

DESCRIPTION

Title of Invention

REFRIGERATOR

5 Technical Field

[0001]

The present disclosure relates to a door of a refrigerator.

Background Art

[0002]

10 Refrigerator doors for opening and closing compartments of refrigerators include front plates that are typically made of glass face plates or steel plates. In general, as the front plate of a refrigerator door, a glass face plate is thicker than a steel plate. When the front plate to be attached to a frame component of the refrigerator door is made of a steel plate, the frame component is provided with a

15 groove for holding an end face of the steel plate. When the front plate is made of a glass face plate, the frame component is provided with a receiving surface that supports the glass face plate in the height direction, and a bonding surface that extends along the back face of the glass face plate and to which the glass face plate is fixed.

20 [0003]

A known refrigerator door includes a door body including a frame component having a groove, and a thin plate such as a steel plate having an inwardly folded edge projection at its periphery. The edge projection is fitted in the groove. When the door body is provided with a decorative plate, the decorative plate is placed over

25 the front face of the door body, and a batten (cover) is fitted over the decorative plate and is screwed and fixed to the frame component (see Patent Literature 1, for example).

Citation List

Patent Literature

[0004]

Patent Literature 1: Japanese Unexamined Patent Application Publication No.
62-98181

Summary of Invention

5 Technical Problem

[0005]

10 To obtain the above refrigerator, a cover is necessary for fixing the decorative plate to the front face of the door, and a process of screwing the cover to the door frame is therefore necessary. Moreover, the above configuration is not applicable to a case where the front plate to be attached to the frame component is a plate such as a glass plate that is thicker than a steel plate and has no inwardly folded edge projection at its periphery.

[0006]

15 The present disclosure is to solve the above problems and provides a door of a refrigerator that includes a single frame component configured to receive both a glass face plate and a steel plate, either of which serves as a front plate to be fixed to the frame component, while the increase in the number of components is limited.

Solution to Problem

[0007]

20 To solve the above problems, a refrigerator according to an embodiment of the present disclosure includes a refrigerator body having a compartment inside, and a refrigerator door with which the compartment of the refrigerator body is opened and closed. The refrigerator door includes a door frame, a rear plate, and a front plate. The door frame includes an upper cap, a lower cap, a right cap, and a left cap. The
25 lower cap includes a cap body that is plate-shaped and forms a lower face of the refrigerator door, a front rib that is provided on an upper face of the cap body and extends upward, and a recess that is provided between the front rib and the cap body and where the front plate is nipped. A front face of the front rib serves as a bonding surface to which the front plate is bonded. The front rib is offset rearward from a

front end of the cap body by a length over which the cap body is able to support a glass plate. A portion of the upper face of the cap body that is located further forward than the front rib serves as a supporting surface. When the front plate is made of a steel plate material, the front plate includes an end portion that is located at a lower portion of the front plate and is folded rearward, the end portion being inserted in the recess. When the front plate is made of glass, a lower end face of the front plate is joined to the supporting surface and a rear face of the front plate is joined to the bonding surface.

Advantageous Effects of Invention

[0008]

According to an embodiment of the present disclosure, while the increase in the number of components is limited, the door frame, which is provided as a single frame component, is configured to receive a front plate made of a glass face plate and a front plate made of a steel plate material, either of which is to be fixed to the door frame.

Brief Description of Drawings

[0009]

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

[Fig. 2] Fig. 2 is a sectional view of the refrigerator according to Embodiment 1 of the present disclosure.

[Fig. 3] Fig. 3 illustrates a configuration of a refrigerator-compartment left door and a refrigerator-compartment right door according to Embodiment 1 of the present disclosure.

[Fig. 4] Fig. 4 is a perspective view of a left cap and a lower cap included in the refrigerator-compartment right door according to Embodiment 1 of the present disclosure.

[Fig. 5] Fig. 5 is a sectional view of a front plate and the lower cap included in the refrigerator-compartment right door according to Embodiment 1 of the present disclosure in a case where the front plate is made of a steel plate material.

[Fig. 6] Fig. 6 is a sectional view of the front plate and the lower cap included in the refrigerator-compartment right door according to Embodiment 1 of the present disclosure in a case where the front plate is made of glass.

[Fig. 7] Fig. 7 is a sectional view of the front plate and a right cap included in the refrigerator-compartment right door according to Embodiment 1 of the present disclosure in the case where the front plate is made of a steel plate material.

[Fig. 8] Fig. 8 is a sectional view of the front plate and the right cap included in the refrigerator-compartment right door according to Embodiment 1 of the present disclosure in the case where the front plate is made of glass.

[Fig. 9] Fig. 9 is a sectional view of the right cap included in the refrigerator-compartment right door according to Embodiment 1 of the present disclosure.

[Fig. 10] Fig. 10 is a sectional view of a lower cap included in a refrigerator-compartment right door according to Embodiment 2 of the present disclosure.

[Fig. 11] Fig. 11 is a sectional view of a lower cap included in the refrigerator-compartment right door according to Embodiment 2 of the present disclosure.

[Fig. 12] Fig. 12 is a sectional view of a lower cap included in a refrigerator-compartment right door according to Embodiment 3 of the present disclosure.

