

DESCRIPTION

Title of Invention

REFRIGERATOR

Technical Field

5 [0001]

The present invention relates to a refrigerator.

Background Art

[0002]

Japanese Unexamined Patent Application Publication No. 2004-61014

10 discloses a refrigerator which supplies air cooled at an evaporator to a refrigerator compartment through a cold air duct. The cold air duct is defined by an inner box and an air-passage thermal insulator. An ion sheet which generates negative ions is attached to a face of the air-passage thermal insulator, wherein the face surrounds the cold air duct. The inner box facing the ion sheet has a protrusion. The ion
15 sheet is secured by the air-passage thermal insulator and the protrusion. A cylindrical or elliptical form of protrusion can decrease stack loss to discharged cold air, as disclosed in Japanese Unexamined Patent Application Publication No. 2004-61014.

Citation List

20 Patent Literature

[0003]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2004-61014

Summary of Invention

25 Technical Problem

[0004]

Unfortunately, the refrigerator of Japanese Unexamined Patent Application Publication No. 2004-61014 is not capable of decreasing stack loss if no protrusion exists in the cold air duct, whereas the refrigerator can decrease stack loss if a
30 protrusion exists in the cold air duct. In general, the cross-sectional area of a cold

air passage should be increased to decrease the stack loss in the cold air passage. Unfortunately, the volume of the cold air passage increases with the cross-sectional area thereof, and the capacity of the storage compartment decreases by amount of reduction.

5 [0005]

The present invention has been made to overcome the above-stated problems, and an object of the present invention is to provide a refrigerator which allows an increase in the capacity of a storage compartment while preventing increase of the stack loss in a cold air passage.

10 Solution to Problem

[0006]

A refrigerator according to an aspect of the present invention includes a storage compartment defined by thermally insulating walls and having a front being open; a cold air duct extending in a vertical direction of the refrigerator along an inner
15 face of a back wall of the storage compartment, the cold air duct including a cold air passage configured to deliver cold air; and a cold air discharge port configured to discharge cold air delivered through the cold air passage into the storage compartment, the cold air passage having an elliptical cross section.

20 Advantageous Effects of Invention

[0007]

According to the present invention, the cold air passage is elliptical in cross section. Thus, this configuration allows the cold air passage to have a smaller cross-sectional area and a smaller volume than those of a cold air passage which is
25 rectangular in cross section and which has a same stack loss. The refrigerator can thereby increase the capacity of the storage compartment while preventing the stack loss in the cold air passage from increasing.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a schematic elevational view of a refrigerator 1 according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a cross-sectional view of the refrigerator 1 taken along the line II-II of Fig. 1.

5 Description of Embodiments

[0009]

Embodiment 1

A refrigerator according to Embodiment 1 of the present invention will now be described. Fig. 1 is a schematic elevational view of the refrigerator 1 according to this embodiment. Fig. 2 is a cross-sectional view of the refrigerator 1 taken along the line II-II of Fig. 1. Dimensional relationships among components, shapes and other properties of the components in Figs. 1 and 2 may differ from actual ones.

[0010]

Referring to Figs. 1 and 2, the refrigerator 1 includes a thermally insulating casing 10 with a front being open. The thermally insulating casing 10 includes an outer box 11 made of a steel sheet, an inner box 12 made of a resin, and a thermal insulator 13 filling between the outer and the inner boxes 11 and 12. The thermally insulating casing 10 serves as a thermally insulating walls for insulating an interior space thereof from the outside. The thermal insulator 13 is made from foamed polyurethane or any other vacuum heat insulating material. The interior space of the thermally insulating casing 10 is divided into a plurality of storage compartments by partitions 21 (thermally insulating walls) formed of thermal insulators. The storage compartments are kept cool at respective predetermined temperatures. In this embodiment, examples of the storage compartments of the refrigerator 1 include a refrigerator compartment 20, a freezer, a crisper, an ice-making chamber, and a switching chamber. The refrigerator 1 can keep the storage compartments cool at mutually different temperatures, for example. Fig. 1 illustrates only the refrigerator compartment 20 disposed at the uppermost location out of the storage compartments of the refrigerator 1, for example. A rotatable heat insulating door (not shown) is

provided to the open front of the refrigerator compartment 20 so that the refrigerator compartment 20 can be opened and closed.

[0011]

A cold air duct 30 for the refrigerator compartment 20 is provided along a back wall inner face 20a that is at the back of the refrigerator compartment 20 (behind the refrigerator compartment 20). In this embodiment, the cold air duct 30 is composed of combined two resin members 30a and 30b and is shaped cylindrically. The cold air duct 30 constitutes an outer wall for a cold air passage 31 described later. The cold air duct 30 is disposed at the middle in the horizontal direction of the refrigerator compartment 20 and extends in the vertical direction of the refrigerator 1. The cold air duct 30 protrudes from the back wall inner face 20a behind the refrigerator compartment 20 toward the indoor side.

