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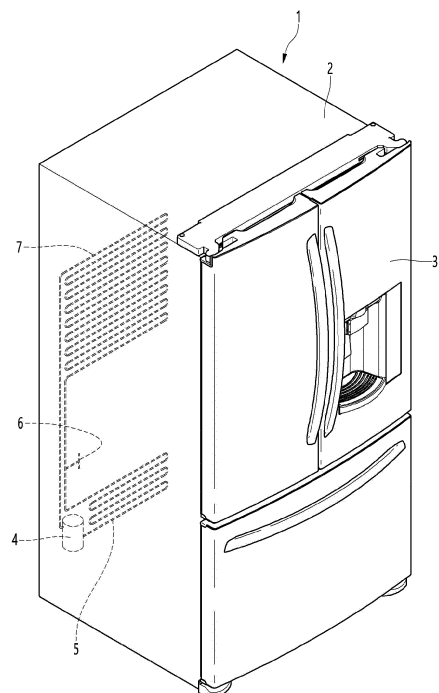
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(54) **VACUUM ADIABATIC BODY**

(57) A vacuum adiabatic body of the present invention includes: a first plate having a first temperature; a second plate having a second temperature different from the first temperature; and a sealing part configured to seal the first plate and the second plate, thereby providing a vacuum space.

【Figure 1】



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Description

TECHNICAL FIELD

[0001] The present invention relates to a vacuum adiabatic body.

BACKGROUND ART

[0002] Adiabatic performance may be improved by forming an adiabatic wall using vacuum. A device of which at least a portion of an internal space is provided in a vacuum state to achieve an adiabatic effect may be called a vacuum adiabatic body.

[0003] The applicant has developed a technology to obtain a vacuum adiabatic body that may be used in various devices and home appliances, and has disclosed a vacuum adiabatic body and a refrigerator in Korean Patent Publication No. 1020200001396A. The vacuum adiabatic body of the cited document discloses a structure in which a heat exchanger is installed inside a vacuum space.

[0004] The cited document proposes a self-configuration and support structure in which the heat exchanger is placed in the vacuum space. The cited document does not disclose a specific installation structure of the heat exchanger and its relationship with other members. For example, it does not disclose the relationship between the heat exchanger and other members inside the vacuum space, or a method of mounting the heat exchanger.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0005] The present invention proposes an installation structure of a heat exchanger without a loss of adiabatic efficiency.

[0006] In addition to the examples proposed above, the present invention proposes specific solutions to problems and solutions for solving the problems in [Technical Solution] and [Best Mode].

TECHNICAL SOLUTION

[0007] The vacuum adiabatic body of the present invention may include: a first plate having a first temperature; a second plate having a second temperature that differs from the first temperature; and a vacuum space provided between the first and second plates. The vacuum adiabatic body of the present invention may include a sealing part that seals the first plate and the second plate to provide the vacuum space. A support may be provided to maintain the vacuum space.

[0008] Optionally, the support may include a support plate and a bar extending in a thickness direction of the vacuum space to the support plate. The vacuum space

may include at least two spaces that are bent to each other. The supports inserted into the at least two spaces may be in contact with each other. The outermost surface of the supports that are in contact with each other may not have the bar. The outermost part of the support may be provided with an independent branch of which an end is not supported, or a connection branch connecting at least two adjacent independent branches. At least one of the independent branch and the connection branch may not have the bar.

[0009] The independent branches and the connection branches may be mixed with and supported with respect to each other. At least one of the connection branch and the independent branch may be equal to at least one of a thickness and width of the support plate. The independent branch may have a first terminal fixed to the support plate and a second terminal that is not supported by the support plate. A tolerance of at least one of the connection branch and the independent branch may be within 0.1 mm. The support plate may include an inner support plate and an outer support plate. The inner support plate and the outer support plate may be in contact with each other. The inner support plate and the outer support plate may have different specifications. A length of the independent branch of the inner support plate may be a value obtained by subtracting a thickness of the vacuum space from a length of the independent branch of the outer support plate. A length of the connection branch of the inner support plate may be a value obtained by subtracting a thickness of the vacuum space from a length of the connection branch of the outer support plate. The supports that are in contact with each other may include a first support and a second support. The first support and the second support have free ends that move to be in contact with each other.

[0010] Optionally, the vacuum space may include at least two spaces that are bent to each other, and the at least two supports inserted into the at least two spaces may be in contact with each other. The contact between the two supports may include at least one of line contact or point contact. The two supports may freely move relative to each other except that the first support pushes the second support due to the contact. The contact part of the two supports may have a smaller tolerance than a non-contact part. The support plate may include an inner support plate and an outer support plate. The inner support plate and the outer support plate may be in contact with each other. The support may include a support plate and a bar extending from the support plate in the thickness direction of the vacuum space. The outermost portion of the at least two supports may not have the bar. The outermost portion of the support may be provided with an independent branch of which an end portion is not supported.

[0011] Optionally, the outermost portion of the at least two supports may be provided with an independent branch of which an end portion is not supported, or a connection branch connecting at least two adjacent in-

dependent branches. The support may include two support plates and a support body that maintains a gap between the two support plates. At least one of the connection branch or the independent branch may not be provided with the support.

[0012] Optionally, the support may include at least one support plate corresponding to at least one of the first or second plate. The vacuum space may include at least two spaces that are bent to each other. At least two of the supports inserted into the at least two spaces may be fixed to each other. A coupling part may be provided at an end portion of the support plate. The support plate may include an inner support plate and an outer support plate corresponding to the first and second plates. A size of the outermost lattice of the inner support plate may be smaller than a size of the inner lattice of the inner support plate. At least two of the supports may be restricted to move in at least one of an X, Y, or Z direction. At least two of the supports may be restricted to move in at least one of the X, Y, or Z direction. The support plate may include an inner support plate and an outer support plate corresponding to the first and second plates. One coupling part may be provided at an end portion of each of the outer and inner support plates. Two coupling parts may be provided at a predetermined interval at the end portion of the inner support plate. A gap between the two coupling parts may correspond to a thickness of the vacuum space part. At least one of the at least two supports may have an end portion of the support plate that is not fixed. The outer support plate may be provided with two coupling parts. At least one of the at least two supports may be provided with one coupling part spaced a predetermined distance from an end portion of the inner support plate. In at least one of the at least two supports, an end portion of the inner support plate may be a predetermined distance shorter than the outer support plate. At least one of the support and the unit of the support may be provided with at least two having the same shape.

[0013] Optionally, a gap between the inner support plate and the outer support plate may have a portion that is narrowed toward an edge. An end portion of the outer support plate may be provided as a free end with respect to the other intersecting outer support plate. An end portion of the inner support plate may be provided as a fixed end by the other intersecting inner support plate. The end portion of the inner support plate may be provided as a free end with respect to the other intersecting inner support plate.

[0014] Optionally, at least two supports may be provided, and the at least two supports may be coupled to each other. At least a portion of the support may be provided by coupling units having the same shape. The outer support plate may be provided by coupling the units having the same shape. The inner support plate may use the units having different shapes. The inner support plate may be used by cutting the units having the same shape for coupling before the coupling.

[0015] Optionally, at least two supports inserted into

the at least two spaces may be restricted to each other in the three X, Y, and Z direction. The support plate may include an inner support plate and an outer support plate corresponding to the first and second plates. An outer support plate of one of the at least two supports and an outer support plate of the other may be coupled to each other. An inner support plate of one of the at least two supports and an inner support plate of the other of the at least two supports may be coupled to each other. At least one of the at least two supports may be provided with an extension bar connecting an end of the inner support plate to an end of the outer support plate. At least one of the two supports may be provided with an extension bar for connecting an end of the inner support plate to the outer support plate. At least one outer support plate of the at least two supports may be provided with two extension bars having a predetermined gap at the ends. The gap may correspond to the thickness of the vacuum space or the length of the bar provided on the support plate. The two extension bars may be provided at the ends of at least one inner support plate of the at least two supports. One of the two extension bars may be provided on a side surface or inner surface of the end. At least one inner support plate of the at least two supports may not be provided with an outermost lattice. At least one inner support plate of the at least two supports may be provided with an outermost lattice. An extension bar may be provided at the end of the support plate, and a radiation resistance sheet may be included to extend to the extension bar, thereby reducing radiation heat transfer. The support may include a first support and a second support of which extension directions intersect each other.

[0016] Optionally, the first support and the second support may be fixed to each other at a position at which the first and second supports meet each other. A coupling part provided on a side surface of the first support; and an extension bar provided on an inner surface of the second support and fitted into the coupling part may be included. The coupling part and the extension bar may be provided in two pieces, which are spaced a predetermined interval from each other. The coupling part and the extension bar may be provided at the ends of the support, respectively.

[0017] Optionally, a first extension bar provided at the end of the first support; and a coupling part provided at the second support to which the first extension bar is fitted may be included. The radiation resistance sheet may extend to the first extension bar. A second extension bar spaced a predetermined interval from the first extension bar; and a coupling part provided to the second support to which the second extension bar is fitted may be included. A second extension bar spaced a predetermined interval from the first extension bar; and a coupling part provided to the first support to which the second extension bar is fitted may be included.

ADVANTAGEOUS EFFECTS

[0018] According to the present invention, the vacuum

adiabatic body having the high adiabatic efficiency may be proposed.

[0019] According to the present invention, the vacuum adiabatic body may be conveniently manufactured.

[0020] The effects of the present invention are disclosed in more detail in [Specific details for carrying out the invention].

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a perspective view of a refrigerator according to an embodiment.

Fig. 2 is a view schematically illustrating a vacuum adiabatic body used in a main body and a door of the refrigerator.

Fig. 3 is a view illustrating an example of a support that maintains a vacuum space.

Fig. 4 is a view for explaining an example of the vacuum with respect to a heat transfer resistor.

Fig. 5 is a graph illustrating results obtained by observing a process of exhausting the inside of the vacuum adiabatic body with a time and pressure when the support is used.

Fig. 6 is a graph illustrating results obtained by comparing a vacuum pressure to gas conductivity.

Fig. 7 is a view for explaining a method for manufacturing a vacuum adiabatic body.

FIG. 8 is a view for explaining an example in which a support and a heat exchanger are installed.

FIG. 9 is a view of the support according to an embodiment.

FIG. 10 is a view for explaining an example in which the support having a connection branch is in contact with the support.

FIG. 11 is a view for explaining an example in which the support having an independent branch is in contact with the support.

FIGS. 12 to 13 are views illustrating an example in which the two supports are fixed in at least one direction according to an embodiment.

FIG. 14 is a view illustrating an example in which the two supports are fixed in at least one direction according to another embodiment.

FIG. 15 is a view illustrating an example in which the two supports are fixed in at least two directions.

FIG. 16 is a view for explaining details of the support of FIG. 12.

FIG. 17 is a view for explaining details of the support of FIG. 14.

FIG. 18 is a view for explaining details of the support of FIG. 15.

FIG. 19 is a view illustrating an example in which the two supports are strongly restricted according to an embodiment.

FIG. 20 is a view illustrating a coupling process of the support of FIG. 19.

FIG. 21 is a view illustrating an example in which the two supports are strongly restricted according to an embodiment.

MODE FOR CARRYING OUT THE INVENTION

[0022] Hereinafter, specific embodiments will be described in detail with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein, and a person of ordinary skill in the art, who understands the spirit of the present invention, may readily implement other embodiments included within the scope of the same concept by adding, changing, deleting, and adding components; rather, it will be understood that they are also included within the scope of the present invention.

[0023] The present invention may have many embodiments in which the idea is implemented, and in each embodiment, any portion may be replaced with a corresponding portion or a portion having a related action according to another embodiment. The present invention may be any one of the examples presented below or a combination of two or more examples.

[0024] The present disclosure may be a vacuum adiabatic body including a first plate; a second plate; and a vacuum space provided between the first and second plates. The vacuum adiabatic body may include a sealing part for providing the vacuum state space (vacuum space). The vacuum space may be a space in a vacuum state provided in an internal space between the first plate and the second plate. The seal may seal the first plate and the second plate to provide the internal space provided in the vacuum state. The vacuum adiabatic body may optionally include a side plate connecting the first plate to the second plate. In the present disclosure, the expression "plate" may mean at least one of the first and second plates or the side plate. At least a portion of the first and second plates and the side plate may be integrally provided, or at least portions may be sealed to each other. Optionally, the vacuum adiabatic body may include a support that maintains the vacuum space. The vacuum adiabatic body may selectively include a thermal insulator that reduces an amount of heat transfer between a first space provided in vicinity of the first plate and a second space provided in vicinity of the second plate or reduces an amount of heat transfer between the first plate and the second plate.

[0025] Optionally, the vacuum adiabatic body may include a component coupling portion provided on at least a portion of the plate. Optionally, the vacuum adiabatic body may include another adiabatic body. Another adiabatic body may be provided to be connected to the vacuum adiabatic body. Another adiabatic body may be an adiabatic body having a degree of vacuum, which is equal to or different from a degree of vacuum of the vacuum adiabatic body. Another adiabatic body may be an adiabatic body that does not include a degree of

vacuum less than that of the vacuum adiabatic body or a portion that is in a vacuum state therein. In this case, it may be advantageous to connect another object to another adiabatic body.

[0026] In the present disclosure, a direction along a wall defining the vacuum space may include a longitudinal direction of the vacuum space and a height direction of the vacuum space. The height direction of the vacuum space may be defined as any one direction among virtual lines connecting the first space to the second space to be described later while passing through the vacuum space. The longitudinal direction of the vacuum space may be defined as a direction perpendicular to the set height direction of the vacuum space.

[0027] In the present disclosure, that an object A is connected to an object B means that at least a portion of the object A and at least a portion of the object B are directly connected to each other, or that at least a portion of the object A and at least a portion of the object B are connected to each other through an intermedium interposed between the objects A and B. The intermedium may be provided on at least one of the object A or the object B. The connection may include that the object A is connected to the intermedium, and the intermedium is connected to the object B.

[0028] A portion of the intermedium may include a portion connected to either one of the object A and the object B. The other portion of the intermedium may include a portion connected to the other of the object A and the object B. As a modified example, the connection of the object A to the object B may include that the object A and the object B are integrally prepared in a shape connected in the above-described manner. In the present disclosure, an embodiment of the connection may be support, combine, or a seal, which will be described later.

[0029] In the present disclosure, that the object A is supported by the object B means that the object A is restricted in movement by the object B in one or more of the +X, -X, +Y, -Y, +Z, and -Z axis directions. In the present invention, an embodiment of the support may be the combine or seal, which will be described later. In the present invention, that the object A is combined with the object B may define that the object A is restricted in movement by the object B in one or more of the X, Y, and Z-axis directions.

[0030] In the present disclosure, an embodiment of the combining may be the sealing to be described later. In the present disclosure, that the object A is sealed to the object B may define a state in which movement of a fluid is not allowed at the portion at which the object A and the object B are connected. In the present disclosure, one or more objects, i.e., at least a portion of the object A and the object B, may be defined as including a portion of the object A, the whole of the object A, a portion of the object B, the whole of the object B, a portion of the object A and a portion of the object B, a portion of the object A and the whole of the object B, the whole of the object A and a portion of the object B, and the whole of the object A and

the whole of the object B. In the present disclosure, that the plate A may be a wall defining the space A may be defined as that at least a portion of the plate A may be a wall defining at least a portion of the space A.

[0031] That is, at least a portion of the plate A may be a wall forming the space A, or the plate A may be a wall forming at least a portion of the space A. In the present disclosure, a central portion of the object may be defined as a central portion among three divided portions when the object is divided into three sections based on the longitudinal direction of the object. A periphery of the object may be defined as a portion disposed at a left or right side of the central portion among the three divided portions. The periphery of the object may include a surface that is in contact with the central portion and a surface opposite thereto.

[0032] The opposite side may be defined as a border or edge of the object. Examples of the object may include a vacuum adiabatic body, a plate, a heat transfer resistor, a support, a vacuum space, and various components to be introduced in the present disclosure. In the present disclosure, a degree of heat transfer resistance may indicate a degree to which an object resists heat transfer and may be defined as a value determined by a shape including a thickness of the object, a material of the object, and a processing method of the object. The degree of the heat transfer resistance may be defined as the sum of a degree of conduction resistance, a degree of radiation resistance, and a degree of convection resistance.

[0033] The vacuum adiabatic body according to the present disclosure may include a heat transfer path defined between spaces having different temperatures, or a heat transfer path defined between plates having different temperatures. For example, the vacuum adiabatic body according to the present disclosure may include a heat transfer path through which cold is transferred from a low-temperature plate to a high-temperature plate. In the present disclosure, when a curved portion includes a first portion extending in a first direction and a second portion extending in a second direction different from the first direction, the curved portion may be defined as a portion that connects the first portion to the second portion (including 90 degrees).

[0034] In the present disclosure, the vacuum adiabatic body may optionally include a component coupling portion. The component coupling portion may be defined as a portion provided on the plate to which components are connected to each other. The component connected to the plate may be defined as a penetration portion disposed to pass through at least a portion of the plate and a surface component disposed to be connected to a surface of at least a portion of the plate.

[0035] At least one of the penetration component or the surface component may be connected to the component coupling portion. The penetration component may be a component that defines a path through which a fluid (electricity, refrigerant, water, air, etc.) passes mainly. In the present disclosure, the fluid is defined as any kind

of flowing material. The fluid includes moving solids, liquids, gases, and electricity. For example, the component may be a component that defines a path through which a refrigerant for heat exchange passes, such as a suction line heat exchanger (SLHX) or a refrigerant tube.

[0036] The component may be an electric wire that supplies electricity to an apparatus. As another example, the component may be a component that defines a path through which air passes, such as a cold duct, a hot air duct, and an exhaust port. As another example, the component may be a path through which a fluid such as coolant, hot water, ice, and defrost water pass. The surface component may include at least one of a peripheral adiabatic body, a side panel, injected foam, a pre-prepared resin, a hinge, a latch, a basket, a drawer, a shelf, a light, a sensor, an evaporator, a front decor, a hotline, a heater, an exterior cover, or another adiabatic body.

[0037] As an example to which the vacuum adiabatic body is applied, the present disclosure may include an apparatus having the vacuum adiabatic body. Examples of the apparatus may include an appliance. Examples of the appliance may include home appliances including a refrigerator, a cooking appliance, a washing machine, a dishwasher, and an air conditioner, etc. As an example in which the vacuum adiabatic body is applied to the apparatus, the vacuum adiabatic body may constitute at least a portion of a body and a door of the apparatus.

[0038] As an example of the door, the vacuum adiabatic body may constitute at least a portion of a general door and a door-in-door (DID) that is in direct contact with the body. Here, the door-in-door may mean a small door placed inside the general door. As another example to which the vacuum adiabatic body is applied, the present disclosure may include a wall having the vacuum adiabatic body. Examples of the wall may include a wall of a building, which includes a window.

[0039] Hereinafter, the present disclosure will be described in detail with reference to the accompanying drawings. Each of the drawings accompanying the embodiment may be different from, exaggerated, or simply indicated from an actual article, and detailed components may be indicated with simplified features. The embodiment should not be interpreted as being limited only to the size, structure, and shape presented in the drawings. In the embodiments accompanying each of the drawings, unless the descriptions conflict with each other, some configurations in the drawings of one embodiment may be applied to some configurations of the drawings in another embodiment, and some structures in one embodiment may be applied to some structures in another embodiment.

[0040] In the description of the drawings for the embodiment, the same reference numerals may be assigned to different drawings as reference numerals of specific components constituting the embodiment. Components having the same reference number may perform the same function. For example, the first plate constituting

the vacuum adiabatic body has a portion corresponding to the first space throughout all embodiments and is indicated by reference number 10. The first plate may have the same number for all embodiments and may have a portion corresponding to the first space, but the shape of the first plate may be different in each embodiment. Not only the first plate, but also the side plate, the second plate, and another adiabatic body may be understood as well.

[0041] Fig. 1 is a perspective view of a refrigerator according to an embodiment, and FIG. 2 is a schematic view illustrating a vacuum adiabatic body used for a body and a door of the refrigerator. Referring to Fig. 1, the refrigerator 1 includes a main body 2 provided with a cavity 9 capable of storing storage goods and a door 3 provided to open and close the main body 2.

[0042] The door 3 may be rotatably or slidably disposed to open or close the cavity 9. The cavity 9 may provide at least one of a refrigerating compartment and a freezing compartment.

[0043] A cold source that supplies cold to the cavity may be provided. For example, the cold source may be an evaporator 7 that evaporates the refrigerant to take heat. The evaporator 7 may be connected to a compressor 4 that compresses the refrigerant evaporated to the cold source. The evaporator 7 may be connected to a condenser 5 that condenses the compressed refrigerant to the cold source. The evaporator 7 may be connected to an expander 6 that expands the refrigerant condensed in the cold source.

