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(54) REFRIGERATOR

(57) The application discloses a refrigerator, comprising an outer cabinet and an inner cabinet, and a refrigerant pipe, a vacuum thermally-insulating material, a foam thermally-insulating material and a buffering member between the outer cabinet and the inner cabinet. The refrigerant flows in the refrigerant pipe. In a region where the refrigerant pipe and the vacuum thermally-insulating material are disposed, a buffering member is provided between the refrigerant pipe and the vacuum thermally-insulating material, an inner surface of the outer cabinet is connected to the refrigerant pipe, and the space between the inner surface of the outer cabinet and the vacuum thermally-insulating material is filled with the foam thermally-insulating material. When the liquid-state foam thermally-insulating material is filled, deformation does not occur on the outer surface of the outer cabinet.

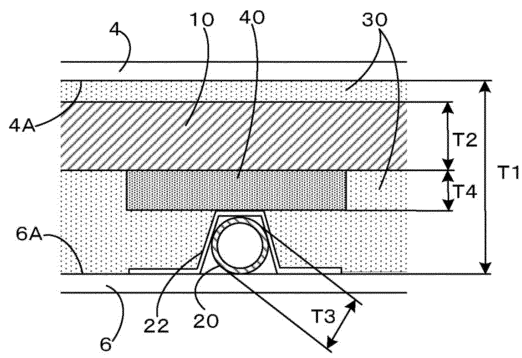

FIG. 2

EP 4 227 619 A1

Description

TECHNICAL FIELD

[0001] The application relates to a refrigerator including a vacuum thermally-insulating material.

BACKGROUND

[0002] In order to keep a storage region in an inner cabinet of a refrigerator cold, a thermally-insulating material is disposed in a region between an outer cabinet and the inner cabinet. Generally, the filled foamed thermally-insulating material serves as a thermally-insulating material, for example, polyurethane foam. However, some refrigerators meanwhile use a vacuum thermally-insulating material (e.g., reference may be made to patent document 1: JP Patent Laid-open 2005-55086).

[0003] In the refrigerator disclosed in the patent document 1, the vacuum thermally-insulating material is provided in a region in which a refrigerant pipe is not disposed, and the refrigerant flows in the refrigerant pipe. However, in order to improve the thermally-insulating performance of the refrigerator, the vacuum thermally-insulating material is expected to be disposed in a broader region in addition to the position where the refrigerant pipe lies. In this case, the space between the outer cabinet and the inner cabinet might be obstructed by the refrigerant pipe and the vacuum thermally-insulating material, and the liquid-state foam thermally-insulating material cannot be sufficiently filled upon manufacturing, so that an air accumulation might occur and the thermally-insulating performance falls.

[0004] In addition, the liquid-state foam thermally-insulating material might be injected locally and unevenly. In this case, the vacuum thermally-insulating material or refrigerant pipe might be pushed towards the outside so that an outwardly-protruding deformation occurs on the outer surface of the outer cabinet.

SUMMARY

[0005] An object of the present invention is to solve the above problems by providing a refrigerator, wherein a foam thermally-insulating material is sufficiently filled in a region where a refrigerant pipe and a vacuum thermally-insulating material are provided, between an outer cabinet and an inner cabinet, and deformation does not occur on the outer surface of the outer cabinet.

[0006] According to the present invention, in the region where the refrigerant pipe and the vacuum thermally-insulating material are provided between the outer cabinet and inner cabinet, the inner surface of the outer cabinet is connected to the refrigerant pipe, and the buffering member is provided between the refrigerant pipe and the vacuum thermally-insulating material. A space can be ensured between the refrigerant pipe and the vacuum thermally-insulating material by using the buffering member. Therefore, the foam thermally-insulating material is sufficiently filled in the space between the inner surface of the outer cabinet and the vacuum thermally-insulating material, through the space upon manufacturing. In addition, air between the outer cabinet and inner cabinet can escape through the space to the external, so the air accumulation does not occur. In addition, the liquid-state foam thermally-insulating material smoothly flows through the space, so that it will not be filled locally and unevenly and the outwardly-protruding deformation of the outer surface of the outer cabinet does not occur.