[0012]

The cold air passage 31 configured to deliver cold air extends in the vertical direction in the cold air duct 30. The cold air passage 31 penetrates through the partitions 21 and is connected to an air passage in a cooler chamber (not shown). The cooler chamber includes an evaporator (a cooler), i.e. a part of a refrigeration cycle, and a fan for supplying cold air cooled at the evaporator to the refrigerator compartment 20 and other storage compartments. A damper for adjusting the opening degree of the air passages is provided between the cooler chamber and the cold air passage 31.

[0013]

The cold air passage 31 is elliptical in cross section (refer to Fig. 2). Where an elliptical cross section has an ellipticity b/a , i.e. the ratio of a minor axis b to a major axis a of the elliptical cross section (the ellipticity of a perfect circle: 1), the ellipticity of the elliptical cross section of the cold air passage 31 in this example ranges from 0.36 to 1. In this example, the major axis of the elliptical cross section of the cold air passage 31 is parallel to the horizontal direction of the refrigerator compartment 20, whereas the minor axis of the elliptical cross section is parallel to

the depth direction (the anterior-posterior direction) of the refrigerator compartment 20.

[0014]

The cold air duct 30 has a plurality of cold air discharge ports 32 configured to discharge cold air delivered through the cold air passage 31 into the refrigerator compartment 20 at its front face (the indoor side face of the refrigerator compartment 20). The plurality of cold air discharge ports 32 are disposed in a predetermined arrangement in the vertical or the horizontal direction of the cold air duct 30. In this example, the plurality of cold air discharge ports 32 are disposed at upper positions of respective multi-stage spaces into which the refrigerator compartment 20 is divided by shelves 22 described later such that the refrigerator 1 provides cooling for up to forward sides (open front sides) of the respective multi-stage spaces. The air passage width (air passage cross-sectional area) of the cold air passage 31 and the opening areas of the cold air discharge ports 32 are set such that unevenness in temperature among the multi-stage spaces in the refrigerator compartment 20 is reduced.

[0015]

In the refrigerator compartment 20, a plurality of the shelves 22 are horizontally placed. Each shelf 22, which is shaped like a shallow container or a flat board, holds stored goods on it. The shelf 22 is made of a transparent resin, for example. The space inside the refrigerator compartment 20 is divided into multiple stages by the shelves 22. The shelf 22 has a flat shape and extends along the surface of the inner box 12 (the back wall inner face of the refrigerator compartment 20). The shelf 22 comes into contact with or comes close to the back wall inner face 20a at the deep side of the refrigerator compartment 20. The shelf 22 also has a cutout 22a that is formed along the protrusion of the cold air duct 30 at a position corresponding to that of the cold air duct 30. The end face of the cutout 22a comes into contact with or comes close to the front of the cold air duct 30.

[0016]

The refrigerator 1 having the configuration described above supplies cold air cooled at the evaporator in the cooler chamber using the fan. The cold air delivered by the fan passes through the cold air passage 31 and other air passages and is discharged into the refrigerator compartment 20 and other storage compartments.

5 The amount of cold air discharged into the storage compartments is controlled by adjusting the opening degree of the air passages with the damper. This configuration keeps the storage compartments cool at respective predetermined temperatures.

[0017]

10 As described above, the refrigerator 1 according to this embodiment includes the refrigerator compartment 20 (one of the storage compartments) being defined by thermally insulating walls and having a front being open; the cold air duct 30 extending along the back wall inner face 20a at the back of the refrigerator compartment 20 in the vertical direction and including the cold air passage 31
15 configured to deliver cold air; and the cold air discharge ports 32 configured to discharge cold air delivered through the cold air passage 31 into the refrigerator compartment 20. The cross section of the cold air passage 31 is elliptical.

[0018]

20 According to this configuration, the cold air passage 31 is elliptical in cross section. Thus, the cross-sectional area of the cold air passage 31 can be smaller than that of a cold air passage which is rectangular in cross section and has an identical stack loss (identical pressure loss). The cold air passage 31 with a smaller cross-sectional area allows the cross-sectional area of the cold air duct 30 serving as an outer wall of the cold air passage 31 to be smaller. This configuration can reduce
25 the volumes of the cold air passage 31 and the cold air duct 30 in the refrigerator compartment 20 while preventing the stack loss in the cold air passage 31 from increasing. The refrigerator 1 according to this embodiment can thereby increase the capacity of the refrigerator compartment 20 while maintaining the cooling capability of the refrigerator 1 (the refrigerator compartment 20).

