

DESCRIPTION

Title of Invention

REFRIGERATOR

5 Technical Field

[0001]

The present invention relates to a refrigerator in which a vacuum thermal insulator is located in each wall section partitioning off a storage compartment.

Background Art

10 [0002]

With some refrigerator, a refrigerator compartment, an ice-making compartment, a freezer compartment, and a vegetable compartment are arranged in order from top. In the case of such an arrangement, the vegetable compartment is located at the lowest position of the refrigerator. Consequently, users have to bend their knees and squat, or have to bend over to take out vegetables from the vegetable compartment.

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[0003]

When a comparison is made between the vegetable compartment and the freezer compartment regarding the number of times of opening and closing of a door or an opening period of the door, usually, the number of times of opening and closing of the door is greater and the opening period of the door is longer for the vegetable compartment, albeit with variations from person to person. Consequently, convenience is expected to be increased with the refrigerator as a whole by switching positions of the vegetable compartment and the freezer compartment, and by locating the vegetable compartment higher than the freezer compartment.

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[0004]

However, firstly, some refrigerator is configured in such a manner that a plurality of compartments each in a refrigeration temperature range are collected at one position to increase a thermal efficiency.

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Secondly, some refrigerator is configured by locating a cooler at a rear surface of the freezer compartment so that inconveniences such as attachment of dew or

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frost are not easily caused even when a special thermal insulation component is not provided between the freezer compartment and the cooler.

[0005]

On the other hand, it is conceivable to arrange the refrigerator compartment, the ice-making compartment, the vegetable compartment, and the freezer compartment in order from the top of a refrigerator to increase convenience of users. With such a refrigerator, storage compartments in a cooling temperature range, or in other words, a plus temperature range, and storage compartments in a refrigeration temperature range, or in other words, a minus temperature range, are alternately arranged. Consequently, firstly, a refrigerator having such an arrangement is inferior to some refrigerator in thermal efficiency. Furthermore, to secure necessary thermal insulation properties, a thickness of a wall section of each compartment is increased, and a space where food can be stored is reduced when a comparison is made between refrigerators having the same outer shape.

[0006]

Furthermore, secondly, with a refrigerator having such an arrangement, the cooler is located at a rear surface of the vegetable compartment, and thus, a wall section separating the vegetable compartment and the cooler has to have higher thermal insulation properties than those of some refrigerator. To increase the thermal insulation properties, a thickness of the wall section is increased. However, a food storage space is sacrificed as described above. Consequently, a molded product of expanded polystyrene foam, which is easily processed, easily attached and removed, and easily carried is used as some thermal insulation component. However, when a vacuum thermal insulator having higher thermal insulation properties is used as the thermal insulation component, both the thermal insulation properties and a food storage space may be secured. High thermal insulation properties mean a small coefficient of heat transfer.

Citation List

Patent Literature

[0007]

Patent Literature 1: Japanese Unexamined Patent Application Publication No.

2012-242072

Summary of Invention

Technical Problem

5 [0008]

In a case where a vacuum thermal insulator is located between the vegetable compartment and the cooler, an air passage for sending air that is cooled by the cooler into the vegetable compartment is necessary. Claim 10 of Patent Literature 1 describes that "the vacuum thermal insulator is provided at a front surface, of the partitioning wall forming an inner wall surface, other than the inlet port and the outlet port". In this manner, there is a method of covering everything other than the inlet port and the outlet port with a vacuum thermal insulator. However, in such a case, a hole has to be opened in the vacuum thermal insulator, or a cut-out has to be provided in the vacuum thermal insulator, or a plurality of vacuum thermal insulators have to be used. Consequently, manufacturing costs are increased.

Furthermore, when convenience of users is taken into account, it is desirable to secure a capacity of the vegetable compartment while increasing a thermal insulation effect of the vacuum thermal insulator.

[0009]

20 The present invention has been made to solve the problems described above, and has its object to provide a refrigerator allowing a reduction in manufacturing costs regarding a vacuum thermal insulator while securing a capacity of a vegetable compartment.

Solution to Problem

25 [0010]

A refrigerator according to an embodiment of the present invention includes a first storage compartment in a refrigeration temperature range; a second storage compartment in a refrigeration temperature range; a third storage compartment, in a cooling temperature range, including wall sections that include a front surface section and a rear surface section, and located between the first storage compartment and

the second storage compartment; and a vacuum thermal insulator provided in each of the wall sections partitioning off the third storage compartment. The vacuum thermal insulator provided in the rear surface section of the third storage compartment is tilted and having a lower end positioned closer to the front surface section than is an upper end positioned closer to the rear surface section than is the lower end.

Advantageous Effects of Invention

[0011]

With the refrigerator according to an embodiment of the present invention, the vacuum thermal insulator provided in the rear surface section of the third storage compartment is tilted and has the lower end positioned closer to the front surface section than is the upper end positioned closer to the rear surface section than is the lower end, and thus, manufacturing costs regarding the vacuum thermal insulator may be reduced.

Brief Description of Drawings

[0012]

[Fig. 1] Fig. 1 is an external perspective view schematically showing an example of a refrigerator according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a schematic front view schematically showing an arrangement of storage compartments of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a refrigerant circuit configuration diagram schematically showing an example of a refrigerant circuit configuration of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a cross-sectional view schematically showing a cross-section of a part of a wall section of a box body of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 5] Fig. 5 is a schematic diagram for describing an air circulation path of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 6] Fig. 6 is a cross-sectional view schematically showing a cross-section along Y-Y in Fig. 5.

[Fig. 7] Fig. 7 is an explanatory diagram schematically showing return of air to a cooler of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 8] Fig. 8 is an enlarged cross-sectional view schematically showing a cross-section of a part of a refrigerator according to Embodiment 2 of the present invention.

[Fig. 9] Fig. 9 is a schematic diagram for describing an air circulation path of a refrigerator according to Embodiment 3 of the present invention.

[Fig. 10] Fig. 10 is a cross-sectional view schematically showing a cross-section along Z-Z in Fig. 9.

[Fig. 11] Fig. 11 is an explanatory diagram schematically showing return of air to a cooler of the refrigerator according to Embodiment 3 of the present invention.

[Fig. 12] Fig. 12 is an enlarged cross-sectional view schematically showing a cross-section of a part of a refrigerator according to Embodiment 4 of the present invention.

Description of Embodiments

[0013]

Embodiments of the present invention will be described hereinafter with reference to the drawings.

Additionally, in the drawings, those denoted by the same reference sign are identical or correspond to each other, and this note is applied to the entire specification.

Furthermore, modes of components described in the entire specification are merely exemplary, and are not limited to the example.

[0014]

Embodiment 1

Fig. 1 is an external perspective view schematically showing an example of a refrigerator 1 according to Embodiment 1 of the present invention. Fig. 2 is a schematic front view schematically showing an arrangement of storage compartments of the refrigerator 1. A configuration of the refrigerator 1 will be described with reference to Figs. 1 and 2. Additionally, in the following description, a refrigerator

compartment 11, an ice-making compartment 21, a versatile compartment 22, a vegetable compartment 31, and a freezer compartment 41 may each be referred to as a storage compartment.

[0015]

5 As shown in Fig. 2, with the refrigerator 1, the refrigerator compartment 11, the ice-making compartment 21 and the versatile compartment 22, the vegetable compartment 31, and the freezer compartment 41 are arranged in order from top. The ice-making compartment 21 and the versatile compartment 22 are arranged next to each other, and the ice-making compartment 21 is positioned on a left side on the drawing sheet, and the versatile compartment 22 is positioned on a right side on the drawing sheet.

 Additionally, the ice-making compartment 21 and the versatile compartment 22 are storage compartments in a refrigeration temperature range. The vegetable compartment 31 is a storage compartment in a cooling temperature range. The freezer compartment 41 is a storage compartment in the refrigeration temperature range.

 The ice-making compartment 21 corresponds to a first storage compartment of the present invention.

20 The freezer compartment 41 corresponds to a second storage compartment of the present invention.

 The vegetable compartment 31 corresponds to a third storage compartment of the present invention.

[0016]

25 Partitions used as wall sections separate storage compartments including the refrigerator compartment 11, the ice-making compartment 21, the versatile compartment 22, the vegetable compartment 31, and the freezer compartment 41. The wall sections will be described with reference to Fig. 4.

 The refrigerator compartment 11 and the ice-making compartment 21 are partitioned by a partition 51A. The refrigerator compartment 11 and the versatile compartment 22 are partitioned by a partition 51B. The ice-making compartment 21

and the versatile compartment 22 are partitioned by a partition 52 formed from one plate-shaped part. The ice-making compartment 21 and the vegetable compartment 31 are partitioned by a partition 53A. The versatile compartment 22 and the vegetable compartment 31 are partitioned by a partition 53B. The vegetable compartment 31 and the freezer compartment 41 are partitioned by a partition 54 formed from one plate-shaped part.

[0017]

The partition 51A and the partition 51B are formed from one plate-shaped part, but are separately described in correspondence with the ice-making compartment 21 and the versatile compartment 22 for the sake of convenience. In the following description, the partition 51A and the partition 51B will be collectively referred to as the partition 51 where it is not necessary to describe them separately.

In the same manner, the partition 53A and the partition 53B are formed from one plate-shaped part, but are separately described in correspondence with the ice-making compartment 21 and the versatile compartment 22 for the sake of convenience. In the following description, the partition 53A and the partition 53B will be collectively referred to as the partition 53 where it is not necessary to describe them separately.

[0018]

The refrigerator 1 includes a box body 50 configured as a vertically long cuboid. The box body 50 includes a front surface section 50A, a top surface section 50B, a bottom surface section 50C, a right side surface section 50D, a left side surface section 50E, and a rear surface section 50F. The box body 50 includes storage compartments obtained by dividing an inner space of the box body 50 by the partition 51A, the partition 51B, the partition 52, the partition 53A, the partition 53B, and the partition 54. Moreover, door sections that can be opened and closed are provided at the front surface section 50A that is a front surface of the box body 50. As shown in Fig. 1, door sections of the refrigerator compartment 11 are shown as door sections 11A, a door section of the ice-making compartment 21 as a door section 21A, a door section of the versatile compartment 22 as a door section 22A, a door section of the

vegetable compartment 31 as a door section 31A, and a door section of the freezer compartment 41 as a door section 41A.