[0007] EPS is manufactured by foaming polystyrene primarily with hydrocarbon gases such as butane or pentane. Due to the existence of bubbles, EPS has elasticity, good shock absorption, and good thermal insulation. Therefore, EPS can reliably ensure a space between the refrigerant pipe and the vacuum thermally-insulating material. The space becomes a flow path of the liquid-state foam thermally-insulating material and serves as a buffering material to prevent the occurrence of the deformation on the outer surface of the outer cabinet.

[0008] Therefore, the buffering member retains the refrigerant pipe in a bite-in manner, thereby preventing the buffering member from sliding off the refrigerant pipe. Therefore, the buffering member can be stably arranged between the refrigerant pipe and the vacuum thermally-insulating material.

[0009] According to the present invention, buffering members are disposed at positions where the refrigerant pipe and the vacuum thermally-insulating material are provided, in a direction connecting the injection port of the liquid-state foam thermally-insulating material with a position which is in an injection region the liquid-state foam thermally-insulating material provided with the vacuum thermally-insulating material and is farthest from the injection port. Therefore, a space can be reliably ensured in the direction in which the buffering members are configured. By injecting the liquid-state foam thermally-insulating material so that the liquid-state foam thermally-insulating material flows into the air accumulation existing between the outer cabinet and inner cabinet, the air can be pushed out along the direction connecting the farthest position with the injection port, so that the air escapes through the injection port to the external. In this way, the formation of air accumulation can be prevented.

Effects of the invention

[0010] As stated above, the present invention provides a refrigerator, wherein the foam thermally-insulating material is sufficiently filled in the region where the refrigerant pipe and the vacuum thermally-insulating material are provided, between the outer cabinet and the inner cabinet, and deformation does not occur on the outer surface of the outer cabinet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1A schematically illustrates a bottom view of a refrigerator upon lying horizontally with a door side facing downward in a first embodiment of the present invention;

FIG. 1B schematically illustrates a side view of a refrigerator in the present invention upon lying horizontally with a door side facing downward and with a small amount of liquid-state foam thermally-insulating material being injected into the refrigerator;

FIG. 1C schematically illustrates a side view of a refrigerator in the present invention upon lying horizontally with a door side facing downward and with a liquid-state foam thermally-insulating material being injected into the refrigerator;

FIG. 1D schematically illustrates a side view of a refrigerator in the present invention upon lying horizontally with a door side facing downward and with a liquid-state foam thermally-insulating material being injected into the refrigerator;

FIG. 2 schematically illustrates a cross-sectional view of a construction of a buffering member disposed between a refrigerant pipe and a vacuum thermally-insulating material in the refrigerator shown in FIG. 1A to FIG. 1D;

FIG. 3A schematically illustrates a cross-sectional view of another embodiment 1 of a buffering member disposed between a refrigerant pipe and a vacuum thermally-insulating member;

FIG. 3B schematically illustrates a perspective view of the buffering member shown in FIG. 3A;

FIG. 4A schematically illustrates a cross-sectional view of another embodiment 2 of a buffering member disposed between a refrigerant pipe and a vacuum thermally-insulating member;

FIG. 4B schematically illustrates a perspective view of a buffering member shown in FIG. 4A;

FIG. 5A schematically illustrates a side view of a refrigerator in a second embodiment of the present invention;

FIG. 5B schematically illustrates a side view of flow of air remaining between an outer cabinet and an inner cabinet in the refrigerator shown in FIG. 5A;

FIG. 6A schematically illustrates a bottom view of a refrigerator upon lying horizontally with a door side facing downward;

FIG. 6B schematically illustrates a side view of a refrigerator upon lying horizontally with a door side facing downward and with a liquid-state foam thermally-insulating material being injected into the refrigerator;

FIG. 6C schematically illustrates a side view of a refrigerator upon lying horizontally with a door side facing downward and with a liquid-state foam thermally-insulating material being injected into the refrigerator;

FIG. 6D schematically illustrates a side view of a refrigerator upon lying horizontally with a door side facing downward and with a liquid-state foam thermally-insulating material being injected into the refrigerator;

FIG. 7 schematically illustrates a cross-sectional view showing a problem occurring at positions where the refrigerant pipe and the vacuum thermally-insulating material are provided in the refrigerator shown in FIG. 6A to FIG. 6D.

