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(54) METHOD FOR MANUFACTURING HEAT INSULATING BOX FOR REFRIGERATOR, AND THE REFRIGERATOR

(57) A refrigerator is provided with an outer box, an inner box which is provided within the outer box, and vacuum heat insulating panels which are provided between the outer box and the inner box. Of the vacuum heat insulating panels, adjacent vacuum heat insulating panels are disposed so as to be in contact with each other at a corner of both the outer box and the inner box.

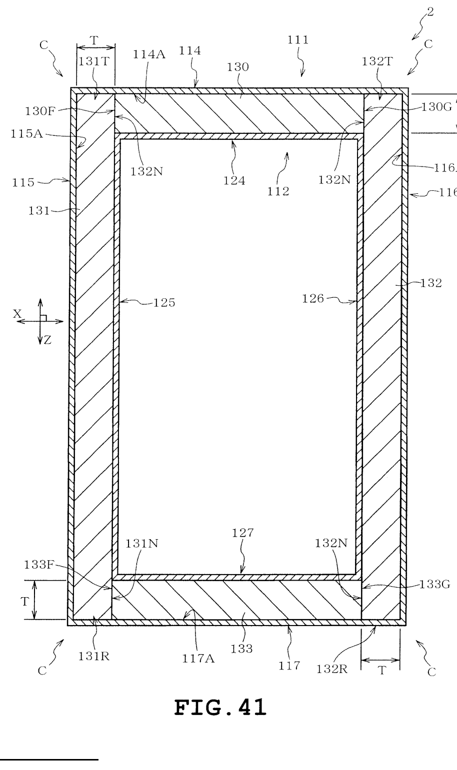

FIG.41

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Description

Technical Field

[0001] Embodiments described herein relate to a method of manufacturing a heat insulating box for a refrigerator and the refrigerator.

Background Art

[0002] There has conventionally been provided a heat insulating box for a refrigerator, including vacuum insulation panels as heat insulators, instead of a conventional urethane foam and the like.

Prior Art Document

Patent Document

[0003]

Patent Document 1: Japanese Patent Application Publication No. JP-A-H04-260780
Patent Document 2: Japanese Patent Application Publication No. JP-A-H06-147744
Patent Document 3: Japanese Patent Application Publication No. JP-A-2006-90649

Summary of the Invention

Problem to be overcome by the Invention

[0004] The vacuum insulation panel is generally formed into a plate shape. Accordingly, the following construction is considered as a heat insulating box provided with vacuum insulation panels. Firstly, a plurality of divided heat insulating walls constructing the heat insulating box are manufactured, and the divided heat insulating walls are thereafter combined into a box shape.

[0005] However, the heat insulating box constructed as described above has the following problems. Firstly, an enclosure of the heat insulating box is composed of outer plates which further form outer surfaces of the heat insulating walls. Accordingly, gaps are likely to occur in joints of the outer plates. External moisture flows through the gaps into the heat insulating box, with the result of possibility of adverse effects on the interior of the heat insulating box.

[0006] Secondly, a clearance is likely to occur in joints of the heat insulating walls, namely, at corners of the heat insulating box. Accordingly, there is a possibility that cold air in the refrigerator would leak through the clearance and the heating insulating performance of the heat insulating box may be reduced.

[0007] Therefore, an object is to provide a method of manufacturing a heat insulating box for a refrigerator and the refrigerator both of which can firstly reduce the joints of the outer plates and secondly ensure the heat insulation performance at the corners of the heat insulating box.

Means for Overcoming the Problem

[0008] According to one embodiment, a method of manufacturing a heat insulating box of a refrigerator is provided wherein the heat insulating box includes a right heat insulating wall, a left heat insulating wall, an upper heat insulating wall, a lower heat insulating wall and a rear heat insulating wall and is formed into a rectangular box shape with an open front; wherein the heat insulating box has vacuum insulation panels between outer plates and inner plates respectively; and wherein a heat insulating wall main body is manufactured by the method, the heat insulating wall main body including one of the heat insulating walls and two of the remaining heat insulating walls, continuous with opposite ends of the one heat insulating wall respectively, the other remaining heat insulating walls being joined to the heat insulating wall main body.

[0009] The method includes a first step of bonding one sides of the vacuum insulation panels to an inner surface of a plate member formed into a flat shape and having regions corresponding to the outer plates of the one heat insulating wall and the two remaining heat insulating walls respectively, the inner surface of the plate member belonging to the corresponding regions, wherein one of the vacuum insulation panels adjacent to each other at a boundary of the corresponding regions has an end caused to correspond to the boundary, and the other vacuum insulation panel has an end spaced away from the boundary by a minimum distance which allows the plate member to be folded at the boundary; a second step of bonding the inner plates to sides of the vacuum insulation panels opposed to the one sides of the vacuum insulation panels bonded at the first step, before or after execution of the first step; and a third step of folding the plate member inward at the boundaries after execution of the first and second steps.

[0010] According to one embodiment, a refrigerator includes an outer box, an inner box provided in the outer box and vacuum insulation panels provided between the outer box and the inner box. Of the vacuum insulation panels, the vacuum insulation panels adjacent to each other are disposed to be in contact with each other at a corner of the outer and inner boxes.

Brief Description of the Drawings

[0011]

FIG. 1 is a perspective view of a refrigerator according to a first embodiment as viewed obliquely from above;
FIG. 2 is a perspective view of a heat insulating box as viewed obliquely from above;
FIG. 3 is a perspective view of the heat insulating box as viewed obliquely from below;

FIG. 4 is a transversely sectional plan view of the heat insulating box;
FIG. 5 is an exploded perspective view of a left heat insulating wall;
FIG. 6 is a perspective view of an upper inner plate as viewed obliquely from below;
FIG. 7 is a perspective view of a lower inner plate as viewed obliquely from above;
FIG. 8 is an enlarged view of part K as shown in FIG. 4;
FIG. 9 is a transversely sectional plan view of a corner formed by the left heat insulating wall and a rear insulating wall;
FIG. 10 is a longitudinally sectional front view of a corner formed by the left heat insulating wall and an upper heat insulating wall;
FIG. 11 is an exploded perspective view of a fixture and a left inner plate;
FIG. 12 is a perspective view showing the fixture mounted on the left inner plate;
FIG. 13 is a longitudinal section of the fixture mounted on the left inner plate;
FIG. 14 is a longitudinal section of the fixture on which a connecting plate is mounted;
FIG. 15 is a transversely sectional plan view of a joint of a transverse beam and the left heat insulating wall;
FIG. 16 is a perspective view of a shelf plate support as viewed from the back;
FIG. 17 is an exploded longitudinally sectional side view of the shelf plate support, the left inner plate and a screw;
FIG. 18 is a longitudinally sectional side view of the shelf plate support, showing the mounted state thereof;
FIG. 19 is a perspective view of the heat insulating box of the refrigerator according to a second embodiment, as viewed obliquely from below;
FIG. 20 is a is a perspective view of the heat insulating box as viewed obliquely from above;
FIG. 21 is an exploded perspective view of the left heat insulating wall;
FIG. 22 is a transversely sectional plan view of the corner formed by the left heat insulating wall and the inner insulating wall;
FIG. 23 is a longitudinally sectional side view of the shelf plate support;
FIG. 24 is a longitudinally sectional side view of the shelf plate support, as viewed at a different position from Fig. 23;
FIG. 25 is an exploded perspective view of the shelf plate support and a reinforcing plate, as viewed from the back;
FIG. 26 is a longitudinally sectional side view of a partition wall support;
FIG. 27 is a perspective view of the partition wall support;
FIG. 28 is a perspective view of the heat insulating box of the refrigerator according to a third embodiment, as viewed obliquely from above;
FIG. 29 is an exploded perspective view of the left heat insulating wall;
FIG. 30 is a longitudinally sectional side view of the shelf plate support, showing a fourth embodiment;
FIG. 31 is an exploded longitudinally sectional side view of the shelf plate support;
FIG. 32 is a longitudinally sectional front view of the heat insulating box according to a fifth embodiment;
FIG. 33 is a transversely sectional plan view taken along line X33-X33 in FIG. 32;
FIG. 34 is a longitudinally sectional side view of an integral piece of the right outer plate and the right unit panel in the manufacturing process;
FIG. 35 is a view explaining application of adhesive by a roll coating method;
FIG. 36 illustrates a manufacturing process (No. 1);
FIG. 37 illustrates a manufacturing process (No. 2);
FIG. 38 illustrates a manufacturing process (No. 3);
FIG. 39 is a view similar to FIG. 36, showing a sixth embodiment;
FIG. 40 is a view similar to FIG. 38;
FIG. 41 is a longitudinally sectional view of the refrigerator according to a seventh embodiment;
FIGS. 42A and 42B are a development view of an outer surface and a side surface of a metal plate forming the outer box and a perspective view of an outer box formed by folding the metal plate as shown in FIG. 42A, respectively;
FIG. 43 illustrates a schematic structure of the vacuum insulation panel;
FIG. 44 illustrates an eighth embodiment;
FIG. 45 illustrates a ninth embodiment;
FIG. 46 illustrates a tenth embodiment;
FIG. 47 illustrates an eleventh embodiment;
FIG. 48 illustrates a twelfth embodiment;
FIG. 49 illustrates another embodiment;
FIG. 50 illustrates further another embodiment; and
FIG. 51 illustrates a method of manufacturing the heat insulating box.

Best Mode for Carrying Out the Invention

[0012] A plurality of embodiments will be described in the following. Identical or similar parts through the embodiments are labelled by the same reference symbols throughout the embodiments and duplicate description will be eliminated.

First Embodiment

[0013] A refrigerator 1 according to a first embodiment will be described with reference to FIGS. 1 to 18. Referring to FIG. 1, the refrigerator 1 includes a heat insulating box 2. The heat insulating box 2 has a front formed with an opening. Double doors, that is, a left pivot door 3 and a right pivot door 4, and a plurality of pullout doors 5 to 8 are mounted at the front side of the heat insulating box

2. Each one of the doors 3 to 8 has a heat insulator (not shown) therein. More specifically, the doors 3 to 8 are heat insulating doors. The left pivot door 3 is pivotally mounted on a pair of upper and lower hinges 3a and 3b further mounted on a left part of the heat insulating box 2. The right pivot door 4 is pivotally mounted on a pair of upper and lower hinges 4a and 4b further mounted on a right part of the heat insulating box 2.

[0014] The heat insulating box 2 is constructed by connecting a left heat insulating wall 9, a right heat insulating wall 10, an upper heat insulating wall 11, a lower heat insulating wall 12 and a rear heat insulating wall 13 to one another. The heat insulating walls 9 to 13 serve as unit heat insulating walls.

[0015] The heat insulating box 2 has transverse beam members 51, 52 and 53, a longitudinal beam member 54, a first partition wall 55 and a second partition wall 56, as shown in FIGS. 2 and 3. The transverse beam members 51 to 53 extend transversely between right and left edges of the front opening of the heat insulating box 2. The longitudinal beam member 54 vertically connect midway parts of the transverse beam members 52 and 53 to each other. The first partition wall 55 is provided for defining storage compartments and is located in the rear of the transverse beam member 51. The second partition wall 56 is provided for defining storage compartments and is located in the rear of the transverse beam member 52.

[0016] The refrigerator 1 includes, inside the heat insulating box 2, a refrigerating compartment 57, a vegetable compartment 58, a small freezing compartment 59, an ice-making compartment 60 and a freezing compartment 61, all of which serve as the storage compartments. The refrigerating compartment 57 is defined above the first partition wall 55. The vegetable compartment 58 is located between the first and second partition walls 55 and 56. The small freezing compartment 59 is a space defined between the transverse beam members 52 and 53 and is located on the right of the longitudinal beam member 54 as viewed at the front. The ice-making compartment 60 is another space defined between the transverse beam members 52 and 53 and is located on the left of the longitudinal beam member 54 as viewed at the front. The freezing compartment 61 is located below the small freezing compartment 59 and the ice-making compartment 60.

[0017] The pivot doors 3 and 4 open and close the refrigerating compartment 57. The pullout door 5 opens and closes the vegetable compartment 58. A vegetable container (not shown) is mounted on the back of the pullout door 5. The pullout door 6 opens and closes the small freezing compartment 59. A frozen food container (not shown) is mounted on the back of the pullout door 6. The pullout door 7 opens and closes the ice-making compartment 7. An ice-receiving vessel (not shown) is mounted on the back of the pullout door 7. The pullout door 8 opens and closes the freezing compartment 61. A frozen food container (not shown) is mounted on the back of the pullout door 8.

[0018] The second partition wall 56 separates the vegetable compartment 58 from the small freezing compartment 59 and the ice-making compartment 60 in a heat-insulation manner. There is a large temperature difference between the vegetable compartment 58, and the small freezing compartment 59 and the ice-making compartment 60. Accordingly, the second partition wall 56 comprises a heat insulating material such as polystyrene foam or urethane foam. On the other hand, the first partition wall 55 divides the refrigerating compartment 57 from the vegetable compartment 58. The temperature difference between the refrigerating compartment 57 and the vegetable compartment 58 is relatively smaller. Accordingly, the first partition wall 55 is constructed of a plate made of synthetic resin, for example.

[0019] The heat insulating box 2 has an outer box 14 and an inner box 15 as shown in FIGS. 2 to 4. The outer box 14 forms an entire framework of the heat insulating box 2 and has a left outer plate 14A, a right outer plate 14B, an upper outer plate 14C, a lower outer plate 14D and a rear outer plate 14E, all of which are formed separately from one another. Each one of the outer plates 14A to 14E is made of a steel plate. The left outer plate 14A forms a left outer surface of the heat insulating box 2. The right outer plate 14B forms a right outer surface of the heat insulating box 2. The upper outer plate 14C forms an upper outer surface of the heat insulating box 2. The lower outer plate 14D forms a lower outer surface of the heat insulating box 2. The rear outer plate 14E forms a rear outer surface of the heat insulating box 2. The left and right outer plates 14A and 14B are configured to be bilaterally symmetric.

[0020] The inner box 15 has a plurality of, for example, five separately formed inner plates, that is, a left inner plate 15A, a right inner plate 15B, an upper inner plate 15C, a lower inner plate 15D and a rear inner plate 15E. The left inner plate 15A forms a left inner surface of the heat insulating box 2. The right inner plate 15B forms a right inner surface of the heat insulating box 2. The upper inner plate 15C forms an upper inner surface of the heat insulating box 2. The lower inner plate 15D forms a lower inner surface of the heat insulating box 2. The rear inner plate 15E forms an inner rear surface of the heat insulating box 2.

[0021] The right and left inner plates 15B and 15A are configured to be bilaterally symmetric. Each one of the inner plates 15A and 15B is constructed of a flat plate-shaped sheet member Sa made of a synthetic resin such as ABS resin, for example. FIG. 5 shows the sheet member Sa to which are attached fixtures 26, a shelf plate support 30, guide rail mountings 33 and 34 and partition wall support fixtures 35 and 36.

[0022] The upper inner plate 15C has an L-shaped part 17 which is formed integrally therewith and bulges inside the refrigerator as a folded part, as shown in FIG. 6. The upper inner plate 15C is, for example, an integral molded article Ia made of a synthetic resin such as olefin resin, for example. The lower inner plate 15D has a discharged water receiver 18 which is formed integrally therewith and serves as a folded part, as shown in FIG. 7. The lower inner plate 15D is, for example, an integral molded article Ib made of a synthetic resin such as olefin resin. The integral molded articles Ia and Ib are formed by the injection molding or vacuum molding.

[0023] The rear inner plate 15E is constructed of a flat plate-shaped sheet member Sb made of a synthetic resin. The sheet members Sa and Sb can be manufactured by extrusion molding or vacuum molding without use of a molding die having a special configuration. The sheet members Sa and Sb may be commercially available flat plate-shaped sheet members.

[0024] The heat insulating box 2 has a vacuum insulation panel 16 as shown in FIG. 4. The vacuum insulation panel 16 is located between the outer and inner boxes 14 and 15. The vacuum insulation panel 16 is constructed of a left unit panel 16A, a right unit panel 16B, an upper unit panel 16C as shown in FIG. 10, a lower unit panel (not shown) and a rear unit panel 16E, all of which are formed separately from one another. These left, right, upper, lower and rear unit panels 16A to 16E serve as unit panels. The left, right, upper, lower and rear unit panels 16A to 16E are common in a basic construction. Accordingly, the basic construction of the left unit panel 16A will be described.

[0025] The left unit panel 16A is formed by putting a base material 19 into an envelope 20 and decompressing and closely sealing the envelope 20 by vacuum evacuation, as shown in FIGS. 8 and 9. The base material 19 is formed into a plate shape by compressing and thereby hardening a laminated material of inorganic fiber such as glass wool. The envelope 20 contains a metal layer such as vapor deposited aluminum layer or aluminum foil layer. Each unit panel is generally referred to as "vacuum insulation panel."

[0026] The left heat insulating wall 9 is a unit heat insulating wall and has the left outer plate 14A, the left inner plate 15A and the left unit panel 16A as shown in FIG. 5. The left unit panel 16A is located between the left outer and inner plates 14A and 15A. The left unit panel 16A and the left outer plate 14A are bonded together by an adhesive, and the left unit panel 16A and the left inner plate 15A are bonded together by an adhesive.

[0027] The heat insulating box 2 has a front end connecting member 21 as shown in FIG. 8. The front end connecting member 21 has heat insulating properties and connects front ends of the outer and inner boxes 14 and 15 together. More specifically, the front end connecting member 21 is mounted on front ends of the right and left heat insulating walls 10 and 9. The front end connecting members 21 connect the front ends of the right and left heat insulating walls 10 and 9. The front ends of the right and left heat insulating walls 10 and 9 are bilaterally symmetric. The left heat insulating wall 9 will be described regarding the construction of the right and left heat insulating walls 10 and 9.

[0028] The left outer plate 14A has a folded part 14Aa. The left outer plate 14A has a front end including a part extending in front of the left unit panel 16A. The folded part 14Aa is formed by folding the extending part of the outer plate 14A to the left inner plate 15A side. The folded part 14Aa extends midway in a thickness direction of the left heat insulating wall 9 but does not enter the inside of the heat insulating box 2, namely, the storage compartment side. This suppresses transfer of heat of the left outer plate 14A, namely, the outer box 14 or outside air heat to the interior of the storage compartment.

[0029] The heat insulating box 2 has a soft tape serving as a heat insulator, for example. The soft tape 22 is disposed in a space defined by a front end of the left unit panel 16A, a front end inner surface of the left outer plate 14A and an inner surface of the front end connecting member 21. Polystyrene foam may be used instead of the soft tape 22. The right heat insulating wall 10 is constructed in the same manner as the left heat insulating wall 9 except for bilateral symmetry.

[0030] The upper heat insulating wall 11 is constructed as follows, for example. The upper unit panel 16C is disposed between the upper inner plate 15C and the upper outer plate 14C, and the upper inner plate 15C and the upper unit panel 16C are bonded together by an adhesive, as shown in FIGS. 2 and 10. A space defined between the upper unit panel 16C and the upper outer plate 14C is filled with urethane foam 24F, which is then solidified. The upper inner plate 15C is constructed of the integral molded article Ia made of a synthetic resin and has the L-shaped part 17 which is formed integrally therewith and bulges inside the refrigerator as the folded part, as shown in FIG. 6. The upper outer plate 14C also has an L-shaped part 17a as shown in FIG. 2. Accordingly, the upper heat insulating wall 11 has an overall rear part protruding downward. More specifically, the upper heat insulating wall 11 includes a rear part formed with a recess 11a. A space in the rear of the recess 11a is formed into a component chamber 11b. A compressor, a condenser and the like constituting a refrigerating cycle are disposed in the component chamber 11b.

[0031] A space defined between the upper unit panel 16C and the upper outer plate 14C as shown in FIG. 10, namely, the space defined between the upper unit panel 16C and the upper outer plate 14C and filled with urethane foam 24F has a vertical dimension that is smaller than a thickness of the upper unit panel 16C and an outer diameter of the piping of the refrigerating cycle, such as a suction pipe. This reduces an amount of the urethane foam 24F used. When a pipe of the refrigerating cycle is drawn, the pipe may pass in a front-back direction through a space surrounded by a left end surface of the upper unit panel 16C, an upper end surface of the left unit panel 16A and a corner of the upper outer plate 14C. The component chamber 11b is closed by a component chamber cover 11c as shown in FIG. 1.

[0032] The upper outer plate 14C has a left end connected to the left outer plate 14A of the left heat insulating wall 9 while the left end is spaced away from an upper surface of the upper unit panel 16C. The upper outer plate 14C also has a right end connected to the right outer plate 14B of the right heat insulating wall 10 while the right end is spaced away from an upper surface of the upper unit panel 16C, in the same manner as the left end thereof. The upper inner plate 15C has connecting parts 15C1 formed on right and left side edges thereof respectively. The left connecting part 15C1 has a distal end connected to the left inner plate 15A by a connector (not shown) . The right connecting part 15C1 also has a distal end connected to the right inner plate 15B by a connector (not shown) in the same manner as the left connecting part 15C1.

[0033] The left connecting part 15C1 will be described here. However, the right connecting part 15C1 is constructed in the same manner as the left connecting part 15C1 except for bilateral symmetry. A rib 15C2 is formed on an inside of the distal end of the connecting part 15C1 so as to protrude upward, as shown in FIG. 10. A soft tape 23 is interposed between the rib 15C2 and the left inner plate 15A to serve as an insulator leak preventing member, for example. The corner including the space above the upper unit panel 16C, that is, a space surrounded by the left unit panel 16A, the upper unit panel 16C and the connecting part 15C1 is filled with urethane foam 24F serving as a heat insulator, for example, and the urethane foam is solidified. In this case, the soft tape 23 prevents leak of the urethane foam 24F when the urethane foam 24F is supplied into the space.

[0034] The lower heat insulating wall 12 is a unit heat insulating wall and includes the lower outer plate 14D, the lower inner plate 15D and a lower unit panel (not shown) disposed between the lower outer plate 14D and the lower inner plate 15D. The lower unit panel is bonded to the lower outer plate 14D and further to the lower inner plate 15D by the adhesive. The lower heat insulating wall 12 may be constructed by bonding the lower inner plate 15D to the lower unit panel and filling the space between the lower unit panel and the lower outer plate 14D with the urethane foam, which is then solidified. A lowest part of the discharged water receiver 18 communicates with the outside of the heat insulating box 2.

[0035] Regarding the rear heat insulating wall 13, too, the rear unit panel 16E is disposed between the rear outer plate 14E and the rear inner plate 15E. The rear unit panel 16E is bonded to the rear outer plate 14E and further to the rear inner plate 15E by the adhesive. In this case, too, the construction in which the urethane foam is supplied and solidified may be added appropriately.

[0036] A surface treatment for roughening a surface is applied to the integral molded articles Ia and Ib each made of olefin resin, that is, surfaces of the upper and lower inner plates 15C and 15D bonded to the unit panel. This can improve a bonding performance between the bonding surfaces of the upper and lower inner plates 15C and 15D and the unit panel. The sheet members Sa and Sb made of the ABS resin, that is, the left, right and rear inner plates 15A, 15B and 15C each have a good adhesion to the unit panel.

[0037] The construction for connecting the left and rear heat insulating walls 9 and 13 will be described with reference to FIGS. 9 and 11 to 14. The left and rear heat insulating walls 19 and 13 are connected to each other using a sheet member connecting plate 25, fixtures 26 and the like. The sheet member connecting plate 25 serves as a sheet member connecting member. Each fixture 26 serves as a protruding part which is a component discrete from the sheet member. Further, the construction for connecting the left and rear heat insulating walls 9 and 13 is the same as that of the left and rear heat insulating walls 9 and 13 except for bilateral symmetry. The construction for connecting the left and rear heat insulating walls 9 and 13 will be described in the following.

[0038] Firstly, the fixture 26 will be described. The fixture 26 is made of a synthetic resin such as an ABS resin, for example. The fixtures 26 are mounted on the left and rear heat insulating walls 9 and 13 respectively. The fixtures 26 have the same structure and the left and rear heat insulating walls 9 and 13 have the same structure for mounting the respective fixtures 26. Accordingly, the fixture 26 mounted on the left heat insulating wall 9 will be described. The fixture 26 is made of a synthetic resin and is formed into a slightly vertically long rectangular shape as shown in FIG. 11 and the like. The fixture 26 has flanges 26a and a screw hole 26c. The flanges 26a are located at one end of the fixture 26 and protrude in the up-down direction. The screw hole 26c has an internal thread and is formed to extend from the other end surface toward the one end side of the fixture 26.

[0039] The sheet member Sa serving as the left inner plate 15A has a hole 15u formed therethrough. The hole 15u is formed into a vertically long rectangular shape and is slightly larger than a profile of the fixture 26. The fixture 26 is bonded to the left unit panel 16A, for example, by an adhesive at a stage of fabrication process before assembly of the left heat insulating wall 9. The fixture 26 is inserted into the hole 15u. The left unit panel 16A is then bonded to a back side of the left inner plate 15A including an end surface of the fixture 26 at the left unit panel 16A side by an adhesive. In this case, the upper and lower flanges 26a are held between the left inner plate 15A which is the sheet member Sa and the left unit panel 16A which is the vacuum insulation panel. The fixture 26 is mounted on the left heat insulating wall 9, protruding into the inner box 15. A plurality of the upper and lower fixtures 26 is mounted on adjacent ends of the left heat insulating wall 9 and the rear heat insulating wall 13.

[0040] The sheet member connecting plate 25 has a vertical dimension or length that is substantially equal to that of the left inner plate 15A, as shown in FIGS. 2 and 3. The sheet member connecting plate 25 has recesses 25a and screw holes 25b. The recesses 25a are formed in both transverse ends of the sheet member connecting plate 25 so as to correspond to the fixtures 26 respectively. The screw holes 25b are formed through central parts of the recesses 25a so as to be circular in shape, respectively. The screws 27 are passed through the screw holes 25b from the refrigerator interior side to be screwed into the screw holes 26c of the fixtures 26 respectively. As a result, the sheet member connecting plate 25 connects the left inner plate 15A of the left heat insulating wall 9 and the rear inner plate 15E of the rear heat insulating wall 13. The sheet member connecting plates 25 are located at both corners of the refrigerating compartment 57, the vegetable compartment 58, the small freezing compartment 59, the ice-making compartment 60 and the freezing compartment 61 respectively.

[0041] Polystyrene foam 28 serving as a heat insulator and a soft tape 29 are inserted in a rear space of the sheet member connecting plate 25. The piping of the refrigerating cycle may pass through the polystyrene foam 28 as viewed in FIG. 9.

[0042] The right and left heat insulating walls 10 and 9 have shelf supports 30 respectively as shown in FIG. 5. Each shelf support 30 is made of a synthetic resin and serves as a protrusion configured to be discrete from the sheet material. Since the shelf supports 30 have the same mounting structure in the right and left heat insulating walls 10 and 9, the following will describe the construction and mounting structure of only the shelf support 30 of the left heat insulating wall 9 with reference to FIGS. 16 to 18.

[0043] The shelf support 30 includes a body 30a and three shelf support portions 30b both formed integrally therewith. The body 30a is formed into a vertically long plate shape. The shelf support portions 30b are mounted to protrude from the surface of the body 30a toward the refrigerator interior. The shelf support portions 30b are vertically aligned. The shelf support portion 30b has three female screw holes 30c and three counterbores 30d. The screw holes 30c extend from the surface of the body 30a opposed to the refrigerator interior to the respective middle insides of the shelf support portions 30b. The screw holes 30c serve as clamping member engaging portions. The counterbores 30d each have a dish shape and are formed on peripheral edges of the openings of the screw holes 30c so as to correspond to the screw holes 30c respectively.

[0044] The left inner plate 15A of the left heat insulating wall 9 has three screw holes 31 serving as clamping member insertion holes. The screw holes 31 are formed to correspond to the refrigerating compartment 57 and to be vertically aligned. FIG. 17 shows one of the screw holes 31. In assembly of the left heat insulating wall 9, countersunk head screws 32 serving as clamping members are firstly passed through the screw holes 31 from the back side of the left inner plate 15A to be screwed into the screw holes 30c of the shelf supports 30, respectively. As a result, the shelf support 30 is fixed to the left inner plate 15A so as to protrude to the interior of the inner box 15.

[0045] In this case, the left inner plate 15A is slightly deformable since it is a sheet member. Accordingly, when the countersunk head screw 32 is screwed into the shelf plate support 30, a countersunk head 32a of the screw 32 deforms the peripheral edge of the screw hole 31 of the left inner plate 15A into a countersunk shape (or is caused to bulge to the interior side) till the peripheral edge abuts against the counterbore 30d. As a result, the peripheral edge 31a of the screw hole 31 is spaced away from the left unit panel 16A. The countersunk head screw 32 does not protrude toward the left unit panel 16A from the back of the left inner plate 15A.

[0046] Each one of the right and left heat insulating walls 10 and 9 has two guide rail mountings 33 and 34 as shown in FIGS. 2, 3 and 5, all of which show only the guide rail mountings 33 and 34 of the left heat insulating wall 9. The guide rail mounting 33 is mounted on an interior side surface of the inner box 15 defining the vegetable compartment 58. The guide rail mounting 34 is mounted on an interior side surface of the inner box 15 defining the freezing compartment 61. The guide rail mountings 33 and 34 are made of synthetic resin and serve as protrusions configured to be discrete from the sheet material.

[0047] The guide rail mountings 33 and 34 are mounted on the left inner plate 15A of the left heat insulating wall 9 and the right inner plate 15B of the right heat insulating wall 10 in a mounting structure similar to that of the shelf plate supports 30. The guide rail mountings 33 are provided for mounting a guide rail drawably supporting a vegetable container formed integrally with the pullout door 5. The guide rail mountings 34 are provided for mounting a guide rail drawably supporting a frozen food container formed integrally with the pullout door 8.

[0048] Each one of the right and left heat insulating walls 10 and 9 has two partition wall supports 35 and two partition wall supports 36. The partition wall supports 35 are mounted on the inner surface of the inner box 15 to support the first partition wall 55. The partition wall supports 36 are also mounted on the inner surface of the inner box 15 to support the second partition wall 56. The partition wall supports 35 and 36 are made of synthetic resin and serve as protrusions configured to be discrete from the sheet material. The partition wall supports 35 and 36 are mounted on the right and left heat insulating walls 10 and 9 in a mounting structure similar to that of the fixtures 26.

[0049] The rear heat insulating wall 13 has rear cover mountings 37 as shown in FIGS. 2 and 3. The rear cover mountings 37 are mounted on the inner surface of the inner box 15, that is, the inner plate 15E configured of the sheet member Sb. The rear cover mountings 37 are made of synthetic resin and serve as protrusions configured to be discrete from the sheet material. The rear cover mountings 37 are provided for mounting a rear cover to hide ducts disposed in front of the rear heat insulating wall 13, and the like. The rear cover mountings 37 are mounted in a mounting structure similar to that of the fixtures 26. No urethane foam fills the spaces between the inner plates and the unit panels forming the heat insulating walls 9 to 13.

[0050] An evaporator 64 forming the refrigerating cycle is disposed in an inner interior of the freezing compartment 61 as shown in FIG. 2. A drain receiver 18 is disposed below the evaporator 64 to receive defrost water resulting from frost removal from the evaporator 64, and the like. The defrosted water received by the drain receiver 18 is then discharged downward outside the rear heat insulating wall 13.

[0051] The following will describe connecting portions between the transverse beam member 52 and the right and left heat insulating walls 10 and 9 with reference to FIG. 15. Although

[0052] FIG. 15 shows the connecting portion between the transverse beam member 52 and the left heat insulating wall 9, the connecting portion between the transverse beam member 52 and the right heat insulating wall 10 is basically similar to that between the transverse beam member 52 and the left heat insulating wall 9. The transverse beam member 52 includes a front partition plate 52a forming a front, a reinforcing plate 52b, a rear partition cover 52c and heat insulator 52d. The left outer plate 14A of the left heat insulating wall 9 has a front 14A3 having a distal end folded.

