

DESCRIPTION

Title of Invention

REFRIGERATOR

Technical Field

5 [0001]

The present invention relates to a refrigerator in which a handle is provided at a drawer-type door.

Background Art

[0002]

10 In a conventional refrigerator, a single handle is provided at a drawer-type door (refer to, for example, Patent Literature 1). In a refrigerator disclosed in Patent Literature 1, a handle is provided at an upper portion of each of two drawer-type doors disposed in parallel. In this case, a user cannot easily pull out each of the doors in the case where the handle is located higher than the shoulders of the user. In the case
15 where the drawer is provided with only one handle, there can be a case where the user cannot easily open or close the drawer, although whether such a case occurs or not depends on the height of the user.

[0003]

20 To solve the above problem, in another type of refrigerator, a handle is provided at the front of a drawer-type door (for example, Patent Literature 2). In a refrigerator disclosed in Patent Literature 2, a recess is provided in a front plate of a door, and a grasping element is provided over the recess. In this refrigerator, if the user is tall, and the door is located lower than the shoulders of the user, the user can easily pull out the door while grasping the grasping element, with the user's palm facing downwards. If
25 the user is short, and the door is located higher than the shoulders of the user, the user can easily pull out the door while grasping the grasping element, with the user's palm facing upwards. Despite of such advantages, in the case where the grasping element is formed to allow the user to easily put the user's hand on the grasping element of the door regardless of whether the user's palm faces upwards or downwards, the shape of
30 the grasping element is complicated, thus increasing the manufacturing cost. In the

refrigerator disclosed in Patent Literature 2, it is necessary to perform drawing processing for forming a recess in the front plate of the door, and this processing increases the manufacturing cost. Furthermore, because of provision of the recess in the front plate of the door, constraints are placed on the design of the front plate.

[0004]

In a still another type of refrigerator formed to solve the above problem, two handles are provided on sides of a drawer (refer to, for example, Patent Literature 3). In a refrigerator disclosed in Patent Literature 3, handles are provided at uppermost portions of both sides of a door provided at each of the lower two of four storage compartments vertically arranged. To be more specific, in this refrigerator, a vacuum heat insulation material is provided in the door in close contact with the front plate of the door, and the handles are provided at uppermost portions of both sides of the vacuum heat insulation material.

[0005]

Furthermore, it should be noted that a refrigerator provided with a double-leaf door to which a plurality of handles are attached is also known, though it is not a refrigerator provided with a drawer (see, for example, Patent Literature 4). Patent Literature 4 discloses that handles are attached to three surfaces of a double-leaf door of an uppermost storage compartment, i.e., a side surface, a top surface and a bottom surface of the double-leaf door. Also, Patent Literature 4 discloses as an advantage of the above configuration that any user can easily open and close the door by selecting any of the handles as appropriate in accordance with the preference and height of the user. The double-leaf door is rotated around a hinge provided at a side of the door which is located opposite to a side thereof to which a handle is attached, and is opened and closed in a manner different from that of a drawer-type door which is moved forwards and backwards. Thus, even if the technique of the double-leaf door is applied to the drawer-type door, it is not possible to obtain an advantage which can be obtained by the double-leaf door.

Citation List

Patent Literature

[0006]

Patent Literature 1: Japanese Unexamined Patent Application Publication No.
2015-75273

Patent Literature 2: Japanese Unexamined Patent Application Publication No.
2015-194296

Patent Literature 3: Japanese Unexamined Patent Application Publication No.
2015-31441

Patent Literature 4: Japanese Unexamined Patent Application Publication No.
2011-106696

Summary of Invention

Technical Problem

[0007]

In the refrigerator disclosed in Patent Literature 3, handles provided at uppermost portions of both side surfaces of a door are located at the same level from a floor surface. Thus, in the case where a drawer-type door is provided at an upper level, there is a possibility that a short user cannot easily open or close the door.

[0008]

The present invention is intended to solve the above problems, and provide a refrigerator including a drawer-type door which can be easily opened and closed regardless of the height of a user.

Solution to Problem

[0009]

A refrigerator according to an embodiment of the present invention includes: a box body including an outer box and an inner box between which a heat insulation material is provided; a drawer compartment provided in the inner box and having an opening at the front of the drawer compartment; and a door which is moved forwards and backwards to open and close the opening of the drawer compartment, respectively. The door includes a main handle provided on an upper side and a sub handle provided on a lower side.

Advantageous Effects of Invention

[0010]

According to an embodiment of the present invention, handles are provided at both upper and lower portions of a drawer-type door. Therefore, a user can easily put his or her fingers on either handle regardless of the height of the user, thus reducing the load of the user in opening and closing of the door.

Brief Description of Drawings

[0011]

[Fig. 1A] Fig. 1A is an external perspective view illustrating an example of the configuration of a refrigerator according to embodiment 1 of the present invention.

[Fig. 1B] Fig. 1B is a plan view of the refrigerator as illustrated in Fig. 1A, as viewed from above.

[Fig. 1C] Fig. 1C is a side view illustrating the example of the configuration of the refrigerator as illustrated in Fig. 1A, as viewed side-on.

[Fig. 2] Fig. 2 is a sectional view taken along line A-A in Fig. 1B.

[Fig. 3] Fig. 3 is an external perspective view of a box body of the refrigerator as illustrated in Fig. 1A, that is provided for explanation of a foam formation process using a foam heat insulation material.

[Fig. 4A] Fig. 4A is a sectional view taken along line B-B in Fig. 1C.

[Fig. 4B] Fig. 4B is an enlarged view of circle F as indicated in Fig. 4A.

[Fig. 5A] Fig. 5A is a plan view illustrating an example of the configuration of a vacuum heat insulation material and heat transfer pipe as illustrated in Fig. 4A.

[Fig. 5B] Fig. 5B is a sectional view taken along line C-C in Fig. 5A.

[Fig. 6A] Fig. 6A is a sectional schematic view illustrating a process which is carried out in manufacturing of the vacuum heat insulation material as illustrated in Fig. 5A.

[Fig. 6B] Fig. 6B is a sectional schematic view illustrating another process which is carried out in manufacturing of the vacuum heat insulation material as illustrated in Fig. 5A.

[Fig. 7A] Fig. 7A is a front view illustrating appearance of doors of a second freezer compartment and a vegetable compartment as illustrated in Fig. 1A.

[Fig. 7B] Fig. 7B is an external perspective view illustrating an example of the door of the vegetable compartment as illustrated in Fig. 1A.

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

[Fig. 9] Fig. 9 is an enlarged sectional view of a boundary region between two doors as illustrated in Fig. 8.

[Fig. 10] Fig. 10 is another enlarged sectional view of the boundary region between the two doors as illustrated in Fig. 8.

[Fig. 11] Fig. 11 is an exterior diagram illustrating an upper surface, a front surface and a bottom surface of the door of the freezer compartment as illustrated in Fig. 7A.

[Fig. 12] Fig. 12 is a plan view of a section taken along line E-E in Fig. 11, as viewed from a back-surface side of the refrigerator.

