CLAIMS

[Claim 1]

A refrigerator, comprising:

a box body comprising an outer shell formed of an external box and an internal box, the outer shell comprising:

a top wall;

a rear wall;

lateral walls; and

a bottom wall,

the box body having a storage compartment formed in an inside of the outer shell to have an opening formed on a front side of the box body;

a vacuum heat insulating material arranged between a part of the internal box and a part of the external box corresponding to the rear wall, one of the lateral walls, an other of the lateral walls, the top wall, or the bottom wall forming the storage compartment; and

a foam heat insulating material charged between the vacuum heat insulating material and the internal box,

wherein a bending elastic modulus of the vacuum heat insulating material is 20 MPa or more,

wherein a thickness of the foam heat insulating material is 11 mm or less, and

wherein a ratio of the thickness of the foam heat insulating material relative to a sum of the thickness of the foam heat insulating material and a thickness of the vacuum heat insulating material is 0.3 or less.

[Claim 2]

The refrigerator of claim 1,

wherein the box body comprises, on the rear wall forming the storage compartment:

a concave portion formed at a central portion in a width direction of the rear wall to extend over a vertical direction of the rear wall; and

convex portions formed respectively at a corner portion between the concave portion and the one of the lateral walls facing the concave portion, and at a corner portion between the concave portion and the other of the lateral walls facing the concave portion, the convex portions each being projected to the front side with respect to the concave portion,

wherein the refrigerator further comprises an atomizing device arranged in the rear wall of the storage compartment or in a second storage compartment other than the storage compartment, for supplying mist into the storage compartment or the second storage compartment, and

wherein an internal space of the concave portion or an internal space of each of the convex portions comprises an air passage through which the mist is to be supplied into the storage compartment.

[Claim 3]

A refrigerator, comprising:

a box body comprising an outer shell formed of an external box and an internal box, the outer shell comprising:

a top wall;

a rear wall;

lateral walls; and

a bottom wall,

the box body having a storage compartment formed in an inside of the outer shell to have an opening formed on a front side of the box body,

the box body comprising a concave portion formed at a central portion in a width direction of the rear wall forming the storage compartment to extend over a vertical direction of the rear wall;

a vacuum heat insulating material arranged between the internal box and the external box at a part facing the concave portion, the vacuum heat insulating material having a flat plate shape larger in width than the concave portion at least in the width direction; and

a foam heat insulating material charged between the internal box and the vacuum heat insulating material at the part facing the concave portion,

wherein a bending elastic modulus of the vacuum heat insulating material is 20 MPa or more,

wherein a thickness of the foam heat insulating material is 11 mm or less at the part facing the concave portion, and

wherein a ratio of the thickness of the foam heat insulating material relative to a sum of the thickness of the foam heat insulating material and a thickness of the vacuum heat insulating material is 0.3 or less.

[Claim 4]

The refrigerator of any one of claims 1 to 3,

wherein the vacuum heat insulating material is arranged at least in the rear wall, and

wherein a proportion of a sum of areas of projection of the vacuum heat insulating material arranged in each of the rear wall, the one of the lateral walls, and the other of the lateral walls onto the rear wall, the one of the lateral walls, and the other of the lateral walls relative to a total surface area of the rear wall, the one of the lateral walls, and the other of the lateral walls is 70% or more.

[Claim 5]

The refrigerator of any one of claims 1 to 4, wherein a proportion of a volume of the vacuum heat insulating material relative to a volume of a space between the external box and the internal box forming the box body is 40% or more.

[Claim 6]

The refrigerator of any one of claims 2 to 5, further comprising a cooler for generating cooling air for cooling the storage compartment,

wherein the concave portion comprises a cooling air passage through which the cooling air generated by the cooler is to be supplied into the storage

compartment.

[Claim 7]

The refrigerator of any one of claims 2 to 6, further comprising:

a cooler for generating cooling air for cooling the storage compartment; and

protruding portions each formed to project to the front side in at least two positions in the width direction on the rear wall side in the concave portion,

wherein the concave portion comprises a cooling air passage through which the cooling air generated by the cooler is to be supplied into the storage compartment.