[0044] A fan corresponding to the evaporator and the condenser may be provided to promote heat exchange. As another example, the cold source may be a heat absorption surface of a thermoelectric element. A heat absorption sink may be connected to the heat absorption surface of the thermoelectric element. A heat sink may be connected to a heat radiation surface of the thermoelectric element. A fan corresponding to the heat absorption surface and the heat generation surface may be provided to promote heat exchange.

[0045] Referring to FIG. 2, plates 10, 15, and 20 may be walls defining the vacuum space. The plates may be walls that partition the vacuum space from an external space of the vacuum space. An example of the plates is as follows. The present disclosure may be any one of the following examples or a combination of two or more examples.

[0046] The plate may be provided as one portion or may be provided to include at least two portions connected to each other.

[0047] As a first example, the plate may include at least two portions connected to each other in a direction along a wall defining the vacuum space. Any one of the two portions may include a portion (e.g., a first portion) defining the vacuum space. The first portion may be a single portion or may include at least two portions that are sealed to each other. The other one of the two portions may include a portion (e.g., a second portion) extending

from the first portion of the first plate in a direction away from the vacuum space or extending in an inner direction of the vacuum space.

[0048] As a second example, the plate may include at least two layers connected to each other in a thickness direction of the plate. Any one of the two layers may include a layer (e.g., the first portion) defining the vacuum space. The other one of the two layers may include a portion (e.g., the second portion) provided in an external space (e.g., a first space and a second space) of the vacuum space.

[0049] In this case, the second portion may be defined as an outer cover of the plate. The other one of the two layers may include a portion (e.g., the second portion) provided in the vacuum space. In this case, the second portion may be defined as an inner cover of the plate.

[0050] The plate may include a first plate 10 and a second plate 20. One surface of the first plate (the inner surface of the first plate) provides a wall defining the vacuum space, and the other surface (the outer surface of the first plate) of the first plate A wall defining the first space may be provided. The first space may be a space provided in the vicinity of the first plate, a space defined by the apparatus, or an internal space of the apparatus. In this case, the first plate may be referred to as an inner case. When the first plate and the additional member define the internal space, the first plate and the additional member may be referred to as an inner case.

[0051] The inner case may include two or more layers. In this case, one of the plurality of layers may be referred to as an inner panel. One surface of the second plate (the inner surface of the second plate) provides a wall defining the vacuum space, and the other surface (the outer surface of the first plate) of the second plate A wall defining the second space may be provided. The second space may be a space provided in vicinity of the second plate, another space defined by the apparatus, or an external space of the apparatus. In this case, the second plate may be referred to as an outer case. When the second plate and the additional member define the external space, the second plate and the additional member may be referred to as an outer case. The outer case may include two or more layers. In this case, one of the plurality of layers may be referred to as an outer panel.

[0052] The second space may be a space having a temperature higher than that of the first space or a space having a temperature lower than that of the first space. Optionally, the plate may include a side plate 15. In FIG. 2, the side plate may also perform a function of a conductive resistance sheet 60 to be described later, according to the disposition of the side plate. The side plate may include a portion extending in a height direction of a space defined between the first plate and the second plate.

[0053] The side plate may include a portion extending in a height direction of the vacuum space.

[0054] One surface of the side plate may provide a wall defining the vacuum space, and the other surface of the side plate may provide a wall defining an external space

of the vacuum space. The external space of the vacuum space may be at least one of the first space or the second space or a space in which another adiabatic body to be described later is disposed. The side plate may be integrally provided by extending at least one of the first plate or the second plate or a separate component connected to at least one of the first plate or the second plate.

[0055] The plate may optionally include a curved portion. In the present disclosure, the plate including a curved portion may be referred to as a bent plate. The curved portion may include at least one of the first plate, the second plate, the side plate, between the first plate and the second plate, between the first plate and the side plate, or between the second plate and the side plate. The plate may include at least one of a first curved portion or a second curved portion, an example of which is as follows.

[0056] First, the side plate may include the first curved portion. A portion of the first curved portion may include a portion connected to the first plate. Another portion of the first curved portion may include a portion connected to the second curved portion. In this case, a curvature radius of each of the first curved portion and the second curved portion may be large. The other portion of the first curved portion may be connected to an additional straight portion or an additional curved portion, which are provided between the first curved portion and the second curved portion. In this case, a curvature radius of each of the first curved portion and the second curved portion may be small.

[0057] Second, the side plate may include the second curved portion. A portion of the second curved portion may include a portion connected to the second plate. The other portion of the second curved portion may include a portion connected to the first curved portion. In this case, a curvature radius of each of the first curved portion and the second curved portion may be large. The other portion of the second curved portion may be connected to an additional straight portion or an additional curved portion, which are provided between the first curved portion and the second curved portion. In this case, a curvature radius of each of the first curved portion and the second curved portion may be small. Here, the straight portion may be defined as a portion having a curvature radius greater than that of the curved portion. The straight portion may be understood as a portion having a perfect plane or a curvature radius greater than that of the curved portion. Third, the first plate may include the first curved portion. A portion of the first curved portion may include a portion connected to the side plate. A portion connected to the side plate may be provided at a position that is away from the second plate at a portion at which the first plate extends in the longitudinal direction of the vacuum space.

[0058] Fourth, the second plate may include the second curved portion. A portion of the second curved portion may include a portion connected to the side plate. A portion connected to the side plate may be provided at a position that is away from the first plate at a portion at which the second plate extends in the longitudinal direc-

tion of the vacuum space. The present disclosure may include a combination of any one of the first and second examples described above and any one of the third and fourth examples described above.

[0059] In the present disclosure, the vacuum space 50 may be defined as a third space. The vacuum space may be a space in which a vacuum pressure is maintained. In the present disclosure, the expression that a vacuum degree of A is higher than that of B means that a vacuum pressure of A is lower than that of B.

[0060] In the present disclosure, the seal 61 may be a portion provided between the first plate and the second plate. Examples of sealing are as follows. The present disclosure may be any one of the following examples or a combination of two or more examples. The sealing may include fusion welding for coupling the plurality of objects by melting at least a portion of the plurality of objects. For example, the first plate and the second plate may be welded by laser welding in a state in which a melting bond such as a filler metal is not interposed therebetween, a portion of the first and second plates and a portion of the component coupling portion may be welded by high-frequency brazing or the like, or a plurality of objects may be welded by a melting bond that generates heat. The sealing may include pressure welding for coupling the plurality of objects by a mechanical pressure applied to at least a portion of the plurality of objects.

[0061] For example, as a component connected to the component coupling portion, an object made of a material having a degree of deformation resistance less than that of the plate may be pressure-welded by a method such as pinch-off.

[0062] A machine room 8 may be optionally provided outside the vacuum adiabatic body. The machine room may be defined as a space in which components connected to the cold source are accommodated. Optionally, the vacuum adiabatic body may include a port 40. The port may be provided at any one side of the vacuum adiabatic body to discharge air of the vacuum space 50.

[0063] Optionally, the vacuum adiabatic body may include a conduit 64 passing through the vacuum space 50 to install components connected to the first space and the second space.

[0064] Fig. 3 is a view illustrating an example of a support that maintains the vacuum space. An example of the support is as follows. The present disclosure may be any one of the following examples or a combination of two or more examples.

[0065] The supports 30, 31, 33, and 35 may be provided to support at least a portion of the plate and a heat transfer resistor to be described later, thereby reducing deformation of at least some of the vacuum space 50, the plate, and the heat transfer resistor to be described later due to external force.

[0066] The external force may include at least one of a vacuum pressure or external force excluding the vacuum pressure. When the deformation occurs in a direction in which a height of the vacuum space is lower, the support

may reduce an increase in at least one of radiant heat conduction, gas heat conduction, surface heat conduction, or support heat conduction, which will be described later.

[0067] The support may be an object provided to maintain a gap between the first plate and the second plate or an object provided to support the heat transfer resistor. The support may have a degree of deformation resistance greater than that of the plate or be provided to a portion having weak degree of deformation resistance among portions constituting the vacuum adiabatic body, the apparatus having the vacuum adiabatic body, and the wall having the vacuum adiabatic body.

[0068] According to an embodiment, a degree of deformation resistance represents a degree to which an object resists deformation due to external force applied to the object and is a value determined by a shape including a thickness of the object, a material of the object, a processing method of the object, and the like. Examples of the portions having the weak degree of deformation resistance include the vicinity of the curved portion defined by the plate, at least a portion of the curved portion, the vicinity of an opening defined in the body of the apparatus, which is provided by the plate, or at least a portion of the opening.

[0069] The support may be disposed to surround at least a portion of the curved portion or the opening or may be provided to correspond to the shape of the curved portion or the opening. However, it is not excluded that the support is provided in other portions. The opening may be understood as a portion of the apparatus including the body and the door capable of opening or closing the opening defined in the body.

[0070] An example in which the support is provided to support the plate is as follows. First, at least a portion of the support may be provided in a space defined inside the plate. The plate may include a portion including a plurality of layers, and the support may be provided between the plurality of layers. Optionally, the support may be provided to be connected to at least a portion of the plurality of layers or be provided to support at least a portion of the plurality of layers. Second, at least a portion of the support may be provided to be connected to a surface defined on the outside of the plate. The support may be provided in the vacuum space or an external space of the vacuum space. For example, the plate may include a plurality of layers, and the support may be provided as any one of the plurality of layers. Optionally, the support may be provided to support the other one of the plurality of layers. For example, the plate may include a plurality of portions extending in the longitudinal direction, and the support may be provided as any one of the plurality of portions.

[0071] Optionally, the support may be provided to support the other one of the plurality of parts. As further another example, the support may be provided in the vacuum space or the external space of the vacuum space as a separate component, which is distinguished from the

plate. Optionally, the support may be provided to support at least a portion of a surface defined on the outside of the plate. Optionally, the support may be provided to support one surface of the first plate and one surface of the second plate.

[0072] One surface of the first plate and one surface of the second plate may be provided to face each other.

[0073] Third, the support may be provided to be integrated with the plate. An example in which the support is provided to support the heat transfer resistor may be understood instead of the example in which the support is provided to support the plate. A duplicated description will be omitted.

[0074] An example of the support in which heat transfer through the support is designed to be reduced is as follows. First, at least a portion of the components disposed in the vicinity of the support may be provided so as not to be in contact with the support or provided in an empty space provided by the support. Examples of the components include a tube or component connected to the heat transfer resistor to be described later, an exhaust port, a getter port, a tube or component passing through the vacuum space, or a tube or component of which at least a portion is disposed in the vacuum space.

[0075] Exemplified of the tube may include the exhaust port, a getter port. Examples of the empty space may include an empty space provided in the support, an empty space provided between the plurality of supports, and an empty space provided between the support and a separate component that is distinguished from the support.

[0076] Optionally, at least a portion of the component may be disposed in a through-hole defined in the support, be disposed between the plurality of bars, be disposed between the plurality of connection plates, or be disposed between the plurality of support plates. Optionally, at least a portion of the component may be disposed in a spaced space between the plurality bars, be disposed in a spaced space between the plurality of connection plates, or be disposed in a spaced space between the plurality of support plates. Second, the adiabatic body may be provided on at least a portion of the support or in the vicinity of at least a portion of the support.

[0077] The adiabatic body may be provided to be in contact with the support or provided so as not to be in contact with the support. The adiabatic body may be provided at a portion in which the support and the plate are in contact with each other. The adiabatic body may be provided on at least a portion of one surface and the other surface of the support or be provided to cover at least a portion of one surface and the other surface of the support. The adiabatic body may be provided on at least a portion of a periphery of one surface and a periphery of the other surface of the support or be provided to cover at least a portion of a periphery of one surface and a periphery of the other surface of the support.

[0078] The support may include a plurality of bars. The adiabatic body may be disposed on an area from a point at which any one of the plurality of bars is disposed to a

midpoint between the one bar and the surrounding bars. Third, when cold is transferred through the support, a heat source may be disposed at a position at which the heat adiabatic body described in the second example is disposed. When a temperature of the first space is lower than a temperature of the second space, the heat source may be disposed on the second plate or in the vicinity of the second plate. When heat is transmitted through the support, a cold source may be disposed at a position at which the heat adiabatic body described in the second example is disposed.

[0079] When a temperature of the first space is higher than a temperature of the second space, the cold source may be disposed on the second plate or in the vicinity of the second plate. As fourth example, the support may include a portion having heat transfer resistance higher than a metal or a portion having heat transfer resistance higher than the plate. The support may include a portion having heat transfer resistance less than that of another adiabatic body.

[0080] The support may include at least one of a non-metal material, PPS, and glass fiber (GF), low outgassing PC, PPS, or LCP. This is done for a reason in which high compressive strength, low outgassing, and a water absorption rate, low thermal conductivity, high compressive strength at a high temperature, and excellent workability are being capable of obtained.

[0081] Examples of the support may be the bars 30 and 31, the connection plate 35, the support plate 35, a porous material 33, and a filler 33. In this embodiment, the support may include any one of the above examples, or an example in which at least two examples are combined.

[0082] As first example, the support may include bars 30 and 31. The bar may include a portion extending in a direction in which the first plate and the second plate are connected to each other to support a gap between the first plate and the second plate. The bar may include a portion extending in a height direction of the vacuum space and a portion extending in a direction that is substantially perpendicular to the direction in which the plate extends. The bar may be provided to support only one of the first plate and the second plate or may be provided both the first plate and the second plate.

[0083] For example, one surface of the bar may be provided to support a portion of the plate. the other surface of the bar may be provided so as not to be in contact with the other portion of the plate. As another example, one surface of the bar may be provided to support at least a portion of the plate. the other surface of the bar may be provided to support the other portion of the plate.

[0084] The support may include a bar having an empty space therein or a plurality of bars, and an empty space are provided between the plurality of bars. In addition, the support may include a bar, and the bar may be disposed to provide an empty space between the bar and a separate component that is distinguished from the bar.

[0085] The support may selectively include a connec-

tion plate 35 including a portion connected to the bar or a portion connecting the plurality of bars to each other. The connection plate may include a portion extending in the longitudinal direction of the vacuum space or a portion extending in the direction in which the plate extends. An XZ-plane cross-sectional area of the connection plate may be greater than an XZ-plane cross-sectional area of the bar. The connection plate may be provided on at least one of one surface and the other surface of the bar or may be provided between one surface and the other surface of the bar.

[0086] At least one of one surface and the other surface of the bar may be a surface on which the bar supports the plate. The shape of the connection plate is not limited. The support may include a connection plate having an empty space therein or a plurality of connection plates. An empty space may be provided between the plurality of connection plates. In addition, the support may include a connection plate.

[0087] The connection plate may be disposed to provide an empty space between the connection plate and a separate component that is distinguished from the connection plate. As a second example, the support may include a support plate 35. The support plate may include a portion extending in the longitudinal direction of the vacuum space or a portion extending in the direction in which the plate extends. The support plate may be provided to support only one of the first plate and second plate.

[0088] The support plate may be provided to support both the first plate and the second plate. For example, one surface of the support plate may be provided to support a portion of the plate, and the other surface of the support plate may be provided so as not to be in contact with the other portion of the plate. As another example, one surface of the support plate may be provided to support at least a portion of the plate, and the other surface of the support plate may be provided to support the other portion of the plate. A cross-sectional shape of the support plate is not limited.

[0089] The support may include a support plate having an empty space therein or a plurality of support plates, and an empty space are provided between the plurality of support plates. In addition, the support may include a support plate, and the support plate may be disposed to provide an empty space between the support plate and a separate component that is distinguished from the support plate.

[0090] As a third example, the support may include a porous material 33 or a filler 33. The inside of the vacuum space may be supported by the porous material or the filler. The inside of the vacuum space may be completely filled by the porous material or the filler. The support may include a plurality of porous materials or a plurality of fillers. The plurality of porous materials or the plurality of fillers may be disposed to be in contact with each other.

[0091] When an empty space is provided inside the porous material, provided between the plurality of porous

materials, or provided between the porous material and a separate component that is distinguished from the porous material, the porous material may be understood as including any one of the aforementioned bar, connection plate, and support plate.

[0092] When an empty space is provided inside the filler, provided between the plurality of fillers, or provided between the filler and a separate component that is distinguished from the filler, the filler may be understood as including any one of the aforementioned bar, connection plate, and support plate. The support according to the present disclosure may include any one of the above examples or an example in which two or more examples are combined.

[0093] Referring to Fig. 3a, as an embodiment, the support may include a bar 31 and a connection plate and support plate 35. The connection plate and the supporting plate may be designed separately. Referring to Fig. 3b, as an embodiment, the support may include a bar 31, a connection plate and support plate 35, and a porous material 33 filled in the vacuum space. The porous material 33 may have emissivity greater than that of stainless steel, which is a material of the plate, but since the vacuum space is filled, resistance efficiency of radiant heat transfer is high.

[0094] The porous material may also function as a heat transfer resistor to be described later. More preferably, the porous material may perform a function of a radiation resistance sheet to be described later. Referring to Fig. 3c, as an embodiment, the support may include a porous material 33 or a filler 33. The porous material 33 and the filler may be provided in a compressed state to maintain a gap between the vacuum space.

[0095] The film 34 may be provided in a state in which a hole is punched as, for example, a PE material. The porous material 33 or the filler may perform both a function of the heat transfer resistor and a function of the support, which will be described later. More preferably, the porous material may perform both a function of the radiation resistance sheet and a function of the support to be described later.

[0096] Fig. 4 is a view for explaining an example of the vacuum adiabatic body based on heat transfer resistors 32, 33, 60, and 63 (e.g., thermal insulator and a heat transfer resistance body). The vacuum adiabatic body according to the present disclosure may optionally include a heat transfer resistor. An example of the heat transfer resistor is as follows. The present disclosure may be any one of the following examples or a combination of two or more examples.

[0097] The heat transfer resistors 32, 33, 60, and 63 may be objects that reduce an amount of heat transfer between the first space and the second space or objects that reduce an amount of heat transfer between the first plate and the second plate. The heat transfer resistor may be disposed on a heat transfer path defined between the first space and the second space. The heat transfer resistor may be disposed on a heat transfer path formed

between the first plate and the second plate. The heat transfer resistor may include a portion extending in a direction along a wall defining the vacuum space.

[0098] The heat transfer resistor may include a portion extending in a direction in which the plate extends. Optionally, the heat transfer resistor may include a portion extending from the plate in a direction away from the vacuum space. The heat transfer resistor may be provided on at least a portion of the periphery of the first plate or the periphery of the second plate.

[0099] The heat transfer resistor may be provided on at least a portion of an edge of the first plate or an edge of the second plate. The heat transfer resistor may be provided at a portion, in which the through-hole is defined. The heat transfer resistor may be provided as a tube connected to the through-hole. A separate tube or a separate component that is distinguished from the tube may be disposed inside the tube.

[0100] Exemplified of the aforementioned tube may include the exhaust port, a getter port. The heat transfer resistor may include a portion having heat transfer resistance greater than that of the plate. In this case, adiabatic performance of the vacuum adiabatic body may be further improved. A shield 62 may be provided on the outside of the heat transfer resistor to be insulated. The inside of the heat transfer resistor may be insulated by the vacuum space. The shield may be provided as a porous material or a filler that is in contact with the inside of the heat transfer resistor.

[0101] The shield may be an adiabatic structure that is exemplified by a separate gasket placed outside the inside of the heat transfer resistor. The heat transfer resistor may be a wall defining the third space.

[0102] An example in which the heat transfer resistor is connected to the plate may be understood as replacing the support with the heat transfer resistor in an example in which the support is provided to support the plate. A duplicate description will be omitted. The example in which the heat transfer resistor is connected to the support may be understood as replacing the plate with the support in the example in which the heat transfer resistor is connected to the plate. A duplicate description will be omitted. The example of reducing heat transfer via the heat transfer body may be applied as a substitute the example of reducing the heat transfer via the support, and thus, the same explanation will be omitted.

[0103] In the present disclosure, the heat transfer resistor may be one of a radiation resistance sheet 32, a porous material 33, a filler 33, and a conductive resistance sheet. In the present disclosure, the heat transfer resistor may include a combination of at least two of the radiation resistance sheet 32, the porous material 33, the filler 33, and the conductive resistance sheet. As a first example, the heat transfer resistor may include a radiation resistance sheet 32.

[0104] The radiation resistance sheet may include a portion having heat transfer resistance greater than that of the plate, and the heat transfer resistance may be a

degree of resistance to heat transfer by radiation. The support may perform a function of the radiation resistance sheet together. A conductive resistance sheet to be described later may perform the function of the radiation resistance sheet together. As a second example, the heat transfer resistor may include conduction resistance sheets 60 and 63.

