



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
15.10.2014 Bulletin 2014/42

(51) Int Cl.:
F25D 23/06 ^(2006.01) **F25D 19/00** ^(2006.01)

(21) Application number: **12854926.8**

(86) International application number:
PCT/JP2012/075984

(22) Date of filing: **05.10.2012**

(87) International publication number:
WO 2013/084583 (13.06.2013 Gazette 2013/24)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **07.12.2011 JP 2011267809**

(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:
• **OIKAWA, Makoto**
Tokyo (JP)
• **SAEKI, Tomoyasu**
Tokyo (JP)
• **KAWADA, Ryo**
Tokyo (JP)

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

(54) **REFRIGERATOR**

(57) A refrigerator includes an insulation box constructed by disposing an insulation panel between an outer box and an inner box. The insulation box has in an inside a storage space surrounded by a ceiling wall, a

bottom wall, a left sidewall, a right sidewall and a rear wall. The insulation box includes piping located outside the storage space.

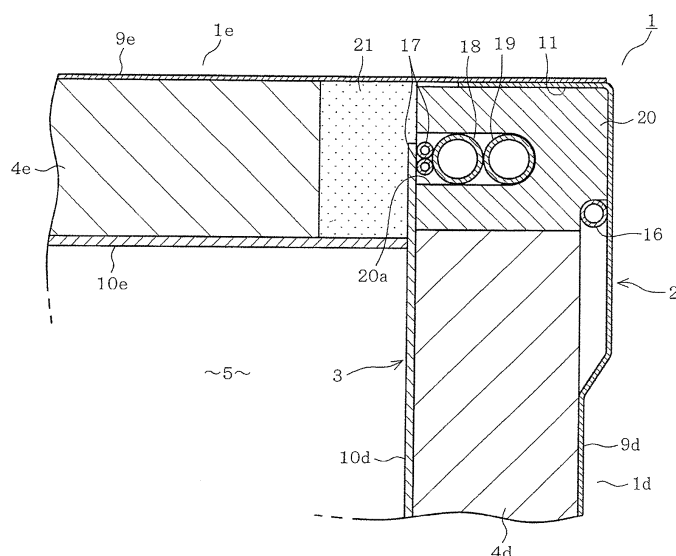


FIG. 1

Description

Technical Field

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

Background Art

[0002] For example, interior volumes of household refrigerators have recently had an increasing tendency. The increase in the interior volume has been tried to be realized by reducing a thickness of peripheral wall of a heat insulation box which is a refrigerator body, but not by increasing the size of the insulation box. In this case, a sufficient insulation performance needs to be ensured even when the peripheral wall is rendered thinner. For this purpose, a vacuum insulation panel is used in addition to filling the peripheral wall of the insulation box with foam insulation.

[0003] The vacuum insulation panel comprises a core material made by forming, for example, glass wool as a flock of fine glass fiber into a mat shape, by putting the core material into a gas barrier container made of a laminate film comprising aluminum foil and synthetic resin, and by evacuating an interior of the gas barrier container and closing an opening. As a result, the vacuum insulation panel maintains the container interior in an evacuated state. The vacuum insulation panel has a low heat conductivity, in other words, high insulation properties even though thin. Accordingly, the use of the vacuum insulation panel can allow the peripheral wall of the insulation box to have high heat insulation properties.

Prior Art Document

Patent Document

[0004]

Patent Document 1: Japanese Patent No. 2728318
Patent Document 2: Japanese Patent Application Publication No. JP-A-H06-147744

Summary of the Invention

Problem to be overcome by the Invention

[0005] A refrigerating cycle of the refrigerator necessitates a number of pipes and tubes including a condenser pipe, a capillary tube and a suction pipe. The capillary tube connects between the condenser pipe and an evaporator or a cooler, and the suction pipe connects between the evaporator and a compressor. The capillary tube and the suction pipe are routed in a storage space or an interior of the insulation box since the evaporator is disposed in the storage space. This reduces a substantial interior volume of the storage space, resulting in a reduc-

tion in a storage volume for food or the like.

[0006] Therefore, an object is to provide a refrigerator which can suppress the narrowing of the storage space of the insulation box by piping.

Means for Overcoming the Problem

[0007] According to one embodiment, a refrigerator includes an insulation box constructed by providing an insulation panel between an outer box and an inner box. The insulation box has in an inside thereof a storage space surrounded by a ceiling wall, a bottom wall, a left sidewall, a right sidewall and a rear wall. The insulation box is provided with piping located outside the storage space.

Brief Description of the Drawings

[0008]

FIG. 1 is a partial transverse section of an insulation box according to one embodiment;
FIG. 2 is a side view of the insulation box;
FIG. 3 is a perspective view of the insulation box as viewed from the front;
FIG. 4 is a perspective view of the insulation box as viewed from the rear;
FIG. 5 is an exploded perspective view of the insulation box; and
FIGS. 6A and 6B are an exploded perspective view of the vacuum insulation panel and a sectional view of the vacuum insulation panel, respectively.
FIG. 7 is a view similar to FIG. 1, showing a second embodiment;
FIG. 8 is a partial longitudinal section of the insulation box according to a third embodiment;
FIG. 9 is a view similar to FIG. 4, showing a fourth embodiment; and
FIG. 10 is a view similar to FIG. 1.

Best Mode for Carrying Out the Invention

[0009] Several embodiments will be described with reference to the drawings. A refrigerator has a side where doors are located, and the side is referred to as "front" and a right side as viewed from the front is referred to as "right."

First Embodiment

[0010] A first embodiment will be described with reference to FIGS. 1 to 6. FIGS. 3 and 4 illustrate a heat insulation box 1 constituting a refrigerator body. The insulation box 1 includes an outer box 2, an inner box 3 and a vacuum insulation panel 4 serving as an insulation panel and provided between the outer and inner boxes 2 and 3. The insulation box 1 is generally formed into the shape of a vertically long box or a rectangular parallele-

piped having an open front. The insulation box 1 has an interior serving as a storage space 2.

[0011] A ceiling wall 1a, a bottom wall 1b, a left sidewall 1c, a right sidewall 1d and a rear wall 1e are separately manufactured as a peripheral wall as shown in FIG. 5. The insulation box 1 is constructed by combining the walls or insulation walls 1a to 1e. In this case, each one of the bottom wall 1b, the left sidewall 1c, the right sidewall 1d and the rear wall 1e is formed into a rectangular flat plate shape. The ceiling wall 1a has a rear part which is lower than the other part thereof, so that the ceiling wall 1a is formed into a stepped shape. As a result, a component chamber 6 is formed in the upper rear of the insulation box 1 when the walls 1a to 1e are combined together to be constructed into the insulation box 1. A compressor constituting the refrigerating cycle (not shown) and the like are disposed in the component chamber 6.

[0012] The construction of the walls 1a to 1e will now be described. The walls 1a to 1e are provided with respective vacuum insulation panels 4 to provide an insulation performance. The vacuum insulation panel 4 includes a core material 7 and a gas barrier container 8 as shown in FIG. 6A. The core material 7 is made by forming, for example, glass wool as a flock of fine glass fiber into a mat shape. The gas barrier container 8 is made of a laminate film comprising aluminum foil and synthetic resin. The core material 7 is put into the gas barrier container 8, and an interior of the gas barrier container 8 is evacuated and an opening is closed. As a result, the vacuum insulation panel 4 maintains the interior of the gas barrier container 8 in an evacuated state.

[0013] Each of the walls 1a to 1e is constructed by interposing the vacuum insulation panel 4 between an outer shell 9 made of a metal such as steel plate and an inner shell 10 made of plastic, for example, as shown in FIGS. 6A and 6B. The vacuum insulation panel 4 is fixed to at least either one of the outer shell 9 and the inner shell 10 by an adhesive agent or the like. Although each wall is shown as a flat plate in FIGS. 6A and 6B, the ceiling wall 1a is formed into a stepped shape.

