

DESCRIPTION

Title of Invention

REFRIGERATOR

5 Technical Field

[0001]

The present invention relates to a refrigerator in which wall portions defining a storage compartment each has a vacuum thermal insulator.

Background Art

10 [0002]

In an existing refrigerator, a refrigerator compartment, an ice-making compartment, a freezer compartment, and a vegetable compartment are arranged in this order from the top. In this arrangement, the vegetable compartment is disposed at the lowest position of the refrigerator. This configuration has made it necessary for a user to kneel and squat down or bend down for taking vegetables out of the vegetable compartment.

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[0003]

When the door opening-closing frequency or the door opening time is compared between the vegetable compartment and the freezer compartment, while the results vary depending on individual differences, roughly, the door opening-closing frequency is higher and the door opening time is longer in the vegetable compartment. It is thus expected that by exchanging the positions of the vegetable compartment and the freezer compartment to dispose the vegetable compartment at a higher position than the position of the freezer compartment, the usability of the refrigerator as a whole improves.

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[0004]

However, the existing refrigerator is configured primarily to have a plurality of compartments with a refrigeration temperature zone collected in one place so that thermal efficiency is improved.

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The existing refrigerator is configured secondly to have a cooler disposed on

the rear face of the freezer compartment so that an inconvenient phenomenon such as frosting and dew condensation hardly occurs without a special thermal insulation part provided between the freezer compartment and the cooler.

[0005]

5 In contrast, for improving the usability of the user, it is conceivable to arrange the refrigerator compartment, the ice-making compartment, the vegetable compartment, and the freezer compartment in this order from the top of the refrigerator. In this refrigerator, from the top, the compartments with a refrigerating temperature zone (plus temperature) and the compartments with the refrigeration temperature zone (minus temperature) are disposed alternately.

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Consequently, the refrigerator having such an arrangement is primarily inferior in thermal efficiency to the existing refrigerator. Further, the wall portion of each compartment is increased in thickness to ensure necessary thermal insulation performance, which causes decrease in food storable space as compared to that of an existing refrigerator having the same external form.

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In the refrigerator with such an arrangement, secondly, the cooler is disposed on the rear face of the vegetable compartment, thus requiring a wall portion that separates the vegetable compartment from the cooler to have high thermal insulation performance as compared to that of the existing refrigerator. The wall portion may be increased in thickness to enhance the thermal insulation performance. However, this increased thickness leads to reduction in food storable space as described above.

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Consequently, as the existing thermal insulation part, a molded article of styrene foam has been used, the article having favorable processability and convenience in attachment, removal, and transportation. However, the use of a vacuum thermal insulator having higher thermal insulation performance (a small heat transfer coefficient) as the thermal insulation part makes it possible to ensure both the thermal insulation performance and the food storable space.

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Citation List

30 Patent Literature

[0006]

Patent Literature 1: Japanese Unexamined Patent Application Publication No.
2012-242072

Summary of Invention

5 Technical Problem

[0007]

In the case of placement of the vacuum thermal insulator between the vegetable compartment and the cooler, an air passage is necessary for sending cool air, cooled in the cooler, into the vegetable compartment. Patent Literature 1 describes that "the vacuum thermal insulator" is provided "on the front face, except for the flow inlet and the flow outlet, out of the partitions constituting the inner wall faces" (see claim 10 of Patent Literature 1). As thus described, there is a method of covering all, except for the flow inlet and the flow outlet, with the vacuum thermal insulator.

15 However, in this case, the need arises to open a hole in the vacuum thermal insulator, provide a notch in the vacuum thermal insulator, or use a plurality of pieces of the vacuum thermal insulators. This need leads to increase in manufacturing cost.

[0008]

20 The present invention has been made to solve the above problem, and it is an object of the present invention to provide a refrigerator that can be reduced in manufacturing cost, simply assembled, and manufactured efficiently.

Solution to Problem

[0009]

25 A refrigerator according to one embodiment of the present invention includes a storage compartment set at a temperature higher than temperatures of ones of other compartments of the refrigerator that surround the storage compartment, and the storage compartment is for storing an item. Wall portions defining the storage compartment each have a vacuum thermal insulator.

30 Advantageous Effects of Invention

[0010]

In the refrigerator according to one embodiment of the present invention, wall portions defining the storage compartment each have a vacuum thermal insulator. Hence an area covered with the vacuum thermal insulators in the storage

5 compartment increases as much as possible. Further, the vacuum thermal insulator has an easily manufacturable shape, such as a rectangular shape, and does not need to be provided with a notch and a hole, so that necessary thermal insulation performance can be ensured in a simple configuration. This shape can reduce manufacturing cost, simplify assembly, and make manufacturing efficiency favorable.

10 Brief Description of Drawings

[0011]

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

15 [Fig. 2] Fig. 2 is an explanatory view illustrating a refrigerant circuit of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is an explanatory view illustrating a lateral vertical cross section of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is an explanatory view illustrating a cross section of a part of a wall portion of a box body of the refrigerator according to Embodiment 1 of the

20 present invention.

[Fig. 5] Fig. 5 is an explanatory view illustrating a cross section of a part of the wall portion in a left side-face portion of the box body of the refrigerator according to Embodiment 1 of the present invention.

25 [Fig. 6] Fig. 6 is an explanatory view illustrating another example of the cross section of a part of the wall portion of the box body of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 7] Fig. 7 is an explanatory view illustrating another example of the cross section of a part of the wall portion of the box body of the refrigerator according to Embodiment 1 of the present invention.

30 [Fig. 8] Fig. 8 is a cross-sectional view illustrating a front-back vertical cross

section of a periphery of a lower portion of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 9] Fig. 9 is a cross-sectional view illustrating a lateral vertical cross section of the periphery of the lower portion of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 10] Fig. 10 is a cross-sectional view illustrating a lateral vertical cross section of a periphery of a vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 11] Fig. 11 is an explanatory view illustrating a vertical cross section of another example of a ceiling wall portion in the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 12] Fig. 12 is an explanatory view illustrating a vertical cross section of another example of the ceiling wall portion in the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 13] Fig. 13 is a cross-sectional view illustrating another example of a lateral vertical cross section of the periphery of the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 14] Fig. 14 is a cross-sectional view illustrating another example of the lateral vertical cross section of the periphery of the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 15] Fig. 15 is a front view illustrating a rear-face wall portion viewed through the inside of the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 16] Fig. 16 is a front view illustrating another example of the rear-face wall portion viewed through the inside of the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 17] Fig. 17 is a front view illustrating another example of the rear-face wall portion viewed through the inside of the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 18] Fig. 18 is a schematic view illustrating vacuum thermal insulators in

some of wall portions defining the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 19] Fig. 19 is a schematic view illustrating vacuum thermal insulators in some of the wall portions defining the vegetable compartment, as viewed from the rear face, in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 20] Fig. 20 is a schematic view illustrating a thermal heater installed in the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 21] Fig. 21 is a schematic view illustrating a radiation pipe installed in the vegetable compartment in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 22] Fig. 22 is a schematic view illustrating the radiation pipe in a refrigerant circuit of the refrigerator according to Embodiment 1 of the present invention.

[Fig. 23] Fig. 23 is a diagram illustrating a flow-rate characteristic on an outlet pipe that is not connected to the radiation pipe that radiates heat into the vegetable compartment, at a flow switching three-way valve in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 24] Fig. 24 is an explanatory view illustrating the configuration of the flow switching three-way valve in the refrigerator according to Embodiment 1 of the present invention.

[Fig. 25] Fig. 25 is an explanatory view collectively illustrating flow formation states associated with steps of a rotary gear at the flow switching three-way valve in the refrigerator according to Embodiment 1 of the present invention. Fig. 25(a) illustrates a step 0 state of the rotary gear, Fig. 25(b) illustrates the case of a closed flow passage in a step 4 state, Fig. 25(c) illustrates the case of restriction A in a step 36 state of the rotary gear, Fig. 25(d) illustrates the case of restriction B in a step 73 state of the rotary gear, Fig. 25(e) illustrates the case of restriction C in a step 110 state of the rotary gear, Fig. 25(f) illustrates the case of an open flow passage in a step 177 state of the rotary gear, and Fig. 25(g) illustrates the case of the stage end

in a step 200 state of the rotary gear.

[Fig. 26] Fig. 26 is an explanatory view illustrating, in a cross section along a line A-A of Fig. 25(c), a rotary pad and a valve seat at the flow switching three-way valve in the refrigerator according to Embodiment 1 of the present invention.

5 [Fig. 27] Fig. 27 is an explanatory view collectively illustrating a blow air passage and a return air passage for cool air supplied to and from the refrigerator compartment in the refrigerator according to Embodiment 1 of the present invention. Fig. 27(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air passage and the return air passage for cool air supplied to and from the
10 refrigerator compartment, Fig. 27(b) is an explanatory view illustrating, in a front-back vertical cross section, the blow air passage for cool air supplied to the refrigerator compartment, and Fig. 27(c) is an explanatory view illustrating, in a front-back vertical cross section, the return air passage for cool air supplied from the refrigerator compartment.

15 [Fig. 28] Fig. 28 is an explanatory view collectively illustrating a blow air passage and a return air passage for cool air supplied to and from an ice-making compartment in the refrigerator according to Embodiment 1 of the present invention. Fig. 28(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air passage and the return air passage for cool air supplied to and from the ice-
20 making compartment, and Fig. 28(b) is a perspective view illustrating the state of cool air blowing into the ice-making compartment.

[Fig. 29] Fig. 29 is an explanatory view collectively illustrating a blow air passage and a return air passage for cool air supplied to and from a temperature switchable compartment in the refrigerator according to Embodiment 1 of the present
25 invention. Fig. 29(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air passage and the return air passage for cool air supplied to and from the temperature switchable compartment, and Fig. 29(b) is an explanatory view illustrating, in a front-back vertical cross section, the return air passage for cool air supplied from the temperature switchable compartment.

