view and sectional views of the refrigerator according to Embodiment 2 of the present disclosure with a state in which a freezer compartment door and a refrigerator compartment door are open, the sectional views being taken along the line S-S and the line T-T.

[Fig. 14] Fig. 14 includes sectional views of the refrigerator according to Embodiment 2 of the present disclosure, the sectional views being taken along the line Y-Y and the line V-V.

[Fig. 15] Fig. 15 is a perspective view of an internal configuration of a partition according to Embodiment 2 of the present disclosure.

20 [Fig. 16] Fig. 16 is a schematic vertical sectional view illustrating a configuration of a multistory shelf included in a refrigerator according to Embodiment 3 of the present disclosure.

[Fig. 17] Fig. 17 is a schematic top view roughly illustrating the multistory shelf included in the refrigerator according to Embodiment 3 of the present disclosure.

25 [Fig. 18] Fig. 18 is a schematic vertical sectional view illustrating a configuration of the multistory shelf included in the refrigerator according to Embodiment 3 of the present disclosure.

Description of Embodiments

[0011]

30 Hereinafter, a refrigerator according to the present disclosure will be described with reference to the drawings. The present description is not limited only to the following embodiments, and modifications or omissions are possible within the range

not departing from the gist of the present description. In the drawings, actual structures may be simply illustrated. In the drawings, the size of each component and positional relationships among components may differ from actual ones. Regarding reference signs, the same sign is given to parts identical or corresponding to each other, and description of the parts is omitted or simplified, as appropriate. This is common to the entire text of the present description.

In the following description, terms (for example, "above", "upper side", "below", "lower side", "left", "left side", "right", "right side", "front", "front side", "near side", "rear", "rear side", "back", "depth", "width", "inner side", "outer side", and other similar terms) denoting directions are used, as appropriate, for ease of understanding. These terms are, however, used for description and are not intended to limit the present disclosure. The directions described above are basically positional relationships among components in a front view of a box body when a refrigerator is installed in a usable state, and a surface in which an opening port of a storage compartment is formed is considered as the front surface (front face).

[0012]

Embodiment 1.

Fig. 1 is a schematic front view illustrating an exterior of a refrigerator 100 according to Embodiment 1 of the present disclosure.

Fig. 2 is a schematic perspective view of the refrigerator 100 according to Embodiment 1 of the present disclosure, the schematic perspective view illustrating an interior configuration with a state in which a freezer compartment door and a refrigerator compartment door are open.

Fig. 3 is a schematic sectional view of the refrigerator 100 according to Embodiment 1 of the present disclosure, the schematic sectional view being taken along the line A-A and illustrating a cooling air passage 35, a refrigerator-compartment blowing air passage 37, a versatile-compartment blowing air passage 38, and a freezer-compartment blowing air passage 39. In Fig. 3, air passages through which return cool air that flows from storage compartments to a cooler chamber passes are omitted for simplification.

Fig. 4 is a schematic sectional view of the refrigerator 100 according to Embodiment 1 of the present disclosure, the schematic sectional view being taken along the line A-A and illustrating the cooling air passage 35, a refrigerator-compartment return air passage 41, a versatile-compartment return air passage 42, and a freezer-compartment return air passage 43. In Fig. 4, blowing air passages through which cool air to be supplied from the cooler chamber to the storage compartments passes are omitted for simplification.

[0013]

[Configuration of Refrigerator 100]

As illustrated in Fig. 1 and Fig. 2, the refrigerator 100 according to Embodiment 1 includes a box body 1 that is a refrigerator body having a storage space 7 in the inside of the refrigerator body. The box body 1 is formed by an outer box 2 made of a metal, an inner box 3 made of a resin, and a heat insulator 4 packed between the outer box 2 and the inner box 3. Materials, such as a foam heat insulator 4a (not illustrated) and a vacuum heat insulator 4b (not illustrated), having low thermal conductivity compared with the outer box 2 and the inner box 3 are used in the heat insulator 4.

The box body 1 is a structure having a cuboidal shape with an opening port 6 in a front surface portion 1a and has the storage space 7 in the inside of the box body 1. A portion of the inner box 3 located higher than the storage space 7, a portion of the inner box 3 located lower than the storage space 7, a portion of the inner box 3 located left of the storage space 7, and a portion of the inner box 3 located right of the storage space 7 in a front view of the front surface portion 1a of the box body 1 are referred to as an upper surface portion 8a, a lower surface portion 8b, a left side surface portion 8c, and a right side surface portion 8d, respectively.

[0014]

The storage space 7 of the box body 1 is a space for storing a cooling target, such as food. The storage space 7 is divided into a plurality of storage compartments by one or a plurality of partitions. In the refrigerator 100 according to Embodiment 1, the storage space 7 is vertically divided by one partition 9 into two storage compartments that are a refrigerator compartment 10 as a first storage compartment

and a freezer compartment 11 as a second storage compartment. The freezer compartment 11 is located higher than the refrigerator compartment 10.

[0015]

The front surface portion 1a of the box body 1 is provided with a refrigerator compartment door 14a for opening and closing the refrigerator compartment 10, and a freezer compartment door 14b for opening and closing the freezer compartment 11. The refrigerator compartment door 14a and the freezer compartment door 14b are attached to the box body 1 by use of a hinge 16a and a hinge 16b, respectively, such that the doors are each turnable. The refrigerator compartment 10 and the freezer compartment 11 are opened and closed by the refrigerator compartment door 14a and the freezer compartment door 14b that are of a single swing type, respectively. The configuration of each of the refrigerator compartment door 14a and the freezer compartment door 14b is, however, not limited to the foregoing, and a configuration in which two doors of a double door type open and close one storage compartment may be employed.

[0016]

The refrigerator compartment 10 is set to a refrigerating temperature zone, which is a first temperature zone. The refrigerating temperature zone is, for example, a temperature zone of higher than or equal to 3 degrees C and lower than or equal to 5 degrees C.

As illustrated in Fig. 2, Fig. 3, and Fig. 4, the refrigerator compartment 10 includes, in its inside, a plurality of shelves 15 that divide, at different positions in the up-down direction, the storage space 7. The plurality of shelves 15 include, in order from the top, a highest-stage shelf 15a, a first shelf 15b, a second shelf 15c, a third shelf 15d, and a lowest-stage shelf 15e. The first shelf 15b, the second shelf 15c, and the third shelf 15d are detachable and are adjustable in height by supports 17 that are each provided at a corresponding one of a left side surface portion 10c of the refrigerator compartment 10, the left side surface portion 10c being a portion of the left side surface portion 8c of the inner box 3, and a right side surface portion 10d of the refrigerator compartment 10, the right side surface portion 10d being a portion of the right side

surface portion 8d of the inner box 3. The first shelf 15b, the second shelf 15c, and the third shelf 15d may be each a plurality of shelves connected to each other in the front-rear direction, and one of the plurality of shelves on the near side of the refrigerator compartment 10 may be able to be set to overlap another shelf at the back of the refrigerator compartment 10 by being slid rearward. The number of the plurality of shelves 15 inside the refrigerator 100 is not limited to the foregoing.

[0017]

The freezer compartment 11 is set to a freezing temperature zone, which is a second temperature zone. The freezing temperature zone is a temperature zone lower than the refrigerating temperature zone. The freezing temperature zone is a temperature zone of less than 0 degrees C and is, for example, a temperature zone of higher than or equal to -20 degrees C and lower than or equal to -18 degrees C.

[0018]

A vegetable compartment 12 is a storage compartment that is set to a temperature zone of a higher set temperature (for example, about 3 degrees C to 7 degrees C) than the set temperature of the refrigerator compartment 10. The vegetable compartment 12 is a storage compartment suited for refrigerating, among foods, vegetables in particular. The vegetable compartment 12 is divided from the refrigerator compartment 10 by a drawer-type container 18 and the lowest-stage shelf 15e and is provided lower than the refrigerator compartment 10. The drawer-type container 18 is set on the lower surface portion 8b of the inner box 3 to be movable in the front-rear direction (depth direction) of the box body 1.