[0014] The inner shell 10 has smaller vertical and horizontal dimensions than the outer shell 9 in each of the walls 1a to 1e. Further, the vacuum insulation panel 4 has smaller vertical and horizontal dimensions than the inner shell 10. Accordingly, four sides or ends of the vacuum insulation panel 4 do not reach four sides or ends of the outer shell 9, being located inside the four sides of the outer shell 9. Further, predetermined sides of the outer shell 9 of each one of the walls 1a to 1e have respective connecting pieces 11 bent at a right angle. The connecting pieces 11 formed on the predetermined sides of each one of the walls 1a to 1e are used to connect the outer shells 9 of the adjacent walls by screws or the like.

[0015] When the walls 1a to 1e are combined together, the outer shell 9 of the walls 1a to 1e constitutes the outer box 2, and the inner shell 10 of the walls 1a to 1e constitutes the inner box 3. As a result, the insulation box 1

having a lower heat conductivity, namely, a higher insulation performance than the urethane foam is constructed between the outer and inner boxes 2 and 3.

[0016] FIG. 1 is a transverse section of a right rear corner of the insulation box 1, showing a connection between the right sidewall 1d and the rear wall 1e. In order that the vacuum insulation panel 4, the outer shell 9 and the inner shell 10 constituting the right sidewall 1d may be distinguished from the vacuum insulation panel 4, the outer shell 9 and the inner shell 10 constituting the rear wall 1e, suffix "d" is added to the vacuum insulation panel 4, the outer shell 9 and the inner shell 10 of the right sidewall 1d. Suffix "e" is added to the vacuum insulation panel 4, the outer shell 9 and the inner shell 10 of the rear wall 1e.

[0017] No connecting piece 11 is provided on a right end of the outer shell 9e of the rear wall 1e although the connecting piece 11 is provided on the rear end of the outer shell 9d of the right sidewall 1d. The connecting piece 11 of the outer shell 9d of the right sidewall 1d is abutted on an inner surface of a right end of the outer shell 7d of the rear wall 1d. Further, a right end of the inner shell 10 of the rear wall 1e is abutted on a rear end surface of the inner shell 10d of the right sidewall 1d. The connecting piece 11 of the right sidewall 1d and the right end of the outer shell 9e of the rear wall 1e are fastened to each other by a screw (not shown). The right end of the inner shell 10e of the rear wall 1e and the inner shell 10d of the right sidewall 1d are sealed and connected together by a sealing agent and a corner member having a triangular section.

[0018] Three horizontal frames 12, 13 and 14 are mounted on the front of the insulation box 1 so as to partition the front in the up-down direction. A vertical frame 15 is mounted between the middle horizontal frame 13 and the lower horizontal frame 14 of the insulation box 1. Although not shown, insulation walls or partition plates are provided in the rear of the horizontal frames 12 to 14 and in the rear of the vertical frame 15. The storage space 5 is partitioned by the insulation walls and the partition plates into a refrigerating compartment 5a, a vegetable compartment 5b, an ice-making compartment 5c, a mode changeable compartment 5d and a freezing compartment 5e. The ice-making compartment 5c and the mode changeable compartment 5d are juxtaposed to each other.

[0019] The refrigerator is provided with two evaporators for refrigeration and freezing, as coolers. The refrigerating evaporator is disposed in a cooling compartment formed in a rear interior of the refrigerating compartment 5a. The freezing evaporator is disposed in a cooling compartment formed in a rear interior of the freezing compartment 5e. Cold air cooled by the refrigerating evaporator is supplied by a fan into the refrigerating compartment 5a and the vegetable compartment 5b. As a result, atmospheres in the refrigerating compartment 5a and the vegetable compartment 5b are cooled to a refrigeration temperature. Cold air cooled by the freezing evaporator

is supplied by a fan into the ice-making compartment 5c, the mode changeable compartment 5d and the freezing compartment 5e. As a result, atmospheres in the ice-making compartment 5c, the mode changeable compartment 5d and the freezing compartment 5e are cooled to a freezing temperature.

[0020] A condenser pipe 16 is mounted on the insulation box 1 to liquefy the refrigerant compressed by the compressor. The condenser pipe 16 is mounted on an inner surface of the outer shell 9 of all or a part of the walls 1a to 1e of the insulation box 1 or surfaces located at the vacuum insulation panel 4 side. The condenser pipe 16 is configured to release condensation heat with the outer shell 9 serving as a radiator plate. A part of the condenser pipe 16 is mounted on backsides of a peripheral edge of the front opening of the insulation box 1, the horizontal frames 12, 13 and 14 and the vertical frame 15. The condenser pipe 16 warms the peripheral edge of the front opening of the insulation box 1, the horizontal frames 12, 13 and 14 and the vertical frame 15, thereby suppressing dew condensation.

[0021] The refrigerant condensed by the condenser pipe 16 is supplied via the refrigerating and freezing capillary tubes 17 to the refrigerating and freezing evaporators. The refrigerant evaporated by the evaporators is drawn via the suction pipes 18 and 19 to the compressor. The capillary tubes 17 and the suction pipes 18 and 19 are provided outside the storage space 5 relative to the insulation box 1. In the embodiment, the capillary tubes 17 and the suction pipes 18 and 19 are provided in the walls 1a to 1e of the insulation box 1, for example, an interior of a right rear corner of the insulation box 1, which is a connection of the right sidewall 1d and the rear wall 1e, more specifically, the corner interior of the insulation box 1 where ends of the right sidewall 1d and the rear wall 1d intersect with each other.

[0022] The positions of the capillary tubes 17 and the suction pipes 18 and 19 will be described in relation to the vacuum insulation panels 4d and 4e. The capillary tubes 17 and the suction pipes 18 and 19 are disposed on an extension of or outside the rear end of the vacuum insulation panel 4d of the right sidewall 1d and inside the end of the outer box 2, that is, the outer shell 9d of the right sidewall 1d, and outside an extension of the right end of the vacuum insulation panel 4e of the rear wall 1e and inside the end of the outer box 2, that is, the connecting piece 11 of the right sidewall 1d. In this case, the rear end of vacuum insulation panel 4d where the capillary tubes 17 and the suction pipes 18 and 19 are disposed will be referred to as "end at pipe disposition side." The right end of the vacuum insulation panel 4e where the capillary tubes 17 and the suction pipes 18 and 19 are disposed will be also referred to as "end at pipe disposition side."

[0023] The rear end of the vacuum insulation panel 4d of the right sidewall 1d is located inside the connecting piece 11 which is an end of the right sidewall 1d, that is, a rear end of the outer shell 9d, being spaced from the

connecting piece 11. Further, the right end of the vacuum insulation panel 4e of the rear wall 1e is located inside the end of the rear wall 1e, that is, the right end of the outer shell 9e, being spaced from the end. As a result, a space is defined between both vacuum insulation panels 4d and 4e, and the capillary tubes 17 and the suction pipes 18 and 19 are disposed in the space.

[0024] In this case, for example, a rigid rectangular bar-shaped insulator 20 made of expandable plastic is enclosed in the corner of the right rear side of the insulation box 1. The two suction pipes 18 and 19 are inserted into a groove 20a formed in the bar-shaped insulator 20, together with the capillary tubes 17. For example, a spongy insulation material 21 is provided between the bar-shaped insulator 20 and the right end of the vacuum insulation panel 4e. Accordingly, the suction pipes 18 and 19 and the capillary tubes 17 are insulated by the bar-shaped insulator 20 and the spongy insulation material 21.

[0025] The inner shell 10d of the right sidewall 1d extends over the inner shell 10e of the rear wall 1e in the rear of the inner shell 10e. Accordingly, a space defined in the rear of the vacuum insulation panel 4d in the right sidewall 1d is partially separated from a space defined in the right of the vacuum insulation panel 4e in the rear wall 1e. The capillary tubes 17 and the suction pipes 18 and 19 put in the bar-shaped insulator 20 are disposed in the space defined in the rear of the vacuum insulation panel 4d in the right sidewall 1d.