30 [Fig. 30] Fig. 30 is an explanatory view collectively illustrating a blow air

passage and a return air passage for cool air supplied to and from a freezer compartment in the refrigerator according to Embodiment 1 of the present invention. Fig. 30(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air passage and the return air passage for cool air supplied to and from the freezer compartment, and Fig. 30(b) is an explanatory view illustrating, in a front-back vertical cross section, the blow air passage and the return air passage for cool air supplied to and from the freezer compartment.

[Fig. 31] Fig. 31 is a front view illustrating a rear-face wall portion viewed through the inside of a vegetable compartment in a refrigerator according to Embodiment 2 of the present invention.

[Fig. 32] Fig. 32 is a front view illustrating another example of the rear-face wall portion viewed through the inside of the vegetable compartment in the refrigerator according to Embodiment 2 of the present invention.

[Fig. 33] Fig. 33 is a front view illustrating another example of the rear-face wall portion viewed through the inside of the vegetable compartment in the refrigerator according to Embodiment 2 of the present invention.

Description of Embodiments

[0012]

In the following, embodiments of the present invention will be described with reference to the drawings.

Note that parts provided with the same signs in drawings are the same or corresponding ones, and this note applies throughout the specification.

Further, the forms of components illustrated in the whole of the specification are merely illustrative, and the components are not limited to these descriptions.

[0013]

Embodiment 1

Fig. 1 is an external perspective view illustrating a refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 1, a refrigerator compartment 2, an ice-making compartment 3 on the left, a temperature switchable compartment 4 on the right

adjacent to the ice-making compartment 3, a vegetable compartment 5, and a freezer compartment 6 are arranged in this order from the top of the refrigerator 1.

Partitions, not illustrated, separate storage compartments from each other, and the storage compartments are the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6.

The refrigerator 1 is provided with a box body 19 formed in a vertically long cuboid shape. The box body 19 has an upper face portion, a bottom face portion, a right side-face portion, a left side-face portion, a rear face portion, and a door portion of each of the storage compartments, which are the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6.

[0014]

Fig. 2 is an explanatory view illustrating a refrigerant circuit 7 of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 2, in the refrigerant circuit 7 of the refrigerator 1, refrigerant discharged from a compressor 8 is supplied to an air-cooled condenser 9 installed in a machine compartment, not illustrated. Then, the refrigerant having flowed through the air-cooled condenser 9 flows through a condenser 10 installed inside urethane of the body of the refrigerator 1. The refrigerant having flowed through the condenser 10 flows through a dew-condensation preventive pipe 11 stretched around each of the storage compartments, which are the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6, on the front face of the refrigerator 1.

The refrigerant flowing through the dew-condensation preventive pipe 11 is condensed by a condensation process. The refrigerant having flowed through the dew-condensation preventive pipe 11 passes through a dryer 12 and is then supplied to a decompression device 13. The refrigerant decompressed in the decompression device 13 is supplied to one cooler 14. The refrigerant supplied to the cooler 14 evaporates in the cooler 14 and exchanges heat with cool air that is circulated in the

refrigerator 1 forcibly by an air-sending device 15. The cool air generated by the heat exchange in the cooler 14 cools each storage compartment in the refrigerator 1. The refrigerant having exchanged heat in the cooler 14 passes through a suction pipe, increases its temperature while exchanging heat with the decompression device 13, and returns to the compressor 8.

The cool air of the refrigerator 1 is first supplied to the cooler 14. The cool air circulated in the refrigerator 1 forcibly by the air-sending device 15 exchanges heat with the refrigerant in the cooler 14. The cool air generated by the heat exchange in the cooler 14 cools each of the storage compartments, which are the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6 in the refrigerator 1.

[0015]

Fig. 3 is an explanatory view illustrating a lateral vertical cross section of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 3, temperature sensors 16a, 16b, 16c, 16d installed separately in the storage compartments, which are the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6, each measure an air temperature or a temperature of stored food in a corresponding one of the storage compartments. The measured temperature information is input into a control board 17 installed on the upper back of the inside of the refrigerator 1. On the control board 17, a microcomputer and an electronic component are disposed to perform various control of the refrigerator 1. The control board 17 causes air-volume control devices (dampers) 18a, 18b, 18c for the storage compartments to operate on the basis of the input temperature information. The air-volume control devices 18a, 18b, 18c are each an electric part for controlling opening and closing of an air passage.

With this configuration, an air volume of the cool air circulating in the storage compartments and the cooler 14 is controlled by the air-volume control devices 18a,

18b, 18c on the basis of temperatures measured by the temperature sensors 16a, 16b, 16c, 16d to keep the storage compartments at appropriate temperatures.

[0016]

Fig. 4 is an explanatory view illustrating a cross section of a part of a wall portion 20 of the box body 19 of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 4, the wall portion 20 of the box body 19 is made of a plate metal 21 included in an outer shell, an inner box 22 included in each storage-compartment inner wall, and a thermal insulator 23 disposed between the plate metal 21 and the inner box 22 and reduces an amount of heat entering from the outside.

Here, in the thermal insulator 23, a vacuum thermal insulator 24 is stuck to the plate metal 21 of the outer shell so that the amount of heat entering from the outside can be reduced greatly with the vacuum thermal insulator 24. The vacuum thermal insulator 24 is one rectangular plate disposed in each wall portion 20.

[0017]

For the thermal insulator 23, other than the vacuum thermal insulator 24, a urethane foamed material is mainly used. In the thermal insulator 23, various internally installed parts, such as a reinforcement material for correcting distortion of the refrigerator 1, the refrigerant circuit parts described above, and electric wiring parts, are disposed in the space to be filled with the urethane foamed material, and these internally installed parts are fixed by the urethane foamed material.

[0018]

Fig. 5 is an explanatory view illustrating a cross section of a part of the wall portion 20 in the left side-face portion of the box body 19 of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 5, in the thermal insulator 23 of the wall portion 20 in the left side-face portion of the box body 19 of the refrigerator 1, in the space to be filled with the urethane foamed material, a support 25 of a rail structure that receives a frame structure included in a drawer-type storage compartment door is also disposed as the internally installed part in addition to the internally installed parts described

above, and these internally installed parts are fixed by the urethane foamed material. Further, this thermal insulator 23 is formed to fix the rail structure that receives the frame structure included in the drawer-type storage compartment door.

[0019]

5 Fig. 6 is an explanatory view illustrating another example of the cross section of a part of the wall portion 20 of the box body 19 of the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 7 is an explanatory view illustrating another example of the cross section of a part of the wall portion 20 of the box body 19 of the refrigerator 1 according to Embodiment 1 of the present invention.

10 As illustrated in Fig. 6, the vacuum thermal insulator 24 disposed in the thermal insulator 23 may be disposed using a spacer 26 in an intermediate position between a part of the plate metal 21 of the outer shell and a part of the wall face of the inner box 22, depending on the installation place of the vacuum thermal insulator 24. As illustrated in Fig. 7, the vacuum thermal insulator 24 disposed in the thermal insulator 23 may be stuck to the wall face of the inner box 22, depending on the installation place of the vacuum thermal insulator 24. As thus described, the vacuum thermal insulator 24 disposed in the thermal insulator 23 may be disposed by any of the methods illustrated in Figs. 4, 6, and 7. However, the vacuum thermal insulator 24 is installed to be prevented from interfering with the internally installed parts described above.

[0020]

20 For an area covered with the vacuum thermal insulators 24 disposed in the thermal insulators 23 of the box body 19 of the refrigerator 1, an area equal to or larger than 40% of the entire surface area of the outer shell, including the door surface area of each storage compartment, is ensured. Further, 60 kg/cm³ or higher of a foaming density of the urethane foamed material that fills the periphery of the vacuum thermal insulator 24 is ensured. Moreover, 15.0 MPa or higher of a flexural modulus of the urethane foamed material is ensured. These conditions secure the strength of the box body 19 of the refrigerator 1.

As thus described, the vacuum thermal insulator 24 is disposed in the thermal insulator 23 of the box body 19 of the refrigerator 1, whereby the length of a thermal insulation thickness between the outer shell of the refrigerator 1 and the inner wall of the inner box 22 can be reduced. This configuration enables increase in inner
5 volume of the refrigerator 1.

[0021]

As illustrated in Fig. 3, in the refrigerator 1, a length L from the floor face to the floor face of the refrigerator compartment is set to be 954 mm or longer and 994 mm or shorter through taking into consideration the accessibility to each of the storage
10 compartments, which are the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6, and the balance of the inner volumes of the storage compartments.

[0022]

As illustrated in Fig. 3, the cooler 14 is stored in a cooler compartment 27 formed on the rear faces of the ice-making compartment 3, the temperature switchable compartment 4, and the vegetable compartment 5. In the cooler compartment 27, the lower end of the cooler 14 is located below a floor face F of the vegetable compartment 5.
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By the lower end of the cooler 14 positioned below the floor face F of the vegetable compartment 5, a large space can be ensured above the cooler 14. This configuration increases the flexibility in size of the air-sending device 15 disposed in this space and sending cool air to each of the storage compartments, which are the refrigerator compartment 2, the ice-making compartment 3, the temperature
20 switchable compartment 4, the vegetable compartment 5, and the freezer compartment 6. Further, the air-volume control devices 18a, 18b, 18c, held by the foamed thermal insulator and used for the air passages toward the storage compartments, are installed above the air-sending device 15.

[0023]

Fig. 8 is a cross-sectional view illustrating a front-back vertical cross section of the periphery of the lower portion of the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 9 is a cross-sectional view illustrating a lateral vertical cross section of the periphery of the lower portion of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 8, a return air passage 28 for air circulation from the refrigerator compartment 2 is formed on the right side of the cooler 14. As illustrated in Fig. 9, a return air passage 29, extending from the temperature switchable compartment 4, and a blow air passage 30, extending to the vegetable compartment 5, are formed in front of the return air passage 28 for the air circulation from the refrigerator compartment 2.

As illustrated in Fig. 9, a rear-face wall portion 31, which is a thermal insulation wall from the space in the vegetable compartment 5, is formed in front of the cooler 14 and the air passages 29, 30 described above.

[0024]

Fig. 10 is a cross-sectional view illustrating a lateral vertical cross section of the periphery of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 10, a ceiling wall portion 32 of the vegetable compartment 5 serves as a partition between the vegetable compartment 5 and the set of the ice-making compartment 3 and the temperature switchable compartment 4. The ceiling wall portion 32 is a thermal insulation wall and prevents transfer of heat.

