

[Name of Document] DESCRIPTION

[Title of Invention] REFRIGERATOR

[Technical Field]

[0001]

5 The present invention relates to a refrigerator that employs a vacuum heat insulating material.

[Background Art]

[0002]

10 In recent years, a vacuum heat insulating material that has high heat-insulating properties has been employed to refrigerators as a means to improve heat insulating performance for the purpose of acquiring energy-saving and space-saving refrigerators.

[0003]

15 For example, in cases where an outer casing of a heat insulating cabinet has portions (for example, sections where condensing pipes are disposed) whose surface temperature is higher than the ambient temperature or has portions thereinside where some intervening object is present, the vacuum heat insulating material is embedded in a closed cell rigid urethane foam between the outer casing and an inner casing of the heat insulating cabinet, thereby making
20 up for the shortage of the closed cell rigid urethane foam resulting from the lamination of vacuum heat insulating materials. In these cases, the vacuum heat insulating material has a metallic foil layer film and an aluminum vapor deposited layer film, as jacketing material, and the aluminum vapor deposited layer film is configured to be disposed on the inner casing side (for example, see Patent
25 Literature 1).

[0004]

 Also, there is a heat insulator with a heat insulating pack mounted on one plate constituting a pair of plates with the space between the plates filled with a foamed heat insulating material. In this case, the heat insulating pack is

constituted by a first laminate film having a laminated metallic foil and plastic film,
a second laminate film having aluminum vapor deposited on a plastic film, a core
material provided between the two films and a heat seal for sealing the
circumference of the films after depressurizing the space between them. The
5 heat insulating pack is configured in such a manner that the second laminate film
is disposed on the outer plate side, thereby maintaining the degree of vacuum
inside the heat insulating pack for a prolonged period of time as well as improving
the heat insulating performance of the heat insulating material (for example, see
Patent Literature 2).

10 [Citation List]

[Patent Literature]

[0005]

[Patent Literature 1] Japanese Unexamined Patent Application Publication
No. 2003-014368 (Figs. 1 and 3)

15 [Patent Literature 2] Japanese Examined Patent Application Publication
No. 7-113513 (Figs. 1 and 2)

[Summary of Invention]

[Technical Problem]

[0006]

20 However, in cases where the vacuum heat insulating material is embedded
in the closed cell rigid urethane foam filled between the outer casing and the
inner casing of the heat insulating cabinet with the aluminum vapor deposited
layer film disposed on the inner casing side, the metal foil layer film will be
disposed on the outer casing side, which can maintain temporal reliability, but
25 hinders heat insulating performance due to heat wrap known as a heat bridge.

[0007]

Also, in cases where the second laminate film having an aluminum vapor
deposited on a plastic film is disposed on the outer plate side, the heat insulating

performance does improve, but a drawback that drop of temporal reliability occurs.

[0008]

Accordingly, the object of the present invention is to provide temporal
5 reliability as well as improved heat insulating performance.

[Solution to Problem]

[0009]

A refrigerator according to the present invention includes a closed cell rigid
urethane foam, a vacuum heat insulating material, and a condensing pipe
10 provided between an outer casing and an inner casing thereof, wherein the
vacuum heat insulating material includes a jacketing material having gas barrier
properties, the jacketing material constituted by a first laminate film having a
metallic foil and a second laminate film having an aluminum vapor deposited
layer or an alumina vapor deposited layer overlapped and heat-welded at their
15 circumference to be formed into a bag-like package which is vacuumed and
sealed with a core material thereinside, and the condensing pipe is disposed at
the side of the outer casing and the vacuum heat insulating material is embedded
in the closed cell rigid urethane foam between the outer casing and the inner
casing in such a manner that the second laminate film having an aluminum vapor
20 deposited layer or an alumina vapor deposited layer faces the condensing pipe.

[Advantageous Effects of Invention]

[0010]

The refrigerator according to the present invention includes the second
laminate film having an aluminum vapor deposited layer or an alumina vapor
25 deposited layer having a low heat conductivity disposed so as to face the
condensing pipe, thereby allowing heat generated by the condensing pipe to be
released to the outside of the refrigerator without causing the heat to be diffused.

[0011]

Also, the vacuum heat insulating material is embedded in the closed cell rigid urethane foam so as to be disposed between the outer casing and the inner casing, preventing the vacuum heat insulating material from being directly exposed to outside air and eliminating a pathway through which outside air can enter, thereby minimizing the time degradation of the vacuum heat insulating performance.

In addition, with the closed cell rigid urethane foam in which the vacuum heat insulating material is embedded, uneven or wavy surfaces of the outer casing can be pushed from the inside allowing pleasing appearance to be maintained.

Furthermore, even if the refrigerator has a surface temperature in excess of 40 degrees C due to heat generating from high-temperature refrigerant piping as a result of operating under heavy load, the time degradation of the vacuum heat insulating performance can be kept minimal.