[0019]

A versatile compartment 13 is a storage compartment (third storage compartment) whose inside temperature can be set in a range from the refrigerating temperature zone to the freezing temperature zone. In the versatile compartment 13, the inside temperature can be set to a temperature zone suited for an intended use. The versatile compartment 13 is a storage compartment suited for preserving, for example, food such as meat and fish, and processed products of meat or fish. In Embodiment 1, the temperature in the versatile compartment 13 can be set to, mainly,

three temperature zones of the first temperature zone, the second temperature zone, and the third temperature zone. The versatile compartment 13 is, however, not limited to the foregoing and may be set to a temperature in a temperature zone other than these three temperature zones. The temperature in the versatile compartment 13 can
5 be freely set by a user of the refrigerator 100. Therefore, the user can preserve a cooling target, such as food, in the versatile compartment 13 in a temperature zone preferred by the user. It is thus possible to improve the convenience of the refrigerator 100.

As illustrated in Fig. 3 and Fig. 4, the versatile compartment 13 includes a
10 versatile-compartment back surface portion 13c that is formed by a back surface panel (refrigerator-compartment back surface panel 34) shared with the refrigerator compartment 10. The versatile compartment 13 is divided from the refrigerator compartment 3 by the highest-stage shelf 15a set in the refrigerator compartment 10, a storage container 20 set on the highest-stage shelf 15a, and a front door 19.

15 The storage container 20 is a drawer-type storage container. A ceiling 10a of the refrigerator compartment 10 and a ceiling 13a of the versatile compartment 13 correspond to the partition 9. The ceiling 13a of the versatile compartment 13 is provided behind the ceiling 10a of the refrigerator compartment 10.

[0020]

20 The storage container 20 is a container for storing a cooling target that is preserved in the versatile compartment 13. For example, polystyrene is used as a material of the storage container 20, similarly to storage containers of general refrigerators. The material of the storage container 20 is, however, not limited to the foregoing. The storage container 20 is moved in the front-rear direction (depth
25 direction) of the box body 2 by being slid to guides (not illustrated) that are each provided, between the highest-stage shelf 15a and the partition 9, on a corresponding one of the left side surface portion 8c and the right side surface portion 8d of the inner box 3. The storage container 20 is a cuboidal container whose upper surface is open. A front surface portion 20a of the storage container 20 has a low height compared with
30 rear portions of a left side surface portion 20b and a right side surface portion 20c of the

storage container 20. An upper end side 20a2 is inclined further forward than a lower end side 20a1. A grip portion 21 is provided on the front surface of the front surface portion 20a. With the storage container 20 formed as described above, when a user pulls out the storage container 20 with the fingers of the user being hooked on the grip portion 21 in a state in which the storage container 20 is stored at the back on the highest-stage shelf 15a and closed by the front door 19, a fin 22 is pushed up by the left and right side surface portions 20b, and the front door 19 is turned toward the near side. Consequently, the front door 19 is separated from the front surface portion 20a, and the storage container 20 is opened. Thus, a storing target can be taken out from and placed in the storage container 20.

[0021]

The front door 19 is pivotally supported by an attachment portion 19a provided on a bottom surface portion 9c of the partition 9 such that one end side is turnable. The attachment portion 19a is a mechanism that attaches the front door 19 to the bottom surface portion 9c of the partition 9, and a position at which the attachment portion 19a is provided on the bottom surface portion 9c corresponds to an attachment position at which the front door 19 is attached to the bottom surface portion 9c of the partition 9.

In a state in which the storage container 20 is pushed to the back on the highest-stage shelf 15a, the front door 19 is located in front of the storage container 20 and is in contact with the front surface portion 20a of the storage container 20 to close an opening 13b of the versatile compartment 13, the opening 13b being defined by the ceiling 13a of the versatile compartment 13, the left side surface portion 8c of the inner box 3, the right side surface portion 8d of the inner box 3, and the front surface portion 20a.

In this state, when a user pulls out forward the storage container 20 with the fingers of the user being hooked on the grip portion 21, the fin 22 provided on the rear surface of the front door 19 comes into contact with the side surface portion 20b of the storage container 20 and is pushed up by the side surface portion 20b having a height that increases from the front toward the rear, and the front door 19 is turned forward (the front door 19 is turned clockwise about the attachment portion 19a in a right side view of

the box body 1). As described above, the front door 19 enables the storage container 20 to be pulled out forward, and the front door 19 opens the opening 13b of the versatile compartment 13 defined by the partition 9, the front surface portion 20a of the storage container 20, and the left side surface portion 8c and the right side surface portion 8d of the inner box 3. When the opening 13b of the versatile compartment 13 is to be closed by the front door 19, the storage container 20 is moved in a direction (direction of pushing rearward) opposite to that when the front door 19 opens the opening 13b of the versatile compartment 13. By the above movement, the front door 19 opens and closes the opening 13b of the versatile compartment 13 defined by the partition 9 (the ceiling 13a of the versatile compartment 13), the front surface portion 20a of the storage container 20, the left side surface portion 8c of the inner box 3, and the right side surface portion 8d of the inner box 3.

The configuration of the front door 19 according to Embodiment 1 is not limited to the foregoing and may be a configuration in which the attachment portion 19a is provided on each of the left side surface portion 8c of the inner box 3 and the right side surface portion 8d of the inner box 3 to extend along the bottom surface portion 9c of the partition 9 and in which the front door 19 is pivotally supported by the attachment portion 19a. Alternatively, a configuration in which the front door 19 comes into contact with the upper surface or a distal end portion of the highest-stage shelf 15a to close the opening 13b of the versatile compartment 13 may be employed. In this case, the grip portion 21 is provided on the front surface of the front door 19.

[0022]

The bottom surface portion 9c of the partition 9 includes a first portion that is a region in front of the attachment portion 19a, the first portion facing the refrigerator compartment 10 and corresponding to the ceiling 10a of the refrigerator compartment 10. The bottom surface portion 9c includes a second portion that is a region behind the attachment portion 19a, the second portion facing the versatile compartment 13 and corresponding to the ceiling 13a of the versatile compartment 13. As illustrated in Fig. 3 and Fig. 4, in front of the third storage compartment, a space 10f is defined between the door and the third storage compartment.

The ceiling 10a facing the space 10f has a refrigerator-compartment return air passage inlet 41a, which is a first return air passage inlet, and the ceiling 13a has a versatile-compartment return air passage inlet 42a, which is a second return air passage inlet.

5 With the refrigerator-compartment return air passage inlet 41a and the versatile-compartment return air passage inlet 42a being disposed in front of and behind the attachment portion 19a, respectively, cool air that has flowed into the versatile compartment 13 in a state in which the front door 19 closes the opening of the versatile compartment 13 is prevented by the front door 19 from flowing into the refrigerator compartment 10. The cool air that has flowed into the versatile compartment 13 flows out to the cooler chamber through the versatile-compartment return air passage inlet 42a formed in the ceiling 13a of the versatile compartment 13. Therefore, fluctuation of the temperature zone of the refrigerator compartment 10 due to temperature control for the versatile compartment 13 is prevented by the front door 19. The front door 19 also prevents transmission of the smell of a cooling target stored in the versatile compartment 13 to the refrigerator compartment 10.

[0023]

Temperature zones selectable for the versatile compartment 13 will be described. For the versatile compartment 13, a plurality of temperature zones including the first temperature zone, the second temperature zone, and the third temperature zone are selectable.