[0053] The front partition plate 52a is held between the reinforcing plate 52b and a folded portion 14A2 of the left outer plate 14A. More specifically, the front partition plate 52a has an end which is placed on the back of the front 14A3 of the left outer plate 14A. A screw 62 is inserted through holes (not shown) of the front partition plate 52a and the folded portion 14A2 to be screwed into a screw hole of the reinforcing plate 52b. The front partition plate 52a and the reinforcing plate 52b are unified together by screws 63.

[0054] The back partition cover 52c is disposed on the rear of the front partition plate 52a. The heat insulator 52d is placed inside the rear partition cover 52c. The right and left edges of the front opening of the heat insulating box 2 are connected together by the front partition plate 52a. More specifically, the right and left heat insulating walls 9 and 10 are fixed with the front partition plate 52a being interposed therebetween. This can suppress extension and/or shrinkage of the front opening of the heat insulating box 2 and can maintain the heat insulating box 2 in a rectangular parallelepiped shape.

[0055] The reinforcing plate 52b may not be provided when the front partition plate 52a has a sufficiently high strength. Further, the back partition cover 52c has a downwardly protruding mounting portion although the mounting portion is not shown. The mounting portion is screwed by a fixture similar to the fixture 26.

[0056] According to the first embodiment, the right and left inner plates 15B and 15A are constructed of the flat sheet members Sa. The rear inner plate 15E is constructed of the flat sheet member Sb. Accordingly, when the right, left and rear inner plates 15B, 15A and 15E are manufactured, no forming dies are required with the result that the manufacturing of the inner box can be rendered easier and the manufacturing costs can be reduced. Although the upper and lower inner plates 15C and 15D which are other portions of the inner box 15 are formed integrally with each other by the use of a forming die, the manufacturing of the inner box can be rendered easier and the manufacturing costs can be reduced as compared with the case where the overall inner box 15 is formed into an integrally molded article by the use of a large-sized forming die. This can generally reduce the manufacturing costs of the refrigerator. In this case, a part of the inner plates 15A to 15E may be constructed of the sheet member.

[0057] The inner box has the right, left, upper lower and rear inner plates 15A to 15E. In this case, the rear inner plate 15E and the left inner plate 15A are adjacent to each other and are separately constructed of different sheet members. The rear inner plate 15E and the right inner plate 15B are adjacent to each other and are separately constructed of different sheet members. The sheet connecting members 25 are disposed between the adjacent inner plates, that is, between the rear inner plate 15E and the left inner plate 15A and between the rear inner plate 15E and the right inner plate 15B respectively. The sheet member connecting plates 25 serve as sheet member connecting members connecting the adjacent inner plates.

[0058] According to the above-described construction, the rear inner plate 15E and the left inner plate 15A are constructed of the sheet members respectively, and the rear inner plate 15E and the right inner plate 15B are constructed of the sheet members respectively. However, the rear inner plate 15E and the left inner plate 15A can easily be connected to each other by the sheet member connecting plate 25, and the rear inner plate 15E and the right inner plate 15B can easily be connected to each other by the sheet member connecting plate 25. This can render the assembly of the heat insulating box 2 easier.

[0059] The outer box 14 is constructed of a plurality of divided outer plates, that is, the left outer plate 14A, the right outer plate 14B, the upper outer plate 14C, the lower outer plate 14D and the rear outer plate 14E. The inner box 15 is constructed of a plurality of divided inner plates, that is, the left inner plate 15A, the right inner plate 15B, the upper inner plate 15C, the lower inner plate 15D and the rear inner plate 15E. Of a plurality of the inner plates, the left inner plate 15A, the right inner plate 15B and the rear inner plate 15E are constructed of the sheet members Sa and Sb.

[0060] The vacuum insulation panel 16 is constructed of a plurality of divided unit panels, that is, the left unit panel 16A, the right unit panel 16B, the upper unit panel 16C, the lower unit panel (not shown) and the rear unit panel 16E. The left, right, upper, lower and rear heat insulating walls 9 to 13 serving as a plurality of unit heat insulating walls are constructed of the divided unit panels disposed between the divided outer and inner plates. The heat insulating box 2 is constructed by connecting the unit heat insulating walls 9 to 13 to one another.

[0061] According to this construction, the heat insulating box 2 having the unit panels serving as the vacuum insulation panels can be assembled by assembling the heat insulating walls 9 to 13. Accordingly, the assembly of the heat insulating box 2 can be rendered easier. In the conventional construction, the heat insulating box is constructed by assembling an outer box and an inner box both of which are undivided. Accordingly, the heat insulating box of the conventional construction is larger in size and necessitates an extensive assembling work. In the embodiment, however, the assembling work can be rendered easier than in the convention construction.

[0062] In the inner box 15, the part thereof constructed of the sheet member has the front end connected to the front end of the outer box 14 by the front end connecting member 21. Accordingly, even the part of the inner box 15 constructed of the sheet member can easily be connected to the outer box 14 by the front end connecting member 21 as the discrete component with the result that the inner box 15 can easily be assembled with the outer box 14.

[0063] The inner box 15 has the L-shaped portion 17 serving as the folded portion and the discharged water receiver 18. The L-shaped portion 17 is formed integrally with the upper inner plate 15C. The discharged water receiver 18 is formed integrally with the lower inner plate 15D. According to this construction, the L-shaped portion 17 and the discharged water receiver 18 can easily be formed by integral molding with the use of a die even though each of the L-shaped portion 17 and the discharged water receiver 18 has a complicate shape.

[0064] The inner box 15 has the fixtures 26, which are discrete from the sheet members Sa and Sb and serve as the protrusions protruding into the refrigerator interior. The fixtures 26 are directly bonded to the left unit panel 16A, for example, by the adhesive at a stage before assembly of the left heat insulating wall 9. The sheet members Sa and Sb are formed with the respective holes 15u. The fixtures 26 are inserted into the holes 15u respectively.

[0065] According to this construction, the fixtures 26 can be positioned in the inner box 15 by inserting the fixtures 26 into the respective holes 15u. Further, the wall supports 35 and 36 and the rear cover 37 have the similar mounting structure to that of the fixtures 26. Accordingly, the wall supports 35 and 36 and the rear cover 37 can be positioned in the same manner as the fixtures 26.

[0066] The fixtures 26 may be inserted into the holes 15u of the sheet member from the backside and bonded at the stage before assembly of the left heat insulating wall 9. According to this construction, the fixtures 26 and the sheet member can be handled in an integrated state. Accordingly, the unit panel and the integral piece of the fixture 26 and the sheet member can be bonded together when the unit heat insulating walls are assembled, with the result that the assembling work efficiency can be improved.

[0067] The unit panel 16A has a mounting surface for the fixture 26, which mounting surface is recessed, as shown in FIG. 13. Accordingly, the fixture 26 can be mounted on the unit panel 16A without the sheet member Sa curving. Even if the unit panel 16A bulges, the inner plate 15A is slightly deformed without breakage of the inner plate 15A since the inner plate 15A is constructed of the sheet member Sa. The fixtures 26, the shelf plate supports 30, the guide rail mountings 33 and 34 and the partition wall supports 35 and 36 can be used in common with heat insulating boxes of different types of refrigerators.

[0068] The fixtures 26 are directly bonded and fixed to the left, right and rear unit panels 16A, 16B and 16E respectively. Accordingly, with insertion of the fixtures 26 into the respective holes 15u of the inner plates 15A, 15B and 15E, the inner plates 15A, 15B and 15E and the unit panels 16A, 16B and 16E can be positioned. In this case, the fixtures 26 are made of an ABS resin having a good adherence. This can improve the bonding strength between the fixtures 26 and the unit panels.

[0069] The partition wall supports 35 and 36 and the rear cover mountings 37 have the same mounting structure as the fixtures 26. Accordingly, the partition wall supports 35 and 36 and the rear cover mountings 37 can contribute to the positioning of the inner plates and the unit panels. The fixtures 26 may be bonded via discrete members to the left, right and rear unit panels 16A, 16B and 16E.

[0070] The fixtures 26 have the respective flanges 26a, which are larger than the holes 15u. The flanges 26 are held between the right and left inner plates 15B and 15A constructed of the sheet members Sa and the rear inner plate 15E constructed of the sheet member Sb, and the unit panels corresponding to the inner plates 15A, 15B and 15E.

[0071] According to this construction, the flanges 26a are locked around the holes 15u respectively. Accordingly, the flanges 26a can be prevented from dropping out of the holes 15u. Further, the flanges 26a can be bonded to the inner plates. Accordingly, the flanges 26a can contribute to an improvement in the strength of peripheral parts of the inner plates to which the flanges 26a are bonded. Further, since the flanges 26a are thin, the flanges 26a can be flexed and inserted into the holes 15u from the refrigerator interior side in the flexed state thereby to be caused to enter between the inner plates and the unit panels.

[0072] The shelf plate supports 30 are discrete from the sheet members Sa and serve as the protrusions protruding in the refrigerator interior. The sheet members Sa, namely, the right and left inner plates 15B and 15A have screw insertion holes 31 respectively. The countersunk head screws 32 serving as the fastening members are inserted through the screw insertion holes 31 from the backside of the sheet member Sa to be screwed into the shelf plate supports 30. As a result, the shelf plate supports 30 are fixed to the surface side of the sheet member Sa.

[0073] According to this construction, the shelf plate supports 30 discrete from the sheet members Sa can be attached to the sheet members Sa by the countersunk head screws 32 serving as the fastening members. In this case, rivets may be used as the fastening members to fasten both the sheet members Sa and the shelf plate supports 30.

[0074] The peripheral edge 31a of the screw hole 31 is spaced away from the left unit panel 16A or the right unit panel 16b. The head 32a of the countersunk head screw 32 does not protrude from the peripheral edge 31a toward the left unit panel 16A side or the right unit panel 16B side. According to this construction, the screw heads 32a are prevented from protruding from the inner plates 15A and 15B respectively. Accordingly, the screw heads 32a are prevented from coming into contact with the unit panels 16A and 16B respectively. This can prevent damage to the envelope 20 due to contact of the screw heads 32a with the respective unit panels 16A and 16B. Further, since the screw heads 32a do not come into contact with the respective unit panels 16A and 16b, the left unit panel 16A and the left inner plate 15A are allowed to be bonded together, and the right unit panel 16B and the right inner plate 15B are allowed to be bonded together.

[0075] Further, the screw holes 30c have the opening peripheral edges formed with the respective dish-shaped counterbores 30d. As a result, when the countersunk head screw 32 is fastened, the peripheral edge 31a of the screw hole 31 of the sheet member Sa is deformed toward the counterbore 30d thereby to depart from the right and left unit panels 16B and 16A. Accordingly, the sheet member Sa need not be formed with a recess in which the screw head 32a is to be placed.

[0076] The guide rail mountings 33 and 34 also have the mounting structure similar to that of the shelf plate supports 30. Accordingly, the guide rail mountings 33 and 34 achieve the same effect as the shelf plate supports 30. Further, the shelf plate supports 30 and the guide rail mountings 33 and 34 (none of them being shown) mounted on the right heat insulating wall 10 achieve the same effects as the shelf plate supports 30.

Second Embodiment

[0077] A second embodiment will be described with reference to FIGS. 19 to 27. The structure of the right and left heat insulating walls 10A and 9A in the second embodiment differs from the structure of the right and left heat insulating walls 10A and 9A in the first embodiment. Since the right and left heat insulating walls 10A and 9A are bilaterally symmetrical, only the left heat insulating wall 9A will be described. A left inner plate 15A2 which is a part of the inner box 15 in the left heat insulating wall 9A has shelf plate supports 40a, 40b and 40c, guide rail mounts 41a and 41b and partition wall supports 42a and 42b, all of which serve as protrusions. The left inner plate 15A2 is constructed of an integral molding Ic of the shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b all of which are integrally molded. The integral molding Ic is formed by molding by the use of die, for example, injection molding or vacuum molding.

[0078] A sheet member connecting part 25A2 is formed integrally with the left inner plate 15A2. The sheet member connecting part 25A2 is provided on a rear end of the left inner plate 15A2. The sheet member connecting part 25A2 serves as a sheet member connecting member for connecting the left inner plate 15A2 and the rear inner plate 15E constructed of the sheet member Sb. The sheet member connecting part 25A2 is connected to the rear heat insulating wall 13 by fixtures 26 mounted on the rear inner plate 15E.

[0079] The shelf plate supports 40a, 40b and 40c differ from the guide rail mounts 41a and 41b in the front-back dimension. More specifically, the guide rail mounts 41a and 41b have a longer front-back dimension than the shelf plate supports 40a, 40b and 40c. On the other hand, the guide rail mounts 41a and 41b and the shelf plate supports 40a, 40b and 40c have the same cross-sectional shape and the same reinforcement structure. Accordingly, only the shelf support plate 40a will be described in the following.

[0080] The shelf plate support 40a is provided on the left inner plate 15A2 as the integral molding Ic and protrudes toward the interior of the refrigerator, as shown in FIGS. 22 to 25. The shelf support plate 40a has a screw boss 43 and a screw hole 43a as shown in FIGS. 23 and 25. The screw boss 43 is provided on a part of an inner surface of the shelf plate support 40a. The screw hole 43a is provided in the screw boss 43.

[0081] A metal reinforcing plate 44 serving as a reinforcing member is provided between the shelf support plate 40a and the unit panel 16A. The reinforcing plate 44 is shaped to correspond to an inner surface of the shelf plate support 40a. The reinforcing plate 44 is applied to the inner surface of the shelf plate support 40a, and a screw 45 is inserted through a screw insertion hole 44b. The screw 45 is then screwed into the screw hole 43a of the shelf plate support 40a, so that the reinforcing plate 44 is mounted to the inner surface of the shelf plate support 40a. Thus, the shelf plate support 40a is reinforced by the reinforcing plate 44.

[0082] The partition wall supports 42a and 42b correspond to the partition wall support fixtures 35 and 36 in the first embodiment respectively. The partition wall supports 42a and 42b have inner surfaces on which metal reinforcing plates 46 serving as reinforcing members are provided, respectively, as shown in FIGS. 26 and 27.

[0083] The reinforcing plates 44 and 46 may be screwed as necessary. For example, the reinforcing plates 44 and 46 may be bonded, instead of being screwed. The point is that the reinforcing plates 44 and 46 are provided between the left unit panel 16A and the left inner plate 15A2 so that the shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 43b are reinforced by the reinforcing plates 44 and 46.

[0084] In the second embodiment, the inner box 15 has the shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b, all of which serve as the protrusions protruding toward the interior of the refrigerator. The left inner plate 15A2 is constructed of the integral molding Ic of the shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b all of which are integrally molded. The shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b are all reinforced by the reinforcing plates 44 and 46 serving as the reinforcing members provided between the unit panels 16A as the vacuum insulation panels and the integral molding Ic.

[0085] According to this construction, the shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b are provided on the integral molding Ic. Accordingly, these protrusions need not be constructed of separate components. When the protrusions are formed into the integral molding, an olefin resin such as a polypropylene material having a slightly lower strength than an ABS resin in consideration of low material cost. The insufficient strength can be compensated by the reinforcing plates 44 and 46.

Third Embodiment

[0086] A third embodiment will be described with reference to FIGS. 28 and 29. The construction of the right and left heat insulating walls 10B and 9B in the third embodiment differs from those in the first and second embodiments. Only the difference will be described in the following. In this case, since the right and left heat insulating walls 10B and 9B are bilaterally symmetrical, only the left heat insulating wall 9B will be described.

[0087] The left inner plate 15A is divided into an upper plate 15Aa and a lower plate 15Ab in the third embodiment as shown in FIG. 29. The upper and lower plates 15Aa and 15Ab are vertically adjacent to each other. The upper plate 15Aa is formed into an integral molding Id by injection molding or vacuum molding. The upper plate 15Aa has shelf plate supports 40a, 40b and 40c formed integrally therewith in the same manner as in the second embodiment. The left heat insulating wall 9B is connected via sheet member connecting parts 25A and 25B to the rear heat insulating wall 13. The sheet member connecting part 25A is located in the refrigerating compartment 57 and is provided integrally with the upper plate 15Aa as shown in FIG. 29. The sheet member connecting part 25B is located in the vegetable compartment 58, the small freezing compartment 59, the ice-making compartment 60 and the freezing compartment 61 and formed to be discrete from the upper and lower plates 15Aa and 15Ab.

[0088] The lower plate 15Ab is formed of a flat plate-shaped sheet member Sc. The lower plate 15Ab has fixtures 26, guide rail mountings 33 and 34 and partition wall supports 35 and 36. The fixtures 26, the guide rail mountings 33 and 34 and the partition wall supports 35 and 36 are formed to be discrete from the sheet member Sc and serve as protrusions. The mounting structures of the fixtures 26, the guide rail mountings 33 and 34 and the partition wall supports 35 and 36 are similar to those in the first embodiment.

[0089] The upper plate 15Aa is located in the refrigerating compartment 57, forming an inner surface of the refrigerating compartment 57. The lower plate 15Ab is located in the vegetable compartment 58, the small freezing compartment 59, the ice-making compartment 60 and the freezing compartment 61, forming inner surfaces of these compartments. The first partition wall 55 is provided in a boundary of the upper and lower plates 15Aa and 15Ab.

[0090] According to the third embodiment, the right and left inner surfaces of the refrigerating compartment 57 are constructed of the upper plates 15Aa as the integral moldings Id respectively. Accordingly, the inner surface of the refrigerating compartment 57 looks good. More specifically, the user can easily view the inner surface of the refrigerating compartment 57 when pivot doors 3 and 4 are open. The user can also easily view the protrusions provided on the inner surface of the refrigerating compartment 57, that is, the shelf plate supports 40a, 40b and 40c when the pivot doors 3 and 4 are open.

[0091] In this case, since the shelf plate supports 40a, 40b and 40c as the protrusions are formed integrally with the integral molding Id by die forming, the shelf plate supports 40a, 40b and 40c protrude gently from the upper plate 15Aa. As a result, the overall integral molding Id inclusive of the shelf plate supports 40a, 40b and 40c looks good and renders the impression of hygiene better.

Fourth Embodiment

[0092] A fourth embodiment will be described with reference to FIGS. 30 and 31. The fourth embodiment differs from the first embodiment in that the shelf plate support 30 has a fin 30e. The fin 30e is provided on a peripheral edge of the body 30a. The fin 30e is inclined to the inner surface side of the inner box 15, that is, to the left inner plate 15A side in FIGS. 30 and 31 and is formed to be elastically deformable.

[0093] The fin 30e closely adheres to the inner surface of the inner box 15 in the mounted state of the shelf plate support 30. Accordingly, a gap between the inner surface of the inner box 15 and the shelf plate support 30 is concealed by the fin 30e. More specifically, the countersunk head screw 32 deforms the peripheral edge 31a of the screw hole 31 of the left inner plate 15 when screwed into the screw hole 30c of the shelf plate support 30. This sometimes results in occurrence of creases on the screw hole 31, and the creases sometimes cause a gap between the left inner plate 15A and the shelf plate support 30. According to the fourth embodiment, the gap can be concealed by the fin 30e.

Fifth Embodiment

[0094] A fifth embodiment will be described with reference to FIGS. 32 to 38. In the fifth embodiment, as shown in FIGS. 32 and 33, the heat insulating box 2 includes a left heat insulating wall 9, a right heat insulating wall 10, an upper heat insulating wall 11, a lower heat insulating wall 12 and a rear heat insulating wall 13 and is constructed into the shape of a rectangular box with an open front. The heat insulating walls 9 to 13 have vacuum insulation panels 16A to 16E serving as unit panels, between outer plates 14A to 14E and inner plates 15A to 15E, respectively. In this case, one heat insulating wall and two heat insulating walls continuous with both ends of the one heat insulating wall form a heat insulating wall entity with continuous outer plates. In the embodiment, the upper heat insulating wall 11 and the right and left heat insulating walls 10 and 9 continuous with both sides of the upper heat insulating wall 11 form a heat insulating wall main body 2S with continuous outer plates. In the heat insulating box 2, an upper interior serves as the refrigerating compartment 80, a middle interior serves as the freezing compartment 81 and a lower interior serves as a vegetable compartment 82.

[0095] A method of manufacturing the heat insulating box 2 will be described. Firstly, the heat insulating wall main body 2S is manufactured as will be described in the following.

[0096] An integral body 10U shown in FIG. 34 is constructed by joining the right unit panel 16B and the right inner plate 15B by an adhesive in the right heat insulating wall 10. A roll coater type is employed as a manner of applying an adhesive as shown in FIG. 35. The roll coater type uses a pair of feed rollers 71 and 72 and a supply roller 73. The supply roller 73 is provided to be capable of contacting with the roller 71, thereby supplying an adhesive to the roller 71.

[0097] When the adhesive is applied to an inner surface 16Bn of the right unit panel 16B, the rollers 71 to 73 are rotated in the directions of respective arrows while the right unit panel 16B is held between the paired rollers 71 and 72. The supply roller 73 then supplies the adhesive to the rolling side between the supply roller 73 and the feed roller 71. The feed roller 71 applies the adhesive supplied from the supply roller 73, to the inner surface 16Bn of the right unit panel 16B, and the paired rollers 71 and 72 feeds the right unit panel 16B in the direction of arrow in FIG. 35. In this case, the inner surface 16Bn corresponds to a surface opposed to an outer surface 16Bg, namely, one surface. A process of applying the adhesive to the inner surface 16Bn of the right unit panel 16B corresponds to a second step.

[0098] A right inner plate 15B is bonded to the inner surface 16Bn of the right unit panel 16B as shown in FIG. 34 after the adhesive has been applied to the inner surface 16Bn of the right unit panel 16B, whereby the integral body 10U is manufactured. In this case, the right inner plate 15B has a bent part 15Bs. The bent part 15Bs is located at one end of the right inner plate 15B and formed by bending the end substantially at 45° in the direction opposed to the unit panel 16B. The bent part 15Bs has a reverse face on which a heat insulator 74B configured of polystyrene foam or the like and having a triangular cross-section. The heat insulator 74B is bonded to the bent part 15Bs and the unit panel 16B by an adhesive, for example. A left inner plate 15A of the left heat insulating wall 9 and a left unit panel 16A are also bonded in the same manners as described above as shown in FIG. 36, so that the integral body 9U is formed. Further, the left heat insulating wall 9 has a folded portion 15As and a heat insulator 74A in the same manner as the right heat insulating wall 10.

[0099] Further, the upper inner plate 15C of the upper heat insulating wall 11 and the upper unit panel 16C are also bonded in the same manner as described above, so that an integral body 11U is constructed, as shown in FIG. 36. The upper inner plate 15C has two ends further having folded portions 15Cs1 and 15Cs2 and heat insulators 74C1 and 74C2, respectively.

[0100] The upper outer plate 14C of the upper heat insulating wall 11, the left outer plate 14A of the left heat insulating wall 9 and the right outer plate 14B of the right heat insulating wall 10 are formed of a single plate member 75. When the upper, left and right heat insulating walls 11, 9 and 10 are manufactured, the flat plate member 75 is firstly placed on a work table Ws as shown in FIG. 36. The plate member 75 has a flat shape before processing. Symbol 14C1 is assigned to a region corresponding to the upper outer plate 14C of the upper heat insulating wall 11. Symbol 14A1 is assigned to a region corresponding to the left outer plate 14A of the left heat insulating wall 9. Symbol 14B1 is assigned to a region corresponding to the right outer plate 14B of the right heat insulating wall 10.

[0101] The upper unit panel 16C has a length set to be equal to or slightly shorter than that of the upper outer plate corresponding region 14C1. Further, the upper inner plate 15C has a length set to be shorter by a dimension "9Ut1+10Ut1" than that of the upper unit panel 16C. The upper inner plate 15C includes folded portions 15Cs1 and 15Cs2 which serve as two ends thereof and are spaced away from the boundaries K1 and K2 by the dimensions 9Ut1 and 10Ut1 respectively. The dimension 9Ut1 is substantially equal to a thickness 9Ut of the integral body 9U, and the dimension 10Ut1 is substantially equal to a thickness 10Ut of the integral body 10U.

[0102] The integral body 11U corresponds to the upper heat insulating wall 11. The integral body 11U is bonded to an inner surface of the upper outer plate corresponding region 14C1 while both ends of the upper unit panel 16C are positioned at the boundaries K1 and K2 respectively. More specifically, the upper unit panel 16C has an outer surface 16Cg bonded to an inner surface of the upper outer plate corresponding region 14C1. In this case, the adhesive is applied, for example, by a spray, to one of the outer surface 16Cg of the upper unit panel 16C or the inner surface of the upper outer plate corresponding region 14C1.

[0103] The integral body 10U corresponds to the right heat insulating wall 10. The integral body 10U is bonded to an inner surface of the right outer plate corresponding region 14b1 while spaced away from the boundary K2 with the upper outer plate corresponding region 14C1 by a predetermined distance Sk1. More specifically, the right unit panel 16B has an outer surface 16Bg bonded to an inner surface of the upper outer plate corresponding region 14C1 at a location spaced away from the boundary K2 with the upper outer plate corresponding region 14C1. In this case, the distance Sk1 is set to be equal to or slightly larger than a thickness Sk of the upper unit panel 16C.

[0104] The left unit panel 16A has an outer surface 16Ag bonded to an inner surface of the left outer plate corresponding region 14A1 at a location spaced away from the boundary K1 with the upper outer plate corresponding region 14C1. In this case, the vacuum insulation panel of one of the unit panels 16A and 16C adjacent to each other, for example, the upper unit panel 16C is disposed so that an end thereof at the left unit panel 16A side corresponds to the boundary K1. The vacuum insulation panel of the other of the unit panels 16A and 16C, in this case, the left unit panel 16A is disposed so that an end thereof at the upper unit panel 16C side is spaced away from the boundary K1 by the predetermined distance Sk1.

[0105] In the same manner, the vacuum insulation panel of one of the unit panels 16B and 16C adjacent to each other, for example, the upper unit panel 16C is disposed so that an end thereof at the right unit panel 16B side corresponds to the boundary K2. The vacuum insulation panel of the other of the unit panels 16B and 16C, in this case, the right unit panel 16B is disposed so that an end thereof at the upper unit panel 16C side is spaced away from the boundary K2 by the predetermined distance Sk1. Subsequently, one sides of the unit panels 16A, 16B and 16C are bonded to the outer plate corresponding regions 14A1, 14B1 and 14C1 respectively. This process corresponds to a first step. In this case, the predetermined distance Sk1 corresponds to the thickness of the upper unit panel 16C. In other words, the predetermined distance Sk1 is a minimum foldable distance of the plate member 75 at the boundary K1.

[0106] Next, the plate member 75 is folded at the boundaries K1 and K2 90° inward as shown in FIG. 37. This process corresponds to a third step. In this case, the integral bodies 9U and 10U are spaced away by distances Sk1 from the boundaries K1 and K2 respectively. Accordingly, the plate member 75 is folded at the boundaries K1 and K2 while the integral bodies 9U and 10U are prevented from abutting against the ends of the upper unit panel 16C respectively. As a result, the process of folding the plate member 75 can be carried out without any trouble.

[0107] Since the integral bodies 9U and 10U are spaced away from the boundaries K1 and K2 by the distance Sk1 respectively, the end surfaces of the integral bodies 9U and 10U abut against or come close to the inner surface 16Cn of the end of the upper unit panel 16C. As a result, the unit panels 16A, 16C and 16B are connected one another and accordingly, no large spaces are defined inside the corners of the boundaries K1 and K2 respectively. Further, no large space is defined inside the corner of the boundary K2. This can reduce heat leak to the outside.

[0108] The ends of the upper inner plate 15C, that is, the ends of the folded portions 15Cs1 and 15Cs2 are spaced away from the boundaries K2 and K1 by the dimensions 9Ut1 and 10Ut1 respectively. Accordingly, when a left outer plate corresponding region 14A1 is folded substantially 90° with the boundary K1 serving as the fulcrum, the integral body 9U abuts against the end of the folded portion 15Cs2 thereby to limit further folding. In the same manner, when the right outer plate corresponding region 14B1 is folded substantially 90° with the boundary K2 serving as the fulcrum, the integral body 10U abuts against the end of the folded portion 15Cs1 thereby to limit further folding. Thus, the right and left outer plate corresponding regions 14A1 and 14B1 are prevented from being folded 90° or more. In this case, the folded portion 15Cs1 serves as a stopper for the folding of the right outer plate corresponding region 14B1. Further, the folded portion 15Cs2 serves as a stopper for the folding of the left outer plate corresponding region 14A1. As a result, the upper outer plate corresponding region 14C1 is folded at an appropriate angle in this case, at angle 90° relative to the upper outer plate corresponding region 14C1.

[0109] Subsequently, as shown in FIG. 38, the lower heat insulating wall 12 is mounted to the heat insulating wall main body 2S so as to close openings of the right and left heat insulating walls 10 and 9 forming the heat insulating wall main body 2S. In this case, one end of the lower outer plate 14D is connected to an open end of the left outer plate 14A, and the other end of the lower outer plate 14D is connected to an open end of the right outer plate 14B. One end of the lower inner plate 15D abuts against or comes close to the folded portion 15As of the left inner plate 15A and the heat insulator 74A, and the other end of the lower inner plate 15D abuts against or comes close to the folded portion 15Bs of the right inner plate 15B and the heat insulator 74B.

[0110] Subsequently, the rear heat insulating wall 13 is mounted to the rear ends of the heat insulating walls 9 to 12, as shown in FIG. 33. The sheet member connecting plate 25 and the polystyrene foam 28 are provided inside the corner of the rear heat insulating wall 13 and the left heat insulating wall 9 and inside the corner of the rear heat insulating wall 13 and the right heat insulating wall 10 respectively. A cold air duct 78 communicating with the refrigerating compartment 80 and the vegetable compartment 82 is formed inside the sheet member connecting plate 25, in this case, in the polystyrene foam 28.

[0111] The plate member 75 includes parts which correspond to the folded part 14Aa in the plate member 75 as shown in FIG. 33. The parts of the plate member 75 further include portions which correspond to the respective boundaries K1 and K2 and are cut substantially at 90° into a V-shape so as not to prevent the folding of the plate member 75.

[0112] According to the fifth embodiment, the single plate member 75 forms the outer plates 14A, 14B and 14C. Accordingly, these plates 14A to 14C are continuous without any joints, so that the joints can be reduced in the outer plate. As a result, moisture absorption from the outside of the heat insulating box 2 and cold air leak to the outside can be reduced while an amount of urethane foam to be used is reduced.

[0113] Further, in the fifth embodiment, the upper unit panel 16C is disposed so that the end thereof located at the left unit panel 16B side substantially corresponds to the boundary K1 and so that the end thereof located at the right unit panel 16A side substantially corresponds to the boundary K2. The left unit panel 16A is disposed so that the end thereof located at the upper unit panel 16C side is spaced away from the boundary K1 while spaced away from the boundary K2 by the predetermined distance Sk1. The right unit panel 16B is disposed so that the end thereof located at the upper unit panel 16C is spaced away from the boundary K2 by the predetermined distance Sk1. The distance Sk1 is set to a minimum distance by which the plate member 75 can be folded at the boundaries K1 and K2.

[0114] According to this construction, no large spaces are defined inside the corners of the boundaries K1 and K2 respectively when the plate member 75 to which the unit panels 16A to 16C have been bonded is folded at the boundaries K1 and K2. More specifically, the unit panels 16A, 16C and 16B enter into the insides of the corners of the boundaries K1 and K2 with almost no gaps, so that heat leak can be reduced in the corners of the boundaries K1 and K2. Further, the adhesive is applied to the outer surfaces 16Ag, 16Bg and 16Cg by the roll coater method. This can realize a uniform adhesive layer.

Sixth Embodiment

[0115] A sixth embodiment will be described with reference to FIGS. 39 and 40. The integral body 9U corresponding to the left heat insulating wall 9 is disposed so that an end thereof located at the upper heat insulating wall 11 side corresponds with the boundary K1. The integral body 11U corresponding to the upper heat insulating wall 11 is disposed so that an end thereof located at the left heat insulating wall 9 is spaced away from the boundary K1 by a distance 9Ut1. Further, the integral body 10U corresponding to the right heat insulating wall 10 is disposed so that an end thereof located at the upper heat insulating wall 11 side corresponds with the boundary K2. The integral body 11U is disposed so that an end thereof located at the right heat insulating wall 10 side is spaced away from the boundary K2 by the distance 10Ut1.