[Fig. 13A] Fig. 13A is a diagram for explaining the location of the vacuum heat insulation material in the door as illustrated in Fig. 8.

[Fig. 13B] Fig. 13B is another diagram for explaining the location of the vacuum heat insulation material in the door as illustrated in Fig. 8.

Description of embodiments

[0012]

Embodiment 1

A configuration of a refrigerator according to embodiment 1 will be described. Fig. 1A is an external perspective view illustrating an example of the configuration of the refrigerator according to embodiment 1 of the present invention. Fig. 1B is a plan view of the refrigerator as illustrated in Fig. 1A, as viewed from above. Fig. 1C is a side view illustrating the example of the configuration of the refrigerator as illustrated in Fig. 1A, as viewed side-on. Fig. 1C illustrates a right side surface of a refrigerator 1 (as viewed in a Y axial direction as indicated by an arrow Y) in the configuration as illustrated in Fig. 1A. Although Fig. 1C illustrates a side plate 32 on the right side of the refrigerator 1, another side plate 32 is provided on the left side of the refrigerator 1.

[0013]

As illustrated in Fig. 1A, the refrigerator 1 includes a refrigerator compartment 2, a freezer compartment 27 and a vegetable compartment 6 as storage compartments which accompany stored goods such as food while keeping them cold or frozen. The freezer compartment 27 includes an ice-making compartment 3, a first freezer compartment 4 and a second freezer compartment 5. A refrigeration temperature is, for example, 10 degrees C or lower. A freezing temperature is, for example, -12 degrees C or lower.

[0014]

As illustrated in Fig. 1A, the refrigerator compartment 2 is provided at an uppermost portion of the refrigerator 1, and the ice-making compartment 3 and the first freezer compartment 4 are disposed in parallel under the refrigerator compartment 2. The second freezer compartment 5 is provided under the ice-making compartment 3 and the first freezer compartment 4, and the vegetable compartment 6 is provided under the second freezer compartment 5.

[0015]

The refrigerator 1 includes a plurality of doors 7 to 12 which open and close front openings of the storage compartments. The doors 7 and 8 are provided at the front of the refrigerator compartment 2. The doors 7 and 8 form a double-leaf door which opens and closes the refrigerator compartment 2. The door 7 is a left leaf, that is, a left door, and the door 8 is a right leaf, that is, a right door. The door 9 is provided at the front of the ice-making compartment 3. The door 10 is provided at the front of the first freezer compartment 4. The door 11 is provided at the front of the second freezer compartment 5. The door 12 is provided at the front of the vegetable compartment 6.

[0016]

The doors 7 to 12 are drawer-type doors of the storage compartments which are the ice-making compartment 3, the first freezer compartment 4, the second freezer compartment 5 and the vegetable compartment 6. The storage compartment a front opening of which is opened and closed by moving a drawer-type door provided thereat forwards and backwards, respectively, will be hereinafter referred to as a drawer compartment. The drawer-type door is moved forwards and backwards to open and

close the opening of the drawer compartment. For example, the door 11 is provided at the front of the second freezer compartment 5, and is moved forwards and backwards to open and close the opening of the second freezer compartment 5.

[0017]

5 Fig. 2 is a sectional view taken along line A-A in Fig. 1B. The refrigerator 1 includes a refrigerant circuit in which a fan 16, a cooler 17, a compressor 18, a condenser, a capillary tube, etc., are connected by refrigerant pipes. A heat transfer pipe (not illustrated) is provided as a condenser between a foam heat insulation material 19 and the side plate 32 which is part of an outer periphery of the refrigerator 1. The
10 heat transfer pipe externally transfer heat of circulating refrigerant through the side plate 32 which is provided as illustrated in Fig. 1C. The configuration of the heat transfer pipe will be described later in detail. The refrigerant is, for example, isobutane which is named R600a. As the refrigerant, another refrigerant may be used. However, isobutane is advantageous, since it does not break the ozone layer when discarded,
15 and has a low global warming potential.

[0018]

The refrigerator 1 is provided with air passages (not illustrated) through which cool air flows from the cooler 17 to each of the storage compartments. The air passages are provided with respective electric opening and closing dampers (not
20 illustrated). In a rear region of the uppermost portion of the refrigerator 1, a controller 14 is provided to control a refrigeration cycle of the refrigerator 1. The controller 14 is covered by an upper lid 13. The controller 14 is, for example, a microcomputer. The controller 14 controls the rotation speeds of the compressor 18 and the fan 16 and the opening degrees of the opening and closing dampers such that the refrigeration
25 temperature and the freezing temperature of the refrigerator 1 are equalized to respective set temperatures.

[0019]

Air cooled by the cooler 17 through the refrigeration cycle is sent to the refrigerator compartment 2, the freezer compartment 27 and the vegetable
30 compartment 6 by the fan 16. At this time, the amounts of cooled air to be sent to

those storage compartments are adjusted by controlling of the opening degrees of the opening and closing dampers provided at the air passages, which is performed by the controller 14.

[0020]

5 Next, a box body 30 which forms the outer periphery of the refrigerator 1 will be described below. First of all, it will be described how to foam the foam heat insulation material 19 in the box body 30. In the following, it is assumed that the foam heat insulation material 19 is urethane foam.

[0021]

10 Fig. 3 is an external perspective view of the box of the refrigerator illustrated in Fig. 1A, that is provided for explaining a foam formation process using the foam heat insulation material. Fig. 4A is a sectional view taken along line B-B in Fig. 1C. Fig. 4B is an enlarged view of circle F in Fig. 4A. As illustrated in Figs. 3 and 4A, the box body 30 includes an inner box 31 which partitions space therein into the storage
15 compartments, and an outer box 21 including the side plates 32 and a back plate 20. The outer box 21 forms the outline of the refrigerator 1.

[0022]

 The side plates 32 and the back plate 20 as illustrated in Fig. 3 are each, for example, an iron plate having a thickness of approximately 0.4 to 0.5 mm. The box
20 body 30 is provided with a pair of elements with which the inner box 31 is hooked onto the outer box 21. As illustrated in Figs. 4A and 4B, as one of the pair of elements, an R bent portion 21a is provided on a front surface side of the outer box 21. As the other element of the pair of elements, a to-be-engaged portion 31a is provided on a front surface side of the inner box 31. When the R bent portion 21a is elastically deformed
25 to hold the to-be-engaged portion 31a, the outer box 21 and the inner box 31 are fixed to each other while engaged with each other.

[0023]

 In order that an undiluted solution of urethane foam be injected into space between the outer box 21 and the inner box 31, the box body 30 is installed in a
30 foaming device (not illustrated) such that the back plate 20 of the box body 30 of the

refrigerator 1 faces upwards as illustrated in Fig. 3. Then, the undiluted solution of urethane foam is injected through a plurality of injection ports 33 provided in the back plate 20.

[0024]

5 The injected undiluted solution of urethane foam reaches all regions between the outer box 21 and the inner box 31 along an inner wall. Thereafter, the urethane foam starts foaming toward the back plate 20, and the space between the inner box 31 and the outer box 21 is filled with the urethane foam.

