

[Name of Document] DESCRIPTION

[Title of Invention] REFRIGERATOR

[Technical Field]

[0001]

The present invention relates to a refrigerator, and particularly to a structure of a vegetable compartment.

[Background Art]

[0002]

Many fruits and vegetables contain 90% or more water, and are generally said to lose their commercial values if about 5% of the water is lost. Such loss of water by drying causes quality deterioration, such as weight loss and wilting. To keep vegetables fresh, it is important to reduce drying.

[0003]

Under such circumstances, refrigerators have been proposed which reduce drying by indirectly cooling a vegetable compartment, instead of directly supplying cold air into the vegetable compartment. For example, Patent Literature (Patent Literature) 1 proposes a configuration in which, to prevent drying of a vegetable compartment caused by blowing of cold air, the vegetable compartment is cooled by natural convection using a cooling panel made of highly thermal conductive material. The cooling panel is disposed such that its inner surface forms at least part of the wall surface of the vegetable compartment, and that its outer surface is in contact with cold air circulating in storage rooms other than the vegetable compartment.

[0004]

However, the configuration proposed in Patent Literature 1 does not address the problem of condensation in the refrigerator caused by moisture contained in air in the vegetable compartment. Falling of condensed water droplets onto vegetables may promote the growth of mold and bacteria. Since an entire surface of the cooling panel is exposed to the vegetable compartment, there is a large temperature difference between two sides of the cooling panel, one side being close to a door of

the vegetable compartment and the other side being close to a back side of the vegetable compartment. Condensation is readily to occur easily in this configuration.

[0005]

Patent Literature 2 proposes a structure in which a vegetable-compartment top air path is disposed above a vegetable compartment. The vegetable-compartment top air path allows passage of cold air by which an ice compartment has been cooled. The vegetable-compartment top air path is partially provided with a metal plate of high thermal conductivity. Thus, by indirectly cooling the vegetable compartment through a surface of the vegetable-compartment top air path, drying of the vegetable compartment is prevented. At the same time, the vegetable-compartment top air path is partially provided with a plurality of openings having a diameter of 2 mm or less. Thus, condensation is prevented by allowing some of cold air passing through the vegetable-compartment top air path to directly flow into the vegetable compartment.

[0006]

However, in the condensation prevention measure proposed in Patent Literature 2, the cold air from the ice compartment always flows into the vegetable compartment. As a result, blowing of cold air onto vegetables may promote their drying. That is, since the openings described above are provided on a back side of the vegetable compartment, cold air in the vegetable compartment and cold air from the ice compartment circulate through the openings of the vegetable-compartment top air path. This promotes drying of the vegetable compartment.

[Citation List]

[Patent Literature]

[0007]

[Patent Literature 1] Japanese Unexamined Patent Application Publication No. 2008-121939

[Patent Literature 2] Japanese Unexamined Patent Application Publication No. 2006-2999

[Summary of Invention]

[Technical Problem]

[0008]

The present invention has been made to solve the problems described above. An object of the present invention is to provide a refrigerator that can prevent drying of a vegetable compartment and can reduce condensation.

[Solution to Problem]

[0009]

A refrigerator according to the present invention includes a refrigerating compartment, a vegetable compartment, a cooler configured to cool storage rooms, the refrigerating compartment and the vegetable compartment, a ceiling air path disposed in a ceiling portion of the vegetable compartment, a partition configured to separate the ceiling air path from the vegetable compartment, and a thermal conductive member disposed inside or on an upper surface of the partition. The ceiling air path includes a vegetable-compartment cooling air path through which return cold air from the refrigerating compartment flows to cool the vegetable compartment by radiation, a vegetable-compartment return air path through which return cold air from the vegetable compartment flows, a junction where the vegetable-compartment cooling air path and the vegetable-compartment return air path meet, and a return air path through which return cold air from the refrigerating compartment and the vegetable compartment flows from the junction to return to the cooler. An exposure portion is provided which opens part of the partition to allow the thermal conductive member to be exposed to the vegetable compartment. The exposure portion is located on a door side of the vegetable compartment.