[0024]

The first temperature zone is a temperature zone of higher than or equal to 0 degrees C and less than 3 degrees C and is, for example, a temperature zone of about 1 degree C. By setting a temperature in the versatile compartment 4 to be in this temperature zone, the versatile compartment 13 can be used as a chiller compartment. Targets of such a method of using the versatile compartment 13 are users who lack for the capacity of the refrigerator compartment 10 and users who consume a large amount of food on the day of storage of food.

[0025]

The second temperature zone is a minus temperature zone of a lower temperature than the temperature of the refrigerator compartment 10 and is a temperature zone (subcooling temperature zone) that causes food to be in a subcooled state. The subcooled state is a state in which, even when the temperature of food has reached a temperature lower than or equal to a freezing point (freezing temperature) of the food, the food does not start to freeze and keeps a non-frozen state. Such a subcooling temperature zone is, for example, a temperature zone of higher than or equal to -3 degrees C and less than 0 degrees C, which is lower than or equal to the freezing point of food.

By setting a temperature in the versatile compartment 13 to be in this temperature zone, the versatile compartment 13 can be used as a subcooling preservation compartment in which food is preserved in a subcooled state. Maintaining food to have a temperature as low as possible without causing the food to freeze is desirable for preserving the food while maintaining the quality of the food. Such food preservation can be achieved by the subcooling preservation compartment. By use of the versatile compartment 13 as the subcooling preservation compartment, a user can preserve food whose preservation period is short, such as fresh food such as meat and fish and processed products of meat or fish, without causing the food to freeze.

[0026]

The third temperature zone is a temperature zone of higher than or equal to -10 degrees C and lower than or equal to -5 degrees C and is, for example, a temperature zone of about -7 degrees C. In this temperature zone, even when food is preserved for a long period, the surface of the food does not become too hard. It is thus possible to crush or break the food easily. Therefore, the user can immediately use the food that has been preserved in the versatile compartment 13.

[0027]

In Embodiment 1, the storage space 7 in the refrigerator 100 is divided by the one partition 9 into two storage compartments, which are the refrigerator compartment 10 and the freezer compartment 11. However, Embodiment 1 is not limited to the

foregoing. The freezer compartment 11 may be a storage compartment in another temperature zone other than the freezing temperature zone. The box body 1 may be divided by a plurality of partitions into five storage compartments including a refrigerator compartment, an ice-making compartment, a versatile compartment, a freezer compartment, and a vegetable compartment. In such a case, the versatile compartment is divided inside the refrigerator compartment, and the refrigerator compartment and the versatile compartment are divided from the other storage compartments by one partition plate.

[0028]

As illustrated in Fig. 3, the refrigerator 100 includes, at a portion closer to a back surface 1b than the storage compartments of the box body 1, a compressor 25 that compresses and discharges refrigerant; a cooler 26 that serves as an evaporator and cools air; a fan 27 that moves cool air generated by the cooler 26; and a heating heater 28 (not illustrated). As illustrated in Fig. 3, the compressor 25 is disposed in a machinery chamber 30 that is provided, at a portion in the vicinity of the back surface 1b of the box body 1, below a cooler chamber 29. At a portion of an upper surface 1c of the box body 1 in the vicinity of the back surface 1b, a recessed substrate storage portion 32 for storing a controller 31 is formed. This controller 31 is, for example, a dedicated hardware or a central processing unit (CPU; also called, central processor, processing unit, arithmetic unit, microprocessor, microcomputer, or processor) that executes a program stored in a memory.

[0029]

The compressor 25 and the cooler 26 form, together with a condensation device (not illustrated) and a decompression device (not illustrated), a refrigeration cycle circuit. In the refrigeration cycle circuit, the compressor 25, the condensation device, the decompression device, and the evaporator (cooler 26) are connected to each other in this order by refrigerant pipes. The compressor 25 is connected at the refrigerant discharge side to the condenser and connected at the refrigerant suction side to the cooler 26. The cooler 26 serves as an evaporator and generates cool air by causing

refrigerant that passes through the cooler 26 and air that flows in the cooler chamber 29 to exchange heat.

The heating heater 28 (not illustrated) is provided lower than the cooler 26 and provided in a state of not being in contact with the cooler 26. The heating heater 28 is a defrosting device that is provided for defrosting of the cooler 26 and that heats and removes frost adhering to the cooler 26. The frost adhering to the cooler 26 is heated by the heating heater 28 and is discharged as drain water to the outside of the cooler chamber 29 through a drain pipe opening port 29b provided in the partition 9.

[0030]

The box body 1 includes the cooler chamber 29 and the freezer-compartment blowing air passage 39 between a freezer-compartment back surface panel 33, which forms the back surface of the freezer compartment 11, and the back surface 1b of the box body 1. The cooler chamber 29 is disposed behind the freezer compartment 11 such that at least part of the cooler chamber 29 overlaps the freezer compartment 11 in a front view of the box body 1 of the refrigerator 100. The cooler 26, the fan 27, and the heating heater 28 (not illustrated) are installed inside the cooler chamber 29.

The box body 1 includes the refrigerator-compartment blowing air passage 37 and the versatile-compartment blowing air passage 38 between the refrigerator-compartment back surface panel 34, which forms the back surface of the refrigerator compartment 10 and the back surface of the versatile compartment 13, and the back surface 1b of the box body 1.

[0031]

Further, the refrigerator 100 includes, at a portion in the vicinity of the back surface 1b of the box body 1, the cooling air passage 35 for causing cool air to flow from the cooler chamber 29 to each of the storage compartments (the refrigerator compartment 10, the vegetable compartment 12, and the versatile compartment 13).

The cooling air passage 35 is formed such that the cooling air passage 35 is located closer to the back surface 1b of the box body 1 than the refrigerator compartment 10 and the freezer compartment 11. The cooling air passage 35 is divided from the freezer compartment 11 by the freezer-compartment back surface

panel 33, which forms the back surface of the freezer compartment 11, and is located between the freezer compartment 11 and a back surface portion 36 of the box body 1.

The cooling air passage 35 is also divided from the refrigerator compartment 11 by the refrigerator-compartment back surface panel 34, which forms a back surface 10e of the refrigerator compartment 10, and is formed between the refrigerator compartment 10 and the back surface portion 36 of the box body 1.

The cooling air passage 35 vertically extends through a rear portion (directly below the cooler chamber 29) of the partition 9. In Fig. 3 and Fig. 4, the cooling air passage 35 passing through the inside of the partition 9 is represented by dashed lines.

The cooling air passage 35 extending through the partition 9 is represented by the dashed lines since the cooling air passage 35 is located on the right side (or the left side) of the line A-A in a front view of the refrigerator 100.

The cooling air passage 35 is connected to the cooler chamber 29 and is connected to the refrigerator-compartment blowing air passage 37 and the versatile-compartment blowing air passage 38.

In Embodiment 1, the freezer-compartment back surface panel 33 and the refrigerator-compartment back surface panel 34 are formed by parts independent from each other. However, Embodiment 1 is not limited to the foregoing. The freezer-compartment back surface panel 33 and the refrigerator-compartment back surface panel 34 may be formed by one panel part. In this case, the cooler chamber 29 is formed between the one panel part and the back surface portion 36, which corresponds to the back surface 1b of the box body 1, and the partition 9 is disposed in front of the panel part.

[0032]

The fan 27 sends air (cool air) cooled by the cooler 26 to the storage compartments, in other words, the refrigerator compartment 10, the freezer compartment 11, the vegetable compartment 12, and the versatile compartment 13. The cool air is supplied by the fan 27 from the cooler chamber 26 to the freezer compartment 11 through the freezer-compartment blowing air passage 39. In addition the cool air is supplied by the fan 27 from the cooler chamber 26 to the refrigerator

compartment 10 through the refrigerator-compartment blowing air passage 37. In addition, the cool air is supplied by the fan 27 from the cooler chamber 26 to the versatile compartment 13 through the versatile-compartment blowing air passage 38.

