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(71) Applicants:
- **Kabushiki Kaisha Toshiba**
  Minato-ku
  Tokyo 105-8001 (JP)
- **Toshiba Consumer Electronics Holdings Corporation**
  Tokyo 101-0021 (JP)
- **Toshiba Home Appliances Corporation**
  Tokyo 101-0021 (JP)

(72) Inventors:
- **SAEKI, Tomoyasu**
  Tokyo 105-8001 (JP)
- **ISHIBASHI, Ikuo**
  Tokyo 105-8001 (JP)
- **OIKAWA, Makoto**
  Tokyo 105-8001 (JP)
- **ABE, Tokimi**
  Tokyo 105-8001 (JP)
- **ABE, Masanori**
  Tokyo 105-8001 (JP)
- **YOSHIDA, Takaaki**
  Tokyo 105-8001 (JP)
- **KOMABA, Takashi**
  Tokyo 105-8001 (JP)
- **KAWADA, Ryo**
  Tokyo 105-8001 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) REFRIGERATOR

(57) There has been a problem where, because an inner case is configured as a single integral molded article by molding, a large mold is required and manufacturing costs are high. Provided is a low-cost refrigerator. The refrigerator comprises an insulative case body (2) that includes an outer case (14), an inner case (15) provided inside the outer case, and a vacuum insulation panel (16) provided between the outer case (14) and the inner case (15). At least a portion of the inner case (15) is configured using plate-shaped sheet members (Sa and Sb).

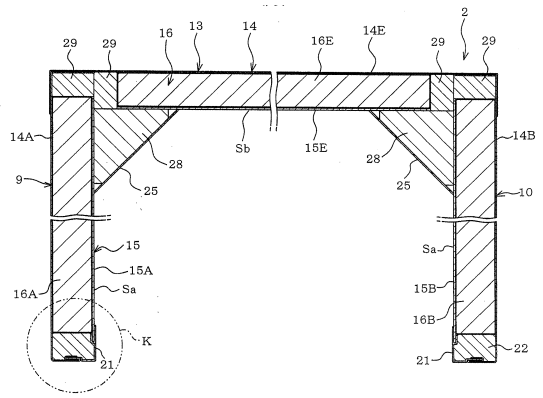

FIG. 4

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Description

Technical Field

[0001] Embodiments of the present invention relate to a refrigerator.

Background Art

[0002] A heat insulation box of a refrigerator has recently been constructed to have a vacuum heat insulation panel between an inner box and an outer box. In this case, the inner box is composed into an integrally molded article formed by injection molding or vacuum molding in its entirety.

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

Summary of the Invention

Problem to be overcome by the Invention

[0004] Since the inner box is composed into a single integrally molded article by die forming in the above-mentioned refrigerator, a large die is required, resulting in a problem of an increase in the production cost.

[0005] Therefore, an object is to provide a low cost refrigerator.

Means for Overcoming the Problem

[0006] One embodiment of the present invention provides a refrigerator comprising a heat insulation box including an outer box, an inner box provided inside the outer box and a vacuum heat insulation panel provided between the outer box and the inner box, wherein at least a part of the inner box is constructed of a flat-plate-shaped sheet member.

Brief Description of the Drawings

[0007]

FIG. 1 is a perspective of a heat insulation box of a refrigerator in accordance with a first embodiment, as viewed from below;
FIG. 2 is a perspective view of the heat insulation box as viewed from above;
FIG. 3 is a perspective view of the refrigerator as viewed from above;
FIG. 4 is a transversely sectional plan view of the heat insulation box;
FIG. 5 is an exploded perspective view of a left heat insulation wall;
FIG. 6 is a perspective view of an upper inner plate as viewed from below;
FIG. 7 is a perspective view of a lower inner plate as viewed from above;
FIG. 8 is an enlarged view of a part indicated by symbol K in FIG. 4;
FIG. 9 is a transversely sectional plan view of a corner portion between the left heat insulation wall and an inner heat insulation wall;
FIG. 10 is a longitudinally sectional front view of a corner portion between the left heat insulation wall and an upper heat insulation wall;
FIG. 11 is an exploded perspective view of a fixture and the left inner plate;
FIG. 12 is a perspective view of the fixture attached to the left inner plate;
FIG. 13 is a longitudinal section of the fixture and its periphery;
FIG. 14 is a longitudinal section of the fixture to which a connecting plate is attached;
FIG. 15 is a transversely sectional plan view of a connecting portion of a transverse beam and the left heat insulation wall;
FIG. 16 is a perspective view of a shelf plate support as viewed from the rear;
FIG. 17 is an exploded longitudinal section 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 in its mounted state;
FIG. 19 is a view similar to FIG. 1, showing a second embodiment;
FIG. 20 is a view similar to FIG. 2;
FIG. 21 is a view similar to FIG. 5;
FIG. 22 is a view similar to FIG. 9;
FIG. 23 is a longitudinally sectional side view of a shelf plate supporting part;
FIG. 24 is a longitudinally sectional side view of the shelf plate supporting part as viewed from a different angle from FIG. 23;
FIG. 25 is an exploded perspective view of the shelf plate support and a reinforcing plate as viewed from the rear;
FIG. 26 is a longitudinally sectional side view of a partition wall supporting part;
FIG. 27 is a perspective view of the partition wall supporting part;
FIG. 28 is a view similar to FIG. 1, showing a third embodiment;
FIG. 29 is a view similar to FIG. 5;
FIG. 30 is a view similar to FIG. 18, showing a fourth embodiment;
FIG. 31 is a view similar to FIG. 17;

FIG. 32 is a longitudinally sectional front view of a part of the heat insulation box of a refrigerator in accordance with a fifth embodiment;
FIG. 33 is a longitudinally sectional front view of a partially developed heat insulation box; and
FIG. 34 is a longitudinally sectional front view of a part of the heat insulation box in an exploded state.

Best Mode for Carrying Out the Invention

[0008] Refrigerators in accordance with several embodiments will be described with reference to the drawings. Identical or similar parts in the embodiments are labeled by the same reference symbols and the description of these parts will be eliminated.

(First Embodiment)

[0009] A first embodiment will be described with reference to FIGS. 1 to 18. A refrigerator 1 as shown in FIG. 3 includes a heat insulation box 2. The heat insulation box 2 has one side that is open. In the specification, the open side of the heat insulation box 2 corresponds to a front of the refrigerator 1 and a right-left direction on the paper of FIG. 1 corresponds to a right-left direction of the refrigerator 1.

[0010] On the front of the heat insulation box 2 are provided a left pivot door 3, a right pivot door 4 and a plurality of slide-out doors 5 to 8 as shown in FIG. 3. Each of the doors 3 to 8 has a heat insulation material (not shown) therein. The heat insulation box 2 has a pair of upper and lower hinges 3a and 3b and a pair of upper and lower hinges 4a and 4b as shown in FIGS. 1 and 2. The left pivot door 3 is pivotally supported by the hinges 3a and 3b. The right pivot door 4 is pivotally supported by the hinges 4a and 4b.

[0011] The heat insulation box 2 is constructed by connecting a plurality of divided unit heat insulation walls 9 to 13. More specifically, the heat insulation box 2 is constructed by connecting a left heat insulation wall 9, a right heat insulation wall 10, an upper heat insulation wall 11, a lower heat insulation wall 12 and an inner heat insulation wall 13.

[0012] The heat insulation box 2 has transverse beams 51, 52 and 53 and a longitudinal beam 54. The transverse beams 51, 52 and 53 are provided at the opening side of the heat insulation box 2. The transverse beams 51 to 53 transversely connect between right and left edges of the heat insulation box 2, that is, between a right heat insulation wall 10 and a left heat insulation wall 9. The longitudinal beam 54 longitudinally connects between the transverse beams 52 and 53 midway in the right-left direction of the transverse beams 52 and 53. A first partition wall 55 for storage compartment partition is provided in the rear of the transverse beam 51. A second partition wall 56 for storage compartment partition is provided in the rear of the transverse beam 52.

[0013] The heat insulation box 2 has therein a refrigerating compartment 57, a vegetable compartment 58, a small freezing compartment 59, an ice making compartment 60 and a freezing compartment 61 all as storage compartments. The refrigerating compartment 57 is formed above a first partition wall 55. The vegetable compartment 58 is formed between the first and second partition walls 55 and 56. The small freezing compartment 59 is formed between the transverse beams 52 and 53 so as to be located in the right of the longitudinal beam 54. The ice making compartment 60 is formed between the transverse beams 52 and 53 so as to be located on the left of the longitudinal beams 54, that is, so as to be located on the left of the small freezing compartment 59. The freezing compartment 61 is formed below the transverse beam 53.

[0014] The refrigerating compartment 57 has a front opening opened and closed by the pivot doors 3 and 4 as shown in FIG. 3. The vegetable compartment 58 has a front opening opened and closed by the slide-out door 5. The slide-out door 5 has a vegetable container (not shown) formed integrally on the rear side thereof. The small freezing compartment 59 has a front opening opened and closed by the slide-out door 6. The slide-out door 6 has a frozen food container (not shown) formed integrally on the rear side thereof. The ice making compartment 60 has a front opening opened and closed by the slide-out door 7. The slide-out door 7 has an ice receiving container (not shown) formed integrally on the rear side thereof. The freezing compartment 61 has a front opening opened and closed by a slide-out door 8. The slide-out door 8 has a frozen food container (not shown) formed integrally with the rear side thereof.

[0015] The second partition wall 56 as shown in FIGS. 1 and 2 has therein a heat insulation material such as foam polystyrene or foam urethane. As a result, the second partition wall 56 separates the small freezing compartment 59 and the ice making compartment 60, and the vegetable compartment 58 in a heat insulation manner. There is a large difference in a storage temperature between the small freezing compartment 59 and the ice making compartment 60, and the vegetable compartment 58. The first partition wall 55 is constructed of a synthetic resin plate member, for example, and separates the refrigerating compartment 57 and the vegetable compartment 58. There is not a large difference in storage temperature between the refrigerating compartment 57 and the vegetable compartment 58.

[0016] The heat insulation box 2 and the heat insulation walls 9 to 13 will now be described. An outer box 14 constitutes an entire outer frame of the heat insulation box 2. The outer box 14 is constructed by combining a plurality of divided outer plates. More specifically, the outer box 14 is constructed by combining 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. The left outer plate 14A constitutes a left outer surface of the outer box 14. The right outer plate 14B constitutes a right outer surface of the outer box 14. The upper outer plate

14C constitutes an upper outer surface of the outer box 14. The lower outer plate 14D constitutes a lower outer surface of the outer box 14. The rear outer plate 14E constitutes a rear outer surface of the outer box 14. The outer plates 14A to 14E are made of a steel plate. The left outer plate 14A and the right outer plate 14b are bilaterally symmetrical.

[0017] The inner box 15 constitutes an inner surface of the heat insulation box 2. The inner box 15 is constructed by combining a plurality of divided inner plates. More specifically, the inner box 15 is constructed by combining 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 constitutes a left inner surface of the inner box 15. The right inner plate 15B constitutes a right inner surface of the inner box 15. The upper inner plate 15C constitutes an upper inner surface of the inner box 15. The lower inner plate 15D constitutes a lower inner surface of the inner box 15. The rear inner plate 15E constitutes a rear inner surface of the inner box 15.

[0018] The right and left inner plates 15B and 15A are bilaterally symmetrical and are constructed of a flat-plate shaped sheet member Sa made from a synthetic resin such as ABS resin. FIG. 5 shows the sheet member Sa to which are mounted fixtures 26, a shelf plate support 30, guide rail fixtures 33 and 34 and partition wall supports 35 and 36 all of which will be described later.

[0019] The upper inner plate 15C has an L-shaped portion 17 formed integrally therewith as also shown in FIG. 6. The L-shaped portion 17 serves as a curved portion and protrudes to the compartment interior, that is, to an interior of the heat insulation box 2. The upper inner plate 15C is comprised of an integrally molded article 1a from a synthetic resin such as olefin resin.

[0020] The lower inner plate 15D has a waste receiving portion 18 formed integrally therewith as also shown in FIG. 7. The waste receiving portion 18 serves as a curved portion. The lower inner plate 15D is comprised of an integrally molded article Ib from a synthetic resin. These integrally molded articles Ia and Ib are molded by injection molding or vacuum molding.

[0021] The rear inner plate 15E is comprised of a flat-plate shaped sheet member Sb made from synthetic resin as shown in FIGS. 1 and 2. Note that the sheet members Sa and Sb can be produced by extrusion or rolling without use of any molding die having a special shape. Furthermore, a commercially available flat-plate shaped sheet member may be used.

[0022] A vacuum heat insulation panel 16 is provided between the outer and inner boxes 14 and 15 as shown in FIG. 4. The vacuum heat insulation panel 16 is composed of a plurality of divided plate-shaped unit panels. More specifically, the vacuum heat insulation panel 16 is composed of a left upper 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. Since the unit panels are constructed in the same manner, the left unit panel 16A will be described, for example.

[0023] The left unit panel 16A is constructed by putting a base material 19 into an envelope 20 and decompressing and sealing an interior of the envelope 20 by vacuum evacuation, as shown in FIGS. 8 and 9. The base material 19 is formed into a plate shape by hardening a laminated material of inorganic fiber such as glass wool. The envelope 20 contains a metal layer such as an aluminum vapor deposition layer or aluminum foil layer in order to have a gas barrier performance that causes gas to pass through the envelope 20. Each unit panel is generally referred to as "vacuum heat insulation panel."

[0024] The left heat insulation wall 9 includes a left outer plate 14A, a left inner plate 15A and a left unit panel 16A disposed between the plate 14A and 15A as shown in FIG. 5. The plates are bonded to one another into a unit heat insulation wall.

[0025] Front ends of the outer and inner boxes 14 and 15, that is, front ends of the left and right heat insulation walls 9 and 10 are connected to each other by a front end connecting member 21, as shown in FIG. 8. More specifically, regarding the front end of the left heat insulation wall 9, the front ends of the left outer and inner plates 14A and 15A are connected to each other by a front end connecting member 21. The front end connecting member 21 is made from synthetic resin and has a heat insulation performance. In this case, since the front ends of the right and left heat insulation walls 10 and 9 are bilaterally symmetrical, only the front end of the left heat insulation wall 9 will be described.

[0026] The front ends of the left outer and inner plates 14A and 15A extend forward from a front end of the left unit panel 16A. The front end of the left outer plate 14A is bent to the left inner plate 15A side, extending to a central part in a thicknesswise direction of the left unit panel 16A. A bent portion of the front end of left outer heat insulation wall 16A will be referred to as "bent portion 14Aa." IN this case, the bent portion 14Aa does not extend rightward over the left inner plate 15A. This suppresses flow of heat outside the heat insulation box 2 via the outer box 14, in this case, the left outer plate 14A into the storage compartment.

[0027] An inner space is defined by the 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. A heat insulation material such as a soft tap 22 is provided in the inner space. The heat insulation material may be made from foam polystyrene, instead of the soft tape 22.

[0028] The right heat insulation wall 10 and the left heat insulation wall 9 are bilaterally symmetrical and are constructed in the same manner.

[0029] The upper heat insulation wall 11 has an upper unit panel 16C between the upper outer and inner plates 14C and 15C as shown in FIG. 10. The upper unit panel 16C is bonded to the upper inner plate 15C. Foam urethane 24 fills a gap between the upper unit panel 16S and the upper outer plate 14C. The upper outer plate

14C has an L-shaped portion 17a corresponding to the L-shape portion 17 of the upper inner plate 15C as shown in FIG. 2. As a result, the rear part of the upper heat insulation wall 11 protrudes downward as a whole. More specifically, the upper heat insulation wall 11 has a recess 11a in the rear part thereof. A space in the rear of the recess 11a serves as a mechanical compartment. A compressor, a condenser and the like constituting the refrigeration cycle are provided in the mechanical compartment 11b although none of them are shown. The mechanical compartment 11b is closed by a mechanical compartment cover 11c as shown in FIG. 3.

[0030] A distance between the upper unit panel 16C and the upper outer plate 14C or a thickness of a part of the foam urethane is set to be smaller than a thickness of the upper unit panel 16C and an outer diameter of a pipe of the refrigeration cycle, for example, a suction pipe. This reduces an amount of foam urethane 24 used. In FIG. 10, when pipes of the refrigeration cycle are arranged, the pipes may be caused to pass through the left upper corner of the heat insulation box 2 in the front-rear direction. In this case, the corner is a space surrounded by a left end surface of the upper unit panel 16C, an upper end surface of the left unit panel 16A, a left edge of the upper outer plate 14C and an upper edge of the left outer plate 14A.

[0031] The left end of the upper outer plate 14C is connected to the left outer plate 14A while being separate from the upper surface of the upper unit panel 16C, as shown in FIG. 10. The right end of the upper outer plate 14C is also connected to the right outer plate 14B while being separate from the upper surface of the upper unit panel 16C although the connection is not shown in detail. The upper inner plate 15C has connecting portions 15C1 which are provided on right and left side edges of the upper inner plate 15C, as also shown in FIG. 6. The connecting portions 15C1 connect the upper inner plate 15C and the left inner plate 15A to each other as shown in FIG. 10. In this case, distal ends of the connecting portions 15C1 are connected to the left inner plate 15A by a connecting member (not shown).

[0032] The left connecting portion 15C1 will now be described. Note that the right connecting portion is constructed in the same manner as the left connecting portion 15C1 and that the right connecting portion and the left connecting portion 15C1 are bilaterally symmetrical. The connecting portions 15C1 have respective ribs 15C2 as shown in FIG. 10. The connecting portion 15C1 has a rib 15C2 which is located at the inside of the distal end of the connecting portion 15C1 or at the foam urethane 24 side and protrudes upward substantially in parallel to the left inner plate 15A. A soft tape 23 as a heat insulation material leak preventing member is inserted between the rib 15C2 and the left inner plate 15A. The soft tape 23 suppresses leak of foam urethane 24 during the filling of the foam urethane.

[0033] The lower heat insulation wall 12 has a lower unit panel (not shown) 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 the lower inner plate 15D. Thus, a unit heat insulation wall is constructed. The lower heat insulation wall 12 may be constructed by bonding the lower inner plate 15D and the lower unit panel to each other and by filling a gap between the lower unit panel and the lower outer plate 14D with foam urethane. A lowermost part of the waste receiving portion 18 communicates with the outside of the heat insulation box 2 in the lower heat insulation wall 12.

[0034] The rear heat insulation wall 13 also includes a rear outer plate 14E, a rear inner plate 15E and a rear unit panel 16E disposed between the rear outer and inner plates 14E and 15E. The rear outer and inner plates 14E and 15E and the rear unit panel 16E are bonded to one another by a bonding agent. In this case, too, the construction may be added that foam urethane suitably fills and be solidified.

[0035] Regarding the upper and lower inner plates 15C and 15D, the integrally molded articles Ia and Ib each composed of the olefin resin have respective improved bonding capabilities to the unit panel by applying surface treatment to bonding surfaces to the unit panel so that the bonding surfaces become rough. Furthermore, the left, right and rear inner plates 15A, 15B and 15E have respective high bonding capabilities since the sheet members Sa and Sb are made from ABS resin.

[0036] Connection between the left and rear heat insulation walls 9 and 13 will be described with reference to FIGS. 9 and 11 to 14. The left and rear heat insulation walls 9 and 13 are connected to each other by a sheet member connecting plate 25 and a fixture 26 and the like. In this case, the sheet member connecting plate 25 functions as a sheet member connecting member, and the fixture 26 functions as a first protrusion. The construction of the connection of the left and rear heat insulation walls 9 and 13 will be described in the following. The connection of the right and rear walls 10 and 13 is constructed in the same manner as the connection of the left and rear heat insulation walls 9 and 13. These connections are bilaterally symmetrical.