[0019]

The door sections 11A of the refrigerator compartment 11 are configured to open to left and right from a center portion by hinges, not shown, provided on left and right sides of the box body 50 in a width direction. There may be provided one door section 11A that opens from one of the left and right sides of the box body 50 in the width direction. The door section 21A of the ice-making compartment 21 is configured as a pull-out door that moves in a front-back direction of the refrigerator 1. The door section 22A of the versatile compartment 22 is configured as a pull-out door that moves in the front-back direction of the refrigerator 1. The door section 31A of the vegetable compartment 31 is configured as a pull-out door that moves in the front-back direction of the refrigerator 1. The door section 41A of the freezer compartment 41 is configured as a pull-out door that moves in the front-back direction of the refrigerator 1.

[0020]

Fig. 3 is a refrigerant circuit configuration diagram schematically showing an example of a refrigerant circuit configuration of the refrigerator 1. A refrigerant circuit 70 and an air circulation path 80 of the refrigerator 1 will be schematically described with reference to Fig. 3. Additionally, in Fig. 3, flows of refrigerant and air are represented by arrows. Furthermore, in Fig. 3, the storage compartments are shown for description of the air circulation path 80. Moreover, refrigerant to be used in the refrigerant circuit 70 is not particularly limited.

[0021]

A configuration of the refrigerant circuit 70 will be described.

The refrigerator 1 includes the refrigerant circuit 70. As shown in Fig. 3, the refrigerant circuit 70 is configured by connecting a compressor 71, an air-cooled condenser 72, a heat dissipation pipe 73, a pressure reducing device 76, and a cooler 600 by pipes. A dew condensation preventing pipe 74 and a drier 75 are connected between the heat dissipation pipe 73 and the pressure reducing device 76.

Furthermore, Fig. 3 shows, as an example, a state where a fan 800 for sending air to the cooler 600 is installed.

[0022]

An effect of the refrigerant circuit 70 will be described.

5 When the compressor 71 is driven, refrigerant is discharged from the compressor 71. The refrigerant discharged from the compressor 71 flows into the air-cooled condenser 72 installed in a machine chamber formed in the box body 50. The refrigerant flowing out of the air-cooled condenser 72 flows through the heat dissipation pipe 73 installed inside urethane of the box body 50 of the refrigerator 1.
10 The refrigerant flowing through the heat dissipation pipe 73 flows through the dew condensation preventing pipe 74 extended around the front surface section 50A of the storage compartments of the refrigerator 1. The refrigerant is condensed by a condensation process through the air-cooled condenser 72, the heat dissipation pipe 73, and the dew condensation preventing pipe 74.

15 [0023]

 After the condensed refrigerant passes through the drier 75, the condensed refrigerant is supplied to the cooler 600 through the pressure reducing device 76. At the cooler 600, the refrigerant supplied to the cooler 600 evaporates and exchanges heat with air that is forced to circulate inside by the fan 800, and cool air is generated.
20 The generated cool air is supplied to each storage compartment, and cools each storage compartment. Then, the refrigerant raises its temperature by passing through a suction pipe and exchanging heat with the pressure reducing device 76, and returns to the compressor 71.

 As described above, the refrigerator 1 includes the refrigerant circuit 70, and
25 generates cool air for cooling each storage compartment.

[0024]

A configuration of the air circulation path 80 will be described.

 The refrigerator 1 includes the air circulation path 80. The air circulation path 80 is configured by including an air outlet passage 110 and an air return passage 140.
30 The air outlet passage 110 introduces cool air into each storage compartment.

Furthermore, the air return passage 140 guides cool air used to cool each storage compartment to the cooler 600. That is, the air circulation path 80 is a path for circulating cool air through the cooler 600 and each storage compartment through the air outlet passage 110 and the air return passage 140.

5 [0025]

Air volume adjustment devices are installed at inlets for the air outlet passage 110. The air volume adjustment device installed at an inlet port of the refrigerator compartment 11 is a first damper 101. The air volume adjustment device installed at an inlet port of the ice-making compartment 21 is a second damper 201a. The air
10 volume adjustment device installed at an inlet port of the versatile compartment 22 is a third damper 202. The air volume adjustment device installed at an inlet port of the vegetable compartment 31 is a fourth damper 301.

[0026]

An effect of the air circulation path 80 will be described.

15 When the fan 800 is driven, air in the refrigerator 1 is supplied to the cooler 600. Then, air that is forced to circulate inside by the fan 800 exchanges heat with refrigerant at the cooler 600, and is cooled. Cool air generated by heat exchange at the cooler 600 flows through the air outlet passage 110 to be blown into each storage compartment inside the refrigerator 1, and cools each storage compartment.

20 [0027]

Air circulating through each storage compartment and the cooler 600 maintains each storage compartment at an appropriate temperature by use of each air volume adjustment device operated by a controller, not shown, in response to an air temperature inside each storage compartment measured by a temperature sensor,
25 not shown, installed in each storage compartment or a temperature of stored food. Air used to cool each storage compartment flows through the air return passage 140 to return to the cooler 600.

[0028]

30 Fig. 4 is a cross-sectional view schematically showing a cross-section of a part of a wall section 55 of the box body 50 of the refrigerator 1. The wall section 55 of

the box body 50 of the refrigerator 1 will be described with reference to Fig. 4.

As shown in Fig. 4, the wall section 55 of the box body 50 of the refrigerator 1 is configured from a sheet metal 56 forming an outer frame, an inner box 57 forming an inner wall of each storage compartment, and a thermal insulator 500 installed
5 between the sheet metal 56 and the inner box 57, and reduces an amount of heat entering from outside. The wall sections 55 form the partition 51A, the partition 51B, the partition 52, the partition 53A, the partition 53B, and the partition 54.

[0029]

A multi-layer structure of a vacuum thermal insulator and a urethane foam
10 material is desirably used as the thermal insulator 500 of the wall sections 55 forming at least the right side surface section 50D and the left side surface section 50E of the refrigerator 1. Using a multi-layer structure of a vacuum thermal insulator and a urethane foam material as the thermal insulator 500 may increase thermal insulation properties.

15 [0030]

The vacuum thermal insulators may be mounted not only on the wall sections 55 forming the right side surface section 50D and the left side surface section 50E of the refrigerator 1, but also on at least one of the wall sections 55 forming the top surface section 50B, the bottom surface section 50C, and the rear surface section
20 50F of the refrigerator 1. By mounting the vacuum thermal insulators, the thermal insulation properties may be further increased. Furthermore, by mounting the vacuum thermal insulators, a distance between the outer frame of the refrigerator 1 and an inner wall surface of the inner box 57, or in other words, a thermal insulation thickness, may be reduced, and an internal capacity may be increased.

25 [0031]

Additionally, various inner parts such as a reinforcement part for correcting deformation of the refrigerator 1, refrigerant circuit parts described above, electrical wiring parts are located in a space, in the thermal insulator 500, where the urethane foam material is encapsulated, and such inner parts are fixed by the urethane foam
30 material.

[0032]

A covering area of the vacuum thermal insulators of the thermal insulator 500 covers at least 40% of an entire outer surface area including a door surface area of each storage compartment. A foam density of at least 60 kg/cm³ and a flexural
5 modulus of elasticity of at least 15.0 MPa are secured for the urethane foam material encapsulated around the vacuum thermal insulator. This configuration guarantees strength of the box body 50 of the refrigerator 1.

[0033]

Fig. 5 is a schematic diagram for describing the air circulation path 80 of the
10 refrigerator 1. Fig. 6 is a cross-sectional view schematically showing a cross-section along Y-Y in Fig. 5. Fig. 7 is an explanatory diagram schematically showing return of air to the cooler 600 of the refrigerator 1. The air circulation path 80 of the refrigerator 1 will be described in detail with reference to Figs. 5 to 7. Additionally, in Figs. 5 to 7, flows of air are represented by arrows. Additionally, Fig. 5 shows, as an
15 example, a case where a chilled compartment is installed in the refrigerator compartment 11.

[0034]

First, the location of the cooler 600 will be described.

As shown in Fig. 6, a cooler compartment 27 is formed at a portion located
20 toward the rear surface section 50F from the ice-making compartment 21, the versatile compartment 22, and the vegetable compartment 31 of the box body 50 of the refrigerator 1. The cooler 600 is located in the cooler compartment 27. Moreover, a lower end of the cooler 600 located in the cooler compartment 27 is at a position, inside the cooler compartment 27, lower than a floor surface 31B of the
25 vegetable compartment 31.

[0035]

By positioning the lower end of the cooler 600 lower than the floor surface 31B of the vegetable compartment 31, a larger space may be secured above the cooler 600. A degree of freedom regarding a size of the fan 800 installed at a part of the
30 cooler compartment 27 is thereby increased. Furthermore, an air volume adjustment

device, held by a foam thermal insulator, for an air passage to each storage compartment is installed above the fan 800.

[0036]

Additionally, a heater 700 is located below the cooler 600. The heater 700 is provided to avoid blocking of a fifth air return passage 412 due to frosting, and is energized to generate heat as necessary.

Furthermore, as shown in Fig. 7, a drip heater 750 is installed at a drip tray 751. The drip tray 751 for receiving water melted at the time of defrosting is provided at a lower part in the cooler compartment 27. The drip heater 750 is provided to prevent refreezing of melted water received by the drip tray 751, and is energized to generate heat as necessary. Additionally, the drip heater 750 is not a necessary component, and the heater 700 may also be used as the drip heater.

[0037]

Next, the vegetable compartment 31 and surroundings of the vegetable compartment 31 will be described.