[0033]

5 The refrigerator compartment 10 has, in the refrigerator-compartment back surface panel 34, a refrigerator-compartment blowing air passage outlet 37a through which the cool air in the refrigerator-compartment blowing air passage 37 is supplied to the refrigerator compartment 10.

10 The freezer compartment 11 has, in the freezer-compartment back surface panel 33, a freezer-compartment blowing air passage outlet 39a through which the cool air in the freezer-compartment blowing air passage 39 is supplied to the freezer compartment 11.

15 The versatile compartment 13 has, in the refrigerator-compartment back surface panel 34, a versatile-compartment blowing air passage outlet 38a through which the cool air in the versatile-compartment blowing air passage 38 is supplied to the versatile compartment 13. The versatile-compartment blowing air passage outlet 38a is located higher than the refrigerator-compartment blowing air passage outlet 37a. The versatile-compartment blowing air passage outlet 38a is provided between the highest-stage shelf 15a and the partition 9.

20 [0034]

25 The air (cool air) cooled by exchanging heat with the refrigerant in the cooler 26 is caused by the fan 27 to form a flow of the air. The arrows illustrated in Fig. 3 represent the directions of the flows of the cool air that is caused by the fan 27 to flow through the air passages. The cool air flowing toward the refrigerator compartment 10 flows from the refrigerator-compartment blowing air passage 37 into the refrigerator compartment 10 through the refrigerator-compartment blowing air passage outlet 37a. The cool air flowing toward the versatile compartment 13 flows from the versatile-compartment blowing air passage 38 into the versatile compartment 13 through the versatile-compartment blowing air passage outlet 38a. The cool air flowing toward the freezer compartment 11 flows from the freezer-compartment blowing air passage 39 into the

30

freezer compartment 11 through the freezer-compartment blowing air passage outlet 39a.

[0035]

A first damper 40a is provided upstream of the refrigerator-compartment blowing air passage 37. In addition, a second damper 40b is provided upstream of the versatile-compartment blowing air passage 38. The first damper 40a changes its opening degree and regulates the quantity of the cool air that passes through the refrigerator-compartment blowing air passage 37. The second damper 40b changes its opening degree and regulates the quantity of the cool air that passes through the versatile-compartment blowing air passage 38.

Then, as illustrated in Fig. 4, the cool air that has passed through the refrigerator compartment 10 flows into the cooler chamber 29 through the refrigerator-compartment return air passage 41. The cool air that has passed through the versatile compartment 13 flows into the cooler chamber 29 through the versatile-compartment return air passage 42. The cool air that has passed through the freezer compartment 11 flows into the cooler chamber 29 through the freezer-compartment return air passage 43.

The return cool air that has flowed into the cooler chamber 29 is cooled by the cooler 26 and is sent again to each of the storage compartments.

[0036]

The temperature in each storage compartment is detected by a temperature sensor (not illustrated) installed in the storage compartment. The controller 31 controls various devices in the refrigerator 100 such that the temperature detected by the temperature sensor is a temperature that has been set for each storage compartment. For example, the controller 31 controls the opening degree of the first damper 40a installed in the refrigerator-compartment blowing air passage 37, the opening degree of the second damper 40b installed in the versatile-compartment blowing air passage 38, the output of the compressor 26, the output of the heating heater 28, the quantity of air sent by the fan 27, and other factor.

The temperature in the refrigerator compartment 3 is regulated by the controller 31 controlling the opening degree of the first damper 40a to regulate the quantity of air

supplied to the refrigerator compartment 3. The temperature in the versatile compartment 13 is regulated by the controller 31 controlling the opening degree of the second damper 40b to regulate the quantity of air supplied to the versatile compartment 13 and regulating the output of a heater 61 (also referred to as the first heating device), which is described later.

[0037]

[Configuration of Partition 9]

As illustrated in Fig. 3 and Fig. 4, the partition 9 is a wall that is provided between the freezer compartment 11 and the refrigerator compartment 10 and is a wall provided between the freezer compartment 11 and the versatile compartment 13. The partition 9 partitions the freezer compartment 11 and the refrigerator compartment 10 vertically from each other and partitions the freezer compartment 11 and the versatile compartment 13 vertically from each other. The partition 9 includes an outer fence 45 manufactured by injection molding and includes, inside the outer fence 45, a heat insulator 46. The heat insulator 46 prevents transfer of heat from the refrigerator compartment 10 and the versatile compartment 13 to the freezer compartment 11.

When the freezer compartment door 14b and the refrigerator compartment door 14a are closed, a front surface portion 9a of the partition 9 is in contact with a gasket (not illustrated) provided on each of the back surface of the freezer compartment door 14b and the back surface of the refrigerator compartment door 14a and divides the freezer compartment door 14b and the refrigerator compartment door 14a from the outside of the box body 1. A rear surface portion 9b of the partition 9 corresponds to a portion of a side surface of the cooler chamber 29, and the rear surface portion 9b of the partition 9 has a refrigerator-compartment return air passage outlet 41b and a versatile-compartment return air passage outlet 42b, which are described later.

[0038]

The partition 9 includes, inside the outer fence 45, a refrigerator-compartment return air passage 41, which is a first return air passage, through which the cool air (the return cool air in the refrigerator compartment 10) that passes through the heat insulator 46 and flows out from the refrigerator compartment 10 is sent to the cooler chamber 29.

The partition 9 also includes, inside the outer fence 45, a versatile-compartment return air passage 42, which is a second return air passage, through which the cool air (the return cool air in the versatile compartment 13) that passes through the heat insulator 46 and flows out from the versatile compartment 13 is sent to the cooler chamber 29.

5 The refrigerator-compartment return air passage 41 is connected at the refrigerator-compartment return air passage inlet 41a to the refrigerator compartment 3 and is connected at the refrigerator-compartment return air passage outlet 41b to the cooler chamber 3.

10 The versatile-compartment return air passage 42 is connected at the versatile-compartment return air passage inlet 42a to the versatile compartment 13 and is connected at the versatile-compartment return air passage outlet 42b to the cooler chamber 29.

[0039]

15 Fig. 5 is a schematic top view of the box body 1 of the refrigerator 100 according to Embodiment 1. In Fig. 5, the line T-T is a line that divides the upper surface 1c of the box body at a position passing through the refrigerator-compartment return air passage 41. The line Z-Z is a line that divides the upper surface 1c of the box body at a position passing through the versatile-compartment return air passage 42.

20 Fig. 6 is a schematic sectional view illustrating a configuration of the inside of the refrigerator 100 according to Embodiment 1, the schematic sectional view being taken along the line T-T. In Fig. 6, a vertical section of the refrigerator 100 along the refrigerator-compartment return air passage 41 is illustrated.

25 Fig. 7 is a schematic sectional view illustrating a configuration of the inside of the refrigerator 100 according to Embodiment 1, the schematic sectional view being taken along the line Z-Z. In Fig. 7, a vertical section of the refrigerator 100 along the versatile-compartment return air passage 42 is illustrated.

Fig. 8(a) is a schematic sectional view of the box body 1 and illustrating an example of the inside of the refrigerator 100 according to Embodiment 1, the line U-U being a line that divides the partition 9 at a position passing through the refrigerator-

compartment return air passage 41 and the versatile-compartment return air passage 42.

Fig. 8(b) is a schematic sectional view of the box body 1 along the line U-U and illustrating an example of the refrigerator 100 according to Embodiment 1. The cooler chamber 29 and the cooling air passage 35 are formed behind the partition 9. The cooling air passage 35 is provided inside a cool air passage guide 53.