Description of Embodiments

[0010]

A refrigerator according to embodiments of the present specification will be described below with reference to the drawings. The present specification is not limited to the following embodiments, and any modifications or omissions may be made to the present specification without departing from the essence of the present specification. The configurations illustrated in the drawings may be simplified from the actual ones. The sizes of elements illustrated in the drawings and the positional relationships between the elements may be different from the actual ones. The

same reference signs denote the same respective elements, which applies throughout this specification. For easy understanding, terms indicating directions (such as, for example, "top", "upper side", "bottom", "lower side", "left", "left side", "right", "right side", "front", "front side", "near side", "rear", "rear side", "far side", "depth", "inner side", and "outer side") are used accordingly in the following description. Such terms are only explanatory and do not limit the present disclosure. In this specification, such terms are used in expressing the relative positions of relevant elements that are included in the refrigerator and in refrigerator doors of the refrigerator in a front view of the refrigerator and the refrigerator door.

In this specification, the term "right angle" refers to an angular range of 90 ± 5 degrees.

[0011]

Embodiment 1

A configuration of a refrigerator 1 according to Embodiment 1 will be described below.

[0012]

Fig. 1 is a front view of the refrigerator 1 according to Embodiment 1 of the present disclosure.

Fig. 2 is a sectional view of the refrigerator 1 according to Embodiment 1 of the present disclosure.

[0013]

As illustrated in Fig. 1 and 2, the refrigerator 1 includes a box structure 2, which serves as a refrigerator body. The box structure 2 has an open front face and has, in its inside, a storage space 3. The box structure 2 includes a steel outer box 4, a resin inner box 5, and a heat insulator 6. The heat insulator 6 is provided between the outer box 4 and the inner box 5. The storage space 3 is divided by a plurality of heat-insulating partitions 7 into a plurality of compartments: a refrigerator compartment 8, a versatile compartment 9, an ice-making compartment 10, a freezer compartment 11, and a vegetable compartment 12.

[0014]

Below the refrigerator compartment 8, the versatile compartment 9 and the ice-making compartment 10 are positioned. The range of refrigeration temperature of the versatile compartment 9 is changeable. The ice-making compartment 10 is laterally adjacent to the versatile compartment 9. Below the versatile compartment 9 and the ice-making compartment 10, the freezer compartment 11 is positioned. Below the freezer compartment 11, the vegetable compartment 12 is positioned.

The open front face of the refrigerator compartment 8 is opened and closed with a refrigerator-compartment left door 13 and a refrigerator-compartment right door 14, each of which serves as a refrigerator door.

The refrigerator-compartment left door 13 and the refrigerator-compartment right door 14 are attached to the refrigerator body with hinges, which are not illustrated. The refrigerator-compartment left door 13 and the refrigerator-compartment right door 14 are of a rotational type and are rotatable independently of each other. The open front faces of the versatile compartment 9, the ice-making compartment 10, the freezer compartment 11, and the vegetable compartment 12 are opened and closed with a versatile-compartment door 15, an ice-making-compartment door 16, a freezer-compartment door 17, and a vegetable-compartment door 18, respectively, all of which are of a drawer type.

[0015]

While Embodiment 1 relates to a case where the open front face of the refrigerator compartment 8 is opened and closed with the refrigerator-compartment left door 13 and the refrigerator-compartment right door 14, the present disclosure is not limited to such a case. The open front face may be opened and closed with a single refrigerator door. The positions of the versatile compartment 9 and the ice-making compartment 10 illustrated in Fig. 1 may be changed with each other.

In Fig. 1, the refrigerator compartment 8 is positioned at the top, the ice-making compartment 9 and the versatile compartment 10 are laterally adjacent to each other below the refrigerator compartment 8, the freezer compartment 11 is

positioned below the ice-making compartment 9 and the versatile compartment 10, and the vegetable compartment 12 is positioned at the bottom. Such an arrangement in the storage space 3 of the refrigerator 1 is not essential.

[0016]

5 The freezer compartment 11 includes a cooler 19. Air cooled by the cooler 19 is sent to the refrigerator compartment 8, the versatile compartment 9, the ice-making compartment 10, the freezer compartment 11, and the vegetable compartment 12.

[0017]

10 The refrigerator 1 includes an operation panel 20, which is provided on the front face of the refrigerator-compartment left door 13 or the refrigerator-compartment right door 14. The operation panel 20 is a user interface on which the user makes settings of the refrigerator 1 in accordance with the operation to be performed. The temperature settings for the refrigerator compartment 8, the versatile compartment 9, the freezer compartment 11, and the vegetable compartment 12 are adjustable on
15 the operation panel 20.

[0018]

 The refrigerator 1 includes a door-locking device (not illustrated) each located at, in front view, a lower left part of the refrigerator-compartment left door 13 and a lower right part of the refrigerator-compartment right door 14.

20 [0019]

 Fig. 2 illustrates a section in a depth direction of the refrigerator 1 that is taken vertically at the refrigerator-compartment right door.

 A vacuum insulator for reducing the amount of heat transmitted to the storage space 3 from the outside of the refrigerator 1 is provided between the outer box 4 and the inner box 5. A vacuum insulator 23 for the refrigerator-compartment left door, a vacuum insulator 24 for the refrigerator-compartment right door, a vacuum insulator 25 for the freezer-compartment door, and a vacuum insulator 26 for the vegetable-compartment door are provided inside the refrigerator-compartment left door 13, the refrigerator-compartment right door 14, the freezer-compartment door
25

17, and the vegetable-compartment door 18, respectively. The vacuum insulators employed as above each have a thermal conductivity λ of, for example, 0.002 W/m·K.

The space between the vacuum insulator 23 for the refrigerator-compartment left door and the outer frame of the refrigerator-compartment left door 13 and the space between the vacuum insulator 24 for the refrigerator-compartment right door and the outer frame of the refrigerator-compartment right door 21 are filled with urethane foam 27. The urethane foam 27 has a thermal conductivity λ of, for example, 0.02 W/m·K.