DETAILED DESCRIPTION

[0012] Hereinafter, embodiments for implementing the present invention will be described with reference to figures. In addition, the refrigerator described hereunder is intended to embody technical ideas of the present invention. The present invention will not be limited to the following content unless otherwise specifically disclosed. In the figures, sometimes members having the same functions are denoted by the same reference numbers. To facilitate illustration of key points or easy understanding, embodiments are sometimes illustrated separately for purpose of convenience. However, replacement or combination of part of the structures shown in different embodiments is possible. The size and positional relationship etc. of the members shown in the figures are sometimes shown in an enlarged manner to make the depictions become definite.

(Refrigerators in the prior art)

[0013] FIGS. 6A-6D schematically illustrate side views of an example of a refrigerator 102 in the prior art. FIG. 7 schematically illustrates a cross-sectional view showing a problem occurring at positions where a vacuum thermally-insulating material 110 and a refrigerant pipe 120 are provided in the refrigerator 102 shown in FIG. 6. First, reference is made to FIGS. 6A-6D and FIG. 7 to illustrate problems in the refrigerator including the vacuum thermally-insulating material in the prior art.

[0014] FIG. 6A through FIG. 6D illustrate the following case: the refrigerator 102 lies down horizontally with a door side facing downward, so that a liquid-state foam thermally-insulating material 130 is injected between an outer cabinet 106 and an inner cabinet 104 of the refrigerator 102. FIG. 6A shows a bottom surface of the refrigerator 102 in this state, and FIG. 6B through FIG. 6D show a side surface of a lateral side of the refrigerator 102. In the figures, inner members are shown in a perspective manner, especially, FIG. 6B through FIG. 6D show the vacuum thermally-insulating material 110 and the refrigerant pipe 120 provided between the outer cabinet 106 and inner cabinet 104, the injected liquid-state foam thermally-insulating material 130 being shown in gray.

[0015] The Vacuum Insulation Panel (VIP) is a thermally-insulating material which is made of a resin and wrapped with a thin film, whose interior is depressurized to thereby form a vacuum state, and which can prevent thermal movement of gas, and which therefore has a much higher thermally-insulating performance than other thermally-insulating materials. The refrigerant pipe 120 is a member for forming a cooling cycle in the refrigerator, and is a metal pipe in which a refrigerant flows. Especially, in the refrigerant pipe 120 shown flows a high-temperature and high-pressure refrigerant (mainly, a gas) discharged from a compressor C in a machine room. In order to enable the refrigerant flowing in the refrigerant pipe to dissipate heat, the refrigerant pipe 120 forms, between the outer cabinet 106 and the inner cabinet 104, a long flow path whose extension direction changes multiple times.

[0016] In the illustrated example, the vacuum thermally-insulating material 110 is disposed from a center to a lower side (a right side in the figure) of the refrigerator 102 in a region between the outer cabinet 106 and the inner cabinet 104. The refrigerant pipe 120 and the vacuum thermally-insulating material 110 are provided in a central region of refrigerator 102. In addition, in the central region of refrigerator 102 is provided an injection port Q of the liquid-state foam thermally-insulating material 130. The liquid-state foam thermally-insulating material 130 is injected by an injection device P mounted at the injection port Q.

[0017] In such a region where the refrigerant pipe 120 and vacuum thermally-insulating material 110 are provided, as shown in FIG. 7, the refrigerant pipe 120 is fixed in a state of connecting with an inner surface 106A of the outer cabinet 106, by an adhesive tape 122. The vacuum thermally-insulating material 110 is mounted on the inner cabinet 104 side of the refrigerant pipe 120.