[0025]

10 Before the injection of the undiluted solution of urethane foam, a vacuum heat insulation material 23 as illustrated in Fig. 4A is temporarily fixed to the inner surface of the outer box 21 in advance by, for example, a hot-melt bonding agent or a sealing material. In the vacuum heat insulation material 23, recesses 29 are provided in advance, and the heat transfer pipe 22 is provided in the recesses 29. When the
15 undiluted solution of urethane foam foams and the space between the outer box 21 and the inner box 31 is filled with the foam heat insulation material 19, the vacuum heat insulation material 23 is fixed between the outer box 21 and the foam heat insulation material 19.

[0026]

20 Next, the configuration of the vacuum heat insulation material 23 and the heat transfer pipe 22 as illustrated in Fig. 4A will be described with reference to the accompanying drawings. The description is made with respect to states of the vacuum heat insulation material 23 and the heat transfer pipe 22 which are not yet fixed between the foam heat insulation material 19 and the outer box 21. Fig. 5A is a plan
25 view illustrating an example of the configuration of the vacuum heat insulation material and the heat transfer pipe as illustrated in Fig. 4A. Fig. 5A illustrates a state in which the vacuum heat insulation material 23 and the heat transfer pipe 22 are provided inward of the side plate 32 in the side view of Fig. 1C. Fig. 5B is a sectional view taken along line C-C in Fig. 5A.

30 [0027]

As illustrated in Fig. 5A, the vacuum heat insulation material 23 is rectangular.

In Fig. 5A, assuming that a Z axial direction indicated by an arrow Z is a vertical direction, and the Y axial direction is a lateral direction, in the vacuum heat insulation material 23, a plurality of recesses 29 which accommodate the heat transfer pipe 22 are provided at regular intervals such that they extend in the vertical direction. The distances between center lines of the recesses 29 are each a dimension W1 as illustrated in Fig. 5B. In the example of the configuration as illustrated in Figs. 5A and 5B, six recesses 29 are provided in the vacuum heat insulation material 23. As illustrated in Fig. 5A, a single heat transfer pipe 22 is made to extend in the vertical direction from a lower side of the vacuum heat insulation material 23 such that it is made to extend through the six recesses 29 in turn, and to finally return to the lower side of the vacuum heat insulation material 23. The heat transfer pipe 22 is made of, for example, copper. The heat transfer pipe 22 has a diameter of, for example, 4.00 to 5.00 mm.

[0028]

As illustrated in Fig. 5B, each of the recesses 29 is formed in the shape of a recess having wall portions located on right and left sides of the heat transfer pipe 22. Each of the recesses 29 has a depth D1 of 5 mm or greater and a width L1 of 40 to 70 mm. In the example of the configuration as illustrated in Fig. 5B, the section of each recess 29 is rectangular. However, the section of each recess 29 is not limited to the rectangular section. For example, the section of the recess 29 may be triangular or elliptical.

[0029]

With respect to the width L1 of the recess 29, a target dimension and a target tolerance are set in consideration of errors in the process of manufacturing the refrigerator 1. This will be specifically described. As the errors in the process of manufacturing the refrigerator 1, for example, a manufacturing error which is made when each recess 29 is formed in the vacuum heat insulation material 23 and an attachment error which is made when the vacuum heat insulation material 23 is attached to the side plate 32 can be considered. The heat transfer pipe 22 needs to be

prevented from being moved out of each recess 29 even if the heat transfer pipe 22 is slightly bent along the side plate 32 during the attachment of the vacuum heat insulation material 23 to the side plate 32. In consideration of such errors, the target dimension and tolerance of the width L1 of the recess 29 are set such that the recess 29 is sized to accommodate the heat transfer pipe 22.

[0030]

The depth D1 of the recess 29 is set greater than or equal to the diameter of the heat transfer pipe 22 for the following reason. When the urethane foam is foamed, the urethane foam presses the heat transfer pipe 22 against the side plate 32, with the vacuum heat insulation material 23 interposed between the heat transfer pipe 22 and the side plate 32. In this case, there is a possibility that by the pressing, an imprint of the heat transfer pipe 22 will be produced on the side plate 32, and an outer packaging material 25 of the vacuum heat insulation material 23 will be damaged by the heat transfer pipe 22. In order to prevent production of such an imprint and such damage, the depth D1 of the recess 29 is set greater than or equal to the diameter of the heat transfer pipe 22. For example, in the case where the diameter of the heat transfer pipe 22 is 4.0 mm, the depth D1 of the recess 29 is set to 5.0 mm.

[0031]

If the depth D1 of the recess 29 is smaller than the diameter of the heat transfer pipe 22, when the foamed urethane foam presses the heat transfer pipe 22 against the side plate 32, with the vacuum heat insulation material 23 interposed between the heat transfer pipe 22 and the side plate 32, an imprint of the heat transfer pipe 22 is produced on the side plate 32, thus impairing the appearance of the side plate 32. Thus, the depth D1 of the recess 29 is set greater than or equal to the diameter of the heat transfer pipe 22.

[0032]

Although the configuration of the vacuum heat insulation material 23 and the heat transfer pipe 22 is described above with reference to Figs. 5A and 5B, a vacuum heat insulation material 15 provided at the back plate 20 as illustrated in Fig. 4A has the same configuration as or a similar configuration to that of the vacuum heat insulation

material 23. Although it is not illustrated in Fig. 4A, the vacuum heat insulation material 15 is also provided with a heat transfer pipe having the same configuration as or a similar configuration to that of the heat transfer pipe 22.

[0033]

5 With the heat transfer pipe 22 accommodated in the recesses 29 of the vacuum heat insulation materials 15 and 23 as described with reference to Figs. 5A and 5B, the vacuum heat insulation material 23 is bonded to the side plate 32, and the vacuum heat insulation material 23 is bonded to the back plate 20, by using, for example, a hot-melt bonding agent and an aluminum adhesive tape. At this time, in the attachment of the vacuum heat insulation material 23 to the side plate 32, they needs to be temporarily fixed to each other in order to prevent the foam heat insulation material 19 from entering the space between the side plate 32 and the vacuum heat insulation material 23 in the following foam formation process. Also, in the attachment of the vacuum heat insulation material 15 to the back plate 20, they needs to be temporarily fixed to each other in order to prevent the foam heat insulation material 19 from entering the space between the back plate 20 and the vacuum heat insulation material 15 in the foam formation process.

[0034]

20 In the foam formation process described with reference to Fig. 3, the space between the outer box 21 and the inner box 31 is filled with the foam heat insulation material 19. In such a manner, the vacuum heat insulation materials 15 and 23 and the heat transfer pipe 22 are fixed between the outer box and the inner box 31 as illustrated in 4A.

[0035]

25 Next, a method of manufacturing the vacuum heat insulation material 23 as illustrated in Figs. 5A and 5B will be described with reference to with reference to Figs. 6A and 6B. Figs. 6A and 6B are schematic sectional views illustrating processes which are carried out in manufacturing the vacuum heat insulation material as illustrated in Fig. 5A.