[Advantageous Effects of Invention]

[0010]

In the refrigerator according to the present invention, where the ceiling air path in the ceiling portion of the vegetable compartment is configured as described above, the vegetable compartment is cooled by radiation by introducing return cold air from the refrigerating compartment into the ceiling air path. Therefore, drying of the vegetable compartment can be prevented. Return cold air from the vegetable compartment mixes with return cold air from the refrigerating compartment at the

junction in the ceiling air path, and returns to the cooler. Thus, drying of the vegetable compartment is not promoted, and it is possible to reduce efficiency degradation of, and frost on, the cooler. As described above, the exposure portion is provided which opens part of the partition to allow the thermal conductive member to be exposed to the vegetable compartment, and the exposure portion is located on the door side of the vegetable compartment. Since heat of higher temperature on the door side of the vegetable compartment is received through the exposure portion, a uniform temperature distribution can be achieved on a ceiling surface of the vegetable compartment (i.e., on a lower surface of the partition). It is thus possible to reduce condensation on the ceiling surface of the vegetable compartment.

[Brief Description of Drawings]

[0011]

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

[Fig. 2] Fig. 2 is a front view of refrigerator air paths in the refrigerator according to Embodiment of the present invention.

[Fig. 3] Fig. 3 is a lateral cross-sectional view of a vegetable compartment according to Embodiment of the present invention.

[Fig. 4] Fig. 4 is a top view of a ceiling air path in a ceiling portion of the vegetable compartment of the refrigerator according to Embodiment of the present invention.

[Description of Embodiment]

[0012]

Embodiment of a refrigerator 1 according to the present invention will now be described with reference to the drawings. Note that the drawings described below are schematic representations of configurations of the refrigerator 1 and its components. The present invention is not limited to the configurations illustrated in the drawings.

[0013]

Fig. 1 is a front view of the refrigerator 1 according to Embodiment of the present invention.

The refrigerator 1 according to Embodiment includes a refrigerating compartment 100 disposed at the top, having an opening and closing door, and configured to cool and store foods; a switching compartment 200 disposed below the refrigerating compartment 100, having a drawer door, and capable of switching between a refrigeration temperature zone (-18°C) and a soft refrigeration temperature zone (-7°C); an ice compartment 300 disposed side by side with the switching compartment 200, having a drawer door, and configured to make and store ice; a freezer compartment 400 disposed below the switching compartment 200 and the ice compartment 300, having a drawer door, and configured to freeze and store foods; and a vegetable compartment 500 disposed at the bottom, having a drawer door, and configured to store vegetables. The front surface of the door of the refrigerating compartment 100 is provided with an operation panel 30 having operation switches for adjusting the temperature and settings of each compartment, and a liquid crystal display for displaying the temperature and settings of each compartment. The operation panel 30 may be disposed inside the refrigerator 1. For example, the operation panel 30 may be disposed on an inner side surface of the refrigerating compartment 100. The configuration of the refrigerator 1 is not limited to this. For example, the refrigerator 1 may be one without the switching compartment 200 and the ice compartment 300. Each of the compartments (the switching compartment 200, the ice compartment 300, and the freezer compartment 400), other than the refrigerating compartment 100 and the vegetable compartment 500, will be referred to as a storage room.

[0014]

Fig. 2 is a front view of refrigerator air paths in the refrigerator 1 according to Embodiment of the present invention.

Cold air produced by a cooler 2 is supplied by a blower fan 3, passes through each of supply air paths (an ice-compartment supply air path 4, a refrigerating-compartment supply air path 5, a switching-compartment supply air path 6, a freezer-compartment supply air path 7, and a vegetable-compartment supply air path 8), and is blown into each compartment. Return cold air from the refrigerating compartment

100 passes through a refrigerating-compartment return air path 9 to reach a ceiling air path 10 in a ceiling portion of the vegetable compartment 500, meets return cold air flowing from the vegetable compartment 500 through vegetable-compartment cold air return ports 11 into the ceiling air path 10, and returns to the cooler 2.

[0015]

A configuration of the vegetable compartment 500 will now be described in more detail.

Fig. 3 is a lateral cross-sectional view of the vegetable compartment 500 according to Embodiment of the present invention. Fig. 4 is a top view of the ceiling air path 10 in the ceiling portion of the vegetable compartment 500.