As shown in Fig. 6, a first vegetable compartment storage case 420A and a second vegetable compartment storage case 420B are housed in the vegetable compartment 31. The second vegetable compartment storage case 420B is located higher than the first vegetable compartment storage case 420A, and has a smaller capacity than does the first vegetable compartment storage case 420A. In a state where the second vegetable compartment storage case 420B is housed in the first vegetable compartment storage case 420A, and the door section 31A is closed, an open top end at a rear of the second vegetable compartment storage case 420B is positioned further rearward, by a length D3, than is an open top end at a rear of the first vegetable compartment storage case 420A.

[0038]

Additionally, the number of storage cases housed in the vegetable compartment 31 is not particularly limited so long as at least the first vegetable compartment storage case 420A and the second vegetable compartment storage case 420B are housed.

The first vegetable compartment storage case 420A corresponds to a first storage case of the present invention.

The second vegetable compartment storage case 420B corresponds to a second storage case of the present invention.

5 [0039]

Furthermore, as shown in Fig. 6, a lid structure 430 approximately entirely covering an open top of the second vegetable compartment storage case 420B is installed in the vicinity of a top surface portion of the vegetable compartment 31. The lid structure 430 includes a fin portion 430A that is positioned closer to a rear surface than is a rear surface side end portion of the second vegetable compartment storage case 420B and that is bent downward. The fin portion 430A is formed by bending a part of the lid structure 430 at an acute angle.

Furthermore, as shown in Fig. 6, vacuum thermal insulators 500A are located as parts of the thermal insulator 500, and each of the vacuum thermal insulators 500A is located at a front, at a back, at a top, and at a bottom of the vegetable compartment 31 in such a manner that the vegetable compartment 31 is surrounded from the front, the back, the top, and the bottom. Additionally, although not shown in Fig. 6, each of the vacuum thermal insulators 500A as a part of the thermal insulator 500 is also located at the left and right of the vegetable compartment 31.

20 [0040]

Next, an air passage structure of the refrigerator 1 will be specifically described.

As described above, the refrigerator 1 includes the air outlet passage 110 and the air return passage 140.

The air outlet passage 110 includes a first air outlet passage 111, a second air outlet passage 211a, a third air outlet passage 212, a fourth air outlet passage 311, a fifth air outlet passage 411, and a sixth air outlet passage 211b.

The air return passage 140 includes a first air return passage 141, a second air return passage 241a, a third air return passage 242, a fourth air return passage 312, and a fifth air return passage 412.

30 Additionally, an air outlet passage and an air return passage described below

are formed rearward of a rear surface of each storage compartment, or in other words, in a space located toward the rear surface section 50F, an air outlet port and a return port are formed in the rear surface section 50F at each storage compartment.

[0041]

5 The first air outlet passage 111 is used as a refrigerator compartment air outlet passage where cool air to be blown into the refrigerator compartment 11 flows. The first damper 101, which is one of the air volume adjustment devices, is provided at a cool air inlet port of the first air outlet passage 111. When the refrigerator 1 is viewed from a front, the first damper 101 is positioned at a lower part of the refrigerator
10 compartment 11. As described above, operation of the first damper 101 is controlled by the controller. A volume of cool air that is blown into the refrigerator compartment 11 is thus adjusted.

[0042]

15 First air outlet ports 121 are formed in the first air outlet passage 111. Cool air flowing through the first air outlet passage 111 is introduced into the refrigerator compartment 11 through the first air outlet ports 121. A plurality of first air outlet ports 121 are located next to one another in a height direction of the refrigerator compartment 11, when the refrigerator 1 is viewed from the front. Additionally, the number of first air outlet ports 121 is not particularly limited, and a plurality of first air
20 outlet ports 121 may be installed to correspond to a capacity of the refrigerator compartment 11.

[0043]

25 The second air outlet passage 211a is used as an ice-making compartment air outlet passage where cool air to be blown into the ice-making compartment 21 flows. The second damper 201a, which is one of the air volume adjustment devices, is provided at a cool air inlet port of the second air outlet passage 211a. When the refrigerator 1 is viewed from the front, the second damper 201a is positioned at a middle level in the ice-making compartment 21. As described above, operation of the second damper 201a is controlled by the controller. A volume of cool air that is
30 blown into the ice-making compartment 21 is thus adjusted.

[0044]

Moreover, a second air outlet port 221a is formed in the second air outlet passage 211a. Cool air flowing through the second air outlet passage 211a is introduced into the ice-making compartment 21 through the second air outlet port 221a. When the refrigerator 1 is viewed from the front, the second air outlet port 221a is positioned at an upper left in the ice-making compartment 21. Additionally, the number of second air outlet ports 221a is not particularly limited.

[0045]

The third air outlet passage 212 is used as a versatile compartment air outlet passage where cool air to be blown into the versatile compartment 22 flows. The third damper 202, which is one of the air volume adjustment devices, is provided at a cool air inlet port of the third air outlet passage 212. When the refrigerator 1 is viewed from the front, the third damper 202 is positioned at a middle level in the versatile compartment 22. As described above, operation of the third damper 202 is controlled by the controller. A volume of cool air that is blown into the versatile compartment 22 is thus adjusted.

[0046]

Moreover, a third air outlet port 222 is formed in the third air outlet passage 212. Cool air flowing through the third air outlet passage 212 is introduced into the versatile compartment 22 through the third air outlet port 222. When the refrigerator 1 is viewed from the front, the third air outlet port 222 is positioned at an upper center in the versatile compartment 22. Additionally, the number of third air outlet ports 222 is not particularly limited.

[0047]

The fourth air outlet passage 311 is used as a vegetable compartment air outlet passage where cool air to be blown into the vegetable compartment 31 flows. The fourth damper 301, which is one of the air volume adjustment devices, is provided at a cool air inlet port of the fourth air outlet passage 311. When the refrigerator 1 is viewed from the front, the fourth damper 301 is positioned at the middle level in the versatile compartment 22. As described above, operation of the fourth damper 301

is controlled by the controller. A volume of cool air that is blown into the vegetable compartment 31 is thus adjusted.

[0048]

Moreover, a fourth air outlet port 321 is formed in the fourth air outlet passage 311. Cool air flowing through the fourth air outlet passage 311 is introduced into the vegetable compartment 31 through the fourth air outlet port 321. When the refrigerator 1 is viewed from the front, the fourth air outlet port 321 is positioned at an upper right in the vegetable compartment 31. Additionally, the number of fourth air outlet ports 321 is not particularly limited.

[0049]

The fifth air outlet passage 411 is used as a freezer compartment air outlet passage where cool air to be blown into the freezer compartment 41 flows. Furthermore, the fifth air outlet passage 411 is formed overlapping the fifth air return passage 412 in the front-back direction. When the refrigerator 1 is viewed from a side, the fifth air outlet passage 411 is positioned closer to the front surface than is the fifth air return passage 412 positioned closer to the rear surface section 50F. A fifth air outlet port 421 is formed in the fifth air outlet passage 411. Cool air flowing through the fifth air outlet passage 411 is introduced into the freezer compartment 41 through the fifth air outlet port 421. When the refrigerator 1 is viewed from the front, the fifth air outlet port 421 is positioned at an upper center in the freezer compartment 41. Additionally, the number of fifth air outlet ports 421 is not particularly limited.

The fifth air outlet passage 411 corresponds to a first air passage of the present invention.

[0050]

The sixth air outlet passage 211b is used as a chilled compartment air outlet passage where cool air to be blown into the chilled compartment, not shown, flows. A sixth damper 201b, which is one of the air volume adjustment devices, is provided at a cool air inlet port of the sixth air outlet passage 211b. When the refrigerator 1 is viewed from the front, the sixth damper 201b is positioned at the middle level in the ice-making compartment 21. As described above, operation of the sixth damper

201b is controlled by the controller. A volume of cool air that is blown into the chilled compartment is thus adjusted.

[0051]

Moreover, a sixth air outlet port 221b is formed in the sixth air outlet passage 211b. Cool air flowing through the sixth air outlet passage 211b is introduced into the chilled compartment through the sixth air outlet port 221b. When the refrigerator 1 is viewed from the front, the sixth air outlet port 221b is positioned at a lower center in the refrigerator compartment 11. Additionally, the sixth air outlet passage 211b and the sixth damper 201b do not have to be provided in a case where the chilled compartment is not installed. Furthermore, the number of sixth air outlet ports 221b is not particularly limited.

[0052]

The first air return passage 141 is used as a refrigerator compartment air return passage where air used to cool the refrigerator compartment 11 flows. A first return port 131 is formed in the first air return passage 141. When the refrigerator 1 is viewed from the front, the first return port 131 is positioned at a lower right in the refrigerator compartment 11. Furthermore, the first air return passage 141 is joined to the cooler compartment 27 through a first joining portion 151. Consequently, air flowing through the first air return passage 141 is returned to the cooler 600 through the first return port 131 and the first joining portion 151.

[0053]

The second air return passage 241a is used as a cooler compartment air return passage where air used to cool the ice-making compartment 21 flows. A second return port 231a is formed in the second air return passage 241a. When the refrigerator 1 is viewed from the front, the second return port 231a is positioned at a lower left in the ice-making compartment 21. Moreover, the second air return passage 241a is joined to the cooler compartment 27 through a second joining portion 251a. Consequently, air flowing through the second air return passage 241a is returned to the cooler 600 through the second return port 231a and the second joining portion 251a.

[0054]

The third air return passage 242 is used as a versatile compartment air return passage where air used to cool the versatile compartment 22 flows. A third return port 232 is formed in the third air return passage 242. When the refrigerator 1 is viewed from the front, the third return port 232 is positioned at a lower center in the versatile compartment 22. Moreover, the third air return passage 242 is joined to the cooler compartment 27 through a third joining portion 252. Consequently, air flowing through the third air return passage 242 is returned to the cooler 600 through the third return port 232 and the third joining portion 252.