The ceiling wall portion 32 has the outer shell made of an injection molded material and the inside made of a vacuum thermal insulator 33 and a urethane foamed material 34. The vacuum thermal insulator 33 is installed on a face of the ceiling wall portion 32 that is close to the ice-making compartment 3 and the temperature switchable compartment 4 set at temperatures lower than the temperature of the vegetable compartment 5. The vacuum thermal insulator 33 is one rectangular plate.

For a thickness of the urethane foamed material 34, 7 mm or larger is ensured through taking into consideration the flowability during manufacturing and manufacturing variations.

[0025]

5 As illustrated in Fig. 10, a bottom wall portion 35 of the vegetable compartment 5 serves as a partition between the vegetable compartment 5 and the freezer compartment 6. The bottom wall portion 35 is a thermal insulation wall and prevents transfer of heat.

10 Similarly to the ceiling wall portion 32, the bottom wall portion 35 has the outer shell made of an injection molded material and the inside made of a vacuum thermal insulator 36 and a urethane foamed material 37. The vacuum thermal insulator 36 is installed on a face of the bottom wall portion 35 that is close to the freezer compartment 6 set at a temperature lower than the temperature of the vegetable compartment 5. The vacuum thermal insulator 36 is one rectangular plate.

15 For a thickness of the urethane foamed material 37, 7 mm or larger is ensured through taking into consideration the flowability during manufacturing and manufacturing variations.

[0026]

20 The vacuum thermal insulator 33 disposed in the ceiling wall portion 32 of the vegetable compartment 5 is wrapped with the urethane foamed material 34 and the vacuum thermal insulator 36 disposed in the bottom wall portion 35 of the vegetable compartment 5 is wrapped with the urethane foamed material 37 in a urethane injection step during the manufacturing process for the refrigerator 1, thereby preventing deterioration in the vacuum thermal insulators 33, 36.

25 [0027]

Fig. 11 is an explanatory view illustrating a vertical cross section of another example of the ceiling wall portion 32 in the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

30 As illustrated in Fig. 11, in the ceiling wall portion 32, the viscosity of the urethane foamed material 34 and the width of the flow passage may be ensured, so

that the vacuum thermal insulator 33 can be disposed in the middle of the partition outer-shell wall and the whole is wrapped with the urethane foamed material 34, thereby further preventing deterioration in the vacuum thermal insulator 33.

[0028]

5 Fig. 12 is an explanatory view illustrating a vertical cross section of another example of the ceiling wall portion 32 in the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

 As illustrated in Fig. 12, in the ceiling wall portion 32, the vacuum thermal insulator 33 may be disposed on a face of the partition outer-shell wall that is close to the vegetable compartment 5. In this case, a covering ratio of the vacuum thermal insulator 33 to the inner wall face of the vegetable compartment 5 can be increased, and an amount of heat entering from the outside can be reduced.

[0029]

 As illustrated in Fig. 10, the rear-face wall portion 31 separating the vegetable compartment 5 from the cooler compartment 27 is formed on the rear face of the vegetable compartment 5. The rear-face wall portion 31 is a thermal insulation wall and the inside of the rear-face wall portion 31 is made of a thermal-insulation-wall outer shell 38, a vacuum thermal insulator 39, and a foamed thermal insulator 40 installed to wrap the vacuum thermal insulator 39. That is, in the rear-face wall portion 31 of the vegetable compartment 5, the vacuum thermal insulator 39, which is one rectangular plate, is disposed between the inner wall of the vegetable compartment 5 and the cooler 14.

[0030]

 The thickness of the foamed thermal insulator 40 of the rear-face wall portion 31 is set with the smallest moldable thickness as a reference, and when a function is to be added, a necessary thermal insulation thickness is set. In the case of using PS-FO for the material of the foamed thermal insulator 40, for example, when an expansion ratio is 40 times, the foamed thermal insulator 40 has a thickness of at least approximately 5 mm.

The foamed thermal insulator 40 of the rear-face wall portion 31 is provided with an air passage 41 for sending air to the freezer compartment 6. The components before and after the air passage 41 are arranged in such a manner that the cooler 14, the thermal-insulation-wall outer shell 42, the foamed thermal insulator 40 accommodating the form of the air passage 41, the vacuum thermal insulator 39, the foamed thermal insulator 40, and the thermal-insulation-wall outer shell 38 included in the inner walls of the vegetable compartment 5 are arranged in this order from the back. As illustrated in Fig. 8, the air passage 41, extending to the freezer compartment 6, described above, is disposed on the front projected plane of the cooler 14. That is, the rear-face wall portion 31 of the vegetable compartment 5 separates the cooler 14 and the air passage 41, extending to the freezer compartment 6, from the vegetable compartment 5 with the vacuum thermal insulator 39 in a range larger than the front projected planes of the cooler 14 and the air passage 41.

[0031]

As illustrated in Fig. 10, the air-volume control device 18c for the vegetable compartment 5 is held in the foamed thermal insulator 40 having the air passage 41 in the rear-face wall portion 31 of the vegetable compartment 5.

Note that the air-volume control devices 18a, 18b, 18c for the storage compartments may not be provided in the rear-face wall portion 31 of the vegetable compartment 5, but may be stored into the rear-face wall portion in the other compartments at higher positions than the position of the vegetable compartment 5. This configuration eliminates the need to make an unnecessary space behind the vegetable compartment 5, and the vegetable compartment 5 with a large capacity can be provided.

[0032]

Fig. 13 is a cross-sectional view illustrating another example of a lateral vertical cross section of the periphery of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 13, the vacuum thermal insulator 39 in the rear-face wall portion 31 of the vegetable compartment 5 may be stuck to the inner wall of the thermal-insulation-wall outer shell 42 that is closer to the cooler 14 so that the effect of the vacuum thermal insulator 39 is ensured. That is, the vacuum thermal insulator 39 in the rear-face wall portion 31 of the vegetable compartment 5 is provided in a part inside the rear-face wall portion 31 that is closer to the cooler 14.

In this case, with restraints on the position of the outlet for cool air discharged from the air-sending device 15 or the size of the outlet, the dimension in the height direction of the vacuum thermal insulator 39 may be reduced slightly. Further, the vacuum thermal insulator 39 is not covered with the foamed thermal insulator 40, and this configuration can cause a concern of accelerated deterioration in the vacuum thermal insulator 39.

[0033]

Fig. 14 is a cross-sectional view illustrating another example of the lateral vertical cross section of the periphery of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 14, in the rear-face wall portion 31 of the vegetable compartment 5, for the purpose of solving the problems in the case illustrated in Fig. 13 and protecting the vacuum thermal insulator 39, the foamed thermal insulator 40 may also be installed between the vacuum thermal insulator 39 and the inner wall of the thermal-insulation-wall outer shell 42 that is closer to the cooler 14.

[0034]

Fig. 15 is a front view illustrating the rear-face wall portion 31 viewed through the inside of the vegetable compartment 5 in the refrigerator according to Embodiment 1 of the present invention.

As illustrated in Fig. 15, in the rear-face wall portion 31 of the vegetable compartment 5, the vacuum thermal insulator 39, which is one rectangular plate, is disposed between the inner wall of the vegetable compartment 5 and the cooler 14.

The size of the planar portion of the vacuum thermal insulator 39 is larger than the front projected area of the cooler 14. Further, the air passage 41, extending to

the freezer compartment 6, is disposed on the front projected plane of the cooler 14.

Thus, as illustrated in Fig. 10, the rear-face wall portion 31 of the vegetable compartment 5 separates the cooler 14 and the air passage 41, extending to the freezer compartment 6, from the vegetable compartment 5 with the vacuum thermal insulator 39 in a range larger than the front projected planes of the cooler 14 and the air passage 41. This configuration reduces, toward the maximum level, amount of one-dimensional transfer of heat that passes through the rear-face wall portion 31 of the vegetable compartment 5 toward the inside of the vegetable compartment 5.

[0035]

As illustrated in Fig. 15, a cool-air outlet 44 through which cool air is supplied into the vegetable compartment 5 is formed in the right-side upper portion in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. The cool-air outlet 44 does not overlap the front projected plane of the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5, and is located outside the front projected plane.

Using the air-sending device 15 disposed above the cooler 14, the cool-air outlet 44 allows cool air, generated in the cooler 14, to be supplied via the air-volume control device 18c for the vegetable compartment held in the foamed thermal insulator 40 above the cooler compartment 27.

Note that the cool-air outlet 44 may be formed in the inner wall of the wall portion other than the rear-face wall portion 31 of the vegetable compartment 5.

[0036]

A cool-air return inlet 45 through which cool air is discharged from the vegetable compartment 5 is formed in the left-side lower portion, diagonal to the cool-air outlet 44, in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. The cool-air return inlet 45 does not overlap the front projected plane of the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5, and is located outside the front projected plane.

The cool air blown out of the cool-air outlet 44 circulates in such a manner that the cool air is discharged from the cool-air return inlet 45 located at the corner diagonal to the cool-air outlet 44 in the inner wall of the vegetable compartment 5, is guided to the cooler 14, and again passes through the cooler 14 to be cooled.

5 Note that the cool-air return inlet 45 may be formed in the wall portion other than the rear-face wall portion 31 of the inner wall of the vegetable compartment 5. [0037]

As illustrated in Fig. 15, the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5 is installed to have a vertical side substantially parallel to the vertical direction and a horizontal side substantially parallel to the horizontal direction, and not to overlap vertical projected regions of the cool-air outlet 44 and the cool-air return inlet 45.

10 Unlike the configuration illustrated in Fig. 15, the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5 may be installed to have a vertical side substantially parallel to the vertical direction and a horizontal side substantially parallel to the horizontal direction, and not to overlap horizontal projected regions of the cool-air outlet 44 and the cool-air return inlet 45.

20 Alternatively, the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5 may be installed to have a vertical side inclined to the vertical direction and a horizontal side inclined to the horizontal direction, so long as the vacuum thermal insulator 39 is disposed not to block the cool-air outlet 44 and the cool-air return inlet 45.