[0040]

As illustrated in Fig. 6, Fig. 7, and Fig. 8(b), the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 are independent from each other, without being connected to each other, inside the partition 9. In other words, inside the partition 9, the versatile-compartment return air passage 42 is not connected to (in connection with) the refrigerator-compartment return air passage 41. As illustrated in Fig. 8(b), the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 are disposed separately at the left and the right inside the partition 9 in a top view of the box body 1. As illustrated in Fig. 8(b), a plurality of pillars 48 that couple an upper portion 45a and a lower portion 45b of the outer fence 45 to each other are provided inside the partition 9. The periphery of the pillars 48, the refrigerator-compartment return air passage 41, and the versatile-compartment return air passage 42 inside the outer fence 45 is filled with the heat insulator 46 (omitted in Fig. 8(b)). Further, the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 are defined by a first partition wall 51a and a second partition wall 51b. The first partition wall 51a is provided between the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42, and the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 are partitioned from each other by the first partition wall 51a. The refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 are divided by the second partition wall 51b from the heat insulator 46. In one example, the first partition wall 51a and the second partition wall 51b are made of styrene foam.

However, Embodiment 1 is not limited to the foregoing, and the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 may be disposed inside the partition 9 to overlap each other vertically. Urethane foam may be provided between the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42. In Fig. 8(b), sign 29a represents an opening port of a drain pipe for collecting drain water generated as a result of defrosting of the cooler 26. The air passage 35 corresponds to an air passage formation portion 52 made of styrene foam.

As shown by the dashed line in Fig. 8(b), the partition 9 has the refrigerator-compartment return air passage outlet 41b and the versatile-compartment return air passage outlet 42b located higher than the U-U plane. A rear portion of the refrigerator-compartment return air passage 41 and a rear portion of the versatile-compartment return air passage 42 each have an upward curve and are connected to the refrigerator-compartment return air passage outlet 41b and the versatile-compartment return air passage outlet 42b, respectively. Due to such a structure, the cool air that flows out through the refrigerator-compartment return air passage outlet 41b and the versatile-compartment return air passage outlet 42b to the cooler chamber 29 has an upward velocity component toward the cooler 26. Therefore, the return cool air easily flows along the cooler 26 and easily exchanges heat with the refrigerant in the cooler 26. In Fig. 8(b), the refrigerator-compartment return air passage 41 has a narrower passage-section area at a portion near the refrigerator-compartment return air passage outlet 41b than at a portion near the refrigerator-compartment return air passage inlet 41a to increase the flow velocity of the cool air that flows at the refrigerator-compartment return air passage outlet 41b to be larger than the flow velocity of the cool air that flows at the refrigerator-compartment return air passage inlet 41a.

[0041]

The refrigerator-compartment return air passage inlet 41a is formed in an outer fence bottom surface portion 49 (corresponding to the bottom surface portion 9c of the partition 9) of the partition 9 forming the ceiling 10a of the refrigerator compartment 10. The versatile-compartment return air passage inlet 42a is formed in the outer fence

bottom surface portion 49 of the partition 9 forming the ceiling 13a of the versatile compartment 13. The attachment portion 19a of the front door 19 is attached to the outer fence bottom surface portion 49 of the partition 9, a region in front of the attachment portion 19a corresponding to the ceiling 10a of the refrigerator compartment 10, a region behind the attachment portion 19a corresponding to the ceiling 13a of the versatile compartment 13.

[0042]

In a case where the refrigerator-compartment return air passage inlet 41a is provided in a floor surface portion 10b (corresponding to the lower surface portion 8b of the inner box 3) of the refrigerator compartment 10, when the return air passage inlet is located in front of the refrigerator compartment 10, there is a possibility that food juice such as meat juice, food crumbs, and similar substances spill and thereby clog the refrigerator-compartment return air passage 41. For such a reason, when a return air passage inlet of a storage compartment is provided in a floor surface of the storage compartment in a refrigerator in the related art, the return air passage inlet of the storage compartment is basically provided at the back of the storage compartment. In Embodiment 1, the refrigerator-compartment return air passage inlet 41a is formed in the ceiling 10a of the refrigerator compartment 10. Therefore, it is possible to prevent an event in which the refrigerator-compartment return air passage 41 is clogged by food, compared with a case where the refrigerator-compartment return air passage inlet 41a is provided in the floor surface portion 10b. Thus, the refrigerator-compartment return air passage inlet 41a and the versatile-compartment return air passage inlet 42a can be disposed in front of the refrigerator compartment 10 and the versatile compartment 13, respectively.

[0043]

In Embodiment 1, the refrigerator-compartment return air passage 41 extending from the refrigerator-compartment return air passage inlet 41a to the cooler chamber 29 and the versatile-compartment return air passage 42 extending from the versatile-compartment return air passage inlet 42a to the cooler chamber 29 are independent from each other, without being connected to each other, inside the partition 9. The

above structure can prevent generation of frost in the vicinity of a connection portion of air passages and clogging of air passages by frost since the structure does not cause a sudden temperature change in cool air. Such a sudden temperature change is generated when cool air flowing through a refrigerator-compartment return air passage merges with cool air flowing through a versatile-compartment return air passage in a configuration employed in refrigerators in the related art and in which the refrigerator-compartment return air passage and the versatile-compartment return air passage are connected to each other. In addition, the refrigerator-compartment return air passage 41 and the versatile-compartment return air passage 42 being independent from each other without being connected to each other prevent spreading of the smells of meat and fish stored in the versatile compartment 13 into the refrigerator compartment 10 through the versatile-compartment return air passage 42 and the refrigerator-compartment return air passage 41.

[0044]

Moreover, in a state in which the front door 19 closes the opening 13b of the versatile compartment 13, leakage of the cool air supplied to the versatile compartment 13 into the refrigerator compartment 10 is prevented since the front door 19 is provided between the refrigerator-compartment return air passage inlet 41a and the versatile-compartment return air passage inlet 42a. It is thus possible to prevent a temperature change in the vicinity of the refrigerator-compartment return air passage inlet 41a due to the cool air that has passed through the versatile compartment 13 reaching the vicinity of the refrigerator-compartment return air passage inlet 41a. Consequently, it is possible to prevent frost formation in the vicinity of the refrigerator-compartment return air passage inlet.

[0045]

Embodiment 2.

Hereinafter, Embodiment 2 of the present disclosure will be described. Description of duplication with Embodiment 1 is omitted, and the same signs are given to parts that are the same as or correspond to those in Embodiment 1. Embodiment 2 differs from Embodiment 1 in terms of a feature in which the first heating device is

provided inside the partition 9. Embodiment 2 also differs from Embodiment 1 in terms of a feature in which two versatile-compartment return air passages, instead of one versatile-compartment return air passage, are provided inside the partition.

[0046]

5 Fig. 9 is a schematic perspective view illustrating a configuration inside an outer fence 56 of a partition 55 in a refrigerator 101 according to Embodiment 2 of the present disclosure. In Fig. 9, illustrations of the outer fence 56 and a heat insulator 57 are omitted to illustrate air passages inside the partition 55. The shape of the outer fence 56 and the attached position of the outer fence 56 in the refrigerator 101 are the same as those of the outer fence 45 of the partition 9 in Embodiment 1. The material of the heat insulator 57 is the same as the material of the heat insulator 46 in Embodiment 1.

Fig. 10 is a schematic top view of the refrigerator 101 according to Embodiment 2 of the present disclosure.

Fig. 11 is a schematic sectional view of the refrigerator 101 according to Embodiment 2 of the present disclosure, the schematic sectional view being taken along the line P-P in Fig. 10. The line P-P is a line that passes through the inside of a refrigerator-compartment return air passage 58 to extend from a refrigerator-compartment return air passage inlet 58a to a refrigerator-compartment return air passage outlet 58b in a top view of the refrigerator 101.

20 Fig. 12 is a schematic sectional view of the refrigerator 101 according to Embodiment 2 of the present disclosure, the schematic sectional view being taken along the line Q-Q in Fig. 10. The line Q-Q is a line that passes through the inside of a first versatile-compartment return air passage 59 to extend from a first versatile-compartment return air passage inlet 59a to a first versatile-compartment return air passage outlet 59b in a top view of the refrigerator 101.