[0055]

The fourth air return passage 312 is used as a vegetable compartment air return passage where air used to cool the vegetable compartment 31 flows. A fourth return port 331 is formed in the fourth air return passage 312. When the refrigerator 1 is viewed from the front, the fourth return port 331 is positioned at a lower left in the vegetable compartment 31. Moreover, the fourth air return passage 312 is joined to the cooler compartment 27 through a fourth joining portion 351. Consequently, air flowing through the fourth air return passage 312 is returned to the cooler 600 from a lower left of the cooler 600, through the fourth return port 331 and the fourth joining portion 351.

[0056]

The fifth air return passage 412 is used as a freezer compartment air return passage where air used to cool the freezer compartment 41 flows. A fifth return port 431 is formed in the fifth air return passage 412. When the refrigerator 1 is viewed from the front, the fifth return port 431 is formed at the upper center in the freezer compartment 41. Moreover, the fifth air return passage 412 is joined to the cooler compartment 27 through a fifth joining portion 451. Consequently, air flowing through the fifth air return passage 412 is returned to the cooler 600 from a lower right of the cooler 600, through the fifth return port 431 and the fifth joining portion 451.

The fifth air return passage 412 corresponds to a second air passage of the present invention.

[0057]

Flows of air around the cooler 600 will be described with reference to Figs. 5 and 7.

Circulation of air in the refrigerator compartment 11 will be described.

5 Cool air generated by the cooler 600 flows through the first air outlet passage 111, from the lower side on the drawing sheet to the upper side on the drawing sheet, after the volume of the cool air is adjusted by the first damper 101, and is introduced into the refrigerator compartment 11 through the first air outlet ports 121. Cool air used at the refrigerator compartment 11 flows through the first air return passage 141
10 through the first return port 131, from the upper side on the drawing sheet to the lower side on the drawing sheet, as shown in Fig. 5 and by an arrow A1 in Fig. 7, and is returned to the cooler 600 through the first joining portion 151.

[0058]

Circulation of air in the ice-making compartment 21 will be described.

15 Cool air generated by the cooler 600 flows through the second air outlet passage 211a after the volume of the cool air is adjusted by the second damper 201a, and is introduced into the ice-making compartment 21 through the second air outlet port 221a. Cool air used at the ice-making compartment 21 flows through the second air return passage 241a through the second return port 231a, from the upper
20 side on the drawing sheet to the lower side on the drawing sheet, as shown in Fig. 5 and by an arrow A2 in Fig. 7, and is returned to the cooler 600 through the second joining portion 251a.

[0059]

Circulation of air in the versatile compartment 22 will be described.

25 Cool air generated by the cooler 600 flows through the third air outlet passage 212 after the volume of the cool air is adjusted by the third damper 202, and is introduced into the versatile compartment 22 through the third air outlet port 222. Cool air used at the versatile compartment 22 flows through the third air return passage 242 through the third return port 232, from the upper side on the drawing
30 sheet to the lower side on the drawing sheet, as shown in Fig. 5 and by an arrow A3

in Fig. 7, and is returned to the cooler 600 through the third joining portion 252.

[0060]

Circulation of air in the vegetable compartment 31 will be described.

Cool air generated by the cooler 600 flows through the fourth air outlet passage
5 311 after the volume of the cool air is adjusted by the fourth damper 301, and is
introduced into the vegetable compartment 31 through the fourth air outlet port 321.
Cool air used at the vegetable compartment 31 flows through the fourth air return
passage 312 through the fourth return port 331, from a left side on the drawing sheet
to a right side on the drawing sheet, as shown in Fig. 5 and by an arrow A4 in Fig. 7,
10 and is returned to the cooler 600 through the fourth joining portion 351.

[0061]

The fourth return port 331 from the vegetable compartment 31 is formed at a
lower left on a diagonal line to the fourth air outlet port 321 at a portion of the
vegetable compartment 31 that is close to the rear surface section 50F. The fourth
15 return port 331 is positioned outside the forward projection plane of a vacuum thermal
insulator 500A1 that is one rectangular plate-shaped part, without overlapping the
forward projection plane. Cool air that is blown out from the fourth air outlet port 321
is circulated to be ejected from the fourth return port 331 positioned at a corner, of an
inner wall of the vegetable compartment 31, that is diagonal to the fourth air outlet
20 port 321, to be guided to the cooler 600, and to be cooled by passing through the
cooler 600 again.

[0062]

Circulation of air in the freezer compartment 41 will be described.

Cool air generated by the cooler 600 flows through the fifth air outlet passage
25 411, and is introduced into the freezer compartment 41 through the fifth air outlet port
421. Cool air used at the freezer compartment 41 flows through the fifth air return
passage 412 through the fifth return port 431, from the lower side on the drawing
sheet to the upper side on the drawing sheet, as shown in Fig. 5 and by an arrow A5
in Fig. 7, and is returned to the cooler 600 through the fifth joining portion 451.

[0063]

Next, a description will be given of the vacuum thermal insulator 500A.

As shown in Fig. 2, the refrigerator compartment 11, the ice-making compartment 21 and the versatile compartment 22, the vegetable compartment 31, and the freezer compartment 41 of the refrigerator 1 are arranged in order from top.

That is, with the refrigerator 1, storage compartments in the cooling temperature range and storage compartments in the refrigeration temperature range are alternately arranged from the top.

[0064]

A bottom surface section of the refrigerator compartment 11, or in other words, an upper surface section of the ice-making compartment 21 and the versatile compartment 22, is the partition 51 that is one of the wall sections 55. An upper surface section of the vegetable compartment 31, or in other words, a bottom surface section of the ice-making compartment 21 and the versatile compartment 22, is the partition 53 that is one of the wall sections 55. A bottom surface section of the vegetable compartment 31 and an upper surface section of the freezer compartment 41 are the partition 54 that is one of the wall sections 55. The vacuum thermal insulator 500A is provided inside each partition to prevent heat transfer.

[0065]

The vacuum thermal insulators 500A arranged around the vegetable compartment 31 will be described with reference to Fig. 6. As described above, with the refrigerator 1, the vacuum thermal insulators 500A are arranged in such a manner that the vegetable compartment 31 is surrounded from the front, the back, the top, and the bottom. The vacuum thermal insulator 500A located frontward of a front surface of the cooler 600, or in other words, close to a rear surface of the vegetable compartment 31, will be referred to as the vacuum thermal insulator 500A1. The vacuum thermal insulator 500A located close to an upper surface of the vegetable compartment 31 will be referred to as a vacuum thermal insulator 500A2. The vacuum thermal insulator 500A located close to a front surface of the vegetable compartment 31 will be referred to as a vacuum thermal insulator 500A3. The vacuum thermal insulator 500A located close to a bottom surface of the vegetable

compartment 31 will be referred to as a vacuum thermal insulator 500A4.

[0066]

When the vacuum insulator 500A1 is viewed from the side, the vacuum thermal insulator 500A1 is tilted, has an upper end positioned closer to the rear surface section 50F of the box body 50, or in other words, further rearward, than is a lower end positioned closer to the front surface section 50A of the box body 50, or in other words, further forward, than is the upper end, and prevents heat transfer between the vegetable compartment 31 and a portion located toward the rear surface section 50F of the box body 50. Furthermore, the vacuum thermal insulator 500A1 has a width greater than the width of the cooler 600. A tilt angle θ of the vacuum thermal insulator 500A1 is not particularly limited, but may be adjusted in a range of 0 degrees < tilt angle θ < 15 degrees. Additionally, the tilt angle θ is an angle formed by a center line L1 of the vacuum thermal insulator 500A and a vertical line L2.

[0067]

The vacuum thermal insulator 500A2 is provided inside the partition 53, and prevents heat transfer between the vegetable compartment 31, and the ice-making compartment 21 and the versatile compartment 22. The rear end of the vacuum thermal insulator 500A2 is positioned further rearward, by a length D1, than is the rear end of the open top end of the second vegetable compartment storage case 420B housed in the vegetable compartment 31. This configuration prevents the temperature inside the second vegetable compartment storage case 420B from reaching a low temperature because of heat absorption from the ice-making compartment 21 and the versatile compartment 22.

[0068]

However, although the vacuum thermal insulator 500A2 is provided, it is difficult to entirely cover the vegetable compartment 31 in width and horizontal depth directions by the vacuum thermal insulator 500A2. Consequently, an amount of heat absorption from the storage compartments in the refrigeration temperature range is great around front and rear end portions and left and right end portions of the vegetable compartment 31. Moreover, the vacuum thermal insulator 500A2 is

formed by covering a core of glass fiber or other material with a resin bag on which metal such as aluminum is vapor-deposited or with a resin bag covered with a metal foil. A selvage that is an end portion of the bag remains after vacuum packaging, and the vacuum thermal insulator 500A is typically installed with the selvage folded.

5 Consequently, with the vacuum thermal insulator 500A2, heat transport in a metal layer, or in other words, a heat bridge, is caused, and the thermal insulation effect tends to be lower at around the front and rear end portions and the left and right end portions of the vacuum thermal insulator 500A2 than that at a center portion partly because of an influence of the heat transport.

10 [0069]

Furthermore, in a case where air passage structural parts are provided close to the rear surface section 50F of the box body 50, assembly is easier when the partition 53 where the vacuum thermal insulator 500A2 is embedded is attached after the air passage structural parts are attached to the box body 50. However, in such a case,
15 as the air passage structural parts and the partition 53 have to be joined, and the partition 53 and left and right side walls of the box body 50 have to be joined, leakage of cool air is possibly not completely blocked.

Consequently, a temperature is conceivably reduced at front, rear, left, and right edges of the partition 53, and it is possible that moisture evaporating from
20 vegetables stored in the vegetable compartment 31 is locally condensed, or becomes frost or is frozen depending on the degree of reduction.