[0020]

A compressor 30 is provided at the rear bottom of the refrigerator 1. Refrigerant is compressed by the compressor 30 and is then condensed by a condenser (not illustrated). The condensed refrigerant is decompressed by a capillary tube (not illustrated) serving as a decompressor. The decompressed refrigerant evaporates in the cooler 31. While evaporating, the refrigerant receives heat from the vicinity around the cooler 31 and thus cools the vicinity. The compressor 30, the condenser, the capillary tube as a decompressor, and the cooler 31 form a refrigeration cycle.

[0021]

A cooling-air-sending duct 32 is provided at the back of the refrigerator compartment 8. The cooling-air-sending duct 32 is made of, for example, foamed polystyrene and introduces the cooling air into the refrigerator compartment 8. A control circuit board (not illustrated), which is made of synthetic resin, is provided further forward than the cooling-air-sending duct 32 and covers the cooling-air-sending duct 32. The control circuit board 18 is covered with a steel plate and a heat insulator and is attached to the outer box 4 with the steel plate being screwed and fixed to the back face of the outer box 4 of the refrigerator 1. The control circuit board is supplied with commercial power.

[0022]

The control circuit board controls a damper (not illustrated) provided to the cooling-air-sending duct 32, the compressor 30, and a fan. The control circuit board detects the temperatures of the refrigerator compartment 8, the versatile compartment 9, the ice-making compartment 10, the freezer compartment 11, and the vegetable compartment 12 through temperature detectors (not illustrated) such as thermistors, and controls the cooling capacity of the refrigeration cycle, whether to start or stop the cooling operation, whether to open or close the damper, and the state of operation of the fan such that the storage space 3 has a target temperature. [0023]

Fig. 3 is a perspective view of the refrigerator-compartment left door 13 and the refrigerator-compartment right door 14, with relevant elements included in these doors being separated from one another. The refrigerator-compartment left door 13 is provided with the operation panel 20.

[0024]

As illustrated in Fig. 3, the refrigerator-compartment right door 14 includes a front plate 33, double-sided adhesive tape 34, a door frame 35, the vacuum insulator 24, and a rear plate 36. The front plate 33 serves as a design panel. The door frame 35 serves as a frame component provided for the refrigerator right door 14. The front plate 33 is made of glass. With the vacuum insulator 24 being fitted in the door frame 35, the rear plate 36 is attached to the rear of the door frame 35. The front plate 33 is attached to the front of the door frame 35 with the double-sided adhesive tape 34. Lastly, urethane foam (not illustrated) is injected into the gaps between the vacuum insulator 24, the door frame 35, the front plate 33, and the rear plate 36. Thus, the refrigerator-compartment right door 14 is obtained. As with the refrigerator-compartment right door 14, the refrigerator-compartment left door 13 includes a front plate 133, double-sided adhesive tape 134, a door frame 135, which serves as a frame component for the refrigerator-compartment right door, the vacuum insulator 23 for the refrigerator-compartment left door, and a rear plate 136.

The double-sided adhesive tape 34 may be replaced with hot-melt adhesive (not illustrated).

[0025]

Fig. 3 illustrates a configuration in a case where the front plate 33 is made of glass. When the front plate 33 is made of a steel plate material, the double-sided adhesive tape 34 or hot-melt adhesive may be omitted from the configuration illustrated in Fig. 3. In such a configuration, the front plate 33 includes left, right, upper, and lower peripheral portions 37. The peripheral portions 37 includes an end portion 38a, an end portion 38b, an end portion 38c, and an end portion 38d, which are all folded rearward. The end portion 38b and the end portion 38d are illustrated in Figs. 5 and 7. The end portions 38 are provided for attaching and fixing the front plate 33 to the door frame 35. The configuration of the door frame 35 even in such a case is the same as in the case where the front plate 33 is made of glass, that is, the same as that illustrated in Fig. 3.

[0026]

In Fig. 3, the door frame 35 of the refrigerator-compartment right door 14 includes a left cap 39a, a right cap 39b, an upper cap 39c, and a lower cap 39d. The left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d are assembled and fixed together, and the door frame 35 is thus obtained. The left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d form the respective sides of the door frame.

Likewise, the door frame 135 of the refrigerator-compartment left door 13 includes a left cap 139a, a right cap 139b, an upper cap 139c, and a lower cap 139d. The left cap 139a, the right cap 139b, the upper cap 139c, and the lower cap 139d are assembled and fixed together, and the door frame 135 is thus obtained. The left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d form the respective sides of the door frame.

The left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d are each made of plastic. The material for the left cap 39a, the right cap 39b, the

upper cap 39c, and the lower cap 39d is not limited to plastic and may be metal, which also applies to the refrigerator-compartment left door 13.

[0027]

In this specification, the configuration of the refrigerator-compartment right door 14 will be described. Description of the refrigerator-compartment left door 13 is omitted because the refrigerator-compartment left door 13 that is set in the refrigerator 1 is configured bilaterally symmetrically to the refrigerator-compartment right door 14, except for a difference in lateral length.

[0028]

Fig. 4 is an enlarged perspective view of area D of Fig. 3, where the left cap 39a and the lower cap 39d of the door frame 35 are located. In Fig. 4, the left cap 39a and the lower cap 39d of the door frame 35 are disconnected from each other.

