

## DESCRIPTION

### REFRIGERATOR

#### 5 Technical Field

The present invention relates to a refrigerator, and more particularly to a refrigerator having a storage compartment into and out of which a container accommodating food is put and taken by a drawer type door.

#### 10 Background Art

A refrigerator is known which comprises a refrigerator body provided with a front opening closed and opened by a drawer type door. It is further known that a storage container is provided in a storage compartment defined in the back of the door. A  
15 plurality of storage containers are generally provided in a vertical arrangement in the refrigerator of the type that storage containers are provided in the back of the door. Each of the vertically arranged storage containers is of the drawer type. Furthermore, all the storage containers are drawn out together  
20 when the drawer type door is opened.

In the refrigerator of the above-described type, however, all of the storage containers come out of the storage compartment when the door is drawn out. Accordingly, a drawing operation necessitates a relatively larger force. Furthermore, when the  
25 lowest storage container is drawn out, all the other storage containers are located over the lowest one. Therefore, food cannot be taken out of the lowest storage container unless the upper storage containers are moved to the storage compartment

side. As a result, the usability of the refrigerator is low.

In view of the aforesaid problem, Japanese patent publication, JP-A-2006-189224, discloses a construction that only part of a plurality of storage containers are drawn out  
5 together with a door, while the other storage container or containers remain in the storage compartment.

In the refrigerator disclosed in the above-referenced publication, only the storage containers other than the storage containers to remain in the storage compartment are drawn out  
10 together with the door when the door is drawn out. Consequently, a force necessary for drawing out the door and storage containers can be reduced. Furthermore, only the storage containers other than the storage containers remaining in the storage compartment are located over the lowest storage container. Accordingly,  
15 food can be taken out of the lowest storage container just when the storage containers other than the storage containers remaining in the storage compartment are moved backward, whereupon the usability of the refrigerator can be improved.

However, the storage containers of the refrigerator  
20 disclosed in the above publication comprise three or lowest, middle and uppermost containers. The door is drawn out together with the lowest storage container having a largest volume of the three and the middle storage container having a second largest volume when drawn out. The uppermost storage container having  
25 a smallest volume remains in the storage compartment.

In ordinary refrigerators, a large amount of boxed or packet of long-life food is usually stored in a lowest storage compartment. Long-life food is also stored in the middle storage

container with the second largest volume. On the other hand, leftover food or the like is usually stored in the uppermost storage container with the smallest volume. As a result, the uppermost storage container has a highest frequency in taking-out and putting-in of food.

In the above-described refrigerator, however, the uppermost storage container remains in the storage compartment when the door has been drawn out. Accordingly, after the door has been drawn out, the uppermost storage compartment further needs to be drawn out disadvantageously. As a result, the usability of the refrigerator is low. Additionally, the user has a difficulty in viewing the uppermost storage container remaining in the storage compartment and tends to forget the uppermost storage container. As a result, the usability of the refrigerator is also low.

#### Disclosure of the Invention

##### Problem to Be Overcome by the Invention

The invention was made in view of the foregoing circumstances and embodiments of the invention seek to provide a refrigerator in which a force necessary to draw out the door can be reduced, food can easily be taken out of the drawn lowest storage container, and the usability of the storage container into and out of which food is put and taken with the highest frequency can be improved.

##### Means for Overcoming the Problem

In accordance with an aspect of the present invention, there is provided a refrigerator comprising a refrigerator body having a

storage compartment and an opening in a front of the storage compartment; a door provided so as to be drawable from the refrigerator body, thereby being capable of opening and closing the storage compartment, and a plurality of storage containers housed in the storage compartment in the back of the door so as to be vertically arranged and so as to be capable of being put into and taken out of the storage compartment, the storage containers including a plurality of storage containers which are drawn out together with the door and another storage containers which remains in the storage compartment, characterized in that: the storage containers include a middle located storage container and a lower storage container both drawn out together with the door when the door is drawn out and an upper storage container remaining in the storage container when the door is drawn out, the upper storage container having a volume which is intermediate between volumes of the middle and lower storage containers, the uppermost container drawn out together with the door, which uppermost container is the middle storage container, has a smallest volume of the storage containers; the upper storage container which is drawn out independent of the door after the middle and lower storage containers have been drawn out with the door, has a pair of flanges on right and left sides thereof respectively, the flanges being moved on a pair of pulleys provided on the refrigerator body respectively, and said upper storage container is drawn out by a smaller operating force as compared with a case where the lower storage container having the largest volume is drawn out.

According to the foregoing construction, when the door is

drawn out, part of a plurality of storage containers are drawn out together with the door, while the other storage container or containers remain in the storage compartment. Accordingly, only part of the storage containers are drawn out together with the door. As a result, a force necessary for the drawing operation is reduced. Furthermore, the storage container or containers other than the drawn storage container or containers remaining in the storage compartment are located over the drawn lowest storage container. Accordingly, food can be taken out of the drawn lowest storage container when the storage container or containers located over the drawn lowest storage container are just moved to the storage compartment side. Consequently, the usability of the storage container into and out of which food is put and taken with the highest frequency can be improved.