[0070]

Consequently, as the refrigerator 1 is provided with the lid structure 430, it is possible to contain moisture evaporating from vegetables stored in the first vegetable
25 compartment storage case 420A and the second vegetable compartment storage case 420B as much as possible. Furthermore, as the refrigerator 1 is provided with the lid structure 430, it is possible to maintain high humidity inside the first vegetable compartment storage case 420A and the second vegetable compartment storage case 420B, in addition to containing moisture. Consequently, the refrigerator 1 may
30 further prevent evaporation from vegetables stored in the first vegetable compartment

storage case 420A and the second vegetable compartment storage case 420B, and may prevent occurrence of a phenomenon that is inconvenient for users, such as dew condensation or frosting on the partition 53 and other component.

Additionally, the air passage structural parts include parts forming the air outlet
5 passage 110 and the air return passage 140, and the air volume adjustment devices.
[0071]

The vacuum thermal insulator 500A3 is provided inside the door section 31A of the vegetable compartment 31, and prevents heat transfer between the vegetable compartment 31 and the outside of the refrigerator 1.

10 The vacuum thermal insulator 500A4 is provided inside the partition 54, and prevents heat transfer between the vegetable compartment 31 and the freezer compartment 41. A rear end of the vacuum thermal insulator 500A4 is positioned further rearward, by a length D2, than is a rear end of a bottom surface of the first vegetable compartment storage case 420A housed in the vegetable compartment 31.
15 This configuration prevents a temperature inside the first vegetable compartment storage case 420A from reaching a low temperature because of heat absorption from the freezer compartment 41.

[0072]

As described above, with the refrigerator 1, the vacuum thermal insulator
20 500A2 is installed in the partition 53, and the vacuum thermal insulator 500A4 is installed in the partition 54. This configuration prevents temperatures inside the first vegetable compartment storage case 420A and the second vegetable compartment storage case 420B in the vegetable compartment 31 from reaching a low temperature because of heat absorption from the storage compartments in the refrigeration
25 temperature range that are positioned above and below the vegetable compartment 31.

[0073]

Next, a relationship between the vacuum thermal insulator 500A1 and a part of the air circulation path 80 will be described.

30 The vacuum thermal insulator 500A1 is installed frontward of the front surface

of the cooler 600. Furthermore, the vacuum thermal insulator 500A1 is fixed in such a manner that the vacuum thermal insulator 500A1 is tilted and has the lower end positioned closer to the front surface section 50A of the box body 50 than is the upper end positioned closer to the rear surface section 50F of the box body 50 than is the lower end. Moreover, the vacuum thermal insulator 500A1 has a width greater than the width of the cooler 600.

[0074]

Then, as shown in Fig. 5, the first air return passage 141 is formed sideward of a right side surface of the cooler 600 and outside the vacuum thermal insulator 500A in the width direction. Moreover, the third air return passage 242 and the fourth air return passage 312 are formed further forward than is the first air return passage 141. A left side surface of the cooler 600 forms a wall section to the vegetable compartment 31, and a part of the left side surface is used as the fourth air return passage 312.

[0075]

That is, with the refrigerator 1, the first air return passage 141 is formed outside the width of the vacuum thermal insulator 500A1, and thus, the vacuum thermal insulator 500A1 that is formed as one rectangular plate-shaped part may be used. When such a vacuum thermal insulator 500A1 is used, opening a hole in and chamfering of corners of the vacuum thermal insulator 500A1 are not necessary, and also, a large number of parts are not necessary for the vacuum thermal insulator 500A1. Consequently, with the refrigerator 1, processing and manufacturing costs may be prevented from increasing. Consequently, the refrigerator 1 is easily assembled, and a manufacturing efficiency is increased.

[0076]

Moreover, the fifth air outlet passage 411 is formed in substantially parallel to a tilt of the vacuum thermal insulator 500A1, rearward of a rear surface of the vacuum thermal insulator 500A1 and within a projection range of the vacuum thermal insulator 500A1 in the width direction. Furthermore, the fifth air return passage 412 is formed rearward of a rear surface of the fifth air outlet passage 411. The fifth air outlet

passage 411 and the fifth air return passage 412 are formed to have the same width. When the refrigerator 1 is viewed from the front, the fifth air outlet passage 411 and the fifth air return passage 412 are arranged overlapping each other. The fifth air return passage 412 is joined to the cooler compartment 27 in such a manner that air
5 flows in from a lower end of a front surface of the cooler 600 to a middle level of the front surface. Additionally, the width of the fifth air outlet passage 411 and the width of the fifth air return passage 412 do not have to be exactly the same.

[0077]

When the vacuum thermal insulator in the rear surface section of the vegetable
10 compartment of a typical refrigerator is vertically located, a position of a lower end and a position of an upper end coincide with each other in the horizontal depth direction of the box body. Consequently, neither an upper space nor a lower space close to the rear surface section of the vegetable compartment can be increased, and also, air passages have to be formed in such spaces, and only a complex air passage
15 structure has to be adopted. In contrast, with the refrigerator 1, as the vacuum thermal insulator 500A1 is tilted, an upper space in the vegetable compartment 31, or in other words, a capacity of the vegetable compartment 31, may be increased. That is, with the refrigerator 1, a horizontal depth of an upper part of the vegetable compartment 31 may be increased.

20 [0078]

The second vegetable compartment storage case 420B that is movable is housed in such a part. As the vacuum thermal insulator 500A1 is tilted, a space at an upper part in the vegetable compartment 31 may be increased. However, the first vegetable compartment storage case 420A has to be shaped along the tilted location
25 of the vacuum thermal insulator 500A. That is, a storage capacity of the first vegetable compartment storage case 420A may be increased, but a resulting shape possibly reduces convenience of users. On the other hand, with the refrigerator 1, the first vegetable compartment storage case 420A and the second vegetable compartment storage case 420B are arranged overlapping each other, and thus, a
30 capacity not effective for storage may be reduced, and also, more orderly

arrangement suitable to food product size is enabled.

[0079]

Furthermore, as the vacuum thermal insulator 500A1 is tilted, a space located toward the rear surface section 50F from the vegetable compartment 31 in the box body 50 may be increased. Consequently, the fifth air outlet passage 411 and the fifth air return passage 412 positioned toward the rear surface section 50F from the vegetable compartment 31 may be linearly formed. Curving, and a change in air passage areas, of the fifth air outlet passage 411 and the fifth air return passage 412 to the freezer compartment 41 where highest cooling performance is required may therefore be reduced, and pressure loss may be reduced. Furthermore, the fifth air return passage 412 may be formed in such a manner that air flows through from the lower end to the middle level at the front surface of the cooler 600, and air may be caused to flow into the front-surface leading edge of the cooler 600, and a heat exchange efficiency of the cooler 600 may be increased.

[0080]

<Advantageous Effects of Refrigerator 1>

As described above, with the refrigerator 1, the vacuum thermal insulator 500A1 is tilted and has the lower end positioned closer to the front surface section 50A than is the upper end positioned closer to the rear surface section 50F than is the lower end, and thus, the capacity of the vegetable compartment 31 may be increased.

[0081]

With the refrigerator 1, the rear end of the vacuum thermal insulator 500A4 is positioned closer to the rear surface section 50F than is the rear end of the bottom surface of the first vegetable compartment storage case 420A, and the rear end of the vacuum thermal insulator 500A2 is positioned closer to the rear surface section 50F than is an upper rear end of the second vegetable compartment storage case 420B.

Consequently, the refrigerator 1 may prevent the temperatures inside the first vegetable compartment storage case 420A and the second vegetable compartment storage case 420B from reaching a low temperature because of heat absorption from the ice-making compartment 21, the versatile compartment 22, and the freezer

compartment 41.

[0082]

With the refrigerator 1, the fifth air outlet passage 411 and the fifth air return passage 412 are formed overlapping each other in the front-back direction, and the fifth air return passage 412 is formed to return air from the lower end to the middle level at the front surface of the cooler 600.

Consequently, the refrigerator 1 may increase the heat exchange efficiency of the cooler 600.

[0083]

The refrigerator 1 is provided with the lid structure 430 where the fin portion 430A is formed, the lid structure 430 covering the open top of the second vegetable compartment storage case 420B.

Consequently, the refrigerator 1 may maintain high humidity inside the first vegetable compartment storage case 420A and the second vegetable compartment storage case 420B, in addition to containing moisture inside the vegetable compartment 31.

[0084]

The ice-making compartment 21, the vegetable compartment 31, and the freezer compartment 41 of the refrigerator 1 are arranged in order from top, and thus, convenience of users may be increased while the thermal insulation effect is maintained.

[0085]

Embodiment 2

Fig. 8 is an enlarged cross-sectional view schematically showing a cross-section of a part of a refrigerator 1A according to Embodiment 2 of the present invention. The refrigerator 1A according to Embodiment 2 of the present invention will be described with reference to Fig. 8. Fig. 8 corresponds to Fig. 6 described in Embodiment 1. In Fig. 8, flows of air are represented by arrows.

Additionally, in Embodiment 2, differences from Embodiment 1 will be mainly described, and the same parts as those in Embodiment 1 will be denoted with the

same reference signs, and a description of the parts will be omitted.

[0086]

In Embodiment 2, a structure of the fifth air outlet passage 411 is different from that of the fifth air outlet passage 411 described in Embodiment 1. To be distinguished from the fifth air outlet passage 411 in Embodiment 1, the fifth air outlet passage in Embodiment 2 will be described as a fifth air outlet passage 411a, for the sake of convenience. Other structures in Embodiment 2 are as described in Embodiment 1. However, as shown in Fig. 8, a first freezer compartment storage case 440A and a second freezer compartment storage case 440B are housed in the freezer compartment 41.

[0087]

The second freezer compartment storage case 440B is located higher than the first freezer compartment storage case 440A, and has a smaller capacity than does the first freezer compartment storage case 440A. In a state where the second freezer compartment storage case 440B is housed in the first freezer compartment storage case 440A, and the door section 31A is closed, an open top end at a rear of the second freezer compartment storage case 440B is positioned further forward than is an open top end at a rear of the first freezer compartment storage case 440A. Additionally, the number of storage cases housed in the freezer compartment 41 is not particularly limited so long as at least the first freezer compartment storage case 440A and the second freezer compartment storage case 440B are housed.