[0029]

In Fig. 4, the left cap 39a includes a left-cap body 40a, a front rib 41a, a lower rib 42a, and a rear rib 43a. With the left cap 39a being set as a part of the door frame 35, the left-cap body 40a forms the left face of the door frame 35, the front rib 41a extends in the top-to-bottom direction, the lower rib 42a extends in the front-to-rear direction, and the rear rib 43a extends in the top-to-bottom direction. The front rib 41a, the lower rib 42a, and the rear rib 43a are provided on a right face 44a, or the inner face, of the left-cap body 40a. The front rib 41a, the lower rib 42a, and the rear rib 43a are each continuous with the left-cap body 40a and, in the orientation as a part of the door frame 35, extend rightward, thereby having a shape projecting rightward. The front rib 41a is located further forward than the rear rib 43a. The lower rib 42a is located at the lower end of the left-cap body 40a. The left cap 39a further includes, at its upper end of the left-cap body 40a, an upper rib, which is not illustrated. The upper rib extends in the front-to-rear direction and rightward, thereby having a shape projecting rightward. The upper rib is provided on the right face of the left-cap body 40a.

[0030]

As illustrated in Fig. 4, the left cap 39a further includes a receiving rib 46a. The receiving rib 46a is provided on the right face of the left-cap body 40a and above the lower rib 42a and extends parallel to the lower rib 42a. The receiving rib 46a has receiving holes 47a, which are provided for locking.

5 [0031]

In Fig. 4, the lower cap 39d includes a lower-cap body 40d, a front rib 41d, a left rib 48a, and a rear rib 43d. The lower-cap body 40d forms the lower face of the door frame 35. The front rib 41d extends in the lateral direction. The left rib 48a extends in the front-to-rear direction. The rear rib 43d extends in the lateral
10 direction. The front rib 41d, the left rib 48a, and the rear rib 43d are provided on the upper face, or the inner face, of the lower-cap body 40d. The front rib 41d, the left rib 48a, and the rear rib 43d are each continuous with the lower-cap body 40d and, in the orientation as a part of the door frame 35, extend upward, thereby having a shape projecting upward. The front rib 41d is located further forward than the rear
15 rib 43d. The left rib 48d is located at the left end of the lower-cap body 40d. The lower cap 39d further includes, at the upper end of the lower-cap body 40d, a right rib 48b, which is not illustrated. The right rib 48b extends in the front-to-rear direction and upward, thereby having a shape projecting upward. The right rib 48b is provided on the upper face of the lower-cap body.

20 The lower-cap body 40d of the lower cap 39d further includes a grip 49, which is located between the front rib 41d and the rear rib 43d and projects upward.

[0032]

The left rib 48a of the lower cap 39d has catches 51a, which each extend rightward.

25 The lower cap 39d further includes a first locking rib 50a, which is located on the right of the left rib 48a and on the upper face of the lower-cap body 40d and extends parallel to the left rib 48a. The first locking rib 50a includes catch retainers 52a, which are provided for locking and extends leftward.

The lower cap 29a includes a second locking rib 50b, which is not illustrated. With the lower cap 29a being set as a part of the door frame 35, the second locking rib 50b is located on the upper face of the lower-cap body 40d and symmetrically to the first locking rib 50a around a plane passing through the lateral center of the door frame 35. As with the left rib 48a and the first locking rib 50a, the right rib 48b and the second locking rib 50b have catches 51b and catch retainers 52b. The catches 51b and the catch retainers 52b are arranged bilaterally symmetrically to the catches 51a and the catch retainers 52a.

[0033]

The lower cap 39d is assembled with and fixed to the left cap 39a as follows.

The catches 51a of the lower cap 39d are positioned obliquely below the receiving holes 47a provided in the receiving rib 46a of the left cap 39a, and the catches 51a are inserted into the receiving holes 47a.

When the catches 51a are inserted into the receiving holes 47a of the receiving rib 46a, the receiving rib 46a is locked by the catches 51a and the catch retainers 52a. Therefore, the left cap 39a is fixed to the lower cap 39d.

[0034]

When being set as a part of the door frame 35, the right cap 39b is configured bilaterally symmetrically to the left cap 39a around the plane passing through the lateral center of the door frame 35.

When being set as a part of the door frame 35, the upper cap 39c is configured symmetrically to the left cap 39a in the top-to-bottom direction around a plane (horizontal plane) passing through the top-to-bottom center of the door frame 35.

[0035]

The above method of assembling and fixing the lower cap 39d to the left cap 39a also applies to a case of fixing the lower cap 39d to the right cap 39b, a case of fixing the upper cap 39c to the left cap 39a, and a case of fixing the upper cap 39c to the right cap 39b. By fixing the lower cap 39d to the left cap 39a, the lower cap 39d

to the right cap 39b, the upper cap 39c to the left cap 39a, and the upper cap to the right cap 39b, the door frame 35 is obtained.

[0036]

The left cap 39a and the right cap 39b each have, on its inner side, a metal reinforcement (not illustrated). Thus, the left cap 39a and the right cap 39b are reinforced. Therefore, when urethane foam is injected into the refrigerator-compartment right door 14, the door frame 35 is less likely to deform while being pushed by the urethane foam from its inside.

[0037]

The refrigerator-compartment right door 14 is obtained by attaching the front plate 33 and the rear plate 36 to the door frame 35, placing the vacuum insulator 24 for the refrigerator-compartment right door inside the assembly, and injecting urethane foam into the assembly.

A configuration of the door frame 35 where the front plate 33 is held will be described below.

[0038]

Fig. 5 illustrates a perpendicular section in a depth direction of a front plate 33a and the lower cap 39d included in the refrigerator-compartment right door 14. The front plate 33a is a front plate 33 that is made of a steel plate material.

Fig. 6 illustrates a perpendicular section in a depth direction of a front plate 33b and the lower cap 39d included in the refrigerator-compartment right door 14. The front plate 33b is a front plate 33 that is made of glass.

The configuration of the lower cap 39d is common to the cases illustrated in Fig. 5 and 6.