[0026] The bar-shaped insulator 20 is formed to have the rectangular section sized such that the bar-shaped insulator 20 fills a space between the rear end of the vacuum insulation panel 4d of the right sidewall 1d and the connecting piece 11 of the outer shell 9d. Further, the bar-shaped insulator 20 has a vertical dimension is set to a length from a lower end of the right sidewall 1d to the rear lower part of the ceiling wall 1a.

[0027] The suction pipes 18 and 19 and the capillary tubes 17 are assembled to be disposed in the corner at the right rear side of the insulation box 1 in the following manner. The following assembling manner is a mere example and should not be restrictive. Firstly, the capillary tubes 17 and the suction pipes 18 and 19 are inserted into the groove 20a of the bar-shaped insulator 20, so as to be unitized or integrated with the bar-shaped insulator 20. In this case, the capillary tubes 17 and the suction pipes 18 and 19 may be secured to the bar-shaped insulator 20 by an adhesive agent in order to be integrated with the bar-shaped insulator 20 more strongly. Upper ends of the capillary tubes 17 and the suction pipes 18 and 19 are then caused to protrude upward from an upper end of the bar-shaped insulator 20 by a predetermined length as shown in FIG. 2. Subsequently, lower ends of the capillary tubes 17 and the suction pipes 18 and 19 are caused to protrude laterally from a middle part of the bar-shaped insulator 20 by a predetermined length according to the location of the evaporator in the insulation box 1.

[0028] Next, the unitized bar-shaped insulator 20 is bonded to an inner surface of the outer shell 9d of the right sidewall 1d so as to contact with the connecting piece 11 located at the rear end thereof. Subsequently, the vacuum insulation panel 4d is bonded to the inner surface of the outer shell 9d while the rear end of the vacuum insulation panel 4d is in contact with the bar-shaped insulator 20. The inner shell 10d is then bonded to the vacuum insulation panel 4. In this case, the suction pipes 18 and 19 and the capillary tubes 17 extending from the lower end of the bar-shaped insulator 20 are caused to further protrude to the storage space side through a cutout formed in the inner shell 10d.

[0029] The right sidewall 1d and the rear wall 1e are coupled together, and the capillary tubes 17 and the suction pipes 18 and 19 integrated with the bar-shaped insulator 20 are put into the right rear corner of the insulation box 1. Subsequently, when the ceiling wall 1a is combined with the right sidewall 1d and rear wall 1e, the capillary tubes 17 and the suction pipes 18 and 19 protruding upward from the upper end of the bar-shaped insulator 20, that is, the upper end of the right sidewall 1d are drawn into the component chamber 6 through a through hole (not shown) formed in the ceiling wall 1a.

[0030] The capillary tubes 17 drawn into the component chamber 6 are connected to a termination of the condenser pipe 16 via a three-way valve disposed in the component chamber 6. The suction pipes 18 and 19 are connected via joints to an inlet of the compressor. Refrigerant discharged from the compressor is supplied through the condenser pipe 16 to the refrigerating or freezing evaporator by the operation of the three-way valve. The refrigerant evaporated by either evaporator is suctioned via the suction pipe 18 or 19 into the compressor.

[0031] As understood from the foregoing, the capillary tubes 17 and the suction pipes 18 and 19 all serving as piping are disposed outside the storage space 5. Accordingly, differing from the case where the piping is disposed in the storage space 5, narrowing the storage space 5 by the piping can be suppressed. As a result, the storage space 5 can be used for food storage more widely.

[0032] Further, the low-temperature refrigerant flows through the suction pipes 18 and 19. However, since the capillary tubes 17 and the suction pipes 18 and 19 are covered by the insulator 20 and the insulation material 21, occurrence of dew condensation can be suppressed.

[0033] Further, since the capillary tubes 17, the suction pipes 18 and 19 and the foam insulator 20 are unitized, the capillary tubes 17, the suction pipes 18 and 19 and the foam insulator 20 can be handled more easily in the assembly or the like. Moreover, since the foam insulator 20 has a predetermined rigidity, the foam insulator 20 is easier to handle as compared with the case where the foam insulation is soft. Consequently, the capillary tubes 17 and the suction pipes 18 and 19 can be put into the groove 20a more easily.

[0034] Further, the insulation box 1 is constructed by

combining a plurality of walls 1a to 1e. Accordingly, the capillary tubes 17 and the suction pipes 18 and 19 can be put into the connection, namely, the corner of the right sidewall 1d and the rear wall 1e. This is particularly advantageous when each of the right and left walls 1s and 1d has a thickness of not more than 35 mm. In the embodiment, the vacuum insulation panel 4 has a thickness set to about 20 mm. A total thickness of the outer shell 9 and the inner shell 10 is set to about 1.5 mm. In this case, a total thickness of the vacuum insulation panel 4, the outer shell 9 and the inner shell 10 becomes 21.5 mm. Thus, the thickness of each of the right and left walls 1c and 1d is not more than 25 mm which value is further advantageous.

Second Embodiment

[0035] FIG. 7 illustrates a second embodiment. The second embodiment differs from the first embodiment in the arrangement of the capillary tubes 17 and the suction pipes 18 and 19. More specifically, in the second embodiment, the groove 20a of the bar-shaped insulator 20 with the rectangular section is formed on a diagonal line extending from the corner of the inner box 3 to the corner of the outer box 2. A plurality of pipes or tubes, in this case, two capillary tubes 17 and two suction pipes 18 and 19 are arranged in the groove 20a.

[0036] Thus, the suction pipes 18 and 19 having larger diameters than the capillary tubes 17 are arranged on the diagonal line in the corner of the insulation box 1, with the result that the suction pipes 18 and 19 can be enclosed in the corner of the insulation box 1 even when the suction pipes 18 and 19 have respective larger diameters than the thickness of the vacuum insulation panel 4.

Third Embodiment

[0037] FIG. 8 illustrates a third embodiment. In the first embodiment, the suction pipes 18 and 19 are disposed in the corner where two walls intersect. On the other hand, in the third embodiment, the suction pipes 18 and 19 are disposed in an end of one of the walls, for example, in the front end interior of the bottom wall 1b.

[0038] More specifically, the connecting piece 11 of the bottom wall 1b is formed by upwardly bending a front end of the outer shell 9b serving as a front end of the outer box 2. The vacuum insulation panel 4b of the bottom wall 1b has a front end which does not reach the front end of the outer box 2 and is spaced rearward from the connecting piece 11. A bar-shaped insulator 22 is provided between the connecting piece 11 and the front end of the vacuum insulation panel 4. The bar-shaped insulator 22 is formed with a groove 22a. The suction pipes 18 and 19 are inserted into the groove 22a of the bar-shaped insulator 22 together with the capillary tubes 17.

Fourth Embodiment

[0039] FIGS. 9 and 10 illustrate a fourth embodiment. In the fourth embodiment, the capillary tubes 17 and the suction pipes 18 and 19 are disposed outside the storage space 5, more specifically, outside the outer box 2 of the insulation box 1.

[0040] More specifically, as shown in FIG. 9, the covering member 23 is mounted outside the right rear corner of the insulation box 1, for example. The covering member 23 has two sides 23a and 23b intersecting at a right angle, so that the covering member 23 has an L-shaped section. The sides 23a and 23b have respective distal ends bent inward with the result that each of the sides 23a and 23b has a generally container-shaped section.

[0041] Spaces inside the sides 23a and 23b are filled with foam insulation 24. The foam insulation 24 inside the side 23b is formed with a groove 24a. The two suction pipes 18 and 19 and the capillary tubes 17 are enclosed in the groove 24a.