Of a plurality of vertically arranged storage containers

the storage container which has a smallest volume and a highest frequency in taking in and out food is located uppermost of the plural drawn storage containers. Accordingly, since the storage container is drawn out together with the door, the door need not  
5 be re-drawn after having been drawn out. Additionally, the drawn uppermost storage container is easy to view outside the refrigerator body. Consequently, the usability of the storage container having a highest frequency in taking in and out food can be improved.

10

#### Brief Description of the Drawings

FIG. 1 is a longitudinal side section of a major part of a refrigerator of a first embodiment of the present invention, showing the condition where a door is open;

15 FIG. 2 is a longitudinal side section of the major part of the refrigerator, showing the condition where the door is closed;

FIG. 3 is a perspective view of a plurality of vertically arranged storage containers;

20 FIG. 4 is a partially enlarged longitudinal front section taken along line 4-4 in FIG. 2;

FIG. 5 is a longitudinal side section of the major part, showing the condition where the door is open and all storage containers have been drawn out;

25 FIG. 6 is a view similar to FIG. 1, showing a second embodiment of the invention;

FIG. 7 is a view similar to FIG. 1, showing a third embodiment of the invention;

FIG. 8 is a front view of the refrigerator of a fourth

embodiment, showing the condition where part of the doors are open;

FIG. 9 is an enlarged longitudinal side section showing the condition where the door of a freezing compartment is open as shown in FIG. 8;

FIG. 10 is an enlarged longitudinal side section showing the same condition as FIG. 9 in the related art;

FIG. 11 is an enlarged longitudinal section showing the condition where the door of a vegetable compartment is open as shown in FIG. 8;

FIG. 12 is an enlarged longitudinal side section showing the same condition as FIG. 11 in the related art; and

FIG. 13 is a longitudinal side section of a freezing compartment of another embodiment of the invention.

## Best Mode for Carrying Out the Invention

### First embodiment

A first embodiment of the invention will now be described with reference to FIGS. 1 to 5. Referring to FIG. 2, a lower part of a refrigerator body 1 is shown. A whole interior of the lower part of the refrigerator body 1 shown in FIG. 2 is a freezing compartment serving as a storage compartment. The freezing compartment is divided by a partition plate 2 and a crosspiece 3 mounted on a front end of the partition plate 2 into an upper freezing compartment 4 and a lower freezing compartment 5.

A freezing evaporator compartment 6 is provided in the back of rear walls of the upper and lower freezing compartments 4 and 5. The freezing evaporator compartment 6 is common to the upper

and lower freezing compartments 4 and 5. The freezing evaporator compartment 6 includes a partition wall 7, a freezing evaporator 8 and a freezing fan 9. Air in the upper and lower freezing compartments 4 and 5 is circulated by the partition wall 7, the  
5 freezing evaporator 8 and the freezing fan 9 as shown by arrows in FIG. 2. With this, the circulated air is cooled so that temperatures in the upper and lower freezing compartments 4 and 5 are controlled so as to be equal to respective proper freezing temperatures.

10 The refrigerator body 1 has a mechanical compartment 10 in a lower rear thereof. A compressor 11 is provided in the mechanical compartment 10. A refrigerating cycle is constituted by the compressor 11, a condenser (not shown), a throttle (not shown), the aforesaid freezing evaporator 8, a refrigerating  
15 evaporator (not shown) and the like.

The upper and lower freezing compartments 4 and 5 are formed with front openings 12 and 13 which are opened and closed by doors 14 and 15, respectively. The door 14 of the upper freezing compartment 4 has right and left sides one of which is hingedly  
20 mounted on the refrigerator body 1 although the hingedly mounting structure is not shown. The door 14 is caused to pivot about the hinge, thereby opening and closing the opening 12.

On the other hand, the door 15 of the lower freezing compartment 5 is of the drawing type and is moved forward from  
25 the opening 13 thereby to be spaced away from the opening 13 as shown in FIG. 1. Furthermore, the door 15 is moved backward thereby to close the opening 13 as shown in FIG. 2. Thus, the door 15 opens and closes the opening 13. Part of an interior

of the refrigerator body 1 located in the rear of the door 15 is defined as the lower freezing compartment 5. The lower freezing compartment 5 accommodates a plurality of vertically arranged storage containers. In the embodiment, the storage containers accommodated in the lower freezing compartment 5 include three vertically arranged storage containers, that is, an upper storage container 16, a middle storage container 17 and a lower storage container 18.

The lower storage container 18 is a deep generally rectangular parallelepiped container with an open top as shown in FIG. 3. The lower storage container 18 includes right and left side walls having flanges 19 formed on the tops respectively. A rectangular support frame 20 is mounted on a back side of the door 15 as shown in FIG. 2. The lower storage container 18 is put into the support frame 20 from above and the flange 19 is placed on the support frame 20, whereupon the lower storage container 18 is detachably supported on the door 15 provided with the support frame 20.