[0018] FIG. 6B through FIG. 6D show a situation in which the liquid-state foam thermally-insulating material 130 is injected. In the region where the vacuum thermally-insulating material 110 and refrigerant pipe 120 are provided, the refrigerant pipe 120 is connected with the inner surface 106A of the outer cabinet 106, and there is no space between the refrigerant pipe 120 and the vacuum thermally-insulating material 110. Therefore, in a region on an upper side (a left side in the figure) of the vacuum thermally-insulating material 110, the flow of liquid-state foam thermally-insulating material 130 is blocked by the refrigerant pipe 120 and the vacuum thermally-insulating material 110. In this way, the liquid-state foam thermally-insulating material 130 will not flow into the region where the vacuum thermally-insulating material 100 is provided, and an air accumulation A remains as shown in FIG. 6D. Since there occurs a region not filled with the foam thermally-insulating material 130, the thermally-insulating performance falls. In addition, due to changes of the temperature, the air accumulation A expands and shrinks repeatedly, and there might occur a problem in durability.

[0019] In addition, since the liquid-state foam thermally-insulating material 130 will flow towards a place with a small flow resistance, the liquid-state foam thermally-insulating material 130 will be unevenly filled between the vacuum thermally-insulating material 110 and an inner surface 104A of the inner cabinet 104, as shown in FIG. 7. Therefore, the vacuum thermally-insulting material 110 and the refrigerant pipe 120 are pushed towards the outer cabinet 106 side. As a result, the outer cabinet 106 is pushed by the refrigerant pipe 120, resulting in the outwardly-protruding deformation of the outer surface of the outer cabinet 106.

[0020] In the refrigerator 2 in a first embodiment of the present invention as shown below, the problems such as the reduction of the thermally-insulating performance caused by insufficient filling of the foam thermally-insulating material, the problem caused by the air accumulation A and the deformation of the outer surface of the outer cabinet 106 can be solved.

(The refrigerator in the first embodiment)

[0021] FIG. 1 schematically illustrates a side view of the refrigerator 2 in the first embodiment of the present invention. FIG. 2 schematically illustrates a cross-sectional view of a construction of a buffering member 40 disposed between the vacuum thermally-insulating material 10 and the refrigerant pipe 20 in the refrigerator 2 shown in FIG. 1.

[0022] As in FIG. 6, FIGS. 1A-1D also show the following case: the refrigerator 2 lies down horizontally with a door side facing downward, so that a liquid-state foam thermally-insulating material 30 is injected between an outer cabinet 6 and an inner cabinet 4 of the refrigerator 2. FIG. 1A shows a bottom surface of the refrigerator 2 in this state, and FIG. 1B through FIG. 1D show a side surface of a lateral side of the refrigerator 2. In the figures, inner members are shown in a perspective manner, especially, FIG. 1B through FIG. 1D show the vacuum thermally-insulating material 10 and the refrigerant pipe 20 provided between the outer cabinet 6 and inner cabinet 4, the injected liquid-state foam thermally-insulating material 30 being shown in gray.

[0023] As in FIG. 6, in FIG. 1, the vacuum thermally-insulating material 10 is disposed from a center to a lower side (a right side in the figure) of the refrigerator 2 in a region between the outer cabinet 6 and the inner cabinet 4. The refrigerant pipe 20 and the vacuum thermally-insulating material 10 are provided in a central region of refrigerator 102. In addition, in the central region of refrigerator 2 is provided an injection port Q of the liquid-state foam thermally-insulating material 30. The liquid-state foam thermally-insulating material 30 is injected by an injection device P mounted at the injection port Q. There is the construction shown in FIG. 2 in such a region in where the refrigerant pipe 20 and the vacuum thermally-insulating material 10 are provided.