25 [0038]

Fig. 16 is a front view illustrating another example of the rear-face wall portion 31 viewed through the inside of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 17 is a front view illustrating another example of the rear-face wall portion 31 viewed through the inside

of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 16, the cool-air outlet 44 may be formed in the right-side upper portion in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. At this time, the cool-air return inlet 45 is formed in the right-side lower portion in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5.

Alternatively, as illustrated in Fig. 17, the cool-air outlet 44 may be formed in the left-side upper portion in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. At this time, the cool-air return inlet 45 is formed in the left-side lower portion in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5.

That is, in the configurations of Figs. 16 and 17, the cool-air outlet 44 and the cool-air return inlet 45 are located in the same range in the vertical direction of the inner wall of the vegetable compartment 5. Note that the cool-air outlet 44 and the cool-air return inlet 45 may be located in the same range in the horizontal direction of the inner wall of the vegetable compartment 5.

In the case of the configurations illustrated in Figs. 16 and 17, the planar portion of the vacuum thermal insulator 39 in the rear-face wall portion 31 of the vegetable compartment 5 further increases in size. Hence the vacuum thermal insulator 39 is also disposed in a portion where another air passage is provided, to increase a covering ratio of the vacuum thermal insulator 39 of the vegetable compartment 5 and intensify the thermal insulation of the vegetable compartment 5.

[0039]

Fig. 18 is a schematic view illustrating vacuum thermal insulators 24, 33, 36, 39 in some of the wall portions 20 defining the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 19 is a schematic view illustrating the vacuum thermal insulators 24, 33, 36, 39 in some of the wall portions 20 defining the vegetable compartment 5, as viewed from the rear face, in the refrigerator 1 according to Embodiment 1 of the present invention.

The refrigerator 1 is provided with the vegetable compartment 5 set at a temperature higher than the temperatures of the ice-making compartment 3 and the temperature switchable compartment 4 at higher positions than the position of the vegetable compartment 5 and the temperature of the freezer compartment 6 at a lower position than the position of the vegetable compartment 5, and the vegetable compartment 5 is for storing items such as vegetables and other food. As illustrated in Figs. 18 and 19, in the vegetable compartment 5, a corresponding one of the rectangular vacuum thermal insulators 24, 33, 36, 39 is disposed in a corresponding one of the wall portions 20 of the right side-wall portion, the left side-face portion, the ceiling wall portion 32, the bottom wall portion 35, the rear-face wall portion 31, and the door wall portion that define the vegetable compartment 5.

Here, for the right side-wall portion of the vegetable compartment 5, the vacuum thermal insulator 24, which is one rectangular plate, is disposed over the right-side wall portion 20 of the whole box body 19 of the refrigerator 1, including right-side wall portions of corresponding ones of the other storage compartments at higher and lower positions than the position of the vegetable compartment 5. For the left side-wall portion of the vegetable compartment 5, the vacuum thermal insulator 24, which is one rectangular plate, is disposed over the left-side wall portion 20 of the whole box body 19 of the refrigerator 1, including left-side wall portions of corresponding ones of the other storage compartments at higher and lower positions than the position of the vegetable compartment 5.

Meanwhile, in the ceiling wall portion 32 of the vegetable compartment 5, the vacuum thermal insulator 33, which is one rectangular plate, is disposed. In the bottom wall portion 35 of the vegetable compartment 5, the vacuum thermal insulator 36, which is one rectangular plate, is disposed. In the rear-face wall portion 31 of the vegetable compartment 5, the vacuum thermal insulator 39, which is one rectangular plate, is disposed to separate the cooler compartment 27. In the door wall portion of the vegetable compartment 5, the vacuum thermal insulator 24, which is one rectangular plate, is disposed.

[0040]

With such a configuration, all six planes of the vegetable compartment 5 formed in almost a cuboid shape or a cube are covered with the vacuum thermal insulators 24, 33, 36, 39. This configuration makes the covering ratio of the vacuum thermal insulators 24, 33, 36, 39 to the total area of the wall face of the vegetable compartment 5 equal to or higher than 80%. It is thereby possible to prevent transfer of heat from the vegetable compartment 5 to the other storage compartments. Also, it is possible to prevent transfer of cooling energy from the other storage compartments and the cooler compartment 27 to the vegetable compartment 5. Further, it is possible to reduce an amount of heat entering the vegetable compartment 5 from the outside by use of the right side-wall portion, the left side-wall portion, and the door wall portion.

[0041]

Fig. 20 is a schematic view illustrating a thermal heater 46 installed in the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

With the configuration illustrated in Figs. 18 and 19 described above, the average temperature of the vegetable compartment 5 tends to decrease. For this reason, as illustrated in Fig. 20, the thermal heater 46 utilizing electric resistance may be installed in the vegetable compartment 5 to keep an internal temperature of the vegetable compartment 5 when necessary.

The thermal heater 46 of the vegetable compartment 5 is installed in an arbitrary position on the bottom face, the rear face, or both the right and left-side faces of the vegetable compartment 5, and particularly at a point where the internal temperature of the vegetable compartment 5 is relatively low, and with an arbitrary capacity of approximately 3 W or more and 10 W or less. The thermal heater 46 is energized at a duty factor on the time basis (energization time / reference time) on the basis of an outside air temperature and the internal temperature of the vegetable compartment 5.

[0042]

Fig. 21 is a schematic view illustrating a radiation pipe 47 installed in the vegetable compartment 5 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 21, in the vegetable compartment 5, the radiation pipe 47 may be disposed, other than the thermal heater 46, inside the urethane foamed thermal insulator in each of the right and left-side wall portions of the box body 19 for the purpose of keeping the temperature in the vegetable compartment 5.

Alternatively, in the vegetable compartment 5, the radiation pipe 47 may be installed in the inside of the outer shell of the partition of the bottom wall portion 35 that is close to the thermal insulator for the purpose of keeping the temperature in the vegetable compartment 5. The radiation pipe 47 allows the refrigerant for use in the cooler 14 to flow through and reject heat into the vegetable compartment 5.

For a radiation amount of heat from the radiation pipe 47 into the vegetable compartment 5, a total heat amount of approximately 4.5 W may be ensured by disposing the radiation pipe 47 with a unit radiation amount of 1.5 W/m or more and 3.0 W/m or less, and a length of 5 m or larger. Consequently, in the vegetable compartment 5 with an inner volume of approximately 90 L, it is possible to obtain a temperature rise effect of a rise in temperature of approximately 2 degrees C or more and 3 degrees C or less.

In the case of a large capacity of the vegetable compartment 5, the length of the radiation pipe 47 may be adjusted as appropriated.

[0043]

Fig. 22 is a schematic view illustrating the radiation pipe 47 installed in the refrigerant circuit 7 of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 22, on the refrigerant circuit 7, the radiation pipe 47 is connected to the dryer 12 via the dew-condensation preventive pipe 11 on the front face of the refrigerator 1, and connected to the flow switching three-way valve 48 one of which downstream flows can be switched to the flow switching three-way valve 48.

An outlet pipe 49, one of two outlet pipes 49, 50 of the flow switching three-way valve 48, is connected to one of two capillaries 51. The capillary 51 to which the outlet pipe 49 is connected is preferably able to change an amount of depression. The other remaining outlet pipe 50 is connected to the radiation pipe 47 that radiates heat into the vegetable compartment 5 described above.

With such a configuration, the radiation pipe 47 rejects heat of refrigerant into the vegetable compartment 5, and a load increases on the air, but this configuration acts to increase a condensing capacity of the refrigerant on the refrigeration cycle, thereby improving the efficiency of the refrigeration cycle.

That is, when heat is rejected by the thermal heater 46 into the vegetable compartment 5, increase in load on the air and increase in input of the heater have a large influence on power consumption. Hence the case of the radiation pipe 47 rejecting heat into the vegetable compartment 5 is relatively superior in terms of power consumption.

[0044]

As illustrated in Fig. 22, the other outlet pipe 49, not connected to the radiation pipe 47 that radiates heat into the vegetable compartment 5 at the downstream flow of the flow switching three-way valve 48, is preferably able to control a flow rate of refrigerant to be discharged in multi-stages in a simulative manner as an electric control expansion valve. This configuration enables more reduction in power consumption.

[0045]

Fig. 23 is a diagram illustrating a flow-rate characteristic on the outlet pipe 49, not connected to the radiation pipe 47 that radiates heat into the vegetable compartment 5, at the flow switching three-way valve 48 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 23, at the flow switching three-way valve 48, the flow-rate characteristic on the other outlet pipe 49, not connected to the radiation pipe 47 that radiates heat into the vegetable compartment 5, is controlled in flow rate in five stages. The five stages of the flow-rate control include switching between fully

closed, a restricted flow rate A, a restricted flow rate B, a restricted flow rate C, and fully opened.

[0046]

Fig. 24 is an explanatory view illustrating the configuration of the flow switching three-way valve 48 in the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 24, the flow switching three-way valve 48 is roughly divided into two: a low-voltage four-phase stepping motor 52 and a valve body 53. The valve body 53 internally has, as main parts, a magnetizing rotor 54, a center gear 55, a rotary gear 56, a rotary pad 57, a valve seat 58, an outer shell case 59, and a floor plate 60.

The flow switching three-way valve 48 performs unipolar drive on the four-phase stepping motor 52 by 1-2 phase excitation to cause the magnetizing rotor 54 to operate rotationally. The magnetizing rotor 54 is directly connected to the center gear 55, and when the magnetizing rotor 54 rotates, the center gear 55 performs rotational operation of the same amount in the same direction as those of the magnetizing rotor 54.

[0047]

Fig. 25 is an explanatory view collectively illustrating flow formation states associated with steps of the rotary gear 56 at the flow switching three-way valve 48 in the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 25(a) illustrates a step 0 state of the rotary gear 56, Fig. 25(b) illustrates the case of a closed flow passage in a step 4 state of the rotary gear 56, Fig. 25(c) illustrates the case of restriction A in a step 36 state of the rotary gear 56, Fig. 25(d) illustrates the case of restriction B in a step 73 state of the rotary gear 56, Fig. 25(e) illustrates the case of restriction C in a step 110 state of the rotary gear 56, Fig. 25(f) illustrates the case of an open flow passage in a step 177 state of the rotary gear 56, and Fig. 25(g) illustrates the case of the stage end in a step 200 state of the rotary gear 56.