30 [0036]

As illustrated in Fig. 6A, a stacked body 24 in which fiber layers 24a to 24c are stacked together is formed. As fibers which are applied to the fiber layers 24a to 24c, for example, inorganic fiber such as glass wool, glass fiber, alumina fiber or silica alumina fiber is applied; however, natural fiber such as cotton may be applied. Lateral lines in the stacked body 24 as illustrated in Fig. 6A indicate the orientations of fibers. Fig. 6A illustrates the case where the fiber layers 24a to 24c have the same thicknesses, but the fiber layers 24a to 24c may have different thicknesses. In addition, Fig. 6A illustrates the case where the stacked body 24 includes the three fiber layers 24a to 24c; however, the number of fiber layers to be provided is not limited to three. The stacked body 24 is referred to as a core 26 in the vacuum heat insulation material 23 as illustrated in Fig. 5A.

[0037]

Subsequently, the core 26 as illustrated in Fig. 6A is accommodated in the outer packaging material 25. The outer packaging material 25 is, for example, a metal evaporation laminate film including a plastic layer for thermal welding. In order that pressing be performed on the core 26, it is applied onto the outer packaging material 25 containing the core 26, thereby forming the recesses 29 in the fiber layer 24a, which are illustrated in Figs. 5A and 5B. Fig. 6B illustrates some of the six recesses 29 which are provided as illustrated in Fig. 5B. Thereafter, both ends of the outer packaging material 25 are welded as illustrated in Fig. 6B to prevent the fibers from being moved out of the outer packaging material 25. In such a manner, the vacuum heat insulation material 23 which includes the core 26 provided with the recesses 29 and the outer packaging material 25 covering the core 26 is produced.

[0038]

The configurations of the doors of the drawer compartments in the refrigerator 1 will be described. The doors 9 to 12 have the same configuration or similar configurations. The following description will thus be made mainly by referring to the configurations of the doors 11 and 12. Fig. 7A is a front view illustrating the appearance of the doors of the second freezer compartment and the vegetable compartment as illustrated in Fig. 1A. Fig. 7B is an external perspective view

illustrating an example of the door of the vegetable compartment as illustrated in Fig. 1A.

[0039]

As illustrated in Fig. 7A, the doors 11 and 12 are provided vertically adjacent to each other. The door 11 includes a top plate 37, a bottom plate 38 and a front plate 41. The door 11 also includes side plates and a back plate (all not illustrated). As illustrated in Figs. 7A and 7B, the door 12 includes a top plate 39, a bottom plate 40, a back plate 44, a front plate 42 and side plates 47 and 48. The front plate 42 is, for example, a glass plate or a steel plate. In the following description, the side plates and the back plate of the door 11 are denoted by the same reference signs as the side plates 47 and 48 and the back plate 44 of the door 12, respectively.

[0040]

Fig. 7B illustrates the case where a support 58 is attached to the door 12 on the back plate 44 side, and a storage case 57 is mounted on the support 58. Although Fig. 7B illustrates the support 58 attached on the right side of the door 12 in a width direction thereof (an X axial direction indicated by an arrow X), another support 58 is attached on the left side of the door 12. On a side surface of each of the supports 58, a guide 58a is provided to extend parallel to a depth direction (the Y axial direction). Furthermore, at an upper portion of the storage case 57, flanges 57a are provided on both sides in the width direction. The flanges 57a are supported by the supports 58, whereby the storage case 57 is set on the support 58. When the door 12 is in the closed state, and then when it is pulled out by a user, the guides 58a, which are located in grooves (not illustrated) provided in the inner box 31, are slid, and the storage case 57 set on the guides 58a is pulled out. When the storage case 57 is pulled out, the user can take stored goods out of or into the storage case 57.

[0041]

Fig. 8 is a sectional view taken along line D-D in Fig. 7A. The following description is made mainly by referring to the configuration of the door 11. As illustrated in Fig. 8, the top plate 37 is provided with a main handle 51 recessed in the direction of gravity (in the opposite direction to the Z axial direction). The bottom plate

38 is provided with a sub handle 52 recessed in the opposite direction to the direction of gravity. The sub handle 52 of the door 11 and the main handle 51 of the door 12 are located to face each other.

[0042]

5 In addition, a vacuum heat insulation material 43 is provided in space surrounded by the top plate 37, the bottom plate 40, the back plate 44, the front plate 41 and the side plates 47 and 48, and blank space in the space is filled with the foam heat insulation material 19 such as hard urethane foam. As illustrated in Fig. 8, at the top plate 37 and the bottom plate 38, respective ribs 46 are provided to support the vacuum heat insulation material 43. The vacuum heat insulation material 43 is disposed between the main handle 51, the sub handle 52 and the back plate 44. In the example of the configuration as illustrated in Fig. 8, a lower portion of the vacuum heat insulation material 43 is sandwiched and supported between the sub handle 52 and the rib 46. The vacuum heat insulation material 43 is inclined toward the back plate 44 relative to a direction (the Z axial direction) perpendicular to the bottom plate 38. The vacuum heat insulation material 43 has the same configuration as or a similar configuration to that of the vacuum heat insulation material 23, and its detailed description will thus be omitted.

[0043]

20 As illustrated in Fig. 8, in the door 11, a gasket 45 is provided in tight contact with the box body 30 to ensure air-tightness of the vegetable compartment 6. The gasket 45 is provided in the shape of a rectangular frame along the outer periphery of the back plate 44 of the door 11 in such a manner as to face the front surface of the left side plate 32 of the box body 30 as illustrated in Fig. 3, the front surface of the right side plate 32 of the box body 30 and the front surfaces of partitions 49 and 50 as illustrated in Fig. 1A.

[0044]

30 With reference to Fig. 8, it will be described what advantage is obtained by the main handle 51, the sub handle 52 and the rib 46 in the process of filling the inside of the door 11 with the foam heat insulation material 19. In the case where the space between the front plate 41 and the vacuum heat insulation material 43 is first filled with

the foam heat insulation material 19, the foam heat insulation material 19 presses the vacuum heat insulation material 43 toward the back plate 44. In this case, the ribs 46 support the vacuum heat insulation material 43, thereby preventing the vacuum heat insulation material 43 from being moved toward the back plate 44. By contrast, in the case where the space between the back plate 44 and the vacuum heat insulation material 43 is first filled with the foam heat insulation material 19, the foam heat insulation material 19 presses the vacuum heat insulation material 43 toward the front plate 41. In this case, walls of the recessed portions of the main handle 51 and the sub handle 52, that are closer to the back plate 44, function as ribs to support the vacuum heat insulation material 43, thereby preventing the vacuum heat insulation material 43 from being moved toward the front plate 41.