[Brief Description of Drawings]

[0012]

[Fig. 1] Fig. 1 is a cross-sectional view, as seen from the front, of a refrigerator according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a cross-sectional view, as seen from the side, of a refrigerator according to an embodiment of the present invention.

[Fig. 3] Fig. 3 is a graph comparatively showing a specification of laminate films constituting a package of a vacuum heat insulating material and the amount of heat penetration into a refrigerator.

[Description of Embodiments]

[0013]

The present invention will be described below with reference to an embodiment shown in the attached figures.

Fig. 1 is a cross-sectional view, as seen from the front, of a refrigerator according to an embodiment of the present invention. Fig. 2 is a cross-sectional view, as seen from the side.

[0014]

5 As shown in Figs. 1 and 2, a refrigerator according to the embodiment includes a heat insulating cabinet having an outer casing 1 formed of a metallic plate such as a steel plate, an inner casing 2 formed of a synthetic resin such as an ABS resin, a closed cell rigid urethane foam 4 that fills up a space defined between the outer casing 1 and the inner casing 2, and a vacuum heat insulating material 3, all of which are disposed so as to form a multilayer structure. To
10 manufacture the heat insulating cabinet, the vacuum heat insulating material 3 is indirectly bonded in advance to the outer casing 1. Then, a material of the closed cell rigid urethane foam 4 is injected into the space, thereby conducting foam formation in an integral manner.

15 [0015]

As shown in Fig. 1, a vacuum heat insulating material 3a, 3b at either side of the heat insulating cabinet is disposed on the outer casing 1 with a spacer 5a therebetween and is embedded in the closed cell rigid urethane foam 4 between the outer casing 1 and the inner casing 2.

20 [0016]

Also, a vacuum heat insulating material 3c located on the ceiling of the heat insulating cabinet is bonded to the outer casing 1 using a hot-melt adhesive or a double-sided adhesive tape.

[0017]

25 Furthermore, as shown in Fig. 2, a vacuum heat insulating material 3d located on the inner back side of the heat insulating cabinet is disposed in the outer casing 1 with a spacer 5b therebetween, the spacer 5b being formed in a staggered manner on the outer casing 1, and is embedded in the closed cell rigid urethane foam 4 between the outer casing 1 and the inner casing 2 so as to

avoid interfering with a condensing pipe 6 for heat dissipation. The condensing pipe 6 is disposed so as to be in contact with the inner surface of the outer casing 1 and is configured to release heat to the outside via the outer casing 1. In the following description, the vacuum heat insulating materials 3a to 3d may be collectively referred to as a vacuum heat insulating material 3.

[0018]

To fabricate the vacuum heat insulating material 3, a first laminate film 7b having a metallic foil or an aluminum foil laminated between plastic films and a second laminate film 7a having an aluminum vapor-deposited or alumina (oxidized aluminum) vapor-deposited plastic film are overlaid on each other, and their circumferential portions are thermally welded to form a bag-like package having gas barrier properties. Then, a core material 8 is inserted into such a bag-like package, which is vacuumed before its opening is finally sealed. In addition, the second laminate film 7a having an aluminum vapor-deposited or alumina vapor-deposited layer and the first laminate film 7b having an aluminum foil of high gas barrier properties are disposed in such a manner that the former is located on the outer casing 1 side and the latter is located on the inner casing 2 side. In this embodiment, there is no limitation on the configuration of the core material 8 of the vacuum heat insulating material 3.

[0019]

The vacuum heat insulating material 3 has heat insulating properties 10 times higher than that of the closed cell rigid urethane foam 4.

[0020]

The second laminate film 7a having an aluminum vapor-deposited or an alumina-vapor deposited layer consists of a polyethylene terephthalate layer as a surface protection layer, an alumina-deposited layer, a stretched nylon layer, an aluminum vapor-deposited or alumina vapor-deposited layer, an ethylene-vinyl alcohol copolymer resin composition layer, and a low-density polyethylene layer as a thermal seal layer.

[0021]

The first laminate film 7b having an aluminum foil laminated between plastic films consists of a stretched nylon layer as a surface protection layer, a polyethylene terephthalate layer, an aluminum vapor-deposited or an alumina vapor-deposited layer, an aluminum foil, and low-density polyethylene layer as a thermal seal layer.

[0022]

The reason why the second laminate film 7a having an aluminum vapor-deposited or an alumina vapor-deposited layer is used in the side of the outer casing 1 and not in the side of the inner casing 2 is because the aluminum vapor-deposited or an alumina vapor-deposited layer is inferior in gas barrier properties, posing a concern on long-term reliability.

[0023]

Hence, a vapor deposited plastic film is used only in either of the two laminate films that constitute the package. However, the problem is which of the outer casing 1 side and the inner casing 2 side faces the vapor-deposited plastic film.

[0024]

Fig. 3 is a graph comparatively showing specifications of laminate films constituting the package of the vacuum heat insulating material and the amount of heat penetration into a refrigerator, indicating results of the calculated amount of heat penetration into a refrigerator in cases in which the second laminate film 7a having a vapor-deposited layer is disposed on the outer casing 1 side (the condensing pipe 6 side), in which the second laminate film 7a having a vapor-deposited layer is disposed on the inner casing 2 side, and in which the first laminate film 7b having an aluminum foil provided on both sides is disposed on both sides.