[0105] The conductive resistance sheet may include a portion having heat transfer resistance greater than that of the plate, and the heat transfer resistance may be a degree of resistance to heat transfer by conduction. For example, the conductive resistance sheet may have a thickness less than that of at least a portion of the plate. As another example, the conductive resistance sheet may include one end and the other end, and a length of the conductive resistance sheet may be longer than a straight distance connecting one end of the conductive resistance sheet to the other end of the conductive resistance sheet.

[0106] As another example, the conductive resistance sheet may include a material having resistance to heat transfer greater than that of the plate by conduction. As another example, the heat transfer resistor may include a portion having a curvature radius less than that of the plate.

[0107] Referring to Fig. 4a, for example, a conductive resistance sheet may be provided on a side plate connecting the first plate to the second plate. Referring to Fig. 4b, for example, a conductive resistance sheet 60 may be provided on at least a portion of the first plate and the second plate. A connection frame 70 may be further provided outside the conductive resistance sheet. The connection frame may be a portion from which the first plate or the second plate extends or a portion from which the side plate extends.

[0108] Optionally, the connection frame 70 may include a portion at which a component for sealing the door and the body and a component disposed outside the vacuum space such as the exhaust port and the getter port, which are required for the exhaust process, are connected to each other.

[0109] Referring to Fig. 4c, for example, a conductive resistance sheet may be provided on a side plate connecting the first plate to the second plate. The conductive resistance sheet may be installed in a through-hole passing through the vacuum space. The conduit 64 may be provided separately outside the conductive resistance sheet. The conductive resistance sheet may be provided in a pleated shape. Through this, the heat transfer path may be lengthened, and deformation due to a pressure difference may be prevented. A separate shielding member for insulating the conductive resistance sheet 63 may also be provided. The conductive resistance sheet may include a portion having a degree of deformation resistance less than that of at least one of the plate, the radiation resistance sheet, or the support. The radiation resistance sheet may include a portion having a degree of deformation resistance less than that of at least one of the

plate or the support. The plate may include a portion having a degree of deformation resistance less than that of the support. The conductive resistance sheet may include a portion having conductive heat transfer resistance greater than that of at least one of the plate, the radiation resistance sheet, or the support. The radiation resistance sheet may include a portion having radiation heat transfer resistance greater than that of at least one of the plate, the conductive resistance sheet, or the support. The support may include a portion having heat transfer resistance greater than that of the plate.

[0110] For example, at least one of the plate, the conductive resistance sheet, or the connection frame may include stainless steel material, the radiation resistance sheet may include aluminum, and the support may include a resin material.

[0111] Fig. 5 is a graph for observing a process of exhausting the inside of the vacuum adiabatic body with a time and pressure when the support is used. An example of a vacuum adiabatic body vacuum exhaust process vacuum is as follows. The present disclosure may be any one of the following examples or a combination of two or more examples.

[0112] While the exhaust process is being performed, an outgassing process, which is a process in which a gas of the vacuum space is discharged, or a potential gas remaining in the components of the vacuum adiabatic body is discharged, may be performed. As an example of the outgassing process, the exhaust process may include at least one of heating or drying the vacuum adiabatic body, providing a vacuum pressure to the vacuum adiabatic body, or providing a getter to the vacuum adiabatic body. In this case, it is possible to promote the vaporization and exhaust of the potential gas remaining in the component provided in the vacuum space. The exhaust process may include a process of cooling the vacuum adiabatic body. The cooling process may be performed after the process of heating or drying the vacuum adiabatic body is performed. The process of heating or drying the vacuum adiabatic body process of providing the vacuum pressure to the vacuum adiabatic body may be performed together.

[0113] The process of heating or drying the vacuum adiabatic body and the process of providing the getter to the vacuum adiabatic body may be performed together. After the process of heating or drying the vacuum adiabatic body is performed, the process of cooling the vacuum adiabatic body may be performed.

[0114] The process of providing the vacuum pressure to the vacuum adiabatic body and the process of providing the getter to the vacuum adiabatic body may be performed so as not to overlap each other.

[0115] For example, after the process of providing the vacuum pressure to the vacuum adiabatic body is performed, the process of providing the getter to the vacuum adiabatic body may be performed. When the vacuum pressure is provided to the vacuum adiabatic body, a pressure of the vacuum space may drop to a certain level

and then no longer drop. Here, after stopping the process of providing the vacuum pressure to the vacuum adiabatic body, the getter may be input. As an example of stopping the process of providing the vacuum pressure to the vacuum adiabatic body, an operation of a vacuum pump connected to the vacuum space may be stopped. When inputting the getter, the process of heating or drying the vacuum adiabatic body may be performed together. Through this, the outgassing may be promoted. As another example, after the process of providing the getter to the vacuum adiabatic body is performed, the process of providing the vacuum pressure to the vacuum adiabatic body may be performed.

[0116] The time during which the vacuum adiabatic body vacuum exhaust process is performed may be referred to as a vacuum exhaust time. The vacuum exhaust time includes at least one of a time Δt_1 during which the process of heating or drying the vacuum adiabatic body is performed, a time Δt_2 during which the process of maintaining the getter in the vacuum adiabatic body is performed, of a time Δt_3 during which the process of cooling the vacuum adiabatic body is performed. Examples of times Δt_1 , Δt_2 , and Δt_3 are as follows. The present disclosure may be any one of the following examples or a combination of two or more examples. In the vacuum adiabatic body vacuum exhaust process, the time Δt_1 may be a time t_{1a} or more and a time t_{1b} or less. As a first example, the time t_{1a} may be greater than or equal to about 0.2 hr and less than or equal to about 0.5 hr. The time t_{1b} may be greater than or equal to about 1 hr and less than or equal to about 24.0 hr.

[0117] The time Δt_1 may be about 0.3 hr or more and about 12.0 hr or less. The time Δt_1 may be about 0.4 hr or more and about 8.0 hr or less. The time Δt_1 may be about 0.5 hr or more and about 4.0 hr or less. In this case, even if the Δt_1 is kept as short as possible, the sufficient outgassing may be applied to the vacuum adiabatic body. For example, this case may include a case in which a component of the vacuum adiabatic body, which is exposed to the vacuum space, among the components of the vacuum adiabatic body, has an outgassing rate (%) less than that of any one of the component of the vacuum adiabatic body, which is exposed to the external space of the vacuum space. Specifically, the component exposed to the vacuum space may include a portion having a outgassing rate less than that of a thermoplastic polymer.

[0118] More specifically, the support or the radiation resistance sheet may be disposed in the vacuum space, and the outgassing rate of the support may be less than that of the thermoplastic plastic. As another example, this case may include a case in which a component of the vacuum adiabatic body, which is exposed to the vacuum space, among the components of the vacuum adiabatic body, has a max operating temperature ($^{\circ}\text{C}$) greater than that of any one of the component of the vacuum adiabatic body, which is exposed to the external space of the vacuum space.

[0119] In this case, the vacuum adiabatic body may be

heated to a higher temperature to increase in outgassing rate. For example, the component exposed to the vacuum space may include a portion having an operating temperature greater than that of the thermoplastic polymer. As a more specific example, the support or the radiation resistance sheet may be disposed in the vacuum space, and a use temperature of the support may be higher than that of the thermoplastic plastic.

[0120] As another example, among the components of the vacuum adiabatic body, the component exposed to the vacuum space may contain more metallic portion than a non-metallic portion. That is, a mass of the metallic portion may be greater than a mass of the non-metallic portion, a volume of the metallic portion may be greater than a volume of the non-metallic portion, or an area of the metallic portion exposed to the vacuum space may be greater than an area exposed to the non-metallic portion of the vacuum space. When the components exposed to the vacuum space are provided in plurality, the sum of the volume of the metal material included in the first component and the volume of the metal material included in the second component may be greater than that of the volume of the non-metal material included in the first component and the volume of the non-metal material included in the second component. When the components exposed to the vacuum space are provided in plurality, the sum of the mass of the metal material included in the first component and the mass of the metal material included in the second component may be greater than that of the mass of the non-metal material included in the first component and the mass of the non-metal material included in the second component. When the components exposed to the vacuum space are provided in plurality, the sum of the area of the metal material, which is exposed to the vacuum space and included in the first component, and an area of the metal material, which is exposed to the vacuum space and included in the second component, may be greater than that of the area of the non-metal material, which is exposed to the vacuum space and included in the first component, and an area of the non-metal material, which is exposed to the vacuum space and included in the second component.

[0121] As a second example, the time t_{1a} may be greater than or equal to about 0.5 hr and less than or equal to about 1 hr. The time t_{1b} may be greater than or equal to about 24.0 hr and less than or equal to about 65 hr. The time Δt_1 may be about 1.0 hr or more and about 48.0 hr or less. The time Δt_1 may be about 2 hr or more and about 24.0 hr or less. The time Δt_1 may be about 3 hr or more and about 12.0 hr or less.

[0122] In this case, it may be the vacuum adiabatic body that needs to maintain the Δt_1 as long as possible. In this case, a case opposite to the examples described in the first example or a case in which the component exposed to the vacuum space is made of a thermoplastic material may be an example. A duplicated description will be omitted. In the vacuum adiabatic body vacuum exhaust process, the time Δt_1 may be a time t_{1a} or more and

a time t_{1b} or less. The time t_{2a} may be greater than or equal to about 0.1 hr and less than or equal to about 0.3 hr. The time t_{2b} may be greater than or equal to about 1 hr and less than or equal to about 5.0 hr.

[0123] The time Δt_2 may be about 0.2 hr or more and about 3.0 hr or less. The time Δt_2 may be about 0.3 hr or more and about 2.0 hr or less. The time Δt_2 may be about 0.5 hr or more and about 1.5 hr or less. In this case, even if the time Δt_2 is kept as short as possible, the sufficient outgassing through the getter may be applied to the vacuum adiabatic body.

[0124] In the vacuum adiabatic body vacuum exhaust process, the time Δt_3 may be a time t_{3a} or more and a time t_{3b} or less.

[0125] The time t_{3a} may be greater than or equal to about 0.2 hr and less than or equal to about 0.8 hr. The time t_{3b} may be greater than or equal to about 1 hr and less than or equal to about 65.0 hr. The time Δt_3 may be about 0.2 hr or more and about 48.0 hr or less. The time Δt_3 may be about 0.3 hr or more and about 24.0 hr or less. The time Δt_3 may be about 0.4 hr or more and about 12.0 hr or less. The time Δt_3 may be about 0.5 hr or more and about 5.0 hr or less. After the heating or drying process is performed during the exhaust process, the cooling process may be performed.

[0126] For example, when the heating and/or drying process is performed for a long time, the time Δt_3 may be long. The vacuum adiabatic body according to the present disclosure may be manufactured so that the time Δt_1 is greater than the time Δt_2 , the time Δt_1 is less than or equal to the time Δt_3 , or the time Δt_3 is greater than the time Δt_2 .

[0127] The following relational expression is satisfied: $\Delta t_2 < \Delta t_1 \leq \Delta t_3$. The vacuum adiabatic body according to an embodiment may be manufactured so that the relational expression: $\Delta t_1 + \Delta t_2 + \Delta t_3$ may be greater than or equal to about 0.3 hr and less than or equal to about 70 hr, be greater than or equal to about 1 hr and less than or equal to about 65 hr, or be greater than or equal to about 2 hr and less than or equal to about 24 hr. The relational expression: $\Delta t_1 + \Delta t_2 + \Delta t_3$ may be manufactured to be greater than or equal to about 3 hr and less than or equal to about 6 hr.

[0128] An example of the vacuum pressure condition during the exhaust process is as follows. The present disclosure may be any one of the following examples or a combination of two or more examples. A minimum value of the vacuum pressure in the vacuum space during the exhaust process may be greater than about $1.8E-6$ Torr. The minimum value of the vacuum pressure may be greater than about $1.8E-6$ Torr and less than or equal to about $1.0E-4$ Torr, be greater than about $0.5E-6$ Torr and less than or equal to about $1.0E-4$ Torr, or be greater than about $0.5E-6$ Torr and less than or equal to about $0.5E-5$ Torr. The minimum value of the vacuum pressure may be greater than about $0.5E-6$ Torr and less than about $1.0E-5$ Torr.

[0129] As such, the limitation in which the minimum

value of the vacuum pressure provided during the exhaust process is because, even if the pressure is reduced through the vacuum pump during the exhaust process, the decrease in vacuum pressure is slowed below a certain level.

[0130] As an embodiment, after the exhaust process is performed, the vacuum pressure of the vacuum space may be maintained at a pressure greater than or equal to about $1.0\text{E-}5$ Torr and less than or equal to about $5.0\text{E-}1$ Torr. The maintained vacuum pressure may be greater than or equal to about $1.0\text{E-}5$ Torr and less than or equal to about $1.0\text{E-}1$ Torr, be greater than or equal to about $1.0\text{E-}5$ Torr and less than or equal to about $1.0\text{E-}2$ Torr, be greater than or equal to about $1.0\text{E-}4$ Torr and less than or equal to about $1.0\text{E-}2$ Torr, or be greater than or equal to about $1.0\text{E-}5$ Torr and less than or equal to about $1.0\text{E-}3$ Torr. As a result of predicting the change in vacuum pressure with an accelerated experiment of two example products, one product may be provided so that the vacuum pressure is maintained below about $1.0\text{E-}04$ Torr even after about 16.3 years, and the other product may be provided so that the vacuum pressure is maintained below about $1.0\text{E-}04$ Torr even after about 17.8 years.

[0131] As described above, the vacuum pressure of the vacuum adiabatic body may be used industrially only when it is maintained below a predetermined level even if there is a change over time.

[0132] Fig. 5a is a graph of an elapsing time and pressure in the exhaust process according to an example, and Fig. 5b is a view explaining results of a vacuum maintenance test in the acceleration experiment of the vacuum adiabatic body of the refrigerator having an internal volume of about 128 liters.

[0133] Referring to Fig. 5b, it is seen that the vacuum pressure gradually increases according to the aging. For example, it is confirmed that the vacuum pressure is about $6.7\text{E-}04$ Torr after about 4.7 years, about $1.7\text{E-}03$ Torr after about 10 years, and about $1.0\text{E-}02$ Torr after about 59 years. According to these experimental results, it is confirmed that the vacuum adiabatic body according to the embodiment is sufficiently industrially applicable.

[0134] Fig. 6 is a graph illustrating results obtained by comparing the vacuum pressure with gas conductivity. Referring to Fig. 6, gas conductivity with respect to the vacuum pressure depending on a size of the gap in the vacuum space 50 was represented as a graph of effective heat transfer coefficient (eK). The effective heat transfer coefficient (eK) was measured when the gap in the vacuum space 50 has three values of about 3 mm, about 4.5 mm, and about 9 mm. The gap in the vacuum space 50 is defined as follows. When the radiation resistance sheet 32 exists inside surface vacuum space 50, the gap is a distance between the radiation resistance sheet 32 and the plate adjacent thereto. When the radiation resistance sheet 32 does not exist inside surface vacuum space 50, the gap is a distance between the first and second plates. It was seen that, since the size of the gap is small at a

point corresponding to a typical effective heat transfer coefficient of about 0.0196 W/mK , which is provided to an adiabatic material formed by foaming polyurethane, the vacuum pressure is about $5.0\text{E-}1$ Torr even when the size of the gap is about 3 mm.

[0135] Meanwhile, it was seen that the point at which reduction in adiabatic effect caused by the gas conduction heat is saturated even though the vacuum pressure decreases is a point at which the vacuum pressure is approximately $4.5\text{E-}3$ Torr. The vacuum pressure of about $4.5\text{E-}3$ Torr may be defined as the point at which the reduction in adiabatic effect caused by the gas conduction heat is saturated.

[0136] Also, when the effective heat transfer coefficient is about 0.01 W/mK , the vacuum pressure is about $1.2\text{E-}2$ Torr. An example of a range of the vacuum pressure in the vacuum space according to the gap is presented. The support may include at least one of a bar, a connection plate, or a support plate. In this case, when the gap of the vacuum space is greater than or equal to about 3 mm, the vacuum pressure may be greater than or equal to A and less than about $5\text{E-}1$ Torr, or be greater than about $2.65\text{E-}1$ Torr and less than about $5\text{E-}1$ Torr. As another example, the support may include at least one of a bar, a connection plate, or a support plate. In this case, when the gap of the vacuum space is greater than or equal to about 4.5 mm, the vacuum pressure may be greater than or equal to A and less than about $3\text{E-}1$ Torr, or be greater than about $1.2\text{E-}2$ Torr and less than about $5\text{E-}1$ Torr.

[0137] As another example, the support may include at least one of a bar, a connection plate, or a support plate, and when the gap of the vacuum space is greater than or equal to about 9 mm, the vacuum pressure may be greater than or equal to A and less than about $1.0\text{X}10^{-1}$ Torr or be greater than about $4.5\text{E-}3$ Torr and less than about $5\text{E-}1$ Torr.

[0138] Here, the A may be greater than or equal to about $1.0\text{X}10^{-6}$ Torr and less than or equal to about $1.0\text{E-}5$ Torr. The A may be greater than or equal to about $1.0\text{X}10^{-5}$ Torr and less than or equal to about $1.0\text{E-}4$ Torr. When the support includes a porous material or a filler, the vacuum pressure may be greater than or equal to about $4.7\text{E-}2$ Torr and less than or equal to about $5\text{E-}1$ Torr. In this case, it is understood that the size of the gap ranges from several micrometers to several hundreds of micrometers. When the support and the porous material are provided together in the vacuum space, a vacuum pressure may be created and used, which is middle between the vacuum pressure when only the support is used and the vacuum pressure when only the porous material is used.

[0139] Fig. 7 is a view for explaining a process of manufacturing the vacuum adiabatic body.

[0140] Optionally, the vacuum adiabatic body may be manufactured by a vacuum adiabatic body component preparation process in which the first plate and the second plate are prepared in advance. Optionally, the vacuum adiabatic body may be manufactured by a vacuum

adiabatic body component assembly process in which the first plate and the second plate are assembled. Optionally, the vacuum adiabatic body may be manufactured by a vacuum adiabatic body vacuum exhaust process in which a gas in the space defined between the first plate and the second plate is discharged. Optionally, after the vacuum adiabatic body component preparation process is performed, the vacuum adiabatic body component assembly process or the vacuum adiabatic body exhaust process may be performed.

[0141] Optionally, after the vacuum adiabatic body component assembly process is performed, the vacuum adiabatic body vacuum exhaust process may be performed. Optionally, the vacuum adiabatic body may be manufactured by the vacuum adiabatic body component sealing process (S3) in which the space between the first plate and the second plate is sealed. The vacuum adiabatic body component sealing process may be performed before the vacuum adiabatic body vacuum exhaust process (S4). The vacuum adiabatic body may be manufactured as an object with a specific purpose by an apparatus assembly process (S5) in which the vacuum adiabatic body is combined with the components constituting the apparatus. The apparatus assembly process may be performed after the vacuum adiabatic body vacuum exhaust process.

[0142] Here, the components constituting the apparatus means components constituting the apparatus together with the vacuum adiabatic body.

[0143] The vacuum adiabatic body component preparation process (S1) is a process in which components constituting the vacuum adiabatic body are prepared or manufactured. Examples of the components constituting the vacuum adiabatic body may include various components such as a plate, a support, a heat transfer resistor, and a tube. The vacuum adiabatic body component assembly process (S2) is a process in which the prepared components are assembled. The vacuum adiabatic body component assembly process may include a process of disposing at least a portion of the support and the heat transfer resistor on at least a portion of the plate.

[0144] For example, the vacuum adiabatic body component assembly process may include a process of disposing at least a portion of the support and the heat transfer resistor between the first plate and the second plate. Optionally, the vacuum adiabatic body component assembly process may include a process of disposing a penetration component on at least a portion of the plate. For example, the vacuum adiabatic body component assembly process may include a process of disposing the penetration component or a surface component between the first and second plates. After the penetration component may be disposed between the first plate and the second plate, the penetration component may be connected or sealed to the penetration component coupling portion.

[0145] An example of a vacuum adiabatic body vacuum exhaust process vacuum is as follows. The present

disclosure may be any one of the, examples or a combination of two or more examples. The vacuum adiabatic body vacuum exhaust process may include at least one of a process of inputting the vacuum adiabatic body into an exhaust passage, a getter activation process, a process of checking vacuum leakage and a process of closing the exhaust port. The process of forming the coupling part may be performed in at least one of the vacuum adiabatic body component preparation process, the vacuum adiabatic body component assembly process, or the apparatus assembly process. Before the vacuum adiabatic body exhaust process is performed, a process of washing the components constituting the vacuum adiabatic body may be performed. Optionally, the washing process may include a process of applying ultrasonic waves to the components constituting the vacuum adiabatic body or a process of providing ethanol or a material containing ethanol to surfaces of the components constituting the vacuum adiabatic body. The ultrasonic wave may have an intensity between about 10 kHz and about 50 kHz. A content of ethanol in the material may be about 50% or more. For example, the content of ethanol in the material may range of about 50% to about 90%. As another example, the content of ethanol in the material may range of about 60% to about 80%.