[0088]

Similarly to the fifth air outlet passage 411 described in Embodiment 1, the fifth air outlet passage 411a is used as a freezer compartment air outlet passage where cool air to be blown into the freezer compartment 41 flows. The fifth air outlet passage 411a is branched in the freezer compartment 41. One of the branched fifth air outlet passage 411a will be referred to as a lower fifth air outlet passage 411a-1, and the other of the branched fifth air outlet passage 411a will be referred to as an upper fifth air outlet passage 411a-2.

[0089]

The lower fifth air outlet passage 411a-1 is used as a freezer compartment air outlet passage where cool air to be blown into the first freezer compartment storage case 440A of the freezer compartment 41 flows. An air outlet port, not shown, is formed in the lower fifth air outlet passage 411a-1. Cool air flowing through the lower fifth air outlet passage 411a-1 is introduced into the first freezer compartment storage case 440A of the freezer compartment 41 through the air outlet port. Additionally, the air outlet port of the lower fifth air outlet passage 411a-1 is desirably formed at a position lower than an air outlet port of the upper fifth air outlet passage 411a-2, when the refrigerator 1A is viewed from the front. Additionally, the number of air outlet ports of the lower fifth air outlet passage 411a-1 is not particularly limited.

[0090]

The upper fifth air outlet passage 411a-2 is used as a freezer compartment air outlet passage where cool air to be blown into the second freezer compartment storage case 440B of the freezer compartment 41 flows. An air outlet port, not shown, is formed in the upper fifth air outlet passage 411a-2. Cool air flowing through the upper fifth air outlet passage 411a-2 is introduced into the second freezer compartment storage case 440B of the freezer compartment 41 through the air outlet port. Additionally, the air outlet port of the upper fifth air outlet passage 411a-2 is desirably formed at a position higher than the air outlet port of the lower fifth air outlet passage 411a-1, when the refrigerator 1A is viewed from the front. Additionally, the number of air outlet ports of the upper fifth air outlet passage 411a-2 is not particularly limited.

[0091]

Circulation of air in the freezer compartment 41 will be described.

Cool air generated by the cooler 600 flows through the fifth air outlet passage 411, and is branched into the lower fifth air outlet passage 411a-1 and the upper fifth air outlet passage 411a-2.

Cool air flowing through the lower fifth air outlet passage 411a-1 is introduced into the freezer compartment 41 through the air outlet port formed in the lower fifth air outlet passage 411a-1. Cool air introduced into the freezer compartment 41 is

guided to the first freezer compartment storage case 440A, and cools food or other item stored in the first freezer compartment storage case 440A. Cool air used at the freezer compartment 41 flows through the fifth air return passage 412 through a return port, not shown, from the lower side on the drawing sheet to the upper side on the drawing sheet, as shown in Fig. 8, and is returned to the cooler 600.

[0092]

Cool air flowing through the upper fifth air outlet passage 411a-2 is introduced into the freezer compartment 41 through the air outlet port formed in the upper fifth air outlet passage 411a-2. Cool air introduced into the freezer compartment 41 is guided to the second freezer compartment storage case 440B, and cools food or other item stored in the second freezer compartment storage case 440B. Cool air used at the freezer compartment 41 merges with cool air used at the first freezer compartment storage case 440A for cooling, flows through the fifth air return passage 412 through a return port, not shown, from the lower side on the drawing sheet to the upper side on the drawing sheet, as shown in Fig. 8, and is returned to the cooler 600.

[0093]

<Advantageous Effects of Refrigerator 1A>

As described above, with the refrigerator 1A, the fifth air outlet passage 411 is branched into two in the width direction of the vacuum thermal insulator 500A1, and is further branched into two in a vertical direction, and thus, cool air may be effectively introduced into the freezer compartment 41, and a cooling effect of the freezer compartment 41 may be increased.

[0094]

Embodiment 3

Fig. 9 is a schematic diagram for describing the air circulation path 80 of a refrigerator 1B according to Embodiment 3 of the present invention. Fig. 10 is a cross-sectional view schematically showing a cross-section along Z-Z in Fig. 9. Fig. 11 is an explanatory diagram schematically showing a flow of air in the refrigerator 1B. The refrigerator 1B will be described with reference to Figs. 9 to 11. Additionally,

flows of air are represented by arrows in Figs. 9 to 11. Additionally, Fig. 9 shows, as an example, a case where a chilled compartment is installed in the refrigerator compartment 11.

Additionally, in Embodiment 3, differences from Embodiment 1 and Embodiment 2 will be mainly described, and the same parts as those in Embodiment 1 and Embodiment 2 will be denoted with the same reference signs, and a description of the parts will be omitted.

[0095]

An air passage structure of the refrigerator 1B will be specifically described.

Similarly to the refrigerator 1 according to Embodiment 1, the refrigerator 1B includes the air outlet passage 110 and the air return passage 140.

[0096]

As shown in Fig. 9, when the refrigerator 1B is viewed from the front, the fifth air outlet passage 411 is branched into two at a portion located toward the rear surface section 50F from the vegetable compartment 31. One of the branched fifth air outlet passage 411 will be referred to as a left-side fifth air outlet passage 411A, and the other of the branched fifth air outlet passage 411 will be referred to as a right-side fifth air outlet passage 411B.

[0097]

A fifth air outlet port 421A is formed in the left-side fifth air outlet passage 411A. Cool air flowing through the left-side fifth air outlet passage 411A is introduced into the freezer compartment 41 through the fifth air outlet port 421A. When the refrigerator 1B is viewed from the front, the fifth air outlet port 421A is positioned at an upper left in the freezer compartment 41. Additionally, the number of fifth air outlet ports 421A is not particularly limited.

[0098]

A fifth air outlet port 421B is formed in the right-side fifth air outlet passage 411B. Cool air flowing through the right-side fifth air outlet passage 411B is introduced into the freezer compartment 41 through the fifth air outlet port 421B.

When the refrigerator 1B is viewed from the front, the fifth air outlet port 421B is

positioned at an upper right in the freezer compartment 41. The number of fifth air outlet ports 421B is not particularly limited.

[0099]

The first air return passage 141 is joined to the vegetable compartment 31 through an air discharge port 551. Consequently, air flowing through the first air return passage 141 is introduced into the vegetable compartment 31 through the first return port 131 and the air discharge port 551. Cool air that is introduced into the vegetable compartment 31 is used to cool the vegetable compartment 31, and is then, returned to the cooler 600 through the fourth air return passage 312.

When the refrigerator 1B is viewed from the front, the third return port 232 is positioned at a lower right in the versatile compartment 22.

When the refrigerator 1B is viewed from the front, the fourth return port 331 is positioned at a lower center in the vegetable compartment 31.

[0100]

The fifth air return passage 412 is formed to correspond to the number of branches of the fifth air outlet passage 411. Furthermore, the fifth air return passage 412 is formed overlapping the fifth air outlet passage 411 in the front-back direction. One of the branched parts of the fifth air return passage 412 will be referred to as a left-side fifth air return passage 412A, and the other of the branched parts of the fifth air return passage 412 will be referred to as a right-side fifth air return passage 412B.

[0101]

A fifth return port 431A is formed in the left-side fifth air return passage 412A. When the refrigerator 1B is viewed from the front, the fifth return port 431A is positioned at an upper left in the freezer compartment 41. Moreover, the left-side fifth air return passage 412A is joined to the cooler compartment 27 through a fifth joining portion 451A. Consequently, air flowing through the left-side fifth air return passage 412A is returned to the cooler 600 through the fifth return port 431A and the fifth joining portion 451A.

[0102]

A fifth return port 431B is formed in the right-side fifth air return passage 412B.

When the refrigerator 1B is viewed from the front, the fifth return port 431B is positioned at an upper right in the freezer compartment 41. Moreover, the right-side fifth air return passage 412B is joined to the cooler compartment 27 through a fifth joining portion 451B. Consequently, air flowing through the right-side fifth air return passage 412B is returned to the cooler 600 through the fifth return port 431B and the fifth joining portion 451B.

[0103]

Flows of air around the cooler 600 will be described with reference to Figs. 9 and 11.

Circulation of air in the refrigerator compartment 11 will be described.

Cool air generated by the cooler 600 flows through the first air outlet passage 111, from a lower side on the drawing sheet to an upper side on the drawing sheet, after the volume of the cool air is adjusted by the first damper 101, and is introduced into the refrigerator compartment 11 through the first air outlet ports 121. Cool air used at the refrigerator compartment 11 flows through the first air return passage 141 through the first return port 131, from the upper side on the drawing sheet to the lower side on the drawing sheet, and is introduced into the vegetable compartment 31 through the air discharge port 551.

[0104]

Circulation of air in the ice-making compartment 21 will be described.

Cool air generated by the cooler 600 flows through the second air outlet passage 211a after the volume of the cool air is adjusted by the second damper 201a, and is introduced into the ice-making compartment 21 through the second air outlet port 221a. Cool air used at the ice-making compartment 21 flows through the second air return passage 241a through the second return port 231a, from the upper side on the drawing sheet to the lower side on the drawing sheet, and is returned to the cooler 600 through the second joining portion 251a.

[0105]

Circulation of air in the versatile compartment 22 will be described.

Cool air generated by the cooler 600 flows through the third air outlet passage

212 after the volume of the cool air is adjusted by the third damper 202, and is introduced into the versatile compartment 22 through the third air outlet port 222.

Cool air used at the versatile compartment 22 flows through the third air return passage 242 through the third return port 232, from the upper side on the drawing sheet to the lower side on the drawing sheet, and is returned to the cooler 600 through the third joining portion 252.

[0106]

Circulation of air in the vegetable compartment 31 will be described.