[0116] Subsequently, one side of the unit panel 16A of the integral body 9U is bonded to the outer plate corresponding region 14A1. Further, one side of the unit panel 16B of the integral body 10U is bonded to the outer plate corresponding region 14B1. One side of the unit panel 16C of the integral body 11U is bonded to the upper outer plate corresponding region 14C1. The distance 9Ut1 is a minimum distance by which the plate member 75 can be folded at the boundary K1. The distance 10Ut1 is a minimum distance by which the plate member 75 can be folded at the boundary K2.

[0117] In the sixth embodiment, too, the unit panels 16A, 16C and 16B enter into the insides of the corners of the boundaries K1 and K2 with almost no gaps, so that no large spaces are defined inside the corners of the boundaries K1 and K2, respectively. This can reduce heat leak to the outside.

[0118] The combination of three heat insulating walls forming the insulation wall main body should not be limited to the combination of the left, upper and right heat insulating walls 9, 11 and 10. For example, various combinations may be employed and include a combination of the left, lower and right heat insulating walls 9, 12 and 10, a combination of the left, rear and right heat insulating walls 9, 13 and 10 and a combination of the upper, rear and lower heat insulating walls 11, 13 and 12.

[0119] Although the folded portions 15As, 15Bs, 15Cs1 and 15Cs2 are formed integrally with the inner plates 15A, 15B and 15C respectively, the folded portions 15As, 15Bs, 15Cs1 and 15Cs2 may be formed on a separate flat plate, and heat insulators corresponding to those 74A, 74B and 74C1 and 74C2 may be provided on the reverse side of the flat plate. The flat plate and the heat insulators may finally be mounted to the corners, as shown in FIG. 32.

[0120] According to the above-described method of manufacturing the insulation box of the refrigerator of the sixth embodiment, the single plate member forms the outer plates of one heat insulating wall and two other heat insulating walls continuous with both ends of the one heat insulating wall. As a result, the joints can be reduced in the outer plates. Accordingly, even when no urethane foam is used or a small amount of urethane foam is used, absorption of moisture from the outside can effectively be prevented. Further, the vacuum insulation panels are adjacent to each other in the boundary of the outer plate corresponding regions in the plate member. One of the vacuum insulation panels has an end located substantially at the boundary. The other vacuum insulation panel has an end spaced away from the boundary substantially by the minimum distance such that the plate member can be folded at the boundary. In this state, one sides of the vacuum insulation panels are bonded to the outer plate corresponding regions. Consequently, the vacuum insulation panels can enter the inside of the corners of the single plate member with almost no gaps with the result that heat leak can desirably be prevented.

Seventh Embodiment

[0121] In a seventh embodiment, the refrigerator 1 includes the heat insulating box 102 as shown in FIG. 41. The heat insulating box 102 includes an outer box 111, an inner box 112, a plurality of vacuum insulation panels 130, 131, 132 and 133, and sealing members 140. The vacuum insulation panels 130 to 133 are provided between the outer box 111 and the inner box 112. The vacuum insulation panels 130 to 133 are independent of one another. The heat insulating box 102 has four corners C.

[0122] A metal plate 113 as shown in FIG. 42A is formed by folding a band-shaped steel plate. The metal plate 113 includes a ceiling 114, a left side 115, a right side 116 and a bottom 117. The ceiling 114, the left side 115, the right side 116 and the bottom 117 function as outer plates. The metal plate 113 is folded at 90° at mountain fold parts 118, 119 and 120. The mountain fold part 118 is located between the ceiling 114 and the left side 115. The mountain fold part 119 is located between the ceiling 114 and the right side 116. The mountain fold part 120 is located between the right side 116 and the bottom 117.

[0123] The metal plate 113 is folded at the mountain-folded parts 118, 119 and 120 and thereafter, an end 121 of the left side 115 is welded to an end 122 of the bottom 117. As a result, the metal plate 113 is formed into a vertically long outer box 111 as shown in FIG. 42B. The outer box 111 is formed into a parallelepiped box shape and has front and back openings 155 and 156. The bottom 117 can be assembled independent of the ceiling 114 and the right and left sides 116 and 115.

[0124] The heat insulating box 102 has the plate-shaped vacuum insulation panels 130, 131, 132 and 133. The vacuum insulation panel 130 is bonded to an inner surface 114A of the ceiling 114. The vacuum insulation panel 131 is bonded to an inner surface 115A of the left side 115. The vacuum insulation panel 132 is bonded to an inner surface 116A of the ceiling 116. The vacuum insulation panel 133 is bonded to an inner surface 117A of the ceiling 117.

[0125] The inner box 112 is also formed into a vertically long cubic box in the same manner as the outer box 111, as shown in FIG. 41. The inner box 112 is provided inside the outer box 111. The inner box 112 is molded from plastic, for example. The inner box 112 has dimensions smaller than those of the outer box 111 so that the inner box 112 is allowed to be put into the outer box 111. The inner box 112 has a ceiling 124, a left side 125, a right side 126 and a bottom 127. The ceiling 124, the left side 125, the right side 126 and the bottom 127 functions as inner plates. The ceiling 124, the right and left sides 126 and 125 and the bottom 127 need not be an integral piece but may be independent of one another.

[0126] The ceiling 124 of the inner box 112 is in parallel with the ceiling 114 of the outer box 111 and is opposed to the ceiling 114 with a dimension T therebetween, as shown in FIG. 107. The left side 125 of the inner box 112 is in parallel with the left side 115 of the outer box 111 and is opposed to the left side 115 with a dimension T therebetween. The right side 126 of the inner box 112 is in parallel with the right side 116 of the outer box 111 and is opposed to the right side 116 with a dimension T therebetween. The bottom 127 of the inner box 112 is in parallel with the bottom 117 of the outer box 111 and is opposed to the bottom 117 with a dimension T therebetween. The inner box 112 is thus disposed in the outer box 111 with a gap of dimension T being defined therebetween.

[0127] Assume now that arrow X indicates a lateral direction and arrow Y indicates a longitudinal direction in FIG. 41. The vacuum insulation panels 130 and 133 are provided so that sides of the panels 130 and 133 face in the lateral direction or the horizontal direction. The vacuum insulation panels 131 and 132 are provided so that sides of the panels 131 and 132 face in the longitudinal direction or the vertical direction.

[0128] Each of the vacuum insulation panels 130, 131, 132 and 133 has a considerably higher heat insulating performance than polyurethane foam. Accordingly, a necessary heat insulating performance can be ensured even when the vacuum insulation panels 130, 131, 132 and 133 are rendered thinner as compared with the case where polyurethane foam is used as a heat insulating material. Thus, the space between the outer box 111 and the inner box 112 can be rendered smaller when the vacuum insulation panels 130, 131, 132 and 133 are used as the heat insulators of the heat insulating box 102. Accordingly, when external dimensions of the outer box 111 are constant, internal dimensions of the inner box 112 can be rendered larger in the heat insulating box 102 as compared with the case where polyurethane foam is used as the heat insulators. As a result, a storage capacity of the heat insulating box 102 can be increased, so that the capacity of the refrigerator 1 can be increased. In this case, the vacuum insulation panel has a thickness ranging from 10 to 30 mm.

[0129] The vacuum insulation panel 130 is disposed in a space S between the ceiling 124 of the inner box 112 and the ceiling 114 of the outer box 111, as shown in FIG. 41. The vacuum insulation panel 131 is disposed in a space S between the left side 125 of the inner box 112 and the left side 115 of the outer box 111. The vacuum insulation panel 132 is disposed in a space S between the right side 126 of the inner box 112 and the right side 116 of the outer box 111. The vacuum insulation panel 133 is disposed in a space between the bottom 127 of the inner box 112 and the bottom 117 of the outer box 111.

[0130] In the embodiment, the vacuum insulation panels 130 to 133 are bonded to the inner surface 111A of the outer box 111 by an adhesive. However, the mounting manner should not be limited to the bonding. More specifically, the vacuum insulation panels 130, 131, 132 and 133 may be disposed on the inner surface of the outer box 111 without use of an adhesive. According to this construction, the vacuum insulation panels 130, 132, 132 are replaceable after installation.

[0131] The four corners C have the same construction, as shown in FIG. 41. In the vertically disposed vacuum insulation panel 131, an upper end 131T is in contact with an inner surface 114A of the ceiling 114, and a lower end 131R is in contact with an inner surface 117A of the bottom 117. In the vertically disposed vacuum insulation panel 132, an upper end 132T is in contact with the inner surface 114A of the ceiling 114, and a lower end 132R is in contact with the inner surface 117A of the bottom 117 in the same manner.

[0132] Entire surfaces of the ends 131T, 131R, 132T and 132R need not be in contact but may be in contact at least partially. Further, the upper ends 131T and 132T of the vacuum insulation panes 131 and 132 may be spaced slightly from the inner surface 114A of the ceiling 114. For example, the upper ends 131T and 132T of the vacuum insulation panels 131 and 132 have only to be located above the underside of the vacuum insulation panel 130 or, more desirably, have only to be located above a middle part of the vacuum insulation panel 130. The lower ends 131R and 132R of the vacuum insulation panels 131 and 132 have only to be located below the upper surface of the vacuum insulation panel 133 or, more desirably, have only to be located below the middle part of the vacuum insulation panel 130.

[0133] In the horizontally disposed upper vacuum insulation panel 130, a left end 130F is in contact with an inner surface 131N of the vertically disposed vacuum insulation panel 131, and a right end 130G is in contact with an inner surface 132N of the vertically disposed vacuum insulation panel 132. In the horizontally disposed vacuum insulation panel 133, a right end 133F is in contact with the inner surface 131N of the vertically disposed vacuum insulation panel 131, and a right end 133G is in contact with the inner surface 132N of the vertically disposed vacuum insulation panel 132 in the same manner.

[0134] The horizontal vacuum insulation panels 130 and 133 are thus held between the left vertical vacuum insulation panel 131 and the right vertical vacuum insulation panel 132. As a result, the left upper and lower corners C are filled with the left vertical vacuum insulation panel 131. Further, the right upper and lower corners C are filled with the right vertical vacuum insulation panel 131. Accordingly, since all the corners C are filled with the vacuum insulation panels and have no gaps, the heat insulating performance can be insured at each one of the corners C, and leak of air can be suppressed. More specifically, each one of the corners C has a function of preventing vacuum leak or air from leaking through a gap of the corner outside the outer box 111 and can increase the stiffness at each corner of the heat insulating box 102.

[0135] Each of the vacuum insulation panels 130, 131, 132 and 133 is constructed of a core 170 and a laminate film 171 as shown in FIGS. 43A and 43B. The core 170 is a glass-wool plate, for example. The laminate film 171 has a metal foil layer or a metal deposited layer and is superior in moisture-proof property and gas-barrier property. The core 170 is wrapped in the laminate film 171, so that the inside is formed into a vacuum porous structure. As a result, each of the vacuum insulation panels 130, 131, 132 and 133 retains a high vacuum space factor exceeding 90%, for example. The laminate film 171 has two seal-off parts 172 and 173. The seal-off part 172 seals off the core 170. The seal-off parts 172 and 173 are formed by partially applying heat to the seal-off parts 172 and 173, for example.

Eighth Embodiment

[0136] An eighth embodiment will be described with reference to FIG. 44. FIG. 44 shows a right upper one of four corners C of the heat insulating box 102 in the eighth embodiment. The other corners C are also constructed in the same manner as the right upper corner C. The seal-off part 173 of the vacuum insulation panel 130 is folded toward an inner surface 114A of the ceiling 114 of the outer box 111 to be disposed in a recess 130N of the vacuum insulation panel 130. The seal-off part 172 of the vacuum insulation panel 132 is also folded to an inner surface 116A of the side 116 of the outer box 111 to be disposed in a recess 132M of the vacuum insulation panel 132 in the same manner as the seal-off part 173. In this case, the seal-off parts 172 and 173 are configured not to be folded to the inner surface side of the inner box 112. A manner of placing the seal-off parts 172 and 173 at each one of the other three corners C is the same as described above.

[0137] The following will describe the reason for folding and placing the seal-off part 172 as described above. The outer box 111 is made of a metal plate having large stiffness. On the other hand, the inner box 112 is made of a plastic plate having smaller stiffness than the metal. In this case, when the seal-off parts 172 and 173 are folded to the inner box 112 side, the inner box 112 has a possibility of bulging inward under the influence of the thickness of the folded seal-off parts 172 and 173. The inner box 112 would then lose flatness, degrading the appearance thereof.

[0138] In view of the problem, the seal-off parts 172 and 173 are folded to the outer box 111 side. As a result, the inner box 112 can be prevented from being influenced by the thicknesses of the folded seal-off parts 172 and 173. Further, the folded seal-off parts 172 and 173 are placed in the recesses 130N and 132M respectively. As a result, the outer box 111 can also be prevented from being influenced by the thicknesses of the folded seal-off parts 172 and 173. Consequently, the flatness of the outer and inner boxes 111 and 112 can be ensured. As a result, the inner box 112 can be disposed neatly with respect to the vacuum insulation panels 130 to 133. The above-described structure of folding and placing the seal-off parts 172 and 173 is applied to each of the vacuum insulation panels 130 to 133.

[0139] In the eighth embodiment, too, the vacuum insulation panels 130 to 133 are disposed between the outer box 111 and the inner box 112, and each corner C is filled with the vacuum insulation panel. Accordingly, the heat insulating performance can be ensured at each corner C in the eighth embodiment as in the first embodiment. A rectangular vacuum insulation panel is disposed at the rear side of the heat insulating box 102.

Ninth Embodiment

[0140] A ninth embodiment will be described with reference to FIG. 45. In the laterally disposed upper vacuum insulation panel 130, the left end 130C thereof is in contact with the inner surface 115A of the left side 115 of the outer box 111, and the right end 130D thereof is in contact with the inner surface 116A of the right side 116 of the outer box 111. In the laterally disposed lower vacuum insulation panel 133, the left end 130C thereof is in contact with the inner surface 115A of the left side 115 of the outer box 111, and the right end 130D thereof is in contact with the inner surface 116A of the right side 116 of the outer box 111 in the same manner as described above.

[0141] On the other hand, in the vertically disposed left vacuum insulation panel 131, the upper end 131F thereof is in contact with the inner surface 130M of the upper vacuum insulation panel 130, and the lower end 131G thereof is in contact with the inner surface 133M of the lower vacuum insulation panel 133. In the vertically disposed right vacuum insulation panel 132, the upper end 132F thereof is in contact with the inner surface 130M of the upper vacuum insulation panel 130, and the lower end 132G thereof is in contact with the inner surface 133M of the lower vacuum insulation panel 133 in the same manner as described above.

[0142] The vertical vacuum insulation panels 131 and 132 are held between the upper lateral vacuum insulation panel 130 and the lower lateral vacuum insulation panel 133, with the result that the upper right and left corners C are filled with the upper lateral vacuum insulation panel 133. Further, the lower right and left corners C are filled with the lower lateral vacuum insulation panel 133. Accordingly, since each corner is filled with the vacuum insulation panel and accordingly has no void, the heat insulating performance cam be ensured in each corner C, and air leak can be suppressed. More specifically, each one of the corners C has a function of preventing vacuum leak or air from leaking through a gap of the corner outside the outer box 111 and can increase the stiffness at each corner of the heat insulating box 102.

Tenth Embodiment

[0143] A tenth embodiment will be described with reference to FIG. 46. FIG. 46 shows a right upper one of four corners C of the heat insulating box 102 in the tenth embodiment. The other corners C are also constructed in the same manner as the right upper corner C. The seal-off part 173 of the vacuum insulation panel 130 is folded toward the inner surface 114A of the ceiling 114 of the outer box 111 to be disposed in a recess 130H of the vacuum insulation panel 130. The seal-off part 172 of the vacuum insulation panel 132 is also folded to an inner surface 116A of the side 116 of the outer box 111 to be disposed in a recess 132J of the vacuum insulation panel 132 in the same manner as the seal-off part 173. In this case, the seal-off parts 172 and 173 are configured not to be folded to the inner surface side of the inner box 112. A manner of placing the seal-off parts 172 and 173 at each one of the other three corners C is the same as described above.

[0144] According to this, the tenth embodiment can achieve the same advantageous effect as the eighth embodiment.

Eleventh Embodiment

[0145] An eleventh embodiment will be described with reference to FIG. 47. In the eleventh embodiment, the vacuum insulation panels 130, 131, 132 and 133 are connected together into an integral body W1. The integral body W1 is bonded to the inner surface 114A of the ceiling 114, the inner surfaces 116A and 115A of the right and left sides 116 and 115, the inner surface 117A of the bottom 117, thereby forming an integral body W2. More specifically, the integral body W1 is formed by connecting the vacuum insulating panels 130 to 133 sequentially. Further, the integral body W2 is formed by connecting the integral body W1 to the inner surfaces 114A, 115A, 116A and 117A.

[0146] The integral body W2 has three recesses 90 and two recesses 91. The recesses 90 are located at the integral body W1 side and are provided at positions corresponding to mountain-folded parts 118, 119 and 120 respectively. Each recess 190 has a semicircular section as shown in FIG. 47B. The recesses 191 are provided at both ends of the integral body W1 respectively. Each recess 191 is formed to have a cross-section that is a quarter of a circle. When the integral body W1 is folded with the result that both ends thereof are butted together, the recesses 191 have the same cross-section as the recesses 90, that is, the semicircular cross-section. In this case, the vacuum insulation panels 130 to 133 are continuously formed using a connecting part 95 having a smaller thickness than the vacuum insulation panels.

[0147] According to the above-described construction, the integral body W2 can easily be folded at the mountain-folded parts 118 to 120 with the three recesses 90 as the fulcrums as shown in FIG. 47C. As a result, the outer box 111 having the vacuum insulation panels 130 to 133 can easily be obtained. Further, the connecting part 95 of the recesses 90 is thinner than the vacuum insulation panels 130 to 133. As a result, the vacuum insulation panels 130 to 133 can easily be folded at the corners C into the box shape.

Twelfth Embodiment

[0148] A twelfth embodiment will be described with reference to FIG. 48. In the twelfth embodiment, the vacuum insulation panels 130 to 133 are discrete from one another. The vacuum insulation panel 130 is bonded to the inner surface 114A of the ceiling 114. The vacuum insulation panel 131 is bonded to the inner surface 115A of the left side 115. The vacuum insulation panel 132 is bonded to the inner surface 116A of the ceiling 116. The vacuum insulation panel 133 is bonded to the inner surface 117A of the ceiling 117. Thus, the vacuum insulation panels 130, 131, 132 and 133 are bonded to the inner surfaces 114A, 115A, 116A and 117A respectively, thereby forming an integral body W3. More specifically, the integral body W3 includes the vacuum insulation panels 130, 131, 132 and 133 bonded to the inner surfaces 114A, 115A, 116A and 117A respectively.

[0149] The integral body W3 has three recesses 100 and two recesses 101. The recesses 100 are provided to be located at positions corresponding to the mountain-folded parts 118, 119 and 120 of the integral body W3 at the sides of the vacuum insulation panels 130 to 133 respectively. Each recess 100 has a substantially triangular cross-section as shown in FIG. 48B. The recesses 101 are provided on both ends of the integral body W3 at the sides of the vacuum insulation panels 130 to 133 respectively. More specifically, the recesses 101 are provided on a left end 121 and a right end 122. The recesses 101 are formed by slanting the ends of the vacuum insulation panels 131 and 133. When the integral body W3 is folded with the result that both ends thereof are butted together, the recesses 101 have the same cross-section as the recesses 100, that is, the semicircular cross-section. In this case, the ends of the vacuum insulation panels 130 to 133 have first sides located at the inner surface 114A, 115A, 116A and 117A and second sides opposed to the inner surface 114A, 115A, 116A and 117A. The first sides have larger dimensions than the second sides.

[0150] According to the above-described construction, the twelfth embodiment can achieve the same advantageous effects as the eleventh embodiment. Further, as shown in FIG. 48C, the ends of the adjacent vacuum insulation panels, for example, the ends of the vacuum insulation panels 130 and 132 are in contact with each other at about 45°, thereby forming a stopper-shaped part 150. As a result, the adjacent vacuum insulation panels can reliably be brought into contact with each other at the corner C. Another heat insulator 151 is provided inside the stopper-shaped part 150. Consequently, even if the adjacent vacuum insulation panels are separated from each other at the stopper-shaped part thereby to result in a gap therebetween, the insulator 151 can close the gap formed at the corner C. This can ensure an insulating performance at the corner C.

[0151] Other embodiments will be described with reference to FIGS. 49A to 50B. In the embodiment shown in FIG. 49A, recesses 140 are provided between the adjacent vacuum insulation panels 130 to 133. Each recess 140 has a semicircular cross-section. The adjacent vacuum insulation panels, for example, the vacuum insulation panels 130 and 132 have a thin connection 141. In this case, too, the connection 141 is thinner than the vacuum insulation panels. Accordingly, the vacuum insulation panels 130 to 133 can easily be folded at the corners C into the box shape. In this case, the core need not be located in the connection, and the seal-off parts 172 and 173 of the bags enclosing the cores have only to be connected to each other.

[0152] In the embodiment as shown in FIG. 49B, the adjacent vacuum insulation panels, for example, the vacuum insulation panels 130 and 132 are separate members or are formed independent of each other. A gap SS is defined between the vacuum insulation panels 130 and 132. Accordingly, the gap SS is defined between ends 130K and 132K of the vacuum insulation panels 130 and 132 at the corner C, as shown in FIG. 49C. According to this construction, for example, when the horizontal vacuum insulation panel 130 is desired to be moved in the direction of arrow V in FIG. 49C for position adjustment, the position of the vacuum insulation panel 130 can easily be adjusted using the gap SS.

[0153] In the embodiment as shown in FIG. 50A, the adjacent vacuum insulation panels, for example, the vacuum insulation panels 130 and 132 are separate members or are formed independent of each other. The gap SS is defined between the vacuum insulation panels 130 and 132. Further, the vacuum insulation panels 130 and 132 are covered by a laminate film 171 thereby to be integrated with each other. According to this construction, for example, when the vertical vacuum insulation panel 132 is desired to be moved in the direction of arrow P in FIG. 50A for position adjustment, a loosened part 145 of the laminate film 171 can be held between the ends of the panes 130 and 132 to be placed as shown in FIG. 50B.

[0154] A method of manufacturing the insulation box of the embodiments will be described with reference to FIGS. 51A, 51B and 51C. The vacuum insulation panels 130 to 132 are mounted on a metal plate 113M as shown in FIG. 51A. The recesses 90 are provided between the adjacent vacuum insulation panels 130 to 132. The metal plate 113M is folded with the recesses 90 serving as the fulcrums as shown in FIG. 51B. As a result, the ceiling 114, the left side 115 and the right side 116 are formed. The right and left sides 116 and 115 are located opposite each other.

[0155] The vacuum insulation panel 133 of the bottom is held between the bottom 117 made of a metal plate and another bottom 127. The bottom 117 is provided on the side of the vacuum insulation panel 133 opposed to the refrigerator interior. The bottom 127 is provided on the side of the vacuum insulation panel 133 located at the refrigerator interior. The bottom 117 is fixed to mounts

116D and 115D of the right and left sides 116 and 115 by screws 99. As a result, the heat insulating box 102 of the refrigerator is obtained which has the outer box 111, the inner box 112 and the vacuum insulation panels 130 to 133 as shown in FIG. 51C.

[0156] The heat insulating box 102 has covering members 199 as shown in FIG. 51C. The covering members 199 are provided at the corners CN of the inner box 112 in order to cover the gaps at the respective corners CN. Each covering member 199 has a function of maintaining the corner CN at 90° as a holding member and a function of closing the gap of the corner CN to prevent light incidence. The ceiling 124 and the sides 125 and 126 can be prevented from bending thereby to be unable to maintain the angle of 90° by the function of the covering members 199 as the holding member. Passages for electrical cables, piping, cold air passage and the like can be formed inside the covering members 199. The inner box 112 includes a plurality of plates.

[0157] In each of the above-described embodiments, in the heat insulating box 102 shown in FIG. 42B, the vacuum insulation panel mounted to close the rear opening 156 can be provided when the outer box 111 is formed or after the inner box 112 has been disposed in the outer box 111.

[0158] The refrigerator of the embodiment includes the outer box, the inner box disposed in the outer box and the vacuum insulation panels provided between the outer and inner boxes. The adjacent vacuum insulation panels are disposed to be in contact with each other at the corners of the outer and inner boxes. As a result, since the corners of the refrigerator are filled with the vacuum insulation panels, the insulating performance can be ensured at the corners.

[0159] One or more of the above-described embodiments may optionally be combined together. Further, the structure of the refrigerator 1 as shown in FIG. 1 is an example, and any structure may be employed.

[0160] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the invention. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the invention. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the invention.

Claims

1. A method of manufacturing a heat insulating box of a refrigerator,
   wherein the heat insulating box includes a right heat insulating wall, a left heat insulating wall, an upper heat insulating wall, a lower heat insulating wall and a rear heat insulating wall and is formed into a rectangular box shape with an open front;
   wherein the heat insulating box has vacuum insulation panels between outer plates and inner plates respectively;
   wherein a heat insulating wall main body is manufactured by the method, the heat insulating wall main body including one of the heat insulating walls and two of the remaining heat insulating walls, continuous with opposite ends of the one heat insulating wall respectively, the other remaining heat insulating walls being joined to the heat insulating wall main body,
   the method comprising:

   a first step of bonding one sides of the vacuum insulation panels to an inner surface of a plate member formed into a flat shape and having regions corresponding to the outer plates of the one heat insulating wall and the two remaining heat insulating walls respectively, the inner surface of the plate member belonging to the corresponding regions,
   wherein one of the vacuum insulation panels adjacent to each other at a boundary of the corresponding regions has an end caused to correspond to the boundary, and the other vacuum insulation panel has an end spaced away from the boundary by a minimum distance which allows the plate member to be folded at the boundary;
   a second step of bonding the inner plates to sides of the vacuum insulation panels opposed to the one sides of the vacuum insulation panels bonded at the first step, before or after execution of the first step; and
   a third step of folding the plate member inward at the boundaries after execution of the first and second steps.

2. The manufacturing method according to claim 1, wherein the first step is executed after an adhesive has been applied to the opposed sides of the vacuum insulation panels by a roll coater method and the inner plates have been bonded to the opposed sides of the vacuum insulation panels.

3. A refrigerator comprising a heat insulating box including an outer box, an inner box provided in the outer box, a plurality of vacuum insulation panels provided between the outer box and the inner box, wherein the vacuum insulation panels adjacent to each other are disposed to be in contact with each other at a corner of the heat insulating box.

4. The refrigerator according to claim 3, wherein the adjacent vacuum insulation panels are disposed horizontally and vertically respectively, and the horizon-

tally disposed vacuum insulation panel has an end in contact with a side of the vertically disposed vacuum insulation panel at the corner.

5. The refrigerator according to claim 3, wherein the adjacent vacuum insulation panels are disposed horizontally and vertically respectively, and the vertically disposed vacuum insulation panel has an end in contact with a side of the horizontally disposed vacuum insulation panel at the corner.

6. The refrigerator according to claim 3, wherein:

the corner of the heat insulating box is formed by folding a continuous plate;
the adjacent vacuum insulation panels are connected to each other by a thin connection at the corner or separated from each other at the corner.

7. The refrigerator according to claim 3, wherein the adjacent vacuum insulation panels have respectively ends in contact with each other at the corner.

8. The refrigerator according to claim 7, wherein the ends of the adjacent vacuum insulation panels include a contact portion provided with a heat insulator.

9. The refrigerator according to claim 3, wherein:

the inner box is formed by combining a plurality of plates; and
the plates include plates which are adjacent to each other and have respective ends connected to each other by a thin connecting part at the corner or provided at portions where the vacuum insulation panels are separated from each other.

10. The refrigerator according to any one of claims 3 to 5, wherein:

each vacuum insulation panel has a core and a film covering the vacuum insulation panel; and
the film has a seal-off part disposed at an inner surface side of the outer box.

11. The refrigerator according to any one of claims 3 to 9, wherein the heat insulating box is constructed by manufacturing a heat insulating wall main body including one of the heat insulating walls and two of the remaining heat insulating walls, continuous with opposite ends of the one heat insulating wall respectively, the other remaining heat insulating walls being joined to the heat insulating wall main body,
the manufacturing including:

a first step of bonding one sides of the vacuum insulation panels to an inner surface of a plate member formed into a flat shape and having regions corresponding to the outer plates of the one heat insulating wall and the two remaining heat insulating walls respectively, the inner surface of the plate member belonging to the corresponding regions,
wherein one of the vacuum insulation panels adjacent to each other at a boundary of the corresponding regions has an end caused to correspond to the boundary, and the other vacuum insulation panel has an end spaced away from the boundary by a minimum distance which allows the plate member to be folded at the boundary;
a second step of bonding the inner plates to sides of the vacuum insulation panels opposed to the one sides of the vacuum insulation panels bonded at the first step, before or after execution of the first step; and
a third step of folding the plate member inward at the boundaries after execution of the first and second steps.