[0024] As shown in FIG. 2, the refrigerant pipe 20 is fixed in a state of connecting with an inner surface 6A of the outer cabinet 6, by an adhesive tape 22. In the present embodiment, a buffering member 40 is disposed between the refrigerant pipe 20 and the vacuum thermally-insulating material 10. Due to the buffering member 40, a space enabling the liquid-state foam thermally-insulating material 30 to flow can be ensured between the refrigerant pipe 20 and the vacuum thermally-insulating material 10.

[0025] Referring to FIGS. 1B-1D showing the injection of liquid-state foam thermally-insulating material 30, in a region on an upper side (a left side in the figure) of the vacuum thermally-insulating material 10, there is also an inflow space between the refrigerant pipe 20 and the vacuum thermally-insulating material 10 due to the buffering member 40. Therefore, as shown schematically by the arrow, the liquid-state foam thermally-insulating material 30 flows into an entire region where the vacuum thermally-insulating material 10 is provided. Therefore, as shown in FIG. 1D, an air accumulation A does not occur, and the foam thermally-insulating material 30 is sufficiently filled in an entire region between the outer cabinet 6 and the inner cabinet 4.

[0026] The liquid-state foam thermally-insulating material 30 flows in a well-balanced manner in a space between the inner surface 6A of the outer cabinet 6 and the vacuum thermally-insulating material 10, as well as in a space between the vacuum thermally-insulating material 10 and the inner surface 4A of the inner cabinet 4. Therefore, there does not occur a region in which the foam thermally-insulating material 30 is not evenly filled. In addition, since the buffering member 40 properly deforms elastically, as shown in FIG. 2, the outer cabinet 6 will not be pushed by the refrigerant pipe 20, and there will not occur the outwardly-protruding deformation on the outer surface of the outer cabinet 6.

[0027] As mentioned above, in the refrigerator 2 of the present embodiment, in the region where the refrigerant pipe 20 and the vacuum thermally-insulating material 10 are provided between the outer cabinet 6 and inner cabinet 4, the inner surface 6A of the outer cabinet 6 is connected to the refrigerant pipe 20, and the buffering member 40 is provided between the refrigerant pipe 20 and the vacuum thermally-insulating material 10. The foam thermally-insulating material 30 is sufficiently filled in the space between the inner surface 6A of the outer cabinet 6 and the vacuum thermally-insulating material 10.

[0028] Therefore, the refrigerator 2 can be provided, wherein the foam thermally-insulating material 30 is sufficiently filled in the region where the refrigerant pipe 20 and the vacuum thermally-insulating material 10 are provided between the outer cabinet 6 and inner cabinet 4, and the outer surface of the outer cabinet 6 does not deform.

[0029] In the present embodiment, two buffering members 40 are disposed at positions on the lowest side (i.e., the right side in the figure) in the refrigerant pipe 20, and spaced apart from each other a specified distance, i.e., innermost positions of the vacuum thermally-insulating material 10. In this way, a sufficient space enabling the liquid-state foam thermally-insulating material 30 to flow can be ensured between the two buffering members 40, and corresponds to the thickness of the buffering members 40.

[0030] Thus, a sufficient space enabling the liquid-state foam thermally-insulating material 30 to flow can be ensured between the two buffering members 40.

[0031] In the present embodiment, two buffering members 40 have the same shape, but are not limited to this. The buffering members 40 in different shapes can be provided. In addition, the number of buffering members 40 is not limited to two, and more than three buffering members 40 can also be provided.

[0032] In the present embodiment, the buffering member 40 is formed from EPS (Expanded polystyrene). EPS has elasticity, good shock absorption, and good thermal insulation. Therefore, EPS can reliably ensure a space between the refrigerant pipe 20 and the vacuum thermally-insulating material 10. The space becomes a flow path of the liquid-state foam thermally-insulating material 30 and serves as a buffering material to prevent the occurrence of bumps on the outer surface of the outer cabinet 6.

[0033] However, the material of the buffering member 40 is not limited to EPS, and any other materials with elasticity and thermal insulation can be used, including extruded polystyrene foam (XPS), polyurethane foam, highly-foamed polyethylene foam, and phenol foam.