[0037] The fixtures 26 will firstly be described. The fixtures 26 are provided on the left heat insulation wall 9 and the rear heat insulation wall 13 so as to protrude to the refrigerator interior side. Since the structure of the fixture and the structure of the mounting of the fixture are common to the left and rear heat insulation walls 9 and 13, the fixtures 26 of the left heat insulation wall 9 will be described. Each fixture 26 is made of synthetic resin such as ABS resin and is formed into the shape of a rectangular parallelepiped which is long in the up-down direction. Each fixture 26 has a flange 26a and a screw hole 26c. The flange 26a provided on one end side of the rectangular parallelepiped and protrudes in the up-down direction. The screw hole 26c is a female screw hole extending from the other end surface toward one end side of the rectangular parallelepiped of each fixture 26.

[0038] When the left heat insulation wall 9 is assem-

bled, the fixtures 26 are firstly bonded to the left unit panel 16A. The left inner plate 15A or the sealing member Sa has vertically long rectangular holes 15u. After having been bonded to the left unit panel 16A, each fixture 26 is inserted into the hole 15u from the rear side of the left inner plate 15A or the left unit panel 16A side to the surface side or the storage compartment side. In this case, a bonding agent is applied between the left unit panel 16A and the left inner plate 15A. Accordingly, the left unit panel 16A and the left inner plate 15A are bonded to each other. The flange 26a is held between the left inner plate 15A and the left unit panel 16A, whereby each fixture 26 is fixed. Each fixture 26 is thus mounted to the left heat insulation wall 9, protruding into the inner box 15. A plurality of fixtures 26 is provided on adjacent ends of the left and rear heat insulation walls 9 and 13 in a vertical arrangement.

[0039] The sheet member connecting plate 25 has substantially the same length as the left inner plate 15A as shown in FIGS. 1 and 2. The sheet member connecting plate 25 has both horizontal edges formed with L-shaped recesses 25a respectively as shown in FIG. 9. The recesses 25a correspond to the respective fixtures 26. The recesses 25a are formed with screw insertion holes 25b through which screws 27 are inserted. The screws 27 are then screwed into the screw holes 26c of the fixtures 26 respectively. Consequently, the left and rear inner plates 15A and 15E are connected to each other by the sheet member connecting plate 25. The sheet member connecting plates 25 are provided at corners at both sides of the refrigerating compartment 57, the vegetable compartment 58, the small freezing compartment 59, the ice making compartment 60 and the freezing compartment 61.

[0040] Foam polystyrene 28 and a soft tape 29 are provided in a space in the rear of the sheet member connecting plates 25 or a space surrounded by the sheet member connecting plate 25, the left inner plate 15A and the rear inner plate 15E. Each of the foam polystyrene 28 and the soft tape 29 serves as a heat insulating member.

[0041] The piping of the refrigeration cycle may be passed through the part of foam polystyrene 28 in FIG. 9 so as to extend in the up-down direction.

[0042] Shelf plate supports 30 are provided on the right and left heat insulation walls 10 and 9 respectively as shown in FIGS. 1 and 5. The construction of the shelf plate support 30 will be described with reference to FIGS. 16 to 18. The shelf plate support 30 provided on the right heat insulation wall 10 is constructed in the same manner as the shelf plate support 30 provided on the left heat insulation wall 9.

[0043] The shelf plate supports 30 are components apart from the inner plates 15A and 15B comprised of the sheet member SA and are made of synthetic resin such as ABS resin. Each shelf plate support 30 includes a body 30a, shelf plate supporting portions 30b and screw holes 30c all of which are formed integrally therewith. The body 30a is formed into the shape of a rectangular plate long in the up-down direction. The shelf plate supporting portions 30b are provided on one of two opposite sides of the body 30a and protrude to the refrigerator interior side. Each shelf plate supporting portion 30b serves as a second protrusion. Three shelf plate supporting portions 30b are arranged on the body 30a in the up-down direction. The screw holes 30c are located so as to correspond to the shelf plate supporting portions 30b respectively. The screw holes 30c extend through the body 30a from the side opposed to the shelf plate supporting portions 30b to the shelf plate supporting portion 30b side, further to the middle of the shelf plate supporting portion 30b respectively. Each screw hole 30c is formed with a female thread on the inside thereof. Each screw hole 30c serves as a fastening member engagement portion. Each screw hole 30c has an opening peripheral edge formed with a countersink 30d which is open in a conical shape.

[0044] The left inner plate 15A has screw insertion holes 31 as shown in FIG. 17. Each screw insertion hole 31 serves as a fastening member insertion hole. Three screw insertion holes 31 are arranged in the up-down direction on a part of the left inner plate corresponding to the refrigerating compartment 57 in FIG. 1. FIG. 17 shows only one of the three screw insertion holes 31. The shelf plate supports 30 are mounted to the left inner plate 15A before assembly of the left heat insulation wall 9. In this case, countersunk screws 32, which have been inserted through the screw insertion holes 31 of the left inner plate 15A, are screwed into the screw holes 30c of the shelf plate supports 30, respectively. As a result, the shelf plate support 30 is fixed to the inner surface of the left inner plate 15A, that is, the side at the refrigerating compartment 57 while protruding to the refrigerating compartment 57 side. In this case, the countersunk screws 32 serve as fastening members.

[0045] In this case, the left inner plate 15A is slightly deformable since the left inner plate 15A is constructed of the sheet member. Accordingly, in the course of screwing the countersunk screws 32 into the screw holes 30c, countersunk screw heads 32a of the screws 32 deform the peripheral edges of the holes 31 of the left inner plate 15A into a dish shape such that the peripheral edges of the holes 31 are bulged to the refrigerator interior side or the refrigerating compartment 57 side, until the screw heads 32a abut against the countersink 30d, respectively. Consequently, peripheral edges 31a of the screw insertion holes 31 depart from the left unit panel 16A as shown in FIG. 18. Furthermore, ends or the screw heads 32a of the countersunk screw 32 do not protrude from the rear side of the left inner plate 15A to the left unit panel 16A side.

[0046] Guide rail fixtures 33 and 34 are provided on the right and left heat insulation walls 10 and 9 respectively, as shown in FIGS. 1, 2 and 5. The guide rail fixtures 33 correspond to the vegetable compartment 58 and the guide rail fixtures 34 correspond to the freezing compart-

ment 61. The guide rail fixtures 33 and 34 are made from synthetic resin and constructed of parts apart from the sheet member. The guide rail fixtures 33 and 34 serve as second protrusions protruding from the right and left inner plates 15B and 15A to the refrigerator interior side, respectively.

[0047] The guide rail fixtures 33 and 34 are mounted on the right and left inner plates 15B and 15A in the same manner as the shelf plate supports 30. Guide rails (not shown) are mounted on the guide rail fixtures 33 and 34 respectively. The guide rails are configured to drawably support containers integrated with the slide-out doors 5 and 8, respectively although the supporting manner is not shown in detail.

[0048] Partition wall supports 35 and 36 are provided on the right and left heat insulation walls 10 and 9 respectively as shown in FIGS. 1, 2 and 5. A first partition wall 55 is supported by the partition wall supports 35, and a second partition wall 56 is supported by the partition wall supports 36. The partition wall supports 35 and 36 are each made from synthetic resin and constructed of parts apart from the sheet member. The partition wall supports 35 and 36 are mounted on the inner plates 15A and 15B in the same manner as the fixtures 26, respectively. In this case, the partition wall supports 36 and 35 serve as first protrusions protruding from the right and left inner plates 15B and 15A to the refrigerator interior side respectively.

[0049] Rear cover fixtures 37 are provided at suitable locations on the inner surface of the inner box 15 in the rear heat insulation wall 13, that is, on the rear inner plate 15E constructed of the sheet member Sb. The rear cover fixtures 37 are each made from synthetic resin and constructed of parts apart from the rear inner plate 15E comprised of the sheet member Sb. The rear cover fixtures 37 serve as protrusions which protrude from the rear inner plate 15E to the refrigerator interior side. The rear cover fixtures 37 are provided for mounting a rear cover to conceal a duct to be disposed in front of the rear heat insulation wall 13. The rear cover fixtures 37 are mounted on the rear inner plate 15E in the same manner as the fixtures 26. In this case, the rear cover fixtures 37 serve as first protrusions which protrude from the rear inner plate 15E to the refrigerator interior side.

[0050] Gaps between the inner plates and the unit panels are not filled with foam urethane in the heat insulation walls 9 to 13. Furthermore, an evaporator 64 constituting the refrigeration cycle is provided in an inner interior of the freezing compartment 61 as shown in FIG. 2. The waste receiving portion 18 receives defrosting water caused during the defrosting of the evaporator 64, guiding the defrosting water to a lower part outside the left heat insulation wall 13.

[0051] The construction of a connecting portion of the transverse beam 52 and the right and left heat insulation walls 10 and 9 will be described with reference to FIG. 15, which shows the connection of the transverse beam 52 and the left heat insulation wall 9. A connection on the right heat insulation wall 10 and the connection of the transverse beam 52 and the left heat insulation wall 9 are bilaterally symmetrical and are constructed in the same manner. The transverse beam member 52 includes a front partition plate 52a constituting the front, a reinforcing plate 52b, a rear partition cover 52c and a heat insulating member 52d. The left outer plate 14A of the left heat insulation wall 9 has a front 14A1, which has a folded portion 14A2 formed by folding a distal end thereof.

[0052] The front partition plate 52a is held between the reinforcing plate 52b and the folded portion 14A2. In assembling the transverse beam member 52, the front partition plate 52a and the reinforcing plate 52b are firstly integrated by screws 63. Left ends of the front partition plate 52a and the reinforcing plate 52b are inserted into a space in the rear of the front 14A1 of the left outer plate 14A. Subsequently, a screw 62 is inserted through holes in the ends of the folded portion 14A2 of the left outer plate 14A and the front partition plate 52a and then screwed into the screw hole of the reinforcing plate 52b. As a result, the front partition plate 52a is held between the reinforcing plate 52b and the folded portion 14A2 thereby to be fixed.

[0053] A rear partition cover 52c housing the heat insulating material 52d is mounted on the rear of the front partition plate 52a. Right and left edges of the front opening in the heat insulation box 2 are connected by the front partition plate 52a, whereby the right and left heat insulation walls 10 and 9 are fixed. As a result, the front opening of the heat insulation box 2 can be prevented from opening and shrinking, whereby the storage compartment can be maintained in the rectangular parallelepiped shape.

[0054] The reinforcing plate 52b may not be provided when the front partition plate 52a has a sufficient strength. Furthermore, the rear partition cover 52c has a downwardly protruding mount although the mount is not shown. The mount is screwed by a fixture which is similar to the fixtures 26.

[0055] According to the above-described first embodiment, the right and left inner plates 15B and 15A of the inner box 15 are constructed of the flat-plate shaped sheet member Sa. The rear inner plate 15E is constructed of the flat-plate shaped sheet member Sb. According to this construction, the right and left inner plates 15B and 15A and the rear inner plate 15E do not necessitateforming diesin the manufacture. Accordingly, since the production can be simplified greatly with the result that the plates 15B, 15A and 15E can contribute to reduction in the manufacturing cost of the refrigerator.

[0056] The upper and lower inner plates 15C and 15D both constituting another part of the inner box 15 are an integrally molded article by the use of a die. However, the manufacture can be rendered easier and the production cost can also be reduced in this case as compared with the conventional construction in which an entire inner box 15 is integrally molded by the use of a larger die. Thus, the above-described construction can contribute

to cost reduction in the refrigerator 1. In this case, at least one of 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 is constructed of the sheet member.

[0057] In the above-described embodiment, the inner box is constructed by combining 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. In this case, two adjacent inner plates, that is, the left inner plate 15A, the rear inner plate 15E and the right inner plate, are constructed of divided sheet members different from each other. The sheet member connecting plates 25 each serving as sheet member connecting member which connects the adjacent inner plates are provided between the adjacent inner plates, that is, between the left inner plate 15A and the rear inner plate 15E and between the right inner plate 15B and the rear inner plate 15E.

[0058] According to this construction, the left and rear inner plates 15A and 15E and the right and rear inner plates 15B and 15E, all of which are constructed of the respective sheet members, can easily be connected together by using the sheet member connecting plates 25 constructed of discrete components, whereby the assembly can be simplified.

[0059] In the first embodiment, furthermore, the heat insulation box 2 is constructed by connecting a plurality of divided unit heat insulation walls, that is, the left heat insulation wall 9, the right heat insulation wall 10, the upper heat insulation wall 11, the lower heat insulation wall 12 and the rear heat insulation wall 13. In the conventional construction, the heat insulation box is constructed by assembling outer and inner boxes both of which are not divided. As a result, the boxes are large in size and require large-scale assembly operations. In the above-described embodiment, however, since the heat insulation box 2 is constructed by assembling the heat insulation walls 9 to 13 having the vacuum heat insulation panel, the assembly is rendered simpler and the assembling operations can be prevented from being large-scale with the result that the assembling work can be rendered easier.

[0060] According to the first embodiment, furthermore, the front end of the inner box 15 part constructed of the sheet member is connected to the front end of the outer box 14 by the front end connecting member 21. Accordingly, even a part of the inner box 15 constructed of the sheet member can easily be assembled, that is, joined by the front end connecting member 21 which is a component discrete from the outer box 19.

[0061] In the first embodiment, furthermore, the inner box 15 has the L-shaped portion 17 in the upper heat insulation wall 11 and the waste receiving portion 18 in the lower heat insulation wall 12. The L-shaped portion 17 is formed integrally with the upper inner plate 15C, and the waste receiving portion 18 is formed integrally with the lower inner plate 15D. According to this construction, the L-shaped portion 17 and the waste receiving portion 18 can easily be formed by integral molding with the inner plates 15C and 15D respectively even in the case where the L-shaped portion 17 and the waste receiving portion 18 have complicated shapes.

[0062] In the first embodiment, furthermore, the inner box 15 has the fixtures 26 constructed of the component discrete from the sheet members Sa and Sb and serve as the first protrusions which protrude to the refrigerator interior side. The fixtures 26 are directly bonded to the left unit panel in the assembly stage before assembly of the left heat insulation wall 9, for example. The holes 15u are formed through the right and left inner plates 15B and 15A each constructed by the sheet member Sa and the rear inner plate 15E constructed by the sheet member Sb, respectively. The fixtures 26 are inserted through the holes 15u respectively.

[0063] According to this construction, the fixtures 26 can be positioned relative to the inner box 15, that is, the sheet members Sa and Sb by inserting the fixtures 26 through the respective holes 15u. The partition wall supports 35 and 36 and the rear cover fixtures 37 have the same mounting structure as the fixtures 26. Accordingly, the partition wall supports 35 and 36 and the rear cover fixtures 37 can also be positioned in the same manner as the fixtures 26.

[0064] The fixtures 26 may be inserted through the respective holes 15u from the rear side of the sheet members Sa and Sb and bonded in the stage before assembly of the left heat insulation wall 9. According to this construction, the unit panel and the integrally molded article of the unit panel, the fixtures 26 and the sheet members Sa and Sb can be bonded to each other, with the result that the assembly workability can be improved.

[0065] The mounting surface of the fixtures 26 in the unit panel 16A may be recessed as shown in FIG. 13. According to this construction, the fixtures 26 can be mounted without curving the sheet member Sa.

[0066] Furthermore, even if the unit panel 16A bulges, the inner plate 15A is slightly deformed without break of the inner plate 15A since the inner plate 15A is constructed of the sheet member Sa. Furthermore, the fixtures 26, the shelf plate supports 30, the guide rail fixtures 33 and 34 and the partition wall supports 35 and 36 can be used in common to different types of refrigerators.

[0067] According to this construction, the fixtures 26 are directly bonded to the left unit panel 16A, the right unit panel 16B and the rear unit panel 16E. Accordingly, the unit panels 16A, 16B and 16E can be positioned relative to the inner plates 15A, 15B and 15E by inserting the fixtures 26 to the corresponding inner plates 15A, 15B and 15E, respectively. In this case, since the fixtures 26 are constructed of the ABS resin with high bondability, the bonding strength between the fixtures 26 and the unit panels 16A, 16B and 16E can be improved.

[0068] Furthermore, the partition wall supports 35 and 36 and the rear cover fixtures 37 have the same mounting structure as the fixtures 26. Accordingly, the partition wall

supports 35 and 36 and the rear cover fixtures 37 can contribute to the positioning between the inner plates and the unit panels. The fixtures 26 may be bonded via other members to the unit panels 16A, 16b and 16E.

[0069] In the first embodiment, furthermore, the fixtures 26 have the flanges 26a which are larger than the holes 15u. The flanges 26a are held between the sheet members Sa and Sb and the unit panels corresponding to the respective sheet members. According to this construction, the flanges 26a can suppress drop-off of the fixtures 26 from the holes 15u respectively. Furthermore, the flanges 26a can be bonded to corresponding inner plates and can therefore contribute to the improvement in the strength of the corresponding inner plate. Furthermore, since the flanges 26a are formed to be sufficiently thin, the fixtures 26 may also be inserted through the holes 15u from the refrigerator interior side and can further be inserted between the inner plates and the unit panels by flexing the flanges 26a.

[0070] In the first embodiment, furthermore, the inner box 15 has the shelf plate supporting portions 30b serving as the second protrusions. The shelf plate supports 30 having the respective shelf plate supporting portions 30b are constructed of the components discrete from the sheet member Sa composing the right and left inner plates 15A and 15B and protrude to the refrigerator interior side. The sheet member Sa is formed with the screw insertion holes 31. Each shelf plate support 30 is fixed to the surface side of the sheet member Sa, that is, the refrigerator interior side surface of the sheet member Sa by the countersunk screws 32 inserted through the screw insertion hole 31 from the rear side of the sheet member Sa or from the side opposed to the refrigerator interior to the refrigerator interior side.

[0071] According to this construction, the shelf plate supports 30 can be mounted to the sheet member Sa by the countersunk screws 32 serving as the fastening members respectively. In this case, rivets may be used as the fastening members. Each rivet is inserted through the sheet member Sa and the shelf plate support 30, and both ends of each rivet are crimped, whereby each shelf plate support 30 is fixed to the sheet member Sa.

[0072] In the first embodiment, furthermore, the peripheral edge 31a of each screw insertion hole 31 is separate from the right and left unit panels 16B and 16A which are vacuum heat insulation panels. More specifically, the screw heads 32a of the countersunk screws 32 do not protrude from the peripheral edges 31a of the screw insertion holes 31 to the sides of the right and left unit panels 16B and 16A.

[0073] According to this construction, the screw heads 32a do not protrude to the sides of the rear surfaces of the inner plates 15A and 15B or to the sides of unit panels 16A and 16B. Accordingly, since the screw heads 32a can be avoided from contacting with the unit panels 16A and 16B, the envelopes 20 of the unit panels 16A and 16B can also avoid damage due to contact with the screw heads 32a. Furthermore, the bonding of the left unit panel 16A and the left inner plate 15A and the bonding of the right unit panel 16B and the right inner plate 15B can be prevented from being blocked by the screw heads 32a.

[0074] Furthermore, each shelf plate support 30 has the screw hole 30c having the opening peripheral edge formed into the countersink 30d. As a result, when each countersunk screw 32 is screwed into the screw hole 30c, the peripheral edge 31a of the screw insertion hole 31 in the sheet member SA is displaced to the countersink 30d side, thereby being departed from the right or left unit panel 16A or 16B. According to this construction, the sheet member Sa need not be formed with a recess for housing the screw head 32a.

[0075] The guide rail fixtures 33 and 34 each have the same mounting structure as the shelf plate supports 30. Accordingly, the guide rail fixtures 33 and 34 can achieve the same effect as the shelf plate supports 30. Furthermore, the shelf plate supports 30 and the guide rail fixtures 33 and 34 (neither shown) provided in the right heat insulation wall 10 can also achieve the same effect as the shelf plate supports 30.

(Second Embodiment)

[0076] FIGS. 19 to 27 illustrate a second embodiment. The second embodiment differs from the first embodiment in the construction of the left heat insulation wall 9-2 and the right heat insulation wall 10-2. Only the differences will be described in the following. The left heat insulation wall 9-2 will be exemplified. The right heat insulation wall 10-2 and the left heat insulation wall 9-2 are bilaterally symmetrical and are constructed in the same manner.