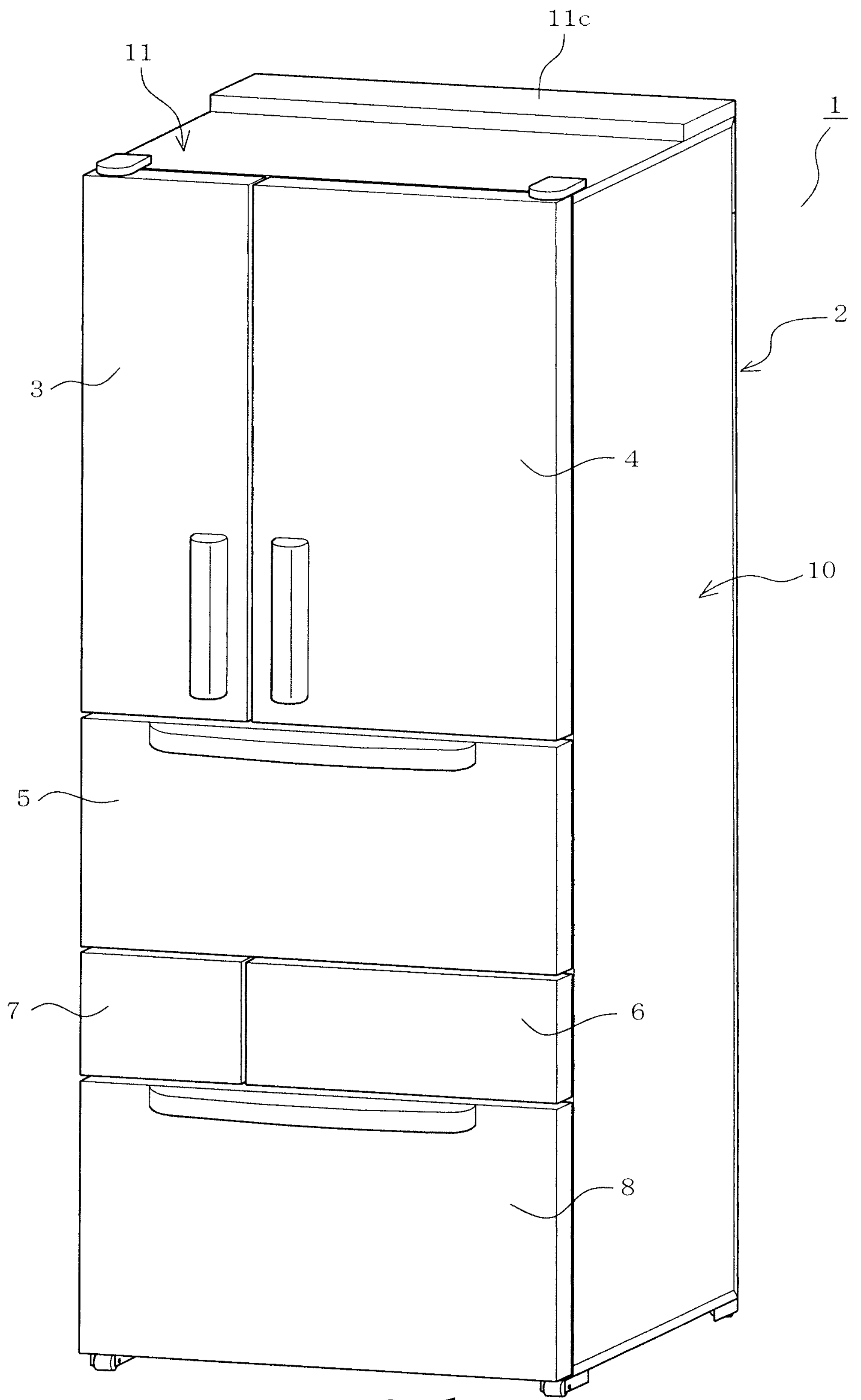


FIG.1

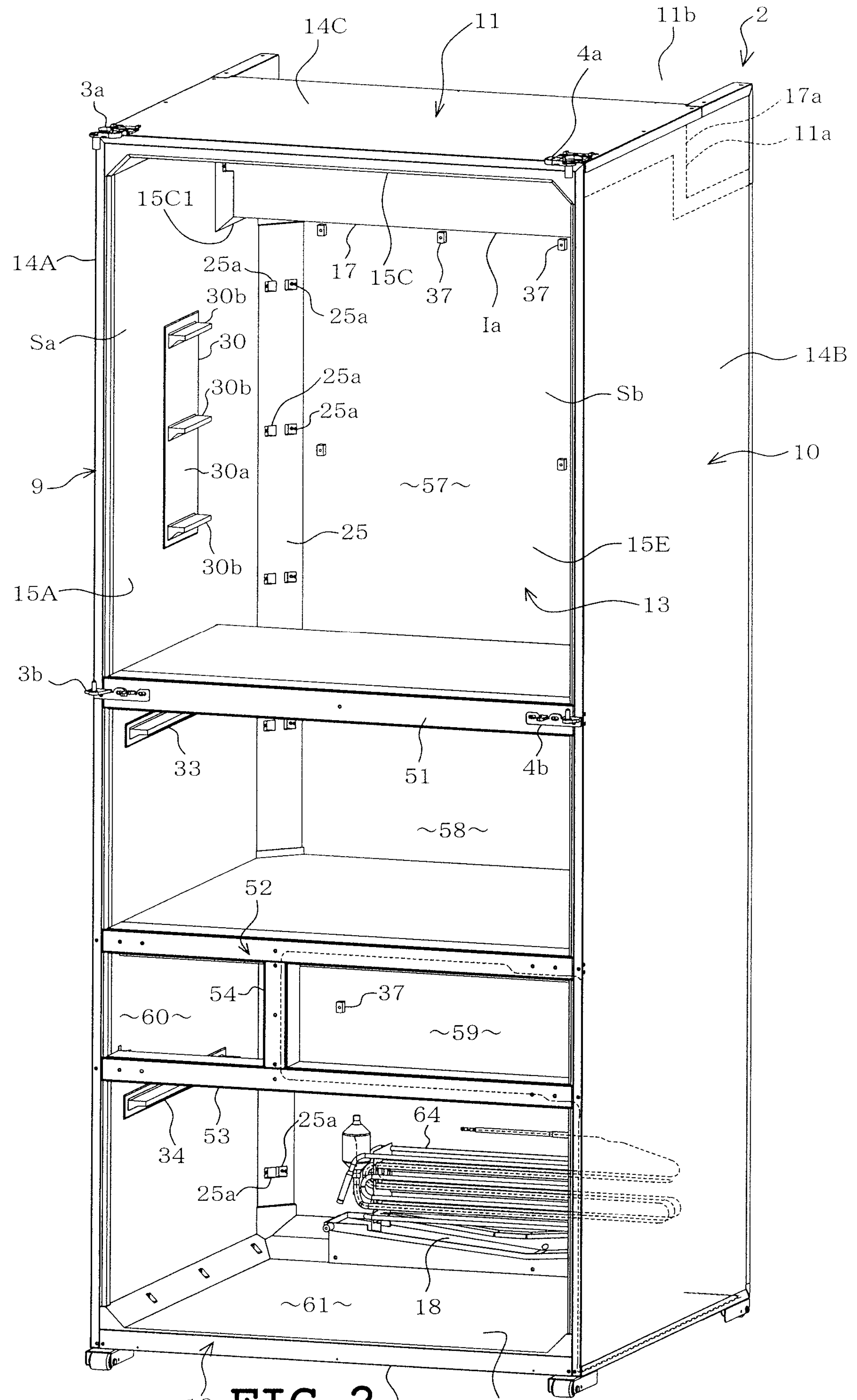

14C
11
11b
2
4a
3a
17a
11a
15C1
14A
25a
17
15C
37
37
25a
30b
Ia
Sa
30
14B
25a
30b
25a
Sb
9
30a
10
~57~
25
15E
30b
15A
13
3b
33
51
4b
~58~
52
54
37
~60~
~59~
64
25a
53
34
25a
~61~
18
12
14D
15D

FIG.2

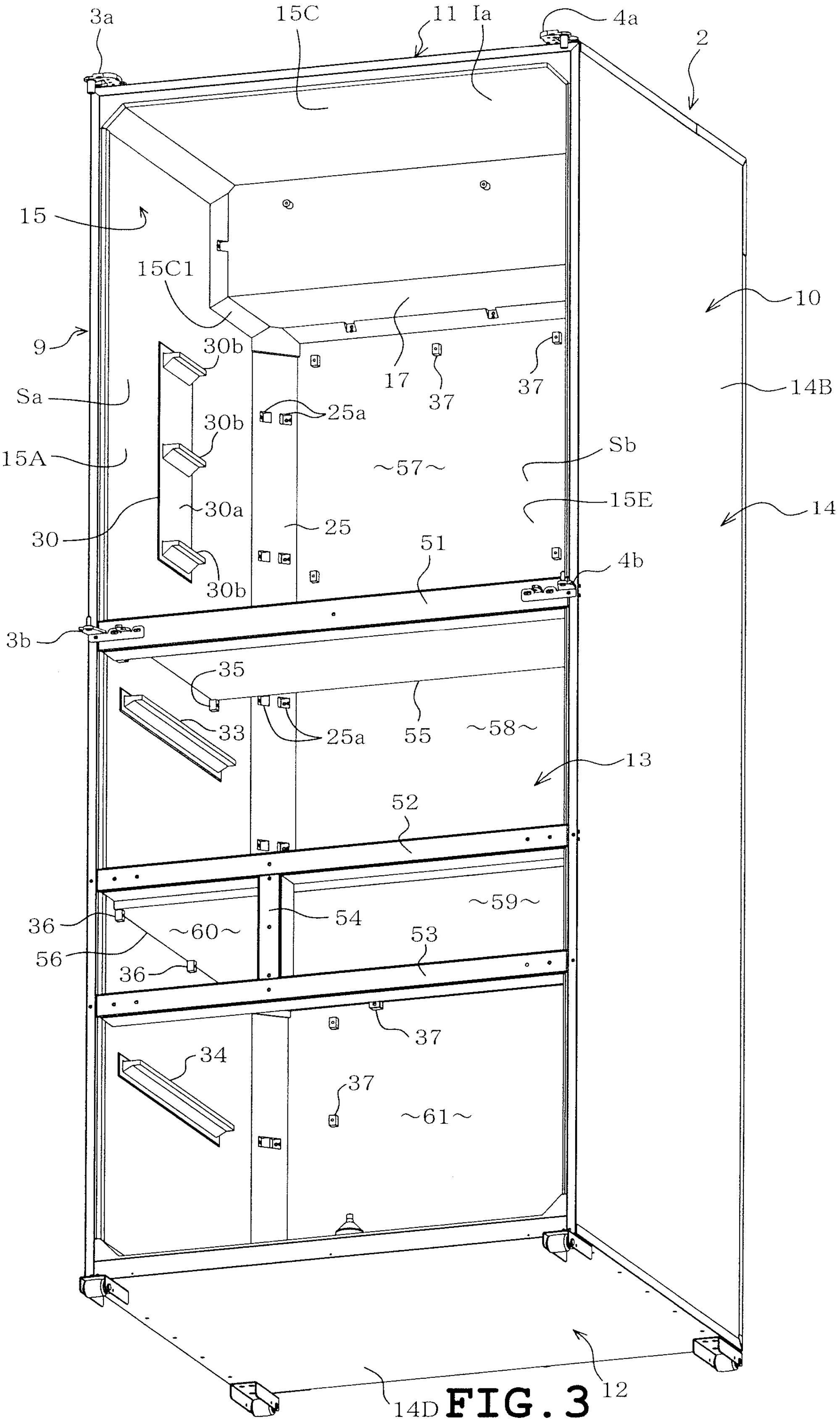

3a
15C
11
Ia
4a
2
15
15C1
10
9
30b
17
37
37
37
Sa
30b
25a
14B
15A
57
Sb
15E
30
30a
25
14
51
4b
30b
3b
35
33
25a
55
58
13
52
36
54
59
60
53
56
36
37
34
37
61
12
14D

FIG.3

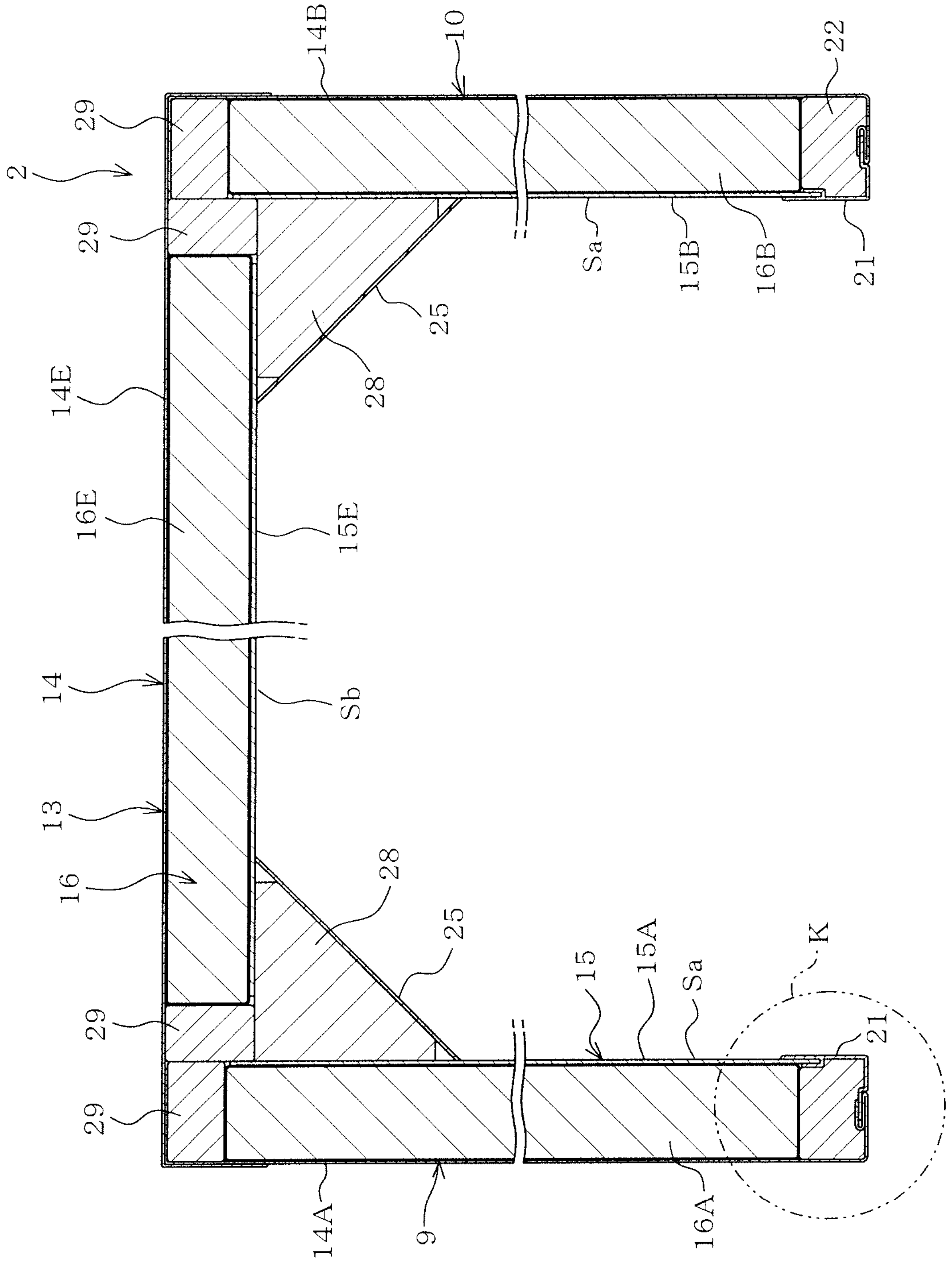

2
29
29
29
29
14B
10
22
21
16B
15B
Sa
25
28
14E
16E
15E
14
Sb
13
16
28
25
15
15A
Sa
K
21
14A
9
16A

FIG.4

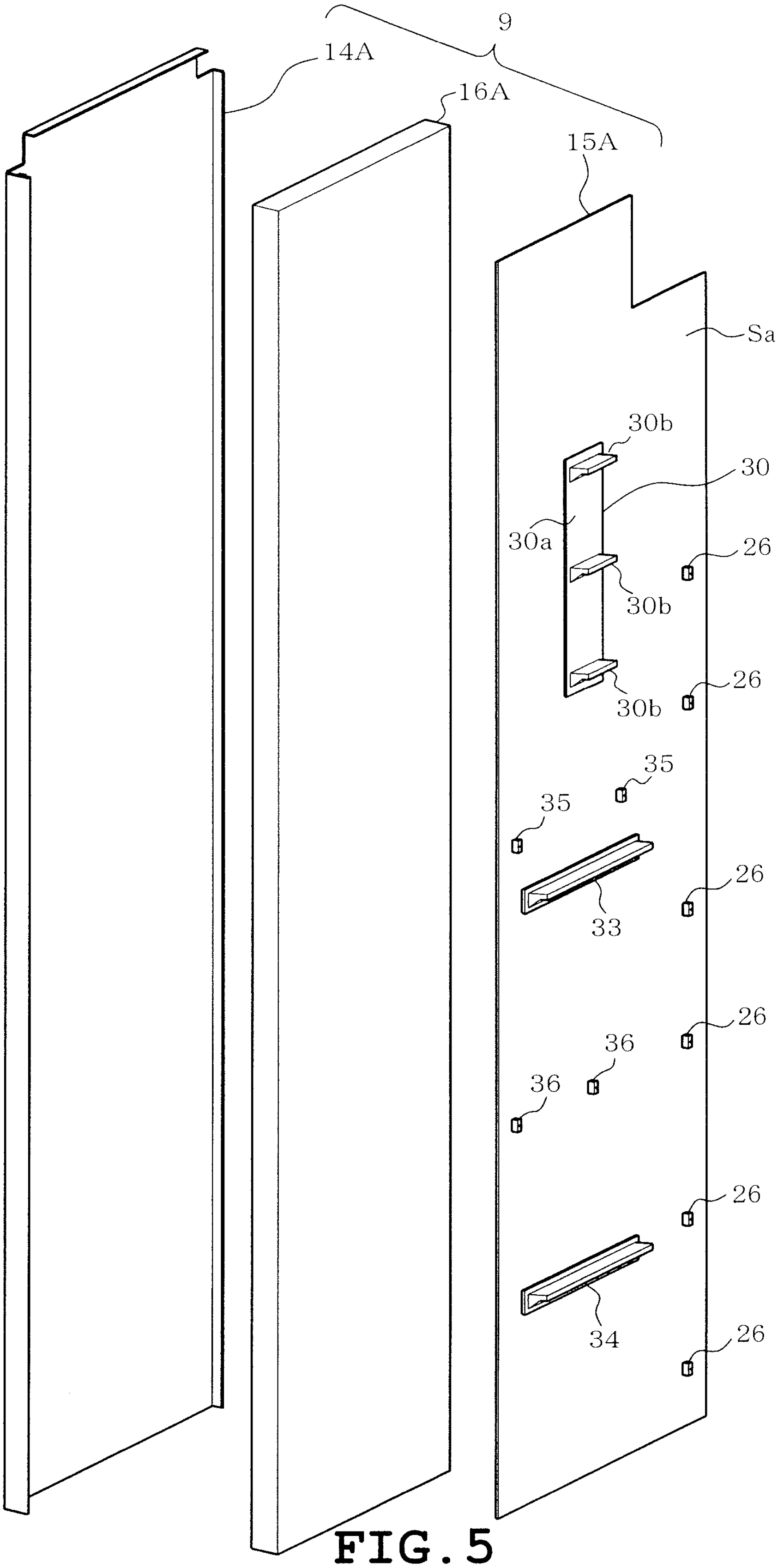

9
14A
16A
15A
Sa
30b
30
30a
26
30b
26
30b
35
35
26
33
26
36
36
26
34
26

FIG.5

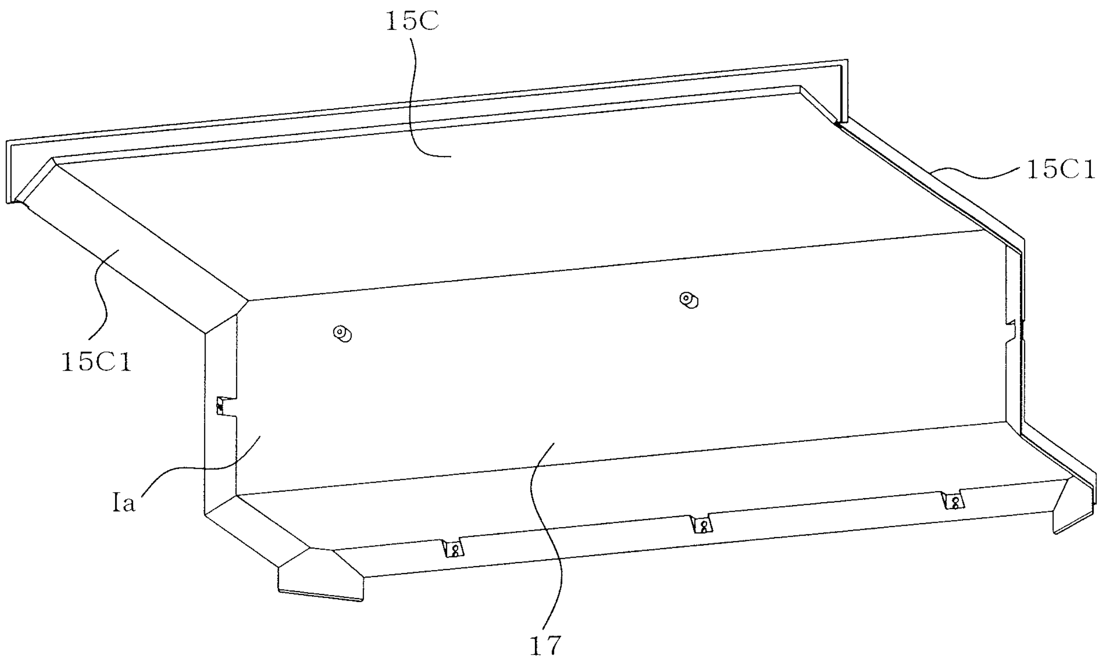


FIG.6

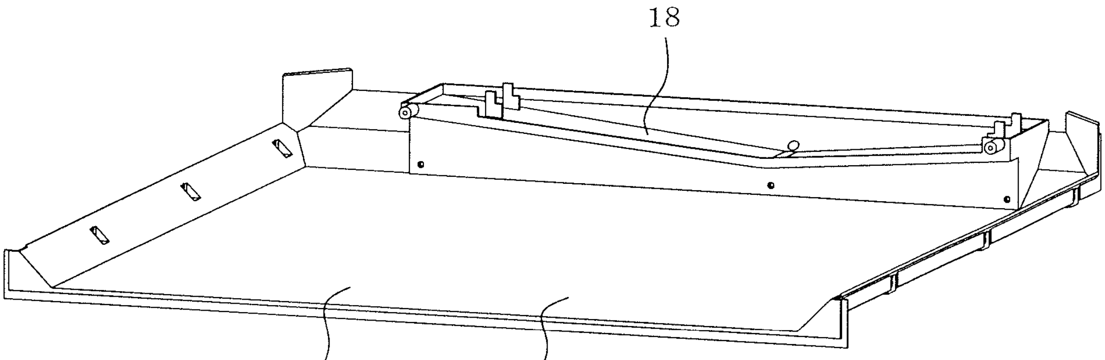


FIG.7

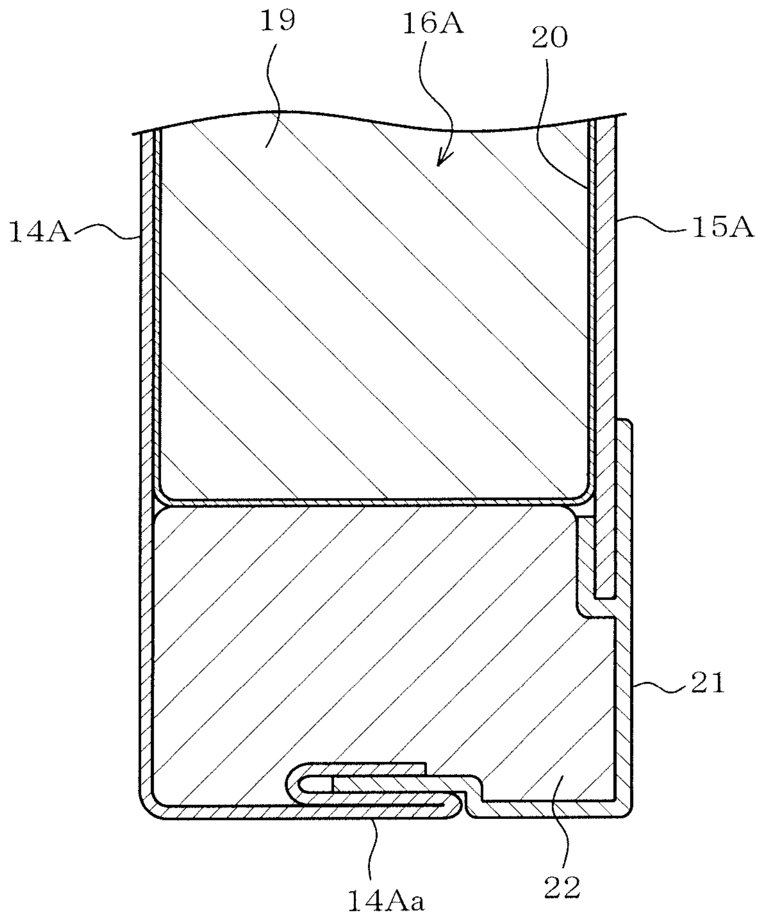


FIG.8

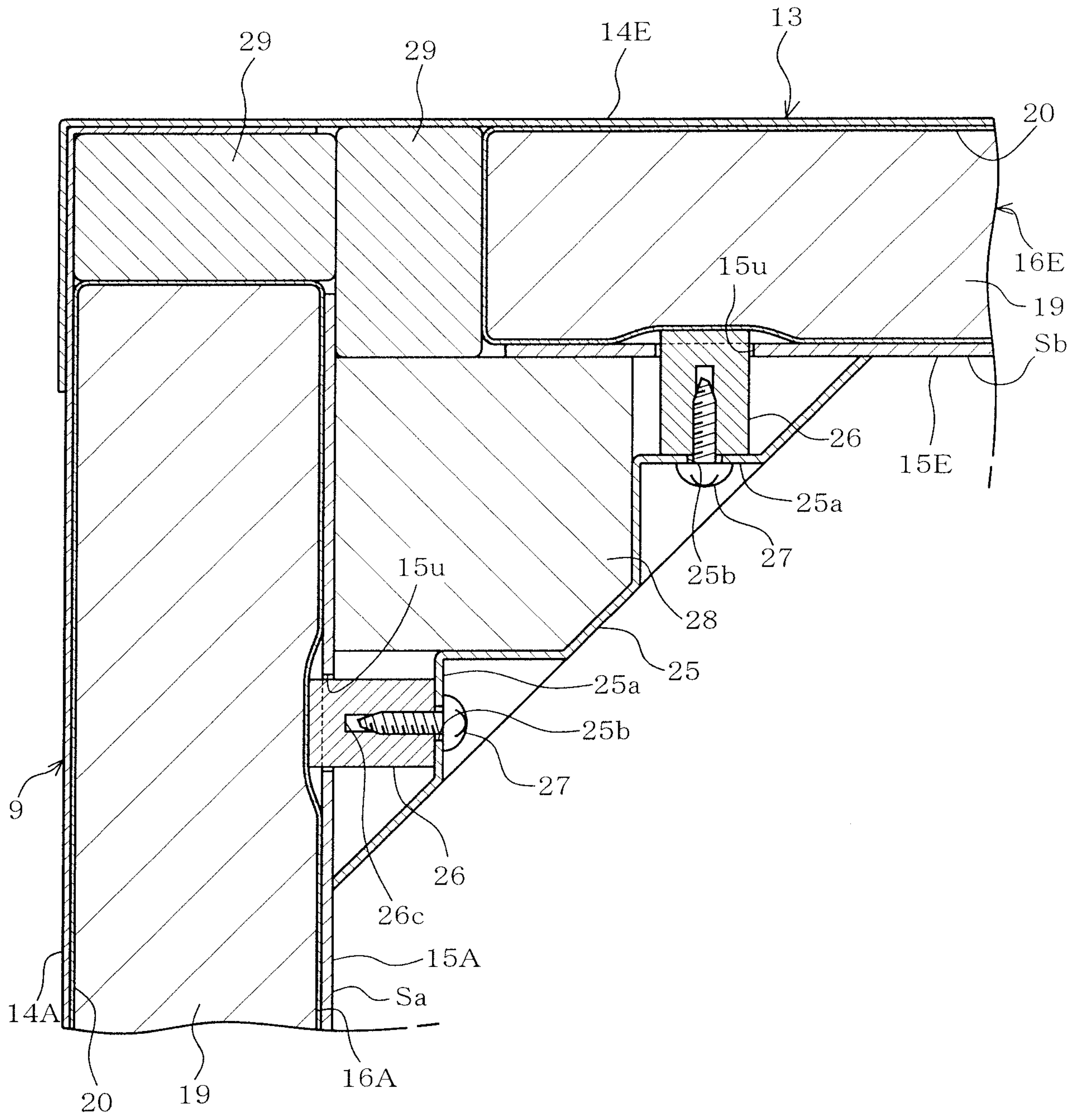

29
29
14E
13
20
16E
15u
19
Sb
26
15E
25a
27
25b
28
15u
25
25a
25b
27
9
26
26c
15A
Sa
14A
20
19
16A