[0045]

In such a manner, when the foam formation process is performed on the door 11, the ribs 46 and the walls of the main handle 51 and the sub handle 52, which are closer to the back plate 44, function to prevent movement of the vacuum heat insulation material 43. If the walls of the main handle 51 and the sub handle 52 which are closer to the back plate 44 are considered as ribs, the heights of ones of the ribs which are closer to the inner compartment side are lower than those of ones of the ribs which are closer to a design surface side. Although it is described above that the foam formation process on the door 11 is performed in two steps separately on the front side and the back side, but the foam formation process may be simultaneously performed on the front side and the back side.

[0046]

Figs. 9 and 10 are enlarged sectional views of a boundary region between two doors each provided as illustrated in Fig. 8. Figs. 9 and 10 omit illustration of the foam heat insulation material provided in the doors 11 and 12 and illustration of the vacuum heat insulation material provided in the door 12.

[0047]

As illustrated in Fig. 9, length T1 is greater than length T2, that is, the relationship of $T1 > T2$ is satisfied, where T2 is the length of the sub handle 52 in the depth direction

(the Y axial direction) and T1 is the length of the main handle 51 in the depth direction.

The length T2 of the sub handle 52 in the depth direction is, for example, greater than or equal to the average thickness of the middle fingers of adults. Fig. 9 illustrates the case where the length T1 is greater than the length T2 by length T3. When the lengths of the main handle 51 and the sub handle 52 in the depth direction are set to satisfy the relationship of $T1 > T2$, the sub handle 52 is located within the range of a shadow of the main handle 51 which is cast when the main handle 51 is projected.

[0048]

In the example of the configuration as illustrated in Fig. 10, H4 is smaller than H2, where H2 is a depth from the bottom plate 38 to the uppermost surface of the recessed portion of the sub handle 52 (in the opposite direction to the Z axial direction), and H4 is a depth from an opening edge of the main handle 51 to the bottom surface of the recessed portion thereof. The depth H2 of the sub handle 52 is, for example, greater than or equal to a depth to which the first joint of the middle finger of an adult which has the average length of the middle fingers of adults holds the handle. It suffices that the depth H4 and the depth H2 satisfy the relationship of $H2 \leq H4$. In this case, the main handle 51 and the sub handle 52 each have a depth corresponding to the length of the first joint of the middle finger of an adult which has the average length of the middle fingers of adults, and the user can thus easily put his or her fingers on either the main handle 51 or the sub handle 52. It should be noted that in the case where $H2 < H4$, when the user puts his or her fingers on the main handle 51, the fingers naturally enter the recessed portion in depth by gravitational force, and the user can be given a sense of security.

[0049]

In the example of the configuration as illustrated in Fig. 10, $H1 > H2$, where H1 is the height of the main handle 51 from the bottom surface of the recessed portion thereof to the uppermost surface of the top plate 39. A height obtained by subtracting H4 from H1 ($H1 - H4$) is greater than or equal to the average thickness (T2) of the middle fingers of adults. Furthermore, the relationship of $H3 \geq H1 - H4 \geq T2$ is satisfied, where H3 is the height of an opening portion between the main handle 51 of the door 12 and the sub

handle 52 of the door 11. These dimensions are set in order to provide the opening portion at the front on the main handle 51 side such that the user can put his or her fingers on either the main handle 51 or the sub handle 52. As a result, in the door 11, as space to be filled with the foam heat insulation material 19, larger space can be provided on the front plate 41 side of the sub handle 52. It is therefore possible to improve the heat insulation performance in the vicinity of the sub handle 52.

[0050]

It should be noted that H1 and H2 may be set to satisfy the relationship of $H1 = H2$. In this case, the opening portion between the main handle 51 of the door 12 and the sub handle 52 of the door 11 is provided to extend evenly upwards and downwards from the boundary between the door 11 and the door 12. As a result, the heat insulation performance of the main handle 51 of the door 12 and that of the sub handle 52 of the door 11 are also evenly improved.

[0051]

As described above, the sub handle 52 of the upper door 11 and the main handle 51 of the lower door 12 are disposed in such positions as to face each other, and the height H3 of the opening portion between the main handle 51 and the sub handle 52 is greater than or equal to the average thickness of the middle fingers of adults. Space having the height H3 serves as common space to the sub handle 52 of the upper door 11 and the main handle 51 of the lower door 12, and the user can thus put his or her fingers on either the sub handle 52 on the upper side or the main handle 51 on the lower side through the space. Therefore, the sub handle 52 and the main handle 51 do not need to be given respective spaces each allowing the user to put his or her fingers on an associated one of the handles through the associated space.

[0052]

The lengths of the main handle 51 and the sub handle 52 in the depth direction satisfy the relationship of $T1 > T2$, and the height H3 of the opening portion between the main handle 51 and the sub handle 52 is greater than or equal to the average thickness (T2) of the middle fingers of adults. Thus, the sub handle 52 of the door 11 is provided at such a position as to be located within the range of a shadow of the main handle 51

of the door 12, which is cast when the main handle 51 is projected, thereby preventing user's fingers from being caught between the doors 11 and 12 in either the case where the user puts his or her fingers on the sub handle 52 of the door 11 and pulls out the door 11 or the case where the user puts his or her fingers on the main handle 51 of the door 12 and pulls out the door 12.

[0053]

Fig. 11 is an external diagram illustrating the upper surface, the front surface and the bottom surface of the door of the freezer compartment as illustrated in Fig. 7A. In Fig. 11, in an upper part thereof, a top view of the door 11 is provided, in an intermediate part of Fig. 11, a front view of the door 11 is provided, and in a lower part of Fig. 11, a bottom view of the door 11 is provided.

[0054]

As illustrated in Fig. 11, $M1$ is greater than $M2$, that is, the relationship of $M1 > M2$ is satisfied, where $M1$ is the length of the main handle 51 in the width direction (the X axial direction), that is, the width of the main handle 51, and $M2$ is the length of the sub handle 52 in the width direction, that is, the width of the sub handle 52. The lengths of the main handle 51 and the sub handle 52 in the width direction satisfy the relationship of $M1 > M2$, and the lengths of the main handle 51 and the sub handle 52 in the depth direction satisfy the relationship of $T1 > T2$ as described with reference to Fig. 9. Therefore, the sub handle 52 is located within the range of a shadow of the main handle 51 which is cast when the main handle 51 is projected

[0055]

As illustrated in Fig. 11, the main handle 51 and the sub handle 52 have recesses which are shaped axi-symmetrical with respect to a center line 55. The length of the recess of the main handle 51 in the depth direction varies from one location to another such that part of the recess which is located at the position of the center line 55 is the longest in the depth direction, and the greater the distance between part of the recess and the center line 55 in the width direction, the smaller the length of the part of the recess. Also, the length of the recess of the sub handle 52 in the depth direction varies from one location to another such that part of the recess which is located at the position

of the center line 55 is the longest in the depth direction, and the greater the distance between part of the recess and the center line 55 in the width direction, the smaller the length of the part of the recess.