30 [0019]

The stack loss in the cold air passage 31 which is elliptical in cross section can be lower than that of a cold air passage which is rectangular in cross section and has an identical cross-sectional area. The refrigerator 1 according to this embodiment can thereby save energy required for supplying cold air to the refrigerator compartment 20 as compared to a refrigerator including a cold air passage which is rectangular in cross section and has an identical cross-sectional area.

[0020]

Where the ratio of the minor axis to the major axis in an elliptical cross section is defined as ellipticity, the ellipticity of the elliptical cross section of the cold air passage 31 in the refrigerator 1 according to this embodiment ranges from 0.36 to 1.

[0021]

As the ellipticity of the elliptical cross section of the cold air passage 31 gets smaller, the volumes of the cold air passage 31 and the cold air duct 30 increase and the capacity of the refrigerator compartment 20 decreases. Under the definition of the ellipticity, the maximum ellipticity is 1. The refrigerator 1 can thereby increase the capacity of the refrigerator compartment 20 while maintaining the cooling capability of the refrigerator 1 (the refrigerator compartment 20) on condition that the ellipticity of the elliptical cross section of the cold air passage 31 is set between 0.36 and 1.

[0022]

In the refrigerator 1 according to this embodiment, the major axis of the elliptical cross section of the cold air passage 31 is parallel to the horizontal direction of the refrigerator compartment 20.

[0023]

This configuration can reduce the protrusion of the cold air passage 31 toward the indoor side from the back wall inner face 20a at the back of the refrigerator compartment 20. This leads to an efficient use of the space inside the refrigerator compartment 20, an increase in the effective capacity of the refrigerator compartment 20, and the improvement of the refrigerator compartment 20 in design.

[0024]

The refrigerator 1 according to this embodiment includes the cold air duct 30 protruding toward the indoor side of the refrigerator compartment 20 from the back wall inner face 20a behind the refrigerator compartment 20 and the shelves 22 placed inside the refrigerator compartment 20. Each shelf 22 has the cutout 22a that is formed along the protruding cold air duct 30.

[0025]

This configuration can maximize the area of each shelf 22 corresponding to the cold air duct 30 protruding toward the indoor side of the refrigerator compartment 20. This leads to an increase in the loading capacity of the shelf 22.

[0026]

Other embodiments

The scope of the present invention is not be limited to the embodiment described above, and includes various modifications and variations.

In the embodiment described above, the cold air passage 31 for the refrigerator compartment 20 is elliptical in cross section, for example. Where a plurality of the storage compartments including a refrigerator compartment 20 are equipped with respective cold air passages configured to deliver cold air discharged into the storage compartments, the cold air passages each may be elliptical in cross section. This configuration can reduce the volumes of the cold air passages and cold air ducts in the respective storage compartments. A refrigerator 1 in this variation can thereby increase the capacities of the storage compartments while maintaining the cooling capabilities of the storage compartments.

[0027]

The embodiment and the variation described above may be combined in implementation.

Reference Signs List

[0028]

1 refrigerator, 10 thermally insulating casing, 11 outer box, 12 inner box, 13 thermal insulator, 20 refrigerator compartment, 20a back wall inner face, 21

partition, 22 shelves, 22a cutout, 30 cold air duct, 30a,30b members, 31 cold
air passage, 32 cold air discharge ports

CLAIMS

[Claim 1]

A refrigerator comprising:

a storage compartment defined by thermally insulating walls and having a front
5 being open;

a cold air duct extending in a vertical direction of the refrigerator along an inner
face of a back wall of the storage compartment, the cold air duct including a cold air
passage configured to deliver cold air; and

a cold air discharge port configured to discharge cold air delivered through the
10 cold air passage into the storage compartment,

the cold air passage having an elliptical cross section.

[Claim 2]

The refrigerator of claim 1, wherein the cold air duct is disposed at a middle in
a horizontal direction of the storage compartment.

[Claim 3]

The refrigerator of claim 1 or 2, wherein the cold air passage has the elliptical
cross section of an ellipticity ranging from 0.36 to 1, where the ellipticity is defined as
a ratio of a minor axis to a major axis of the elliptical cross section.

[Claim 4]

The refrigerator of any one of claims 1 to 3, wherein the major axis of the
elliptical cross section of the cold air passage is parallel to the horizontal direction of
the storage compartment.

[Claim 5]

The refrigerator of any one of claims 1 to 4, further comprising a shelf disposed
25 inside the storage compartment, wherein

the cold air duct protrudes from the inner face of the back wall of the storage
compartment to inside of the storage compartment, and

the shelf has a cutout formed along a contour of the cold air duct.

[Claim 6]

The refrigerator of any one of claims 1 to 5, comprising:

a plurality of the storage compartments; and
a plurality of the cold air passages configured to deliver cold air discharged into
the respective storage compartments,
wherein each of the cold air passages has an elliptical cross section.