Furthermore, a pair of moveable rails 21 are mounted on right and left side walls of the support frame 20 so as to extend in the front-back direction as shown in FIG. 4, respectively. A pair of fixed rails 22 are mounted on right and left side walls of the lower freezing compartment 5 so as to extend in the back-forth direction, respectively. The fixed rails 22 are provided with respective slide rails 22a along which the moveable rails 21 are slidable. As a result, when the slide rail 22a and the moveable rail 21 are slid, the support arm 20 is taken out and put into the lower freezing compartment 5 together with the

lower storage container 18. In this case, the support frame 20 is taken out and put into the lower freezing compartment 5 when the door 15 is opened and closed or moved in the back-forth direction.

5       The middle storage container 17 is a shallow generally rectangular parallelepiped container with an open top as shown in FIG. 3. Accordingly, the middle storage container 17 has a smaller volume than the lower storage container 18. The middle storage container 17 has flanges 23 formed on tops of right and  
10   left side walls respectively. Each flange 23 has a convex portion 24 which is formed on the front thereof so as to protrude downward. Three protrusions 25 to 27 are formed on each of right and left ends of the bottom of the middle storage container 17. The middle protrusion 26 is longer than the other two protrusions  
15   25 and 27.

      The lower storage container 18 has two notches 28 formed in an upper part of a rear wall thereof. A rear bottom of the middle storage container 17 is placed on right and left ends 28a of the notch 28 as shown in FIG. 2. As a result, the middle storage  
20   container 17 is accommodated in the lower storage container 18. The flanges 23 of the middle storage container 17 are placed on the upper edges 18a of right and left side walls of the lower storage container 18. Only one of the notches 28 is shown in FIG. 3.

25       Furthermore, the lower storage container 18 has a number of holes 29 formed in the middle portions of right and left side walls thereof for the purpose of cold air reduction. The lower storage container 18 further has a pair of rails 30 which are

formed on middle inner faces of the right and left side walls thereof so as to extend in the back-forth direction respectively. The front protrusions 25 of the middle storage container 17 are located on the rails 30 respectively.

5           The lower storage container 18 further has a pair of downwardly convex recesses 31 formed in front portions of upper edges of the right and left side walls thereof respectively. The protrusions 24 of the middle storage container 17 are engaged with the recesses 31 respectively, whereupon the middle storage  
10   container 17 is taken out of and put into the lower freezing compartment 5 together with the lower storage container 18 as shown in FIG. 1. Thus, when the middle storage container 17 is pushed rearward with a force larger than an engaging force between the recesses 31 and the protrusions 24, the protrusions 24 are  
15   disengaged from the respective recesses 31 such that the middle storage container 17 is moved rearward on the lower storage container 18.

Accordingly, when food is put into and taken out of the lower storage container 18 after the container 18 and middle storage  
20   container 17 have been drawn out together with the door 15, the middle storage container 17 is pushed rearward with a force larger than an engaging force between the recesses 31 and the protrusions 24 as described above. The middle protrusions 26 abut against the right and left ends 28a of the notches 28 of the lower storage  
25   container 18, thereby serving as stoppers, respectively. As a result, further rearward movement of the middle storage container 17 is limited. Furthermore, when to be returned forward from a rearward position, the middle storage container

17 is drawn forward until the recesses 31 and the protrusions 24 are engaged with each other.

The upper storage container 16 is a shallow generally rectangular parallelepiped container with an open top as shown in FIG. 3. The upper storage container 16 has a volume smaller than a volume of the lower storage container 18 and larger than a volume of the middle storage container 17. More specifically, the lower storage container 18 has a largest volume of the three vertically arranged storage containers. The upper storage container 16 has a second largest volume and the middle storage container 17 has a smallest volume.

The upper storage container 16 has flanges 32 formed on right and left side walls thereof respectively. Only the right flange 32 is shown in FIG. 3. Each flange 32 has a protrusion 33 on a rear part thereof. The lower freezing compartment 5 has a pair of rails 34 formed on upper parts of right and left inner side walls thereof respectively as shown by dotted line in FIG. 2. The rails 34 extend in the back-forth direction and are provided with two pulleys 35 located on front portions thereof respectively. The protrusions 33 of the upper storage container 16 are placed in the rails 34 respectively. The flanges 32 are placed on the pulleys 35 respectively.

In the above-described construction, the protrusions 33 of the upper storage compartment 16 are slid on the rails 34 of the lower freezing compartment 5 respectively. The flanges 32 are moved on the pulleys 35 while turning the pulleys 35. As a result, the upper storage compartment 16 is moved over the middle storage container 17 with a space being defined therebetween.

Consequently, when the door 15 has been opened, the middle and lower storage compartments 17 and 18 are drawn out as described above while the upper storage compartment 16 remains in the lower freezing compartment 5, as shown in FIG. 1. The upper storage container 16 is moved so as to be drawn out and into the lower freezing compartment 5 while the middle and lower storage containers 17 and 18 are assuming respective drawn positions together with the door 15, as shown in FIG. 5.

The refrigerator body 1 has the front opening 13 which is opened and closed by the drawer type door 15. The plural drawer-type storage containers 16 to 18 are accommodated in the interior of the refrigerator body 1 located in the rear of the door 15. Accordingly, when the door 15 is drawn out, part (in plural number) of the storage containers 16 to 18, that is, the middle and lower storage containers 17 and 18 other than the upper storage container 16 are also drawn out together with the door 15. Consequently, the upper storage container 16 remains in the lower freezing compartment 5.