[Claim 8]

The refrigerator of any one of claims 2 to 6, further comprising:

a cooler for generating cooling air for cooling the storage compartment;

protruding portions each formed to project to the front side in at least two positions in the width direction on the rear wall side in the concave portion; and

a second concave portion formed between the protruding portions,

wherein the second concave portion comprises a cooling air passage through which the cooling air generated by the cooler is to be supplied into the storage compartment.

[Claim 9]

The refrigerator of claim 7 or 8, further comprising compressor drive control lead wires, temperature control lead wires, or a refrigerant pipe forming a refrigeration cycle, the compressor drive control lead wires, the temperature control lead wires, or the refrigerant pipe being arranged through each of the protruding portions.

[Claim 10]

The refrigerator of any one of claims 6 to 9, further comprising a cover member for covering a part of a rear surface of an inside of the storage compartment,

wherein the cover member comprises:

an air passage cover portion for forming at least a part of the cooling air passage or covering at least the part of the cooling air passage; and

a rear cover portion extended in the width direction from the air passage cover portion to cover the rear wall.

[Claim 11]

The refrigerator of any one of claims 5 to 10, wherein the cooling air passage has an elliptical cross-sectional shape elongated in the width direction.

[Claim 12]

The refrigerator of any one of claims 1 to 11, wherein the vacuum heat insulating material and the external box are bonded directly to each other with a second adhesive agent other than the foam heat insulating material.

[Claim 13]

The refrigerator of any one of claims 2 to 12, further comprising convex portions formed respectively at a corner portion between the concave portion and the one of the lateral walls facing the concave portion, and at a corner portion between the concave portion and the other of the lateral walls facing the concave portion, the convex portions each being projected to the front side with respect to the concave portion,

wherein the convex portions are each formed to overlap with the vacuum heat insulating material by a predetermined length in the width direction.

[Claim 14]

The refrigerator of claim 13, wherein the foam heat insulating material is charged between the vacuum heat insulating material and a part of the internal box corresponding to each of the convex portions.

[Claim 15]

The refrigerator of any one of claims 1 to 14, further comprising an illumination device arranged in an upper surface, a lower surface, or a lateral surface of the storage compartment, for illuminating the inside of the storage compartment.

[Claim 16]

A refrigerator, comprising:

a box body comprising an outer shell formed of an external box and an internal box, the outer shell comprising:

a top wall;

a rear wall;

lateral walls; and

a bottom wall,

the box body having a storage compartment formed in an inside of the outer shell to have an opening formed on a front side of the box body;

a cooler for cooling the storage compartment;

a control board for controlling the cooler, the control board being arranged in a control board room formed in the top wall or the rear wall;

a vacuum heat insulating material arranged between the control board room and the internal box; and

a foam heat insulating material charged between the vacuum heat insulating material and the internal box,

wherein a thickness of the foam heat insulating material is 11 mm or less at a part facing the control board room, and

wherein a ratio of the thickness of the foam heat insulating material relative to a sum of the thickness of the foam heat insulating material and a thickness of the vacuum heat insulating material is 0.3 or less.

[Claim 17]

The refrigerator of claim 16,

wherein the vacuum heat insulating material is arranged at least in the rear wall, and

wherein a proportion of a sum of areas of projection of the vacuum heat insulating material arranged in each of the rear wall, one of the lateral walls, and an other of the lateral walls onto the rear wall, the one of the lateral walls, and the other of the lateral walls relative to a total surface area of the rear wall, the one of the lateral walls, and the other of the lateral walls is 70% or more.

[Claim 18]

The refrigerator of claim 16 or 17, wherein a proportion of a volume of the vacuum heat insulating material relative to a volume of a space between the external box and the internal box forming the box body is 40% or more.

[Claim 19]

The refrigerator of any one of claims 1 to 18, wherein the foam heat insulating material comprises rigid urethane foam.