[0077] In the left heat insulation wall 9-2, the left inner plate 15A-2 which is a part of the inner box 15 has the shelf plate supporting portions 40a, 40b and 40c, guide rail mounts 41a and 41b and the partition wall supporting portions 42a and 42b, all of which serve as the third protrusions. The shelf plate supports 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b are integrally molded so that the left inner plate 15A-2 is composed into an integrally molded article Ic. The integrally molded article Ic is formed by molding by the use of a die, for example, injection molding or vacuum molding. The shelf plate supporting portions 40a, 40b and 40c, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b protrude to the refrigerator interior side.

[0078] The left inner plate 15A-2 has a sheet member connecting portion 25-2 at an inner end thereof as shown in FIG. 21. The sheet member connecting portion 25-2 is formed integrally with the left inner plate 15A-2. The sheet member connecting portion 25-2 serves as a sheet member connecting member for connecting the left inner plate 15A-2 and the rear inner plate 15E. The sheet member connecting portion 25-2 is connected to the rear heat insulation wall 13 by the fixtures 26 mounted on the rear inner plate 15E as shown in FIG. 22.

[0079] Each of the shelf plate supporting portions 40a, 40b and 40c has a lengthwise dimension different from that of each of the guide rail mounts 41a and 41b. In this case, each of the guide rail mounts 41a and 41b has a larger lengthwise dimension than each of the shelf plate supporting portions 40a, 40b and 40c. On the other hand, each of the shelf plate supporting portions 40a, 40b and 40c has the same vertical cross-sectional shape as each of the guide rail mounts 41a and 41b. Thus, the guide rail mounts 41a and 41b are constructed substantially in the same manner as the shelf plate supporting portions 40a, 40b and 40c except for a specific shape. Accordingly, only the shelf plate supporting portion 40a will be described and the description of the shelf plate supporting portions 40b and 40c and the guide rail mounts 41a and 41b will be eliminated in the following.

[0080] The shelf plate supporting portion 40a is formed integrally with the left inner plate 15A-2 into the integrally molded article Ic as shown in FIGS. 22 to 25. The shelf plate supporting portion 40a protrudes in the direction of the refrigerator interior from the refrigerator interior side surface of the left inner plate 15A-2. The shelf plate supporting portion 40a has a side surface opposed to the refrigerator interior as shown in FIG. 23. A screw boss 43 is formed on a part of the side surface of the shelf plate supporting portion 40a. The screw boss 43 is formed with a screw hole 43a.

[0081] The shelf plate supporting portion 40a has an inner surface opposed to the refrigerator interior. For example, a reinforcing plate 44 comprised of a metal plate is mounted as a reinforcing member on the inner surface of the shelf plate supporting portion 40a. The reinforcing plate 44 is formed into a shape conforming with the inner surface of the shelf plate supporting portion 40a. The reinforcing plate 44 has a boss fitting portion 44a formed with a screw insertion hole 44b. A screw 45 is inserted through the screw insertion hole 44b while the boss fitting portion 44a is in abutment on the inner surface of the shelf plate supporting portion 40a. The screw 45 is further screwed into the screw hole 43a, so that the reinforcing plate 44 is mounted on the shelf plate supporting portion 40a, that is, the left inner plate 15A-2. As a result, the shelf plate supporting portion 40a is reinforced by the reinforcing plate 44.

[0082] The partition wall supports 42a and 42b correspond to the partition wall supports 35 and 36 in the first embodiment. The partition wall supports 42a and 42b have inner surfaces provided with reinforcing plates 46 which are composed of metal plates and serve as reinforcing members respectively, as shown in FIGS. 26 and 27. The reinforcing plates 46 are mounted to the inner surfaces by screws 47 respectively. The partition wall supports 42a and 42b are thus reinforced by the reinforcing plates 46 respectively.

[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. In this case, the reinforcing plates 44 and 46 are configured to be located between the left unit panel 16A and the left inner plate 15A-2 to reinforce the shelf plate supporting portions 40a, 40b and 40c serving as the protrusions, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b.

[0084] According to the second embodiment, the shelf plate supporting portions 40a, 40b and 40c serving as third protrusions, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b are integrally constructed into the integrally molded article Ic. Accordingly, the third protrusions need not be constructed of discrete components. Furthermore, the reinforcing plates 44 and 46 reinforce the shelf plate supporting portions 40a, 40b and 40c serving as third protrusions, the guide rail mounts 41a and 41b and the partition wall supports 42a and 42b. Accordingly, even when the third protrusions in the embodiment are made of a material having a lower strength as compared with the construction that the protrusions are discrete components, the third protrusions can obtain a sufficient strength. Consequently, according to the embodiment, an olefin resin, such as a polypropylene material, can be used as a material of the integrally molded article Ic. The olefin resin is more cost effective although having a lower strength than an ABS resin.

(Third Embodiment)

[0085] FIGS. 28 and 29 illustrate a third embodiment. The third embodiment differs from the first and second embodiments in the construction of the left heat insulation wall 9-3 and the right heat insulation wall 10-3. Only the differences will be described in the following. In this case, the left heat insulation wall 9-3 and the right heat insulation wall 10-3 are bilaterally symmetrical and are constructed in the same manner. Accordingly, the left heat insulation wall 9-3 will be described.

[0086] The left heat insulation wall 9-3 has a unit panel 16A and a left inner plate 15A as shown in FIG. 29. The left inner plate 15A is divided into an upper plate 15Aa and a lower plate 15Ab. The upper and lower plates 15Aa and 15Ab are adjacent to each other in the up-down direction. The upper plate 15Aa is composed into an integrally molded article Id by injection molding or vacuum molding. The upper plate 15Aa has the shelf plate supporting portions 40a, 40b and 40c serving as the third protrusions and a sheet member connecting portion 25-2 all formed integrally therewith in the same manner as in the second embodiment. The sheet member connecting portion 25-2 is located at the refrigerating compartment 57 side. The lower plate 15Ab side and the rear inner plate 15E are connected to each other by a sheet member connecting plate 25-3 as shown in FIG. 28. The upper and lower plates 15Aa and 15Ab are composed into discrete components. The sheet member connecting plate 25-3 is located at the sides of the vegetable compartment 58, the small freezing compartment 59, the ice making compartment 60 and the freezing compartment 61.

[0087] The lower plate 15Ab is constructed of a flat-

plate shaped sheet member Sc. The lower plate 15Ab has the fixtures 26 and the partition wall supports 35 and 36 all of which are discrete from the sheet member Sc and serve as the first protrusion, in the same manner as in the first embodiment. The lower plate 15Ab also has the guide rail fixtures 33 and 34 serving as second protrusions in the same manner as in the first embodiment. The protrusions are mounted in the same manner as in the first embodiment. The upper plate 15Aa is located at the refrigerating compartment 57 and constitutes an inner surface of the refrigerating compartment 57.

[0088] According to the third embodiment, the inner surface of the refrigerating compartment 57 having the pivot doors 3 and 4 is composed of the upper plate 15Aa which is the integrally molded article Id. Accordingly, the inner surface of the refrigerating compartment 57 has an enhanced appearance. More specifically, the inner surface of the refrigerating compartment 57 is easily visible to the user when the doors 3 and 4 are opened. According to the embodiment, the inner surface of the refrigerating compartment 57 is composed of the integrally molded article Id having the integrally molded shelf plate supports 40a, 40b and 40c. Accordingly, the shelf plate supporting portions 40a, 40b and 40c smoothly protrude from the upper plate 15Aa with the result that the inner surface of the refrigerating compartment 57 has the enhanced appearance. According to the embodiment, furthermore, since no gaps are formed between the shelf plate supporting portions 40a, 40b and 40c and the upper plate 15Aa, there is no possibility that foreign matter enters the gap. This can improve the cleanability of the upper plate 15Aa and accordingly improve an impression on hygiene perspective.

(Fourth Embodiment)

[0089] FIGS. 30 and 31 illustrate a fourth embodiment. The fourth embodiment differs from the first embodiment in that each shelf plate support 30 has a fin 30e. In this case, the fin 30e functions as a cover. The fin 30e is formed integrally with the peripheral edge of the body 30a of each shelf plate support 30. The fin 30e is inclined to the left inner plate 15A side, that is, to the inner surface side of the inner box 15.

[0090] The fin 30e adheres closely to the inner surface of the inner box 15, that is, the left inner plate 15A in a mounted state of the shelf plate support 30. 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, when the countersunk screw 32 is screwed into the screw hole 30c of the shelf plate support 30, the peripheral edge 31a of the screw insertion hole 31 of the left inner plate 15 is sometimes deformed with the result of occurrence of creases on the screw insertion hole 31. The creases would produce gaps between the left inner plate 15A and the shelf plate support 30. According to the fourth embodiment, the gaps as described above can be concealed by the fin 30e.

(Fifth Embodiment)

[0091] FIGS. 32 to 34 illustrate a fifth embodiment. The fifth embodiment differs from the first embodiment in the following. More specifically, the left outer plate 14A, the lower outer plate 14D and the right outer plate 14B all constituting a part of the inner box 15 are separated from one another. In the fifth embodiment, however, the left outer plate 14A, the lower outer plate 14D and the right outer plate 14B are constructed into a continuous outer plate 14Z. Reference symbol 16D designates a unit panel provided between the lower outer plate 14D and the lower inner plate 15D.

[0092] All the plates of the outer box 14 may not be separated. Furthermore, each shelf plate support 30 is provided with the fin 30e in the fourth embodiment shown in FIGS. 30 and 31, so that the gaps between the inner surface of the inner box 15 and the shelf plate support 30 are concealed by the fin 30e. However, the shelf plate support 30 may be rendered transparent so that the gaps are rendered less conspicuous.

[0093] All the inner plates of the heat insulation walls 9 to 13 as the unit heat insulation walls may be composed of the sheet members respectively or a single inner plate may be composed of the sheet member. Furthermore, at least two unit heat insulation walls may be provided. For example, the left heat insulation wall 9 is a single component and may be constructed to be integrated with the other heat insulation walls 10 to 13. In other words, the heat insulation walls may be integral by rendering the outer plates, the inner plates or the unit panels continuous to each other.

[0094] Furthermore, each heat insulation wall may be constructed so that the unit panel is provided between the inner and outer plates, the inner plate and one side of the unit panel are bonded to each other, and the other side of the unit panel and the outer plate are bonded to each other. Furthermore, the inner plate and one side of the unit panel may be bonded to each other, and a heat insulation material such as foam urethane may be interposed between the other side of the unit panel and the outer plate. Furthermore, the outer box and the vacuum heat insulation panel may not be divided and only the inner box may be divided into a plurality of inner plates, which are connected together.

[0095] As described above, the refrigerator of each embodiment is provided with the heat insulation box including the outer box, the inner box and the vacuum heat insulation panel disposed between the inner and outer boxes. At least a part of the inner box is constructed of the flat-plate shaped sheet member. According to this construction, a large die is not required and manufacturing is easy and cost-effective.

[0096] 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 refrigerator comprising a heat insulation box including an outer box, an inner box provided inside the outer box and a vacuum heat insulation panel provided between the outer box and the inner box, wherein at least a part of the inner box is constructed of a flat-plate-shaped sheet member.

2. The refrigerator according to claim 1, wherein:

   the inner box includes a plurality of inner plates; at least two of the inner plates, adjacent to each other are made of different sheet members separately; and
   a sheet member connecting member is provided between the two inner plates to connect the inner plates together.

3. The refrigerator according to claim 1 or 2, wherein:

   the heat insulation box is constructed by connecting a plurality of unit heat insulation walls;
   the unit heat insulation walls have a plurality of unit panels made by dividing the vacuum heat insulation panels and located between a plurality of outer plates made by dividing the outer box and a plurality of inner plates made by dividing the inner plate, respectively; and
   at least one of the inner plates is constructed of the sheet member.

4. The refrigerator according to any one of claims 1 to 3, wherein:

   a part of the inner box constructed of the sheet member has a front end;
   the outer box has a front end; and
   the front end of the inner box and the front end of the outer box are connected to each other by the end connecting member.

5. The refrigerator according to any one of claims 1 to 4, wherein:

   the inner box has a curved portion; and
   the inner box includes a part which has the curved portion and is an integrally molded article differing from the sheet member and molded integrally with the curved portion.

6. The refrigerator according to any one of claims 1 to 5, wherein the inner box has a first protrusion protruding to a refrigerator interior, and the first protrusion is constructed of a component differing from the sheet member and passed through a hole formed through the sheet member.

7. The refrigerator according to claim 6, wherein the first protrusion is fixed to the vacuum heat insulation panel.

8. The refrigerator according to claim 6 or 7, wherein the first protrusion has a flange larger than the hole of the sheet member, the flange being interposed between the sheet member and the vacuum heat insulation panel.

9. The refrigerator according to any one of claims 1 to 8, further comprising a fastening member passed through a fastening member insertion hole, wherein the inner box has a second protrusion protruding to the refrigerator interior side, and the second protrusion is constructed of a component differing from the sheet member and is fixed by the fastening member to a side of the sheet member, located at the refrigerator interior side.

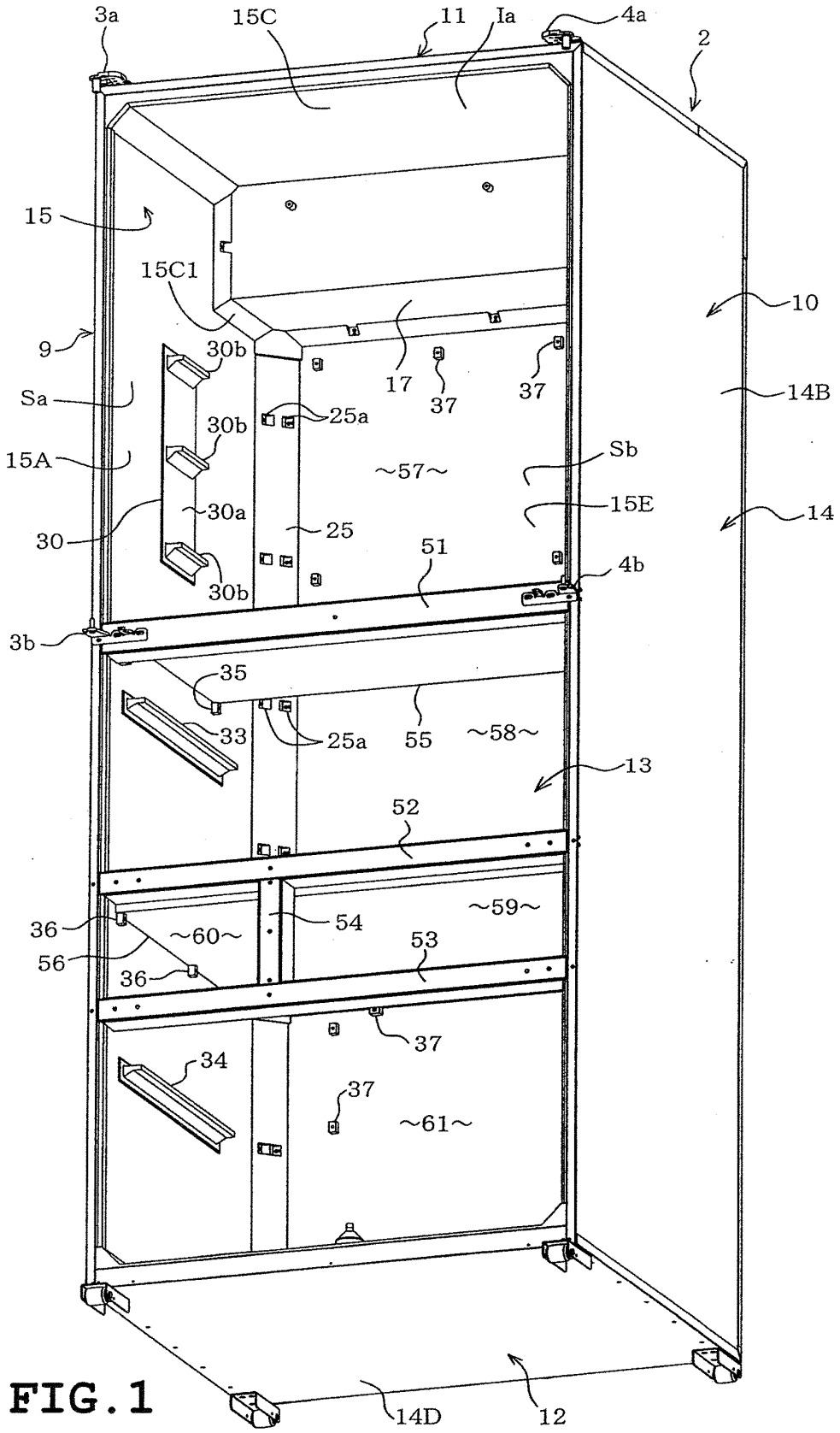
10. The refrigerator according to claim 9, wherein the fastening member insertion hole has a peripheral edge which is spaced from the vacuum heat insulation panel, and the fastening member has an end which does not protrude from the peripheral edge of the fastening member insertion hole to the vacuum heat insulation panel side.

11. The refrigerator according to claim 9 or 10, wherein the second protrusion has a cover portion which covers a gap between the second protrusion and the inner plate.