[0039]

The configuration of the lower cap 39a will be described below with reference to Fig. 5.

[0040]

Fig. 5 illustrates a perpendicular section in a depth direction of the front plate 33a and the lower cap 39d that is taken along line A-A' illustrated in Fig. 4. The lower cap 39d includes the lower-cap body 40d, which has a plate shape. When being set as a part of the door frame 35, the lower-cap body 40d forms the lower face of the door frame 35. The lower cap 39d includes the front rib 41d on the upper face of the lower-cap body 40d. The front rib 41d is continuous with the lower-cap body 40d and extends upward. The lower cap 39d includes the grip 49. The grip 49 is located between the lower-cap body 40d and the front rib 41d and projects upward.

[0041]

The configuration of the upper cap 39c in the perpendicular section in a depth direction illustrated in Fig. 3 is symmetrical in the top-to-bottom direction to the configuration of the lower cap 39d illustrated in Fig. 5. However, the upper cap 39c includes no element equivalent to the grip 49 illustrated in Fig. 5.

[0042]

The front rib 41d is located further rearward than a front end 53 of the lower-cap body 40d. The front rib 41d includes a holding portion 71d and a bonding portion 70d, which are located further inside than (upward of) the frame. The holding portion 71d is continuous with the lower-cap body 40d and extends forward in a direction away from and parallel to the lower cap. The bonding portion 70d is continuous with the holding portion 71d and extends upward. The combination of the holding portion 36 and the bonding portion 37 serves as the front rib 38. A portion of the lower-cap body 40d that is located further forward than the front rib 41d serves as a supporting portion 54. In the case where the front plate 33 is made of glass, the supporting portion 54 supports the front plate 33. The front rib 41d is offset rearward from the front end 53 of the lower-cap body 40d by a length over which the supporting portion 54 located further forward than the front rib 41d is able to support the front plate 33a as a front plate 33 made of glass.

The front face of the front rib 41d serves as a bonding surface 60. The front plate 33b as a front plate 33 made of glass is to be bonded to and thus supported by the bonding surface 60.

The upper face of the supporting portion 54 serves as a supporting surface 55d. The front plate 33b as a front plate 33 made of glass is to be supported by the supporting surface 55d.

[0043]

In Fig. 5, the front plate 33a as a front plate 33 made of a steel plate material is attached to the lower cap 39d. The front plate 33a illustrated in Fig. 5 includes, at its lower portion, the end portion 38d that is folded rearward. A recess 57d has an inner width that is substantially the same as the thickness of the front-face portion 38d.

The end portion 38d is press-fitted into the recess 57d, and the front plate 33a is thus attached to the lower cap 39d. Specifically, while the lower face of the end portion 38d is kept in contact with the supporting surface 55d, the front plate 33a is moved rearward such that the end portion 38d is inserted into the recess 57d. The end portion 38d is nipped between the lower-cap body 40d and the front rib 41d, and the front plate 33a is thus fixed to the lower cap 39d. The recess 57d has a depth that allows the tip of the end portion 38d inserted into its inside to be in contact with and fixed at the bottom of the recess 57d.

[0044]

In Fig. 6, the front plate 33b as a front plate 33 made of glass is attached to the lower cap 39d. In the refrigerator-compartment right door 14 illustrated in Fig. 6, a lower end face of the front plate 33b is in contact with and thus supported by the supporting surface 55d, and the rear face of the front plate 33b and the bonding surface 60d are joined to each other with the double-sided adhesive tape 34 or hot-melt adhesive.

The bonding surface 60d and the supporting surface 55d are at a right angle to each other. Such a configuration improves adhesiveness between the lower end

face of the front plate 33b and the supporting surface 55d to each other and adhesiveness between the rear face of the front plate 33b and the bonding surface 60d to each other when the front plate 33b is attached to the lower cap 39d.

The front plate 33b is bonded to the lower cap 39d with the double-sided adhesive tape 34 or hot-melt adhesive. In Fig. 6, the double-sided adhesive tape 34 or hot-melt adhesive is not illustrated. The double-sided adhesive tape 34 or hot-melt adhesive has a satisfactory bonding strength against an external force that is applied to the refrigerator with the front plate 33b being attached and fixed to the bonding surface 60d. While Fig. 6 illustrates a configuration in which the lower end face of the front plate 33b and the supporting surface 55d are directly in contact with each other, such a configuration is not essential. A shock-absorbing material or a sealing material may be interposed between the lower end face of the front plate 33b and the supporting surface 55d.

[0045]

As illustrated in Fig. 5, when the front plate 33a made of a steel plate material is attached to the lower cap 39d, a space is left between the front plate 33a and the bonding surface 60d of the front rib 41d. The space is filled with urethane foam. Furthermore, the space between the front rib 41d and the grip 49 is filled with urethane foam.

To obtain the refrigerator-compartment right door 14, the rear plate 36 is attached to the door frame 35, the door frame 35 is oriented with the rear plate 36 facing down so that the open aperture of the door frame 35 faces upward, and urethane foam is injected into the door frame 35. Subsequently, the end portion 38d of the front plate 33a is press-fitted from above the door frame 35 into the recess 57d of the lower cap 39d, and the front plate 33a is thus attached to the door frame 35. In such a process, the urethane foam in a central area of the door frame 35 is pressed by the front plate 33a and is pushed into the space between the front plate 33a and the front rib 41d and the space between the front rib 41d and the grip 49. The urethane foam thus pushed into the space between the front plate 33a and the

front rib 41d and the space between the front rib 41d and the grip 49 pushes the end portion 38d of the front plate 33a toward the supporting portion 54. Furthermore, the urethane foam pushed into the space between the front rib 41d and the grip 49 pushes the front rib 41d in a direction that reduces the width of the recess 57d.