[0042] The side 23a of the covering member 23 has a plurality of recesses 25a formed intermittently in the up-down direction. In the same manner, the side 23b of the covering member 23 has a plurality of recesses 25a formed intermittently in the up-down direction. Self-tapping screws 26a are passed through the recesses 25a of the side 23a respectively. The self-tapping screws 26a are then screwed into the outer shell 9d of the right sidewall 1d. Further, self-tapping screws 26b are passed through the recesses 25b of the side 23b respectively. The self-tapping screws 26b are then screwed through through-holes (not shown) formed in the outer shell 9 of the rear wall 1e into the connecting piece 11 of the outer shell 9 of the right sidewall 1d. Thus, the covering member 23 is thus fixed to the outside of the right ear corner of the insulation box 1.

Other Embodiments

[0043] 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.

[0044] For example, the insulation wall may be constructed by filling a space between the inner and outer shells with the vacuum insulation panel and foam insulation located inside or outside the vacuum insulation panel.

[0045] The insulation box may be constructed by combining a box-shaped outer box and a box-shaped inner box. In this case, the vacuum insulation panel is attached

to an inner surface of the outer box or an outer surface of the inner box before combining the outer and inner boxes, whereby the vacuum insulation panel is provided between the outer and inner boxes.

[0046] When the piping is provided inside the walls 1a to 1e, the piping may be provided in a space between the right end of the vacuum insulation panel 4e of the rear wall 1e and the inner shell 10d of the right sidewall 1d as well as the corner inside constituting the connection of two walls, for example, as shown in FIG. 1.

[0047] The bar-shaped insulators 20 and 22 may be soft spongy insulators.

[0048] The piping should not be limited to the capillary tubes and the suction pipes.

Claims

1. A refrigerator comprising an insulation box constructed by providing an insulation panel between an outer box and an inner box, wherein the insulation box has in an inside thereof a storage space surrounded by a ceiling wall, a bottom wall, a left sidewall, a right sidewall and a rear wall; and wherein the insulation box is provided with piping located outside the storage space.
2. The refrigerator according to claim 1, wherein the insulation box is constructed by combining a plurality of insulation walls in which the insulation panel is provided between an outer shell constituting the outer box and an inner shell constituting the inner box.
3. The refrigerator according to claim 1 or 2, wherein the piping is provided inside an insulator.
4. The refrigerator according to claim 3, wherein the insulator inside which the piping is provided has a predetermined rigidity.
5. The refrigerator according to claim 3 or 4, wherein the piping and the insulator inside which the piping is provided are unitized, and the piping has an end protruding out of the insulator.
6. The refrigerator according to any one of claims 1 to 5, wherein the piping is provided in an end of at least one of the insulation walls including the ceiling wall, the bottom wall, the left sidewall, the right sidewall and the rear wall inside the insulation wall.
7. The refrigerator according to claim 6, wherein the insulation wall inside which the piping is provided has an end located at the piping side of the insulation panel; wherein the end of the insulation wall is located inside relative to an end of the outer box, not reaching the

end of the outer box; and
wherein the piping is located outside relative to the
end of the insulation panel and inside relative to the
end of the outer box.

5

8. The refrigerator according to claim 6, wherein the
piping is disposed inside a corner of the insulation
box, in which corner ends of two walls adjacent to
each other intersect, the two walls being included in
the ceiling wall, the bottom wall, the left sidewall, the
right sidewall and the rear wall; and
wherein the two walls have respective ends located
at the piping side of the insulation panel, the ends of
the two walls being located inside relative to an end
of the outer box, being spaced from the end of the
outer box; and
wherein the piping is located between the insulation
panels of the two walls.
9. The refrigerator according to claim 8, wherein the
piping includes a plurality of pipes and/or tubes; and
wherein the pipes and/or tubes are arranged diagonally
between a corner of the outer box and a corner
of the inner box.
10. The refrigerator according to any one of claims 1 to
3, wherein the piping is provided outside the outer
box.
11. The refrigerator according to claim 10, wherein the
piping is enclosed inside a covering member together
with the insulator, the covering member being
mounted on an outer side of the outer box.