[0146] As another example, the content of ethanol in the material may be range of about 65% to about 75%. Optionally, after the washing process is performed, a process of drying the components constituting the vacuum adiabatic body may be performed. Optionally, after the washing process is performed, a process of heating the components constituting the vacuum adiabatic body may be performed.

[0147] A heat exchanger may be installed in a vacuum adiabatic body. The following may be optional. The heat exchanger may connect a first space to a second space. The heat exchanger may exchange heat between a refrigerant discharged from an evaporator and a refrigerant suctioned into the evaporator. At least a portion of the heat exchanger may be placed in a third space.

[0148] Matters and descriptions disclosed in any drawing of this document may provide different embodiments. Contents disclosed in any drawing of this document may be applied to the contents of other drawings.

[0149] FIG. 8 is a view illustrating an example in which a support and a heat exchanger are installed.

[0150] The following may be optional. Referring to FIG. 8, the heat exchanger 57 may be installed on a rear surface of the vacuum adiabatic body. A first end portion of a refrigerant tube constituting the heat exchanger may be withdrawn to a machine room 8. The machine room may be placed in a second space. A second end portion of the refrigerant tube constituting the heat exchanger may be led out to a low-temperature space. The low-temperature space may be placed in the first space. The heat exchanger may be provided to a predetermined length to enable sufficient heat exchange. The heat exchanger may have a bent part. The heat exchanger may

have a straight part extending in a straight line. At least two straight parts may be provided. The bent part may be provided between the straight parts. At least one bent part may be bent in an extension direction of the third space. At least one bent part may be bent in a thickness direction of the third space.

[0151] The following may be optional. A support 30 placed on a rear surface of the vacuum adiabatic body may be provided as a single structure of one body. The single structure may be provided as a structure in which at least two individual units are connected to each other. The units 301 may be respectively coupled vertically. The units 301 may be coupled so that the upper and lower units are alternately disposed. Thus, the single structure may be provided. There may be a left-right gap in a left and right direction of each of the units. The bent part may not be placed in the left-right gap of each unit. Thus, the positioning of the bent part may be convenient. Thus, the heat exchanger may be stably supported. When there are two bent parts, the two bent parts may be placed on the same unit. The heat exchanger may pass through at least two or more units.

[0152] The following may be optional. The support may be provided as a lattice structure. The heat exchanger may pass between the lattices. The heat exchanger may move while being placed on the single structure. The heat exchanger may be placed on the plate while being placed on the single structure. The support may be made of PPS. The support may be made of PPS containing glass fiber.

[0153] FIG. 9 is a view of the support according to an embodiment. FIG. 9A illustrates a support having an edge that is a connection branch. FIG. 9B illustrates a support having an edge that is an independent branch. Descriptions will be made with reference to FIG. 9.

[0154] The vacuum adiabatic body may be provided with at least two spaces. The at least two spaces may be bent. Like the vacuum adiabatic body, the vacuum space part may also be provided as at least two spaces. The at least two spaces may be connected to each other. Extension directions of at least two spaces may intersect each other. For example, the extension directions may intersect each other at 90 degrees. The support may be placed inside each space of the vacuum adiabatic body. The support may be provided corresponding to each space of the vacuum adiabatic body. The supports may be inserted into each of the at least two spaces. At least two supports may be provided. The at least two supports may be in contact with each other. The at least two supports may be in contact with each other at a point at which the two adjacent spaces of the vacuum adiabatic body intersect each other.

[0155] The following contents may be optional. The support may have a support plate 35 having a lattice. The support may have a bar 31 extending from an intersection point of the lattice. The support plate may be provided in a square shape. An edge of the support plate may have an independent branch 352 extending outside the support plate. The independent branch may have a first terminal

fixed to the support plate. The independent branch may have a second terminal that is not fixed to the support plate. The second stage may not be in contact with the support plate. Here, the support plate may mean a support plate to which the first stage is fixed. The second stage may be connected to the other adjacent independent branch. Two adjacent independent branches may be connected to each other. The second terminal of the first independent branch and the second terminal of the second independent branch may be connected to each other. The second terminal of the first independent branch and the second terminal of the second independent branch may be connected by a connection branch 351. The independent branch may disappear due to the connection branch. The connection branch may provide the outermost portion of the support. The connection branch may provide a portion of the support plate. At least some of the connection branches may be connected to each other.

[0156] FIG. 10 is a view for explaining an example in which the support having a connection branch is in contact with the support. FIG. 10(a) is an inner perspective view. FIG. 10(b) is an outer perspective view. Descriptions will be made with reference to FIG. 10.

[0157] The first support 30a and the second support 30b may be in contact with each other at a corner of the vacuum adiabatic body. The following contents may be optional. A first connection branch 351a may be provided on the first support. A second connection branch 351b may be provided on the second support. An inner surface of the first connection branch 351a may be in contact with a side surface of the second connection branch 351b. Conversely, it may also be vice versa. The first and second connection branches that are in contact with each other may not be provided with bars. Movement of the second connection branch 351b in an extension direction of the vacuum space may be supported by the first connection branch 351a. The connection branches may be in line contact with each other. The first connection branch 351a may be supported by a second plate. The support between the connection branches may also be the same for inner support plates. The support between the connection branches may be established in one direction. The support between the connection branches may be established with respect to force that causes the connection branches to approach each other in at least one of a vertical direction or a left and right direction, based on the drawings. For other forces, the connection branch may be a free end. The connection branch may have the same thickness as the support plate. Thus, processing and handling of the unit and support may be convenient. The connection branch may have the same width as the support plate. Thus, processing and handling of the unit and support may be convenient. A tolerance of the thickness of the connection branch may be less than 0.1 mm. The tolerance may be smaller than a tolerance of the support plate. Thus, reliability of the contact between the first and second

connection branches may be obtained. A length 11 of an inner connection branch may be set to a value obtained by subtracting a length in a thickness direction of the vacuum space from a length 12 of an outer connection branch. Accordingly, specifications of the first and second supports 30a and 30b may be different from each other. Accordingly, a size of the unit constituting the first and second supports 30a and 30b may be different from each other. At least one of the first or second side support may be provided by coupling the units 33a and 33b to each other. At least one of the first or second side support may be provided by coupling an opposing structure. At least one of the first or second side support may be coupled to each other so that the first support 31 and the second support 36 are coupled to each other. The description of the outer support plate may be applied to the description of the inner support plate. Descriptions for one support may be applied to other supports.

[0158] FIG. 11 illustrates an example in which supports having independent branches are in line contact with each other. FIG. 11(a) is an inner perspective view. FIG. 11(b) is a view illustrating an example in which a radiation resistance sheet is removed. Descriptions will be made with reference to FIG. 11.

[0159] The first support 30a and the second support 30b may be in contact with each other at a corner of the vacuum adiabatic body. The following contents may be optional. A first independent branch 352a may be provided on the first support. A second independent branch 352b may be provided on the second support. An inner surface of the first independent branch 352a may be in contact with a side surface of the second independent branch 352b. The independent branches may be in point contact with each other. Conversely, it may also be vice versa. The first and second independent branches that are in contact with each other may not be provided with bars. Movement of the first independent branch 351a in the extension direction of the vacuum space may be supported by the second independent branch 351b. The second independent branch 351b may be supported by the second plate. The support between the independent branches may also be the same for the inner support plates. The support between the independent branches may be established in one direction. The support between the independent branches may be established with respect to force that causes the independent branches to approach each other in at least one of the vertical direction or the left and right direction, based on the drawings. The independent branch may be a free end with respect to other force. The independent branch may have the same thickness as the support plate. Thus, processing and handling of the unit and support may be convenient. The independent branch may have the same width as the support plate. Thus, processing and handling of the unit and support may be convenient. A tolerance of the thickness of the independent branch may be less than 0.1 mm. The tolerance may be smaller than a tolerance of the support plate. Thus, reliability of the

contact between the first and second independent branches may be obtained. A length 11 of an inner independent branch may be set to a value obtained by subtracting a length in a thickness direction of the vacuum space from a length 12 of an outer independent branch. Accordingly, specifications of the first and second supports 30a and 30b may be different from each other. Accordingly, a size of the unit constituting the first and second supports 30a and 30b may be different from each other. At least one of the first or second side support may be provided by coupling the units 33a and 33b to each other. At least one of the first or second side support may be provided by coupling an opposing structure. At least one of the first or second side support may be coupled to each other so that the first support 31 and the second support 36 are coupled to each other. The description of the outer support plate may be applied to the description of the inner support plate. Descriptions for one support may be applied to other supports.

[0160] Another embodiment will be described. The following contents may be applied optionally. It is possible to have independent branches of one support and connection branches of another support are supported with respect to each other.

[0161] In the foregoing embodiment, the two supports are in contact with each other. In the foregoing embodiment, the two supports are not substantially restricted with respect to each other. Hereinafter, an embodiment in which the two supports are restricted is described.

[0162] FIGS. 12 to 13 are views illustrating an example in which the two supports are fixed in at least one direction according to an embodiment. FIG. 12 is a perspective view of a support assembly. FIG. 13(a) is a plan view of FIG. 12. FIG. 13(c) is a view illustrating a modified example of FIG. 13(a). FIG. 13(c) is a view illustrating a modified example of FIG. 13(a). This will be described with reference to FIGS. 12 to 13.

[0163] The two supports 30a and 30b may be restricted to each other in at least one direction. The following may be applied optionally. The two supports may move freely in a direction that passes through the ground. The two supports may move freely in the left and right direction relative to the ground. The two supports may be restricted to move vertically relative to the ground. The two supports may be restricted along at least one of the three XYZ axes. The two supports may be fixed along at least one of the three XYZ axes.

[0164] The following may be applied optionally. The support may include at least one of an outer support plate 35a or an inner support plate 35b. A coupling part may be provided at an end portion of the support plate. The coupling part may be provided with at least one of the inner and outer support plates 35a of the first and second supports. The coupling parts 358a, 358b, 359a, and 359b may be provided at at least a pair of facing positions in the inner and outer support plates 35a of the first and second supports. The coupling part may be provided in various examples such as a groove, a protrusion, an uneven-

ness, and a key. As an example, the coupling part may be provided as a groove. An end portion of the opposing support plate may be inserted into the groove. At least one of the outer support plate or the inner support plate may not have the first and second supports coupled to each other. A different support structure may be applied to the non-coupled support plate.

[0165] The following may be applied optionally. The end portions of the first and second supports may act as fixed ends for fixing the opposing supports. A length I1 of the outermost lattice of the inner support plate may be shorter than a length I2 of the inner lattice of the inner support plate. The first and second supports may be fixed to the outer support plates. The first and second supports may be fixed to the inner support plates.

[0166] At least one of the first and second supports or the units of the first and second supports may be provided in at least two identical shapes. In other words, a plurality of supports and units having the same type may be used. At least two supports may be provided. It is desirable to provide the supports in the same shape, and thus, inventory costs may be reduced. The following may be applied optionally. A length I1 of the outermost lattice of the inner support plate may be set to a value obtained by subtracting a length in the thickness direction of the vacuum space from the outermost length I3 of the outer support plate.

[0167] FIG. 14 is a view illustrating an example in which the two supports are fixed in at least one direction according to another embodiment. FIG. 14(a) is a perspective view of a second support. FIG. 14(b) is a plan view of FIG. 14. Descriptions will be made with reference to FIG. 14.

[0168] The two supports 30a and 30b may be restricted to each other in at least one direction. The following may be applied optionally. The two supports may move freely in a direction that passes through the ground. The two supports may move freely vertically relative to the ground. The two supports may be restricted to move in the left and right direction relative to the ground. The two supports may be restricted along at least one of the three XYZ axes. The two supports may be fixed along at least one of the three XYZ axes.

[0169] The following may be applied optionally. The support may include at least one of an outer support plate 35a or an inner support plate 35b. A coupling part may be provided at an end portion of the support plate. The coupling part may be provided in two pieces spaced apart from each other on the inner support plate 35b of the first and second supports. An interval between the two coupling parts may be equal to that between the outer and inner support plates. In the coupling part 358a, 358b, 359a, and 359b, the coupling parts of the inner support plate 35b of one of the first and second supports 30a and the end portions of the outer and inner support plates 35a/35b of the other support 30b may be coupled to each other. At least one of the first and second supports and the units of the first and second supports may be provided in the same shape. A portion of the supports may have a

free end that is not supported. In the drawings, a portion of the end of the outer support plate of the first support may be provided as a free end. A portion of the end of the outer support plate of the first support may be provided as a fixed end.

[0170] FIG. 15 is a view illustrating an example in which the two supports are fixed in at least two directions. FIG. 15(a) is a perspective view of a second support. FIG. 14(b) is a plan view of FIG. 14. Descriptions will be made with reference to FIG. 14.

[0171] The two supports 30a and 30b may be restricted to each other in at least two directions. The following may be applied optionally. The two supports may move freely in a direction that passes through the ground. The two supports may be restricted to move vertically relative to the ground. The two supports may be restricted to move in the left and right direction relative to the ground. The two supports may be restricted along at least two directions in the three XYZ axes. The two supports may be fixed along at least two directions in the XYZ three axes.

[0172] The following may be applied optionally. The support may include at least one of an outer support plate 35a or an inner support plate 35b. A coupling part may be provided at an end portion of the support plate. The coupling parts 359a and 359c and 359b and 358b may be provided in two pieces spaced apart from each other on the outer support plate 35a of the first and second supports. An interval between the two coupling parts may be equal to that between the outer and inner support plates. The coupling part 358a may be provided in one on the inner support plate 35b of the first and second supports. Here, the coupling part 358a may not be provided on the first support. Here, the coupling part 358a may be cut in the first support. For example, the support plate may be cut at the coupling part 358a of the inner support plate of the second support 30b, and the coupling part 358a of the inner support plate of the first support 30a may not be cut. The cut end portion of the first support may be inserted into the coupling part 358a. The end portions of the outer and inner support plates 35a/35b of the other support 30a may be coupled to the two coupling parts of the outer support plates of one of the first and second supports 30b.

[0173] The following contents may be applied optionally. At least one of the first and second supports or the units of the first and second supports may be provided in the same shape before the coupling. Any one of the first and second supports and the units of the first and second supports may be cut before the coupling. At least one of the first and second supports or the units of the first and second supports may be provided in different shapes before the coupling. That is, two types of units may be used. The outer support plate may be provided in the same shape before or after the coupling.

[0174] FIG. 16 is a view for explaining details of the support of FIG. 12. This will be described with reference to FIGS. 12, 13, and 16.

[0175] The following contents may be applied option-

ally. A length of the outermost lattice of the outer support plate is greater than a length of the outermost lattice of the inner support plate. The length of the outermost lattice of the outer support plate may be smaller than the length of the outermost lattice of the inner support plate and the thickness of the vacuum space. The length of the outermost lattice of the inner support plate may be greater than the thickness of the vacuum space. The length of the outermost lattice of the inner support plate may be smaller than an interval between adjacent pairs of bars 31. A length B by which the outermost lattice of the outer support plate in the first support 30a extends from the outermost lattice of the outer support plate is the same as a length A by which the outermost lattice of the outer support plate in the second support extends from the outermost lattice of the outer support plate. Therefore, the support and the unit of the support may be shared.

[0176] FIG. 17 is a view for explaining details of the support of FIG. 14. Descriptions will be made with reference to FIG. 17. The following contents may be applied optionally. The two spaced coupling parts on the inner support plate 35b of the first and second supports may be the same as the interval between the outer and inner support plates. The distance A between the end portions of the inner and outer support plates of the first support 30a may be shorter than the distance B between the end portions of the inner and outer support plates of the second support 30b. This is because the end portions of the inner and outer support plates of the second support 30b are guided by the coupling part. This is because the end portions of the inner and outer support plates of the first support 30a are not guided. It may be desirable for the connection of the inner support plate to be fixed. If adding an attachment for fixing on the inside, an accommodation space will be reduced.

[0177] FIG. 18 is a view for explaining details of the support of FIG. 15. Descriptions will be made with reference to FIG. 18. The following contents may be applied optionally. The two spaced coupling parts on the outer support plate 35b of the first and second supports may be the same as the interval between the outer and inner support plates. The distance A between the end portions of the inner and outer support plates of the first support 30a may be the same as the distance B between the end portions of the inner and outer support plates of the second support 30b. The intervals A and B may be maintained more accurately than in the case of FIG. 16. This is because the end portions of the inner and outer support plates in the first and second supports do not move in the direction of contraction of a vacuum pressure due to the coupling part. However, even in the case of FIG. 16, the interval may be maintained.

[0178] Another embodiment will be proposed. Only one of the outer and inner support plates may be coupled to each other by the coupling part. Another is that the first and second supports are provided as one unit. The configuration of the embodiment may be applied to at least one corner of the vacuum adiabatic body. At least

one corner of the vacuum adiabatic body may be coupled in a different manner.

[0179] In the embodiment, two supports are in contact with each other. In the embodiment, the two supports may be restricted to each other. The foregoing embodiment may allow the two supports to move freely relative to each other in at least one direction along the XYZ axes. In the following implementation, the two supports may be more strongly restricted to each other.

[0180] FIG. 19 is a view illustrating an example in which the two supports are strongly restricted according to an embodiment. FIG. 19(a) is a perspective view of two supports. FIG. 19(b) is a front view illustrating the corner. FIG. 20 is a view illustrating a coupling process of the support of FIG. 19. FIG. 20(a) is a view of the second support. FIG. 20(b) is a view of the first support. FIG. 20(c) illustrates coupling of the first support and the second support. This will be described with reference to FIGS. 19 and 20.

[0181] The two supports 30a and 30b may be restricted in three directions. The following may be applied optionally. The two supports may be restricted from moving in the direction that passes through the ground. The two supports may be restricted to move vertically relative to the ground. The two supports may be restricted to move in the left and right direction relative to the ground. The two supports may be fixed along the XYZ three axes.

[0182] The following may be applied optionally. A first extension bar 356a may be provided at an end of the first support 30a. A second extension bar 356b may be provided at an end of the second support 30b. A third extension bar 356c may be provided at a position spaced inward from the second extension bar 356b. An interval between the second and third extension bars 356b/356c may correspond to the thickness of the vacuum space or the length of the bar 31. The extension bar may be provided to be integrated with at least one of the inner support plate or the outer support plate. The extension bar may be provided together with the bar 31. A sixth coupling part 357a may be provided on a side surface of the end of the first support or the second support. The sixth coupling part 357a may be provided on the outer support plate 35a. At least one end of the first support and the second support may be provided with seventh or eighth coupling parts 357b and 357c on the inner surface. At least one of the seventh or eighth coupling parts may be provided on the inner support plate 35b. The inner support plates of the first and second supports may not be coupled to each other. The inner support plates of the first and second supports may be fixed to the outer support plates by the extension bars.

[0183] The following may be applied optionally. The second extension bar 356b may be coupled to the sixth coupling part 357a. The second extension bar and the sixth coupling part may provide the coupling between the first and second supports. The second extension bar and the sixth coupling part may fix the first and second supports to each other. The first extension bar 356a may be

coupled to the seventh coupling part 357b. The third extension bar 356c may be coupled to the eighth coupling part 357c. The coupling of the first extension bar and the seventh coupling part, and the coupling of the third extension bar and the eighth coupling part may ensure that the interval between the ends of each support is well maintained. The extension bar and the coupling part may be coupled to each other in various manners, such as loose coupling, coupling, press-fitting, fixed coupling, screw coupling, and bonding.

[0184] According to an embodiment, the supports disposed in each space with different extension directions in the vacuum space may be strongly integrated. It is expected that the strength of the vacuum adiabatic body will increase.

[0185] FIG. 21 is a view illustrating an example in which the two supports are strongly restricted according to an embodiment. FIG. 21(a) is a view of a symmetric alignment. FIG. 21(b) is a front view. Descriptions will be made with reference to FIG. 21.

[0186] The two supports 30a and 30b may be restricted in three directions. The following may be applied optionally. The two supports may be fixed along the XYZ three axes. If the coupling part is the loose coupling, relative movement in a negative direction may be permitted.