Fig. 13(a) is a schematic front view of the refrigerator 101 according to Embodiment 2 of the present disclosure.

Fig. 13(b) is a sectional view of a partition, the sectional view being taken along the line S-S in Fig. 13(a). The line S-S is a horizontal line that overlaps a forward projection plane of the first heating device in a front view of the refrigerator 101.

Fig. 13(c) is a sectional view of the partition, the sectional view being taken along the line T-T in Fig. 13(a). The line T-T is a horizontal line that overlaps a forward projection plane of the refrigerator-compartment return air passage 59 in a location higher than the first heating device in a front view of the refrigerator 101.

[0047]

As illustrated in Fig. 9 and Fig. 11, the heater 61 as the first heating device is provided inside the outer fence 56 of the partition 55 in the refrigerator 101. The heater 61 is used when the heat insulator is not sufficient to prevent frost formation at a cool-air return passage. The heater 61 has a cuboidal shape and includes, inside a metallic plate-shaped part, a heating wire, such as a nichrome wire, embedded to meander in the inside, and heat generation of the heater 61 is controlled by the controller 31 or another device. The heater 61 has an upper surface 61a and a lower surface 61b that are each larger than the other surfaces of the heater 61, and is installed on the inner side of the outer fence 56 to extend along the upper surface of a bottom 56a of the outer fence 56. The heater 61 is provided at a position where the heater 61 overlaps the ceiling 13a of the versatile compartment 13 in a top view of the box body 1.

As illustrated in Fig. 9, Fig. 11, and Fig. 12, the partition 55 includes, inside the outer fence 56, the refrigerator-compartment return air passage 58 as the first return air passage through which the cool air (return cool air in the refrigerator compartment 10) that passes through the heat insulator 57 and flows out from the refrigerator compartment 10 is sent to the cooler chamber 29. The partition 55 also includes, inside the outer fence 56, the first versatile-compartment return air passage 59 as the second return air passage and a second versatile-compartment return air passage 60 as a third return air passage through which the cool air (return cool air in the versatile compartment 13) that passes through the heat insulator 46 and flows out from the versatile compartment 13 is sent to the cooler chamber 29. In Embodiment 2, the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 are independent from one another without being connected to one another inside the

partition 9. As illustrated in Fig. 14(b), described later, the first versatile-compartment return air passage 59 is divided from the refrigerator-compartment return air passage 58 and the heater 61 by a first heat insulator 65a. The second versatile-compartment return air passage 59 is divided from the refrigerator-compartment return air passage 58 and the heater 61 by a second heat insulator 65b. The refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 are divided from a space inside the outer fence 56 by a third heat insulator 65c. The space inside the outer fence 56 is filled with urethane foam as a heat insulator. In addition, although not illustrated, a fourth heat insulator 65d is provided between the refrigerator-compartment return air passage 58 and the heater 61 to divide the refrigerator-compartment return air passage 58 and the heater 61 from each other. The first heat insulator 65a, the second heat insulator 65b, the third heat insulator 65c, and the fourth heat insulator 65d may be continuously formed. As one example, the first heat insulator 65a, the second heat insulator 65b, the third heat insulator 65c, and the fourth heat insulator 65d are made of styrene foam.

In Embodiment 2, a heat insulator is disposed between the heater 61 and each of the return air passages. Embodiment 2 is, however, not limited to the foregoing and may employ a configuration in which no heat insulator is provided between the heater 61 and each of return air passages to improve efficiency in heat input from the heater 61 to each of the return air passages and in which the heater 61 is in direct contact with the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60.

[0048]

With reference to Fig. 9, the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 will be described. The refrigerator-compartment return air passage inlet 58a is provided in a portion of the bottom 56a of the outer fence 56 of the partition 55, the portion being in front of the attachment portion 19a, in other words, in a portion of the ceiling 10a of the refrigerator compartment 10, the portion being in front of a front surface 61c of the cuboidal heater 61. A front refrigerator-

compartment return air passage 58c extending upward to be continuous with the refrigerator-compartment return air passage inlet 58a is provided in front of the front surface 61c.

In addition, a central refrigerator-compartment return air passage 58d extending rearward along the upper surface 61a is provided higher than the upper surface 61a of the heater 61 to be continuous with the front refrigerator-compartment return air passage 58c. The central refrigerator-compartment return air passage 58d is continuous with, behind the partition 55, the refrigerator-compartment return air passage outlet 58b formed in a rear surface 56b of the outer fence 56, the rear surface 56b facing the cooler chamber 29. The front refrigerator-compartment return air passage 58a and the central refrigerator-compartment return air passage 58b form the refrigerator-compartment return air passage 58.

[0049]

Further, as illustrated in Fig. 9, the first versatile-compartment return air passage inlet 59a is provided in a portion of the bottom 56a of the outer fence 56 of the partition 55, the portion being behind the attachment portion 19a, in other words, in a portion of the ceiling 13a of the versatile compartment 13, the portion being right of a right side surface 61d of the cuboidal heater 61. The first versatile-compartment return air passage 59 extending rearward along the right side surface 61c is provided at the right of the right side surface 61d of the heater 61 to be continuous with the first versatile-compartment return air passage inlet 59a. The first versatile-compartment return air passage 59 is continuous with, behind the partition 55, the first versatile-compartment return air passage outlet 59b formed in a rear surface 56b of the outer fence 56, the rear surface 56b facing the cooler chamber 29.

[0050]

Similarly, as illustrated in Fig. 9, a second versatile-compartment return air passage inlet 60a is provided in a portion of the bottom 56a of the outer fence 56 of the partition 55, the portion being behind the attachment portion 19a, in other words, in a portion of the ceiling 13a of the versatile compartment 13, the portion being left of a left side surface 61e of the cuboidal heater 61. In addition, the second versatile-

compartment return air passage 60 extending rearward along the left side surface 61e is provided left of the left side surface 61e of the heater 61 to be continuous with the second versatile-compartment return air passage inlet 60a. The second versatile-compartment return air passage 60 is continuous with, behind the partition 55, a second versatile-compartment return air passage outlet 60b formed in the rear surface 56b of the outer fence 56, the rear surface 56b facing the cooler chamber 29.

[0051]

As illustrated in Fig. 13(b) and Fig. 13(c), the width of the central refrigerator-compartment return air passage 58d in the left-right direction is larger than or equal to the width of the upper surface 61a of the heater 61 in the left-right direction.

[0052]

As described above, the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 are disposed along four surfaces (the upper surface 61a, the front surface 61c, the right side surface 61d, and the left side surface 61e (not illustrated)) of the cuboidal heater 61. In the configuration illustrated in Fig. 9, Fig. 13(b), and Fig. 13(c), the two respective versatile-compartment return air passages are disposed, inside the partition 9, left and right of the heater 61 to extend along the right side surface 61d and the left side surface 61e of the heater 61. Inside the partition 9, the refrigerator-compartment return air passage 58 is provided higher than the heater 61 to cover the upper surface 61a of the heater 61. With the heater 61 being provided with the versatile-compartment return air passages one each at the left and right of the heater 61, the heat dissipated from the side surfaces of the heater 61 can be applied to the return cool air from the versatile compartment 13 efficiently.

A region S1 (illustrated in Fig. 14) in which the upper surface 61a of the heater 61 and the refrigerator-compartment return air passage 58 overlap each other in a top view of the partition 9 is larger than a region S2 (a region, which is illustrated in Fig. 12, in which a cross-section of the first versatile-compartment return air passage 59 overlaps the heater 61 (represented by a dashed line)) in which one of the left and right side

surfaces of the heater 61 and the second return air passage overlap each other in a side view of the partition 9.