Accordingly, when the door 15 is drawn out, only the middle and lower storage containers 17 and 18 other than the upper storage container 16 are drawn out together with the door 15. Consequently, a force necessary for drawing out the door 15 is reduced. Furthermore, only the middle storage container 17 is located on the lowest or lower storage container 18 drawn out while the upper storage container 16 remains in the lower freezing compartment 5. Accordingly, food can be taken out of the lowest storage container 18 when only the middle storage container 17 is moved into the refrigerator body 1. Consequently, the usability of

the storage containers can be improved.

Furthermore, the middle storage container 17 has a smallest volume and a highest frequency of taking in and out among the plural storage containers 16 to 18 which are accommodated in the lower freezing compartment 5 of the refrigerator body 1 in the back of the door 15 so as to be taken in and out in a drawing manner. The middle storage container 17 is located upper than the lower storage container 18 when these storage containers 17 and 18 are drawn out together with the door 15. Accordingly, the middle storage container 17 need not be re-drawn out after the door 15 has been drawn out. Furthermore, the middle storage container 17 located upper than the lower storage container 18 can be easily viewed outside the refrigerator body 1. Consequently, the usability of the storage container 17 having a highest frequency of taking in and out food can be improved.

Additionally, the storage containers include three vertically arranged storage containers, that is, the upper, middle and lower storage containers 16 to 18 in the embodiment. The lower and middle storage containers 18 and 17 are drawn out together with the door 15, whereas the upper storage container 16 remains in the lower freezing compartment 5. The upper storage container 16 has a volume which is between the volumes of the middle and lower storage containers 17 and 18. As a result, the upper storage container 16 further drawn out after the door 15 has been drawn out together with the middle and lower storage containers 17 and 18 has a small volume. Accordingly, an operating force necessitated in drawing the door 15 is reduced as compared with the case where the lower storage container 18

having the largest volume is drawn out after the door 15 has been drawn out. Consequently, the operability of the storage containers can further be improved.

Still furthermore, when the door 15 is drawn out, the upper  
5 storage container 16 remaining in the lower freezing compartment  
5 is moved by pulleys 35 over the middle storage container 17  
located upper than the lower storage container 18 when these  
containers 17 and 18 are drawn out together with the door 15.  
Consequently, the upper storage container 16 can smoothly be  
10 taken into and out of the lower freezing compartment 5.

#### Second embodiment

The refrigerator of a second embodiment will be described.  
In the second embodiment, parts identical with or similar to those  
in the first embodiment are labeled by the same reference numerals  
15 as in the first embodiment and the description of the parts will  
be eliminated. Only the differences of the second embodiment  
from the first embodiment will now be described.

In the second embodiment, as shown in FIG. 6, the upper  
storage container 16 has a pair of protrusions 41 and a pair of  
20 legs 42. The protrusions 41 protrude sideways from upper rear  
portions of the right and left side walls of the upper container  
16 respectively. The legs 42 are provided on the front end  
portions of the bottom respectively. A pair of rails 43  
extending in the back-forth direction are provided on upper  
25 portions of the right and left side walls of the lower freezing  
compartment 5 respectively. The protrusions 41 of the upper  
storage compartment 16 are placed on the respective rails 43.  
The legs 42 of the upper storage compartment 16 are placed on

right and left upper edges 17a of the middle storage container 17.

In the above-described construction, the protrusions 41 of the upper storage container 16 are moved along the rails 43 of the lower freezing compartment 5, and the legs 42 of the upper storage container 16 are moved along the upper edges 17a of the middle storage container 17 respectively. Accordingly, the upper storage container 16 is moved over the middle storage container 17. In this case, the protrusions 41 of the upper storage compartment 16 are brought into contact with the middle storage container 17, and the upper storage container 16 is moved over the middle storage container 17 while being in contact with the rails 43. When the middle storage container 17 is moved, the recesses 31 of the lower storage compartment 18 can be prevented from being hooked, for example, the engagement of the respective protrusions 24 with the recesses 31. As a result, when the door 15 has been drawn out, the upper storage container 16 also remains in the lower freezing compartment 5 and the middle and lower storage containers 17 and 18 are also drawn out together with the door 15, as shown in FIG. 6.

Furthermore, when the door 15 has been drawn out, the legs 42 of the upper storage container 16 remaining in the refrigerator body 1 are placed on a rear portion of the middle storage container 17 located higher than the lower storage container 18. Consequently, when the storage container 16 is drawn out, the upper storage container 16 can smoothly be drawn out, differing from the case where the upper storage container 16 spaced away from the middle storage container 17 is transferred to the middle

storage container 17.

#### Third embodiment

A third embodiment of the invention will be described. In the third embodiment, parts identical with or similar to those in the first and second embodiments are labeled by the same reference numerals as in the first and second embodiments and the description of the parts will be eliminated. Only the differences of the third embodiment from the first and second embodiments will now be described.