[0187] The following may be applied optionally. A first extension bar 356a may be provided at an end of the first support 30a. A second extension bar 356b may be provided at an end of the second support 30b. A third extension bar 356c may be provided at a position spaced inward from the second extension bar 356b. An interval between the second and third extension bars 356b/356c may correspond to the thickness of the vacuum space or the length of the bar 31. The extension bar may be provided to be integrated with at least one of the inner support plate or the outer support plate. The extension bar may be provided together with the bar 31. A sixth coupling part 357a may be provided on a side surface of the end of the first support or the second support. The sixth coupling part 357a may be provided on the outer support plate 35a. A seventh coupling part 357b may be provided on the inner surface of at least one end of the first support and the second support. A ninth coupling part 357d may be provided on the side surface of at least one end of the first support and the second support. At least one of the seventh or ninth coupling parts may be provided on the inner support plate 35b. The seventh or ninth coupling parts 357b and 357d may be provided together with the first support. The seventh or ninth coupling parts 357b and 357d may be provided on the same support plate with different surfaces and inner surfaces. The inner support plates of the first and second supports may be coupled to each other by the third extension bar 356c and the ninth coupling part 357d.

[0188] The following may be applied optionally. The second extension bar 356b may be coupled to the sixth coupling part 357a. The third extension bar 356c may be coupled to the ninth coupling part 357d. The coupling

between the second extension bar and the sixth coupling part, and the coupling between the third extension bar 356c and the ninth coupling part 357d may provide the coupling between the first and second supports. The coupling between the second extension bar and the sixth coupling part, and the coupling between the third extension bar 356c and the ninth coupling part 357d may fix the first and second supports to each other. The first extension bar 356a may be coupled to the seventh coupling part 357b. The coupling of the first extension bar and the seventh coupling part, and the coupling of the third extension bar 356c and the ninth coupling part 357d may ensure that the interval between the ends of each support is well maintained. The extension bar and the coupling part may be coupled to each other in various manners, such as loose coupling, coupling, press-fitting, fixed coupling, screw coupling, and bonding. The outermost lattice of the inner support plate of the second support 30b may not be provided. The outermost lattice of the inner support plate of the second support 30b may be provided. In this case, the outermost lattice of the inner support plate of the second support 30b may be provided in a form connected to the third extension bar. In this case, the outermost lattice of the inner support plate of the second support 30b may be provided in a form connected to the third extension bar. Even if not connected, there is an advantage of improving strength because the moment of inertia increases. The outermost lattices of the inner support plates of the first and second supports 30b may be different from each other.

[0189] The following may be applied optionally. The extension bar may support the end of the support. The radiation resistance sheet 32 may extend up to the extension bar. The radiation heat shield effect by the radiation resistance sheet may increase. The contact between the radiation resistance sheet and the plate may be blocked by the extension bar. At least one of the pair of mutually supported supports may have the radiation resistance sheet extending to the extension bar.

[0190] According to an embodiment, the supports placed in each space with different extension directions in the vacuum space may be strongly integrated on both the outside and inside. It is expected that the strength of the vacuum adiabatic body will increase.

INDUSTRIAL APPLICABILITY

[0191] According to the present invention, the vacuum adiabatic body may be conveniently manufactured.

Claims

1. A vacuum adiabatic body comprising:

- a first plate having a first temperature;
- a second plate having a second temperature different from the first temperature;

a vacuum space provided between the first plate and the second plate; and
 a support configured to maintain the vacuum space,
 wherein the vacuum space comprises at least two spaces that are bent with respect to each other, and
 the support comprises:

- a first support comprising a portion that is inserted into the at least two spaces to extend in a first direction; and
 - a second support comprising a portion extending in a direction different from the first direction,
 wherein the first support and the second support are provided to be supported with respect to each other or restricted in movement in at least one direction of XYZ directions.
2. The vacuum adiabatic body according to claim 1, wherein the support comprises a support plate having a portion extending in a longitudinal direction of the vacuum space.
3. The vacuum adiabatic body according to claim 2, wherein an independent branch comprising a first terminal fixed to a support plate of the first support and a second terminal that is not supported by the support plate of the first support is provided on the outermost portion of the first support, wherein a through-hole is defined between at least two adjacent independent branches.
4. The vacuum adiabatic body according to claim 2, wherein an independent branch comprising a first terminal fixed to a support plate of the first support and a second terminal that is not supported by the support plate of the first support is provided on the outermost portion of the first support, and a connection branch configured to connect at least two adjacent independent branches to each other is provided,
 wherein a through-hole is defined between the independent branches and the connection branch.
5. The vacuum adiabatic body according to any one of claims 3 and 4, wherein the support comprises a plurality of bars,
 wherein the bar is not provided on at least one of the independent branches or the connection branch.
6. The vacuum adiabatic body according to any one of claims 3 and 4, wherein the support comprises a plurality of bars,
 wherein the bar or an extension bar is provided on at least one of the independent branches or the con-

nection branch.

7. The vacuum adiabatic body according to claim 2, wherein the outermost lattice of the first support plate comprises a portion having a size less than that of an inner lattice of the first support plate or a portion having a size less than that of an inner lattice of the second support plate.
8. The vacuum adiabatic body according to claim 1, wherein the first support comprises an inner support plate corresponding to the first plate and an outer support plate corresponding to the second plate, and the second support comprises an inner support plate corresponding to the first plate and an outer support plate corresponding to the second plate.
9. The vacuum adiabatic body according to claim 8, wherein the inner support plate of the first support and the inner support plate of the second support are coupled to each other, or the outer support plate of the first support and the outer support plate of the second support are coupled to each other.
10. The vacuum adiabatic body according to claim 8, wherein the inner support plate of the first support and the inner support plate of the second support are coupled or supported to each other, or the outer support plate of the first support and the outer support plate of the second support are spaced apart from each other.
11. The vacuum adiabatic body according to claim 8, wherein the outer support plate of the first support and the outer support plate of the second support are coupled or supported to each other, or the inner support plate of the first support and the inner support plate of the second support are spaced apart from each other.
12. The vacuum adiabatic body according to claim 8, wherein each of the inner support plate and the outer support plate of the first support is coupled to the outer support plate of the second support, or each of the inner support plate and the outer support plate of the second support is coupled to the inner support plate of the first support.
13. The vacuum adiabatic body according to claim 1, wherein the support comprises:
 a plurality of bars comprising a portion extending in a height direction of the vacuum space; and
 a connection plate comprising a portion that connects the plurality of bars to each other,
 wherein the bar provided on the first support comprises a portion coupled or supported to the connection plate provided on the second

support.

14. The vacuum adiabatic body according to claim 1,
wherein a second extension bar provided at or near
an end of the second support; and a coupling part 5
into which the second extension bar is fitted are
provided on the first support.
15. The vacuum adiabatic body according to claim 14,
wherein a third extension bar spaced a predeter- 10
mined interval from the second extension bar; and
a coupling part into which the third extension bar is
fitted are provided on the first support or the second
support. 15
16. The vacuum adiabatic body according to claim 14,
wherein a first extension bar spaced a predeter-
mined interval from the second extension bar; and
a coupling part into which the first extension bar is 20
fitted are provided on the first support.

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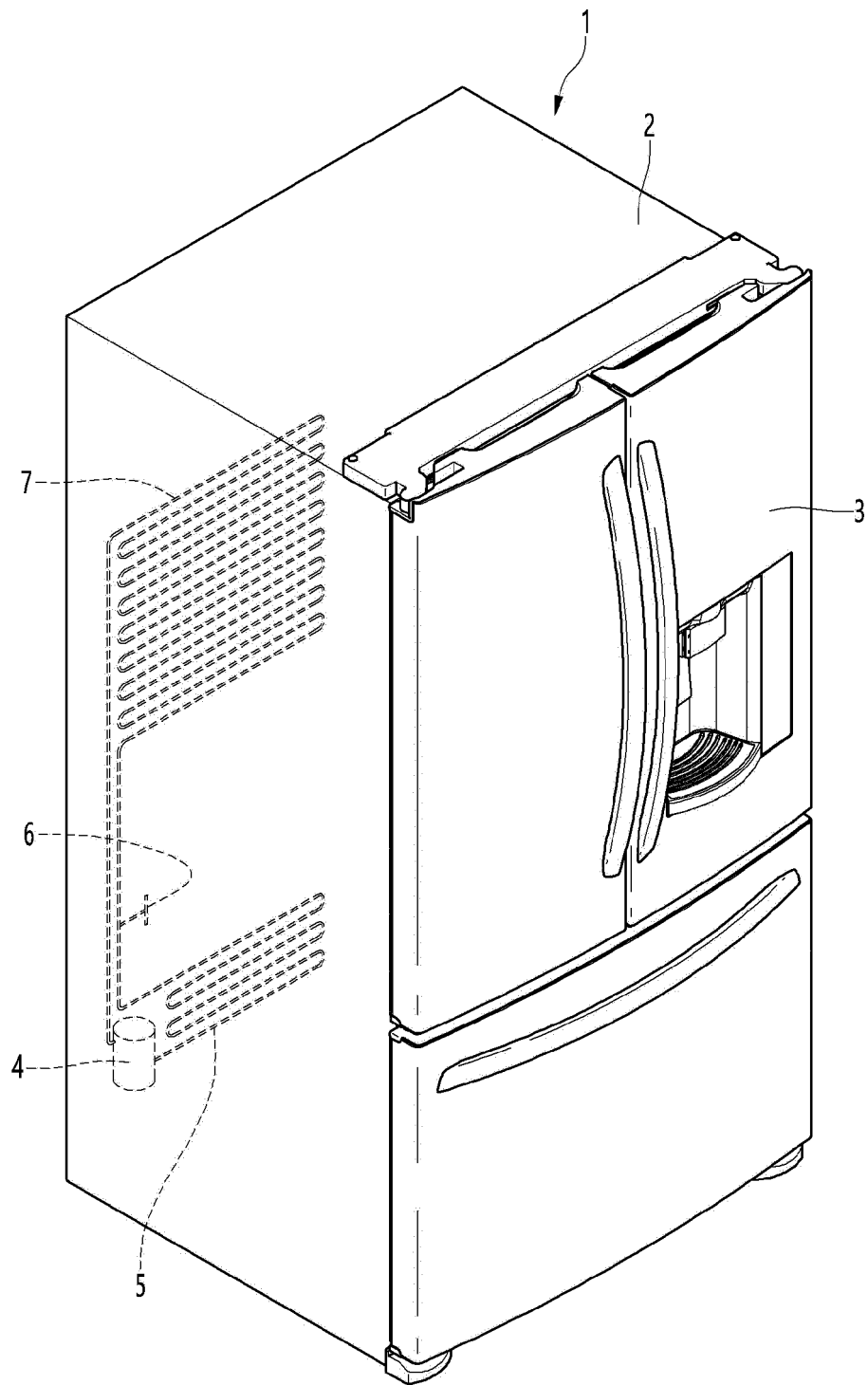
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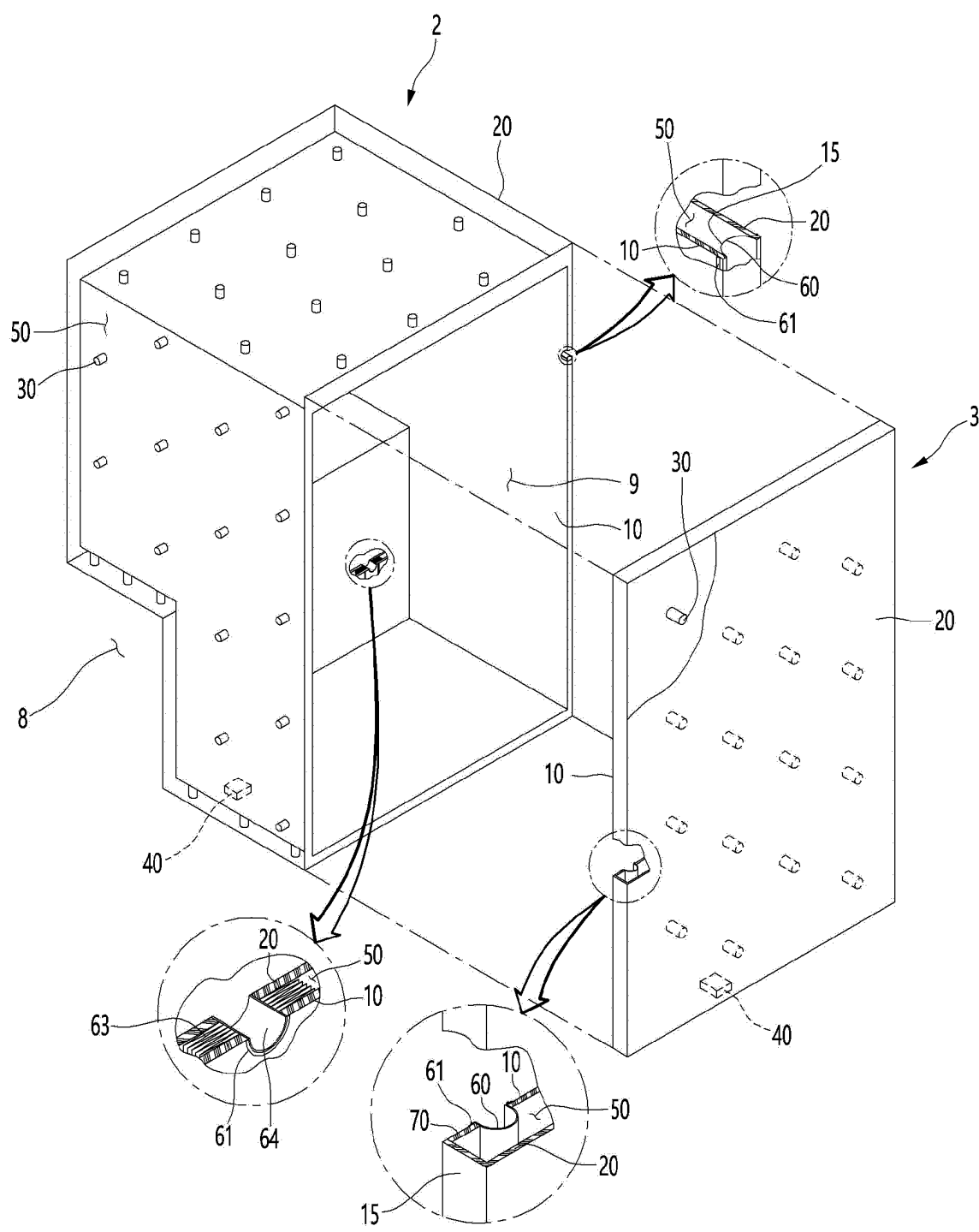
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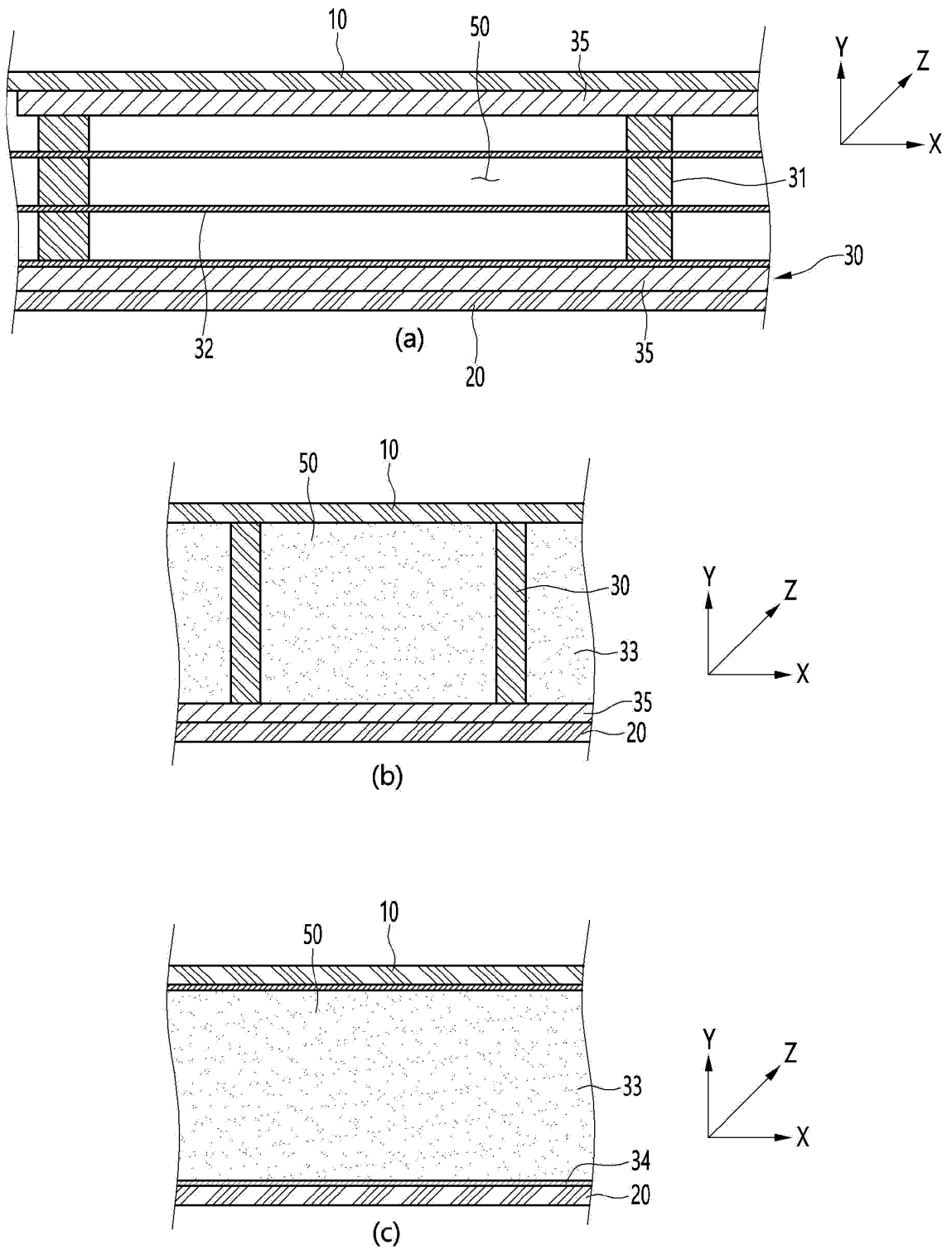
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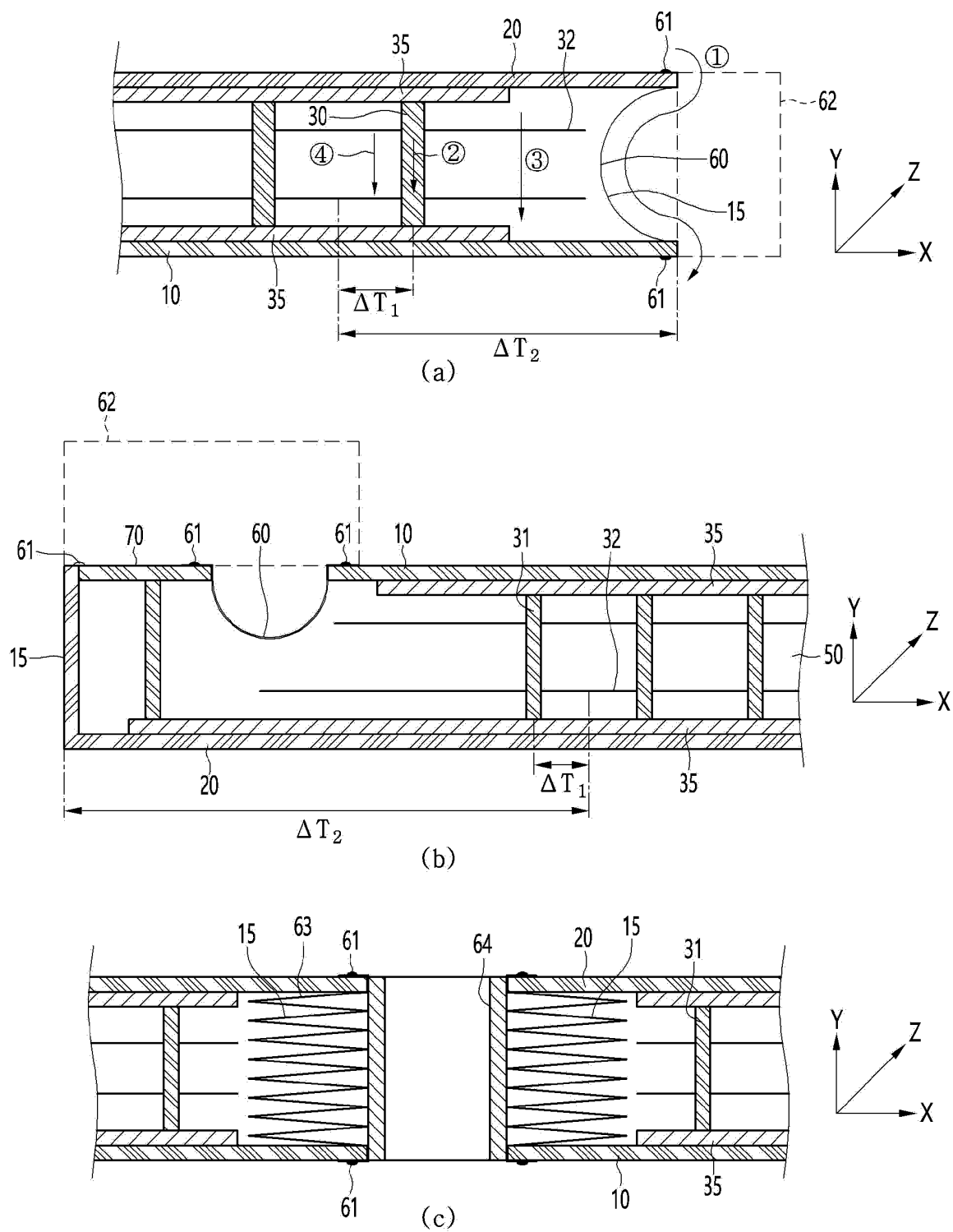
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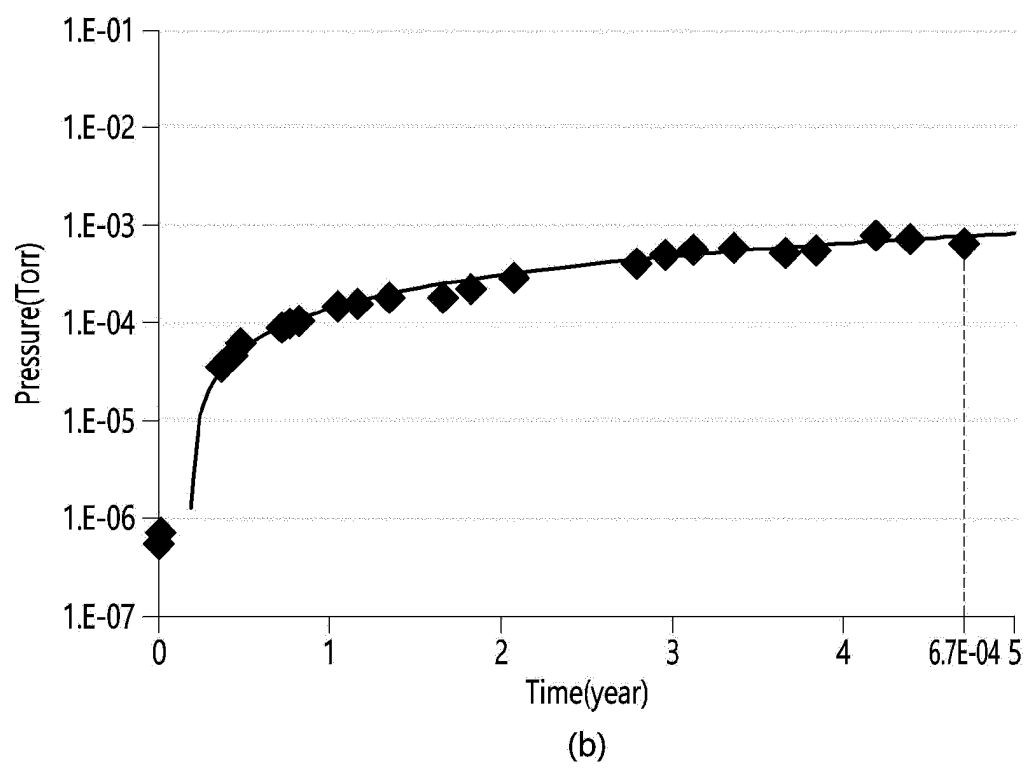
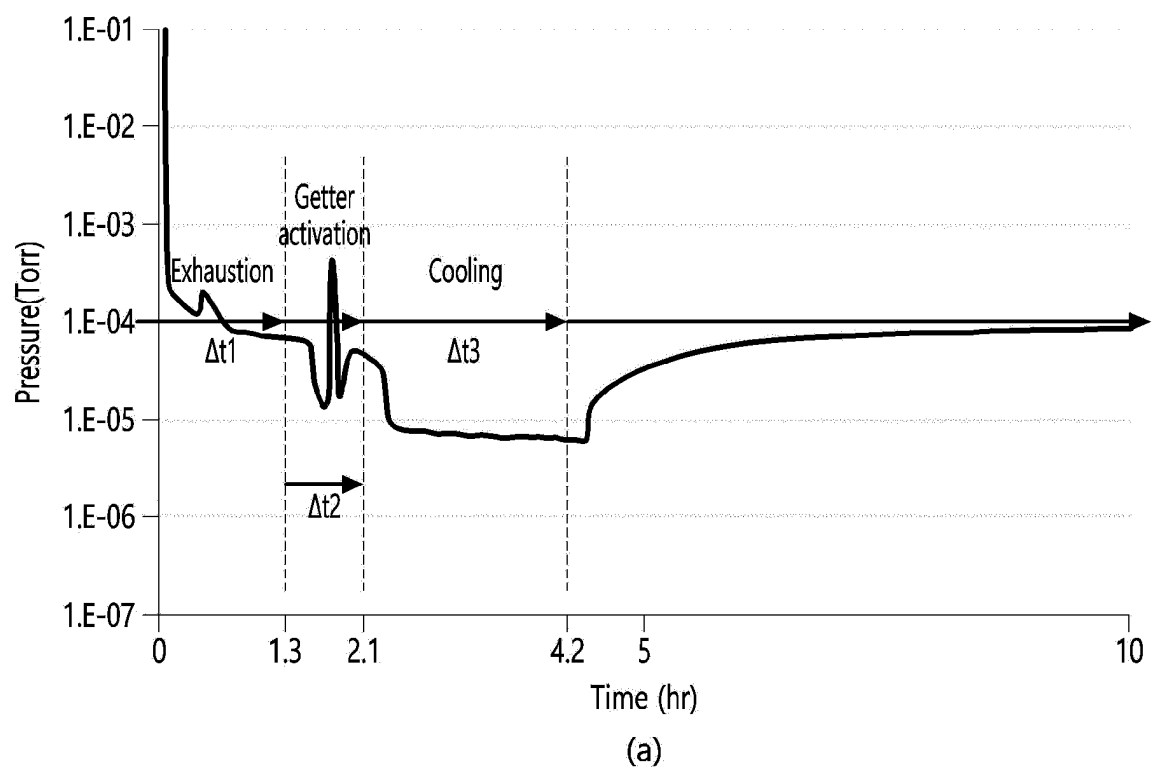
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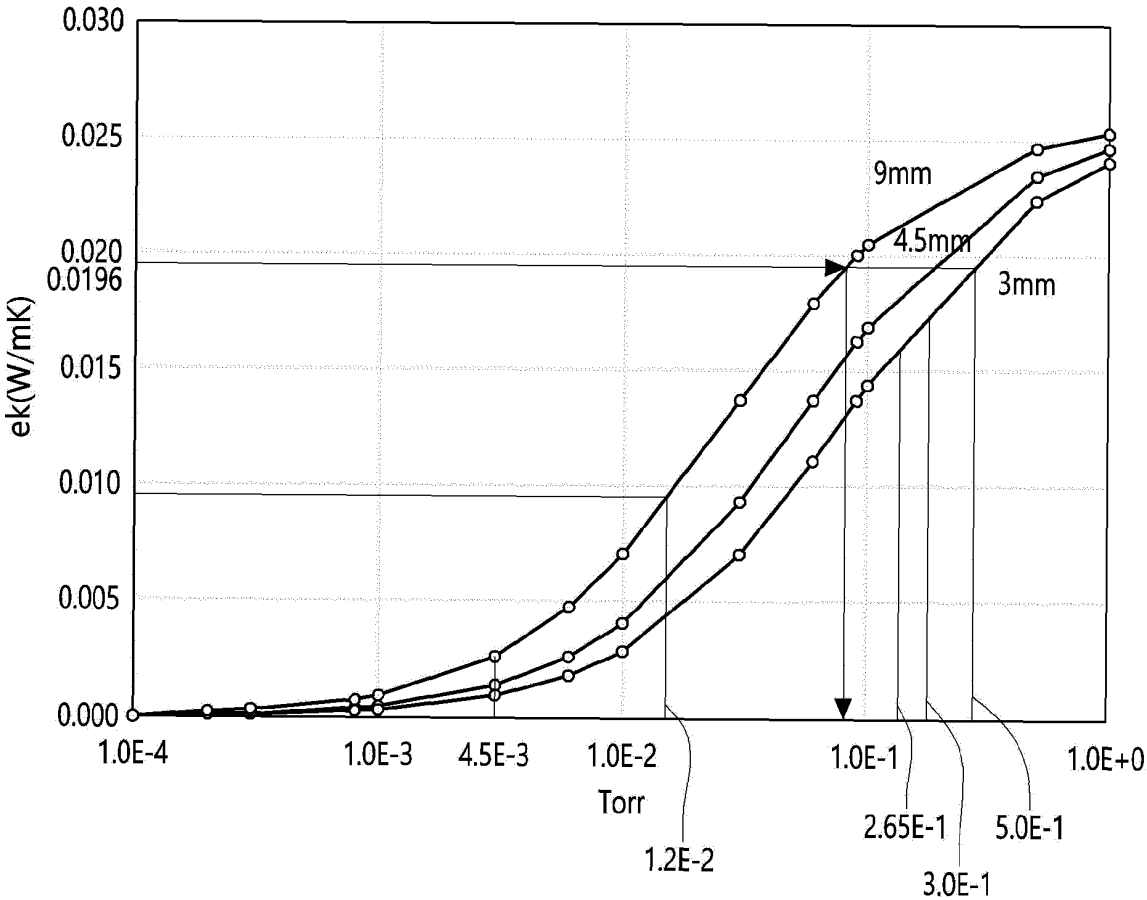
【Figure 4】