10

15

20

25

30

35

40

45

50

55

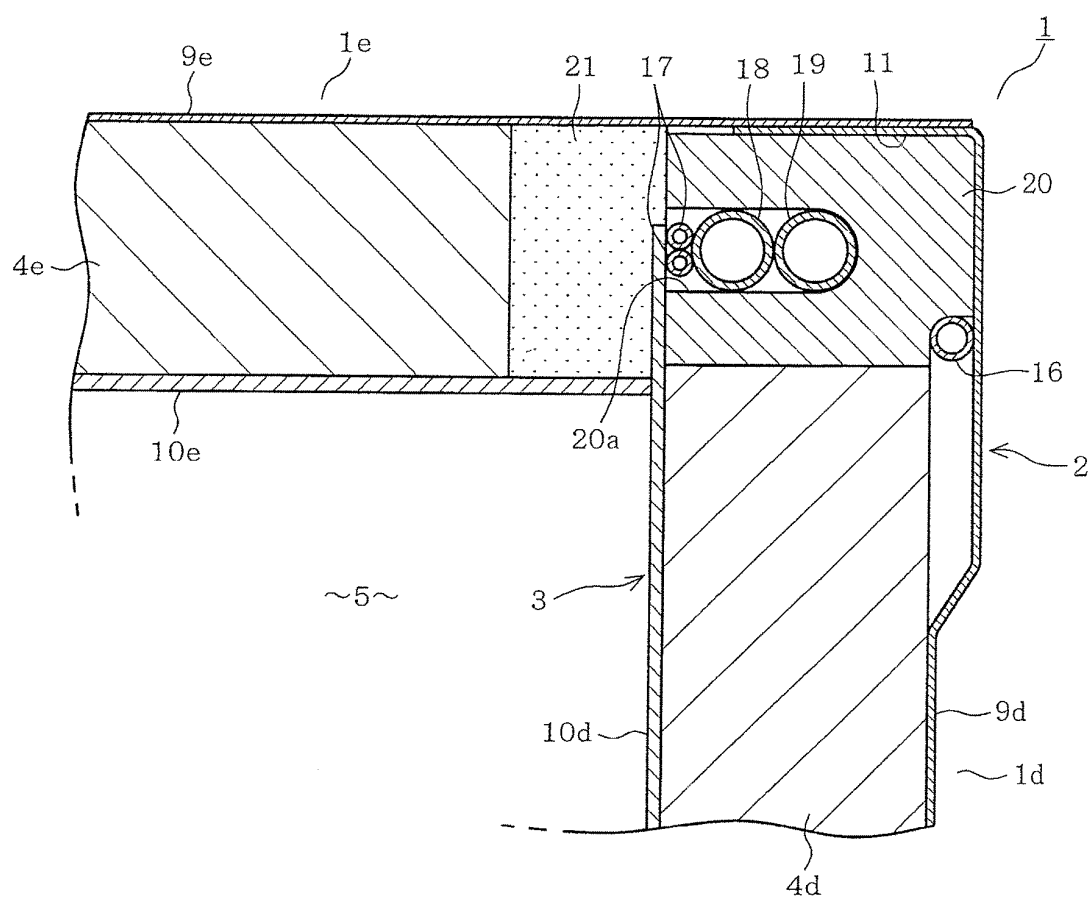


FIG. 1

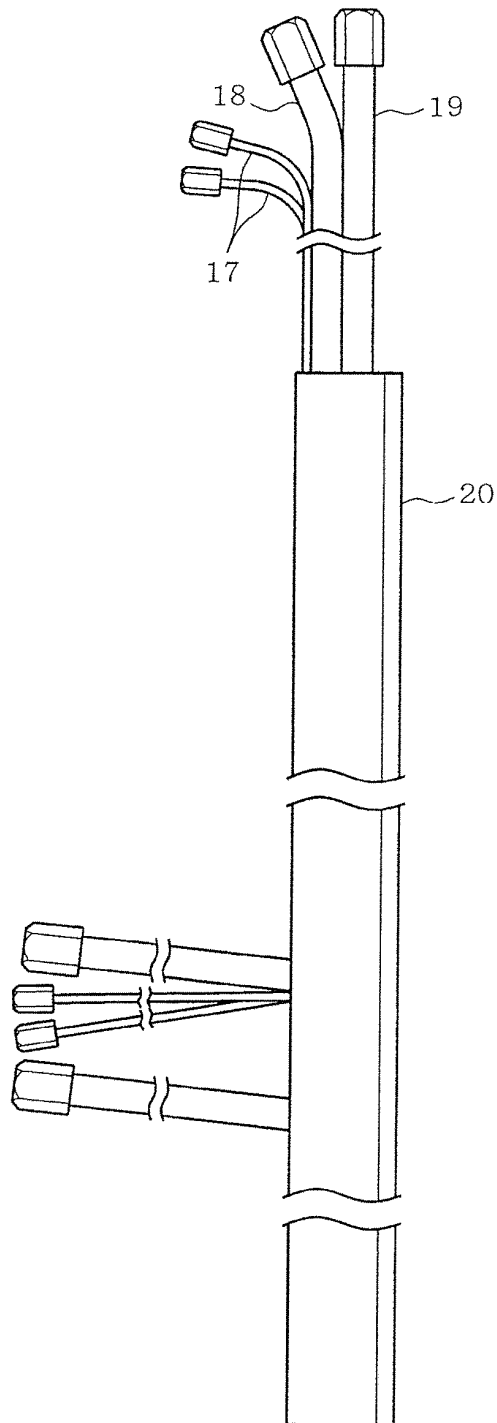


FIG. 2

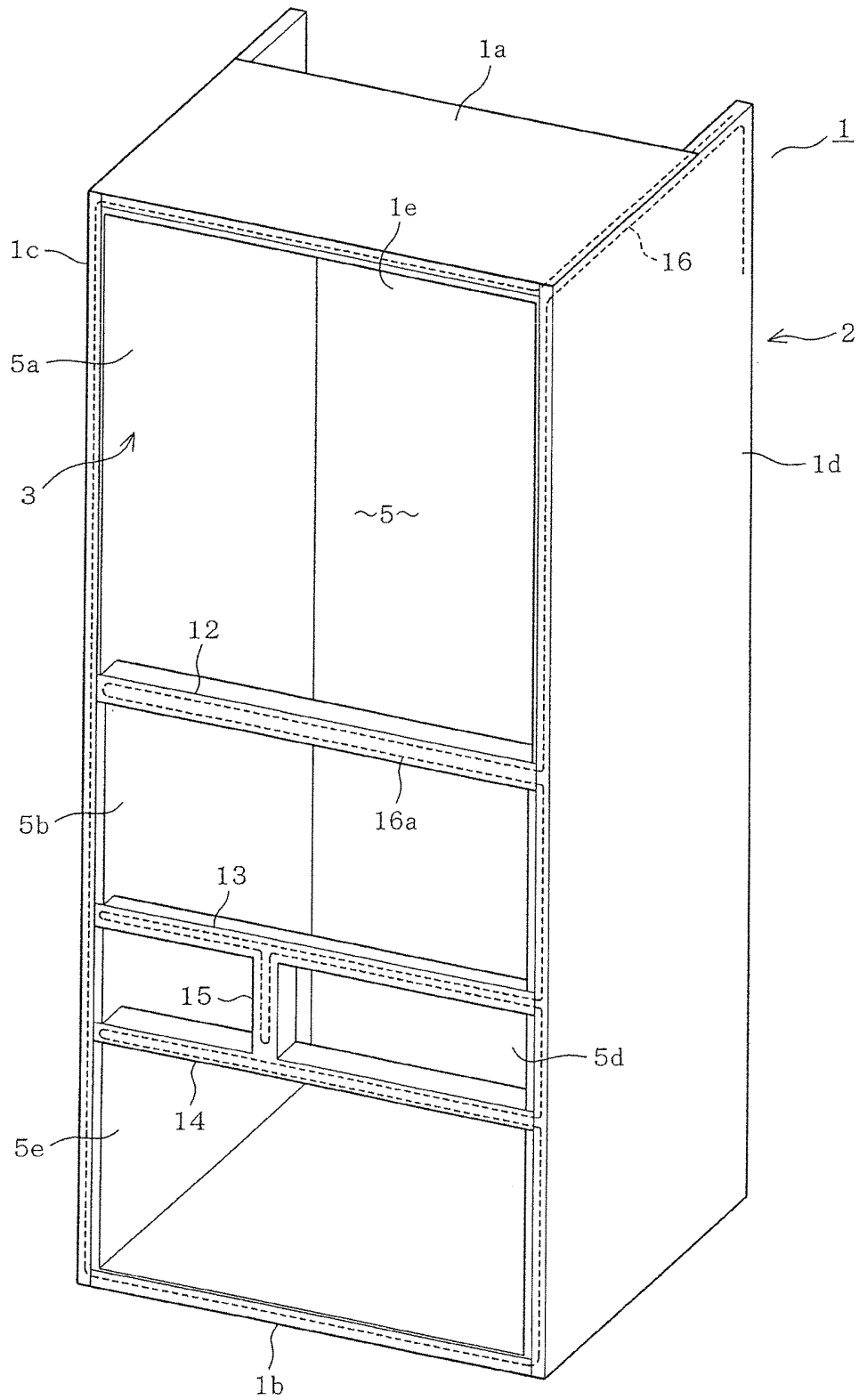


FIG. 3

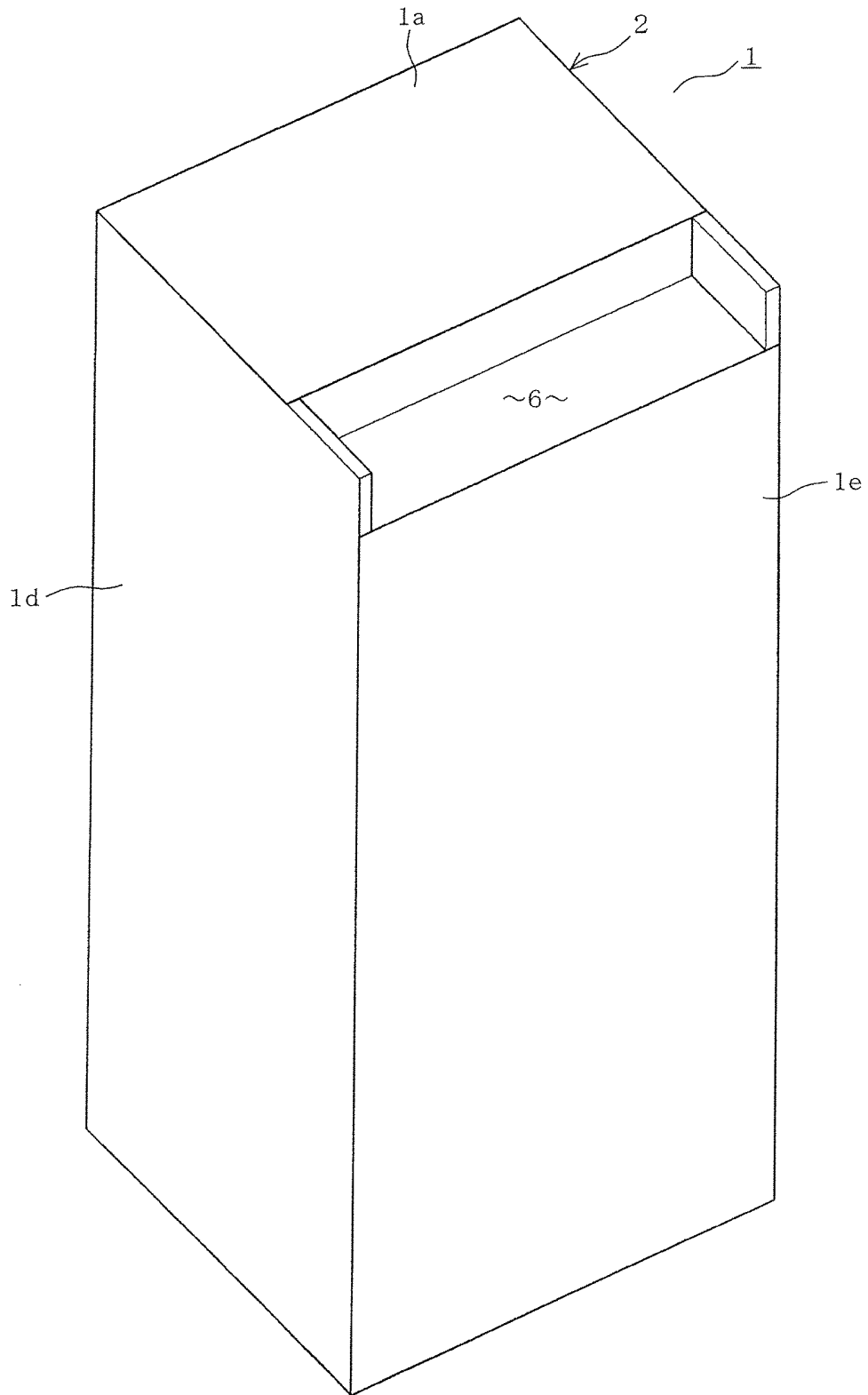


FIG. 4

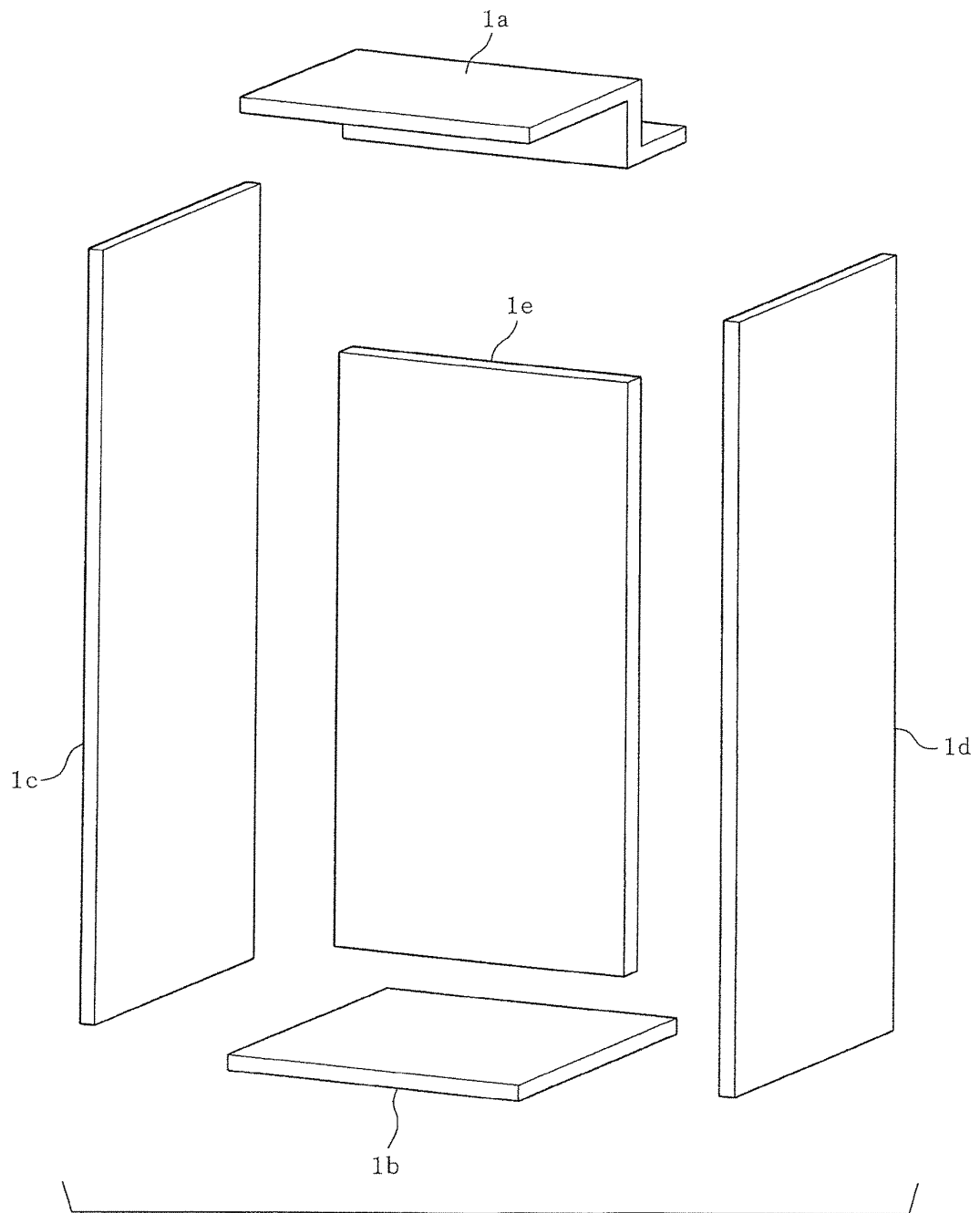


FIG. 5

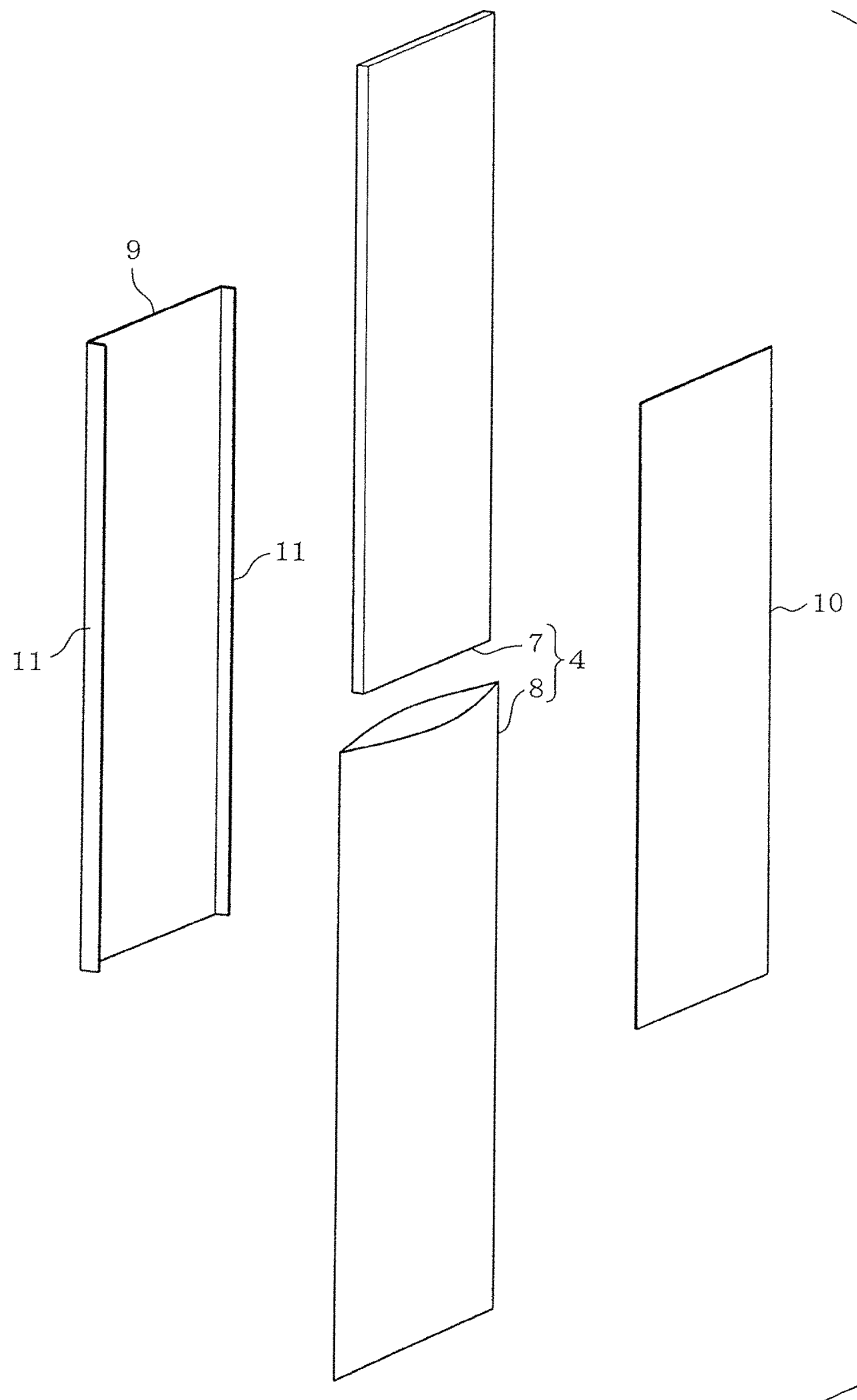


FIG. 6A

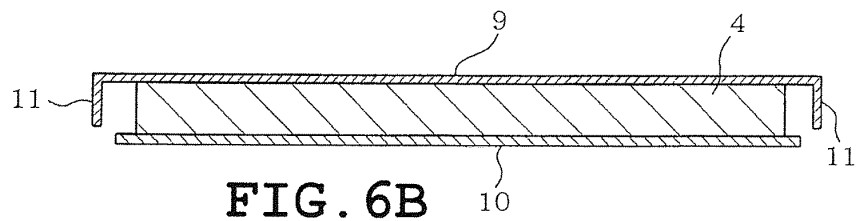


FIG. 6B

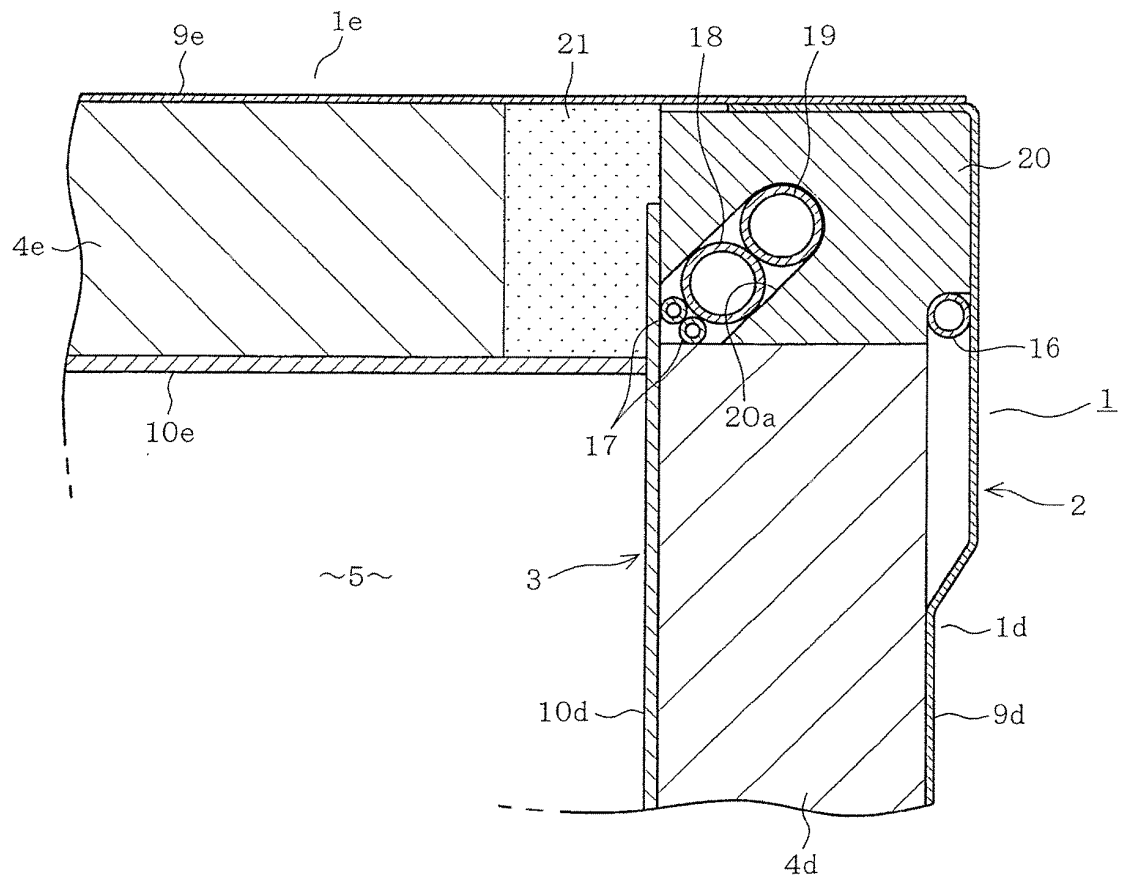


FIG. 7

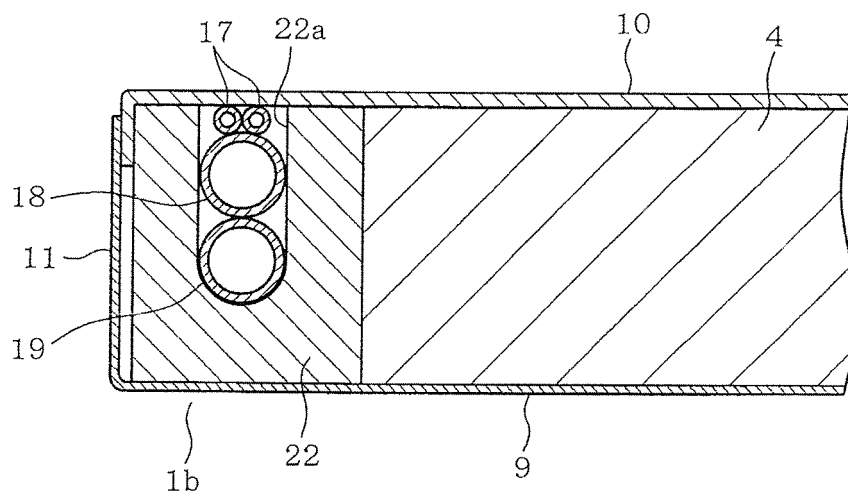


FIG. 8

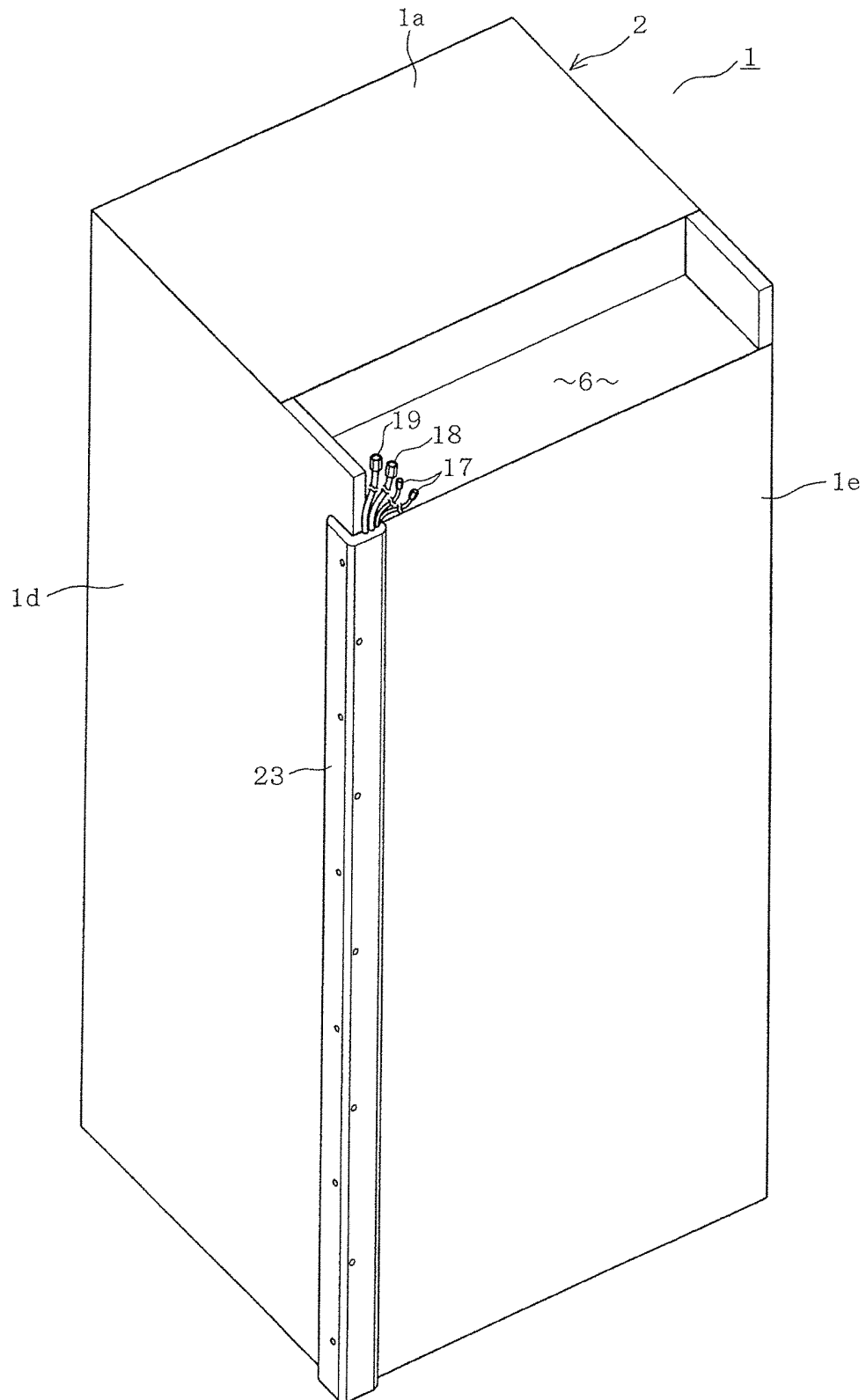


FIG. 9

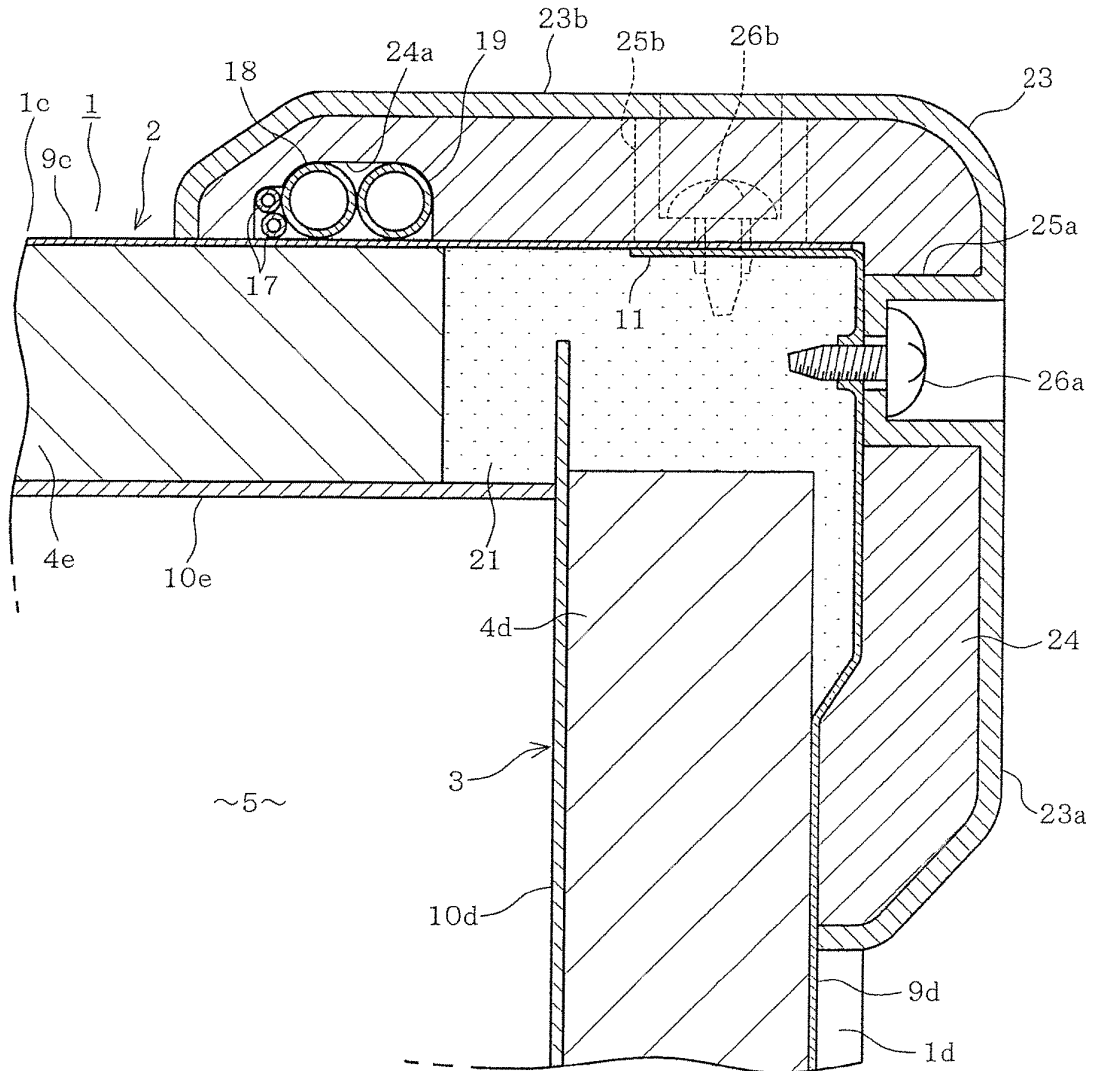