The vegetable compartment 500 includes a vegetable case 13 pulled out in conjunction with an openable and closable drawer door 17, and a fruit case 12 disposed above the vegetable case 13. A thermal insulator 18 is disposed between the vegetable compartment 500 and the freezer compartment 400. A partition 15 that forms the ceiling portion of the vegetable compartment 500 is disposed below the thermal insulator 18. The partition 15 is composed of a thermal insulating material and a plastic skin. The ceiling air path 10 explained below is formed in a space defined by the thermal insulator 18 and the partition 15.

[0016]

A highly thermal conductive member 14 having high thermal conductivity is disposed inside or on an upper surface of the partition 15. Additionally, an exposure portion 16 is provided on a door side (the side close to the drawer door 17) of the vegetable compartment 500. The exposure portion 16 opens part of the plastic skin of the partition 15 to allow the highly thermal conductive member 14 to be partially exposed to the vegetable compartment 500. The material of the highly thermal conductive member 14 is not limited to a specific one, but may be metal, such as aluminum or stainless steel.

[0017]

As illustrated in Fig. 3 and Fig. 4, the ceiling air path 10 includes a vegetable-compartment cooling air path 19 into which return cold air from the refrigerating

compartment 100 flows to cool the vegetable compartment 500 by radiation, a vegetable-compartment return air path 20 through which return cold air flowing in from the vegetable compartment 500 through the vegetable-compartment cold air return ports 11 passes, a junction 21 where the vegetable-compartment cooling air path 19 and the vegetable-compartment return air path 20 meet, and a return air path 22 through which return cold air from the refrigerating compartment 100 and the vegetable compartment 500 flows from the junction 21 to return to the cooler 2. Dotted lines in Fig. 4 represent walls of the air paths (the vegetable-compartment cooling air path 19, the vegetable-compartment return air path 20, the junction 21, and the return air path 22).

The ceiling air path 10 having the above-described configuration and disposed in the ceiling portion of the vegetable compartment 500 is typically formed integrally with the partition 15. Alternatively, the ceiling air path 10 may be formed integrally with a lower surface of the thermal insulator 18.

[0018]

An operation will now be described.

The vegetable compartment 500 is cooled by radiation by allowing return cold air from the refrigerating compartment 100 to pass through the refrigerating-compartment return air path 9, flow into the vegetable-compartment cooling air path 19 of the ceiling air path 10, and pass through the return air path 22. The return cold air from the refrigerating compartment 100 passes through the vegetable-compartment cooling air path 19 and the return air path 22 while being in contact with the highly thermal conductive member 14 on the upper surface of the partition 15 for the ceiling air path 10. The vegetable compartment 500 can thus be efficiently cooled by radiation.

[0019]

Cold air from the cooler 2 passes through the vegetable-compartment supply air path 8 and is blown into the vegetable compartment 500. After circulating around the fruit case 12 and the vegetable case 13, the cold air passes through the vegetable-compartment cold air return ports 11 and flows into the vegetable-

compartment return air path 20 of the ceiling air path 10. Thus, for example, even if the outside air temperature is high and the cooling capability provided only by radiation cooling through the vegetable-compartment cooling air path 19 is not sufficient enough, it is possible to store vegetables at the right temperature.

[0020]

Return cold air from the refrigerating compartment 100 and return cold air from the vegetable compartment 500 flow into the ceiling air path 10, meet at the junction 21, passes through the return air path 22, and returns to the cooler 2. Since warmer return air from the vegetable compartment 500 mixes with colder return air from the refrigerating compartment 100, it is possible to reduce efficiency degradation of, and frost on, the cooler 2. The junction 21 has an air path structure narrower than any of the vegetable-compartment cooling air path 19, the vegetable-compartment return air path 20, and the return air path 22. Even when no cold air flows into the vegetable compartment 500 from either of the vegetable-compartment supply air path 8 and the refrigerating-compartment return air path 9, the junction 21 prevents cold air from the cooler 2 from flowing, through the return air path 22 and the vegetable-compartment return air path 20, back into the vegetable compartment 500. Thus, drying of vegetables caused by such a back flow of cold air can be prevented.