FIG. 9

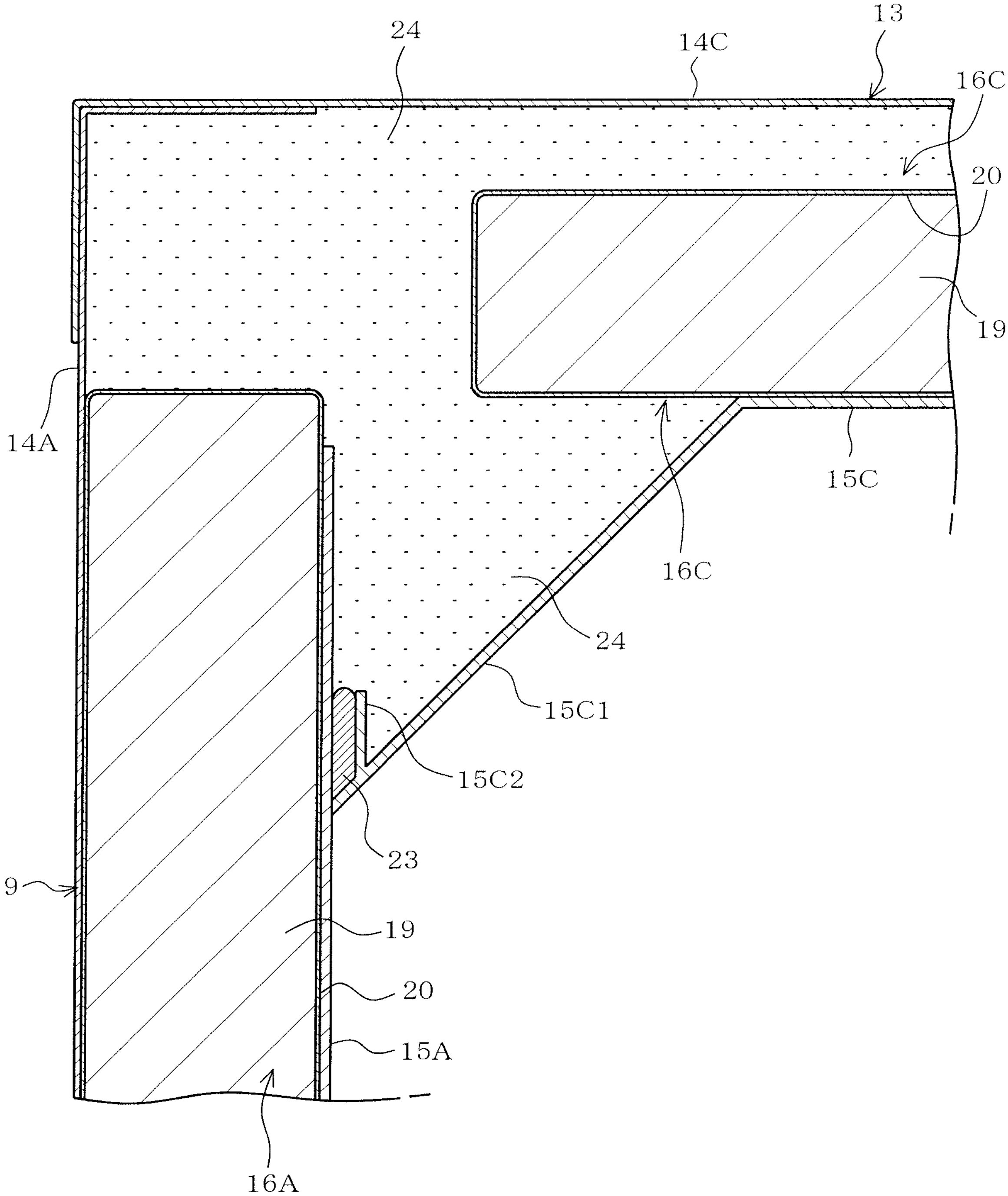


FIG.10

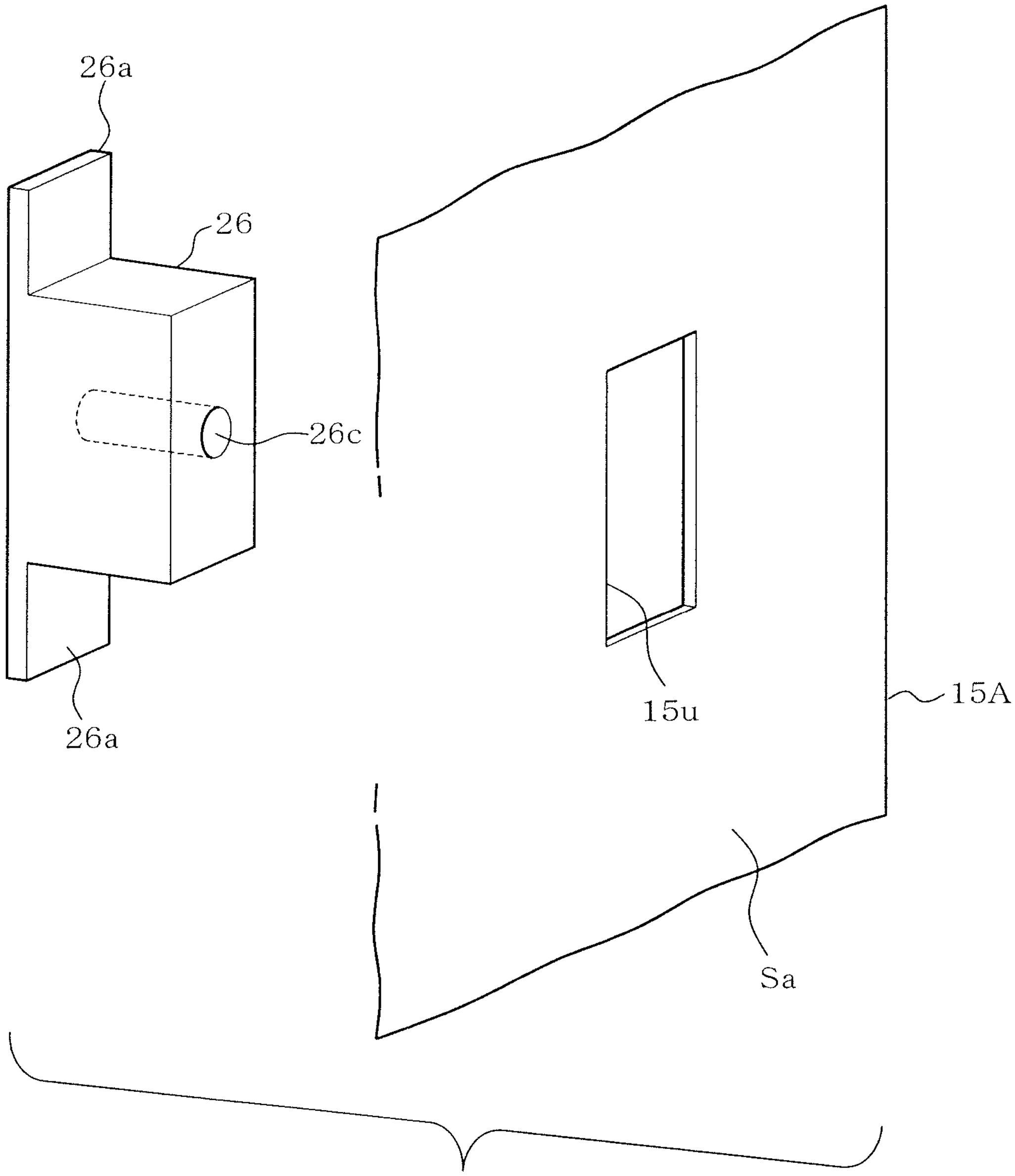


FIG.11

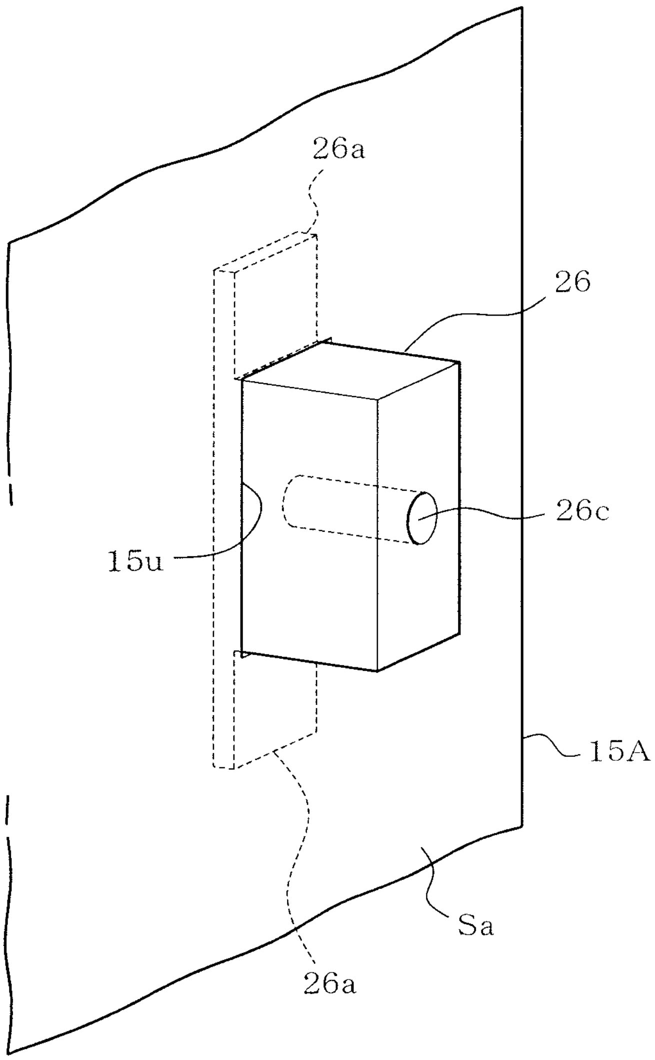


FIG.12

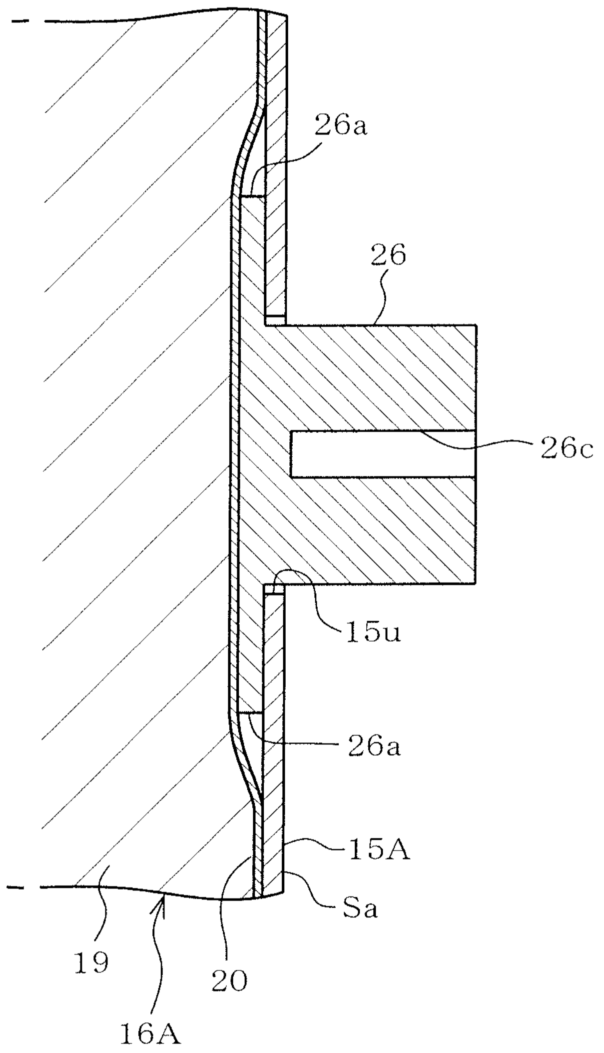


FIG.13

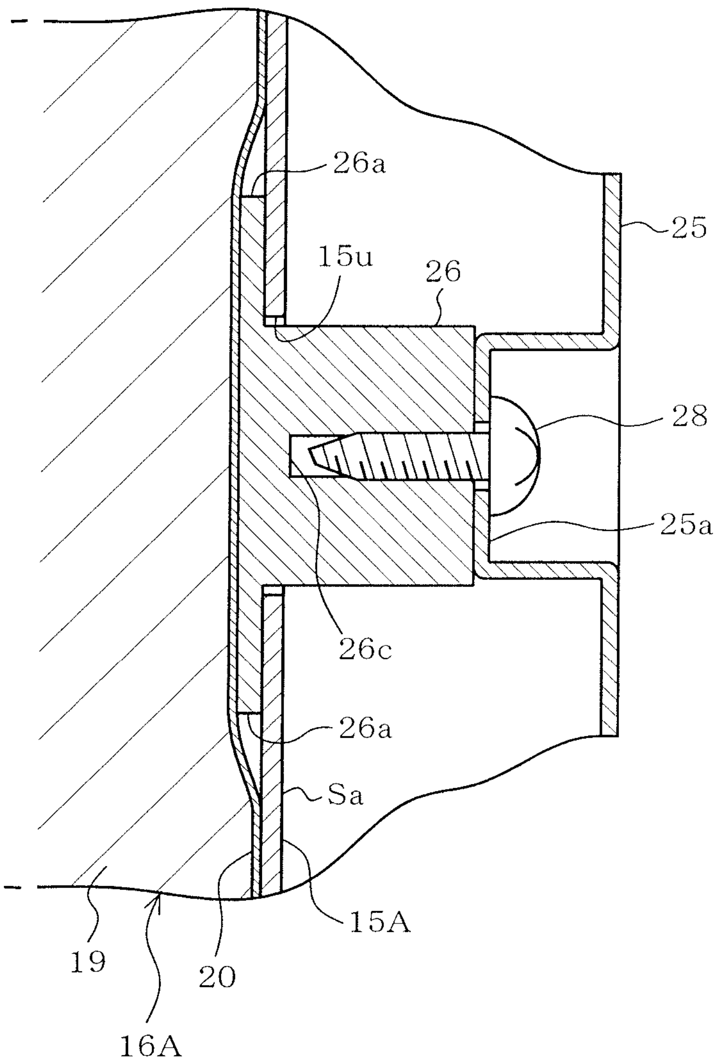


FIG.14

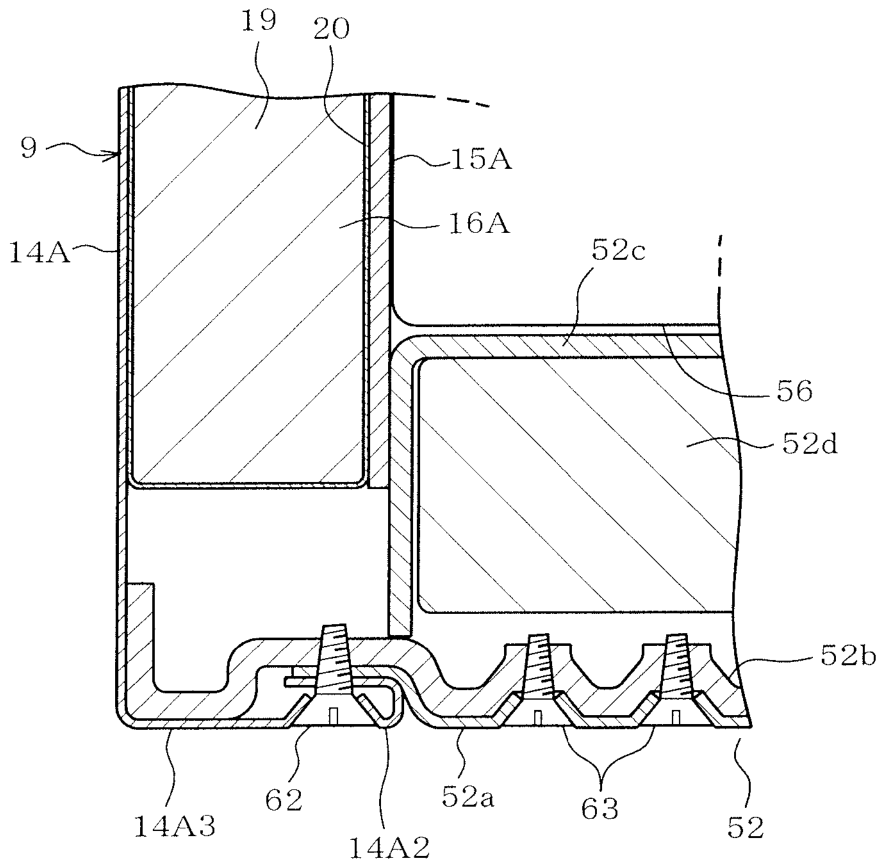


FIG.15

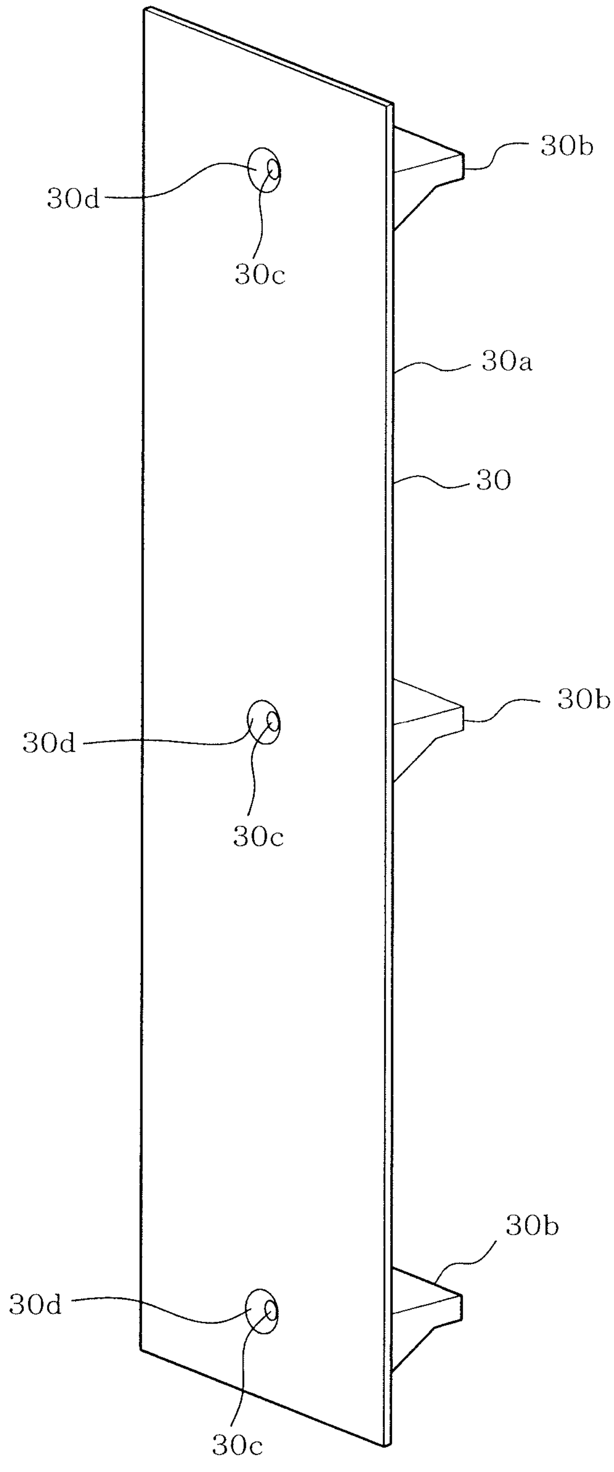


FIG.16

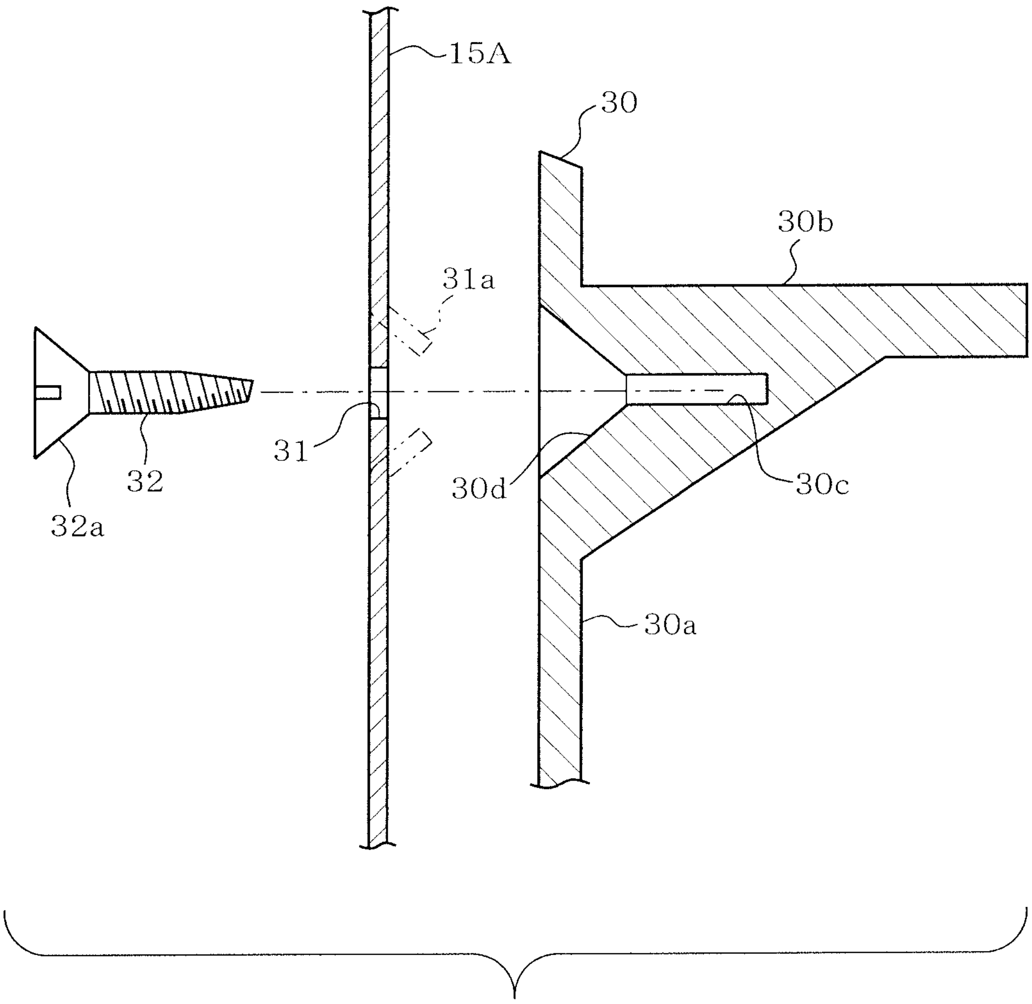


FIG.17

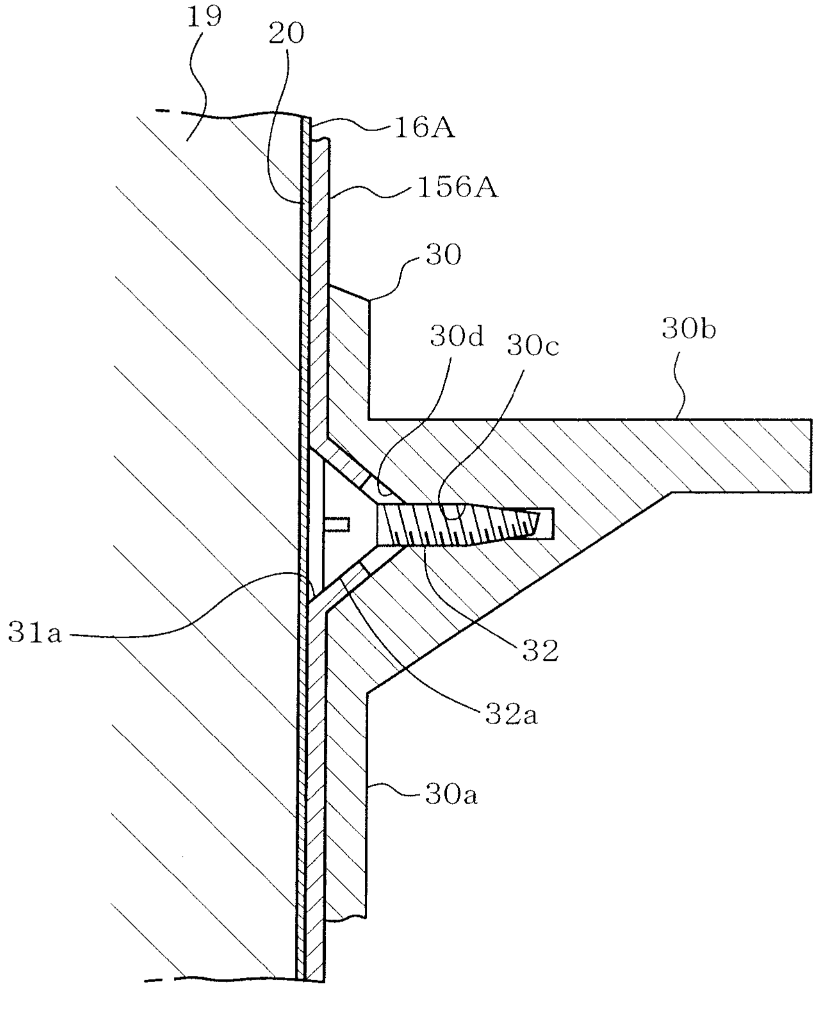


FIG.18

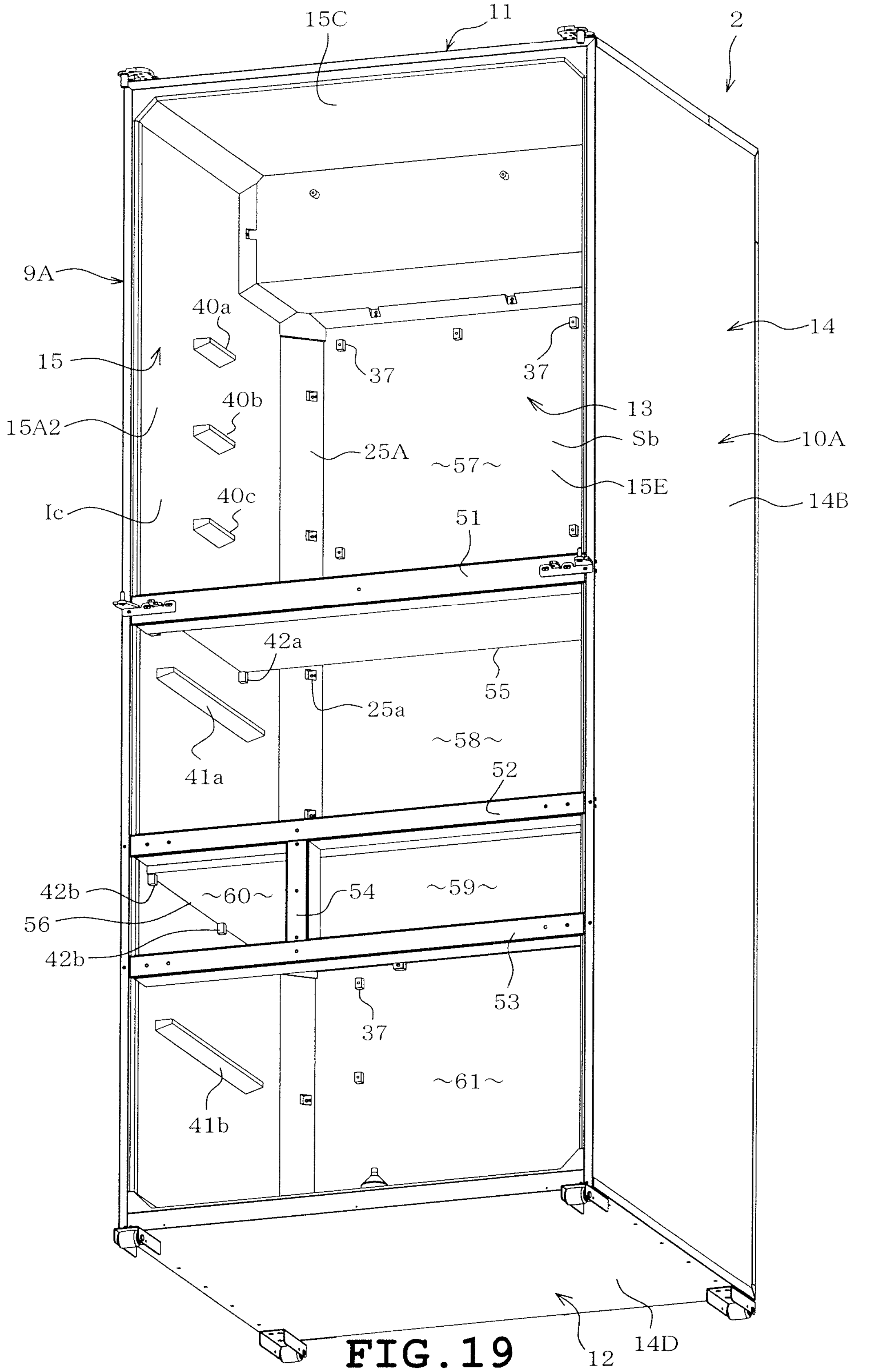

15C
11
2
9A
40a
15
37
37
14
40b
13
15A2
Sb
10A
25A
~57~
15E
40c
Ic
14B
51
42a
55
25a
~58~
41a
52
42b
~60~
54
~59~
56
42b
53
37
~61~
41b
12
14D

FIG.19

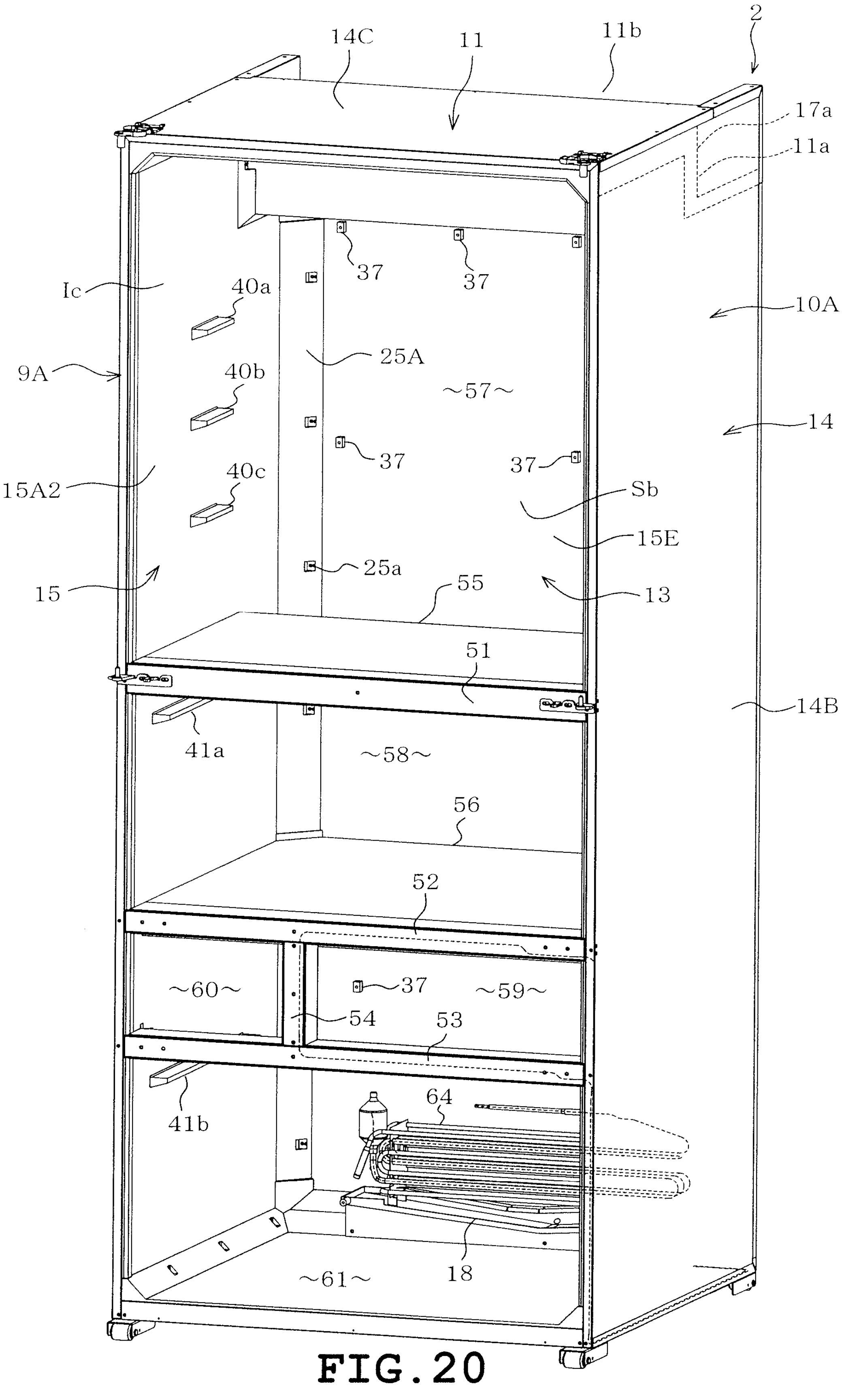

2
14C
11
11b
17a
11a
37
37
Ic
40a
10A
9A
40b
25A
~57~
14
37
37
15A2
40c
Sb
15E
25a
15
55
13
51
14B
41a
~58~
56
52
~60~
37
~59~
54
53
64
41b
18
~61~