With such a configuration, the heat dissipated from the four surfaces of the heater 61 can be efficiently transmitted to the cool air that flows in the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60, and frost formation and freezing inside the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 can be prevented.

The area in which the heater 61 overlaps the refrigerator-compartment return air passage 58 in the up-down direction is larger than the area in which the heater 61 overlaps the first versatile-compartment return air passage 59 or the second versatile-compartment return air passage 60 in the left-right direction. With such a configuration, a larger amount of heat can be applied by the heater 61 to the cool air that flows in the refrigerator-compartment return air passage 58 than to the cool air that flows in the first versatile-compartment return air passage 59 and the second versatile-compartment return air passage 60. With such a configuration, the heater 61 can prevent frost formation and freezing of the cool air that passes in the refrigerator-compartment return air passage 58 and that may have a higher temperature and contain a larger amount of water vapor than the cool air that passes in the first versatile-compartment return air passage 59 and the second versatile-compartment return air passage 60.

[0053]

One example of Embodiment 2 is illustrated in Fig. 14(a) and Fig. 14(b). Fig. 14(a) is a schematic sectional view of the refrigerator 101, the schematic sectional view being taken along the line Y-Y in Fig. 10. Fig. 14(b) is a schematic sectional view of a partition, the schematic sectional view being taken along the line V-V in Fig. 14(a).

The line V-V is a horizontal line that overlaps, above the heater 61, the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 in a front

view of the refrigerator 101. As illustrated in Fig. 14(b), the refrigerator-compartment return air passage inlet 58a is provided in front of the first versatile-compartment return air passage inlet 59a and the second versatile-compartment return air passage inlet 60a.

[0054]

The heat dissipated from the lower surface 61b, which is the rest one surface of the heater 61, is used to heat the cool air inside the versatile compartment 13 and used for switching of the temperature zones in the versatile compartment 13 and for temperature increase control in temperature control within the temperature zones.

With the heater 61 being provided inside the partition 55, the temperature of the air inside the versatile compartment 13 can be more rapidly increased, compared with a case where only temperature control by opening and closing of the damper 40b is performed.

[0055]

The refrigerator 101 according to Embodiment 2 includes, inside the partition 9 partitioning the refrigerator compartment 10 and the freezer compartment from each other, the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, the second versatile-compartment return air passage 60, and the first heating device. With such a configuration, the first heating device can prevent frost formation and freezing by heating the cool air that flows in the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 61, and the second versatile-compartment return air passage 62. In addition, the versatile compartment 13 can be heated indirectly. When a temperature increase in the versatile compartment 13 is required for food preservation, the air inside the versatile compartment 13 can be heated by the heater 61. Consequently, it is possible to prevent an event in which the storage compartments of the refrigerator 101 are not easily cooled due to clogging as a result of frost formation or freezing in the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60.

[0056]

In addition, the refrigerator 101 according to Embodiment 2 includes, inside the partition 9 partitioning the refrigerator compartment 10 and the freezer compartment 11 from each other, the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, the second versatile-compartment return air passage 60, and the first heating device. With such configuration, the first heating device can heat the versatile compartment 13 indirectly while heating the return cool air inside the return air passages. Therefore, warm air is not blown onto food directly. It is thus possible to prevent damage to food and also possible to, when adhesion of frost occurs inside a duct, heat and melt the frost.

[0057]

In Embodiment 2, the heater 61 includes a heating wire that is embedded in the inside of a cuboidal metal plate, such as an aluminum sheet and a copper sheet, excellent in thermal conductivity. Embodiment 2 is, however, not limited to the foregoing. Instead of the cuboidal metal plate, a metallic sheet to which a heat transfer wire is attached may be employed as the heater 61.

[0058]

In the configuration that has been described in Embodiment 2, the area in which the heater 61 overlaps the refrigerator-compartment return air passage 58 in the up-down direction is set to be larger than the area in which the heater 61 overlaps the first versatile-compartment return air passage 59 in the left-right direction and to be larger than the area in which the heater 61 overlaps the second versatile-compartment return air passage 60 in the left-right direction, to thereby prevent clogging of the refrigerator-compartment return air passage 58, the first versatile-compartment return air passage 59, and the second versatile-compartment return air passage 60 due to frost formation and freezing. As a configuration other than the above configuration, the thickness of the heat insulator provided between the heater 61 and the refrigerator-compartment return air passage 58, the thickness of the heat insulator provided between the heater 61 and the first versatile-compartment return air passage 59, and the thickness of the heat insulator provided between the heater 61 and the second versatile-compartment

return air passage 60 may be varied so that the heat from the heater 61 is transferred to the air passages differently.

In other words, with the thickness of the heat insulator between the heater 61 and the refrigerator-compartment return air passage 58 being represented by t_R and the thickness of the heat insulator between the heater 61 and the first versatile-compartment return air passage 59 being represented by t_S , t_R is set to be smaller than t_S . Heat transfer from the heater 61 to each air passage is calculated by a product of an area of a surface of the heater 61 facing the air passage and the reciprocal of a thickness t of the heat insulator between the air passage and the surface of the heater 61 facing the air passage. Therefore, regarding the thicknesses t (t_R and t_S) of the heat insulators between each air passage and the surface of the heater 61 facing the air passage, t_R is set to be smaller than t_S , and consequently, a larger amount of heat can be applied to the refrigerator-compartment return air passage 58 than to the first versatile-compartment return air passage 59 by heat conduction from the heater 61. The same can be said for the second versatile-compartment return air passage 60 and the refrigerator-compartment return air passage 58.

[0059]

In Embodiment 2, the refrigerator-compartment return air passage 58 is formed by the front refrigerator-compartment return air passage 58a and the central refrigerator-compartment return air passage 58b. However, Embodiment 2 is not limited to the foregoing. As illustrated in Fig. 15, the refrigerator-compartment return air passage 58 may include a rear refrigerator-compartment return air passage 58e that is connected to the central refrigerator-compartment return air passage 58b and that extends downward along a rear surface 57f of the heater 61 to be continuous with the refrigerator-compartment return air passage outlet 58b. In such a structure, the amount of heat applied by the heater 61 to the refrigerator-compartment return air passage 58 is large compared with a configuration in which the refrigerator-compartment return air passage 58 does not include the rear refrigerator-compartment return air passage 58e, and the heat from the heater 61 can be applied to the refrigerator-compartment return air passage 58 efficiently.

[0060]

Embodiment 3.

Hereinafter, Embodiment 3 of the present disclosure will be described.

Description of duplication with Embodiments 1 and 2 is omitted, and the same signs are
5 given to parts that are the same as or correspond to those in Embodiments 1 and 2. In
a refrigerator 103 according to Embodiment 3 of the present disclosure, the highest-
stage shelf 15a corresponds to a multistory shelf 210.

[0061]

Fig. 16 is a schematic vertical sectional view illustrating a configuration of the
10 multistory shelf 210 included in the refrigerator 103 according to Embodiment 3 of the
present disclosure.

Fig. 17 is a schematic top view illustrating a configuration of the multistory shelf
210 included in the refrigerator 103 according to Embodiment 3 of the present
disclosure.

15 Fig. 18 is a schematic vertical sectional view illustrating a configuration of the
multistory shelf 210 included in the refrigerator 103 according to Embodiment 3 of the
present disclosure.

[0062]

Hereinafter, with reference to Fig. 16 to Fig. 18, a configuration of the multistory
20 shelf 210 according to Embodiment 3 will be described.