[0048]

As illustrated in Fig. 25, the center gear 55 and the rotary gear 56 are joined directly. Hence the rotary pad 57 fixed to the rotary gear 56, in response to the rotary drive of the center gear 55, with a central axis provided in the valve seat 58 as a reference to operate rotationally.

5 In the rotary pad 57, orifices 61, 62, 63 with different inner diameters are provided at three places. When any of the orifices 61, 62, 63 at the three places overlaps an output orifice 64 in the valve seat 58 by the rotational operation of the rotary pad 57, refrigerant with a predetermined flow rate flows out.

As illustrated in Fig. 25(b), in the case of the closed flow passage in the step 4 state of the rotary gear 56, the flow rate of the flow switching three-way valve 48
10 corresponds to the fully closed state in Fig. 23. As illustrated in Fig. 25(c), in the case of the restriction A in the step 36 state of the rotary gear 56, the flow rate of the flow switching three-way valve 48 corresponds to the state of the flow rate A in Fig. 23. As illustrated in Fig. 25(d), in the case of the restriction B in the step 73 state of
15 the rotary gear 56, the flow rate of the flow switching three-way valve 48 corresponds to the state of the flow rate B in Fig. 23. As illustrated in Fig. 25(e), in the case of the restriction C in the step 110 state of the rotary gear 56, the flow rate of the flow switching three-way valve 48 corresponds to the state of the flow rate C in Fig. 23. As illustrated in Fig. 25(f), in the case of the open flow passage in the step 177 state
20 of the rotary gear 56, the flow rate of the flow switching three-way valve 48 corresponds to the fully opened state in Fig. 23.

[0049]

Fig. 26 is an explanatory view illustrating, in a cross section along a line A-A of Fig. 25(c), the rotary pad 57 and the valve seat 58 in the flow switching three-way
25 valve 48 of the refrigerator 1 according to Embodiment 1 of the present invention.

As illustrated in Fig. 26, the peripheral shape of the orifice 61 formed in the rotary pad 57 is deeply molded in stages. The orifices 61, 62, 63 formed in the rotary pad 57 are so minute that the molding of the orifices 61, 62, 63 is difficult. Consequently, from the relation among the need to make the depths of the orifices
30 61, 62, 63 small, removal of an influence of hysteresis at the time of counterclockwise

drive (CCW) of the stepping motor 52, generated due to backlash of the connection gear, and removal of variations in chamfered shape of the output orifice 64 formed in the valve seat 58, the peripheral shapes of the orifices 61, 62, 63 are deeply molded in stages.

5 With such a configuration, the influence of hysteresis at the time of counterclockwise drive (CCW) of the stepping motor 52 can be removed, the flow rate is stabilized, the molding stability increases, and the risk of modification of a manufactured product can be reduced.

[0050]

10 The flow switching three-way valve 48 described above can switch the flow rate of the refrigerant to the suitable flow rate to a load of the refrigerator 1, and is increased in the range of the flow-rate control as compared to that of an existing flow switching three-way valve. In addition, with the flow switching three-way valve 48, the number of necessary capillaries aimed to control the flow rate is reduced by one,
15 and it is thus possible to reduce cost at the same time.

 In the case of using the thermal heater 46 utilizing electric resistance for keeping the temperature of the vegetable compartment 5, as the flow switching valve, a two-way valve may be used of which one of the two outlets of the flow switching valve that can control the flow rate is available.

20 [0051]

 Fig. 27 is an explanatory view collectively illustrating a blow air passage 65 and a return air passage 28 for cool air supplied to and from the refrigerator compartment 2 in the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 27(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air
25 passage 65 and the return air passage 28 for cool air supplied to and from the refrigerator compartment 2, Fig. 27(b) is an explanatory view illustrating, in a front-back vertical cross section, the blow air passage 65 for cool air supplied to the refrigerator compartment 2, and Fig. 27(c) is an explanatory view illustrating, in a front-back vertical cross section, the return air passage 28 for cool air supplied from
30 the refrigerator compartment 2.

[0052]

As illustrated in Figs. 27(a) and 27(b), the blow air passage 65 for cool air supplied to the refrigerator compartment 2 is formed by connecting a flow passage starting from a position in which cool air is discharged by the air-sending device 15
5 installed above the cooler 14 and passing through the inside of the rear-face wall portion 31 separating the vegetable compartment 5 from the cooler compartment 27, a flow passage toward the refrigerator compartment 2 in the foamed thermal insulator above the cooler compartment 27, a flow passage in the foamed thermal insulator in the partition partitioning a space into the refrigerator compartment 2 and the set of the
10 ice-making compartment 3 and the temperature switchable compartment 4, and a flow passage molded in the foamed thermal insulator installed on the rear face of the refrigerator compartment 2.

Note that the air-volume control device 18a for controlling an amount of cool air supplied to the refrigerator compartment 2 controls an amount of cool air supplied to
15 the refrigerator compartment 2 in the middle of the blow air passage 65 for cool air supplied to the refrigerator compartment 2. The air-volume control device 18a may be installed in any portion of the air passages described above.

Further, as for the cool-air outlet in the refrigerator compartment 2, at least one cool-air outlet is formed in each storage shelf for stored items in the refrigerator
20 compartment 2, and an amount of blown air is controlled so that a cool air distribution in the shelf and a cool air distribution between the shelves are within 2 degrees C.

[0053]

As illustrated in Figs. 27(a) and 27(c), the return air passage 28 for cool air supplied from the refrigerator compartment 2 is installed on the right of the cooler 14
25 by using the foamed thermal insulator so that necessary thermal insulation can be performed. The discharge port of the return air passage 28 for cool air supplied from the refrigerator compartment 2 is connected to a drip tray 66. The drip tray 66 receives melt water generated during defrosting from a portion in the cooler compartment 27 that is on the right side below the cooler 14.

[0054]

As illustrated in Fig. 27(a), in the return air passage 28 extending from the refrigerator compartment 2, when necessary thermal insulation is not ensured, a heater 67 for avoiding blockage of the return air passage 28 due to frosting in the air passage is preferably provided. The heater 67 is installed at an arbitrary position in the return air passage 28 in the longitudinal direction of the air passage in a range equal to or larger than a vertical projected dimension of the cooler 14, and generates heat when necessary. The heater 67 is preferably, for example, in a vertical range of 100 mm, with a joint between the return air passage 28 and the drip tray 66 at the center, to extend along the flowing direction of the returned cool air.

[0055]

Fig. 28 is an explanatory view collectively illustrating a blow air passage 68 and a return air passage 69 for cool air supplied to and from the ice-making compartment 3 in the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 28(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air passage 68 and the return air passage 69 for cool air supplied to and from the ice-making compartment 3, and Fig. 28(b) is a perspective view illustrating the state of cool air blowing into the ice-making compartment 3.

[0056]

As illustrated in Fig. 28(a), the blow air passage 68 for cool air supplied to the ice-making compartment 3 is formed by connecting a flow passage starting from a position in which cool air is discharged by the air-sending device 15 installed above the cooler 14 and passing toward the ice-making compartment 3 in the foamed thermal insulator above the cooler compartment 27, and a flow passage molded in the foamed thermal insulator installed on the rear face of the ice-making compartment 3.

Note that an air-volume control device, not illustrated, for controlling an amount of cool air supplied to the ice-making compartment 3 controls the amount of cool air supplied to the ice-making compartment 3 in the middle of the blow air passage 68 for cool air supplied to the ice-making compartment 3. The air-volume control device may be installed in any portion of the air passages described above.

As illustrated in Fig. 28(b), cool air blown out of the cool-air outlet 70 at an arbitrary position of the rear face of the ice-making compartment 3 flows into an ice-making mechanism 71.

[0057]

As illustrated in Fig. 28(a), the return air passage 69 extending from the ice-making compartment 3 is installed to extend from the front face of the cooler 14 to a position that is closer to the ice-making compartment 3 than the center of the refrigerator 1 of the total width of the cooler 14 and is within the rear face projection width of the ice-making compartment 3.

The return air passage 69 extending from the ice-making compartment 3 is made of a cool-air return inlet 72 arbitrarily installed in the rear-face wall portion of the ice-making compartment 3, the rear side of the outer shell on the front face of the ice-making compartment, and a part of the foamed thermal insulator adjacent to the outer shell of the front face of the ice-making compartment 3, and a discharge port of the return air passage 69 extending from the ice-making compartment 3 merges in the vicinity of a cool-air return inlet through which cool air is supplied from the freezer compartment 6. For avoiding a pressure loss in the merging portion, the cool-air return inlet through which cool air is supplied from the freezer compartment 6 in the vicinity of the discharge port for cool air supplied from the ice-making compartment 3 has a range equal to or larger than a dimension in the lateral width direction of the return air passage 69 extending from the ice-making compartment 3.

Note that the return air passage 69 extending from the ice-making compartment 3 may be directly returned into the cooler compartment 27 in a position above the cool-air return inlet for cool air supplied from the freezer compartment 6.

[0058]

Fig. 29 is an explanatory view collectively illustrating a blow air passage 73 and the return air passage 29 for cool air supplied to and from the temperature switchable compartment 4 in the refrigerator 1 according to Embodiment 1 of the present invention. Fig. 29(a) is an explanatory view illustrating, in a lateral vertical cross section, the blow air passage 73 and the return air passage 29 for cool air supplied to

and from the temperature switchable compartment 4, and Fig. 29(b) is an explanatory view illustrating, in a front-back vertical cross section, the return air passage 29 for cool air supplied from the temperature switchable compartment 4.

[0059]

5 As illustrated in Fig. 29(a), the blow air passage 73 for cool air supplied to the temperature switchable compartment 4 is formed by connecting a flow passage starting from a position in which cool air is discharged by the air-sending device 15 installed above the cooler 14 and passing toward the temperature switchable compartment 4 in the foamed thermal insulator above the cooler compartment 27,
10 and a flow passage molded in the foamed thermal insulator installed on the rear face of the temperature switchable compartment 4.