FIG.20

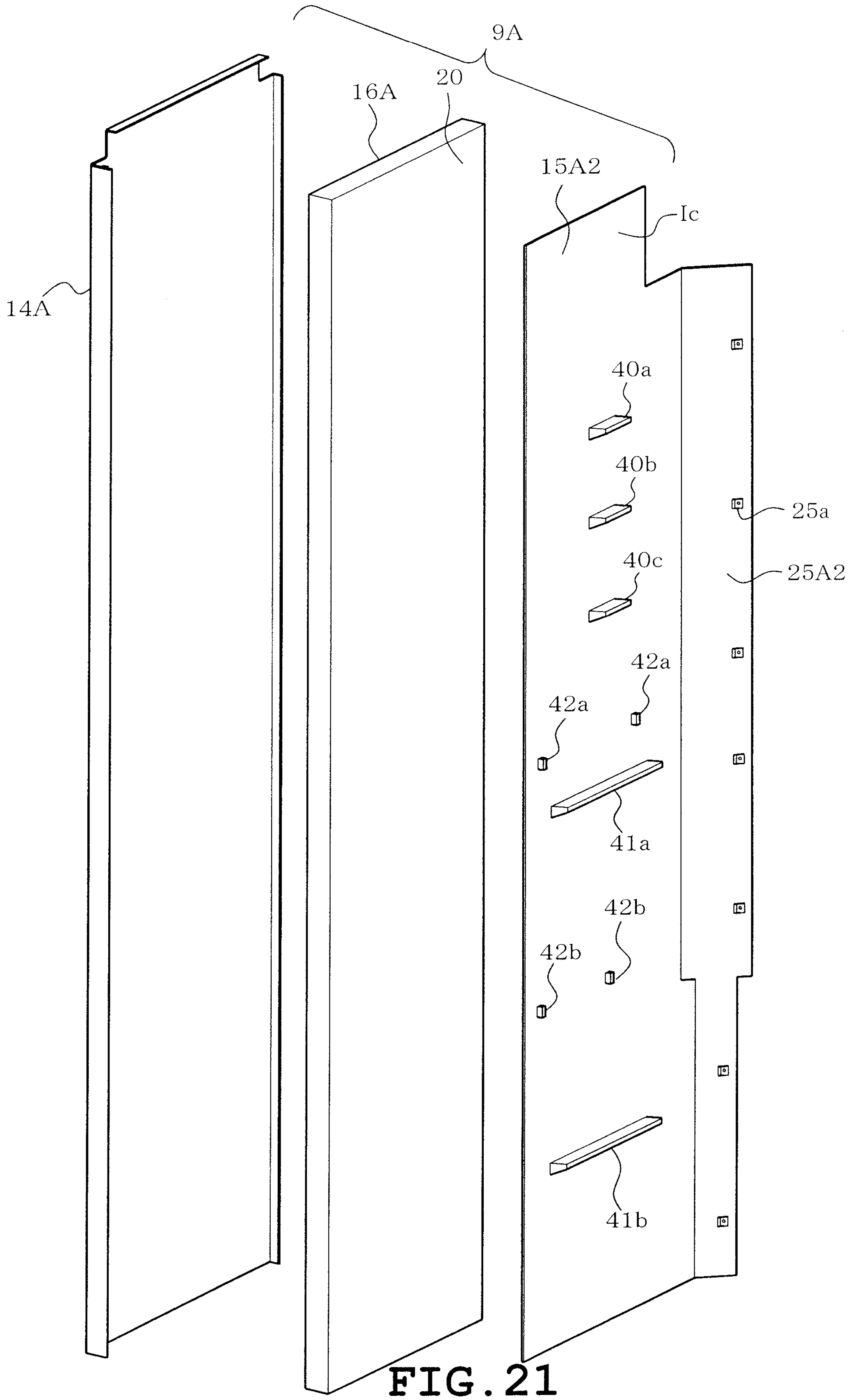

9A
16A
20
15A2
Ic
14A
40a
40b
25a
40c
25A2
42a
42a
41a
42b
42b
41b

FIG.21

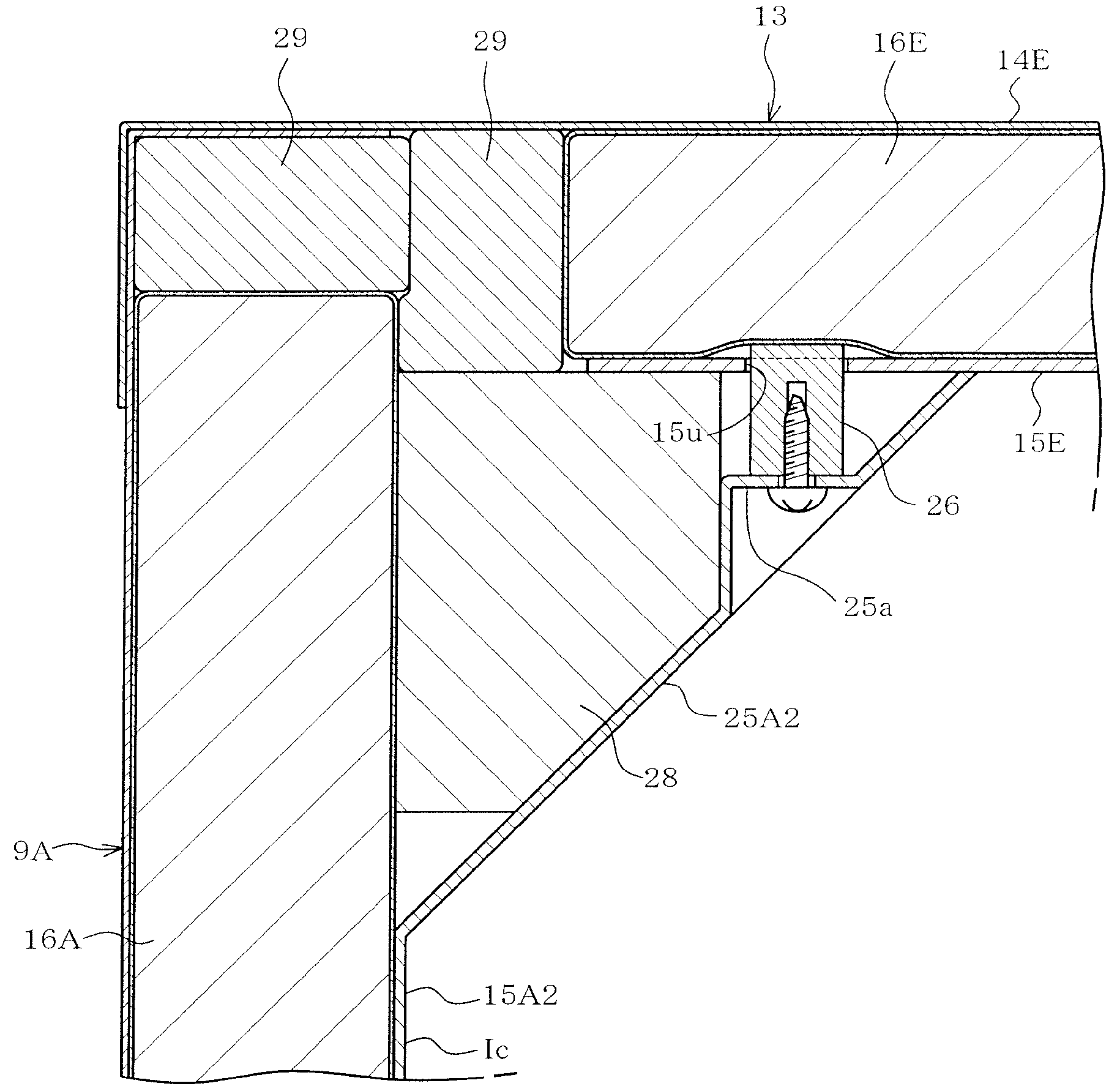


FIG.22

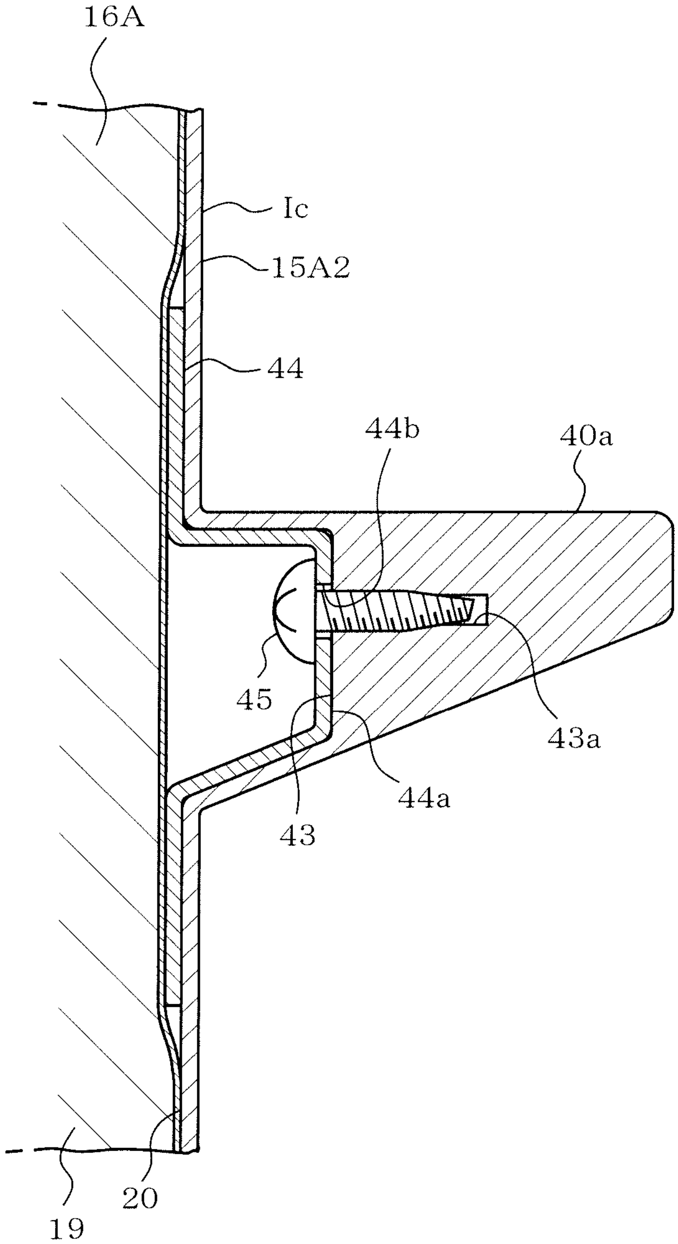


FIG.23

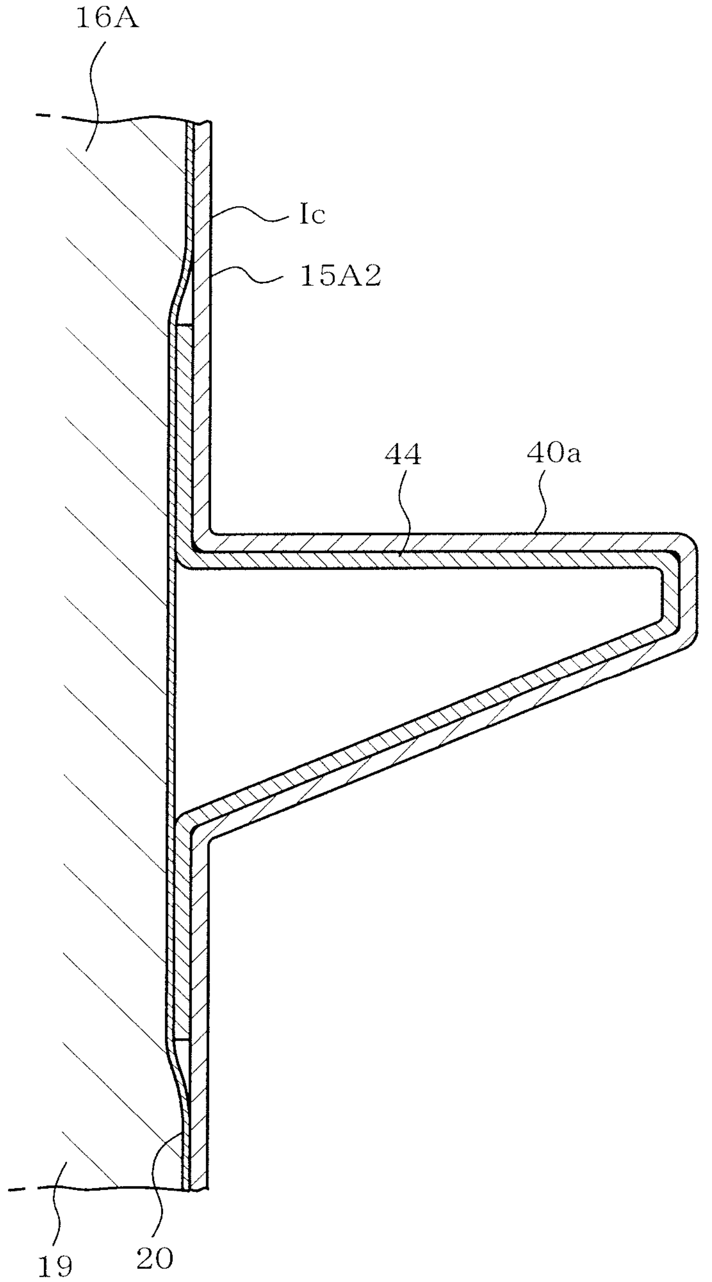


FIG.24

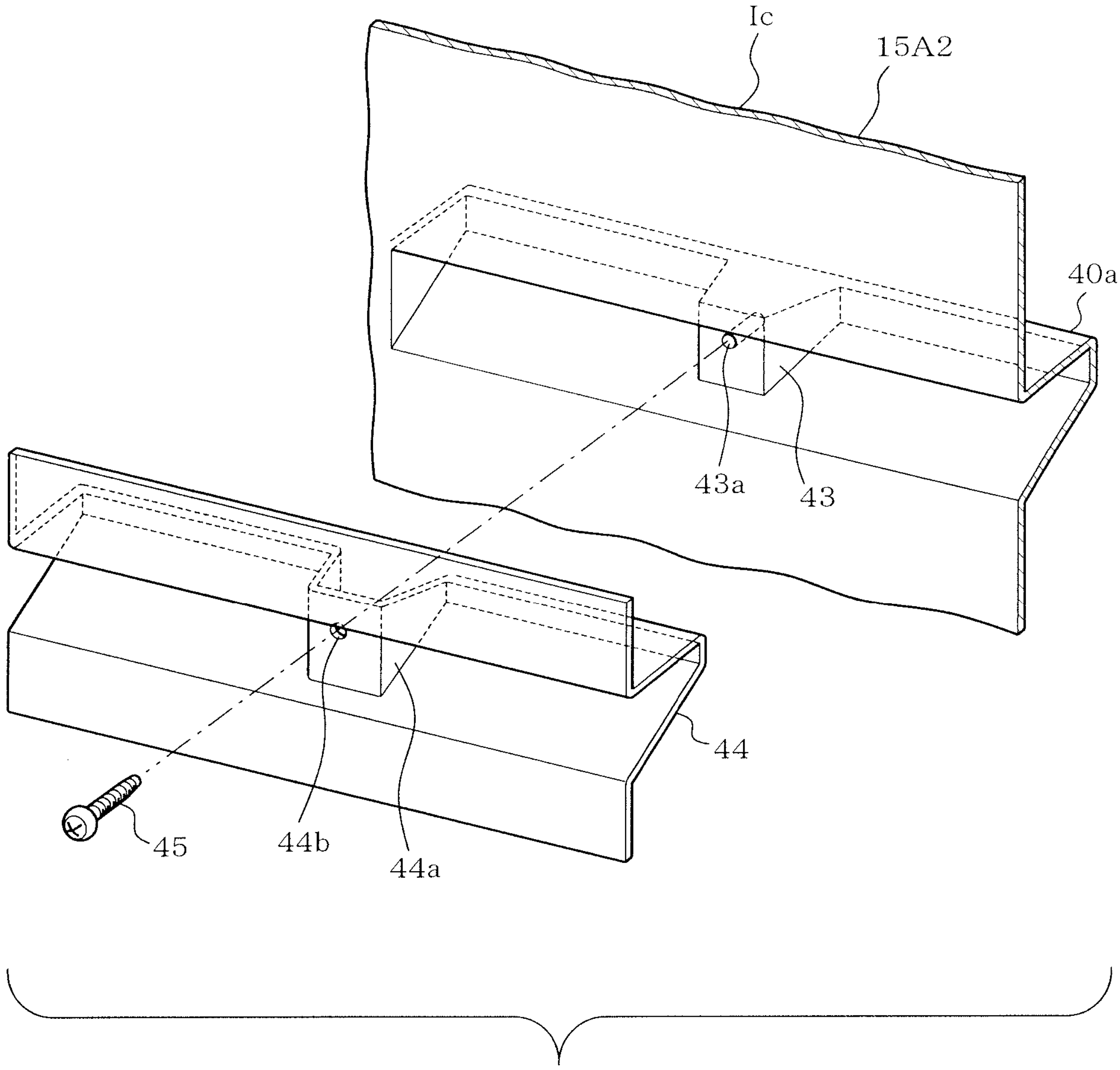


FIG.25

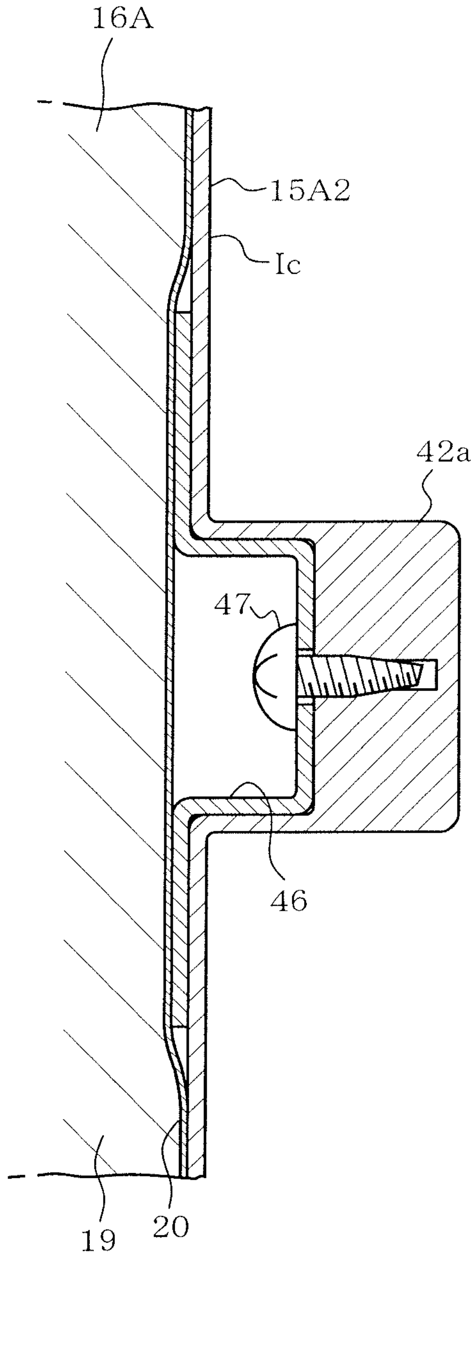


FIG.26

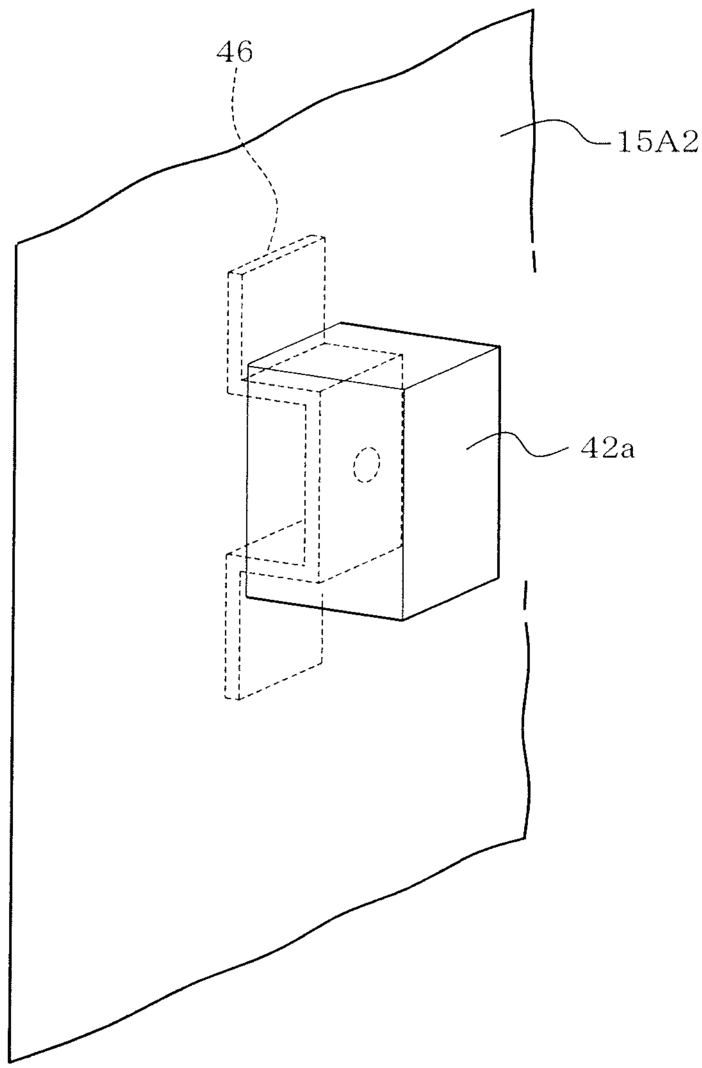


FIG.27

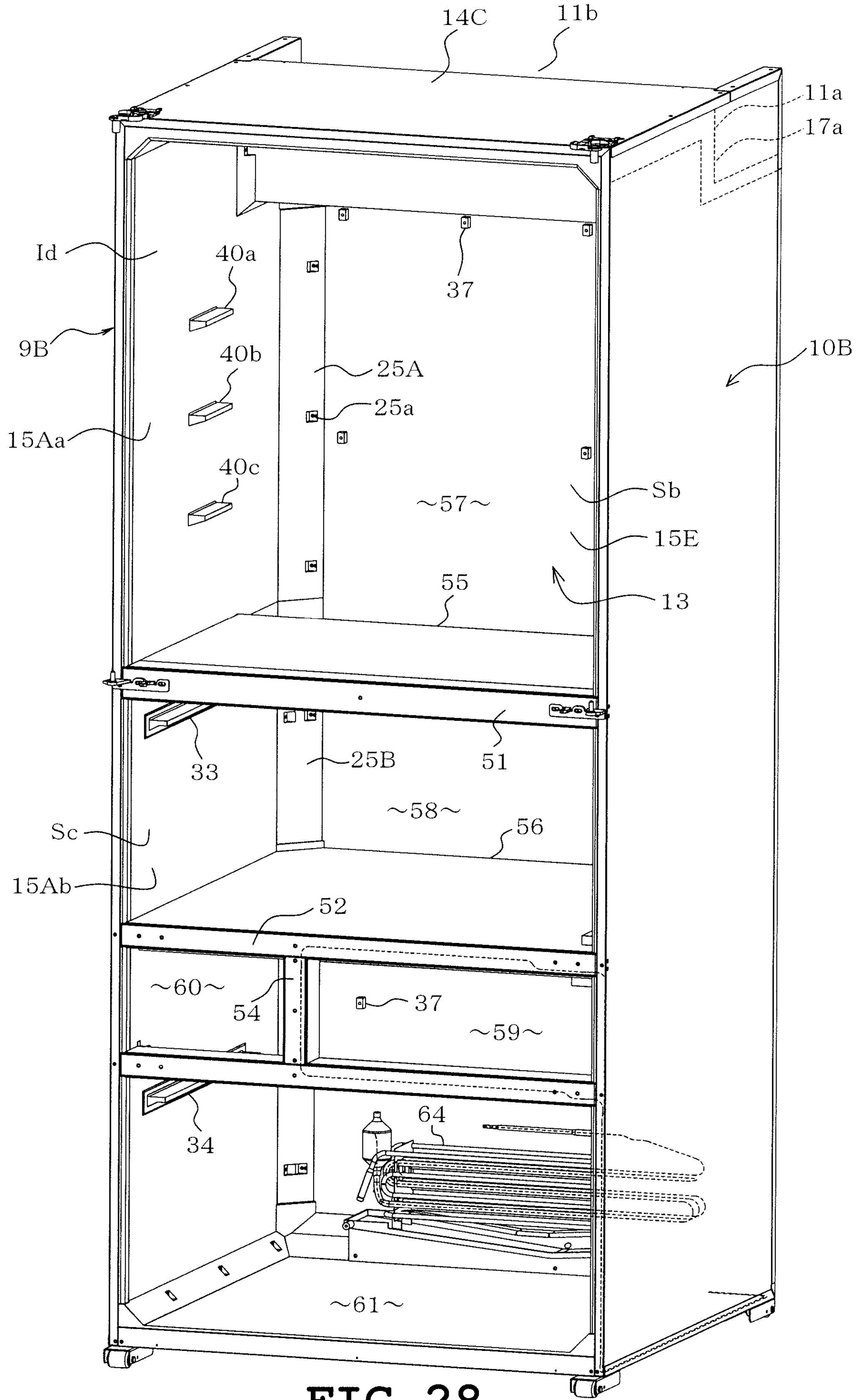

14C
11b
11a
17a
Id
40a
37
9B
10B
40b
25A
25a
15Aa
40c
Sb
~57~
15E
55
13
33
25B
51
~58~
Sc
56
15Ab
52
~60~
54
37
~59~
64
34
~61~

FIG.28

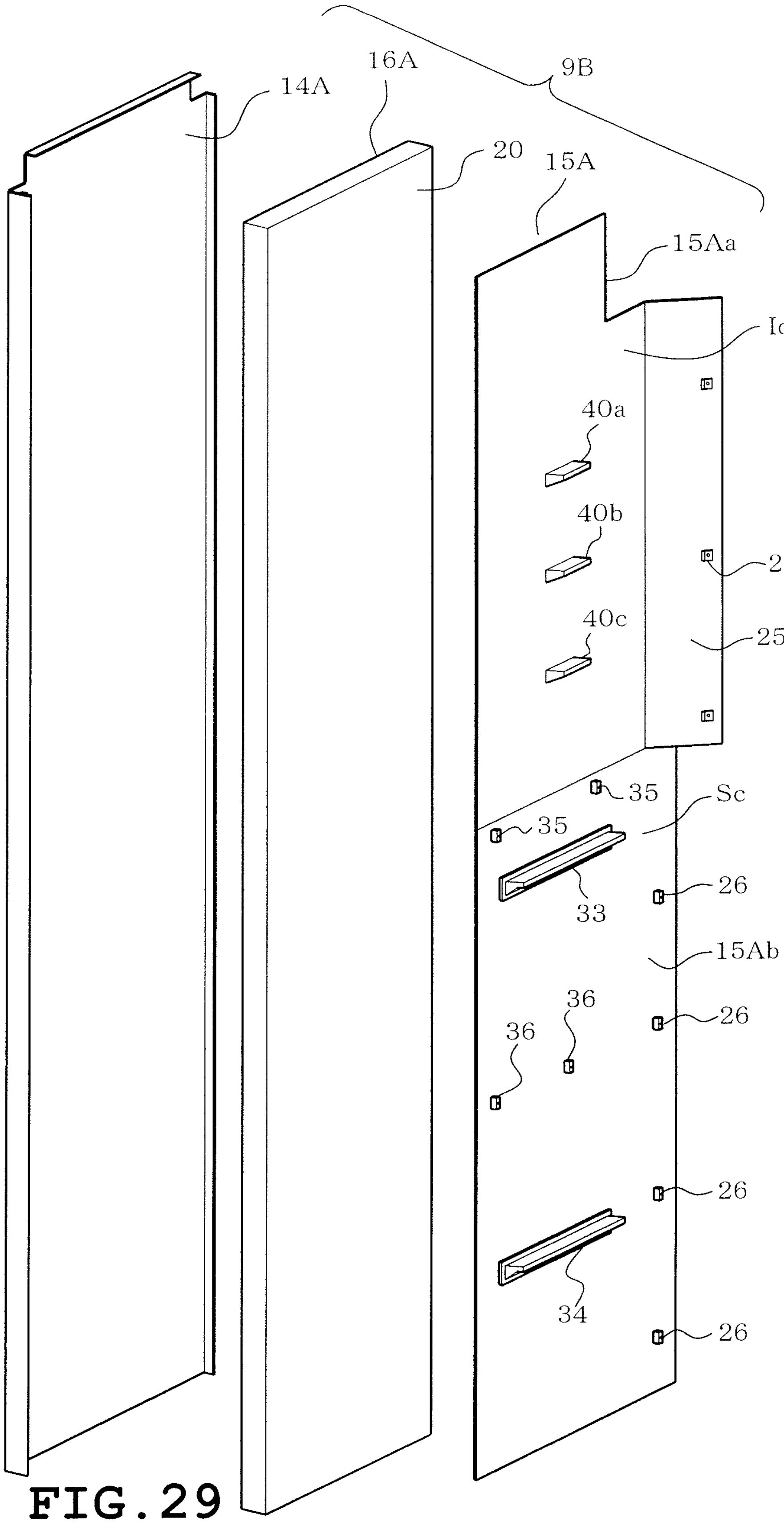

14A
16A
9B
20
15A
15Aa
Id
40a
40b
25a
40c
25A
35
35
Sc
26
33
15Ab
36
36
26
26
34
26

FIG.29

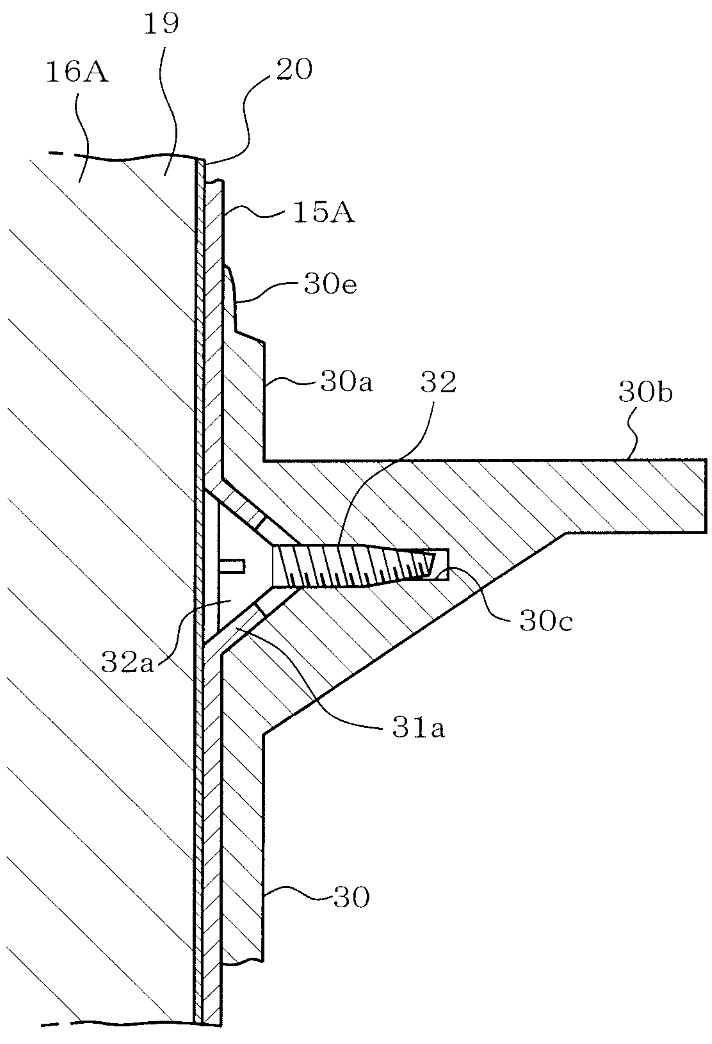


FIG.30

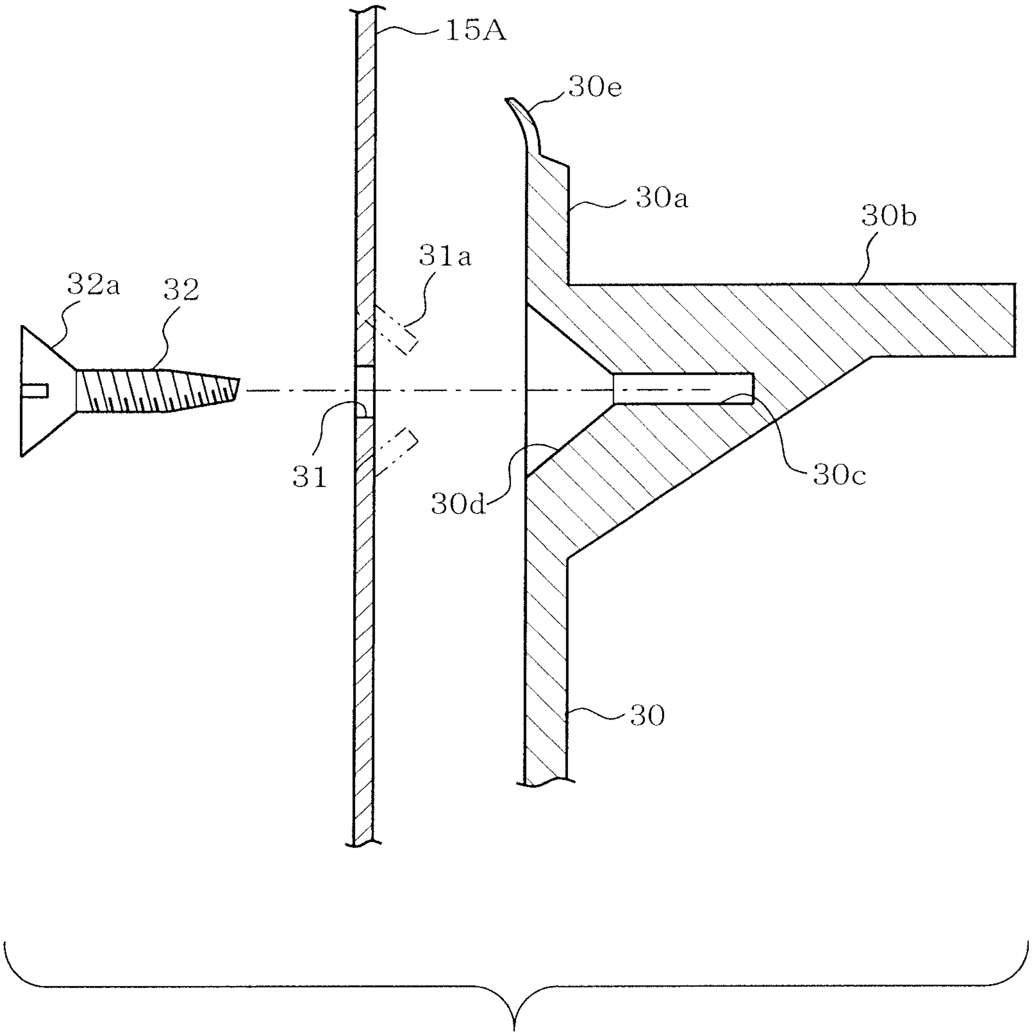


FIG. 31

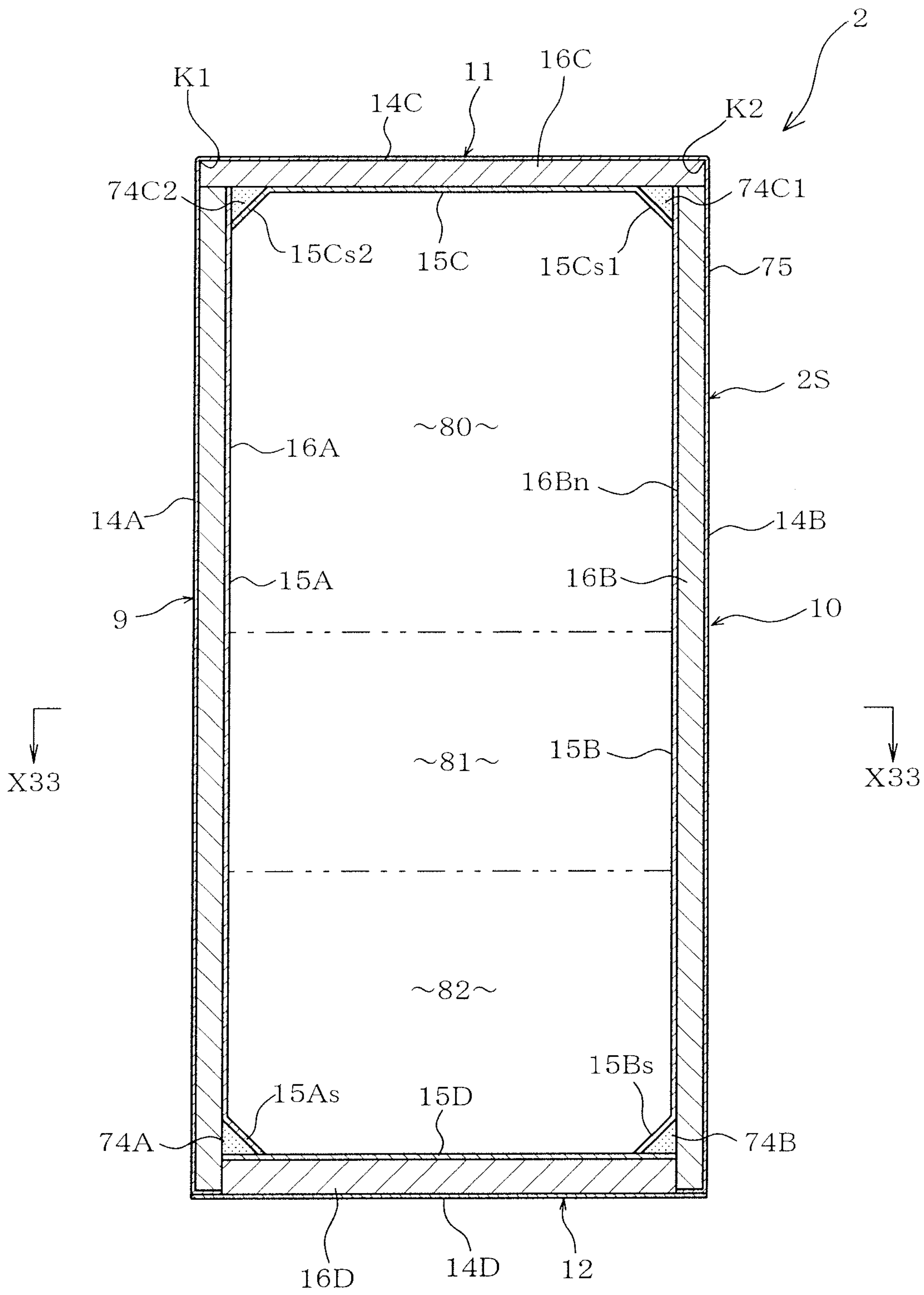

2
K1
11
16C
14C
K2
74C2
74C1
15Cs2
15C
15Cs1
75
2S
~80~
16A
16Bn
14A
14B
15A
16B
9
10
X33
X33
~81~
15B
~82~
15Bs
15As
15D
74A
74B
16D
14D
12