Therefore, compared with a case where urethane foam is not injected, the capability of the lower cap 39d of fixing the front plate 33a is improved, and the probability that the front plate 33a may come off the door frame 35 when the urethane is foamed is thus reduced.

[0046]

Fig. 7 illustrates a horizontal section of a front plate 33 that is made of a steel plate material and the right cap 39b.

Fig. 8 illustrates a horizontal section of a front plate 33 that is made of glass and the right cap 39b.

The configuration of the right cap 39b is common to the cases illustrated in Fig. 7 and Fig. 8.

[0047]

Fig. 7 illustrates a perpendicular section in a depth direction of the front plate 33 and the lower cap 39d that is taken along line B-B' illustrated in Fig. 3. As illustrated in Fig. 7, the right cap 39b includes a right-cap body 40b, a corner portion 56b, and a front rib 41b. The right-cap body 40b forms the right face of the door frame 35. The corner portion 56b is continuous with the right-cap body 40b and is located at the front of the right-cap body 40b. The front rib 41b extends leftward from the left face of the corner portion 56b. The front face of the corner portion 56b forms the front face of the right cap 39b. The right face of the corner portion 56b coincides with the right face of the right-cap body 40b. The lateral thickness of the corner portion 56b is greater than the lateral thickness of the right-cap body 40b. The corner portion 56b is chamfered at its front right end.

[0048]

As with the configuration illustrated in Fig. 5, the front rib 41b includes a holding portion 71b and a bonding portion 70b, which are located further inside than (on the left of) the frame. The holding portion 71b is continuous with the corner portion 56b and extends forward in a direction away from and parallel to the corner portion 56b. The bonding portion 70b is continuous with the holding portion 71b and extends inward (leftward).

[0049]

In the right cap 39b, a recess 57b is provided between the corner portion 56b and the front rib 41b. The recess 57b is a groove for fixing the front plate 33a made of a steel plate material to the right cap 39b and is recessed rearward. The front face of the front rib 41b serves as a bonding surface 60b. The bonding surface 60b is located further rearward than the front face of the corner portion 56b. A part of the corner portion 56b that is located further forward than the front rib 41b serves as a supporting portion 58b. The supporting portion 58b is configured to, as a protecting portion, protect the front plate 33 from an external impact. The upper face of the supporting portion 58b serves as a supporting surface 55b. The front plate 33b as a front plate 33 made of glass is supported by the supporting surface 55b.

The bonding surface 60b and the supporting surface 55b are at a right angle to each other. Such a configuration improves adhesiveness between the lower end face of the front plate 33b and the supporting surface 55b to each other and adhesiveness between the rear face of the front plate 33b and the bonding surface 60b to each other when the front plate 33b is attached to the right cap 39d.

As illustrated in Fig. 8, the distance in a depth direction between the front face of the corner portion 56b and the bonding surface 60b is set such that the protecting portion covers the right end face of the glass front plate 33 joined and attached to the bonding surface 60b of the right cap 39b and thus protects the front plate 33 from a lateral impact.

[0050]

The front plate 33 illustrated in Fig. 7 includes, on its right side, the end portion 38b that is folded rearward. The end portion 38b is press-fitted into the recess 57b, and the front plate 33 is thus attached to the right cap 39b. The end portion 38b is nipped between the corner portion 56a and the front rib 41b, and the front plate 33 is thus fixed to the right cap 39b. The recess 57b has a depth that allows the tip of the end portion 38b inserted into its inside to be in contact with and fixed at the bottom of the recess 57b.

[0051]

When the front face of the corner portion 56 is located further rearward than the front face of the front plate 33, the ease of cleaning and the quality of design are improved.

When the front plate 33 is made of glass, the front face of the corner portion 56a may be located further forward than the front face of the front plate 33. In this case, the front plate 33 is protected by the corner portion 56a from a lateral impact.

[0052]

When being set as a part of the door frame 35, the left cap 39c is configured symmetrically to the right cap 39b around a plane passing through the lateral center of the door frame 35. The left cap 39c includes a corner portion 56b. Embodiment 1 is not limited to such a configuration. As long as the front plate 33 is protected by the corner portion 56b from a lateral impact, the front face of the corner portion 56a of the right cap 39b and the front face of the corner portion 56b of the left cap may be located at different positions in the front-to-rear direction.

[0053]

In Embodiment 1, the left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d have the recess 57a, the recess 57b, the recess 57c, and the recess 57d, respectively. The number of recesses to be provided in the door frame 35 for nipping the front plate 33 is not limited to the above. Such a recess only needs to be designed such that the front plate 33a made of a steel plate material is held by and fixed to the door frame 35 without being displaced by an external force

that is applied when the front plate 33a is pushed by the urethane foam or while the refrigerator 1 is in use. Unless such a function is deteriorated, the recess may be provided in at least one of the left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d.

5 [0054]

While Embodiment 1 relates to a case where the recess 57a, the recess 57b, the recess 57c, and the recess 57d are all recessed rearward, such an orientation is not essential.

10 In the case of the right cap 39b, as illustrated in Fig. 9, the recess 57b of the corner portion 56b may be provided further forward than the bonding surface 60b and be recessed rightward. In the case of the left cap 39, the recess 57a of the corner portion 56a may be recessed leftward. Note that the recess 57c of the upper cap 39c and the recess 57d of the lower cap 39d are recessed rearward as illustrated in Fig. 5.