Cool air generated by the cooler 600 flows through the fourth air outlet passage 311 after the volume of the cool air is adjusted by the fourth damper 301, and is introduced into the vegetable compartment 31 through the fourth air outlet port 321. Cool air used at the vegetable compartment 31 flows through the fourth air return passage 312 through the fourth return port 331, from the lower side on the drawing sheet to the upper side on the drawing sheet, and is returned to the cooler 600 through the fourth joining portion 351.

Additionally, cool air that is introduced into the vegetable compartment 31 through the refrigerator compartment 11 is also returned to the cooler 600 through the fourth return port 331 and the fourth joining portion 351.

[0107]

The fourth return port 331 is positioned outside and lower than a forward projection plane of the vacuum thermal insulator 500A1 that is one rectangular plate-shaped part, without overlapping the forward projection plane. Cool air that is blown out from the fourth air outlet port 321 is circulated to be ejected from the fourth return port 331 positioned at a lower center in the vegetable compartment 31, to be guided to the cooler 600, and to be cooled by passing through the cooler 600 again.

[0108]

Circulation of air in the freezer compartment 41 will be described.

Cool air generated by the cooler 600 flows through the fifth air outlet passage 411, and is branched into the left-side fifth air outlet passage 411A and the right-side fifth air outlet passage 411B. Cool air branched into the left-side fifth air outlet

passage 411A is introduced into the freezer compartment 41 through the fifth air outlet port 421A. Cool air branched into the right-side fifth air outlet passage 411B is introduced into the freezer compartment 41 through the fifth air outlet port 421B. Cool air used at the freezer compartment 41 flows through the left-side fifth air return passage 412A and the right-side fifth air return passage 412B through the fifth return port 431A and the fifth return port 431B, from the lower side on the drawing sheet to the upper side on the drawing sheet, and is returned to the cooler 600 through the fifth joining portion 451A and the fifth joining portion 451B.

[0109]

Next, a description will be given of the vacuum thermal insulator 500A.

As in the case of the refrigerator 1 according to Embodiment 1, the refrigerator compartment 11, the ice-making compartment 21 and the versatile compartment 22, the vegetable compartment 31, and the freezer compartment 41 of the refrigerator 1B are arranged in order from top. That is, with the refrigerator 1B, storage compartments in a cooling temperature range and storage compartments in a refrigeration temperature range are alternately arranged.

[0110]

When the vacuum insulator 500A1 is viewed from a side, the vacuum thermal insulator 500A1 is located with a longitudinal direction extending in a vertical direction, and prevents heat transfer between the vegetable compartment 31 and a portion located toward the rear surface section 50F of the box body 50. Furthermore, the vacuum thermal insulator 500A1 has a width greater than the width of the cooler 600.

[0111]

The vacuum thermal insulator 500A2 is provided inside the partition 53, and prevents heat transfer between the vegetable compartment 31, and the ice-making compartment 21 and the versatile compartment 22. A rear end of the vacuum thermal insulator 500A2 is positioned further rearward than is a rear end of an open top end of the second vegetable compartment storage case 420B housed in the vegetable compartment 31. This configuration prevents a temperature inside the

first vegetable compartment storage case 420A from reaching a low temperature because of heat absorption from the freezer compartment 41.

[0112]

The vacuum thermal insulator 500A3 is provided inside the door section 31A of the vegetable compartment 31, and prevents heat transfer between the vegetable compartment 31 and the outside of the refrigerator 1B.

The vacuum thermal insulator 500A4 is provided inside the partition 53, and prevents heat transfer between the vegetable compartment 31 and the freezer compartment 41. A rear end of the vacuum thermal insulator 500A4 is positioned further rearward, by a length D2, than is a rear end of a bottom surface of the first vegetable compartment storage case 420A housed in the vegetable compartment 31. This configuration prevents a temperature inside the first vegetable compartment storage case 420A from reaching a low temperature because of heat absorption from the ice-making compartment 21 and the versatile compartment 22.

[0113]

Next, a relationship between the vacuum thermal insulator 500A1 and a part of the air circulation path 80 will be described.

The vacuum thermal insulator 500A1 is installed frontward of the front surface of the cooler 600. Furthermore, the vacuum thermal insulator 500A1 has a width greater than the width of the cooler 600. The refrigerator 1B may thus achieve a high thermal insulation effect.

[0114]

Moreover, as shown in Fig. 9, the first air return passage 141 is formed sideward of a right side surface of the cooler 600 and outside the vacuum thermal insulator 500A in the width direction. A lower surface of the cooler 600 forms a wall section to the vegetable compartment 31, and a part of the lower surface is used as the fourth air return passage 312.

[0115]

That is, with the refrigerator 1B, the first air return passage 141 is formed outside the vacuum thermal insulator 500A1 in the width direction, and thus, the

vacuum thermal insulator 500A1 that is formed as one rectangular plate-shaped part may be used.

[0116]

As described above, the vacuum thermal insulator 500A1 is vertically located, and the cooler 600 is installed rearward of a rear surface of the vacuum thermal insulator 500A1. Furthermore, with the refrigerator 1B, the fifth air outlet passage 411 and the fifth air return passage 412 are each branched, and the fourth return port 331 is formed between the branches. That is, when the refrigerator 1B is viewed from the front, the fourth return port 331 is positioned between a set of the left-side fifth air outlet passage 411A and the left-side fifth air return passage 412A and a set of the right-side fifth air outlet passage 411B and the right-side fifth air return passage 412B. Consequently, with the refrigerator 1B, a space located toward the rear surface section 50F from the vegetable compartment 31 is effectively used.

[0117]

When the vacuum thermal insulator in the rear surface section of the vegetable compartment of a typical refrigerator is vertically located, a position of a lower end and a position of an upper end coincide with each other in the horizontal depth direction of the box body. Consequently, neither an upper space nor a lower space close to the rear surface section 50F from the vegetable compartment can be increased, and also, air passages have to be formed in such spaces, and only a complex air passage structure has to be adopted.

In contrast, with the refrigerator 1B, the fifth air outlet passage 411 and the fifth air return passage 412 are each branched and the fourth return port 331 is formed between the branches, while the vacuum thermal insulator 500A1 is vertically located, and thus, the air passage structure is not complicated, and a space located toward the rear surface section 50F from the vegetable compartment 31 may be increased.

[0118]

The fourth air return passage 312 and the fifth air return passage 412 may be formed to allow air to flow in from a lower end of the cooler 600, and air may be caused to flow into the front-surface leading edge of the cooler 600, and the heat

exchange efficiency of the cooler 600 may be increased.

[0119]

<Advantageous Effects of Refrigerator 1B>

As described above, with the refrigerator 1B, the fifth air outlet passage 411
5 and the fifth air return passage 412 are provided behind the vacuum thermal insulator
500A1, and the fifth air outlet passage 411 and the fifth air return passage 412 are
formed overlapping each other in the front-back direction and each branched into two
in the width direction of the vacuum thermal insulator 500A1.

Consequently, with the refrigerator 1B, the air passage structure is not
10 complicated, and a simple air passage structure may be achieved.

[0120]

With the refrigerator 1B, when the fourth return port 331 is viewed from the
front, the fourth return port 331 is formed in the rear surface section 50F of the
vegetable compartment 31, between the set of the left-side fifth air outlet passage
15 411A and the left-side fifth air return passage 412A that are each branched, and the
set of the right-side fifth air outlet passage 411B and the right-side fifth air return
passage 412B that are correspondingly branched.

Consequently, with the refrigerator 1B, the air passage structure is not
complicated, and the space located toward the rear surface section 50F from the
20 vegetable compartment 31 may be effectively used.

[0121]

The vacuum thermal insulator 500A1 of the refrigerator 1B has a width greater
than the width of the cooler 600, and thus, a high thermal insulation effect may be
achieved.

25 [0122]

Embodiment 4

Fig. 12 is an enlarged cross-sectional view schematically showing a cross-
section of a part of a refrigerator 1C according to Embodiment 4 of the present
invention. The refrigerator 1C according to Embodiment 4 of the present invention
30 will be described with reference to Fig. 12. Fig. 12 corresponds to Fig. 10 described

in Embodiment 3. In Fig. 12, flows of air are represented by arrows.

Additionally, in Embodiment 4, differences from Embodiment 1 to Embodiment 3 will be mainly described, and the same parts as those in Embodiment 1 to Embodiment 3 will be denoted with the same reference signs, and a description of the parts will be omitted.

[0123]

In Embodiment 4, a structure of the fifth air outlet passage 411 is different from that of the fifth air outlet passage 411 described in Embodiment 3. To be distinguished from the fifth air outlet passage 411 in Embodiment 3, the fifth air outlet passage in Embodiment 4 will be described as a fifth air outlet passage 411C, for the sake of convenience. Other structures in Embodiment 4 are as described in Embodiment 3. However, as shown in Fig. 12, the first freezer compartment storage case 440A and the second freezer compartment storage case 440B are housed in the freezer compartment 41.

[0124]

The second freezer compartment storage case 440B is located higher than the first freezer compartment storage case 440A, and has a smaller capacity than does the first freezer compartment storage case 440A. In a state where the second freezer compartment storage case 440B is housed in the first freezer compartment storage case 440A, and the door section 31A is closed, the open top end at a rear of the second freezer compartment storage case 440B is positioned further forward than the open top end at a rear of the first freezer compartment storage case 440A. Additionally, the number of storage cases housed in the freezer compartment 41 is not particularly limited so long as at least the first freezer compartment storage case 440A and the second freezer compartment storage case 440B are housed.

[0125]

Similarly to the fifth air outlet passage 411 described in Embodiment 1, the fifth air outlet passage 411C is used as a freezer compartment air outlet passage where cool air to be blown into the freezer compartment 41 flows. The fifth air outlet passage 411 is branched into the left-side fifth air outlet passage 411A and the right-

side fifth air outlet passage 411B. Moreover, with the refrigerator 1C, the left-side fifth air outlet passage 411A and the right-side fifth air outlet passage 411B are each further branched. Here, a description is given of an example where the fifth air outlet passage 411C is the left-side fifth air outlet passage 411A.