FIG. 32

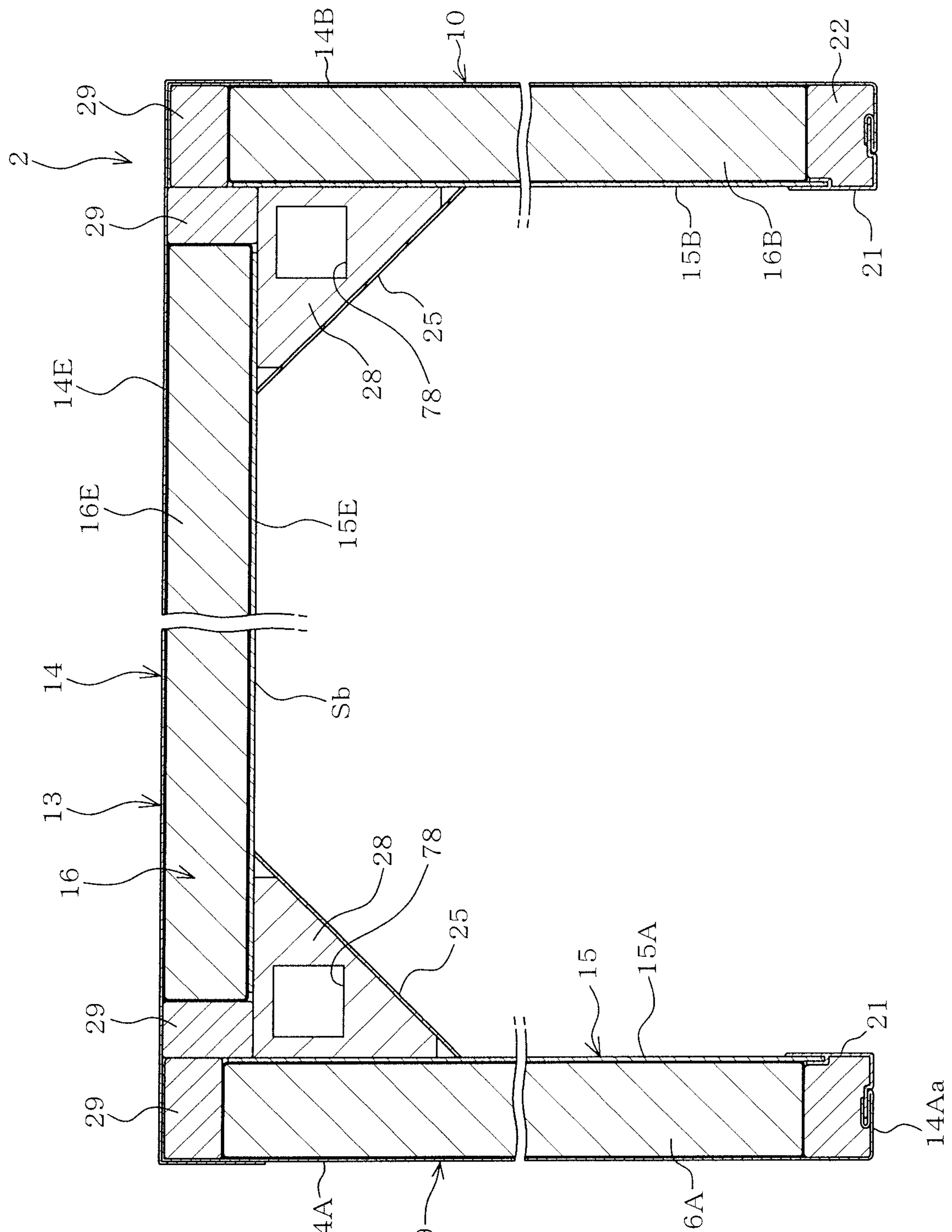

2
29
29
14B
10
22
21
15B
16B
25
78
28
14E
16E
15E
14
Sb
13
16
28
78
25
15
15A
21
29
29
14Aa
14A
9
16A

FIG.33

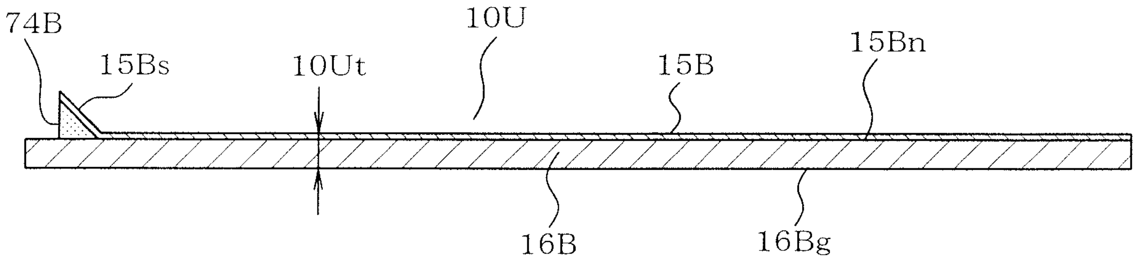

74B
15Bs
10Ut
10U
15B
15Bn
16B
16Bg

FIG.34

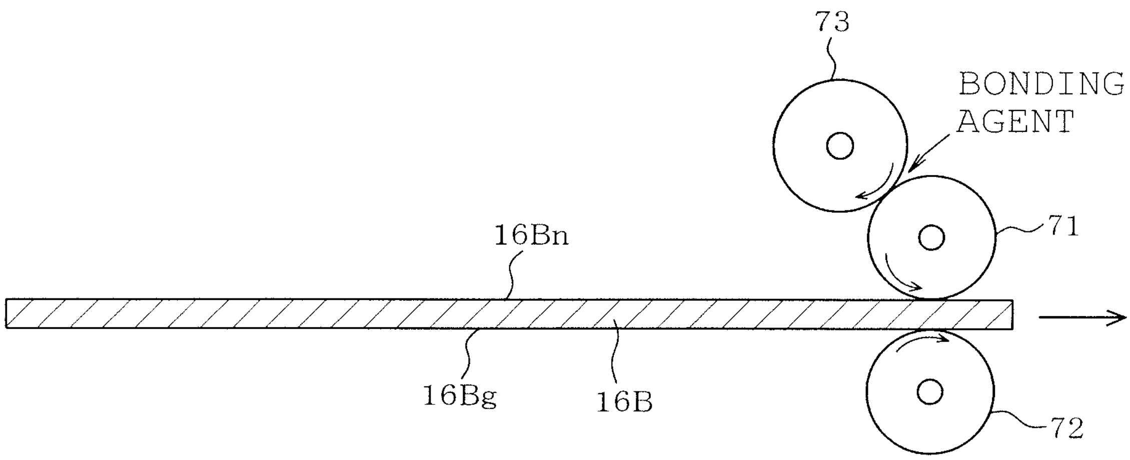

73
BONDING
AGENT
71
16Bn
16Bg
16B
72

FIG.35

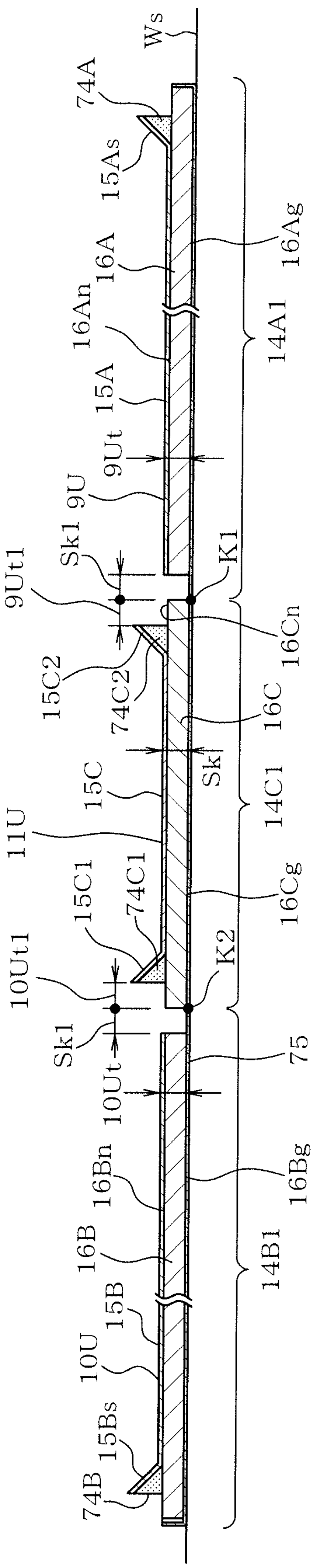

Ws
74A
15As
16Ag
16A
16An
14A1
15A
9Ut
9U
Sk1
9Ut1
K1
16Cn
15C2
74C2
16C
Sk
14C1
15C
11U
16Cg
15C1
74C1
10Ut1
K2
Sk1
75
10Ut
16Bn
16Bg
16B
14B1
15B
10U
15Bs
74B

FIG.36

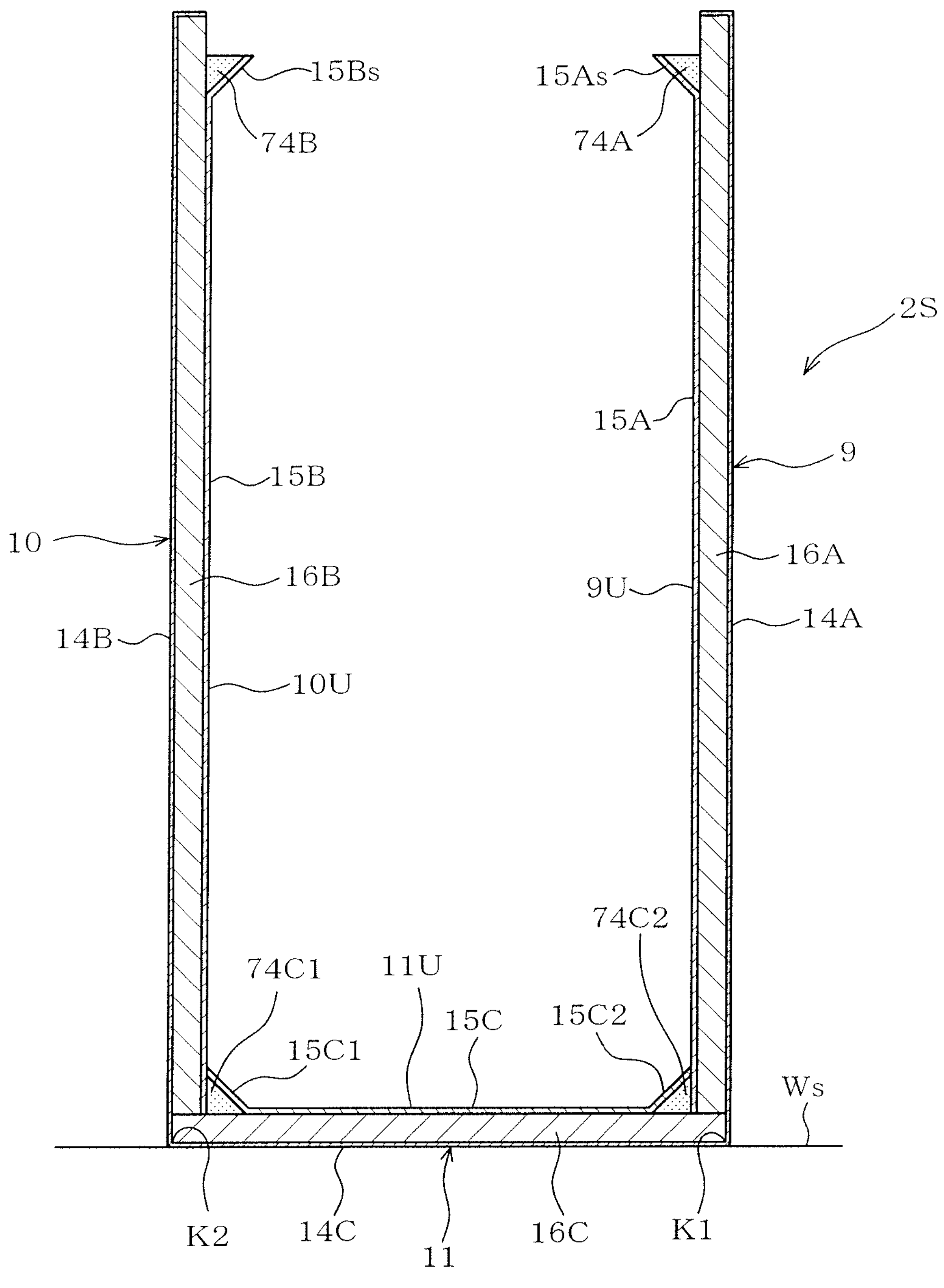

15Bs
15As
74B
74A
2S
15A
9
15B
10
16A
16B
9U
14B
14A
10U
74C2
74C1
11U
15C
15C2
15C1
Ws
K2
14C
11
16C
K1

FIG.37

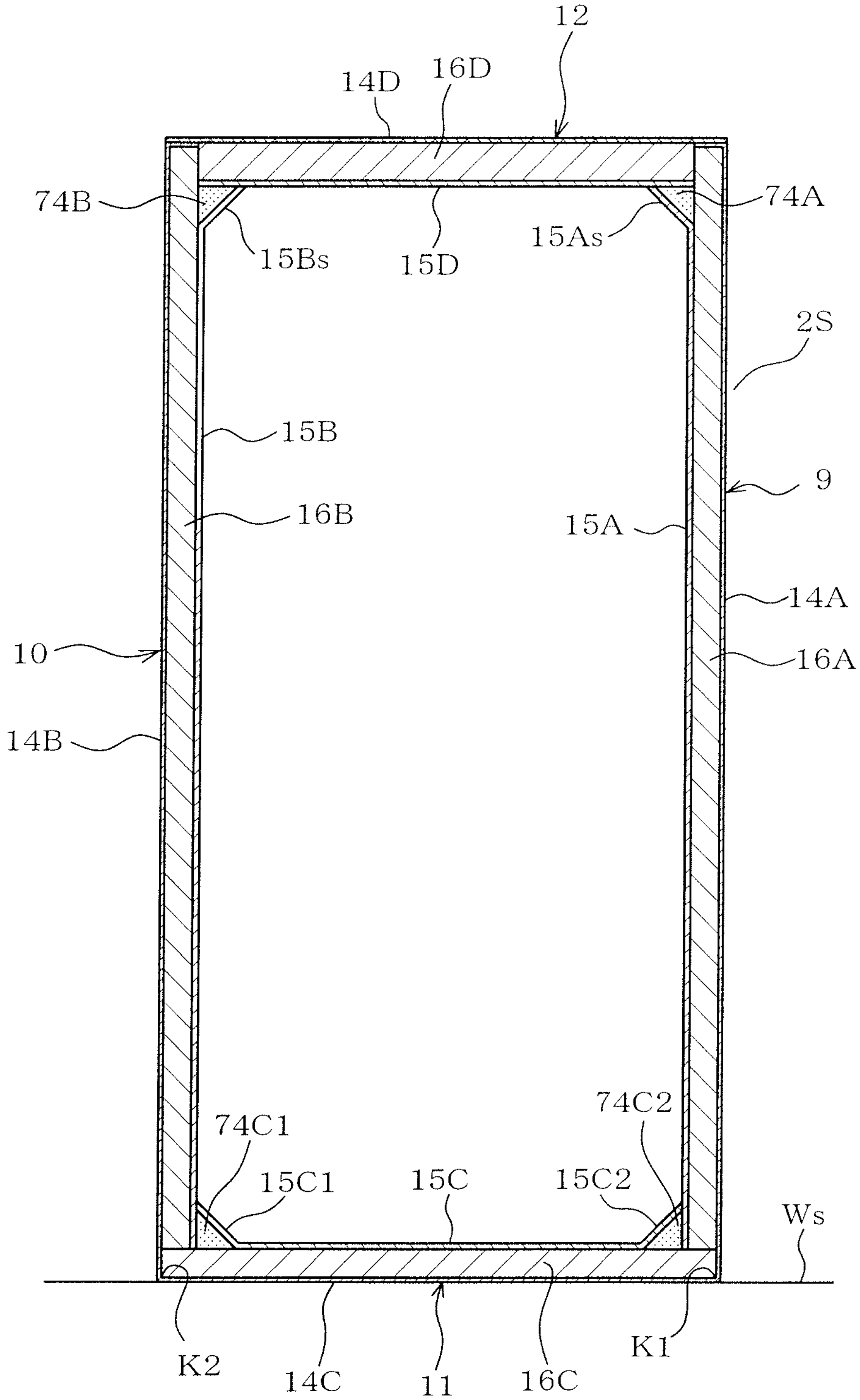

12
14D
16D
74B
74A
15Bs
15D
15As
2S
15B
9
16B
15A
14A
10
16A
14B
74C2
74C1
15C1
15C
15C2
Ws
K2
14C
11
16C
K1

FIG.38

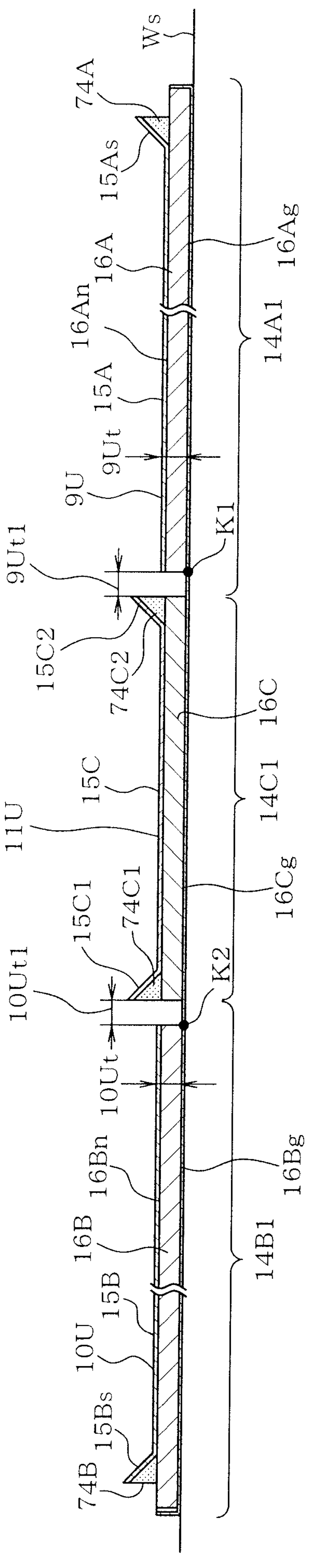

Ws
74A
15As
16A
16Ag
16An
14A1
15A
9Ut
9U
9Ut1
K1
15C2
74C2
16C
15C
14C1
11U
16Cg
15C1
74C1
10Ut1
K2
10Ut
16Bn
16Bg
16B
14B1
15B
10U
15Bs
74B

FIG. 39

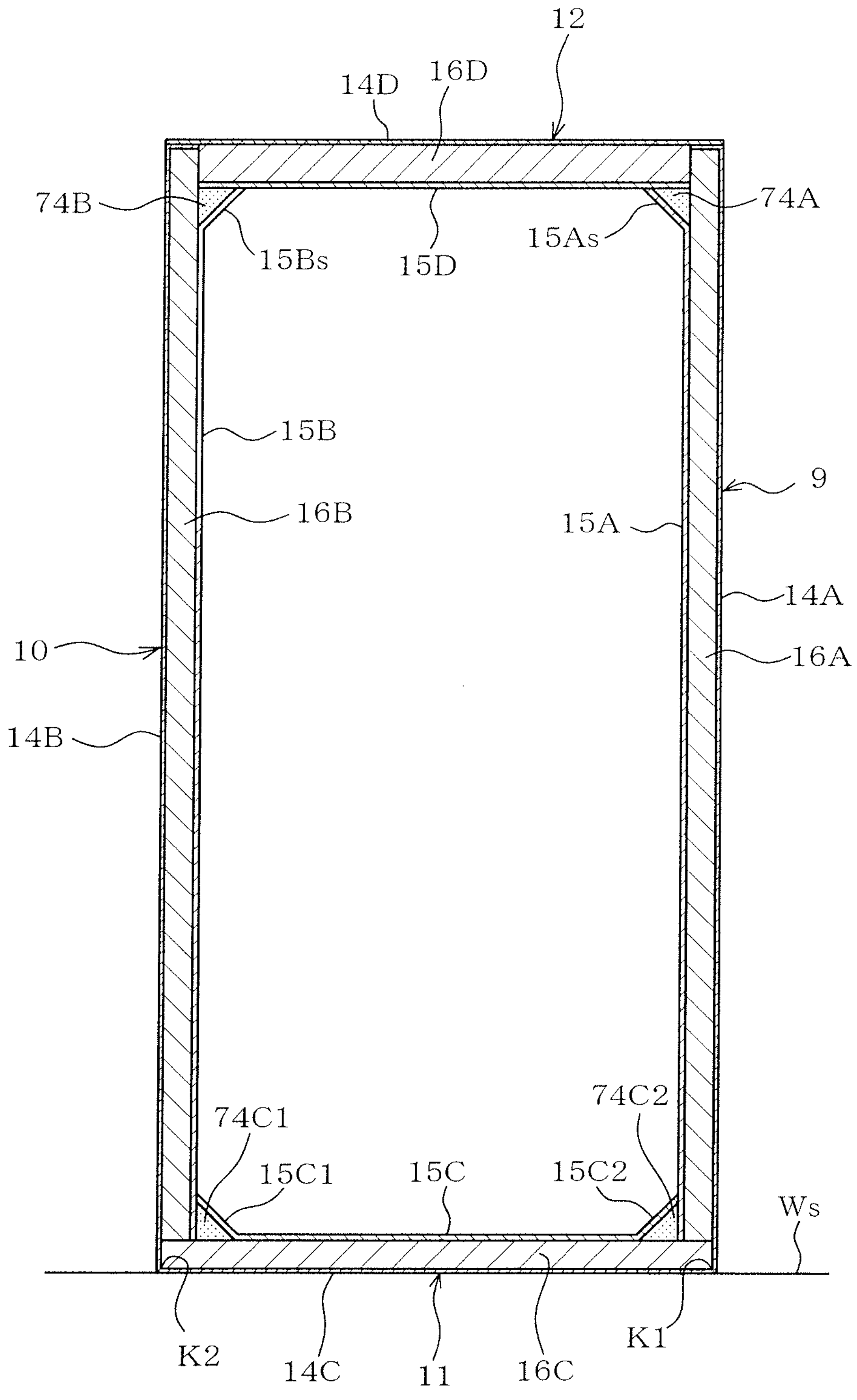

12
14D
16D
74B
74A
15Bs
15D
15As
15B
9
16B
15A
14A
10
16A
14B
74C1
74C2
15C1
15C
15C2
Ws
K2
14C
11
16C
K1

FIG.40

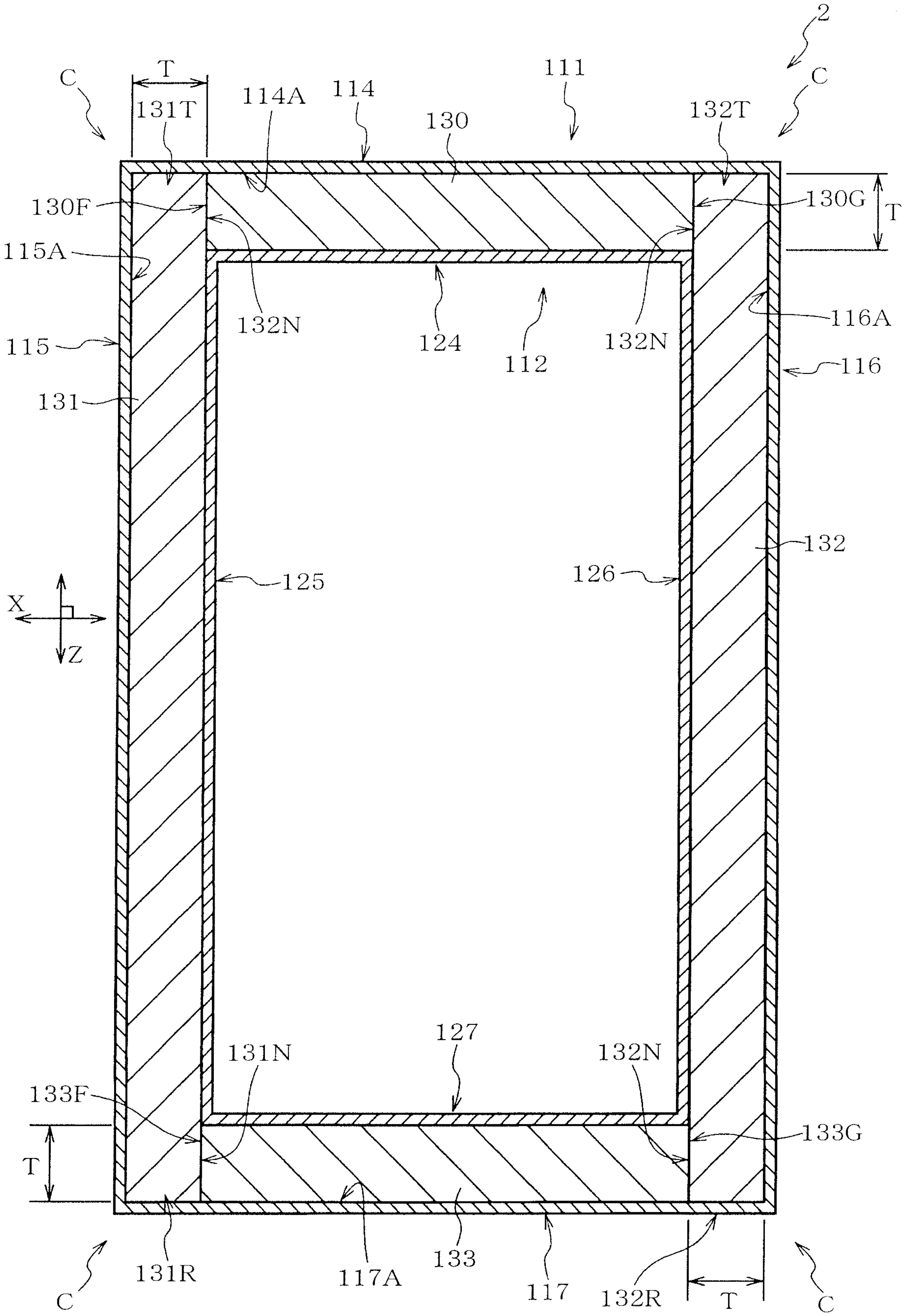

2
C
T
131T
114A
114
111
130
132T
C
130F
130G
T
115A
132N
124
112
132N
116A
115
116
131
132
X
Z
125
126
127
131N
132N
133F
133G
T
131R
117A
133
117
132R
T
C
C