Note that the air-volume control device 18b for controlling an amount of cool air supplied to the temperature switchable compartment 4 controls the amount of cool air supplied to the temperature switchable compartment 4 in the middle of the blow air
15 passage 73 for cool air supplied to the temperature switchable compartment 4. The air-volume control device 18b may be installed in any of portion the air passages described above.

[0060]

As illustrated in Figs. 29(a) and 29(b), the return air passage 29 extending from
20 the temperature switchable compartment 4 is made of a cool-air return inlet arbitrarily installed in the rear-face wall portion of the temperature switchable compartment 4, the rear side of the outer shell on the front face of the temperature switchable compartment 4, and a part of the foamed thermal insulator adjacent to the outer shell of the front face of the temperature switchable compartment 4, and a discharge port
25 of the return air passage 29 extending from the temperature switchable compartment 4 is installed on the right of the return air passage from the freezer compartment 6.

[0061]

Fig. 30 is an explanatory view collectively illustrating a blow air passage 41 and a return air passage 74 for cool air supplied to and from the freezer compartment 6 in
30 the refrigerator according to Embodiment 1 of the present invention. Fig. 30(a) is an

explanatory view illustrating, in a lateral vertical cross section, the blow air passage 41 and the return air passage 74 for cool air supplied to and from the freezer compartment 6, and Fig. 30(b) is an explanatory view illustrating, in a front-back vertical cross section, the blow air passage 41 and the return air passage 74 for cool air supplied to and from the freezer compartment 6.

[0062]

As illustrated in Figs. 30(a) and 30(b), the blow air passage 41 for cool air supplied to the freezer compartment 6 is formed by connecting a flow passage starting from a position in which cool air is discharged by the air-sending device 15 installed above the cooler 14 and passing in the rear-face wall portion 31 of the vegetable compartment 5 separating the vegetable compartment 5 from the cooler compartment 27, and a flow passage provided in the bottom wall portion 35 of the vegetable compartment 5 that is between the vegetable compartment 5 and the freezer compartment 6.

The cool air having passed through the blow air passage 41 for cool air supplied to the freezer compartment 6 is guided into storing cases for stored items, piled in a plurality of stages in the freezer compartment 6, by a guide portion provided on the ceiling on the rear of the freezer compartment 6, to cool stored items in the freezer compartment 6.

[0063]

As illustrated in Figs. 30(a) and 30(b), the return air passage 74 extending from the freezer compartment 6 is made of a flow passage starting from a position in which cool air is discharged from the inside of the freezer compartment 6 by the guide portion provided on the ceiling on the rear of the freezer compartment 6 and formed in a range within the width of the cooler 14 provided behind the bottom wall portion 35 of the vegetable compartment 5 that is between the vegetable compartment 5 and the freezer compartment 6. In the same manner as the return air passage 28 extending from the refrigerator compartment 2, the discharge port of the return air passage 74 extending from the freezer compartment 6 is connected to the drip tray 66. The drip

tray 66 receives melt water generated during defrosting from a portion in the cooler compartment 27 that is on the right side below the cooler 14.

[0064]

5 The guide portion, not illustrated, provided on the ceiling on the rear of the freezer compartment 6 serves as both the guide for cool air to blow into the freezer compartment 6 and the guide for cool air to return from the inside of the freezer compartment 6, and is disposed in the front-back direction when the refrigerator 1 is seen from the front. Specifically, the guide for cool air to blow into the freezer compartment 6 is disposed on the front of the refrigerator 1. The guide for cool air to
10 return from the inside of the freezer compartment 6 is disposed on the rear of the refrigerator 1.

[0065]

According to Embodiment 1, the refrigerator 1 is provided with the vegetable compartment 5, which is set at a temperature higher than temperatures of the other
15 surrounding compartments, and the vegetable compartment 5 is for storing items such as vegetables and other food. In the vegetable compartment 5, a corresponding one of the rectangular vacuum thermal insulators 24, 33, 36, 39 is disposed in a corresponding one of the wall portions 20 corresponding to six faces of the vegetable compartment 5.

20 With this configuration, the area covered with the vacuum thermal insulators 24, 33, 36, 39 in the vegetable compartment 5 increases as much as possible. Further, each of the vacuum thermal insulators 24, 33, 36, 39 is rectangular and does not need to be provided with a notch and a hole, so that necessary thermal insulation performance can be ensured with a simple configuration. This configuration can
25 reduce manufacturing cost, simplify assembly, and make manufacturing efficiency favorable.

[0066]

According to Embodiment 1, the refrigerator compartment 2, the ice-making compartment 3, the temperature switchable compartment 4, the vegetable

compartment 5, and the freezer compartment 6 are arranged in this order from the top of the refrigerator 1.

With this configuration, the ice-making compartment 3 and the temperature switchable compartment 4, which are set at temperatures lower than the temperature of the vegetable compartment 5 and are for storing items including food, are disposed at higher positions than the position of the vegetable compartment 5. The freezer compartment 6, which is set at a temperature lower than the temperature of the vegetable compartment 5 and is for storing items including food, is disposed at a lower position than the position of the vegetable compartment 5. For this reason, the cooling energy may flow into the vegetable compartment 5 to excessively cool the inside of the vegetable compartment 5. However, a corresponding one of the rectangular vacuum thermal insulators 24, 33, 36, 39 is disposed in a corresponding one of the wall portions 20 defining the vegetable compartment 5. This configuration can prevent the inflow of the cooling energy from the periphery of the vegetable compartment 5 toward the inside of the vegetable compartment 5 and prevent excessive cooling inside the vegetable compartment 5. Meanwhile, rejection of heat from the inside of the vegetable compartment 5 to the periphery of the refrigerator 1, which is the outside of the vegetable compartment 5, can also be prevented, to keep the inside of the vegetable compartment 5 at a set temperature in a thermally efficient manner.

Further, the vegetable compartment 5 with high frequency of use can be disposed at the height position of the waist of a user, thereby improving the usability of the user.

[0067]

According to Embodiment 1, two side wall portions of the entire box body 19 of the refrigerator 1 each have one rectangular vacuum thermal insulator 24, and each of the two side wall portions includes each of the side wall portions of the vegetable compartment 5 and a corresponding one of the side wall portions of the other compartments. A corresponding one of the rectangular vacuum thermal insulators 24, 33, 36, 39 is disposed in a corresponding one of the ceiling wall portion 32, the

bottom wall portion 35, the rear-face wall portion 31, and the door wall portion of the vegetable compartment 5.

With this configuration, two side wall portions of the entire box body 19 of the refrigerator 1 each have one rectangular vacuum thermal insulator 24, and each of the two side wall portions includes each of the side wall portions of the vegetable compartment 5 and a corresponding one of the side wall portions of the other compartments. Thus, vacuum thermal insulators are efficiently arranged in the refrigerator 1. It is thereby possible to reduce the number of vacuum thermal insulators used, reduce manufacturing cost, simplify assembly, and improve manufacturing efficiency.

[0068]

According to Embodiment 1, the cooler 14 is provided behind the vegetable compartment 5. In the rear-face wall portion 31 of the vegetable compartment 5, one rectangular vacuum thermal insulator 39 is disposed between the inner wall of the vegetable compartment 5 and the cooler 14.

With this configuration, it is possible to prevent the inflow of the cooling energy from the cooler 14 toward the inside of the vegetable compartment 5. It is thereby possible to prevent increase in temperature of the cooler 14. It is also possible to prevent decrease in temperature of the rear-face wall portion 31 of the vegetable compartment 5. Then, inconvenient phenomena in the vegetable compartment 5, such as dew condensation and frosting, can be prevented.

[0069]

According to Embodiment 1, the rear-face wall portion 31 of the vegetable compartment 5 includes the air passage 41 disposed between the inner wall of the vegetable compartment 5 and the cooler 14, and the air passage 41 allows cool air to flow from the cooler 14 to the freezer compartment 6. The air passage 41 is disposed on the front projected plane of the cooler 14.

With this configuration, the air passage 41 through which cool air to be at a low temperature flows can be gathered with the cooler 14 to improve the thermal efficiency.

[0070]

According to Embodiment 1, one rectangular vacuum thermal insulator 39 disposed between the inner wall of the vegetable compartment 5 and the cooler 14 in the rear-face wall portion 31 of the vegetable compartment 5 has a size to separate the cooler 14 and the air passage 41 from the vegetable compartment 5 in a range larger than the front projected planes of the cooler 14 and the air passage 41.

With this configuration, the inflow of the cooling energy from the cooler 14 and the air passage 41 toward the inside of the vegetable compartment 5 can be prevented only by one rectangular vacuum thermal insulator 39.

[0071]

According to Embodiment 1, the refrigerator 1 is provided with the vegetable compartment 5, which is set at a temperature higher than temperatures of the other surrounding compartments, and the vegetable compartment 5 is for storing items such as vegetables and other food. The refrigerator 1 includes a cooler 14 provided behind the vegetable compartment 5. The refrigerator 1 includes the rear-face wall portion 31 provided between the inner wall of the vegetable compartment 5 and the cooler 14. The refrigerator 1 includes the vacuum thermal insulator 39 provided in a part inside the rear-face wall portion 31 that is close to the cooler 14.

With this configuration, it is possible to prevent the inflow of the cooling energy from the cooler 14 toward the inside of the vegetable compartment 5. It is thereby possible to prevent increase in temperature of the cooler 14. It is also possible to prevent decrease in temperature of the rear-face wall portion 31 of the vegetable compartment 5. Then, inconvenient phenomena in the vegetable compartment 5, such as dew condensation and frosting, can be prevented.

[0072]

According to Embodiment 1, in the refrigerator 1, the vacuum thermal insulator 33 is disposed in the ceiling wall portion 32 that partition a space into the vegetable compartment 5 and one of the other surrounding compartments and the vacuum thermal insulators 36 is disposed in the bottom wall portion 35 that partition a space

into the vegetable compartment 5 and another of the other surrounding compartments.