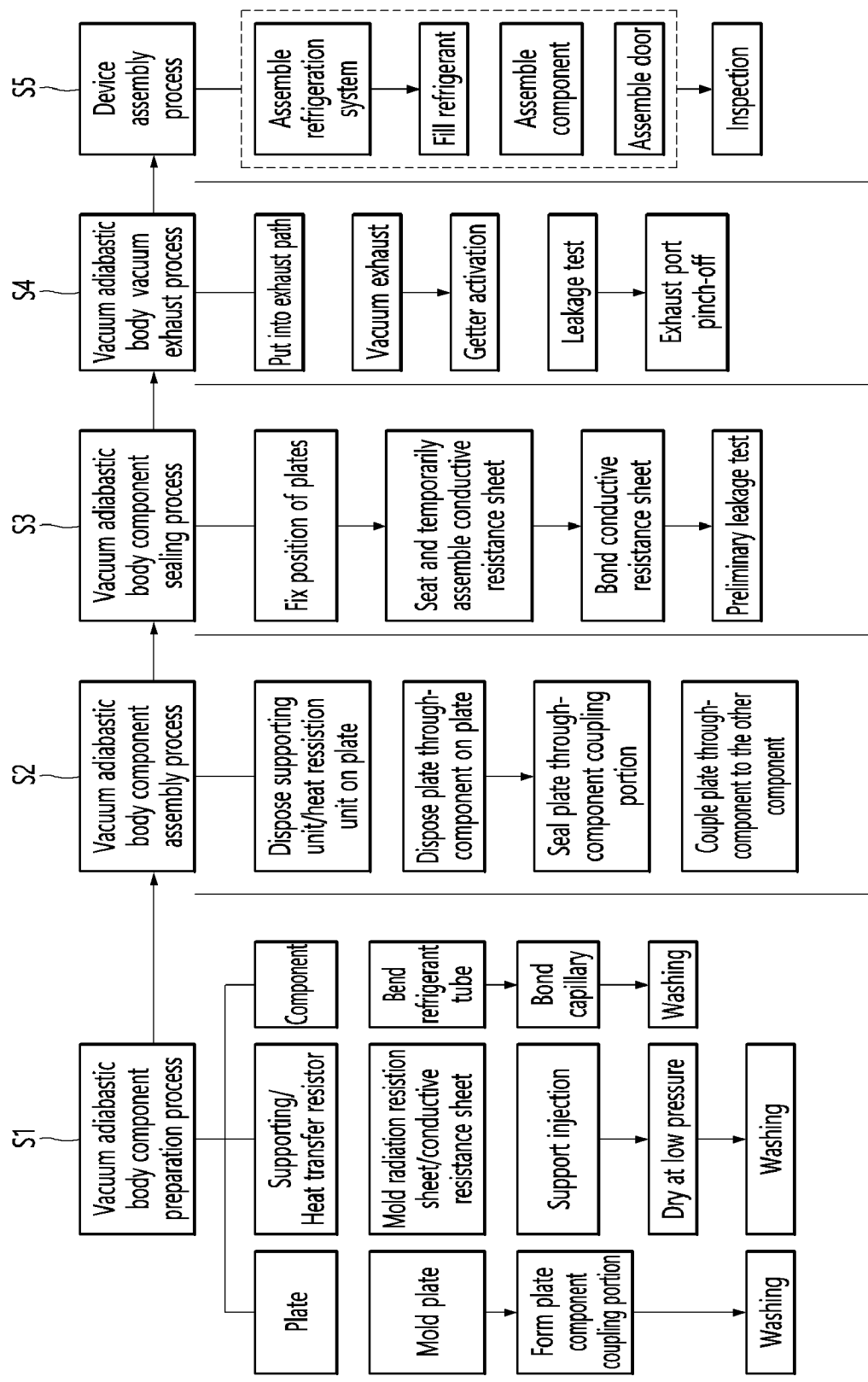
【Figure 5】



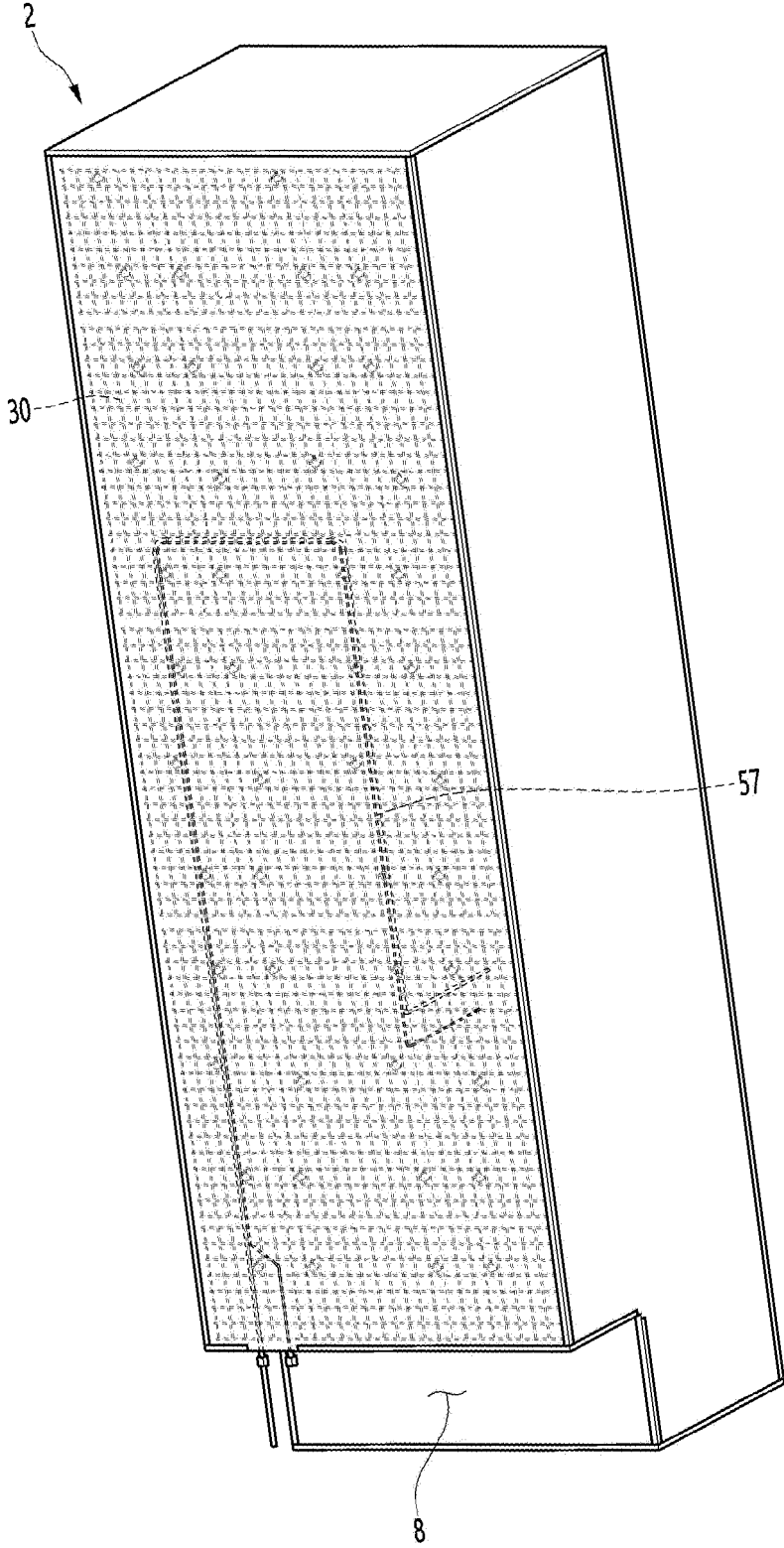
【Figure 6】



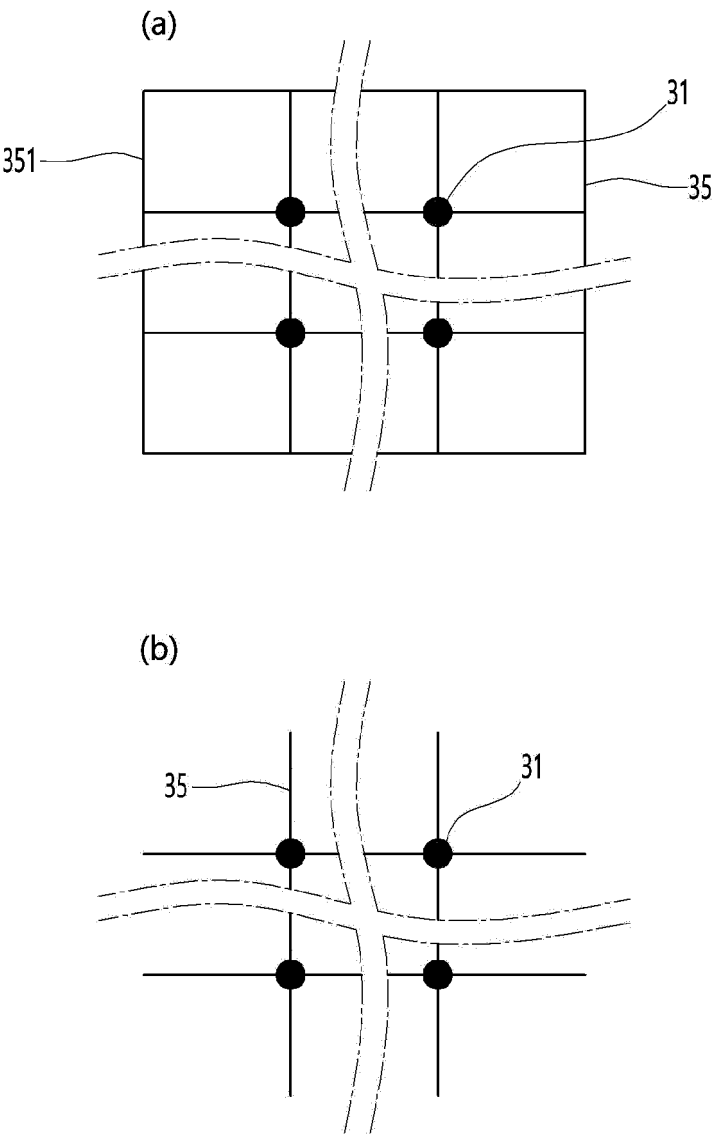
【Figure 7】



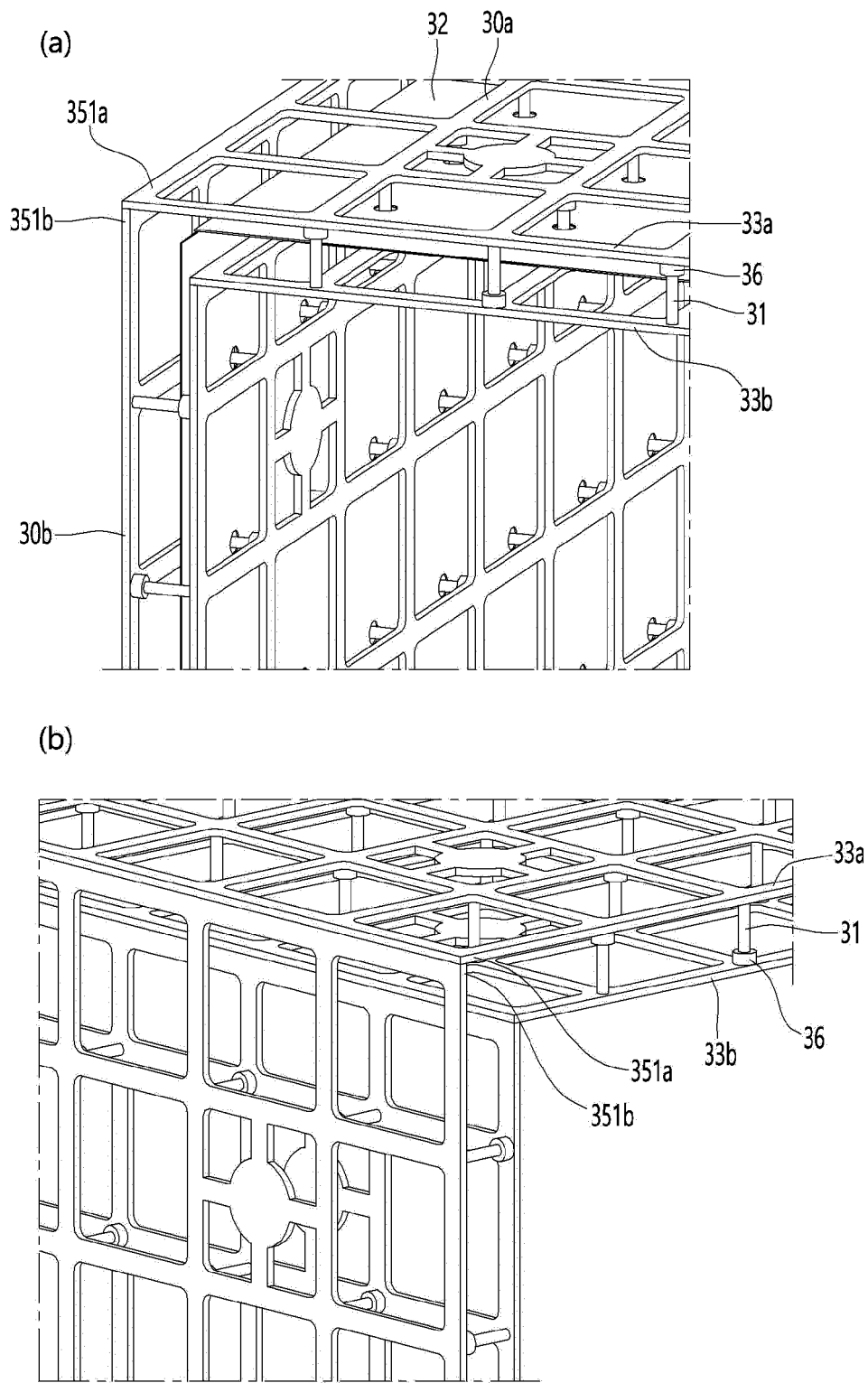
【Figure 8】



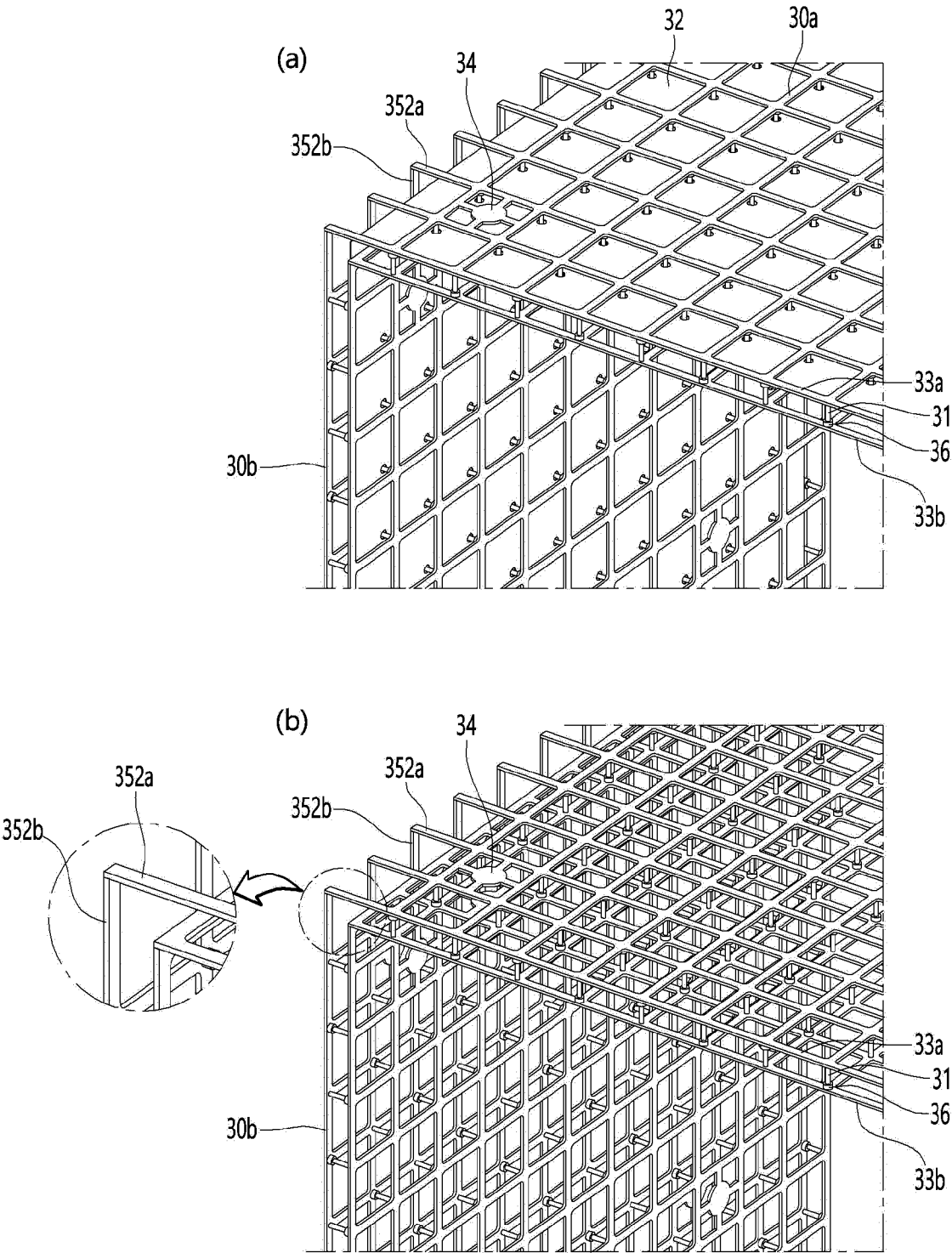
【Figure 9】