15 In such a configuration, the door frame 35 is obtained as follows. The end portion 38c and the end portion 38d of the front plate 33a that are folded rearward are respectively inserted in the direction in a depth direction into the recess 57c of the upper cap 39c and the recess 57d of the lower cap 39d, and the front plate 33a is thus fixed to the upper cap 39c and the lower cap 39d. Subsequently, the recess
20 57a of the left cap 39a and the recess 57b of the right cap 39b are respectively fitted onto the left end portion and the right end portion of the front plate 33a from the left and right. The recess 57a and the recess 57b each have an inner width that is substantially the same as the thickness of the front plate 33a. Employing the door frame 35 configured as above enables a single door frame 35 to receive both the
25 front plate 33a made of a steel plate material and the front plate 33b made of glass, either of which is to be fixed to the door frame 35.

[0055]

<Method of Fixing Design Panel>

A method of fixing the front plate 33 to the door frame 35 will be described below.

The case where the front plate 33 is made of a steel plate material will first be described.

5 [0056]

The left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d are assembled into the door frame 35. The front plate 33a is pushed into the front face of the door frame 35. The left cap 39a and the right cap 39b respectively have the recess 57a and the recess 57b configured as illustrated in Fig. 7. The upper cap 39c and the lower cap 39d respectively have the recess 57c and the recess 57d configured as illustrated in Fig. 5.

10 [0057]

The end portion 38d of the front plate 33a that is folded rearward is inserted into the recess 57d of the lower cap 39d until the end portion 38d is in contact with the bottom of the recess 57d. The end portion 38a, the end portion 38b, and the end portion 38c of the front plate 33a that are folded rearward are also inserted into the recess 57b, the recess 57c, and the recess 57d, respectively. Thus, the front plate 33a is attached to the door frame 35.

15 [0058]

20 Next, the case where the front plate 33 is made of glass will be described below.

[0059]

The left cap 39a, the right cap 39b, the upper cap 39c, and the lower cap 39d are assembled into the door frame 35. The double-sided adhesive tape 30 is pasted or the hot-melt adhesive (not illustrated) is applied to each of the bonding surface 60a, the bonding surface 60b, the bonding surface 60c, and the bonding surface 60d of the door frame 35. Then, the front plate 33b is made to adhere to the double-sided adhesive tape 30 or hot-melt adhesive. In such a state, the lower end face of the front plate 33b is supported by the supporting surface 55d of the lower

cap 39d. Thus, the front plate 33b is fixed to the bonding surface 60b. In such a process, some of the hot-melt adhesive that is pushed out when the front plate 33b is pushed for adhesion flows into the recess 57d provided further outside than the bonding surface 60b. In such a mechanism, the hot-melt adhesive flows into the gap between the surface of the glass and the supporting portion, thereby being prevented from flowing out of the front face of the refrigerator door. Thus, the beauty of the refrigerator door is improved.

[0060]

While Embodiment 1 relates to a case where the front plate 33 is made of steel plate or glass, the material for the front plate 33 is not limited to steel plate or glass and may be, for example, metal sheet or resin. As long as it is possible to shape the front plate 33 for the door frame 35 as illustrated in Fig. 5 or 6, the material for the front plate 33 may be changed to another material such as metal sheet and resin.

[0061]

In a case of the known art where a front plate made of glass is attached to the door frame of the refrigerator door, a portion that supports the front plate has a projection projecting further forward than the front plate. The projection covers a part of the door frame to prevent the front plate from coming off the door frame. In the refrigerator-compartment right door 14 according to Embodiment 1, the bonding surface 60d of the lower cap 39d and the front plate 33b are fixed to each other with the double-sided adhesive tape 34 or hot-melt adhesive, and the front plate 33b is supported by the supporting surface 55d, and the front plate 33b is thus fixed to the door frame 35. In such a configuration, no projection needs to be provided further forward than the front plate 33b. Therefore, the area of the front face of the front plate 33b is increased, and the design quality of the refrigerator-compartment right door 14 is improved. In the known refrigerator door, foreign matter such as dust that tends to build up between the front plate and the projection is hard to remove, which reduces the ease of cleaning. In the refrigerator-compartment right door 14 according to Embodiment 1, the door frame 35 has no such projection further forward

than the front plate 33b. Therefore, foreign matter such as dust is easily removable, which improves the ease of cleaning. Such an aspect also applies to the refrigerator-compartment left door 13.

[0062]

5 <Embodiment 2>

Embodiment 2 of the present disclosure will be described below. Front and sectional views of a refrigerator 200 according to Embodiment 2 and configurations of a refrigerator-compartment left door 201 and a refrigerator-compartment right door 202 are common to those illustrated in Fig. 1, 2, and 3 provided for Embodiment 1.

10 [0063]

A configuration of a door frame 203 according to Embodiment 2 will be described below with reference to Fig. 10 and 11. In Embodiment 2, a lower-cap body 205 includes a front rib that is composed of two components.

[0064]

15 Fig. 10 illustrates a perpendicular section in a depth direction of a lower cap 204 according to Embodiment 2. The lower cap 204 includes the lower-cap body 205, as with the case of Embodiment 1. The lower cap 204 includes, on the upper face of the lower-cap body 205, a step portion 206, which is continuous with the lower-cap body 205 and extends upward.