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/075984

A. CLASSIFICATION OF SUBJECT MATTER

F25D23/06(2006.01) i, F25D19/00(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, F25D19/00

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 6-147744 A (Hitachi, Ltd.), 27 May 1994 (27.05.1994), paragraphs [0012] to [0017]; fig. 1 to 7 (Family: none)	1-11
Y	JP 63-263376 A (Matsushita Refrigeration Co.), 31 October 1988 (31.10.1988), page 2, upper right column, line 14 to lower right column, line 12; fig. 1 to 3 (Family: none)	1-9
Y	JP 2002-318057 A (Fujitsu General Ltd.), 31 October 2002 (31.10.2002), paragraphs [0016], [0017]; fig. 2 (Family: none)	3-9

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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

"I" 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
18 December, 2012 (18.12.12)Date of mailing of the international search report
08 January, 2013 (08.01.13)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/075984

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 2008-116161 A (Matsushita Electric Industrial Co., Ltd.), 22 May 2008 (22.05.2008), paragraph [0035] (Family: none)	4-9
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 310/1981 (Laid-open No. 114392/1982) (Hitachi, Ltd.), 15 July 1982 (15.07.1982), specification, page 3, line 4 to page 4, line 7; fig. 2 (Family: none)	8, 9
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 9749/1982 (Laid-open No. 111878/1983) (Sharp Corp.), 30 July 1983 (30.07.1983), specification, page 1, lines 14 to 18; fig. 1 (Family: none)	10, 11
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 74706/1987 (Laid-open No. 185084/1988) (Sawafuji Electric Co., Ltd.), 28 November 1988 (28.11.1988), specification, page 6, lines 18 to 20; fig. 1 (Family: none)	10, 11

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2728318 B [0004]
- JP H06147744 A [0004]