12. The refrigerator according to claim 9 or 10, wherein the second protrusion is transparent.

13. The refrigerator according to any one of claims 1 to 12, wherein:

   the inner box has a third protrusion protruding to the refrigerator interior side;
   the inner box includes a part which has the third protrusion and is an integrally molded article differing from the sheet member and molded integrally with the third protrusion; and
   a reinforcing member is provided in the third protrusion to reinforce the third protrusion.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30b
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25a
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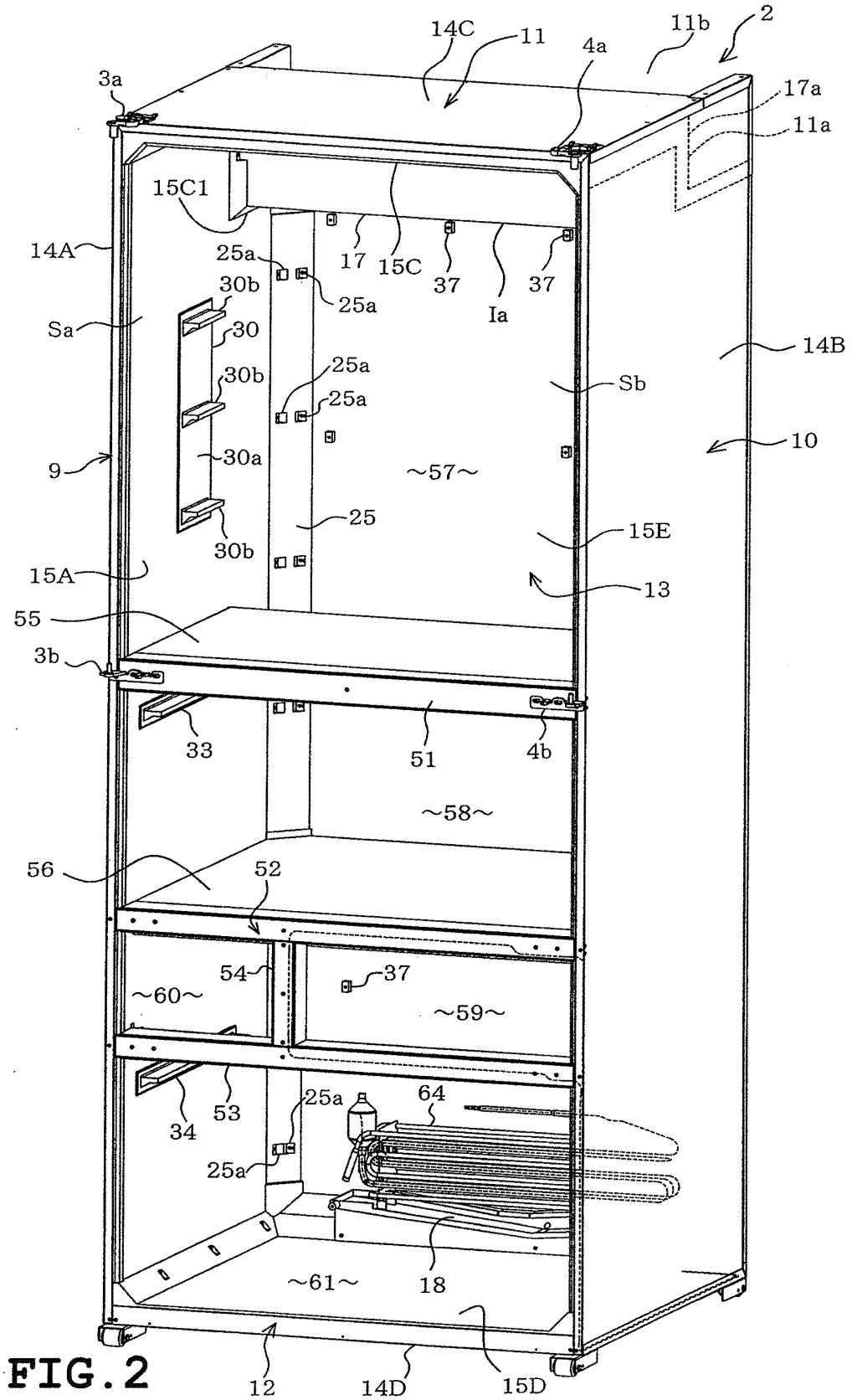
14D
12

FIG.1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Sa
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25
15E
30b
15A
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3b
33
51
4b
~58~
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14D
15D

FIG.2

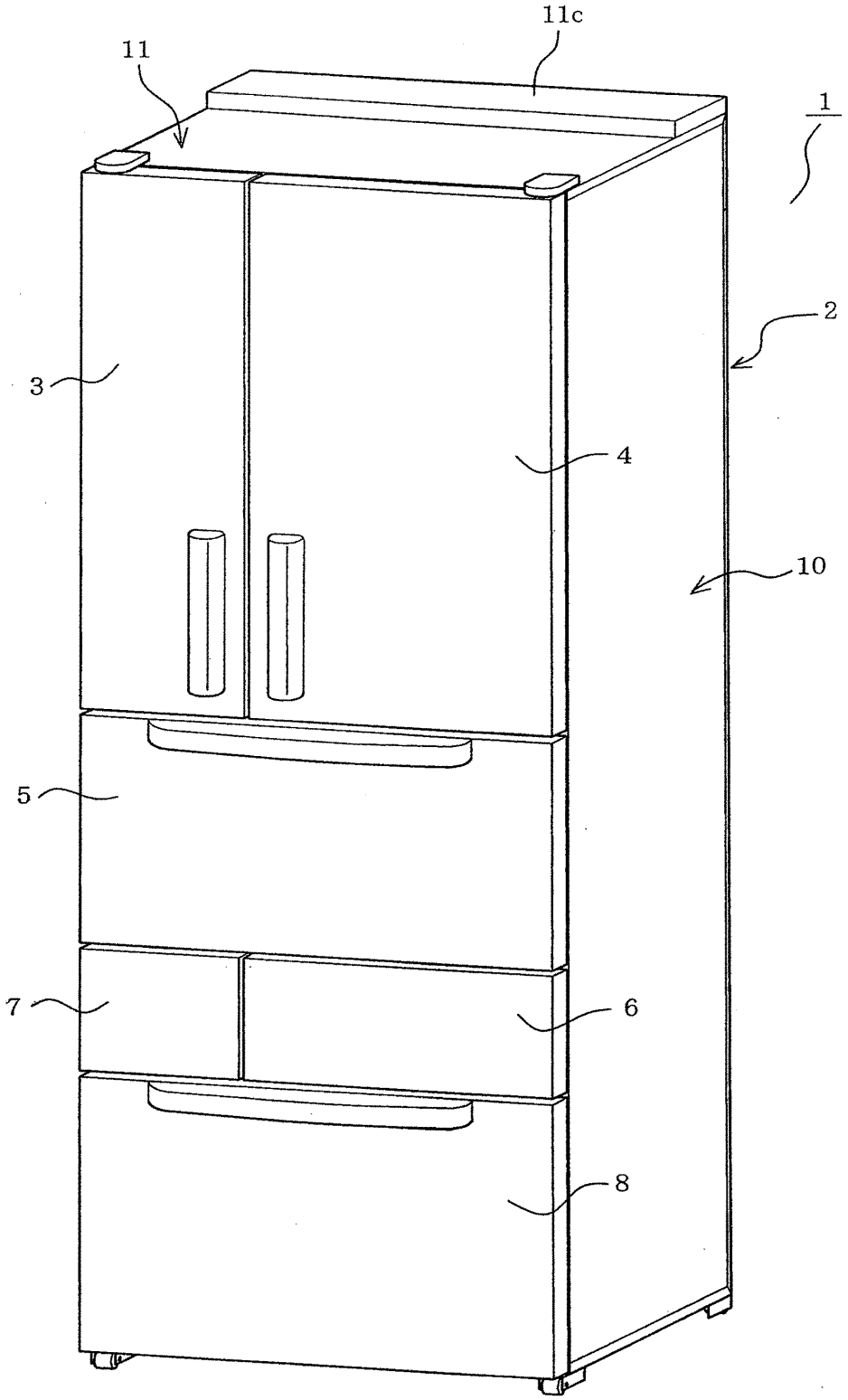
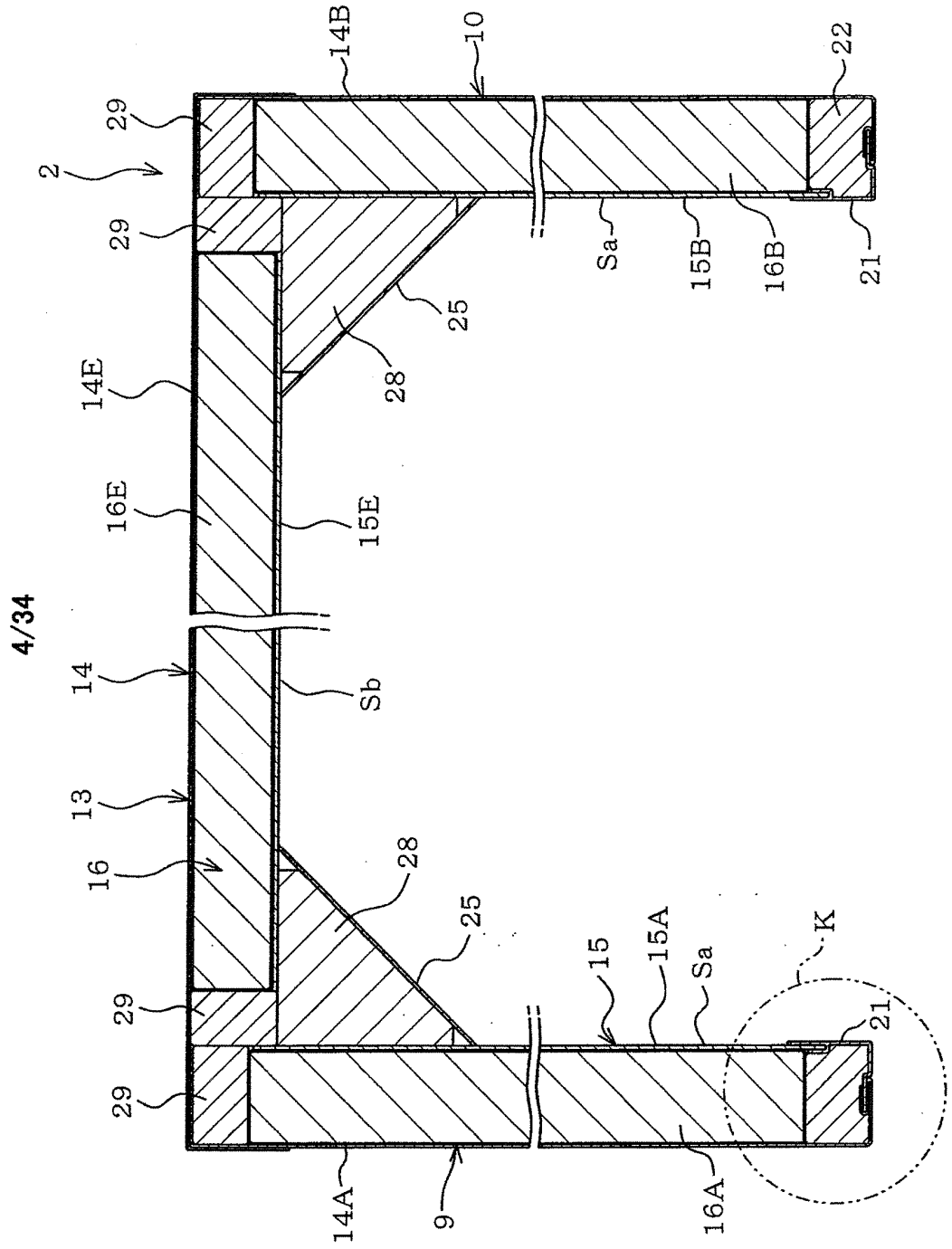


FIG. 3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Sa
15B
16B
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14E
16E
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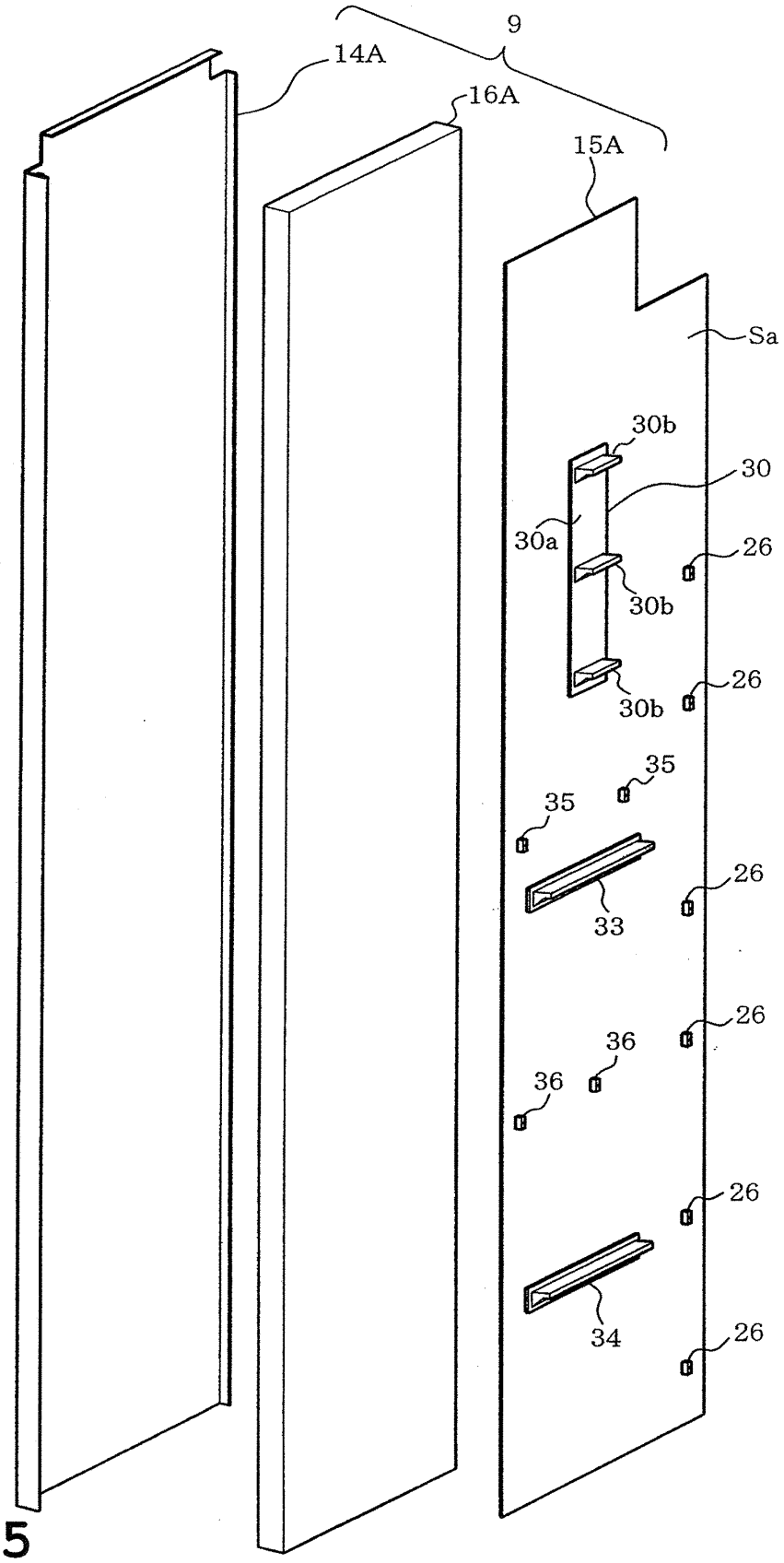
9
16A

FIG. 4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Sa
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30b
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33
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36
36
26
34
26