20 [0065]

In Embodiment 2, as illustrated in Fig. 10, the step portion 206 has an L-shaped step 207. The step 207 is formed to extend over from the front face to an upper face of the step portion 206 and is recessed rearward. A fixing component 208 is bonded to the step portion and is in contact with the two faces of the step 207. The fixing component 208 has an L shape that is composed of a segment 209 and a segment 210. With the fixing component 208 being attached to the step portion 206, the segment 209 extends forward from the step portion 206, and the segment 210 extends upward. The combination of the step portion 206 and the fixing component 208 serves as a front rib 211. The front face of the upward segment of

the fixing component 208 serves as a bonding surface 212. A portion of the lower-cap body 205 that is located further forward than the bonding surface 212 serves as a supporting portion 213. The step portion 206 and the fixing component 208 are bonded to each other with double-sided adhesive tape or fixed to each other by screws. Such a configuration also produces the effects produced by Embodiment 1. A recess 214 is provided between the fixing component 208 and the lower-cap body 205.

[0066]

In Embodiment 1, the lower cap 39d includes the lower-cap body 40d, and the recess 57d is provided between the lower-cap body 40d and the front rib 41d that is continuous with the lower-cap body 40d. To obtain such a lower cap, undercutting for providing the recess 57d is necessary.

In Embodiment 2, the combination of the step portion 206 and the fixing component 208 serves as the front rib 211, and the recess 214 is provided between the lower-cap body 205 and the front rib 211. Such a configuration does not require undercutting. Therefore, the cost for forming the lower cap is lower than in Embodiment 1.

[0067]

The configuration of the two-component front rib including the step portion 206 and the fixing component 208 is not limited to the one illustrated in Fig. 10. For example, as illustrated in Fig. 11, the fixing component 208 may have a rectangular sectional shape, and the entirety of the back face of the fixing component 208 may be bonded to the step portion 206 to form the front rib 211. Such a configuration does not require undercutting in providing the recess 214 in the process of forming the lower cap 204. Therefore, the cost for forming the lower cap is lower than in Embodiment 1.

[0068]

<Embodiment 3>

Embodiment 3 of the present disclosure will be described below. Front and sectional views of a refrigerator 300 according to Embodiment 3 and configurations of a refrigerator-compartment left door 301 and a refrigerator-compartment right door 302 are common to those illustrated in Fig. 1, 2, and 3 provided for Embodiment 1.

5 In Embodiment 3, the refrigerator-compartment right door 302 includes a lower-cap body 303. The lower-cap body 303 includes a front rib 304, which has an opening 305.

[0069]

10 In Embodiment 3, as illustrated in Fig. 12, the front rib 304 included in the lower-cap body 303 has the opening 305, which is provided in a bonding portion 306 and extends through to the back face of the front rib 304. The other details are the same as those illustrated in Fig. 5 and 6.

[0070]

15 In such a configuration, when the front plate 33a is attached to the door frame 35 to which the rear plate 36 has been attached and into which urethane foam has been injected, the urethane foam flows through the opening 305 into the space between the front plate 33a and the front rib 304. Therefore, it is easier to fill the space between the front plate 33 and the front rib 304 with the urethane foam than in a configuration with no opening 305. Accordingly, compared with the case where no opening 305 is provided in the front face of the front rib 304, the urethane foam injected into the space between the front plate 33 and the front rib 304 is less likely to have cavities that may be left when injected urethane foam leaks. Hence, compared with the case where no opening 305 is provided, a greater effect of pushing the end portions of the front plate 33a toward the supporting portion by the urethane foam is produced when the front plate 33a as a front plate 33 made of a steel plate material is attached to the door frame 35.

25 [0071]

When the front plate 33 is made of glass, the front plate 33b is attached to the bonding surface 306 of the lower cap with hot-melt adhesive. In such a case, some

of the hot-melt adhesive flows into the opening 305 provided in the bonding surface 306. Therefore, compared with the case where no opening 305 is provided in the bonding surface 306, the hot-melt adhesive is less likely to flow out of the gap between the front plate 33b and the supporting portion and leak to the front face of the refrigerator door. Thus, the design quality of the refrigerator door that is achieved in the manufacturing process is improved.

[0072]

Note that any combinations of the above embodiments and any modifications and omissions that are made to the above embodiments are included in the technical scope described in the embodiments.

Reference Signs List

[0073]

1: refrigerator, 2: box structure, 35: door frame, 39a: left cap, 39b: right cap, 39c: upper cap, 39d: lower cap, 41d: front rib, 40d: lower-cap body, 14: refrigerator right door, 36: rear plate, 33: front plate, 33a: front plate, 33b: front plate, 60d: bonding surface, 55d: supporting surface, 57d: recess

CLAIMS

[Claim 1]

A refrigerator comprising:

a refrigerator body having a compartment inside; and

5 a refrigerator door with which the compartment of the refrigerator body is opened and closed,

the refrigerator door including a door frame, a rear plate, and a front plate,

the door frame including an upper cap, a lower cap, a right cap, and a left cap,

10 the lower cap including a cap body that is plate-shaped and forms a lower face of the refrigerator door, a front rib that is provided on an upper face of the cap body and extends upward, and a recess that is provided between the cap body and the front rib and where the front plate is nipped,

a front face of the front rib serving as a bonding surface to which the front plate is bonded,

15 the front rib being offset rearward from a front end of the cap body by a length over which the cap body is able to support a glass plate,

a portion of the upper face of the cap body serving as a supporting surface, the portion being located further forward than the front rib,

20 when the front plate is made of a steel plate material, the front plate including an end portion that is located at a lower portion of the front plate and is folded rearward, the end portion being inserted in the recess,

when the front plate is made of glass, a lower end face of the front plate being supported by the supporting surface, a rear face of the front plate being joined to the bonding surface.

25 [Claim 2]

The refrigerator of claim 1, wherein the front rib comprises two components.

[Claim 3]

The refrigerator of claim 1, wherein the front rib has an opening provided in the bonding surface and extending through to a back face of the front rib.