[Claim 20]

The refrigerator of any one of claims 1 to 19, further comprising charging ports for the foam heat insulating material, the charging ports being formed in the external box,

wherein the vacuum heat insulating material is arranged without closing the charging ports.

CLAIMS

[Claim 1]

A refrigerator, comprising:

a box body including:

a top wall;

a rear wall;

lateral walls; and

a bottom wall,

the top wall, the rear wall, the lateral walls and the bottom wall being formed of an external box and an internal box,

the box body having a storage compartment with an opening formed on a front side of the box body;

a vacuum heat insulating material arranged between a part of the internal box and a part of the external box corresponding to the rear wall, one of the lateral walls, an other of the lateral walls, the top wall, or the bottom wall; and

a foam heat insulating material charged and foamed up between the vacuum heat insulating material and the internal box,

wherein a wall in which the vacuum heat insulating material is provided has a thickness in a range of 20 mm to 40 mm,

wherein a thickness of the foam heat insulating material after foaming up is 10 mm or less, and

wherein a ratio of the thickness of the foam heat insulating material relative to a sum of the thickness of the foam heat insulating material and a thickness of the vacuum heat insulating material is 0.3 or less.

[Claim 2]

The refrigerator of claim 1,

wherein, on the rear wall forming the storage compartment,

a concave portion is formed at a central portion in a width direction of the rear wall to extend over a vertical direction of the rear wall; and

wherein the vacuum insulating material is arranged between a part of the external box and a part of the internal box forming the concave portion and the foam heat insulating material is charged in a part or entirety of a range of the concave portion.

[Claim 3]

A refrigerator, comprising:

a box body including:

a top wall;

a rear wall;

lateral walls; and

a bottom wall,

the top wall, the rear wall, the lateral walls and the bottom wall being formed of an external box and an internal box,

the box body having a storage compartment with an opening formed on a front side of the box body,

the box body comprising a concave portion formed at a central portion in a width direction of the rear wall forming the storage compartment to extend over a vertical direction of the rear wall;

a vacuum heat insulating material arranged between a part of the internal box forming the concave portion and a part of the external box forming the rear wall, the vacuum heat insulating material having a flat plate shape larger in width than the concave portion at least in the width direction of the rear wall; and

a foam heat insulating material charged in a part or entirety of a range between the internal box and the vacuum heat insulating material at a part facing the concave portion,

wherein the rear wall has a thickness in a range of 20 mm to 40 mm,

wherein a thickness of the foam heat insulating material is 10 mm or less at the part facing the concave portion, and

wherein a ratio of the thickness of the foam heat insulating material relative to a

sum of the thickness of the foam heat insulating material and a thickness of the vacuum heat insulating material is 0.3 or less.

[Claim 4]

The refrigerator of claim 2 or 3,

wherein the vacuum heat insulating material is arranged at least in the rear wall, and

wherein a proportion of a sum of areas of projection of the vacuum heat insulating material arranged in each of the rear wall, the one of the lateral walls, and the other of the lateral walls onto the rear wall, the one of the lateral walls, and the other of the lateral walls relative to a total surface area of the rear wall, the one of the lateral walls, and the other of the lateral walls is 70% or more.

[Claim 5]

The refrigerator of any one of claims 2 to 4, wherein a proportion of a volume of the vacuum heat insulating material relative to a volume of a space between the external box and the internal box forming the box body is 40% or more.

[Claim 6]

The refrigerator of any one of claims 2 to 5, further comprising convex portions formed respectively at a corner portion between the concave portion and the one of the lateral walls facing the concave portion, and at a corner portion between the concave portion and the other of the lateral walls facing the concave portion, the convex portions each being projected to the front side with respect to the concave portion,

wherein the convex portions are each formed to overlap with the vacuum heat insulating material in the width direction.

[Claim 7]

The refrigerator of any one of claims 2 to 6, further comprising a cooler for

generating cooling air for cooling the storage compartment,

wherein the concave portion is used as a cooling air passage through which the cooling air generated by the cooler is to be supplied into the storage compartment.