With this configuration, the area covered with the vacuum thermal insulators 33, 36 in the vegetable compartment 5 increases as much as possible. Further, each of the vacuum thermal insulators 33, 36 does not need to be provided with a notch and a hole, so that necessary thermal insulation performance can be ensured with a simple configuration. Moreover, it is possible to prevent the inflow of the cooling energy from the periphery of the vegetable compartment 5 toward the inside of the vegetable compartment 5 and prevent excessive cooling inside the vegetable compartment 5.

[0073]

Each of the vacuum thermal insulators 24, 33, 36, 39 is one rectangular plate.

With this configuration, each of the vacuum thermal insulators 24, 33, 36, 39 is rectangular, and each of the vacuum thermal insulators 24, 33, 36, 39 does not need to be provided with a notch and a hole, so that necessary thermal insulation performance can be ensured with a simple configuration. This shape can reduce manufacturing cost, simplify assembly, and make manufacturing efficiency favorable.

[0074]

According to Embodiment 1, the cool-air outlet 44 and the cool-air return inlet 45 are formed in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. One rectangular vacuum thermal insulator 39 provided in the rear-face wall portion 31 of the vegetable compartment 5 does not overlap the back projected planes of the cool-air outlet 44 and the cool-air return inlet 45.

With this configuration, the cool-air outlet 44 and the cool-air return inlet 45 can be formed in positions not separated by one rectangular vacuum thermal insulator 39. Thus, for forming the cool-air outlet 44 and cool-air return inlet 45, it is not necessary to perform special processing such as opening a hole in the vacuum thermal insulator 39 and providing a notch in the vacuum thermal insulator 39, and to use a plurality of pieces of the vacuum thermal insulators. This configuration can reduce manufacturing cost, simplify assembly, and make manufacturing efficiency favorable.

[0075]

According to Embodiment 1, one rectangular vacuum thermal insulator 39 disposed in the rear-face wall portion 31 of the vegetable compartment 5 is installed to have a vertical side substantially parallel to the vertical direction and a horizontal side substantially parallel to the horizontal direction, and not to overlap either ones of vertical projected regions of the cool-air outlet 44 and the cool-air return inlet 45 or horizontal projected regions of the cool-air outlet 44 and the cool-air return inlet 45.

With this configuration, one rectangular vacuum thermal insulator 39 matches the cuboid shape of the refrigerator 1, a manufacturing operator can be prevented from disposing the vacuum thermal insulator 39 in a wrong position, the assembly is simple, and the manufacturing efficiency is favorable.

[0076]

According to Embodiment 1, the cool-air outlet 44 is located at a corner of the inner wall of the vegetable compartment 5, and the cool-air return inlet 45 is located at another corner of the inner wall of the vegetable compartment 5 that is diagonal to the corner at which the cool-air outlet 44 is located.

With this configuration, the cool-air outlet 44 and the cool-air return inlet 45 can be formed in positions not separated by one rectangular vacuum thermal insulator 39. Further, the distance between the cool-air outlet 44 and the cool-air return inlet 45 can be defined to some extent, and cool air blown out of the cool-air outlet 44 and returned to the cool-air return inlet 45 circulates throughout the inside of the vegetable compartment 5, so that the thermal efficiency can be improved.

[0077]

According to Embodiment 1, the cool-air outlet 44 and the cool-air return inlet 45 are located in the same range in the vertical direction or the horizontal direction of the inner wall of the vegetable compartment 5.

With this configuration, the cool-air outlet 44 and the cool-air return inlet 45 can be formed in positions not separated by one rectangular vacuum thermal insulator 39. Further, the cool-air outlet 44 and the cool-air return inlet 45 are close to each other,

thus enabling increase in the region where one rectangular vacuum thermal insulator 39 is disposed in the rear-face wall portion 31 of the vegetable compartment 5.

[0078]

According to Embodiment 1, the refrigerator 1 includes an electric part
5 configured to control opening and closing of a plurality of air passages. The electric part is stored in the rear-face wall portion of one of the other compartments at higher positions than the position of the vegetable compartment 5.

With this configuration, there is no need to make an unnecessary space behind
the vegetable compartment 5, and the vegetable compartment 5 with a large capacity
10 can be provided.

[0079]

According to Embodiment 1, the vegetable compartment 5 includes the thermal
heater 46 in any of the wall portions 20 defining the vegetable compartment 5.

With this configuration, when the inside of the vegetable compartment 5 is
15 excessively cooled, the inside of the vegetable compartment 5 is warmed by the thermal heater 46.

[0080]

According to Embodiment 1, the vegetable compartment 5 includes the
radiation pipe 47 in any of the wall portions 20 defining the vegetable compartment 5,
20 and the radiation pipe 47 allows refrigerant for use in the cooler 14 to flow through and reject heat.

With this configuration, when the inside of the vegetable compartment 5 is
excessively cooled, the inside of the vegetable compartment 5 is warmed with the
refrigerant flowing through the radiation pipe 47 to reject heat.

[0081]

According to Embodiment 1, the storage compartment is the vegetable
compartment 5. The other compartments around the storage compartment are any
set of the freezer compartment 6, the ice-making compartment 3, a chilled
compartment, a preservation compartment at a temperature lower than a temperature
30 zone of the vegetable compartment 5, and the temperature switchable compartment 4

that is switchable to a temperature zone lower than the temperature zone of the vegetable compartment 5.

With this configuration, the cooling energy may flow into the vegetable compartment 5 to excessively cool the inside of the vegetable compartment 5.

5 However, a corresponding one of the rectangular vacuum thermal insulators 24, 33, 36, 39 is disposed in a corresponding one of the wall portions 20 defining the vegetable compartment 5. This configuration can prevent the inflow of the cooling energy from the periphery of the vegetable compartment 5 toward the inside of the vegetable compartment 5 and prevent excessive cooling inside the vegetable
10 compartment 5. Meanwhile, rejection of heat from the inside of the vegetable compartment 5 to the periphery of the refrigerator 1, which is the outside of the vegetable compartment 5, can also be prevented, to keep the inside of the vegetable compartment 5 at a set temperature in a thermally efficient manner.

[0082]

15 Embodiment 2

A refrigerator 1 according to Embodiment 2 is different from the refrigerator 1 according to Embodiment 1 in that returned cool air returned from the refrigerator compartment 2 is allowed to flow into the vegetable compartment 5. Consequently, a return air passage for cool air returned from the refrigerator compartment 2 and a
20 return air passage for cool air returned from the vegetable compartment 5 merge on the lower portion of the rear face of the vegetable compartment 5, and return to the cooler compartment 27 from a space between laterally divided return air passages of the freezer compartment 6.

In Embodiment 2, the above-described characteristic portion will be described.

25 The other configurations are the same as those of Embodiment 1, and the description of the configurations is thus omitted.

[0083]

Fig. 31 is a front view illustrating a rear-face wall portion 31 viewed through the inside of the vegetable compartment 5 in the refrigerator 1 according to Embodiment
30 2 of the present invention.

As illustrated in Fig. 31, a refrigerating return inlet 75 is formed in the right-side upper portion in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. The refrigerating return inlet 75 does not overlap the front projected plane of the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5, and is located outside the front projected plane.

In the vegetable compartment 5, a refrigerating return air passage 76 is formed on the rear face of the inner wall of the rear-face wall portion 31 of the vegetable compartment 5. The refrigerating return air passage 76 is formed to extend from the right-side upper portion, in which the refrigerating return inlet 75 is formed, in the inner wall of the rear-face wall portion 31 of the vegetable compartment 5 to the cool-air outlet 44 in the central lower portion in the inner wall of the rear-face wall portion 31.

The cool-air outlet 44 is formed in a laterally elongated shape in the central lower portion in the inner wall of the rear-face wall portion 31. The cool-air outlet 44 does not overlap the front projected plane of the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5, and is located outside the front projected plane.

The cool-air outlet 44 is formed behind the inner wall of the rear-face wall portion 31, so that the back of the cool-air outlet 44 may be blocked by the vacuum thermal insulator 39, which is one rectangular plate, disposed in the rear-face wall portion 31 of the vegetable compartment 5.

Note that the cool-air outlet 44 may be provided with an opening amount control mechanism as a cool-air amount control mechanism capable of controlling an opening amount from both the right and left of the cool-air outlet 44 as illustrated arrows are shown.

[0084]

The return air passage for cool air, not illustrated, returned from the refrigerator compartment 2 is installed on the right of the cooler 14 by using the foamed thermal insulator so that necessary thermal insulation can be performed. The return air

passage for cool air returned from the refrigerator compartment 2 is extended by forming a guide portion that is on the front face of the outer shell and extends to the outer shell on the lower portion of the ceiling wall portion 32, within the back projected plane of the ceiling wall portion 32 of the vegetable compartment 5 that is between the temperature switchable compartment 4 and the vegetable compartment 5. The return air passage for cool air returned from the refrigerator compartment 2 is connected to the air passage formed in the bottom wall portion 35 of the vegetable compartment 5 that is between the vegetable compartment 5 and the freezer compartment 6 in the substantially central portion of the lower portion of the rear face of the vegetable compartment 5.

[0085]

Cool air sent by the air-sending device 15 installed above the cooler 14 and generated by the cooler 14 is supplied to the refrigerator compartment 2 via the air-volume control device 18a held in the foamed thermal insulator above the cooler compartment 27. The cool air is then supplied to the refrigerating return inlet 75 formed in the rear-face wall portion 31 of the vegetable compartment 5 via the return air passage from the cool-air return inlet in the refrigerator compartment 2. The cool air supplied to the refrigerating return inlet 75 is supplied to the refrigerating return air passage 76 formed in the rear-face wall portion 31 of the vegetable compartment 5 and supplied from the cool-air outlet 44 in the vegetable compartment 5 into the vegetable compartment 5. The cool air is then supplied to the cool-air return inlet 45, not illustrated, in the vegetable compartment 5.

[0086]

Fig. 32 is a front view illustrating another example of the rear-face wall portion 31 viewed through the inside of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 2 of the present invention.

The refrigerating return air passage 76 disposed in the rear-face wall portion 31 of the vegetable compartment 5 does not have the function to insulate heat from the inside of the vegetable compartment 5, and is separated by the inner wall face molded by injection molding.