The refrigerator 103 according to Embodiment 3 is provided with, as the highest-
stage shelf 15a, the multistory shelf 210 at the bottom surface of the versatile
compartment 13. As illustrated in Fig. 16, the multistory shelf 210 is formed by a
plurality of plate-shaped shelves 220 that are made of, for example, glass, resin, or
25 other materials and that are stacked together with a gap in between. Air is enclosed
between the shelves 220 adjacent to each other, and this air works to prevent
convection current and other phenomenon even with variation in heat at the multistory
shelf 210 and maintain its stationary state. The multistory shelf 210 thus has high heat
insulation performance. Hereinafter, a portion in which the air is enclosed between the
30 shelves 220 adjacent to each other is referred to as a stationary air layer 230.

[0063]

As illustrated in Fig. 16 and Fig. 17, a resin frame 240 for assembling the multistory shelf 21 to the inside of the refrigerator 100 is attached to the outer periphery of the shelves 220. The multistory shelf 210 has a configuration in which, after the plurality of shelves 220 are stacked together with a gap in between, the outer periphery of the shelves 220 is sealed with a rubber or silicon material to ensure sealing performance so that air from the outside does not flow into the stationary air layer 230. Here, dehumidification of the air to be enclosed in the stationary air layer 230 may be performed, and the air whose water content is reduced may be enclosed in the stationary air layer 23. A structure in which the resin frame 240 is directly attached to the shelves 22 without the rubber or silicon material covering and sealing the outer periphery of the shelves 220 may be employed as long as the structure has sealability with which outside air does not flow into the stationary air layer 230.

[0064]

As illustrated in Fig. 18, the multistory shelf 200 according to Embodiment 3 is provided with ribs 260 that make a lattice shape in plan view and that are disposed in the stationary air layer 230 between the shelves 220. The vertical section of the rib 260 according to Embodiment 3 has an inverted U-shape to ensure stability but is not limited to the foregoing. A wire heater 250 (also referred to as the second heating device) is housed in the rib 260. Similarly to the heater 61, the wire heater 250 serves as a heating device that is for temperature regulation and that heats food inside the versatile compartment 13 and increases the temperature of the food. By thus housing the wire heater 250 in the rib 260, it is possible to increase heater-heat generation density inside the multistory shelf 210 and improve heat increasing capacity.

[0065]

The wire heater 250 has a diameter ϕ of approximately 2 to 3 mm. The thickness of the entirety of the rib 260 is desirably approximately 5 to 7 mm. In Fig. 18, only the ribs 260 in the stationary air layer 230 at the uppermost stage are each provided with the wire heater 25. However, the wire heater 250 may be not limited to be provided in only one stationary air layer 230.

[0066]

By thus being assembled to the multistory shelf 210, the wire heater 250 can, as assist capacity of the heater 61, supply heat to the food in the versatile compartment 13 during a temperature increase and can prevent dew condensation occurring at the shelves 220 inside the multistory shelf 210.

[0067]

In Embodiments 1 to 3, the controller 31 has been described to regulate the temperature in the versatile compartment 13 by controlling the first damper 40a, the heater 61, and the wire heater 250. The controller 31 is, however, not limited to the foregoing. For example, the controller 31 may regulate the temperature in the versatile compartment 13 by controlling only the wire heater 250 without controlling the first damper 40a.

[0068]

Air may be not enclosed in each gap between the shelves 220. For example, a spacer (not illustrated) that keeps a gap between the shelves 220 and maintains durability may be provided between each or part of the gaps between the shelves 220. Instead of air, another transparent gas may be enclosed between the shelves 220 adjacent to each other.

[0069]

An example in which the heating device inside the multistory shelf 210 that is the lower surface of the versatile compartment 13 is the wire heater 250 has been described. The heating device is, however, not limited to the foregoing. For example, a heat exchanger, a Peltier element, or another heating device may be used as the heating device, as long as the heating device is located inside the rib 260.

[0070]

Note that Embodiments may be combined together, modified, and omitted, as appropriate, and such combinations, modifications, and omissions are also included in the scope of the technical idea described in Embodiments.

Industrial Applicability

[0071]

In the refrigerator according to the present disclosure, a cool-air return passage connecting a storage compartment to be set to a refrigerating temperature zone and a cooler chamber to each other and a cool-air return air passage connecting a storage compartment settable to a minus temperature zone and the cooler chamber to each other are partitioned from each other by a heat insulator and are independent from each other. Therefore, it is possible to provide a refrigerator that prevents frost formation and clogging caused by frost formation in the cool-air return passage connecting the storage compartment to be set to the refrigerating temperature zone and the cooler chamber to each other and in the cool-air return passage connecting the storage compartment settable to a minus temperature zone and the cooler chamber to each other, and that performs stable temperature control.

CLAIMS

[Claim 1]

A refrigerator comprising:

a box body having an opening port in a front surface of the box body and
5 including a first storage compartment to be set to a refrigerating temperature zone and a
second storage compartment located higher than the first storage compartment, the
second storage compartment being to be set to a freezing temperature zone;

a door attached to the front surface of the box body, the door opening or closing
the opening port;

10 a partition dividing the first storage compartment and the second storage
compartment from each other vertically;

a third storage compartment provided lower than the partition and provided in an
uppermost portion inside the first storage compartment, the third storage compartment
being settable to a minus temperature zone;

15 a first return air passage provided in the partition and through which return cool
air in the first storage compartment is returned to a cooler chamber; and

a second return air passage provided in the partition and through which return
cool air in the third storage compartment is returned to the cooler chamber,

the first return air passage and the second return air passage being air passages
20 independent from each other,

the first return air passage and the second return air passage being partitioned
from each other by a heat insulator.

[Claim 2]

The refrigerator of claim 1, wherein the third storage compartment is switchable
25 to at least a temperature zone of 0 to 3 degrees C, a temperature zone of -3 degrees C
to 0 degrees C, or a temperature zone of -10 to -5 degrees C.

[Claim 3]

The refrigerator of claim 1 or claim 2,

wherein the first storage compartment has a space in front of the third storage
30 compartment, and

wherein a bottom surface portion of the partition has
a first return air passage inlet through which cool air inside the first storage
compartment is guided to the first return air passage, the first return air passage inlet
being formed in a first portion facing the space between the door and the third storage
5 compartment, and

a second return air passage inlet through which cool air inside the third storage
compartment is guided to the second return air passage, the second return air passage
inlet being formed in a second portion facing the third storage compartment.

[Claim 4]

10 The refrigerator of any one of claims 1 to 3,
wherein the third storage compartment includes a storage container and a front
door at a front surface of the third storage compartment, the front door being openable
and closable, and

wherein the front door is attached, in front of the storage container, to a bottom
15 surface portion of the partition such that the front door is turnable.

[Claim 5]

The refrigerator of claim 4,
wherein the first storage compartment includes a plurality of shelves, and
wherein the third storage compartment is defined by a highest-stage shelf among
20 the plurality of shelves, the front door, a side wall of the box body, and the partition.

[Claim 6]

The refrigerator of any one of claims 1 to 5, wherein an inside of the partition is
filled with urethane foam.

[Claim 7]

25 The refrigerator of any one of claims 1 to 6,
wherein the partition includes a heater,
wherein the heater has a cuboidal shape,
wherein an area of an upper surface of the heater is larger than each of an area
of a left side surface of the heater and an area of a right side surface of the heater,

wherein, inside the partition, the second return air passage is disposed left or right of the heater and extends along a corresponding one of the left side surface and the right side surface of the heater,

wherein, inside the partition, the first return air passage is disposed higher than the heater to cover the upper surface of the heater, and

wherein a region in which the upper surface and the first return air passage overlap each other in a top view of the partition is larger than a region in which either one of the left side surface and the right side surface and the second return air passage overlap each other in a side view of the partition.

[Claim 8]

The refrigerator of claim 7,

wherein the partition includes a third return air passage through which return cool air in the third storage compartment is returned to the cooler chamber, and

wherein the first return air passage, the second return air passage, and the third return air passage are air passages independent from one another, and the first return air passage, the second return air passage, and the third return air passage are partitioned from one another by a heat insulator.