In the third embodiment, as shown in FIG. 7, the legs 42 of the upper storage container 16 in the second embodiment are changed to pulleys 51 in the third embodiment. The pulleys 51 are moved along the upper edges 17a of the right and left side walls of the middle storage container 17 respectively. Accordingly, since the upper storage container 16 is moved along the middle storage container 17, the upper storage container 16 can smoothly be drawn out as in the first embodiment.

In the foregoing first to third embodiments, the upper storage container 16 remains in the lower freezing compartment 5 when the door 15 is drawn out. However, the upper storage container 16 may be drawn out in the middle of the drawing of the door 15. In this case, the force necessary for the drawing is reduced when the upper storage container 16 closes only part of the upper opening of the middle storage container 17. Furthermore, a large force is not necessitated either when the upper storage container 16 drawn out in the middle of the drawing of the door 15 is moved into the lower freezing compartment 15. In addition, in this case, the upper storage container 16 does

not obstruct food taken into and out of the middle storage container 17 having been drawn out beneath the upper storage container 16. Consequently, the construction that the upper storage container 16 is drawn out together with the door 15 in the middle of the drawing of the door 15 is included as the storage container remaining in the refrigerator body 1 when the door 15 is drawn out.

In other respects, the invention should not be limited to the first to third embodiments described above with reference to the accompanying drawings. In particular, the part of the interior of the refrigerator body 1 located in the rear of the door 5 may be a storage container other than the freezing compartment. Furthermore, the number of vertically arranged storage containers housed in the may be larger than 3. Thus, the invention may be modified in practice suitably without departing from the gist thereof.

#### Fourth embodiment

A fourth embodiment of the invention will be described. FIG. 8 is a front view of the refrigerator of the fourth embodiment. The refrigerator comprises the refrigerator body 101 further comprising a heat-insulating box formed by filling a heat insulating material between an outer casing forming an outer shell and an inner casing defining a storage space. The refrigerator body 101 defines therein an uppermost cold storage compartment 102 and an ice-making compartment 103 which has a relatively smaller volume and is equipped with an automatic ice maker and a temperature-changeable temperature compartment 104 located in parallel with the ice-making compartment 103. The

ice-making compartment 103 and the temperature-changeable compartment 104 are located below the cold storage compartment 102. A vegetable compartment 105 is provided below the ice-making compartment 103 and the temperature-changeable compartment 104. A freezing compartment 106 is provided below the vegetable compartment 105. The vegetable compartment 105 and the freezing compartment 106 are independent of each other. Dedicated doors are provided for closing and opening front openings of the cold storage compartment 102, the ice-making compartment 103, the temperature-changeable compartment 104 and the vegetable compartment 105 and the freezing compartment 106 respectively.

The cold storage compartment 102 has a largest volume and a high frequency of use. Accordingly, a clamshell door of the cold storage compartment 102 is hingedly mounted on the opposite sides of the front opening. The storage compartments including the ice-making and temperature-changeable compartments 103 and 104, the vegetable compartment 105 and the freezing compartment 106 are located below the cold storage compartment 102 sequentially. Each of these storage compartments 103 to 106 has a smaller accommodation capacity than the cold storage compartment 102 and is located so as to be located lower than the waist of the user. Consequently, for the purpose of improving the usability, a container held on a support frame mounted on the rear of each door is of a well known drawing type in which each container is moved in the back-forth direction along the rails mounted on an inner wall of each storage compartment. Each container is drawn out of the corresponding storage

compartment when the drawing type door is opened. As a result, food can be put into and taken out of each container through an upper opening of each container.

5 A machine compartment 110 is defined in the rear of the freezing compartment 106 located lowest. The machine compartment 110 accommodates the evaporator 107 cooling the atmosphere in each storage compartment as shown in FIG. 9. As a result, the freezing compartment 106 has a smaller depthwise dimension than the other compartments.

10 A cold storage space such as the cold storage compartment 102 and a freezing storage space such the freezing compartment 106 are cooled by the refrigerating cycle comprising the evaporator 107 and the compressor 109. Cold air generated by the evaporator 107 is supplied into each storage space, thereby  
15 cooling the atmosphere to a predetermined temperature. The cold air supplied from the evaporator 107 is blown into the freezing compartment 106 by a fan (not shown) provided in an upper interior of the compartment 106 so that the atmosphere in the freezing compartment 106 is cooled to a predetermined temperature. The  
20 cold air supplied into the freezing compartment 106 is circulated through the ice-making compartment 103 and the temperature changeable compartment 104 to refrigerate atmospheres in these compartments, thereafter returning to the evaporator 107.

The freezing compartment 106 has a pair of right and left  
25 support frames (not shown) on the inside of the door 111 capable of opening and closing the front opening thereof. Rail members disposed on both side walls of the freezing compartment 106 in the back-forth direction. The rail members hold an

accommodation container 112 for accommodating frozen food. As a result, the accommodation container 112 is of the drawing type and is slidable in the back-forth direction.

The accommodation container 112 is made from synthetic  
5 resin by injection molding and is a deep generally rectangular parallelepiped with an upper opening. The accommodation container 112 has a flange form on a peripheral edge of the opening. The flange covers almost entire opening of the accommodation container 112, and part of the front edge is cut off. As a result,  
10 a relatively shallower dish shaped middle container 113 is placed on the front edge of the accommodation container 112. The middle container 113 has a rearward recess which is used to accommodate an ice-making milk carton having a substantial height.