[Claim 8]

The refrigerator of any one of claims 2 to 7, further comprising:

a cooler for generating cooling air for cooling the storage compartment; and

protruding portions each formed to project to the front side in at least two positions in the width direction on the rear wall side in the concave portion,

wherein the protruding portions are formed separately from the internal box forming the rear wall.

[Claim 9]

The refrigerator of any one of claims 2 to 6, further comprising:

a cooler for generating cooling air for cooling the storage compartment;

protruding portions each formed to project to the front side in at least two positions in the width direction on the rear wall side in the concave portion; and

a second concave portion formed between the protruding portions,

wherein the second concave portion is used as a cooling air passage through which the cooling air generated by the cooler is to be supplied into the storage compartment.

[Claim 10]

The refrigerator of claim 8 or 9, further comprising compressor drive control lead wires, temperature control lead wires, or a refrigerant pipe forming a refrigeration cycle, the compressor drive control lead wires, the temperature control lead wires, or the refrigerant pipe being arranged through each of the protruding portions.

[Claim 11]

The refrigerator of claim 7 or 9, further comprising a cover member for covering a part of a rear surface of an inside of the storage compartment,

wherein the cover member comprises:

an air passage cover portion for forming at least a part of the cooling air passage or covering at least the part of the cooling air passage; and

a mount portion for mounting to the convex portions or a mount portion of the rear wall.

[Claim 12]

The refrigerator of any one of claims 7, 9, and 11, wherein the cooling air passage has an elliptical cross-sectional shape elongated in the width direction.

[Claim 13]

The refrigerator of any one of claims 1 to 12, wherein the vacuum heat insulating material and the external box are bonded directly to each other with a second adhesive agent other than the foam heat insulating material.

[Claim 14]

The refrigerator of any one of claims 6 to 13, wherein the foam heat insulating material is charged in the convex portions.

[Claim 15]

The refrigerator of any one of claims 1 to 14, further comprising an illumination device arranged in an upper surface, a lower surface, or a lateral surface of the storage compartment, for illuminating the inside of the storage compartment.

[Claim 16]

A refrigerator, comprising:

a box body formed of an external box and an internal box, the box body

including:

a top wall;

a rear wall;

lateral walls; and

a bottom wall,

the box body having a storage compartment formed in an inside of the box body with an opening formed on a front side of the box body;

a control board arranged in a control board room formed in the top wall or the rear wall, the control board controlling a temperature of the storage compartment, rotation speed of a compressor, rotation speed of a cooling air circulation fan, or opening or closing of an airflow rate control unit;

a vacuum heat insulating material arranged between the control board room and the internal box; and

a foam heat insulating material charged between the vacuum heat insulating material and the internal box,

wherein the top wall or the rear wall has a thickness in a range of 20 mm to 40 mm,

wherein a thickness of the foam heat insulating material is 10 mm or less at a part facing the control board room, and

wherein a ratio of the thickness of the foam heat insulating material relative to a sum of the thickness of the foam heat insulating material and a thickness of the vacuum heat insulating material is 0.3 or less.

[Claim 17]

The refrigerator of claim 16,

wherein the vacuum heat insulating material is arranged at least in the rear wall, and

wherein a proportion of a sum of areas of projection of the vacuum heat insulating material arranged in each of the rear wall, one of the lateral walls, and an other of the lateral walls onto the rear wall, the one of the lateral walls, and the other

of the lateral walls relative to a total surface area of the rear wall, the one of the lateral walls, and the other of the lateral walls is 70% or more.

[Claim 18]

The refrigerator of claim 16 or 17, wherein a proportion of a volume of the vacuum heat insulating material relative to a volume of a space between the external box and the internal box forming the box body is 40% or more.

[Claim 19]

The refrigerator of any one of claims 1 to 18, wherein the foam heat insulating material comprises rigid urethane foam.

[Claim 20]

The refrigerator of any one of claims 1 to 19, further comprising charging ports for the foam heat insulating material, the charging ports being formed in the external box,

wherein the vacuum heat insulating material is arranged without closing the charging ports.