FIG. 5

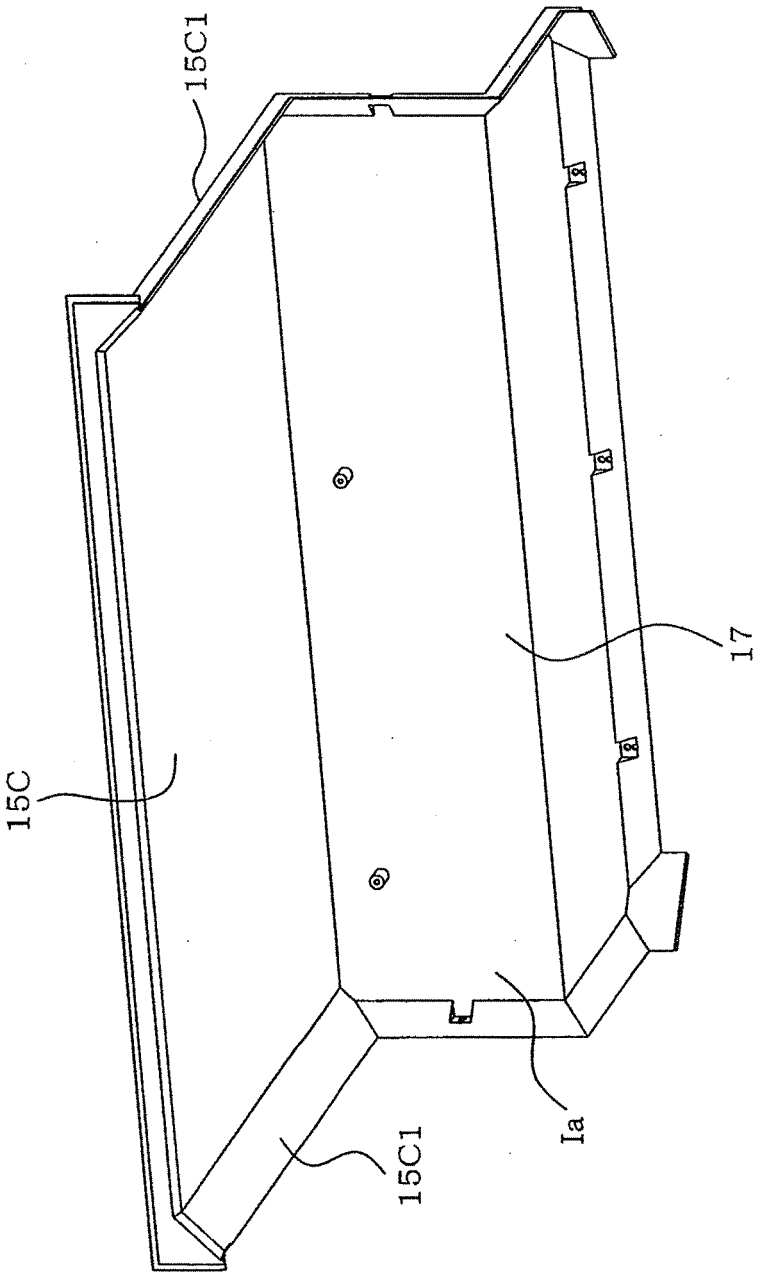


FIG.6

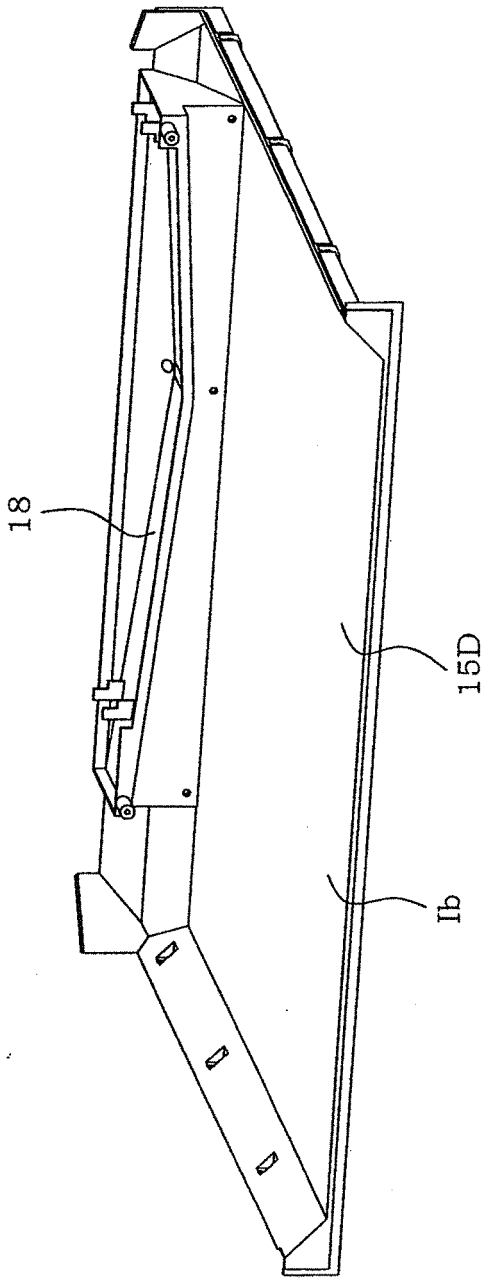


FIG. 7

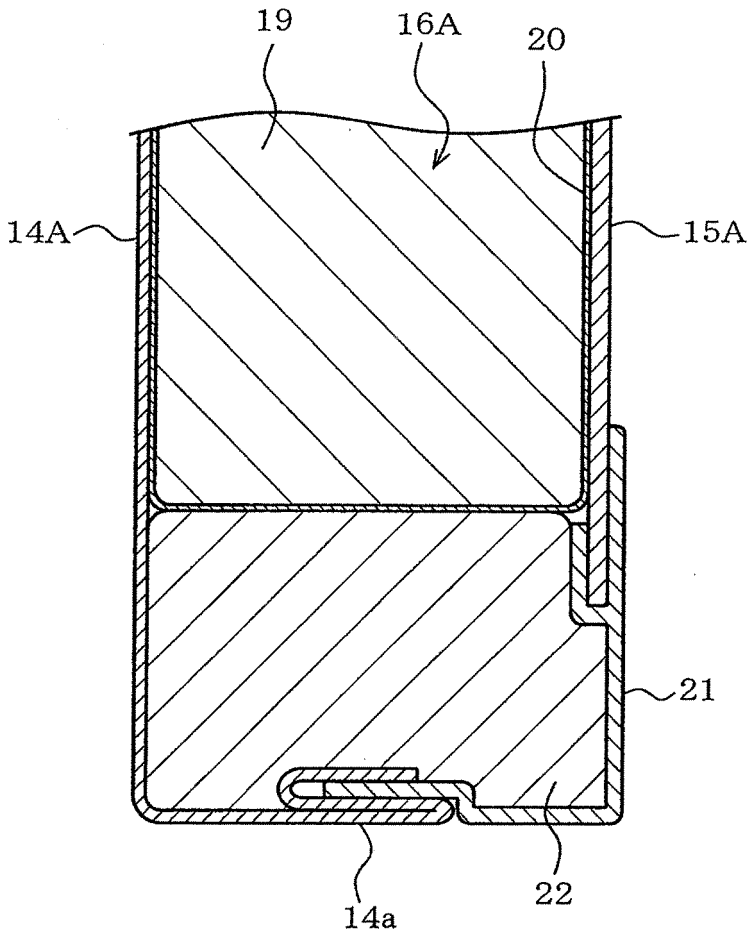
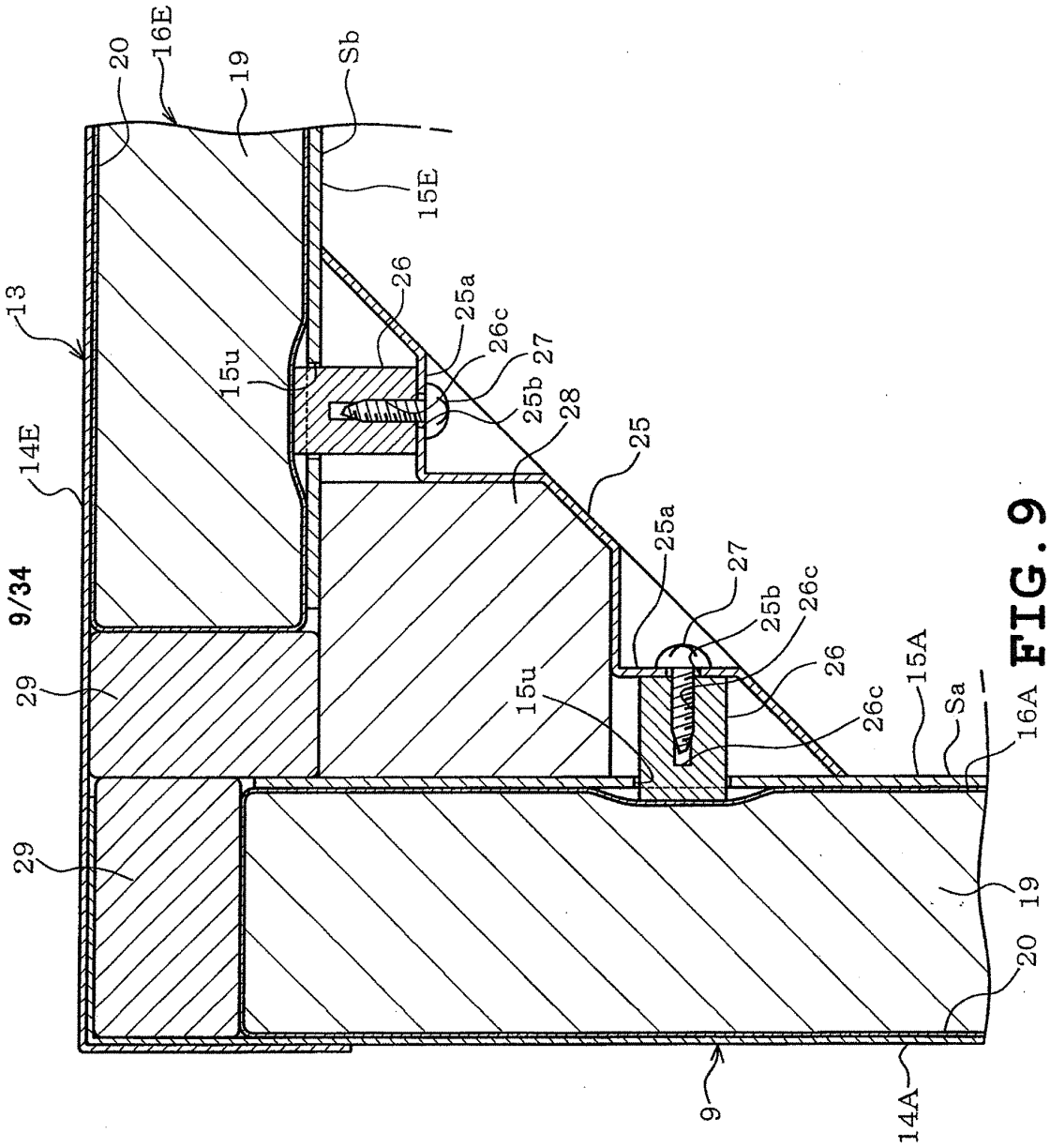


FIG. 8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Sa
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9
14A