The middle container 113 is drawn out to a large extent until  
15 the rear end thereof is located in front of the front opening of the freezing compartment 116 with the accommodation container 112. The middle container 113 can be drawn out and accommodated by moving the middle container 113 in the back-forth direction over the flange of the accommodation container 112 so that the  
20 upper opening of the accommodation container 112 is opened and closed.

An upper container 115 is provided over the accommodation container 112 and the middle container 113. The upper container 115 is drawn out of and housed into the interior of the  
25 refrigerator independently without relation to the opening and closure of the middle container 113 and the freezing container door 111. The upper container 115 has a flange which is formed on the opening side edge and directly supported by support rails

which are provided on the side walls of the freezing compartment 106 so as to protrude inward. As a result, the upper container 115 is moveable in the back-forth direction although located over the middle container 113. Consequently, no large load is exerted on the freezing compartment door 111, the middle container 113 and the rail members supporting the lower accommodation container 112. With this, the upper container 115 is not linked to the opening of the freezing compartment 111. Accordingly, the upper container 115 can be drawn out of or put into the freezing compartment 115 independently using a grip formed on the front wall 115a located near the rear of the freezing compartment door 111.

In the embodiment, the upper container 115 is deeper than the middle container 113. More specifically, the upper container 115 has a depth D1 which is set at 160 mm. On the other hand, the middle container 114 has a depth D2 which is set at a value ranging from 100 mm to 110 mm. Furthermore, the accommodation container 112 has a substantial depth D3 from the bottom of the middle container 114 to the depth of the accommodation container 112. The depth D3 of the accommodation container 112 is set at a value ranging from 160 mm to 170 mm.

Food to be accommodated in the containers is classified according to the difference in depth and presence or absence of the link to the freezing compartment door 111. For example, relatively larger repeatedly used frozen food is accommodated in the lowest accommodation container 112 which is opened and closed in association with the freezing compartment door 111. Relatively smaller frequently used food is accommodated in the

shallow middle container 113. Accordingly, since the accommodation container 112 and the middle container 113 are drawn out in association with the opening of the freezing compartment door 111, frequently used food can be put into and  
5 taken out of either container 112 or 113, whereupon the usability of the containers can be improved.

Larger food aimed at a relatively longer period of storage is accommodated in the upper container 115. The upper container 115 allows enough space for food since the upper container 115  
10 has a larger depth D1. Furthermore, since the upper container 115 is not linked to the opening and closure of the freezing compartment door 111, food is maintained in an accommodated state in the compartment. Accordingly, the upper container 115 can be drawn out optionally when the need arises. As a result, since  
15 the upper container 115 is not drawn out every time the freezing compartment door 111 is opened, the contact of food with air at the room temperature is reduced. Consequently, since an adverse effect of the outside air on food accommodated in the upper container 115 is reduced, stability of food storage can be  
20 improved.

When arranged as described above, the drawer-type accommodation container 112, the middle container 113 and the upper container 115 can effectively be used according to a shape and size of food to be stored, frequency in use and application  
25 of food to be stored and linkage to the opening and closure of the freezing compartment door 111.

Furthermore, the depths of the containers 112, 113 and 115 disposed inside the drawer-type freezing compartment door 111

are set as described above. In particular, the upper storage container 115 located highest of the three has the depth D1 larger than the depth D2 of the middle storage container 113. Consequently, when the freezing compartment door 111 is drawn out, the front wall 115a of the upper storage container 115 can be viewed by the user standing in front of the door 111 without being hidden behind a door of another storage compartment located over the upper storage container 115. Consequently, the upper storage container 115 and food stored therein can easily be recognized.

The foregoing construction is based on the results of a plurality of experiments carried out by the inventors with a dozen females. More specifically, a user assuming a position where he or she has drawn out the door bends forward in order to put and take food into and out of the containers of a refrigerator with the construction that three vertically arranged accommodation containers are provided in a storage compartment with an ordinary drawer-type door. In this case, reference symbol H1 designates an average eye location of the user which is represented as a height from the floor. The eye location H1 is 1330 mm high. Furthermore, an eye location from the front of the refrigerator varies between 323 mm and 523 mm and is averaged to 417 mm.

The ceiling of the freezing compartment 106 disposed lowest in the refrigerator body 101 of almost all refrigerators used in the experiment includes a ceiling which is 550mm high from the floor. When the containers are constructed so as to have conventional depths respectively and the shallow upper container 215 is

located below the lower edge of the vegetable compartment door 216, the front wall 215a of the upper container 215 is hidden behind the vegetable compartment door 216 from the user's eyes as shown by line of sight in FIG. 10. As a result, the user has a difficulty in viewing the upper container 215 and needs to bend his or her body enormously to view the front wall 215a. On the other hand, when the depth D1' of the upper container 215 is set at 90 mm or above in the same manner as depth D1 in FIG. 9 similar to FIG. 10, the front wall 115a of the upper container 115 is visible when the freezing compartment door 111 is drawn out only a predetermined amount without opening the door 111 full. As a result, the presence of the upper container 115 can easily be confirmed. Furthermore, when the depth D1 of the upper container 215 is set at 160 mm, the experiments showed that the front wall 215a of the upper container 215 was visible.