[0021]

Generally, the temperature inside the refrigerator 1 is high on the front side close to the door adjacent to the outside air, and is low on the back side where there are the cooler 2 and the supply air paths for the individual compartments. A similar tendency is seen in each compartment of the refrigerator 1, and a similar temperature distribution takes place in the vegetable compartment 500. The vegetable compartment 500 is cooled by radiation cooling from the vegetable-compartment cooling air path 19 and the return air path 22 through a ceiling surface (which refers to a lower surface of the partition 15), so that the temperature is lower on the ceiling surface than on the door side. Therefore, if the humidity in the vegetable compartment 500 increases rapidly, for example, by putting a large amount of vegetables in the vegetable compartment 500, condensation tends to occur

particularly on the back side of the ceiling surface due to the temperature lower than in other parts.

In the configuration of Embodiment, however, the highly thermal conductive member 14 is disposed on the upper surface of the partition 15 and the exposure portion 16 is provided near the door where the temperature tends to be higher. The highly thermal conductive member 14 efficiently receives heat, increases the temperature on the ceiling surface of the vegetable compartment 500, and makes the temperature distribution uniform on the ceiling surface of the vegetable compartment 500. Thus, it is possible to reduce the occurrence of condensation. Even if condensation occurs, the condensation can be widely dispersed over the ceiling surface of the vegetable compartment 500 because of the uniform temperature distribution on the ceiling surface. Therefore, it is possible to prevent the growth of mold and bacteria caused by falling of water droplets onto vegetables, and possible to keep the vegetables fresh.

[0022]

Although the highly thermal conductive member 14 is disposed on the upper surface of the partition 15 in the example described above, the highly thermal conductive member 14 may be disposed on the upper surface of the partition 15. The walls of the air paths (the vegetable-compartment cooling air path 19, the vegetable-compartment return air path 20, the junction 21, and the return air path 22) forming the ceiling air path 10 may be formed integrally with the highly thermal conductive member 14. In this case, because of the fin effect of the walls of the air paths, it is possible to improve the radiation cooling effect and the condensation preventing effect described above.

[Reference Signs List]

[0023]

1: refrigerator 2: cooler 3: blower fan 4: ice-compartment supply air path
5: refrigerating-compartment supply air path 6: switching-compartment supply air path
7: freezer-compartment supply air path 8: vegetable-compartment supply air path
9: refrigerating-compartment return air path 10:

ceiling air path 11: vegetable-compartment cold air return port 12: fruit case
13: vegetable case 14: highly thermal conductive member 15: partition 16:
exposure portion 17: drawer door 18: thermal insulator 19: vegetable-
compartment cooling air path 20: vegetable-compartment return air path 21:
junction 22: return air path 30: operation panel 100: refrigerating
compartment 200: switching compartment 300: ice compartment 400:
freezer compartment 500: vegetable compartment

[Name of Document] CLAIMS

[Claim 1]

A refrigerator comprising:

- a refrigerating compartment;
- a vegetable compartment;
- a cooler configured to cool storage rooms, the refrigerating compartment and the vegetable compartment;
- a ceiling air path disposed in a ceiling portion of the vegetable compartment;
- a partition configured to separate the ceiling air path from the vegetable compartment; and
- a thermal conductive member disposed inside or on an upper surface of the partition,

wherein the ceiling air path includes

- a vegetable-compartment cooling air path through which return cold air from the refrigerating compartment flows to cool the vegetable compartment by radiation,
- a vegetable-compartment return air path through which return cold air from the vegetable compartment flows,
- a junction where the vegetable-compartment cooling air path and the vegetable-compartment return air path meet, and
- a return air path through which return cold air from the refrigerating compartment and the vegetable compartment flows from the junction to return to the cooler;
- an exposure portion is provided which opens part of the partition to allow the thermal conductive member to be exposed to the vegetable compartment; and
- the exposure portion is located on a door side of the vegetable compartment.

[Claim 2]

The refrigerator of claim 1, wherein the junction is an air path narrower than any of the vegetable-compartment cooling air path, the vegetable-compartment return air path, and the return air path.

[Claim 3]

The refrigerator of claim 1 or 2, wherein a material of the thermal conductive member is aluminum.

[Claim 4]

The refrigerator of any one of claims 1 to 3, wherein walls of the air paths that form the ceiling air path are formed integrally with the thermal conductive member.