FIG. 9

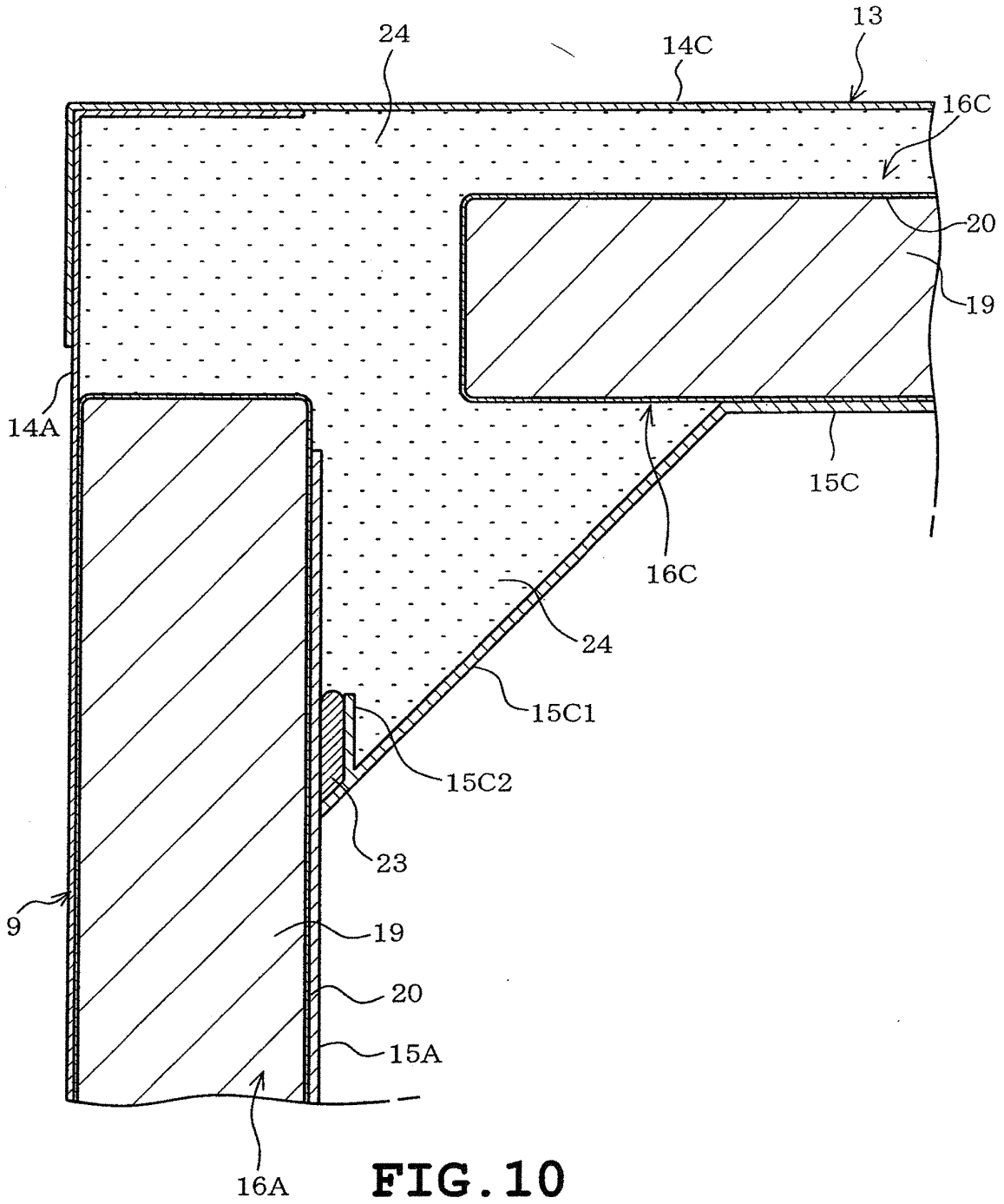


FIG. 10

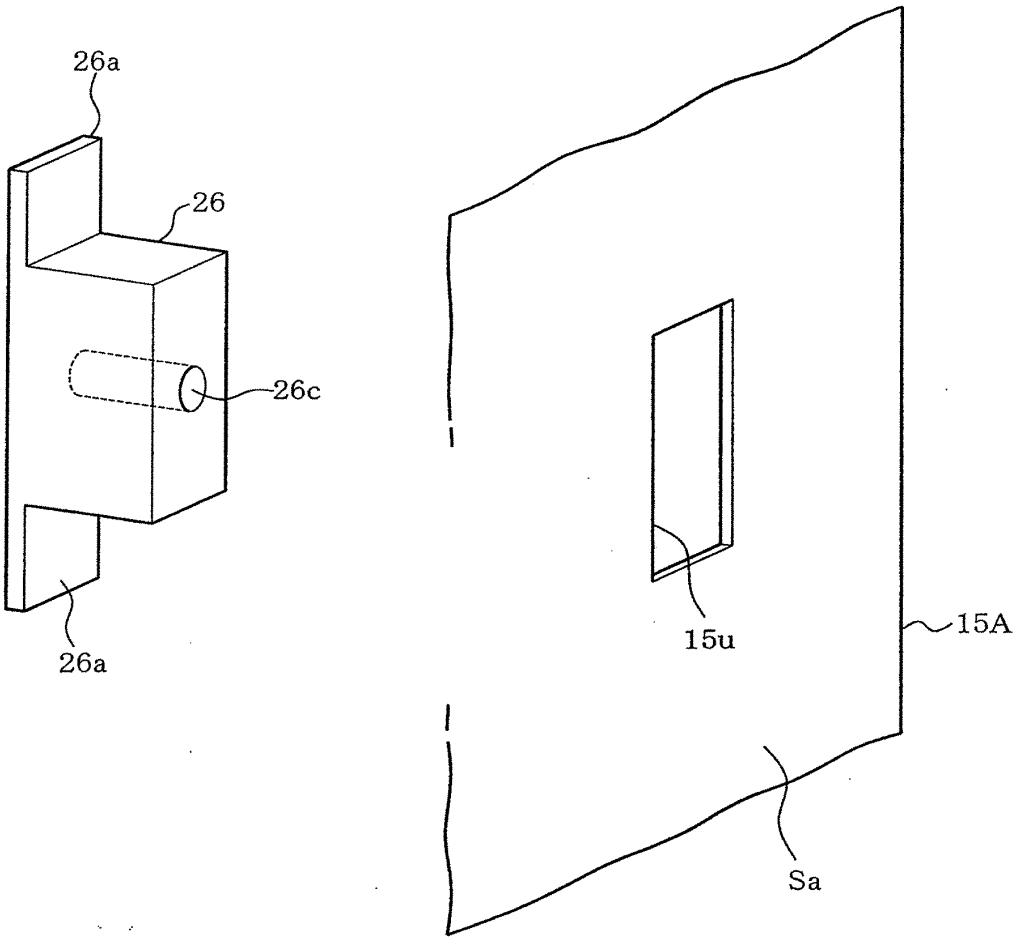


FIG.11

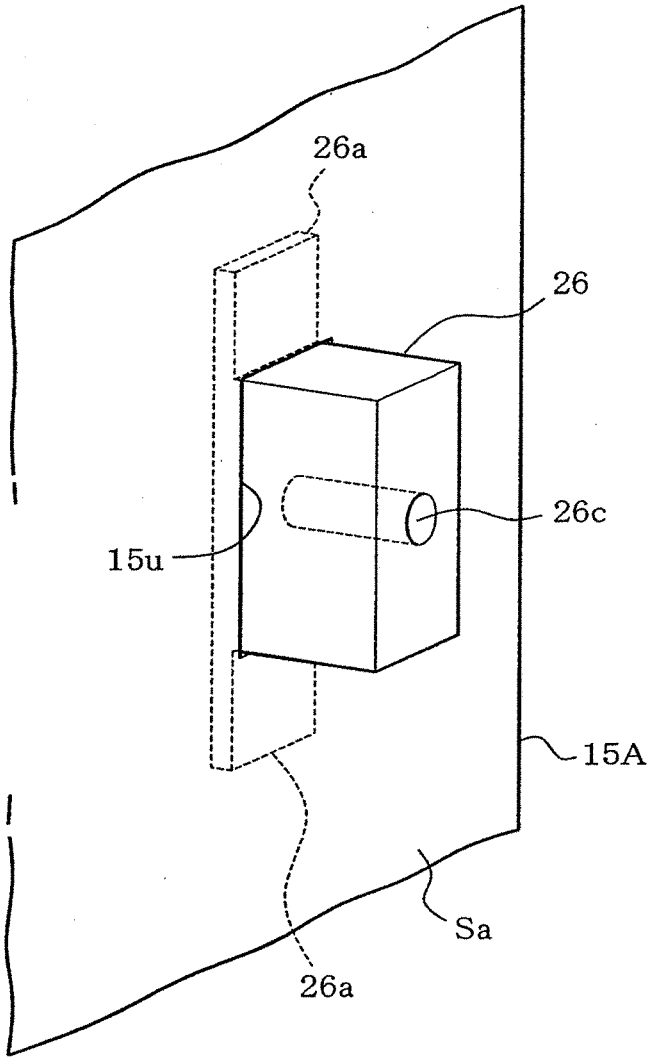


FIG. 12

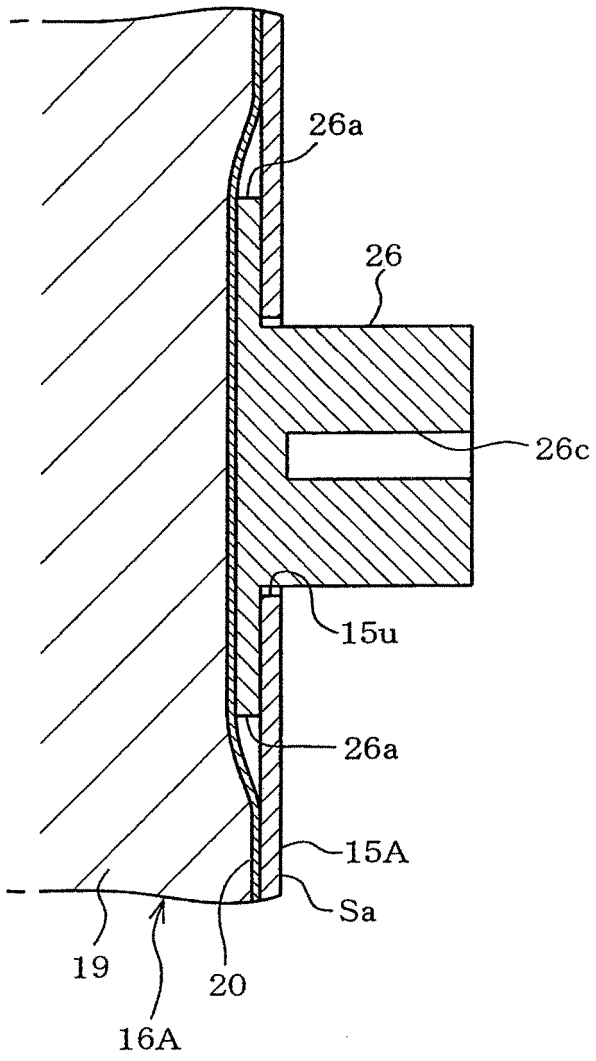


FIG. 13

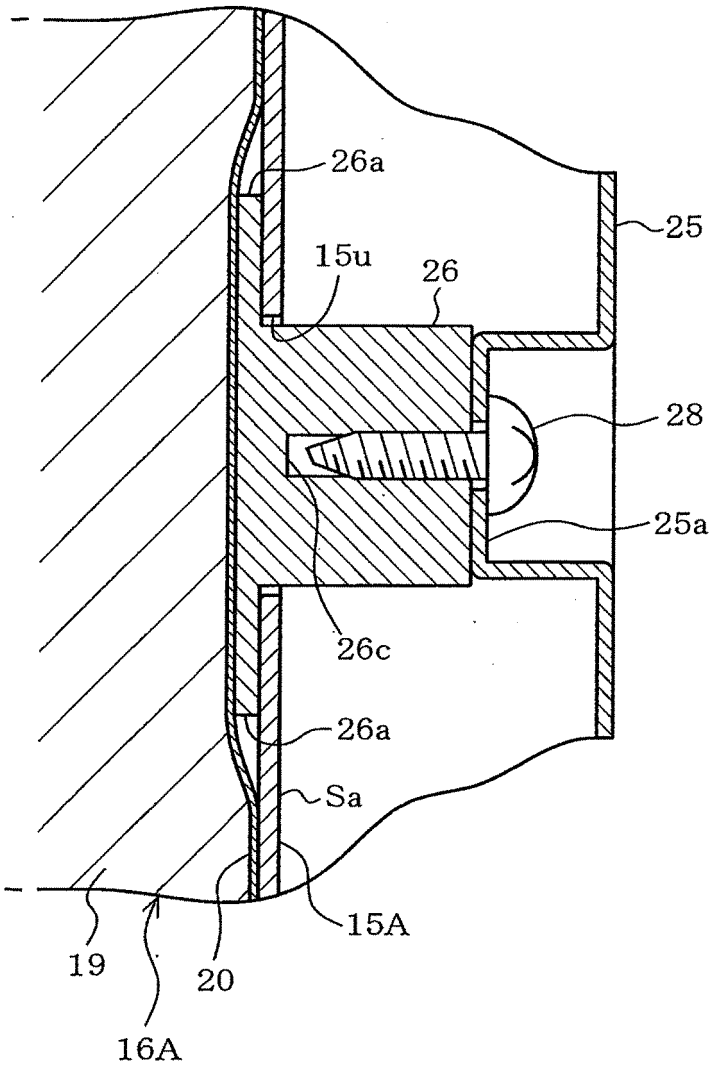


FIG.14

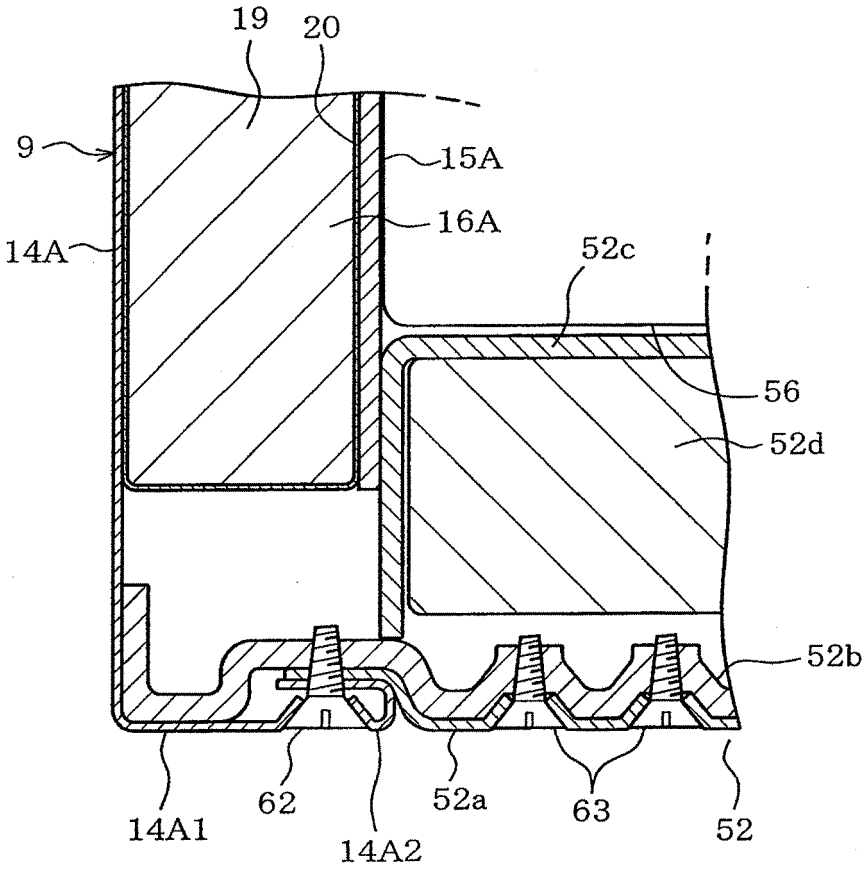


FIG. 15

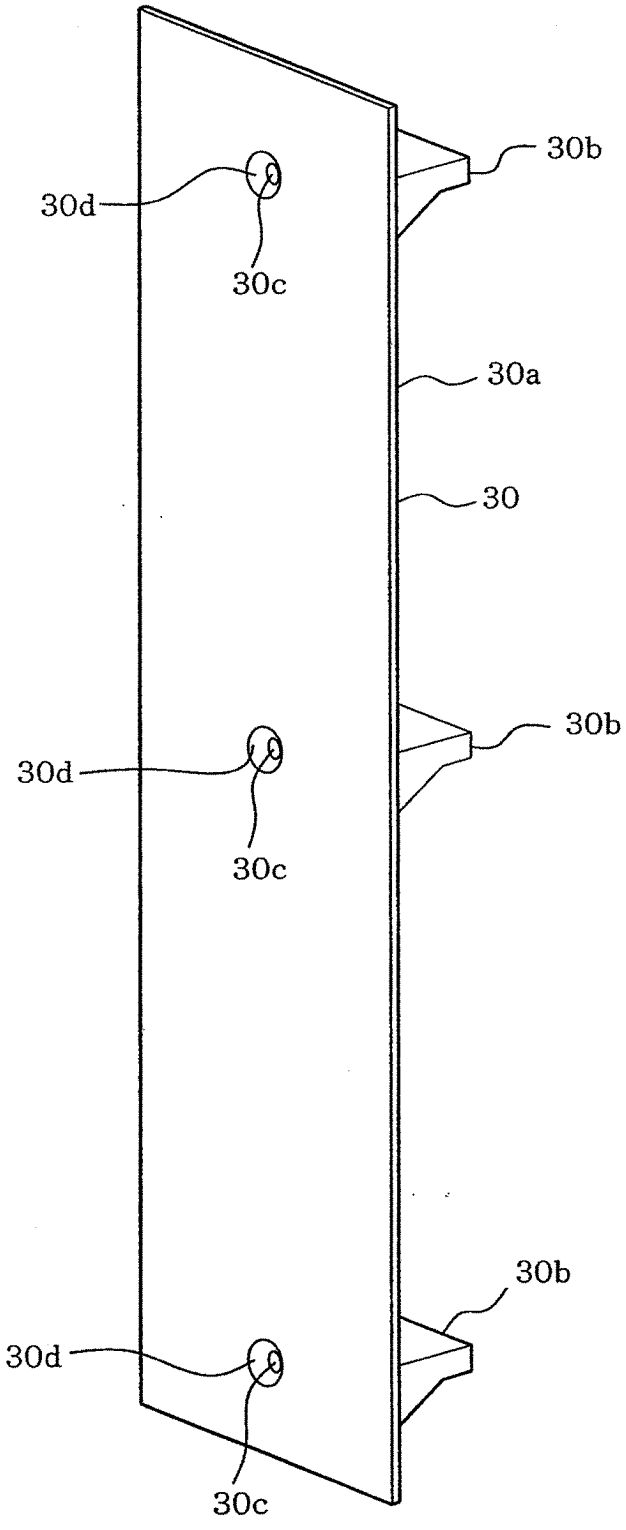


FIG.16

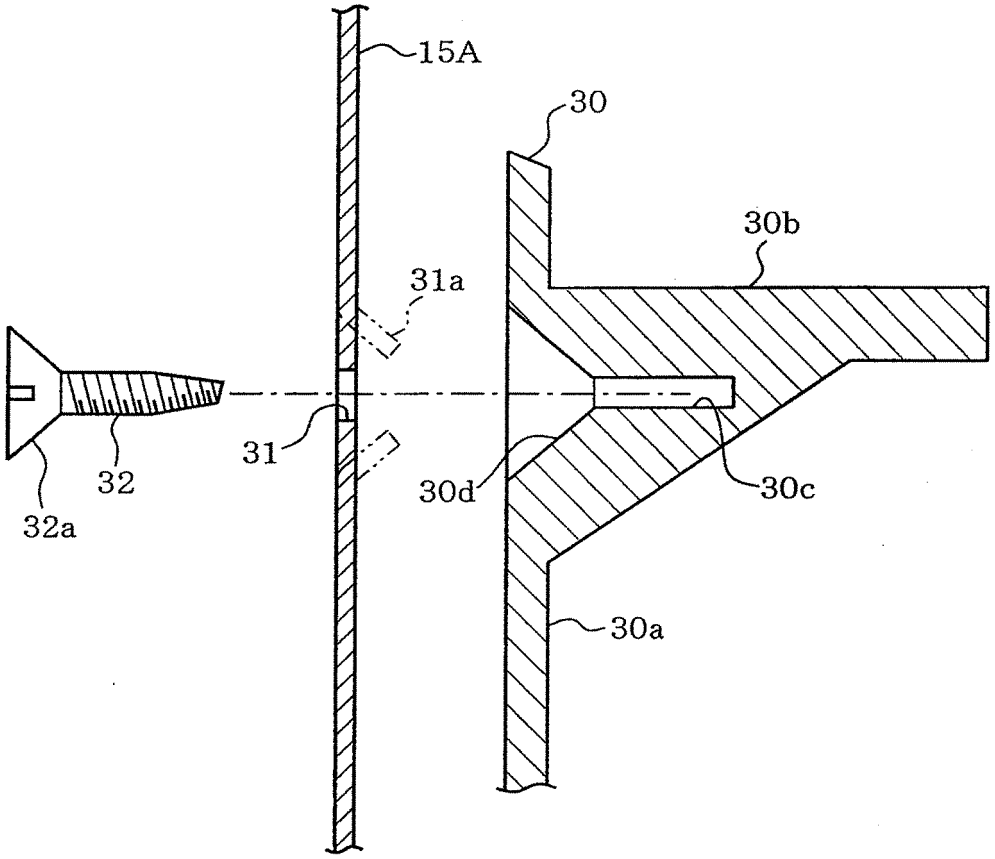


FIG. 17

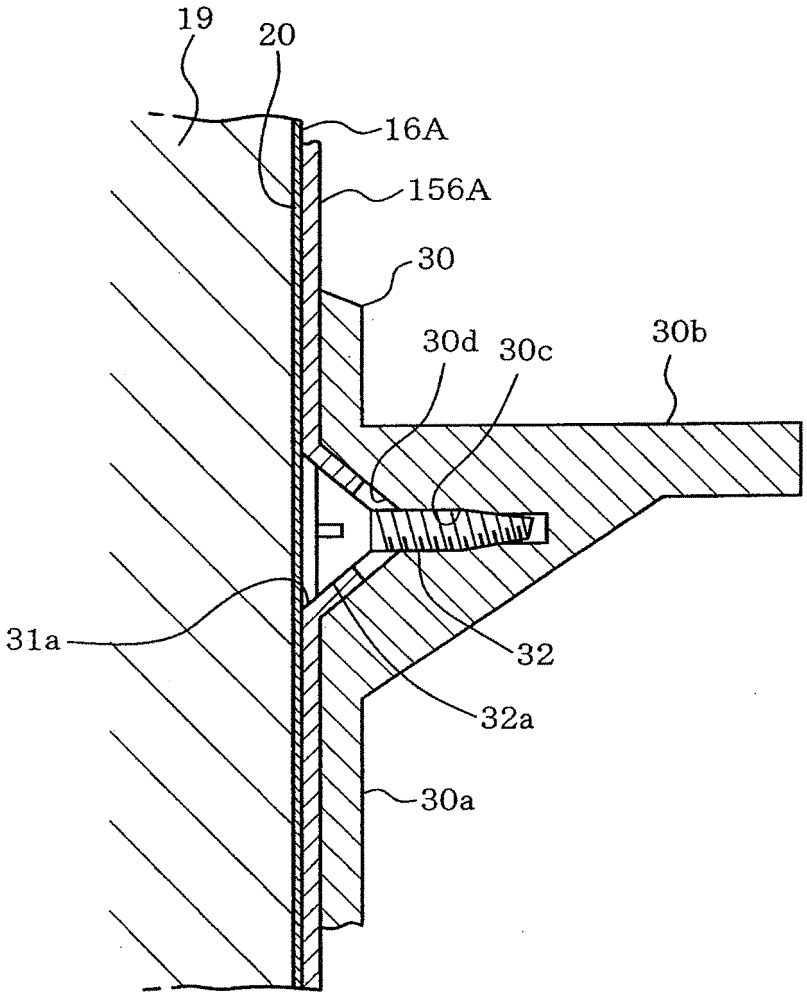
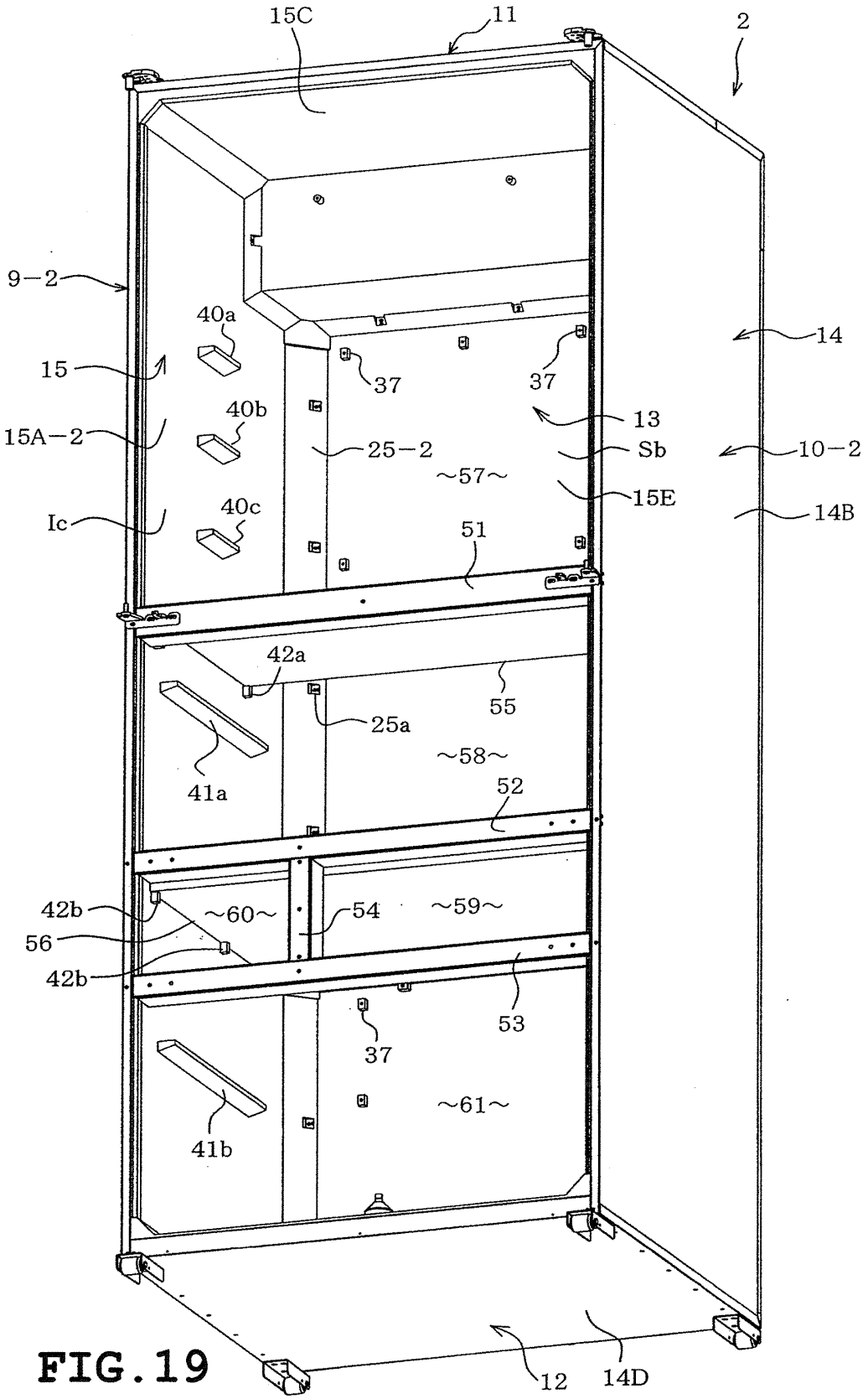


FIG.18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41b
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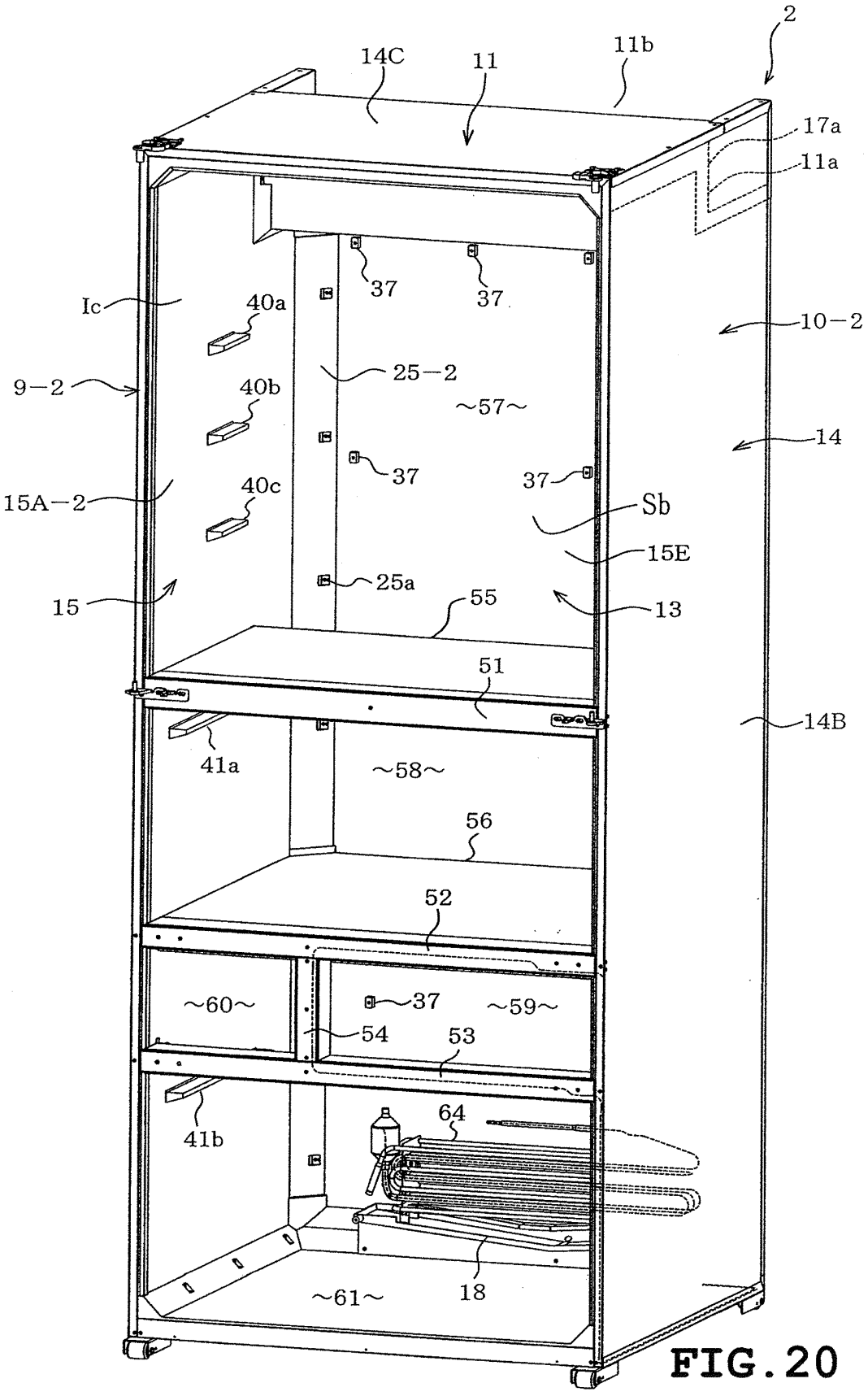
14D

FIG.19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40b
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55
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~60~
37
~59~
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53
41b
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18
~61~