Accordingly, in order that the user may view the uppermost container 115 with the freezing compartment door 111 having been drawn out, the depth of the upper container needs to be set in view of the foregoing. For this purpose, the other containers in the cold storage compartment having a limited overall height, that is, the middle container 113 and the lower accommodation container 112 need to have respective changed depths.

In the embodiment, the containers 112 and 113 are linked to the opening and closure of the freezing compartment door 111, and the container 112 has a high frequency in taking in and out food and accommodates a relatively larger food. Accordingly, the depth D3 of the lower accommodation container 112 is set so as to be ranged from 160 mm to 170 mm. Furthermore, the shallow

middle container 113 accommodates frequently used food and has a depth D2 set so as to be smaller than the depth of the upper container 115 and ranging from 100 mm to 110 mm.

Of the vertically arranged three containers, the depth D1  
5 of the upper container 115 independent of the freezing compartment door 111 is set so as to be larger than the depth D2 of the middle container 113 linked to the drawer-type freezing compartment door 111. As a result, the accommodation container 112 and the middle container 113 are drawn out with the opening  
10 operation of the freezing compartment door 111, whereupon food can smoothly be put into and taken out of the containers 112 and 113. With this, food can advantageously be accommodated in a classified manner according to types of food, frequency in use of food or the like regarding the upper container 115 as well  
15 as the containers 112 and 113.

#### Fifth embodiment

A fifth embodiment of the invention will be described. The fifth embodiment as shown in FIG. 11 is a drawer-type door container which is disposed in a central storage compartment  
20 located between a refrigerating compartment and a lowest storage compartment and which is formed by dividing a container into three vertically arranged. In the embodiment shown in FIG. 11, the accommodation container 132 and the middle container 133 are provided on the rear of a vegetable compartment door 136 which  
25 opens and closes a front opening of a drawer-type vegetable compartment 126 as in the fourth embodiment, for example. The accommodation container 132 and the middle container 133 are linked to the opening and closure of the vegetable compartment

door 136 so as to be drawn out of and returned into the vegetable compartment 126. The upper container 135 has a larger depth D1 than the middle container 133 and is moveably supported on the support rails provided on respective inner walls of the vegetable compartment 126. A freezing compartment 125 is located below the vegetable compartment 126 and an ice-making compartment 123 is located over the vegetable compartment 126.

When the vegetable compartment door 136 is drawn out in the above-described construction, an average eye location H2 at standing positions of users (Japanese females) is higher than the eye location H1 in the fourth embodiment. Accordingly, the eye location H2 is 1440 mm high from the floor. An eye location from the front of the refrigerator varies between 293 mm and 447 mm and is averaged to 358 mm.

The vegetable compartment 125 centrally located in the refrigerator body includes a ceiling which is 770 mm high from the floor on an average. When the containers are constructed so as to have conventional depths respectively and the shallow upper container 235 is located below the lower edge of the door of the ice-making compartment 223, the front wall 235a is hidden behind the ice-making compartment door 237 from the user's eyes as shown by line of sight in FIG. 12. As a result, the user has a difficulty in viewing the upper container 235. On the other hand, when the depth D6' of the upper container 235 is set at 114 mm or above in the same manner as depth D6 in FIG. 11, the front wall 135a of the upper container 135 is visible when the vegetable compartment door 136 is drawn out. As a result, the presence of the upper container 135 can easily be confirmed.

Furthermore, visual confirmation can be rendered further easier when the depth D6 of the upper container 235 is set at 160 mm. When used, the upper container 135 is drawn out using a grip provided on the front wall 135a mounted on the front wall 135a  
5 of the upper container 135.

Accordingly, the depth D6 of the upper container 135 is set at 160 mm. The depth D7 of the middle container 133 is set so as to range from 100 mm to 110 mm. The depth D8 of the lower accommodation container 132 is set so as to range from 160 mm  
10 to 170 mm.

In the foregoing fourth embodiment, the freezing compartment 106 is provided with the drawer-type door on which the three vertically arranged containers are provided. In the foregoing fifth embodiment, the vegetable compartment 125 is  
15 provided with the drawer-type door on which the three vertically arranged containers are provided. However, the compartment on which the drawer-type door is provided should not be limited to those described above. The invention may be applied to the construction of three vertically arranged containers in another  
20 drawer-type storage compartment.

#### Sixth embodiment

FIG. 13 shows the refrigerator of a sixth embodiment. FIG. 13 is a longitudinal section showing a lower portion of the refrigerator body 151. A freezing compartment 156 is defined  
25 in the lowest interior of the refrigerator body 151. Over the freezing compartment 156 are provided a small freezing compartment 154 serving as a storage compartment whose interior temperature is set so as to belong to a freezing temperature zone

and an ice-making compartment (not shown). Each of the small freezing compartment 154 and the ice-making compartment has a relatively smaller volume and is provided with a dedicated drawer-type door. An automatic ice maker is provided in the ice-making compartment. The refrigerator body 151 further includes an uppermost refrigerating compartment having a largest volume.