[0056]

5 In both the main handle 51 and the sub handle 52, the part of the recess which is located at the position of the center line 55 is the longest in the depth direction, the user can easily put his or her fingers on either the main handle 51 or the sub handle 52 at a position close to the center of the handle. The storage case 57 of each of the drawer compartments such as the second freezer compartment 5 and the vegetable
10 compartment 6 can be moved forwards and backwards together with its door. Thus, when the user puts his or her fingers on part of the handle which is close to the center thereof, and pulls out the door, this pulling force evenly acts on the door in the width direction thereof, as a result of which the storage case 57 in which stored goods are accommodated can be more smoothly pulled out from the inner box 31. Furthermore,
15 since the relationship $M1 > M2$ is satisfied, and the sub handle 52 is located within the range of a shadow of the main handle 51 which is cast when the main handle 51 is projected, the fingers can be prevented from being caught between the doors 11 and 13 at positions close to both ends of the doors 11 and 12 in the width direction.

[0057]

20 The ribs 46 and the vacuum heat insulation material 43 provided in the door 11 will be described. The description will be made on the assumption that the door in which the vacuum heat insulation material 43 is provided is the door 11. Fig. 12 is a plan view of a section taken along line E-E in Fig. 11 as viewed from the back-surface side of the refrigerator. Figs. 13A and 13B are diagrams for explaining the location of
25 the vacuum heat insulation material in the door as illustrated in Fig. 8.

[0058]

 In an example of the configuration as illustrated in Fig. 12, two ribs 46 are provided at the top plate 37, and two ribs 46 are also provided at the bottom plate 38. In the case where a plurality of ribs 46 are provided at one or both of the top plate 37
30 and the bottom plate 38, it is possible to prevent the vacuum heat insulation material 43

from being displaced even when in the foam formation process, the foam heat insulation material 19 does not evenly apply a pressure on the vacuum heat insulation material 43, that is, a strong pressure is applied to part of the vacuum heat insulation material 43.

[0059]

5 The sum ($2 \times L_c$) of the heights of the upper rib 46 and the lower rib 46 is smaller than the height L_b of the vacuum heat insulation material 43, when L_c is the height of each of the ribs 46 as illustrated in Fig. 12 in the vertical direction (the Z axial direction), and L_b is the height of the vacuum heat insulation material 43. The sum ($2 \times L_e$) of the lengths of the two ribs 46 in the width direction is smaller than the length L_d of the vacuum heat insulation material 43 in the width direction, where L_e is the length of each rib 46 in the width direction (the X axial direction) and L_d is the length of the vacuum heat insulation material 43 in the width direction.

[0060]

15 Since the sum ($2 \times L_e$) of the lengths of the two ribs 46 in the width direction is smaller than the length L_d of the vacuum heat insulation material 43, when the undiluted solution of urethane foam flows into blank space in the door in the foam formation process, hindering of the flow of the undiluted solution of urethane foam is reduced, thus ensuring a flow passage of the undiluted solution of urethane foam. As a result, the amount of the urethane foam in the door is prevented from being insufficient. In addition, in a final phase of the door manufacturing process, even after the top plate 37 and the bottom plate 38 are assembled in door framing work, a worker can incorporate the vacuum heat insulation material 43 through a side of the door 11 if the side plate 47 or 48 is still not attached. At this time, since the sum ($2 \times L_c$) of the heights of the two ribs 46 is smaller than the height L_b of the vacuum heat insulation material 43, the area of part of the vacuum heat insulation material 43 which rubs with the ribs 46 is small, and the worker can thus easily incorporate the vacuum heat insulation material 43 in the door 11. Furthermore, the risk that the outer packaging material 25 for the vacuum heat insulation material 43 will be broken due to the rubbing against with the ribs 46 can be reduced.

30 [0061]

Next, the following description is made with respect to the case where the vacuum heat insulation material 43 as illustrated in Fig. 12 is viewed from the side plate 48 side of the door 11, as in Fig. 8. As illustrated in Fig. 8, the vacuum heat insulation material 43 is inclined toward the back plate 44 with respect to the direction perpendicular to the bottom plate 38 in the door 11.

[0062]

Fig. 13A illustrates the case in which the vacuum heat insulation material 43 is placed such that the plane of the vacuum heat insulation material 43 is parallel to the direction (the Z axial direction) perpendicular to a floor surface. With respect to the vacuum heat insulation material 43 placed in such a manner, L_a is the height of the vacuum heat insulation material 43 in the vertical direction, and T_a is the thickness of the vacuum heat insulation material 43. When obliquely inclined relative to the vertical direction by an angle θ , the vacuum heat insulation material 43 as illustrated in Fig. 13A is inclined as illustrated in Fig. 13B. In this state, the thickness of the vacuum heat insulation material 43 in the horizontal direction is $T_a/\sin\theta$. That is, the thickness of the vacuum heat insulation material 43 in a horizontal direction increases, depending on the angle θ . The height L_b indicated in Fig. 12 and the height L_a indicated in Fig. 13A satisfy the relationship of $L_b < L_a$.

[0063]

In embodiment 1, the vacuum heat insulation material 43 is provided in the door 11 as illustrated in Fig. 13B. That is, the vacuum heat insulation material 43 is provided in the door 11 such that it is inclined relative to the vertical direction. Thus, the vacuum heat insulation material 43 having a greater height L_a can be provided in the door 11. Furthermore, the thickness of the vacuum heat insulation material 43 in the horizontal direction increases as described with reference to Fig. 13B. Thus, as compared with the case illustrated in Fig. 13A, the amount of the vacuum heat insulation material 43 incorporated into the door 11 increases, thus improving the heat insulation performance.

[0064]

Although with reference to Fig. 12, the above description is made regarding the case where the number of ribs 46 provided at each of the top plate 37 and the bottom plate 38 is two, the number of ribs 46 provided at one or both of the top plate 37 and the bottom plate 38 is not limited to two, that is, it may be one, or three or more. In the case where the number of ribs 46 provided at one or both of the top plate 37 and the bottom plate 38 is one, it suffices that the length L_e as illustrated in Fig. 12 is increased and the rib 46 is provided at the center of vacuum heat insulation material having the length L_d . When the number of ribs 46 provided at each of the top plate 37 and the bottom plate 38 is one, for example, it is set that $L_e > (1/2) L_d$.

[0065]

The height of each of the ribs 46 provided at the top plate 37 may differ from that of each of the ribs 46 at the bottom plate 38. For example, in the case where the heights of the ribs 46 at the top plate 37 are greater than those of the ribs 46 at the bottom plate 38, the vacuum heat insulation material 43 can be prevented from coming off the upper ones of the ribs 46 and falling to the back plate 44 even when the vacuum heat insulation material 43 is inserted into the door while inclined relative to the vertical direction as illustrated in Fig. 13B. Furthermore, since the heights of the ribs 46 at the bottom plate 38 are set small, the worker can easily position a lower end of the vacuum heat insulation material 43 between the rib 46 and the sub handle 52 when inserting the vacuum heat insulation material 43 into the door 11 in a door production process.