FIG. 20

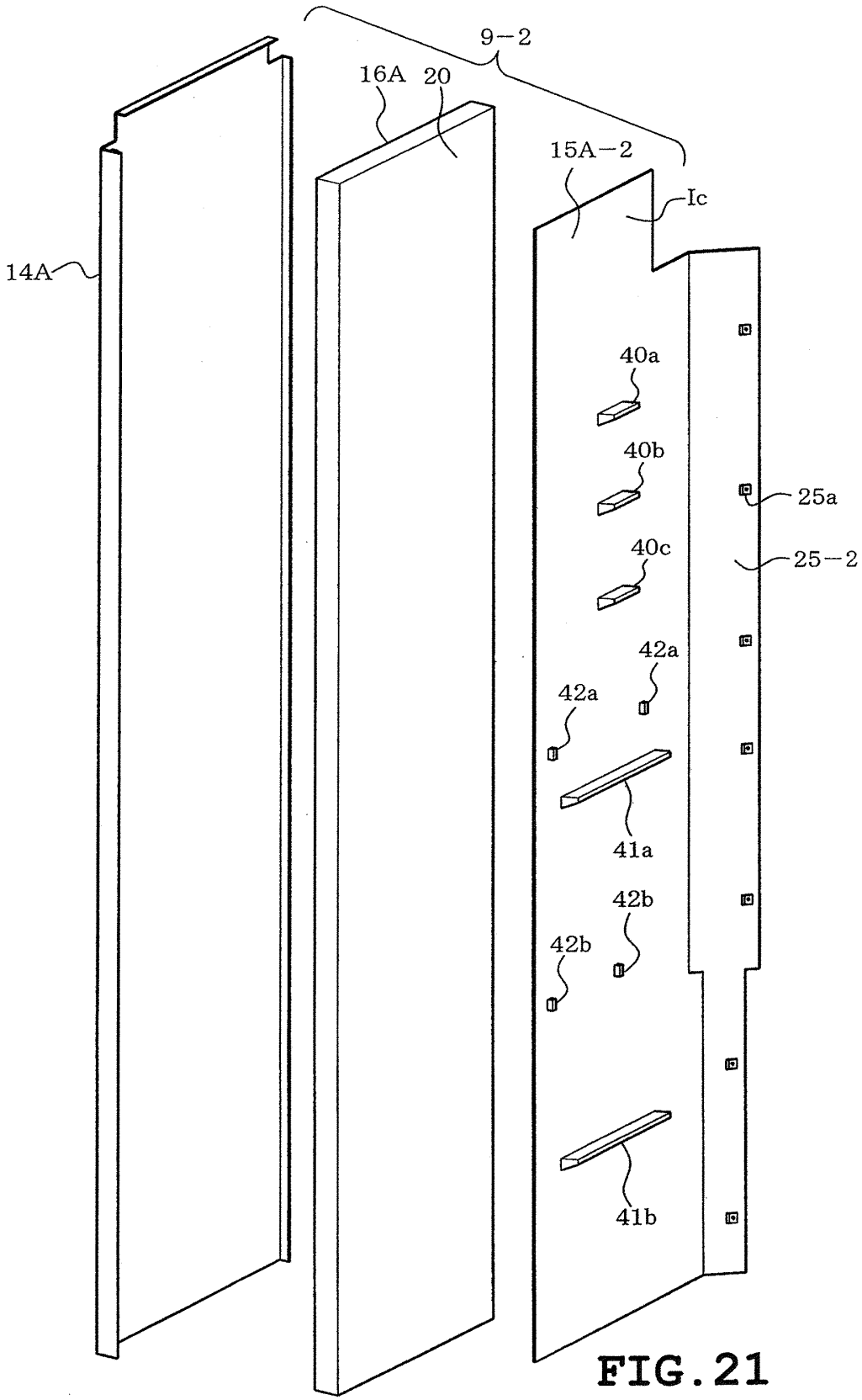

FIG.21

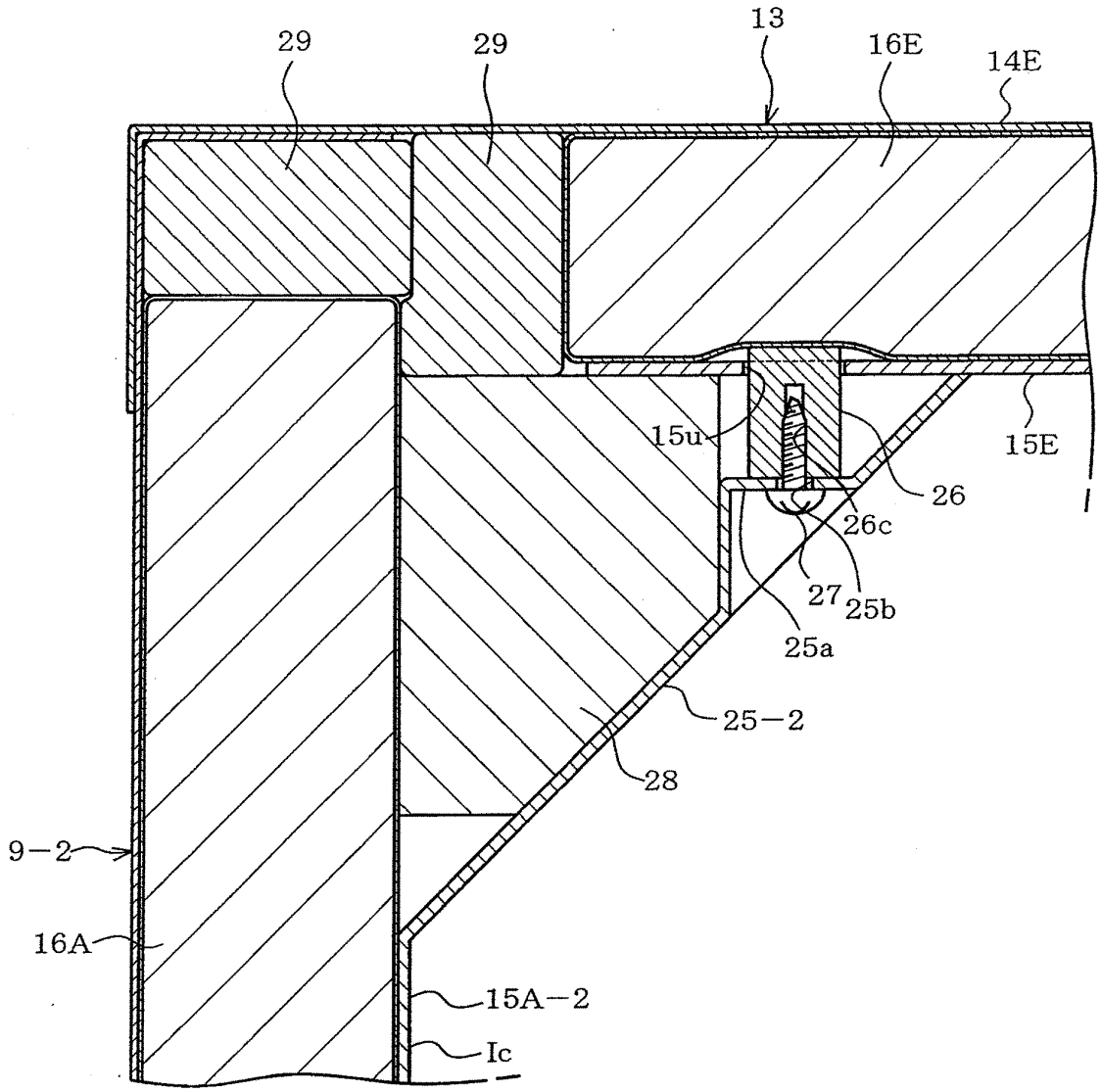

FIG.22

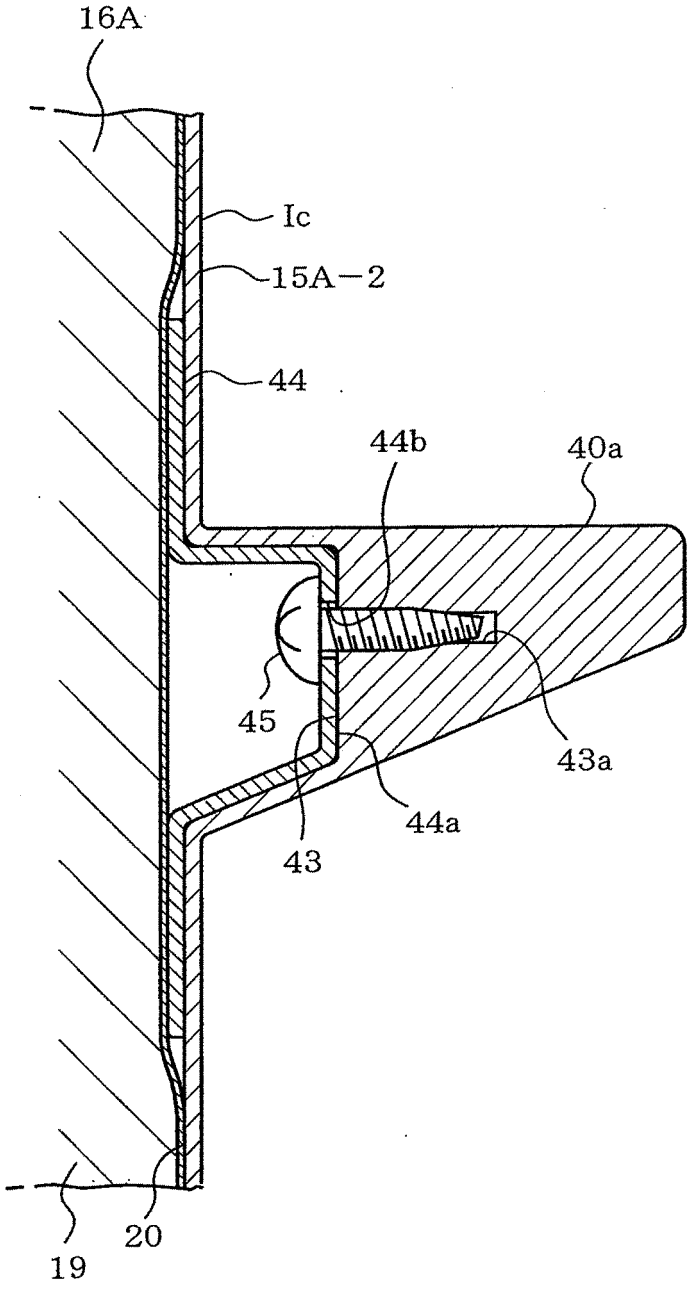

FIG.23

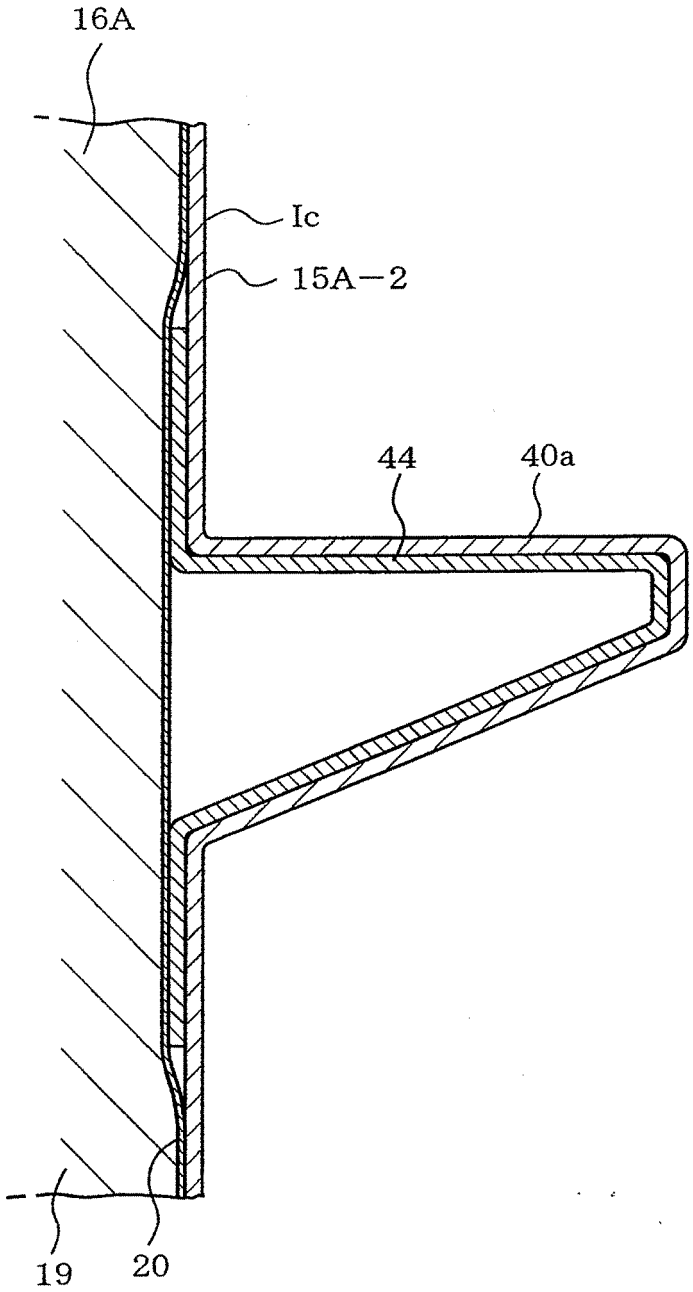

FIG.24

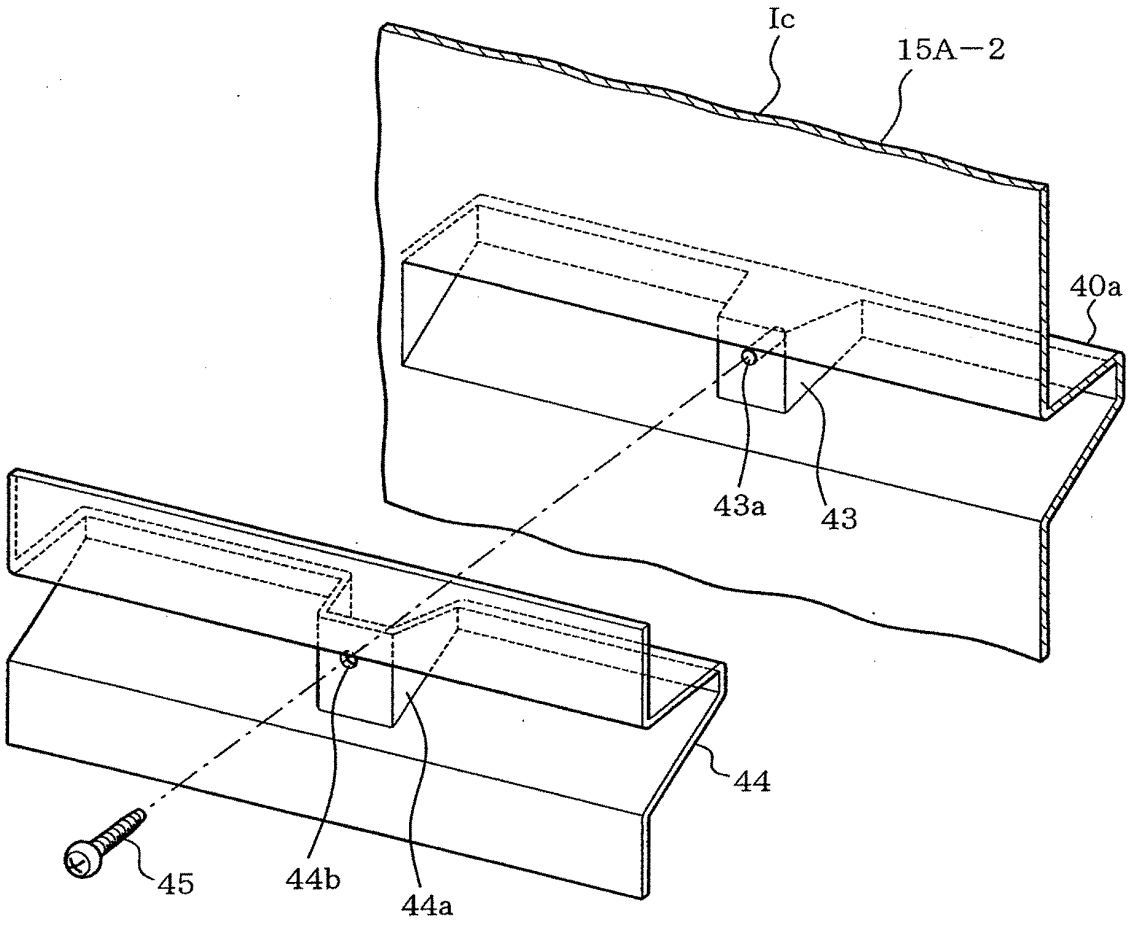

FIG.25

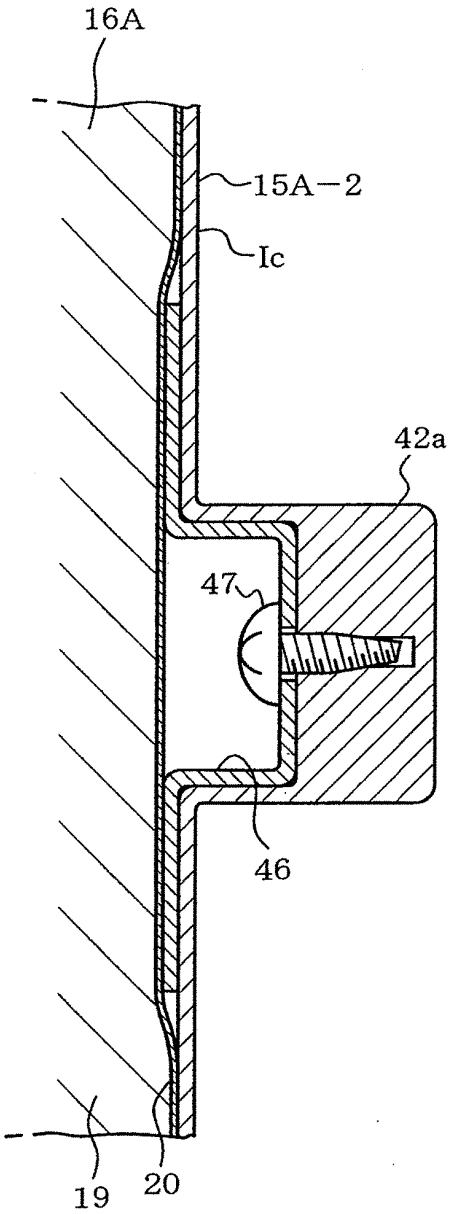

FIG.26

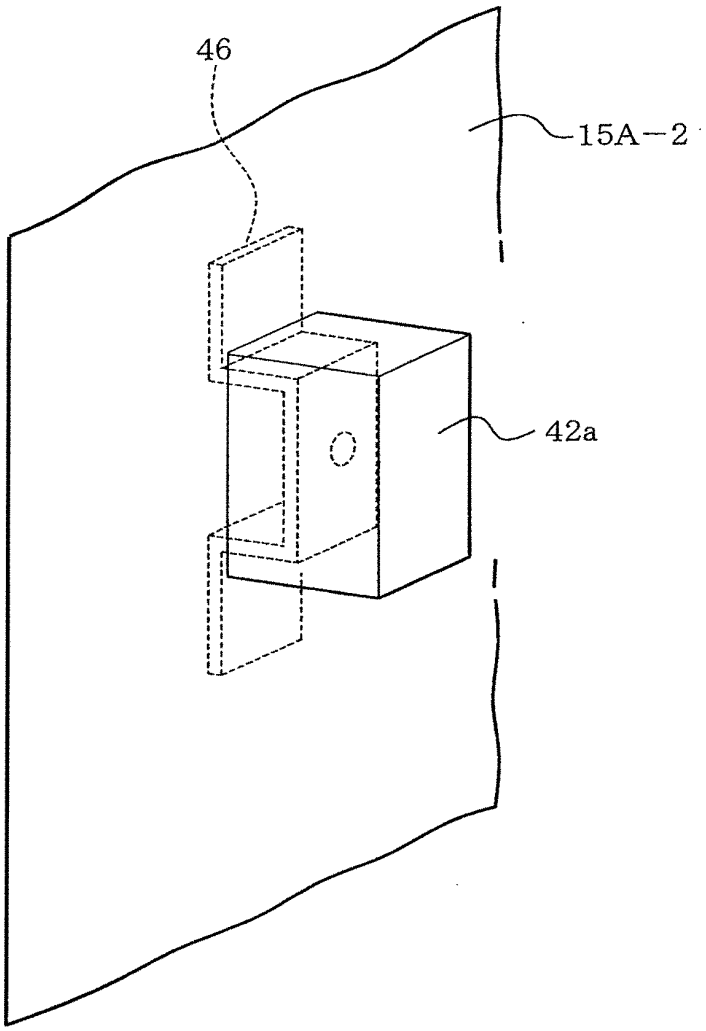

FIG.27

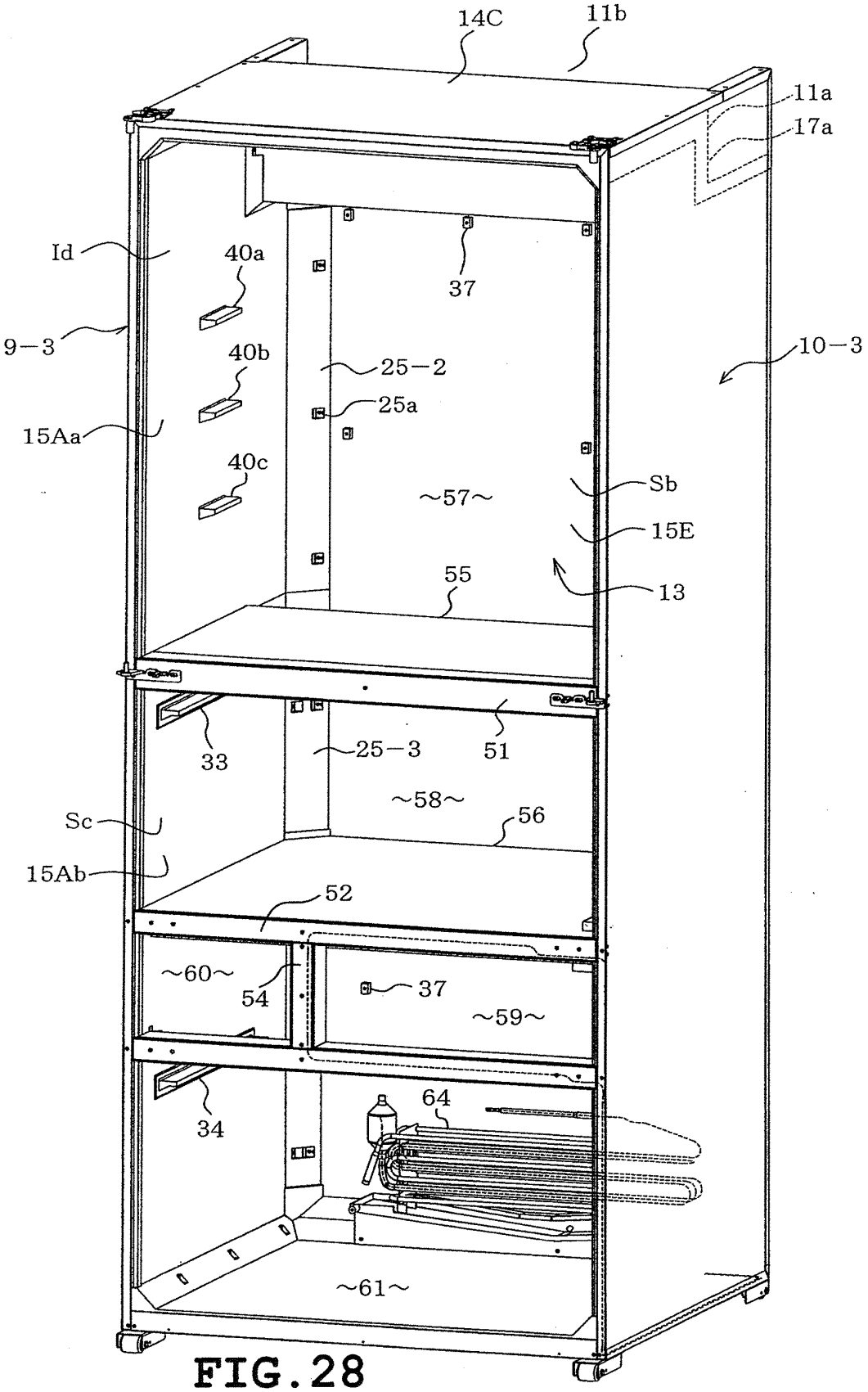
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FIG.28