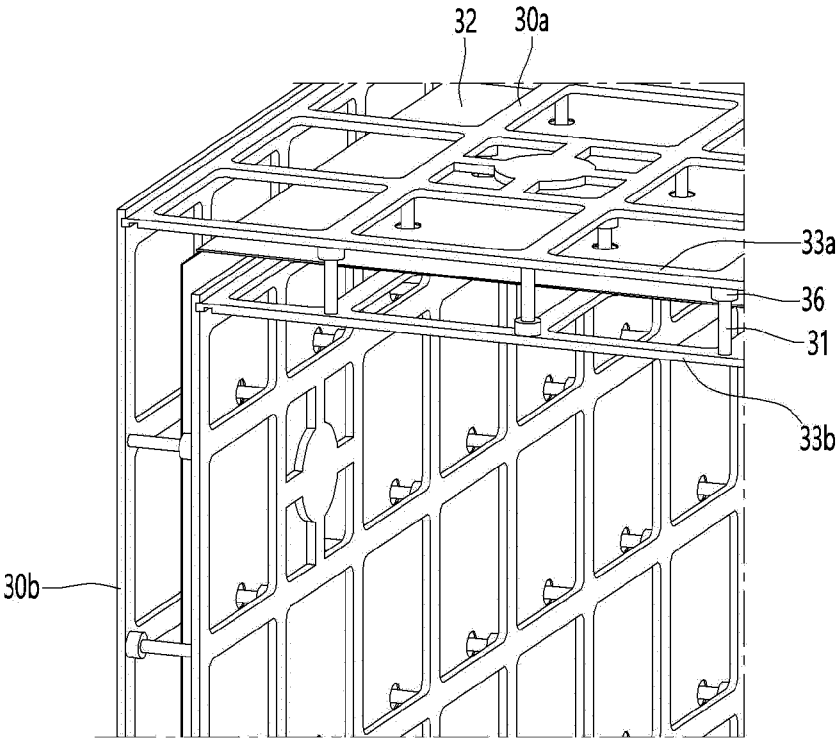
【Figure 10】



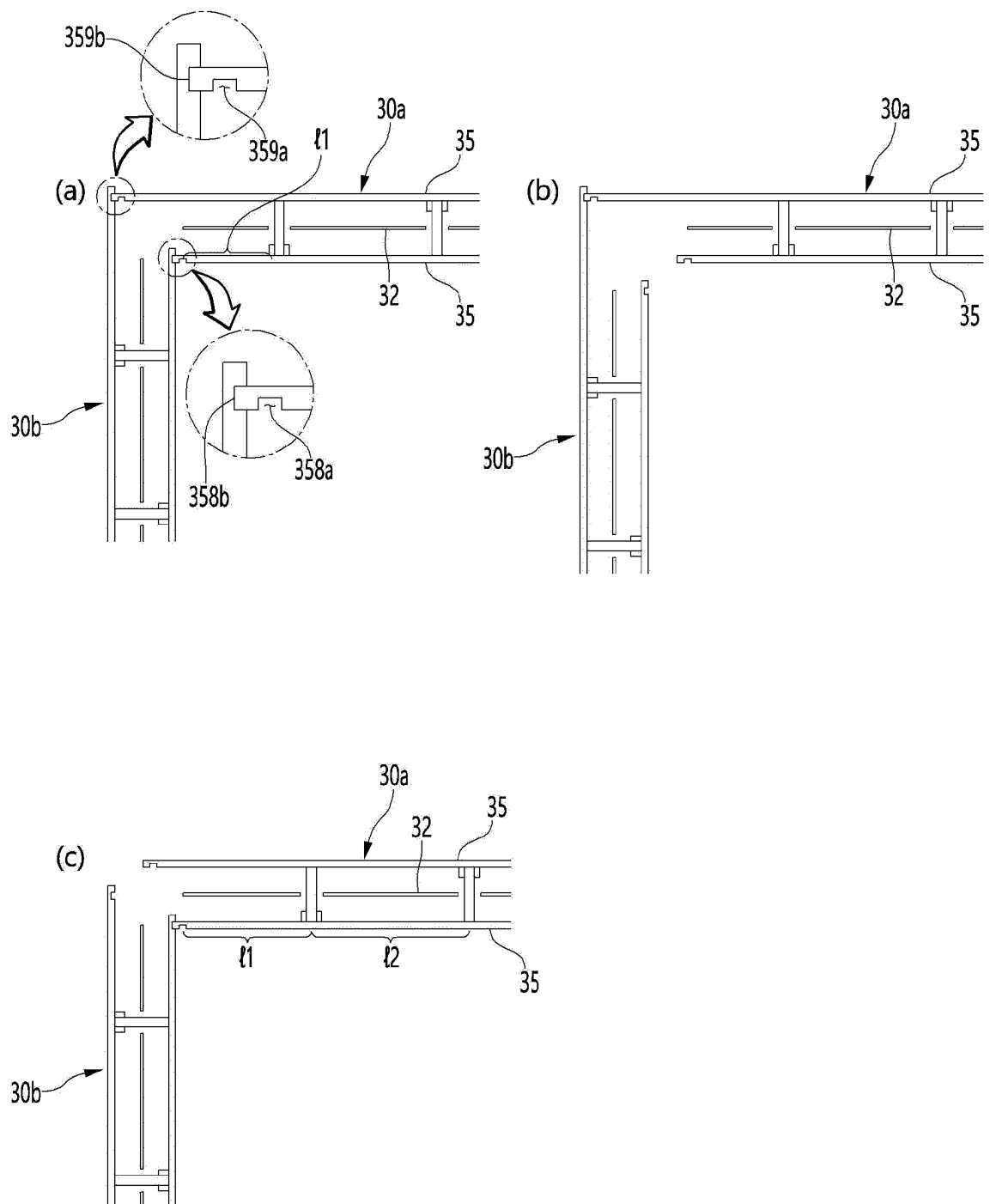
【Figure 11】



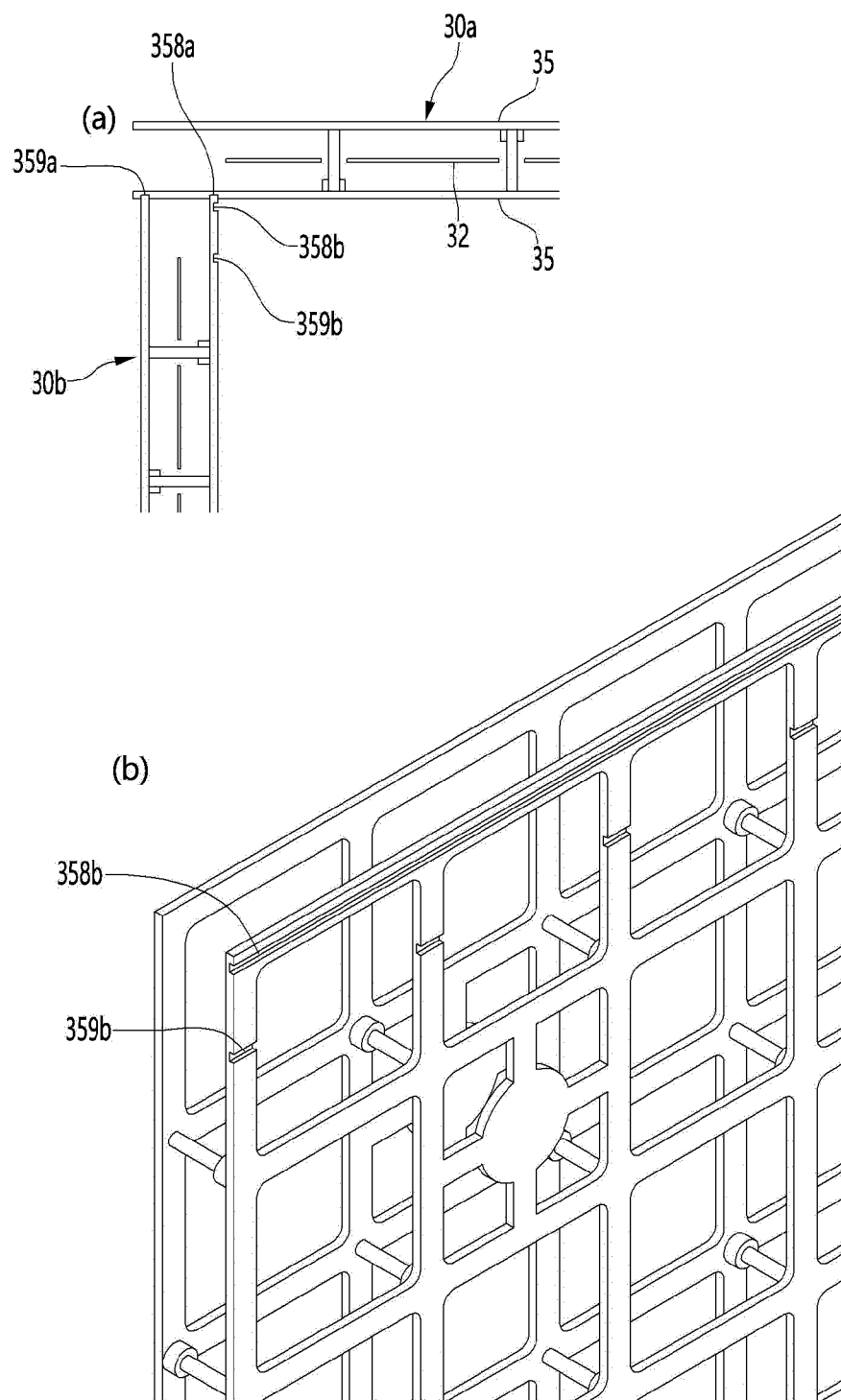
【Figure 12】



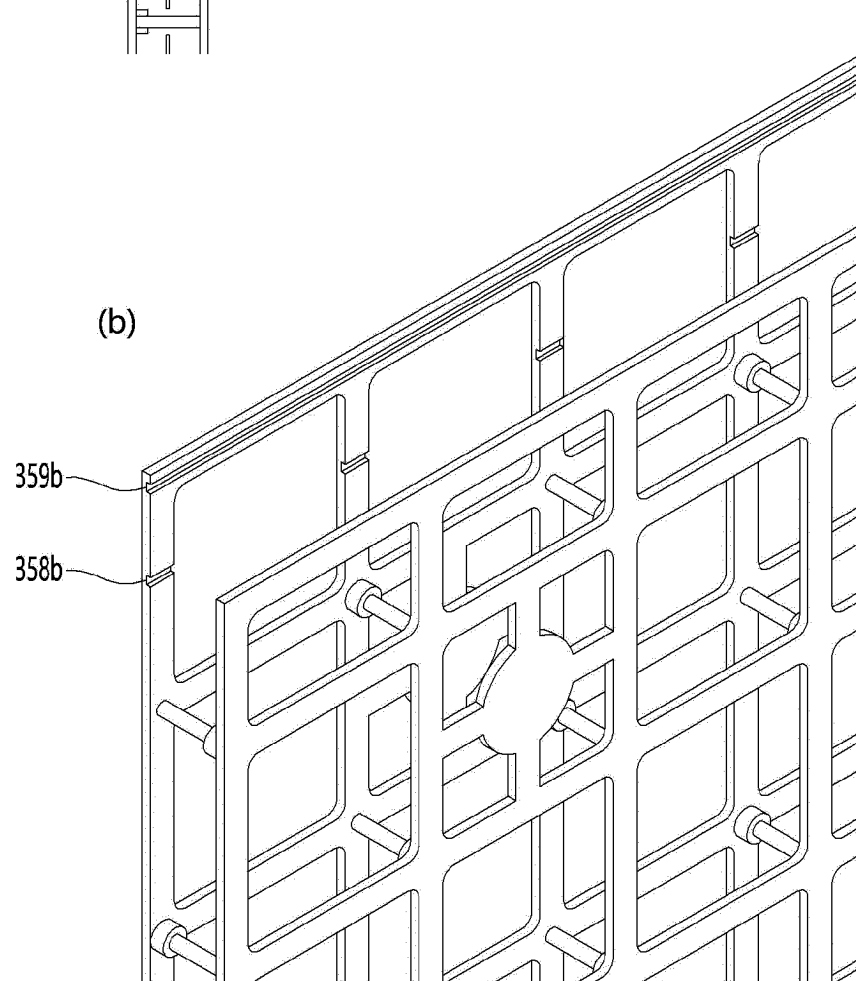
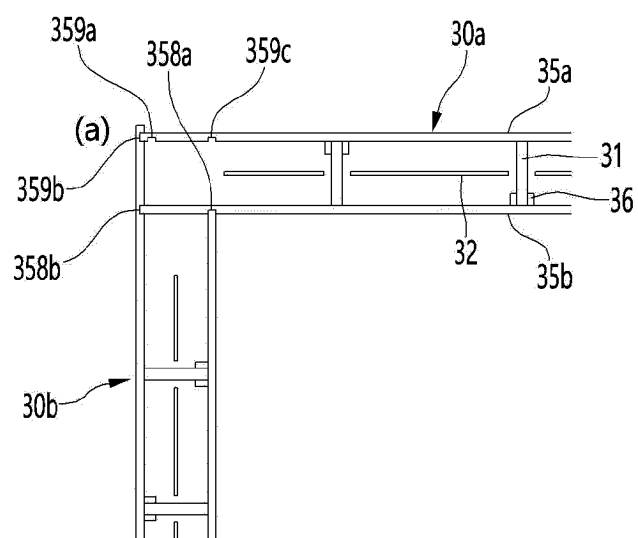
【Figure 13】



