extending from the sealing portion to the inside of the outer wrapping material may be formed. If the through hole is formed, the gas barrier property of the sealing portion is lowered and the degree of vacuum inside the heat insulating material is thus lowered. Therefore, the conventional vacuum heat insulating materials cannot maintain high heat insulation performance for a long period of time. Also, in each of Patent Literatures 1 to 3, air may be caught in the sealing portion during thermal welding. In such case, also, a through hole is formed and the degree of vacuum inside the vacuum heat insulating material is thereby lowered, resulting in failure to provide a vacuum heat insulating material that can maintain high heat insulation performance for a long period of time.

[0005]

The present invention has been made to overcome such problem as mentioned above, and an object of the present invention is to provide a vacuum heat insulating material that can prevent formation of a through hole extending from a sealing portion to the inside of an outer wrapping material and thereby maintain high heat insulation performance for a long period of time, an apparatus for manufacturing the vacuum heat insulating material, and a heat insulating box employing the vacuum heat insulating material.

Solution to Problem

[0006]

A vacuum heat insulating material according to the present invention is a vacuum heat insulating material including: a core material including a fiber assembly; an adsorbent to absorb at least moisture; and an outer wrapping material covering the core material and the adsorbent, the outer wrapping material having inside depressurized and hermetically sealed, and including a sealing portion formed at a peripheral edge portion thereof, at least a part of the sealing portion having a corrugated shape in cross section, the corrugated shape having crest top portions arranged at a pitch of no more than 3 mm, and trough bottom portions arranged at a pitch of no more than 3 mm, wherein a width in a thickness direction of the crest top portions in the corrugated shape and a width in the thickness direction of the trough bottom portions in the corrugated shape are each smaller than a width in the thickness direction of ridgelines in the corrugated shape.

[0007]

Also, a vacuum heat insulating material manufacturing apparatus according to the present invention is a vacuum heat insulating material manufacturing apparatus for manufacturing a vacuum heat insulating material including a core material including a fiber assembly, an adsorbent to absorb at least moisture, and an outer wrapping material including two films, the outer wrapping material covering the core material and the adsorbent with peripheral edge portions of the two films being sealed by thermal welding, an inside of the outer wrapping material being depressurized and hermetically sealed, the apparatus comprising an upper pressure-bonding tool and a lower pressure-bonding tool to press and weld thermally the peripheral edge portions of the two films from above and beneath while heating the peripheral edge portions of the two films from above and beneath, respectively, thereby thermally welding the peripheral edge portions of the two films, each of the upper pressure-bonding tool and the lower pressure-bonding tool having a welding surface having a corrugated shape in cross-section, the corrugated shape having crest top portions arranged at a pitch of no more than 3 mm, and trough bottom portions arranged at a pitch of no more than 3 mm, wherein upon thermal welding, a clearance between a crest top portion of the upper pressure-bonding tool and a crest top portion of the lower pressure-bonding tool, and a clearance between a trough bottom portion of the upper pressure-bonding tool and a trough bottom portion of the lower pressure-bonding tool are each smaller than a clearance between a ridgeline of the upper pressure-bonding tool and a ridgeline of the lower pressure-bonding tool.

[0008]

Also, the vacuum heat insulating material according to the present invention or a vacuum heat insulating material manufactured by the vacuum heat insulating material manufacturing apparatus according to the present invention can be used for a heat insulating box such as a refrigerator.

Advantageous Effects of Invention

[0009]

The vacuum heat insulating material according to the present invention, a vacuum heat insulating material manufactured by the vacuum heat insulating material manufacturing apparatus according to the present invention, and the heat insulating box employing the vacuum heat insulating material according to the present invention each exert the effect of enabling high heat insulation performance to be maintained for a long period of time.

CLAIMS

[Claim 1]

A vacuum heat insulating material comprising:

a core material including a fiber assembly;

an adsorbent to absorb at least moisture; and

an outer wrapping material covering the core material and the adsorbent, the outer wrapping material having inside depressurized and hermetically sealed, and including a sealing portion formed at a peripheral edge portion thereof, at least a part of the sealing portion having a corrugated shape in cross section, the corrugated shape having crest top portions arranged at a pitch of no more than 3 mm, and trough bottom portions arranged at a pitch of no more than 3 mm,

wherein a width in a thickness direction of the crest top portions in the corrugated shape and a width in the thickness direction of the trough bottom portions in the corrugated shape are each smaller than a width in the thickness direction of ridgelines in the corrugated shape.

[Claim 2]

The vacuum heat insulating material of claim 1, wherein an angle formed by adjacent ridgelines in the corrugated shape is no less than 90 degrees and no more than 160 degrees.

[Claim 3]

The vacuum heat insulating material of claim 1 or 2, wherein a width of the sealing portion in a corrugation direction of the corrugated shape is no less than 5 mm and no more than 30 mm.

[Claim 4]

The vacuum heat insulating material of any one of claim 1 to 3, wherein a distance from an end portion of the core material to an end portion on a core material side of the sealing portion is no less than 10 mm and no more than 100 mm.

[Claim 5]

The vacuum heat insulating material of any one of claims 1 to 4, wherein a lower boundary in a thickness direction of the crest top portions in the corrugated shape is located at a position that is higher than an upper surface of an end portion of the outer wrapping material, and an upper limit in the thickness direction of the trough bottom portions in the corrugated shape is located at a position that is lower than a lower surface of the end portion of the outer wrapping material.

[Claim 6]

A vacuum heat insulating material manufacturing apparatus for manufacturing a vacuum heat insulating material including a core material including a fiber assembly, an adsorbent to absorb at least moisture, and an outer wrapping material including two films, the outer wrapping material covering the core material and the adsorbent with peripheral edge portions of the two films being sealed by thermal welding, an inside of the outer wrapping material being depressurized and hermetically sealed,

the apparatus comprising an upper pressure-bonding tool and a lower pressure-

bonding tool to press the peripheral edge portions of the two films from above and beneath while heating the peripheral edge portions of the two films from above and beneath, respectively, thereby thermally welding the peripheral edge portions of the two films,

each of the upper pressure-bonding tool and the lower pressure-bonding tool having a welding surface having a corrugated shape in cross-section,

the corrugated shape having crest top portions arranged at a pitch of no more than 3 mm, and trough bottom portions arranged at a pitch of no more than 3 mm,

wherein upon thermal welding, a clearance between a crest top portion of the upper pressure-bonding tool and a crest top portion of the lower pressure-bonding tool, and a clearance between a trough bottom portion of the upper pressure-bonding tool and a trough bottom portion of the lower pressure-bonding tool are each smaller than a clearance between a ridgeline of the upper pressure-bonding tool and a ridgeline of the lower pressure-bonding tool.

[Claim 7]

The vacuum heat insulating material manufacturing apparatus of claim 6, wherein an angle formed by adjacent ridgelines in the corrugated shape is no less than 90 degrees and no more than 160 degrees.

[Claim 8]

The vacuum heat insulating material manufacturing apparatus of claim 6 or 7, wherein a width in a corrugation direction of the corrugated shape is no less than 5 mm and no more than 50 mm.

[Claim 9]

A heat insulating box employing the vacuum heat insulating material of any one of claims 1 to 5.