FIG.41

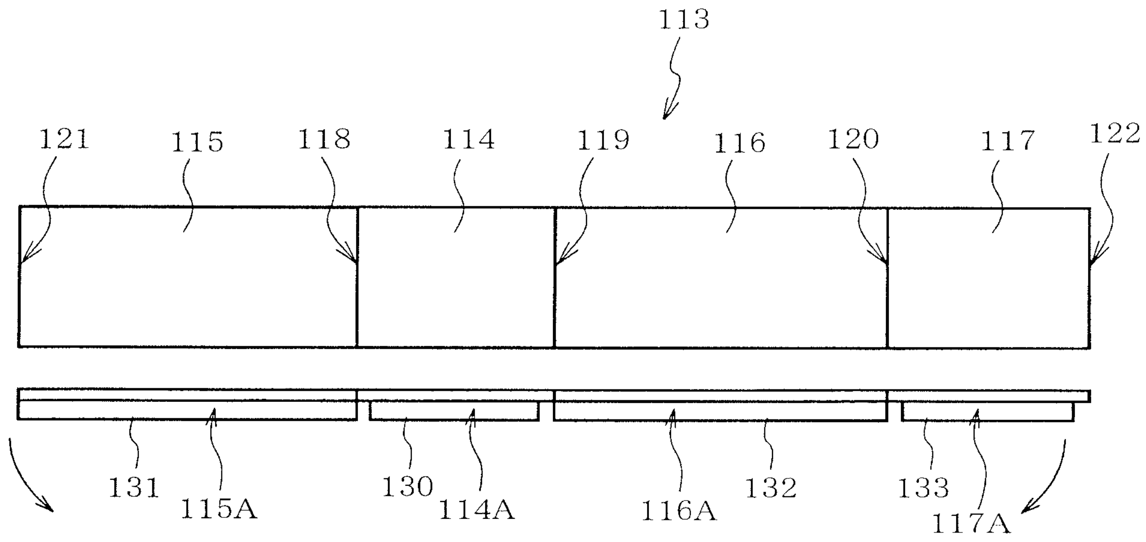


FIG.42A

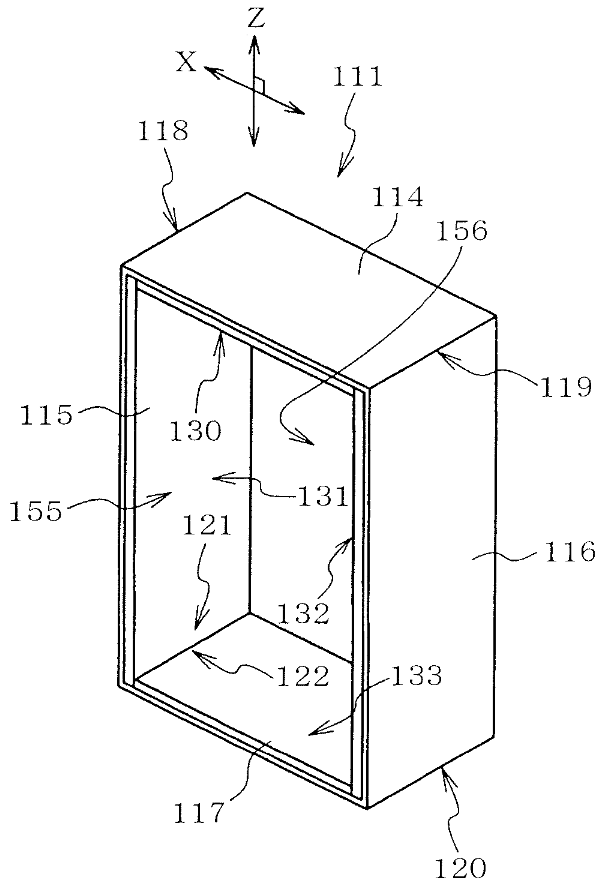


FIG.42B

FIG.43A

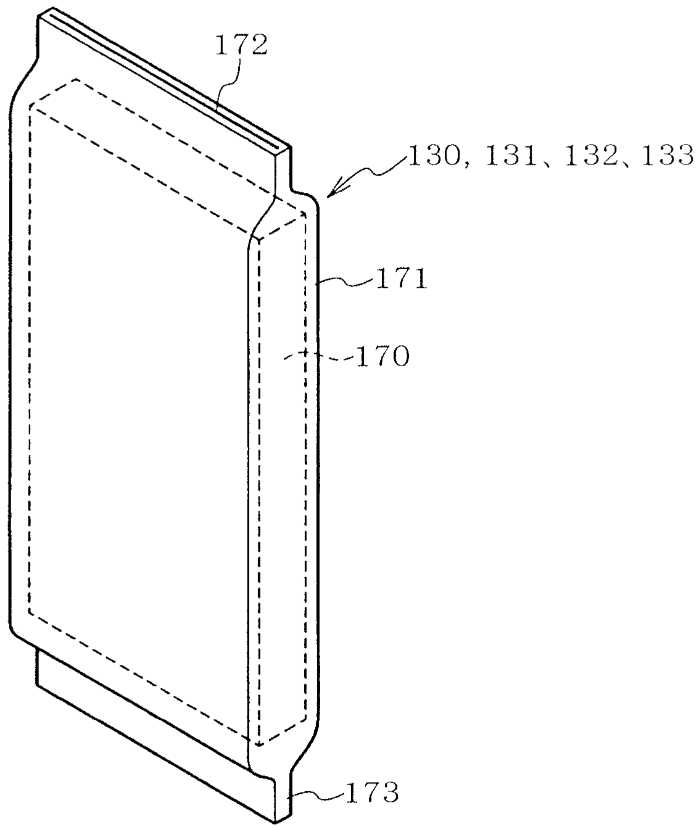
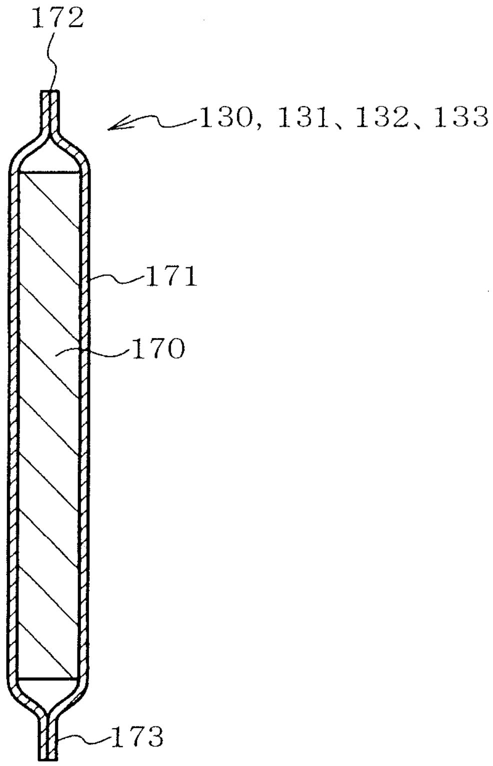


FIG.43B



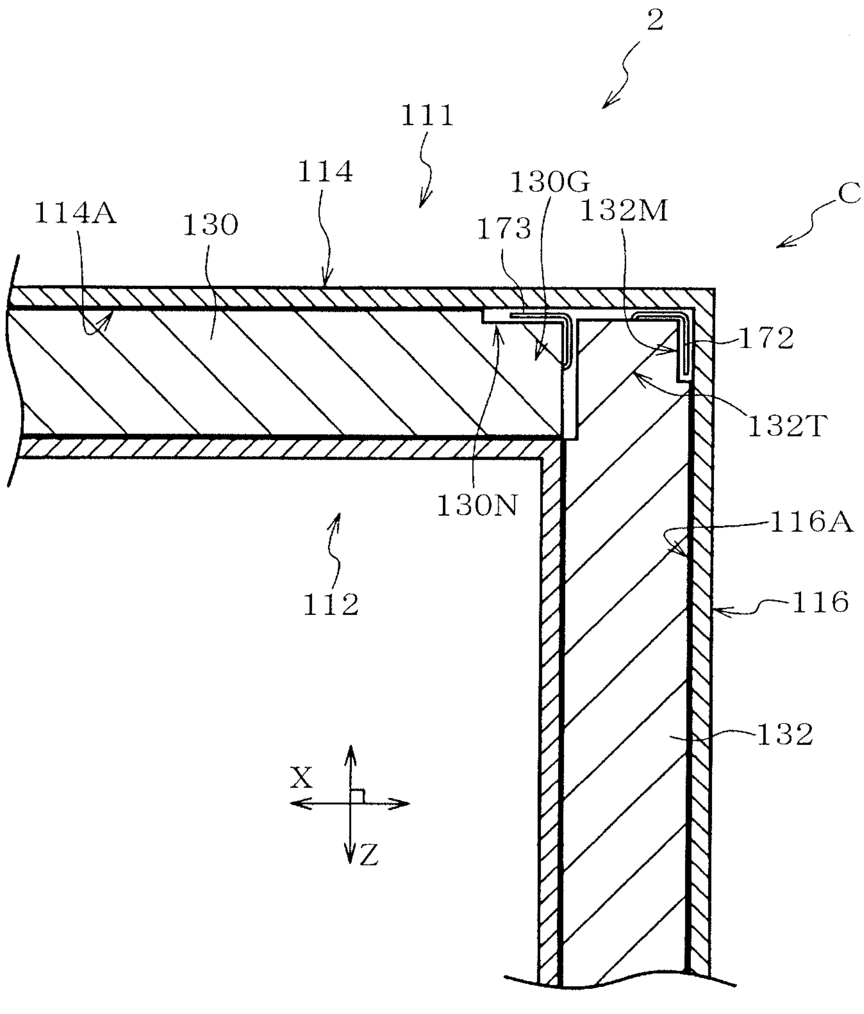
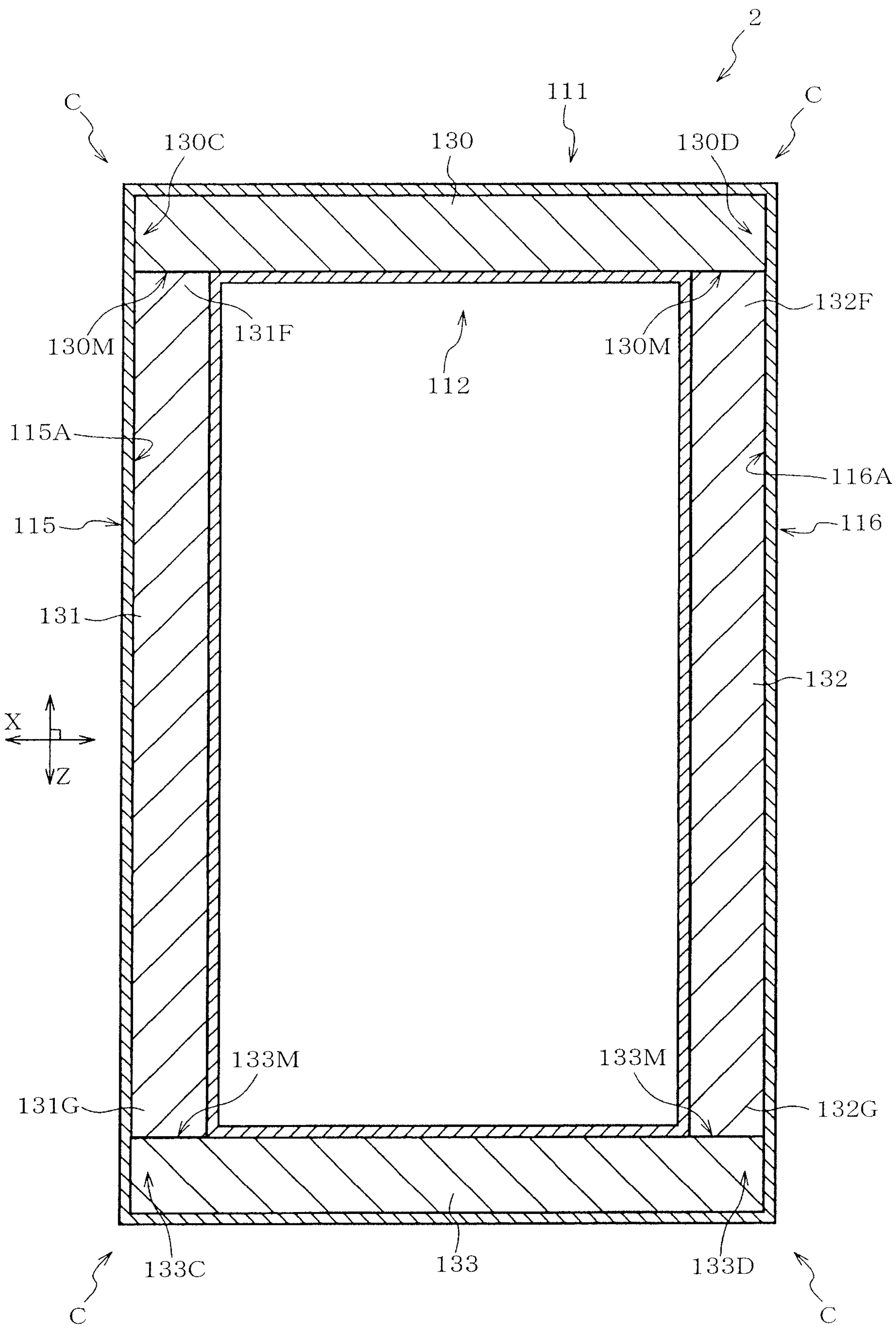

2
111
114
114A
130
130G
173
132M
C
172
132T
130N
116A
116
112
132
X
Z

FIG.44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C
130C
130
130D
130M
131F
130M
132F
112
115A
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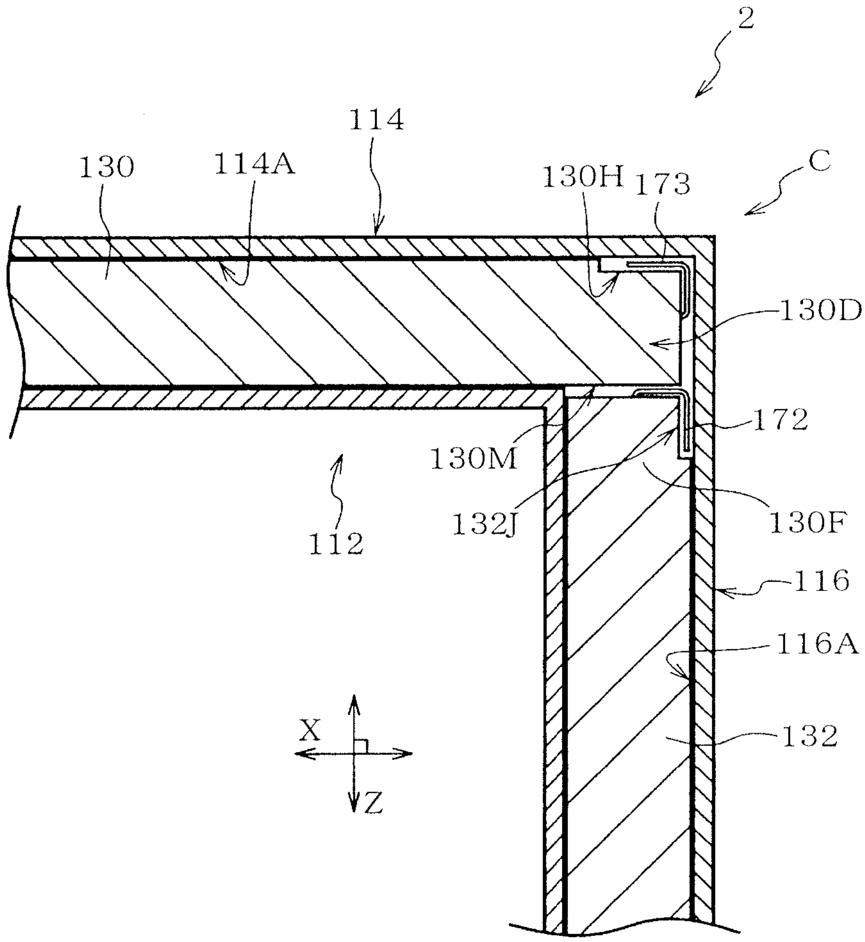
132
X
Z
133M
133M
131G
132G
133C
133
133D
C
C

FIG.45


2
114
130
114A
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173
C
130D
172
130M
132J
130F
112
116
116A
132
X
Z

FIG.46

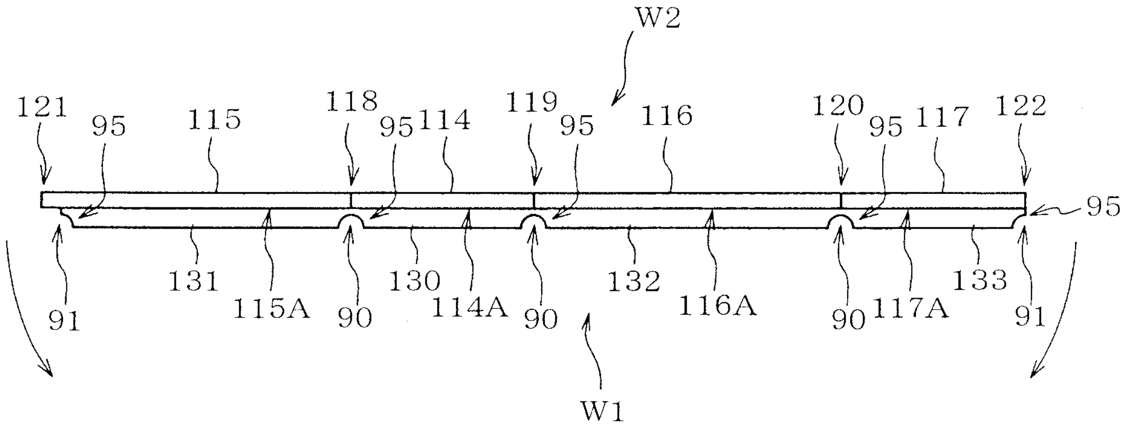


FIG.47A

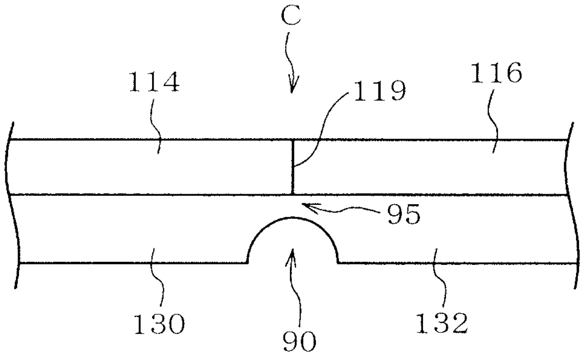


FIG.47B

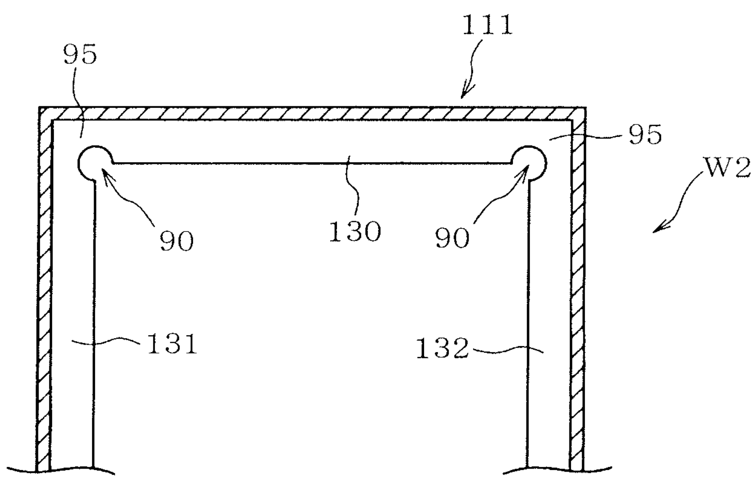


FIG.47C

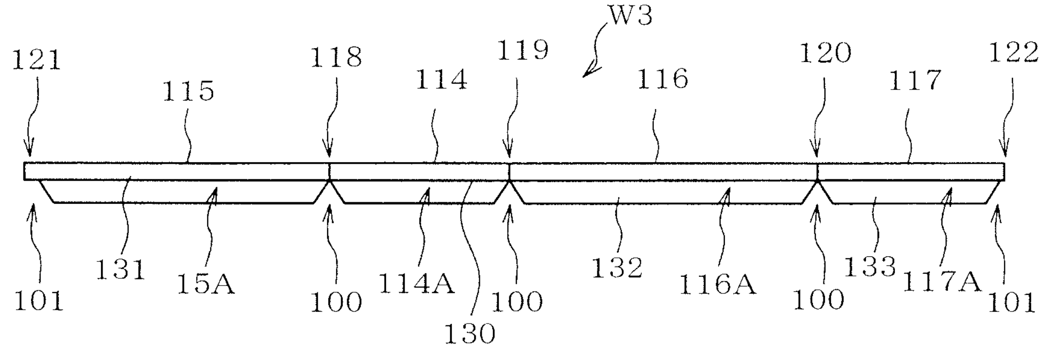


FIG.48A

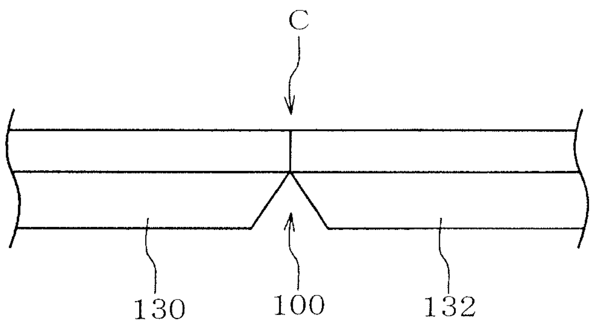


FIG.48B

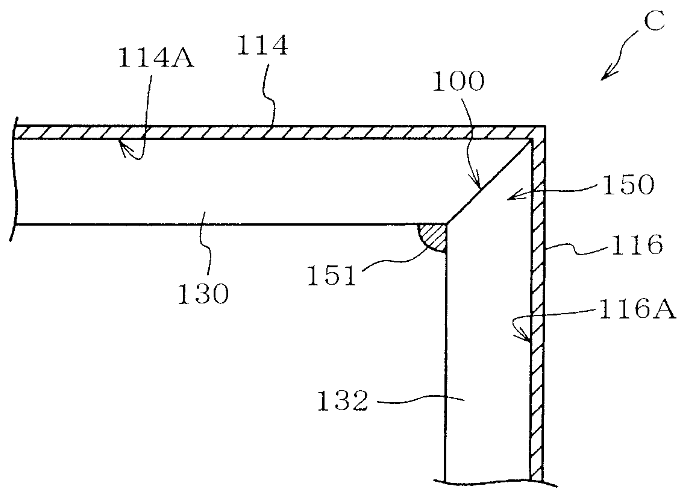


FIG.48C

FIG.49A

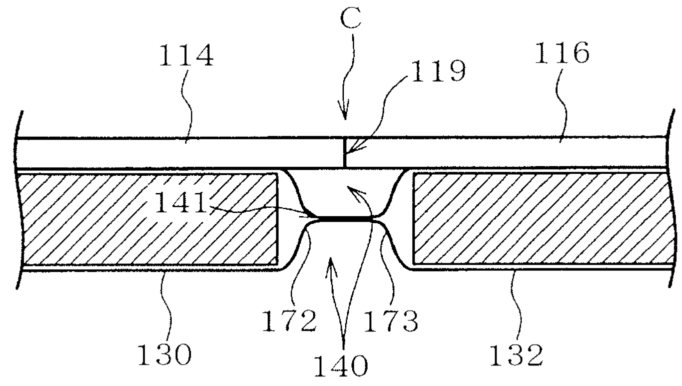


FIG.49B

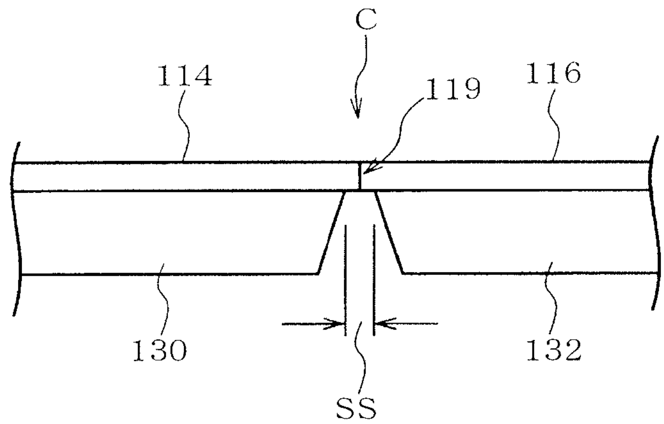
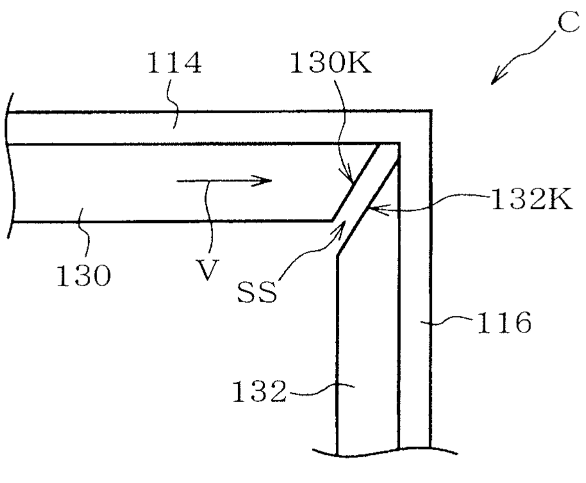


FIG.49C



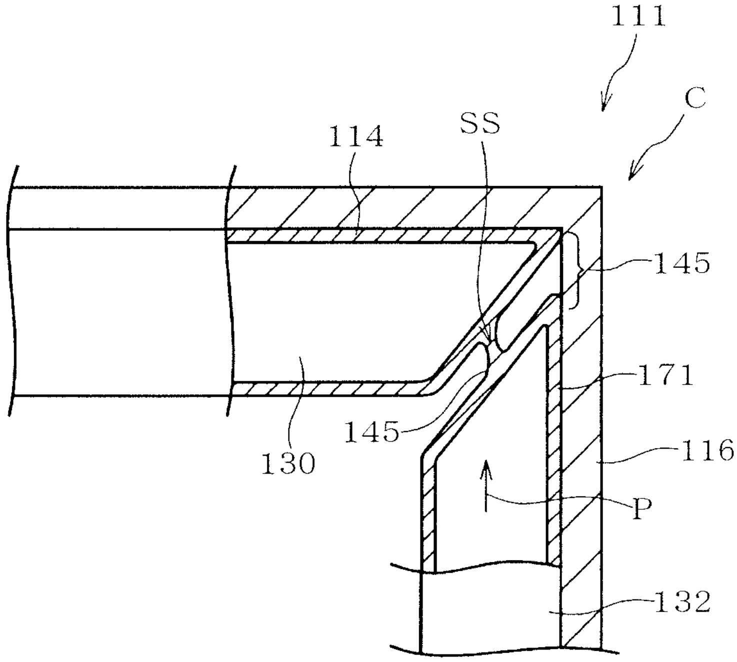


FIG.50A

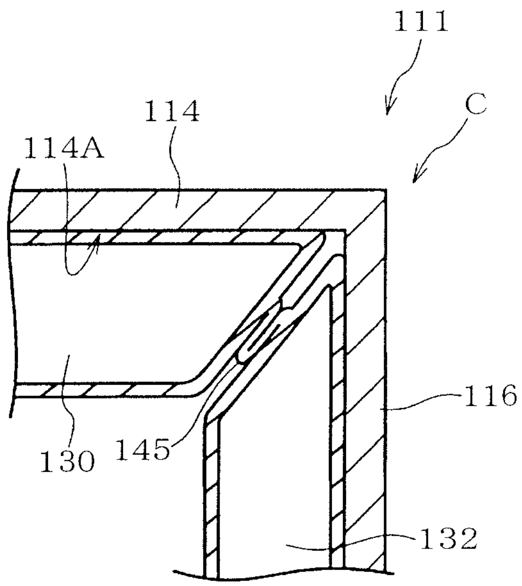


FIG.50B

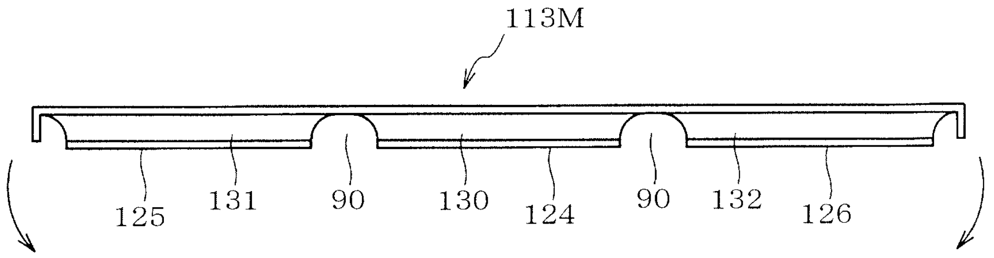


FIG.51A

FIG.51B

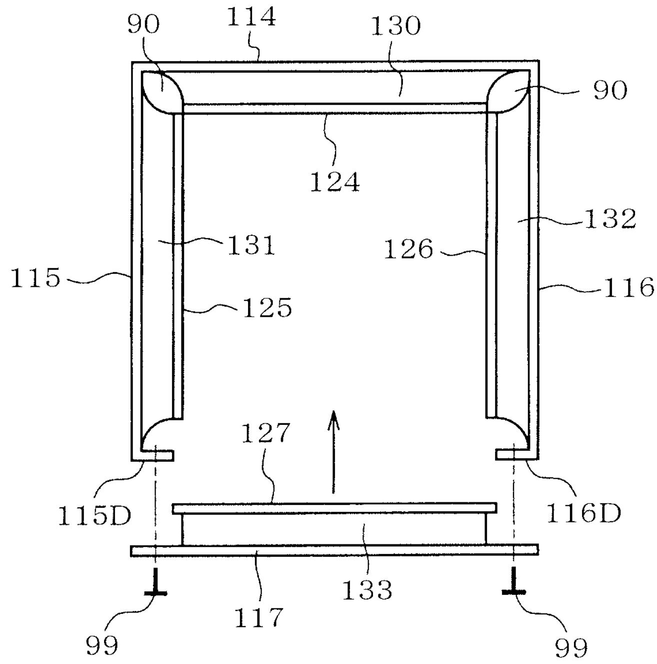
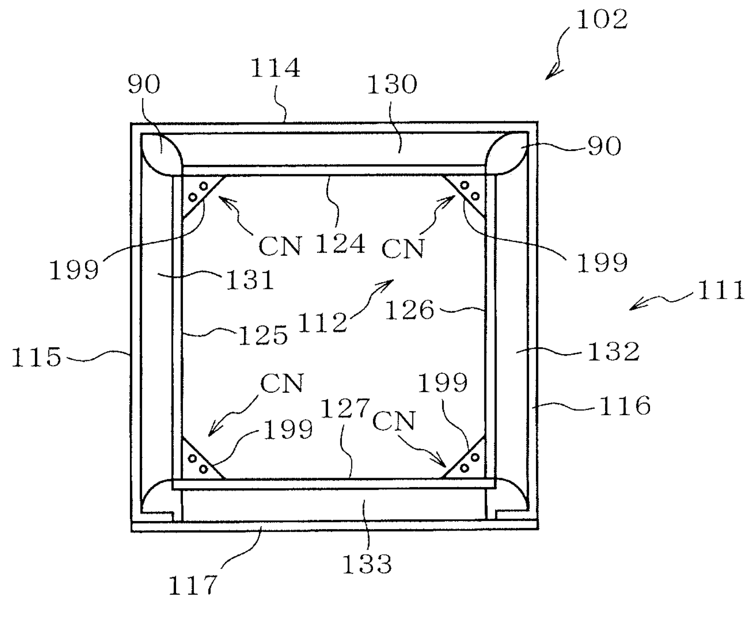


FIG.51C



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/083487

A. CLASSIFICATION OF SUBJECT MATTER
F25D23/06(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)
F25D23/06

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2014
Kokai Jitsuyo Shinan Koho	1971-2014	Toroku Jitsuyo Shinan Koho	1994-2014

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-308257 A (Sharp Corp.), 04 November 2005 (04.11.2005), paragraphs [0018], [0022], [0024] to [0026]; fig. 1 to 5 (Family: none)	1-11
Y	JP 2011-117664 A (Toshiba Corp.), 16 June 2011 (16.06.2011), paragraphs [0011] to [0012]; fig. 2 (Family: none)	1-11
Y	JP 36-029368 Y1 (Seiji DOI), 09 November 1961 (09.11.1961), page 1, left column, line 9 to right column, line 1; fig. 1 (Family: none)	1-11

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

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Date of the actual completion of the international search	Date of mailing of the international search report
26 February, 2014 (26.02.14)	11 March, 2014 (11.03.14)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/083487

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 87399/1983(Laid-open No. 191587/1984) (Matsushita Refrigeration Co.), 19 December 1984 (19.12.1984), page 4, line 14 to page 5, line 3; fig. 4 (Family: none)	8
Y	JP 2005-299972 A (Sanyo Electric Co., Ltd.), 27 October 2005 (27.10.2005), paragraph [0048] (Family: none)	10

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H04260780 A **[0003]**
- JP H06147744 A **[0003]**
- JP 2006090649 A **[0003]**