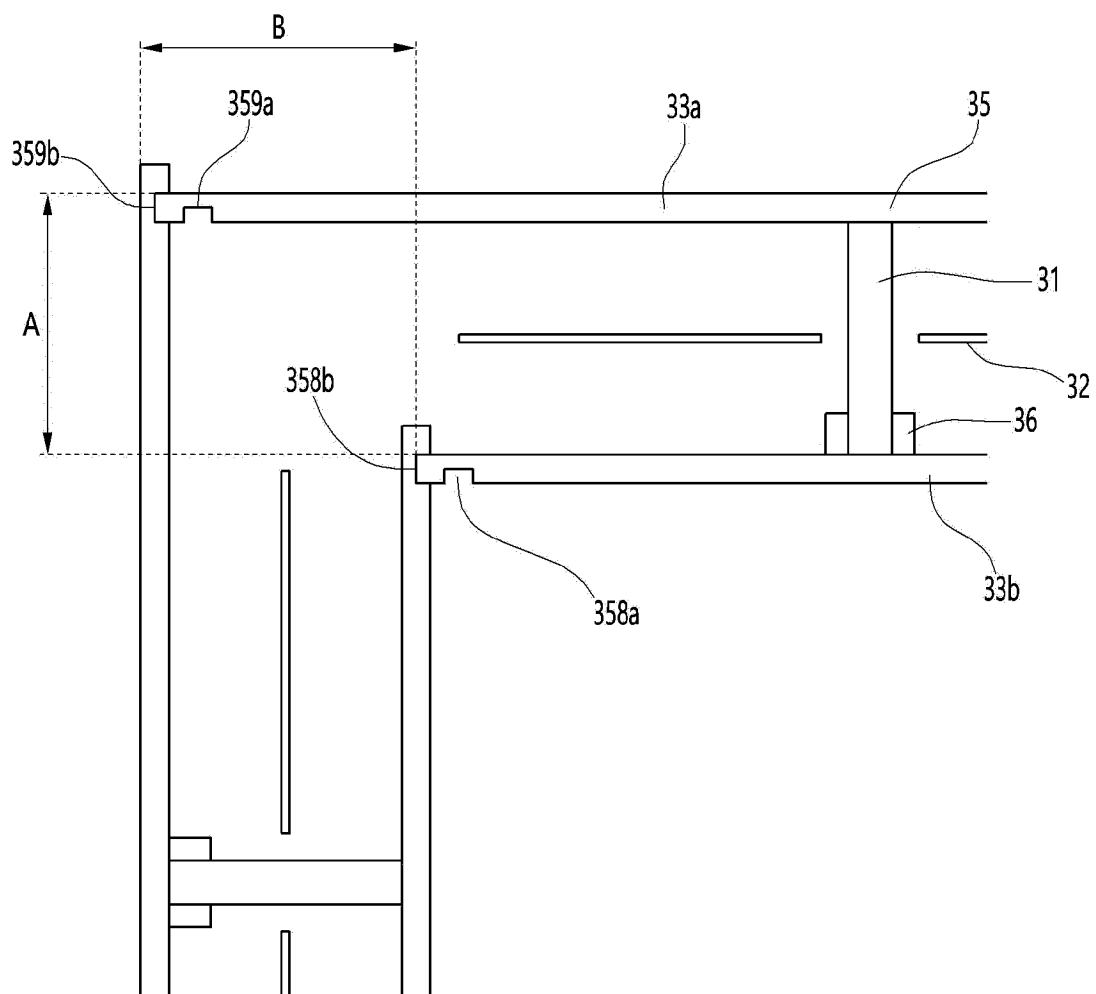
【Figure 14】



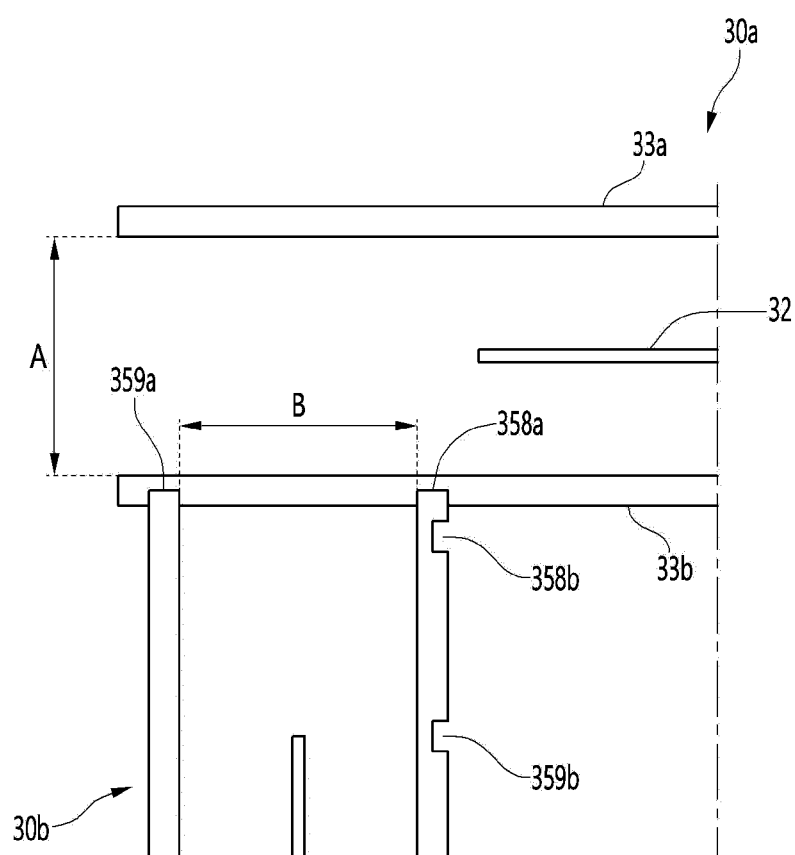
【Figure 15】



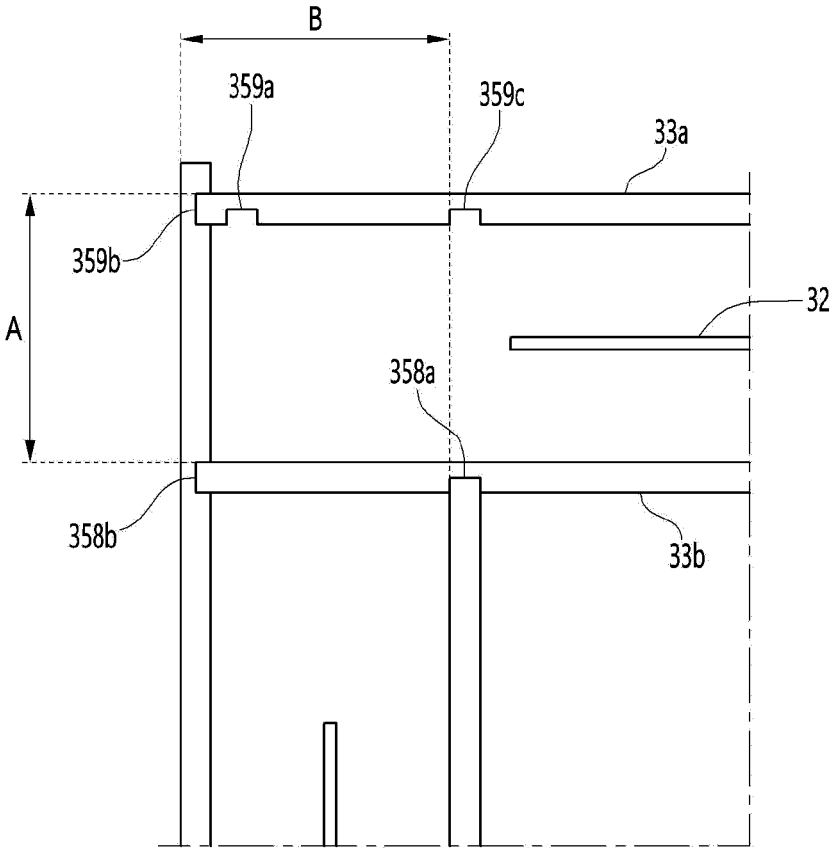
【Figure 16】



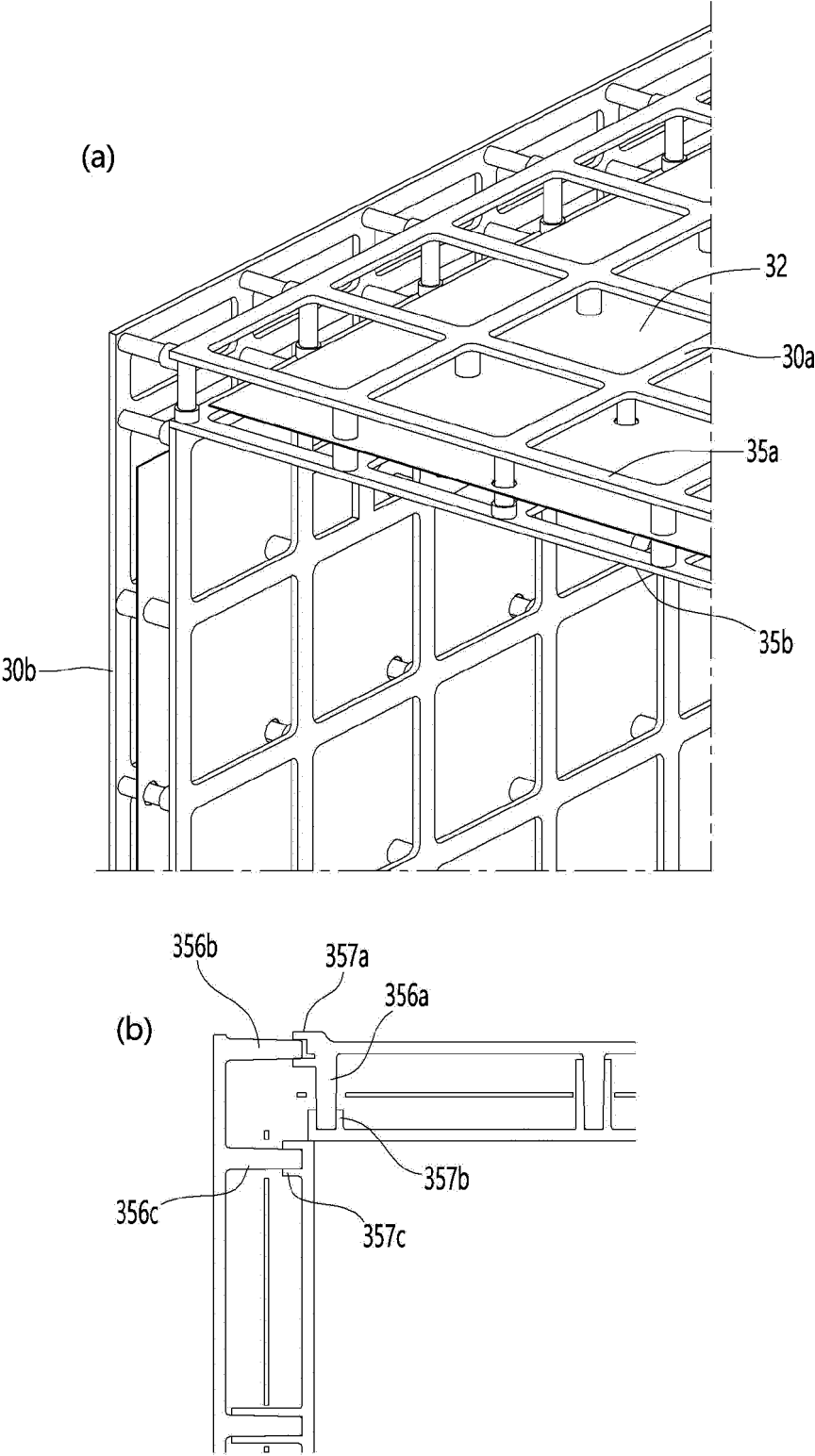
【Figure 17】



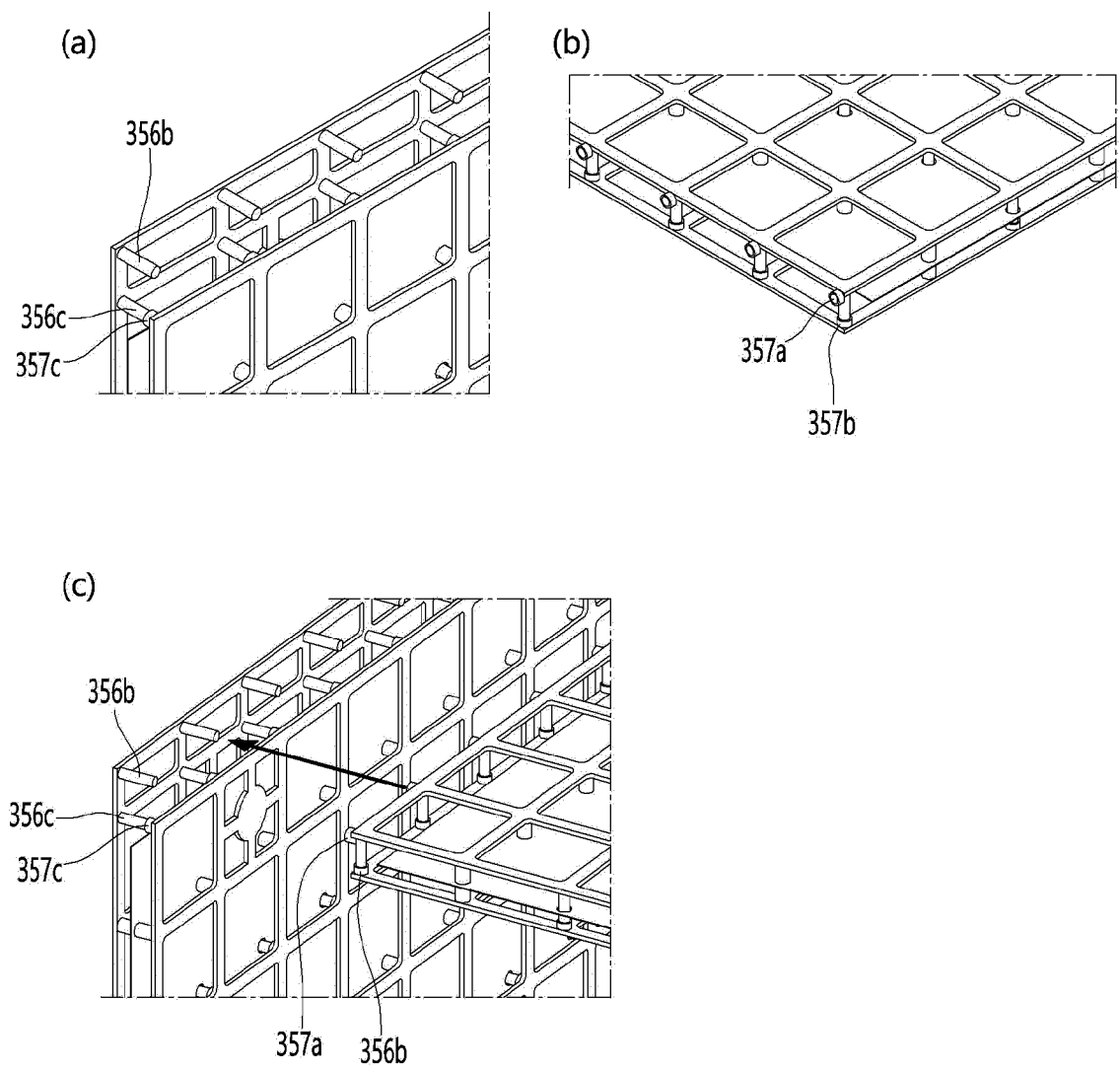
【Figure 18】



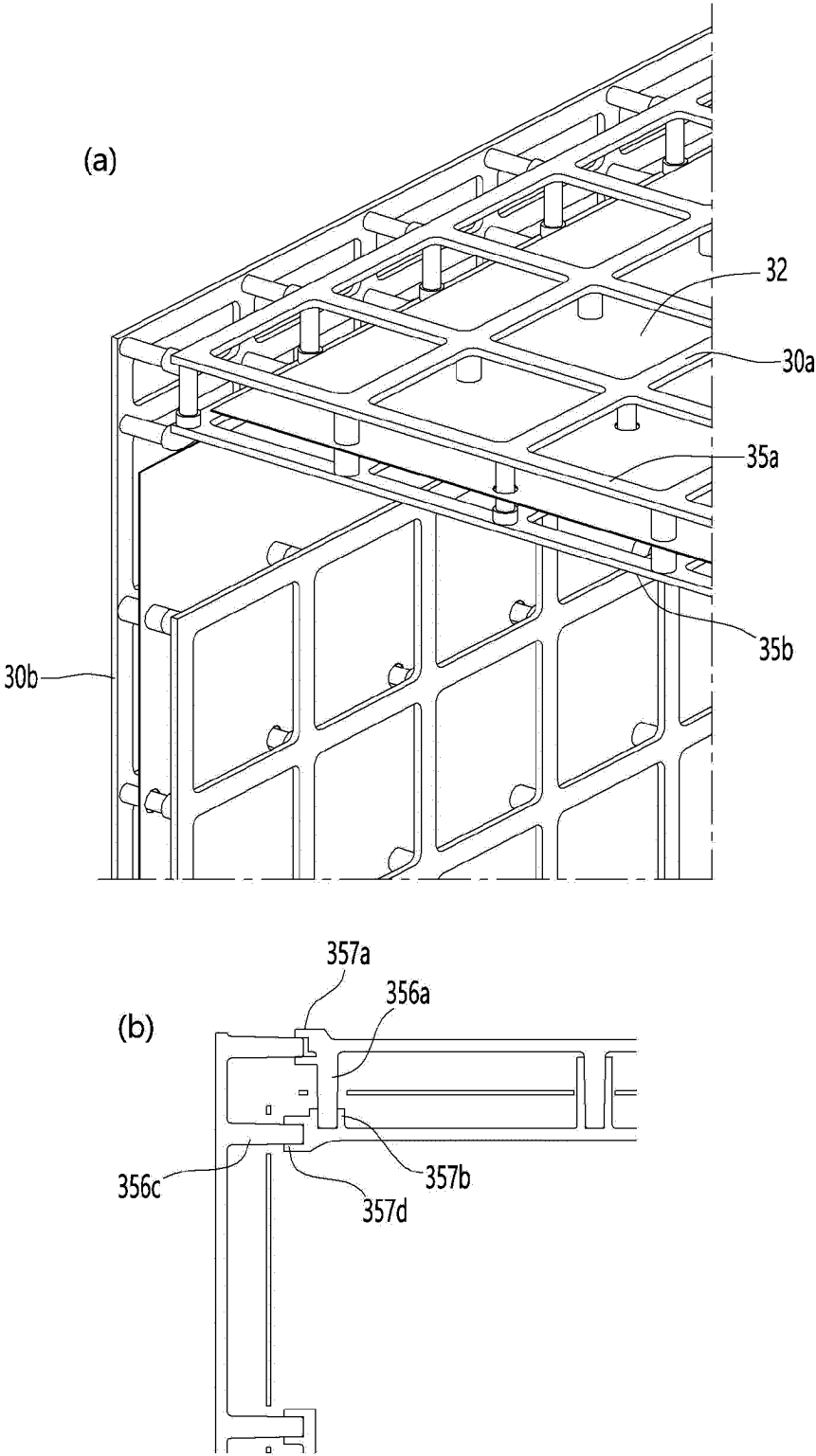
【Figure 19】



【Figure 20】



【Figure 21】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/008148

A. CLASSIFICATION OF SUBJECT MATTER

F25D 23/06(2006.01)i; F16L 59/065(2006.01)i; F16L 59/12(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25D 23/06(2006.01); B23K 1/00(2006.01); F16L 59/00(2006.01); F16L 59/06(2006.01); F16L 59/065(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 플레이트(plate), 진공공간부(vacuum space), 서포트(support), 벤딩 (bending), 진공단열체(vacuum insulator)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2022-0059342 A (LG ELECTRONICS INC.) 10 May 2022 (2022-05-10) See paragraphs [0051]-[0105]; claim 1; and figures 2-4 and 13-16.	1-16
Y	KR 10-2007-0023524 A (HITACHI APPLIANCES, INC.) 28 February 2007 (2007-02-28) See paragraphs [0057]-[0058]; and figure 2.	1-16
A	KR 10-2017-0045649 A (SAMSUNG ELECTRONICS CO., LTD.) 27 April 2017 (2017-04-27) See claim 1; and figures 4-6.	1-16
A	KR 10-2010-0099629 A (KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY) 13 September 2010 (2010-09-13) See paragraphs [0033]-[0037]; and figures 1a-1b.	1-16
A	KR 10-2017-0045645 A (SAMSUNG ELECTRONICS CO., LTD.) 27 April 2017 (2017-04-27) See paragraphs [0146]-[0225]; and figures 14-23.	1-16

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

23 February 2024

Date of mailing of the international search report

23 February 2024

Name and mailing address of the ISA/KR

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Authorized officer

Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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