[0025]

The results prove that when disposing the second laminate film 7a having a vapor deposited layer on the outer casing 1 side (the side of the condensing pipe 6), heat penetration into a refrigerator is lower, thus, has energy-saving effects.

[0026]

When the first laminate film 7b having an aluminum foil that has high heat conductivity is disposed so as to face the condensing pipe 6, heat generated by the condensing pipe 6 is transferred, due to its high heat conductivity, to the outer circumference of the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2, creating larger temperature difference with inside the refrigerator. This causes the refrigerator to be susceptible to heat penetration, resulting in drop of heat insulating performance.

[0027]

In other words, if the second laminate film 7a having a vapor deposited layer is disposed on the condensing pipe 6 side, energy-saving effects can be more greatly achieved by having the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2 cover the condensing pipe 6 in a greater manner. For this reason, in this embodiment the second laminate film 7a having a vapor-deposited layer is disposed at the side of the condensing pipe 6, and 85 percent or more of the condensing pipe 6 is covered lengthwise with the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2. The remaining 15 percent of the condensing pipe 6 has been described as not being covered considering the connecting portions of the condensing pipe 6, for example, but it is preferred that the covered rate of the condensing pipe 6 is as high as it can possible be.

[0028]

As described above in this embodiment, the second laminate film 7a having a vapor deposited layer of the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2 is disposed on the condensing

pipe 6 side. However, the closed cell rigid urethane foam 4 is present between the second laminate film 7a having a vapor deposited layer and the condensing pipe 6, to assure that the second laminate film 7a having a vapor-deposited layer is lower in temperature than the vacuum heat insulating material 3c that is directly bonded to the top ceiling of the heat insulating cabinet, thereby securing temporal reliability.

[0029]

Consequently, in this embodiment, energy-saving effects is provided more efficiently with the second laminate film 7a having a vapor-deposited layer of the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2 being disposed so as to face the condensing pipe 6 at the side where the condensing pipe 6 is embedded in the closed cell rigid urethane foam 4.

[0030]

Also, in this embodiment, since the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2 is embedded in the closed cell rigid urethane foam 4, there is nearly no gas or water content which may cause deterioration of the vacuum heat insulating material 3 disposed between the outer casing 1 and the inner casing 2. This minimizes time degradation of the vacuum heat insulating performance, ensuring reliability.

[0031]

As a result of the advantageous effects above, reduced heat penetration enables the realization of energy-saving refrigerators and ensures temporal reliability.

[0032]

This embodiment is described with the vacuum heat insulating material 3 disposed at both lateral sides, ceiling, and back side of the heat insulating cabinet, but the vacuum heat insulating material 3 need not be disposed at all these sides. It may be disposed only at the side where the condensing pipe 6 is

placed so as to cover the condensing pipe 6, when viewed from the inner casing
2 side, and not be disposed at other sides where the condensing pipe 6 is not
mounted. These other sides may be covered with, for example, an ordinary heat
insulating material such as foamed polystyrene, thereby attaining reduced usage
5 of expensive vacuum heat insulating materials as well as reduced cost.

[Reference Signs List]

[0033]

1: outer casing

2: inner casing

10 3, 3a, 3b, 3c, 3d: vacuum heat insulating material

4: closed cell rigid urethane foam

5a, 5b: spacer

6: condensing pipe

7a: second laminate film

15 7b: first laminate film

8: core material

[Name of Document] CLAIMS

[Claim 1]

A refrigerator comprising:

an outer casing;

5 an inner casing;

a closed cell rigid urethane foam disposed between the outer casing and the inner casing;

a vacuum heat insulating material disposed between the outer casing and the inner casing; and

10 a condensing pipe disposed between the outer casing and the inner casing,

wherein the vacuum heat insulating material includes a jacketing material having gas barrier properties, the jacketing material constituted by a first laminate film having a metallic foil and a second laminate film having an aluminum vapor deposited layer or an alumina vapor deposited layer overlapped and heat-welded at their circumference to be formed into a bag-like package which is vacuumed and sealed with a core material thereinside,

wherein the condensing pipe is disposed on the outer casing side, and

20 wherein the vacuum heat insulating material is embedded in the closed cell urethane foam between the outer casing and the inner casing in such a manner that the second laminate film having the aluminum vapor deposited layer or the alumina vapor deposited layer faces the condensing pipe.

[Claim 2]

25 The refrigerator of Claim 1, wherein the vacuum heat insulating material covers 85 percent or more of an overall length of the condensing pipe disposed between the outer casing and the inner casing.

[Claim 3]

The refrigerator of Claim 1 or 2, wherein, when viewed from a side of the inner casing, the vacuum heat insulating material is disposed only on a side where the condensing pipe is placed so as to cover the condensing pipe, and is not disposed on other sides where the condensing pipe is not disposed.