[0066]

The refrigerator of embodiment 1 includes the box body 30 in which the heat insulation material is provided between the outer box 21 and the inner box 31, drawer compartments provided in the inner box 31 and each having an opening at the front of each of the drawer compartments, and the doors 9 to 12 which are moved forwards and backwards to open and close the drawer compartments. The doors 9 to 12 each include the main handle 51 provided on the upper side of each door, and the sub handle 52 provided on the lower side of each door.

[0067]

According to embodiment 1, since the drawer-type doors 9 to 12 are each provided with the handles on the upper and lower sides of each door, the user can easily put his or her fingers on either the handle on the upper side or that on the lower side of each door regardless of the height of the user, thus enabling the user to more easily open and close each door. If the user is short, he or she can easily put his or her fingers on the sub handle 52 on the lower side, and if the user is tall, he or she can easily put his or her fingers on the main handle 51 on the upper side. Furthermore, if the height of the user is about the average height for adults, he or she can put easily his or her fingers on both the main handle 51 on the upper side and the sub handle 52 on the lower side. If the user is tall, and sits on a chair, he or she can easily put his or her fingers on the sub handle 52 on the lower side. In such a manner, various users including short users, e.g., child users, and tall users, e.g., adjust users, can put their hands on any of the doors in various postures without taking an unnatural posture, and easily open and close the door.

[0068]

In the past, it has been hard for the user to hold a door with a single handle, when the user pulls out the door while putting his or her hand on the handle, for example, in order to remove the door for the purpose of cleaning a drawer compartment. Thus, there has been a risk that the user will drop the door when carrying the door while holding it with the single handle. In the case where the door is made of glass, the door is heavier than doors made of other materials, and the risk tends to rise. If the user drops a glass door, the door is broken. Furthermore, in the case where handles are provided on both sides of the door, the user holds any of the sides of the door with an associated one of the handles. Therefore, the user cannot easily hold the door, and easily drops it. By contrast, in the refrigerator according to embodiment 1, handles are provided on the upper and lower sides on the door of a drawer compartment, as a result of which the user can stably hold the door in such a manner as to sandwich the door from the upper and lower sides of the door. It is therefore possible to reduce the risk that the user will drop the door.

[0069]

In embodiment 1, the door 12 of the drawer compartment is made up of the top plate 39, the bottom plate 40, the back plate 44, the front plate 42 and the side plates 47 and 48; the main handle 51 is provided at the top plate 39, and the sub handle 52 is provided at the bottom plate 40. This configuration thus does not affect or limit the design of the front plate 42.

[0070]

In embodiment 1, the sub handle 52 is recessed upwards at the bottom plate 40. Since no recess is provided at the front plate 42, the design of the front plate 42 is not limited. Also, since no recess is provided at the back plate 44, the back plate 44 can be prevented from protruding toward an inner compartment side.

[0071]

In embodiment 1, in the case where the drawer-type doors 11 and 12 are provided vertically adjacent to each other, the sub handle 52 of the upper door 11 and the main handle 51 of the lower door 12 are disposed to face each other. Since common space is provided between the sub handle 52 on the upper side and the main handle 51 on the lower side, the user can put, through the space, his or her fingers on any of the sub handle 52 on the upper side and the main handle 51 on the lower side.

[0072]

In embodiment 1, the length T2 of the sub handle 52 in the depth direction is smaller than the length T1 of the main handle 51 in the depth direction, and the height H3 of the opening between the main handle 51 and the sub handle 52 is greater than or equal to the length T2 of the sub handle 52 (the average thickness of the middle fingers of adults) in the depth direction. Therefore, the sub handle 52 of the door 11 is provided to fall within the range of a shadow of the main handle 51 of the door 12, that is cast when the main handle 51 is projected, and user's fingers can be prevented from being caught between the doors 11 and 12 when the user puts the fingers on any of the sub handle 52 of the door 11 and the main handle 51 of the door 12 and pulls out the door.

[0073]

In embodiment 1, the depth H2 of the recess from the bottom plate 38 of the sub handle 52 of the door 11 may be smaller than the depth H1 of the recess from the top plate 39 of the main handle 51 of the door 12. In this case, an opening is provided at the front of the door 12 on the main handle 51, and space to be filled with the foam heat insulation material 19 can be provided at the front plate 41 of the sub handle 52 in the door 11, thereby improving the heat insulation performance in the vicinity of the sub handle 52.

[0074]

In embodiment 1, the ribs 46 for supporting the vacuum heat insulation material 43 are provided at the top plate 37 and the bottom plate 38 of the door 11. The vacuum heat insulation material 43 incorporated in the door is fixed to neither the front plate 41 on the design surface side nor the back plate 44 on the inner compartment side, and is supported by the ribs 46. In the past, it has been necessary to provide an auxiliary element such as a tape to fix the vacuum heat insulation material to the inside of a door. However, in embodiment 1, it is not necessary to provide such an auxiliary element such as a tape. It is therefore possible to simplify the manufacturing process, and reduce the manufacturing cost.

[0075]

In embodiment 1, the lengths of the upper rib 46 and the lower rib 46 in the width direction are smaller than the length of the vacuum heat insulation material 43 in the width direction. In this case, when the undiluted solution of urethane foam flows into blank space in the door in the foam formation process, hindering of the flow of the undiluted solution of urethane foam is reduced, thus ensuring a flow passage of the undiluted solution of urethane foam. As a result, the amount of the urethane foam in the door is prevented from being insufficient.

[0076]

In embodiment 1, the sum of the heights of the upper rib 46 and the lower rib 46 is smaller than the height of the vacuum heat insulation material. In this case, when the worker incorporates the vacuum heat insulation material 43 from a side of the door 11, the area of part of the vacuum heat insulation material 43 which rubs with the ribs

46 is small, and the worker can thus easily incorporate the vacuum heat insulation material 43 in the door 11. Furthermore, the risk that the outer packaging material 25 for the vacuum heat insulation material 43 will be broken due to the rubbing against with the ribs 46 can be reduced.

5 [0077]

In embodiment 1, the ribs 46 on the upper side and the ribs 46 on the lower side are provided closer to the back plate 44 than the main handle 51 and the sub handle 52. Thus, the vacuum heat insulation material 43 can be provided closer to the back plate 44 than the main handle 51 and the sub handle 52, and be incorporated in the door; that is, it is not directly bonded to the design surface. Since the ribs 46 are provided at locations separated from the front plate 41 serving as the design surface toward the inner compartment side, the vacuum heat insulation material 43 is not provided in close contact with the design surface. As a result, irregularities formed at the surface of the vacuum heat insulation material 43 are not transferred onto the design surface, thereby preventing deterioration of the appearance thereof. In addition, since the vacuum heat insulation material 43 is provided on the inner compartment side, transfer of heat into the compartment is reduced, thereby improving energy saving.

15 [0078]

In embodiment 1, space between the front plate 41 and the vacuum heat insulation material 43 and that between the back plate 44 and the vacuum heat insulation material 43 are filled with the foam heat insulation material 19. Since the vacuum heat insulation material 43 is separated from the front plate 41, and in addition, the space between the vacuum heat insulation material 43 and the front plate 41 is filled with the foam heat insulation material 19, transfer of heat into the compartment is further reduced.