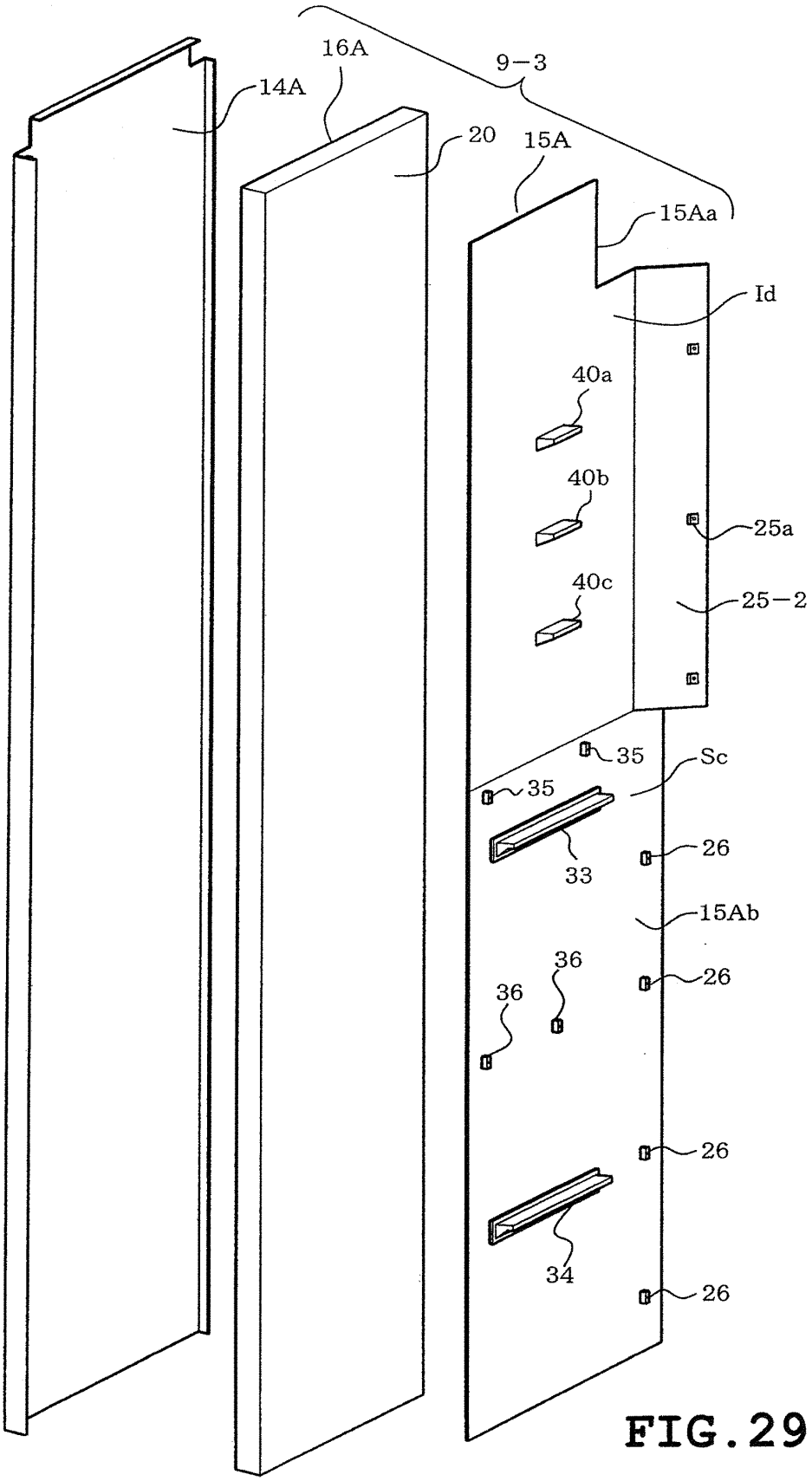
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FIG.29

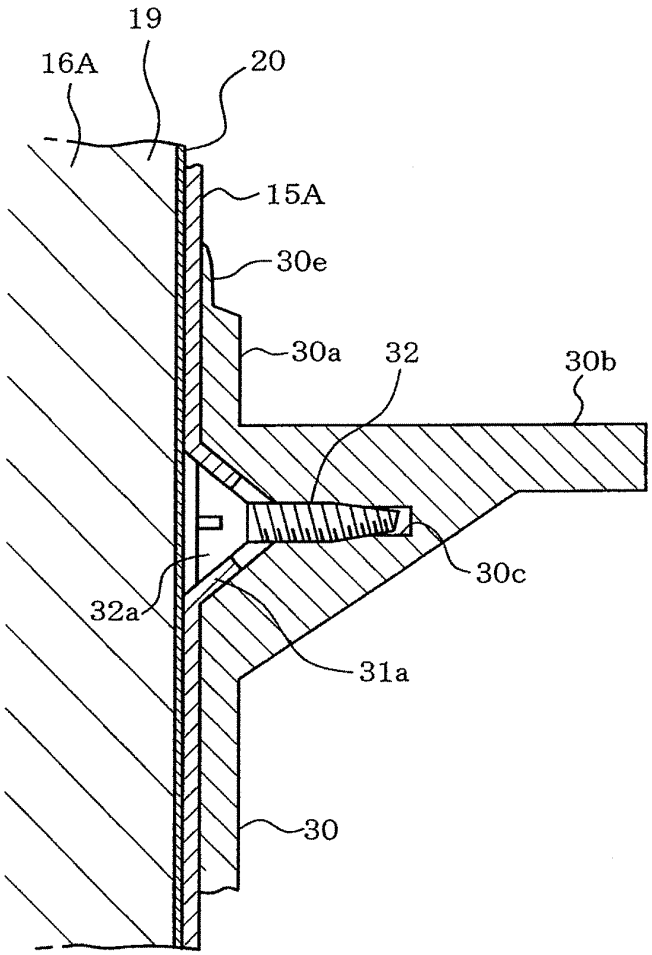

FIG. 30

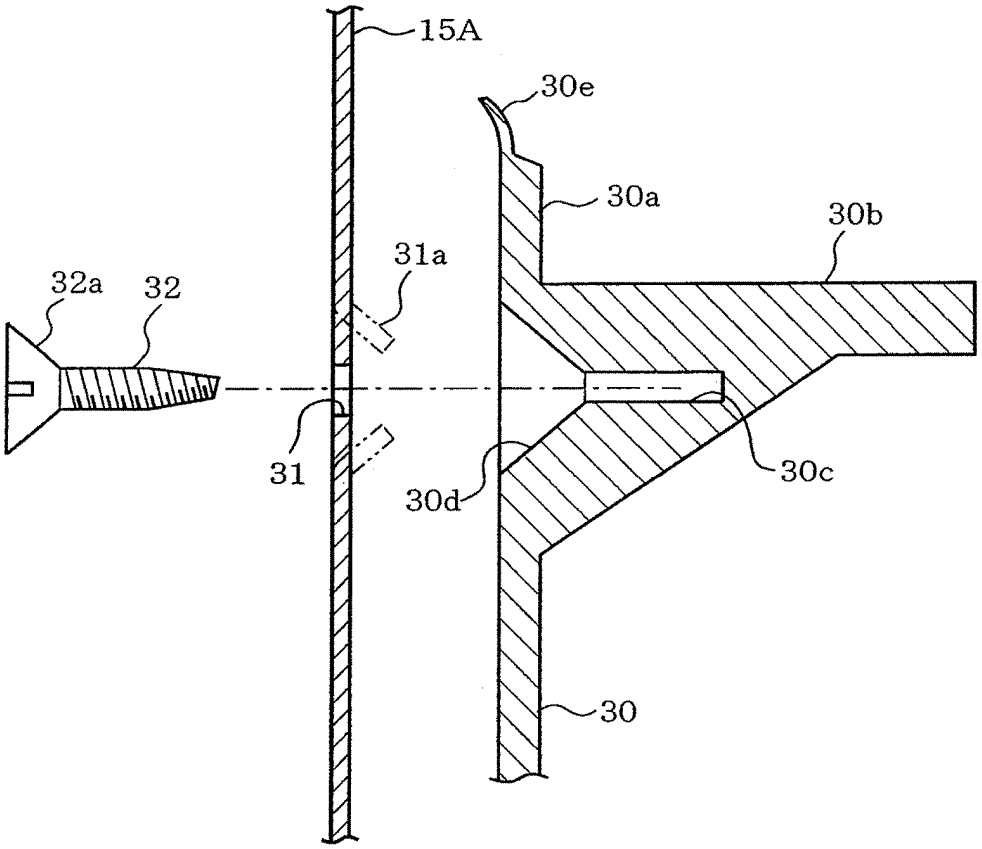

FIG. 31

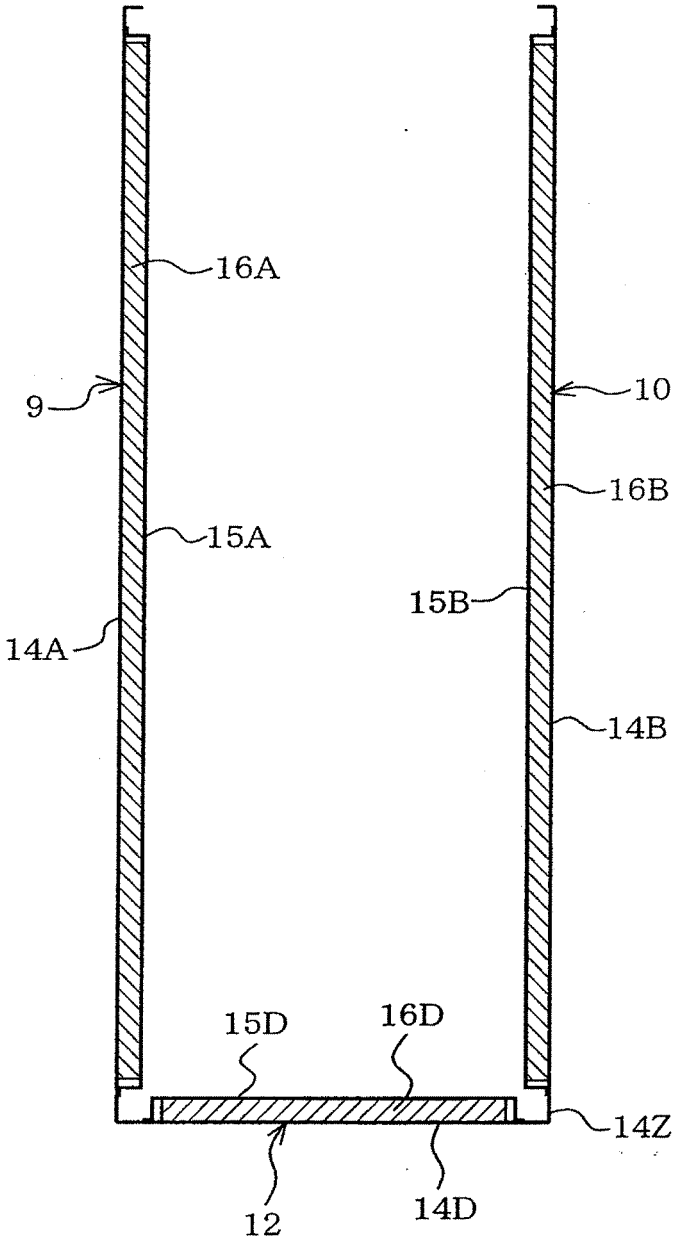

FIG. 32

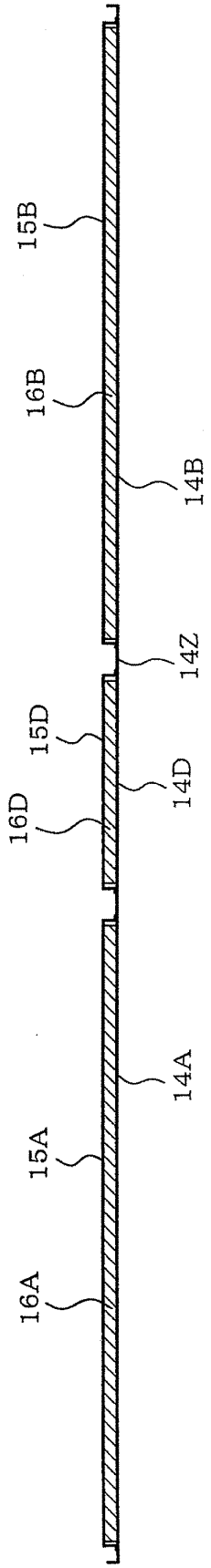

FIG. 33

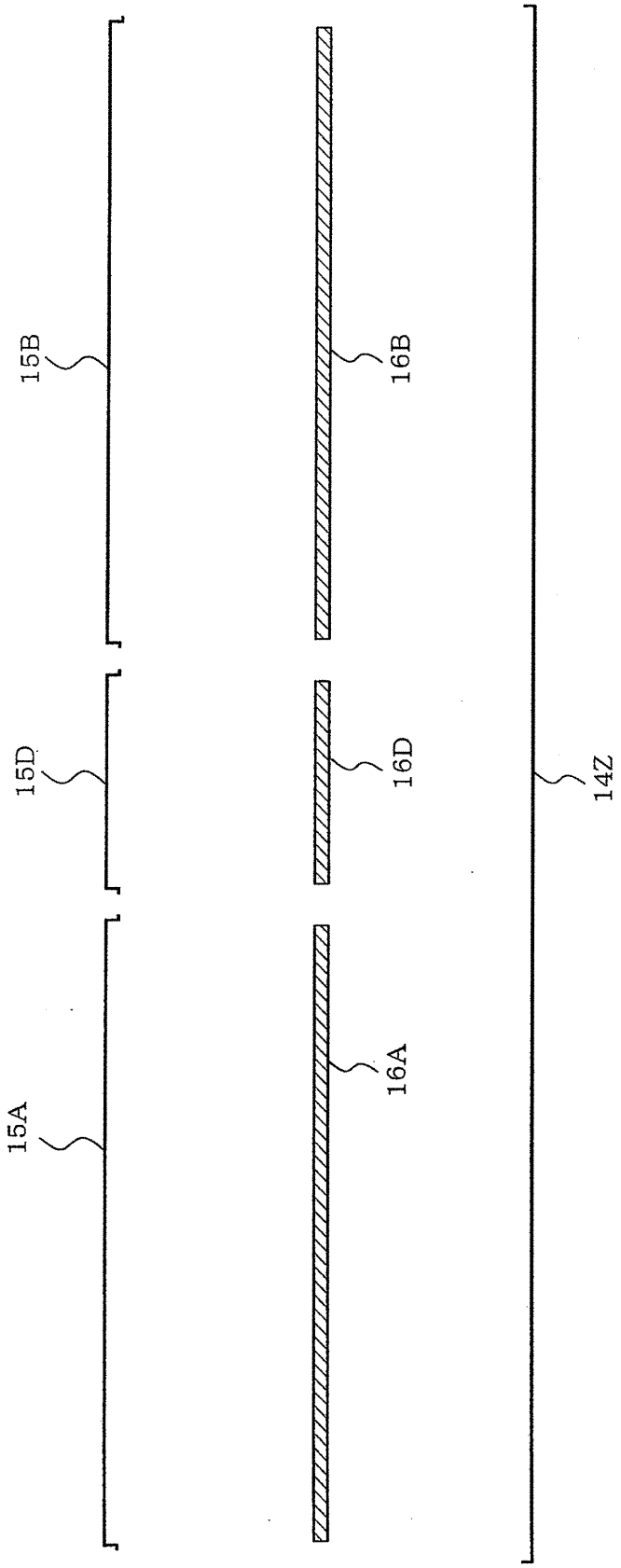

FIG. 34

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/062167

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 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

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 10-205994 A (Sanyo Electric Co., Ltd.), 04 August 1998 (04.08.1998), entire text; all drawings (particularly, fig. 8 to 10) (Family: none)	1-13
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 69311/1985(Laid-open No. 186089/1986) (Hoshizaki Denki Kabushiki Kaisha), 20 November 1986 (20.11.1986), entire text; all drawings (particularly, fig. 3) (Family: none)	1-13

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

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 June, 2012 (13.06.12)	26 June, 2012 (26.06.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/062167

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. 059567/1980(Laid-open No. 161485/1981) (Sankyo Electric Co.), 01 December 1981 (01.12.1981), entire text; all drawings (particularly, fig. 1) (Family: none)	1-13
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 63996/1982(Laid-open No. 177783/1983) (Nippon Trailmobile Co.), 28 November 1983 (28.11.1983), entire text; all drawings (particularly, fig. 2, 3, 4, 6) (Family: none)	2
Y	JP 63-210589 A (Toshiba Corp.), 01 September 1988 (01.09.1988), entire text; all drawings (particularly, fig. 1 to 4) (Family: none)	3
Y	JP 2-136683 A (Sanyo Electric Co., Ltd.), 25 May 1990 (25.05.1990), entire text; all drawings (particularly, specification, page 2, lower left column, line 10 to lower right column, line 19; fig. 1 to 4) (Family: none)	4
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 72031/1992(Laid-open No. 35887/1994) (Hoshizaki Electric Co., Ltd.), 13 May 1994 (13.05.1994), entire text; all drawings (particularly, paragraphs [0003], [0008]; fig. 3, 5) (Family: none)	4
Y	JP 2009-174842 A (Panasonic Corp.), 06 August 2009 (06.08.2009), entire text; all drawings (particularly, paragraphs [0052], [0053], [0058]; fig. 2 to 5, 7, 16) & WO 2009/084181 A1 & CN 101910763 A & TW 200933109 A	5

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/062167

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 56-61576 A (Mitsubishi Electric Corp.), 27 May 1981 (27.05.1981), entire text; all drawings (particularly, fig. 5 to 9) (Family: none)	6-8
Y	JP 7-269779 A (Toshiba Corp.), 20 October 1995 (20.10.1995), entire text; all drawings (particularly, paragraphs [0034] to [0039]; fig. 2 to 5) & US 5512345 A & KR 10-0136956 B & CN 1132346 A	9-13

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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]**