[0126]

As shown in Fig. 12, the fifth air outlet passage 411C is branched inside the freezer compartment 41. One of the branched part of the fifth air outlet passage 411C will be referred to as a lower fifth air outlet passage 411C-1, and the other of the branched part of the fifth air outlet passage 411C will be referred to as an upper fifth air outlet passage 411C-2.

[0127]

The lower fifth air outlet passage 411C-1 is used as a freezer compartment air outlet passage where cool air to be blown into the first freezer compartment storage case 440A of the freezer compartment 41 flows. An air outlet port, not shown, is formed in the lower fifth air outlet passage 411C-1. Cool air flowing through the lower fifth air outlet passage 411C-1 is introduced into the first freezer compartment storage case 440A of the freezer compartment 41 through the air outlet port.

Additionally, the air outlet port of the lower fifth air outlet passage 411C-1 is desirably formed at a position lower than an air outlet port of the upper fifth air outlet passage 411C-2, when the refrigerator 1C is viewed from the front. The number of air outlet ports of the lower fifth air outlet passage 411C-1 is not particularly limited.

[0128]

The upper fifth air outlet passage 411C-2 is used as a freezer compartment air outlet passage where cool air to be blown into the second freezer compartment storage case 440B of the freezer compartment 41 flows. An air outlet port, not shown, is formed in the upper fifth air outlet passage 411C-2. Cool air flowing through the upper fifth air outlet passage 411C-2 is introduced into the second freezer compartment storage case 440B of the freezer compartment 41 through the air outlet port. Additionally, the air outlet port of the upper fifth air outlet passage 411C-2 is desirably formed at a position higher than the air outlet port of the lower fifth air outlet

passage 411C-1, when the refrigerator 1C is viewed from the front. Additionally, the number of air outlet ports of the upper fifth air outlet passage 411C-2 is not particularly limited.

[0129]

5 Circulation of air in the freezer compartment 41 will be described.

Cool air generated by the cooler 600 flows through the fifth air outlet passage 411C, and is branched into the lower fifth air outlet passage 411C-1 and the upper fifth air outlet passage 411C-2.

10 Cool air flowing through the lower fifth air outlet passage 411C-1 is introduced into the freezer compartment 41 through the air outlet port formed in the lower fifth air outlet passage 411C-1. Cool air introduced into the freezer compartment 41 is guided to the first freezer compartment storage case 440A, and cools food or other item stored in the first freezer compartment storage case 440A. Cool air used at the freezer compartment 41 flows through the fifth air return passage 412 through the fifth
15 return port 431A, from the lower side on the drawing sheet to the upper side on the drawing sheet, as shown in Fig. 8, and is returned to the cooler 600.

[0130]

20 Cool air flowing through the upper fifth air outlet passage 411C-2 is introduced into the freezer compartment 41 through the air outlet port formed in the upper fifth air outlet passage 411C-2. Cool air introduced into the freezer compartment 41 is guided to the second freezer compartment storage case 440B, and cools food or other item stored in the second freezer compartment storage case 440B. Cool air used at the freezer compartment 41 merges with cool air used at the first freezer compartment storage case 440A for cooling, flows through the fifth air return passage
25 412 through the fifth return port 431A, from the lower side on the drawing sheet to the upper side on the drawing sheet, as shown in Fig. 8, and is returned to the cooler 600.

[0131]

<Advantageous Effects of Refrigerator 1C>

30 As described above, with the refrigerator 1C, the fifth air outlet passage 411 is branched into two in the width direction of the vacuum thermal insulator 500A1, and is

further branched into two in the vertical direction, and thus, cool air may be effectively introduced into the freezer compartment 41, and the cooling effect of the freezer compartment 41 may be increased.

[0132]

5 Embodiments of the present invention have been described in four embodiments, but the embodiments may be combined as appropriate.

Reference Signs List

[0133]

1 refrigerator 1A refrigerator 1B refrigerator 1C refrigerator 11
10 refrigerator compartment 11A door section 21 ice-making compartment 21A
door section 22 versatile compartment 22A door section 27 cooler
compartment 31 vegetable compartment 31A door section 31B floor
surface 41 freezer compartment 41a door section 50 box body
50A front surface section 50B top surface section 50C bottom surface
15 section 50D right side surface section 50E left side surface section 50F
rear surface section 51 partition 51A partition 51B partition 52
partition 53 partition 53A partition 53B partition 54 partition
55 wall section 56 sheet metal 57 inner box 70 refrigerant circuit
71 compressor 72 air-cooled condenser 73 heat dissipation pipe 74
20 dew condensation preventing pipe 75 drier 76 pressure reducing device 80
air circulation path 101 first damper 110 air outlet passage 111 first air outlet
passage 121 first air outlet port 131 first return port 140 air return
passage 141 first air return passage 151 first joining portion 201a second
damper 201b sixth damper 202 third damper 211a second air outlet
25 passage 211b sixth air outlet passage 212 third air outlet passage 221a
second air outlet port 221b sixth air outlet port 222 third air outlet port
231a second return port 232 third return port 241a second air
return passage 242 third air return passage 251a second joining portion
252 third joining portion 301 fourth damper 311 fourth air outlet
30 passage 312 fourth air return passage 321 fourth air outlet port 331

fourth return port 351 fourth joining portion 411 fifth air outlet passage
411A left-side fifth air outlet passage 411B right-side fifth air outlet passage
411C fifth air outlet passage 411C-1 lower fifth air outlet passage 411C-2
upper fifth air outlet passage 411a fifth air outlet passage 411a-1 lower fifth
5 air outlet passage 411a-2 upper fifth air outlet passage 412 fifth air return
passage 412A left-side fifth air return passage 412B right-side fifth air
return passage 420A first vegetable compartment storage case 420B second
vegetable compartment storage case 421 fifth air outlet port 421A fifth air outlet
port 421B fifth air outlet port 430 lid structure 430A fin portion 431 fifth
10 return port 431A fifth return port 431B fifth return port 440A first freezer
compartment storage case 440B second freezer compartment storage case
451 fifth joining portion 451A fifth joining portion 451B fifth joining
portion 500 thermal insulator 500A vacuum thermal insulator 500A1
vacuum thermal insulator 500A2 vacuum thermal insulator 500A3 vacuum
15 thermal insulator 500A4 vacuum thermal insulator 551 air discharge port
600 cooler 700 heater 750 drip heater 751 drip tray 800 fan

CLAIMS

[Claim 1]

A refrigerator, comprising:

a first storage compartment in a refrigeration temperature range;

5 a second storage compartment in a refrigeration temperature range;

a third storage compartment in a cooling temperature range, the third storage compartment including wall sections that include a front surface section and a rear surface section, and being located between the first storage compartment and the second storage compartment;

10 a vacuum thermal insulator provided in each of the wall sections partitioning off the third storage compartment;

a cooler provided rearward of a rear surface of the third storage compartment;

15 a first air passage formed rearward of a rear surface of the vacuum thermal insulator provided in the rear surface section of the third storage compartment, the first air passage being configured to introduce air from the cooler into the second storage compartment;

20 a second air passage formed rearward of the rear surface of the vacuum thermal insulator provided in the rear surface section of the third storage compartment, the second air passage being configured to return air used at the second storage compartment to the cooler; and

25 a refrigerator compartment air return passage formed sideward of a side surface of the vacuum thermal insulator provided in the rear surface section of the third storage compartment, the refrigerator compartment air return passage being configured to return air used at a refrigerator compartment that is different from the first storage compartment, the second storage compartment, and the third storage compartment to the cooler,

30 the vacuum thermal insulator provided in the rear surface section of the third storage compartment being tilted and having a lower end positioned closer to the front surface section than is an upper end positioned closer to the rear surface section than is the lower end,

when the first air passage and the second air passage are viewed from a front, the first air passage and the second air passage being formed overlapping each other at a portion located toward the rear surface of the vacuum thermal insulator provided in the rear surface section of the third storage compartment,

5 the first air passage being configured to introduce air from the cooler into the second storage compartment at a portion located toward the rear surface of the vacuum thermal insulator provided in the rear surface section of the third storage compartment,

10 the second air passage being configured to return air from a lower end of a front surface of the cooler to a middle level of the front surface.

[Claim 2]

The refrigerator of claim 1, wherein

15 a first storage case, and a second storage case that is located higher than the first storage case are housed in the third storage compartment, the second storage case having a smaller capacity than does the first storage case, and

in a state where a door section of the third storage compartment is closed,

20 a rear end of the vacuum thermal insulator provided in a bottom surface section of the third storage compartment is positioned closer to the rear surface section than is a rear end of a bottom surface section of the first storage case housed in the third storage compartment, and

a rear end of the vacuum thermal insulator provided in an upper surface of the third storage compartment is positioned closer to the rear surface section than is an upper rear end of the second storage case housed in the third storage compartment.

[Claim 3]

25 The refrigerator of claim 2, wherein a lid structure configured to cover an open top of the second storage case is provided in the third storage compartment.

[Claim 4]

30 The refrigerator of claim 3, wherein the lid structure includes a fin portion that is positioned closer to a rear surface than is a rear surface side end portion of the second storage case and that is bent downward.

[Claim 5]

The refrigerator of claim 1, wherein the first air passage is branched into two in a width direction of the vacuum thermal insulator provided in the rear surface section of the third storage compartment, and is further branched into two in a vertical direction.

[Claim 6]

The refrigerator of any one of claims 1 to 5, wherein the first storage compartment is an ice-making compartment, the second storage compartment is a freezer compartment, the third storage compartment is a vegetable compartment, and the ice-making compartment, the vegetable compartment, and the freezer compartment are arranged in order from top.

[Claim 7]

The refrigerator of any one of claims 1 to 6, wherein a return port through which air used at the third storage compartment flows is formed diagonally to an outlet port through which air to be used at the third storage compartment flows.