The lowest freezing compartment 156 belongs to the same freezing temperature zone as the freezing compartment 154 and the ice-making compartment. Accordingly, the freezing compartment 156 need not be heat-insulated from the freezing compartment 154 and the ice-making compartment. As a result, the freezing compartment 156 is partitioned by a thin partition plate 159 from the freezing compartment 154 and the ice-making compartment. The freezing compartment 156 has a front opening closed and opened by a drawer-type door 161 in the same manner as in the fourth embodiment and the like. An accommodation container 162 is provided at the rear side of the door 161 and supported by a pair of right and left support frames. The accommodation container 162 supported on the door 161 is supported on rail members (not shown) provided on the inner side walls of the freezing compartment 156, whereby the accommodation container 162 is moveable in the back-forth direction.

A middle container 163 is provided over the accommodation container 162. The middle container 163 is placed on the accommodation container 162 so as to be moveable in the back-forth direction. The middle container 163 is located highest in the freezing compartment 156. The upper container 165 is provided

over the middle container 163. The upper container 165 is supported on the support rails mounted on the inner side walls of the freezing compartment 156 so as to be moveable. The upper container 165 is independent of the accommodation container 162 and the middle container 163. The upper container 165 has a larger depth than the middle container 163 and a large volume.

A freezing storage space such as the freezing compartment 154, the smaller freezing compartment 154 and the like is cooled by supplying cold air from an evaporator 157 into each compartment by a fan 158. The evaporator 157 is provided on the rear of the freezing compartment 156. The atmosphere in each of the small freezing compartment 154 and the ice-making compartment is cooled by cold air supplied through a cold air outlet 160 formed in an upper part of the rear of each compartment.

The lower accommodation container 162, the middle container 163 and the upper container 165 have cold air outlets 166, 167 and 168 formed in upper portions of the rear walls thereof respectively. The atmosphere in the freezing compartment 156 is cooled by cold air introduced from the cold air outlets 166, 167 and 168. The upper container 165 has a larger volume than the middle container 163. Accordingly, in order that the cooling performance of the cold air supplied from the cold air outlet 168 may be compensated, cold air is also supplied from the small freezing compartment 154 into the upper container 165. More specifically, the cold air supplied into the small freezing compartment 154 and cooling the atmosphere therein flows into the upper container 165 through communicating holes 169 formed in a part of the partition plate 159. As a result, the atmosphere

in the upper container 165 is cooled by the cold air supplied through the communicating holes 169 into the small freezing compartment 154 in addition to the cold air supplied from outlet holes 168. The bottom of the upper container 165 is cooled by  
5 the cold air supplied from the cold air outlets 167 to cool the middle container 163 in addition to the cooling by the cold air supplied from the small freezing compartment 154. Accordingly, the upper container 165 is indirectly cooled by the cold air supplied from the cold air outlets 167.

10 In the sixth embodiment, the temperature distribution in the interior of the upper container 165 is difficult to vary although the upper container has a relatively larger volume. As a result, a large amount of frozen food intended for a long period storage can be accommodated in the upper container 165.  
15 Furthermore, the upper container 165 is not linked to the opening and closure of the freezing compartment door 161. Accordingly, the upper container 165 can be drawn out optionally when necessity arises. Consequently, influences of external temperature with the opening and closure of the freezing compartment door 161 can  
20 be reduced. Thus, a stable food storage can be carried out by the upper container 165 with a sufficient cooling power.

## CLAIMS

1. A refrigerator comprising:

a refrigerator body having a storage compartment and an opening in a front of the storage compartment;

a door provided so as to be drawable from the refrigerator body, thereby being capable of opening and closing the storage compartment; and

a plurality of storage containers housed in the storage compartment in the back of the door so as to be vertically arranged and so as to be capable of being put into and taken out of the storage compartment, the storage containers including a plurality of storage containers which are drawn out together with the door and another storage container which remains in the storage compartment, characterized in that:

the storage containers include a middle located storage container and a lower storage container both drawn out together with the door when the door is drawn out and an upper storage container remaining in the storage container when the door is drawn out, the upper storage container having a volume which is intermediate between volumes of the middle and lower storage containers;

the uppermost container drawn out together with the door, which uppermost container is the middle storage container, has a smallest volume in the storage containers;

the upper storage container which is drawn out independent of the door after the middle and lower storage containers have been drawn out with the door, has a pair of flanges on right and left sides thereof respectively, the flanges being moved on a pair of pulleys provided on the refrigerator body respectively; and

said upper storage container is drawn out by a smaller operating force as compared with a case where the lower storage container having the largest volume is drawn out.

# ABSTRACT

A refrigerator includes a refrigerator body having a storage compartment and an opening in a front of the storage compartment; a door mounted so as to be drawable from the refrigerator body, thereby being capable of opening and closing the storage compartment, and a plurality of storage containers housed in the storage compartment in the back of the door so as to be vertically arranged and so as to be capable of being put into and taken out of the storage compartment, the storage compartments including a plurality of storage compartments which are drawn out together with the door and another storage compartment which remains in the storage compartment. The uppermost container drawn out together with the door has a smallest volume in the storage containers.