Then, as illustrated in Fig. 32, a plurality of holes 77 may be provided in the inner wall face separating the refrigerating return air passage 76 from the inside of the vegetable compartment 5 to control the temperature in the vegetable compartment 5.
[0087]

5 Fig. 33 is a front view illustrating another example of the rear-face wall portion 31 viewed through the inside of the vegetable compartment 5 in the refrigerator 1 according to Embodiment 2 of the present invention.

As illustrated in Fig. 33, similarly to the configuration illustrated in Fig. 32, a plurality of holes 77 may be provided in the inner wall face separating the refrigerating
10 return air passage 76 from the inside of the vegetable compartment 5 to control the temperature in the vegetable compartment 5.

Further, there may be provided a slider 78 for freely opening and closing the plurality of holes 77 provided in the inner wall face.

With such a configuration, by sliding the slider 78 as illustrated arrows are
15 shown to control the number of holes 77 to be closed, the user can arbitrarily control the temperature in the vegetable compartment 5.

[0088]

In Embodiment 2, the temperature can be controlled in the vegetable compartment 5, thus eliminating the need to provide a flow rate control device in the
20 place for the air passage in the rear face portion of the refrigerator 1, the flow rate control device controlling an amount of cool air supplied into the vegetable compartment 5.

[0089]

According to Embodiment 2, the cool-air outlet 44 allows, into the vegetable
25 compartment 5, cool air that returns from one of the other compartments around the vegetable compartment 5, the other compartment being for storing items including food at a temperature lower than the temperature of the vegetable compartment 5 or low-temperature cool air that is cooled in the cooler 14 to be blown.

With this configuration, there is no need to provide an air passage or an electric
30 part that controls opening and closing of the air passage, only for the vegetable

compartment 5. This configuration can reduce manufacturing cost, simplify assembly, and make manufacturing efficiency favorable.

[0090]

According to Embodiment 2, the vegetable compartment 5 includes the cool-air amount control mechanism that controls an amount of cool air blown out of the cool-air outlet 44.

With this configuration, it is possible to control the temperature in the vegetable compartment 5 and suitably keep stored items such as vegetables and other food.

[0091]

Note that Embodiments 1 and 2 of the present invention may be combined or may be applied to other portions.

In Embodiments 1 and 2 of the present invention, each of the vacuum thermal insulators 24, 33, 36, 39 is one rectangular plate. But each shape of the vacuum thermal insulators 24, 33, 36, 39 is not limited to be a rectangular shape. Each of the vacuum thermal insulators 24, 33, 36, 39 may be formed in a shape with round corners, a triangular shape, a polygonal shape, an elliptical shape, a circular shape, or other various shapes.

Reference Signs List

[0092]

1 refrigerator, 2 refrigerator compartment, 3 ice-making compartment, 4 temperature switchable compartment, 5 vegetable compartment, 6 freezer compartment, 7 refrigerant circuit, 8 compressor, 9 air-cooled condenser, 10 condenser, 11 dew-condensation preventive pipe, 12 dryer, 13 decompression device, 14 cooler, 15 air-sending device, 16a temperature sensor, 16b temperature sensor, 16c temperature sensor, 16d temperature sensor, 17 control board, 18a air-volume control device, 18b air-volume control device, 18c air-volume control device, 19 box body, 20 wall portion, 21 plate metal, 22 inner box, 23 thermal insulator, 24 vacuum thermal insulator, 25 support, 26 spacer, 27 cooler compartment, 28 return air passage, 29 return air passage, 30 blow air passage, 31 rear-face wall

portion, 32 ceiling wall portion, 33 vacuum thermal insulator, 34 urethane
foamed material, 35 bottom wall portion, 36 vacuum thermal insulator, 37
urethane foamed material, 38 thermal-insulation-wall outer shell, 39 vacuum
thermal insulator, 40 foamed thermal insulator, 41 blow air passage, 42
5 thermal-insulation-wall outer shell, 44 cool-air outlet, 45 cool-air return inlet,
46 thermal heater, 47 radiation pipe, 48 flow switching three-way valve, 49,
outlet pipe, 50 outlet pipe, 51 capillary, 52 stepping motor, 53 valve
body, 54 magnetizing rotor, 55 center gear, 56 rotary gear, 57 rotary
pad, 58 valve seat, 59 outer shell case, 60 floor, 61 orifice, 62 orifice,
10 63 orifice, 64 outlet orifice, 65 blow air passage, 66 drip tray, 67 heater,
68 blow air passage, 69 return air passage, 70 cool-air outlet, 71 ice-
making mechanism, 72 cool-air return inlet, 73 blow air passage, 74 return
air passage, 75 refrigerating return inlet, 76 refrigerating return air passage,
77 hole, 78 slider

CLAIMS

[Claim 1]

A refrigerator, comprising

a storage compartment set at a temperature higher than temperatures of ones
5 of other compartments of the refrigerator that surround the storage compartment, the
storage compartment being for storing an item,

wall portions defining the storage compartment each having a vacuum thermal
insulator.

[Claim 2]

10 The refrigerator of claim 1, wherein

a refrigerator compartment, an ice-making compartment, a temperature
switchable compartment, a vegetable compartment, and a freezer compartment are
arranged in this order from a top of the refrigerator, and

the storage compartment comprises the vegetable compartment.

[Claim 3]

15 The refrigerator of claim 1 or 2, wherein

two side wall portions of an entire box body of the refrigerator each have the
vacuum thermal insulator, each of the two side wall portions including each of side
wall portions of the storage compartment and a corresponding one of side wall
20 portions of the other compartments, and

the vacuum thermal insulator is disposed in each of a ceiling wall portion, a
bottom wall portion, a rear-face wall portion, and a door wall portion of the storage
compartment.

[Claim 4]

25 The refrigerator of any one of claims 1 to 3, comprising

a cooler provided behind the storage compartment,

wherein in a rear-face wall portion of the storage compartment, the vacuum
thermal insulator is disposed between a storage-compartment inner wall and the
cooler.

[Claim 5]

The refrigerator of claim 4, wherein
the rear-face wall portion of the storage compartment includes an air passage
disposed between the storage-compartment inner wall and the cooler, the air
passage allowing cool air to flow from the cooler to one or more of compartments in
5 the refrigerator, and
the air passage is provided on a front projected plane of the cooler.

[Claim 6]

The refrigerator of claim 5, wherein the vacuum thermal insulator disposed
between the storage-compartment inner wall and the cooler in the rear-face wall
10 portion of the storage compartment has a size to separate the cooler and the air
passage from the storage compartment in a range larger than front projected planes
of the cooler and the air passage.

[Claim 7]

A refrigerator, comprising:

15 a storage compartment set at a temperature higher than temperatures of ones
of other compartments of the refrigerator that surround the storage compartment, the
storage compartment being for storing an item;

a cooler provided behind the storage compartment;

a rear-face wall portion provided between a storage-compartment inner wall
20 and the cooler; and

a vacuum thermal insulator provided in a part inside the rear-face wall portion
that is close to the cooler.

[Claim 8]

The refrigerator of claim 7, wherein the vacuum thermal insulator is disposed in
25 a wall portion partitioning a space into the storage compartment and the ones of the
other compartments of the refrigerator that surround the storage compartment.

[Claim 9]

The refrigerator of any one of claims 1 to 8, wherein the vacuum thermal
insulator comprises one rectangular plate.

30 [Claim 10]

The refrigerator of any one of claims 1 to 9, wherein
a cool-air outlet and a cool-air return inlet are formed in a storage-compartment
inner wall of a rear-face wall portion of the storage compartment, and
the vacuum thermal insulator disposed in the rear-face wall portion of the
5 storage compartment does not overlap back projected planes of the cool-air outlet
and the cool-air return inlet.

[Claim 11]

The refrigerator of claim 10, wherein the vacuum thermal insulator disposed in
the rear-face wall portion of the storage compartment is installed to have a vertical
10 side substantially parallel to a vertical direction and a horizontal side substantially
parallel to a horizontal direction, and not to overlap either ones of vertical projected
regions of the cool-air outlet and the cool-air return inlet or horizontal projected
regions of the cool-air outlet and the cool-air return inlet.

[Claim 12]

15 The refrigerator of claim 10 or 11, wherein
the cool-air outlet is located at a corner of the storage-compartment inner wall
and,
the cool-air return inlet is located at an other corner of the storage-
compartment inner wall that is diagonal to the corner at which the cool-air outlet is
20 located.

[Claim 13]

The refrigerator of claim 10 or 11, wherein the cool-air outlet and the cool-air
return inlet are located in a same range in a vertical direction or a horizontal direction
of the storage-compartment inner wall.

25 [Claim 14]

The refrigerator of any one of claims 5 to 13, comprising
an electric part configured to control opening and closing of a plurality of air
passages,
wherein the electric part is stored in a rear-face wall portion of one of the other
30 compartments that are at higher positions than a position of the storage compartment.

[Claim 15]

The refrigerator of any one of claims 1 to 14, wherein in the storage compartment, a thermal heater is provided in any of wall portions defining the storage compartment.

5 [Claim 16]

The refrigerator of any one of claims 4 to 15, wherein in the storage compartment, a radiation pipe is provided in any of wall portions defining the storage compartment, the radiation pipe allowing refrigerant for use in the cooler to flow through and reject heat.

10 [Claim 17]

The refrigerator of any one of claims 10 to 16, wherein the cool-air outlet allows, into the storage compartment, either one of cool air that returns from one of the other compartments around the storage compartment, the one of the other compartments being for storing an item at a temperature lower than a temperature of the storage compartment or low-temperature cool air that is cooled in the cooler to be blown.

[Claim 18]

The refrigerator of claim 17, wherein the storage compartment includes a cool-air amount control mechanism configured to control an amount of cool air blown out of the cool-air outlet.

20

[Claim 19]

The refrigerator of any one of claims 1 to 18, wherein
the storage compartment comprises a vegetable compartment, and
the other compartments comprise any set of a freezer compartment, an ice-making compartment, a chilled compartment, a preservation compartment at a temperature lower than a temperature zone of the vegetable compartment, and a temperature switchable compartment that is switchable to a temperature zone lower than the temperature zone of the vegetable compartment.

25