25 [0079]

In embodiment 1, a plurality of ribs 46 may be provided at one of the top plate 37 and the bottom plate 38 of the door 11. In this case, it is possible to prevent displacement of the vacuum heat insulation material 43 even when the foam heat

insulation material 19 does not evenly apply a pressure on the vacuum heat insulation material 43 in the foam formation process.

[0080]

In addition, in embodiment 1, the vacuum heat insulation material 43 may be inclined with respect to the direction perpendicular to the bottom plate 38. In this case, the vacuum heat insulation material 43 having a greater height can be provided in the door 11 without changing the entire size of the door 11. As a result, as compared with the case where the vacuum heat insulation material 43 is provided to extend in the direction perpendicular to the bottom plate 38, the amount of the vacuum heat insulation material 43 provided in the door 11 is increased, thus improving the heat insulation performance.

[0081]

In recent years, in refrigerators, the amount of vacuum heat insulation material incorporated therein has been increased to improve energy saving performance.

Thus, vacuum heat insulation material has been incorporated in doors. How to provide the vacuum heat insulation material affects the energy saving performance and the manufacturing cost. In the past, doors have been made to have a thin heat insulation wall in order that it be shaped to include a handle. Thus, the amount of transfer of heat into a compartment through such a door has been large, thus adversely affecting the energy saving performance. Furthermore, the size of the vacuum heat insulation material has been limited, since the vacuum heat insulation material interferes with the handle. Thus, it has been impossible or hard to improve a covering rate of the vacuum heat insulation material incorporated in the door.

[0082]

For example, in a well-known refrigerator, a vacuum heat insulation material is provided in close contact with the front plate of a door, and handles are provided on both side surfaces of the vacuum heat insulation material (for example, Patent Literature 3). However, because of provision of the handles on the both side surfaces of the vacuum heat insulation material, the size of the vacuum heat insulation material to be incorporated into the door is restricted in the lateral direction thereof. As a result,

the vacuum heat insulation material is shortened in the lateral direction by the depth of the handle. Furthermore, because of addition of the handles with no design idea, the thickness of the vacuum heat insulation material at the handle is reduced. In these cases, the energy saving performance deteriorates. On the other hand, in the case where the vacuum heat insulation material is directly bonded to the design surface side, irregularities of the surface of the vacuum heat insulation material may be transferred onto the design surface of the door. Because of bonding of the vacuum heat insulation material to the front plate, the design may be deteriorated, and the manufacturing cost and the work hours may be increased.

[0083]

By contrast, in the refrigerator according to embodiment 1, as described above, the vacuum heat insulation material 43 is provided between a handle and the inner compartment side in a door as described above. In the past, there has been possibility that the heat insulation performance will be deteriorated because of a small thickness of the heat insulation material on the back surface side of the handle. In embodiment 1, the back surface side of the handle is covered by the vacuum heat insulation material to reduce transfer of heat into the compartment. Furthermore, in embodiment 1, since the vacuum heat insulation material 43 is inclined, the size of the vacuum heat insulation material 43 can be increased to increase the covering rate of the vacuum heat insulation material 43 at the front surface of the door.

Reference Signs List

[0084]

1	refrigerator	2	refrigerator compartment	3	ice-making compartment
4	first freezer compartment	5	second freezer compartment	6	
7 to 12	door	13	upper lid	14	controller
15	vegetable compartment	16	fan	17	cooler
	vacuum heat insulation material	18	compressor	19	
	foam heat insulation material	20	back plate	21	outer box
		21a	R bent part		
22	heat transfer pipe	23	vacuum heat insulation material	24	
	stacked body	24a to 24c	fiber layer	25	outer packaging material
26	core				
27	freezer compartment	29	recess	30	box body
31	inner				

box 31a to-be-engaged portion 32 side plate 33 injection port 37,
39 top plate 38 40 bottom plate 41, 42 front plate 43 vacuum heat
insulation material 44 back plate 45 gasket 46 rib 47, 48 side
plate 49, 50 partition 51 main handle 52 sub handle 55 center line
5 57 storage case 57a flange 58 support 58a guide F
circle

CLAIMS

[Claim 1]

A refrigerator comprising:

a box body provided with an outer box and an inner box, between which heat
5 insulation material is provided;

a drawer compartment provided in the inner box and having an opening at a
front of the drawer compartment; and

a door configured to open and close the opening of the drawer compartment
when moved forwards and backwards, respectively, the door including

10 a main handle provided on an upper side, and

a sub handle provided on a lower side,

wherein the door is made up of a top plate, a bottom plate, a back plate, a front
plate and side plates, the main handle is provided at the top plate, and the sub handle
is provided at the bottom plate,

15 wherein two doors each provided as the door are disposed vertically adjacent
to each other,

wherein the sub handle of an upper one of the two doors and the main handle
of a lower one of the two doors are located to face each other,

20 wherein a length of the sub handle of the upper door in a depth direction
thereof is smaller than a depth of the main handle of the lower door in a depth
direction thereof, and

wherein a height of an opening between the sub handle of the upper door and
the main handle of the lower door is greater than or equal to the length of the sub
handle in the depth direction.

25 [Claim 2]

The refrigerator of claim 1, wherein

a length of the sub handle provided at the upper door in a width direction
thereof is smaller than a length of the main handle provided at the lower door in a
width direction thereof.

[Claim 3]

The refrigerator of claim 2, wherein the sub handle is shaped to have a recess which is recessed upwards from the bottom plate.

5 [Claim 4]

The refrigerator of claim 3, wherein a depth of the recess of the sub handle of the upper door from the bottom plate is smaller than a depth of a recess of the main handle of the lower door from the top plate.

[Claim 5]

10 The refrigerator of any one of claims 1 to 4, wherein the door includes a rectangular vacuum heat insulation material, an upper rib provided at the top plate and configured to support the vacuum heat insulation material, and

a lower rib provided at the bottom plate and configured to support the vacuum heat insulation material.

15

[Claim 6]

The refrigerator of claim 5, wherein lengths of the upper rib and the lower rib in the width direction are smaller than a length of the vacuum heat insulation material disposed in the door in the width direction.

20 [Claim 7]

The refrigerator of claim 5 or 6, wherein a sum of heights of the upper rib and the lower rib is smaller than a height of the vacuum heat insulation material provided in the door.

[Claim 8]

25 The refrigerator of any one of claims 5 to 7, wherein the upper rib and the lower rib are provided closer to the back plate than the main handle and the sub handle.

[Claim 9]

The refrigerator of any one of claims 5 to 8, wherein space between the front plate and the vacuum heat insulation material and space between the back plate and the vacuum heat insulation material are filled with foam heat insulation material.

30

[Claim 10]

The refrigerator of any one of claims 5 to 9, wherein the upper and lower ribs are provided such that a plurality of the upper ribs or lower ribs are provided.

5 [Claim 11]

The refrigerator of any one of claims 5 to 10, wherein the vacuum heat insulation material is inclined relative to a direction perpendicular to the bottom plate.