[0034] Referring to FIG. 2, an example of the dimensions of the structure between the outer cabinet 6 and the inner cabinet 4 in this embodiment is shown below. A distance T1 between the inner surface 6A of outer cabinet 6 and the inner surface 4A of inner cabinet 4 can be exemplified as a value in a range of 30 to 50mm. A thickness T2 of the vacuum thermally-insulating material 10 can be exemplified as a value in a range of 10 to 20mm. An outer diameter T3 of refrigerant pipe 20 can be exemplified as a value in a range of 3 to 10mm. In this case, the thickness dimension of the buffering member 40 can be exemplified as a value in a range of 15 to 35mm. The thickness of the buffering member 40 preferably has a thickness in a range of at least 10 to 20mm or so even after the liquid-state foam thermally-insulating material 30 is filled and compressed and deformed.

[0035] With such a thickness dimension of the buffering member 40, a space enabling the liquid-state foam thermally-insulating material 30 to flow can also be ensured between the vacuum thermally-insulating material 10 and the refrigerant pipe 20 even though the elastic deformation happens.

[0036] Assuming that the buffering member 40 is disposed between the inner surface 6A of the outer cabinet 6 and the vacuum thermally-insulating material 10, the thickness of the buffering member 40 becomes larger, so the elastic deformation becomes larger, which might not ensure a sufficient space between the refrigerant pipe 20 and the vacuum thermally-insulating material 10. On the contrary, to prevent this situation, when an elastic modulus of the buffering member 40 is too high (when the buffering member 40 is too hard), the outer surface of the outer cabinet 6 might be pushed by the buffering member 40, resulting in outward protruding deformation.

[0037] Therefore, the buffering member 40 is preferably provided between the refrigerant pipe 20 and the vacuum thermally-insulating material 10 in order to ensure a sufficient space between the refrigerant pipe 20 and the vacuum thermally insulating material 10, without causing the outwardly protruding deformation of the outer surface of the outer cabinet 6.

(Other examples of the buffering member)

[0038] FIG. 3A schematically illustrates a cross-sectional view of another embodiment 1 of the buffering member 40 disposed between the refrigerant pipe 20 and the vacuum thermally-insulating member 10. FIG. 3B schematically illustrates a perspective view of the buffering member 40 shown in FIG. 3A. FIG. 4A schematically illustrates a cross-sectional view of another embodiment 2 of the buffering member to disposed between the refrigerant pipe 20 and the vacuum thermally-insulating member 10. FIG. 4B schematically illustrates a perspective view of the buffering member 40 shown in FIG. 4A.

[0039] In another embodiment 1 and another embodiment 2 of the buffering member 40, a concave portion 42 having a shape along the outer shape of the refrigerant pipe 20, i.e., a concave portion 42 formed by a smooth curved surface, is formed on a surface of the buffering member 40 connected to the refrigerant pipe 20. The curved surface has a circular arc-shaped cross-sectional shape corresponding to the shape of the cylindrical refrigerant pipe 20. Therefore, as shown in FIG. 3A and FIG. 4A, the buffering member 40 can retain the refrigerant pipe 20 in a bite-in manner, thereby preventing the buffering member 40 from sliding off the refrigerant pipe 20. Therefore, the buffering member 40 can be stably arranged between the vacuum thermally-insulating material 10 and the refrigerant pipe 20.

[0040] In addition, in another embodiment 1, a portion of the buffering member 40 in contact with the vacuum thermally-insulating material 10 is a plane, but in another embodiment 2, a portion of the buffering member 40 in contact with the vacuum thermally-insulating material 10 has a curved shape. In another embodiment 2, since a top of a curved raised shape of the buffering member 40 is connected with the vacuum thermally-insulating material 10, there is the following advantage: not prone to the impact of the hot melt adhesive attached to the surface of the vacuum thermally-adhesive material 10.

(Refrigerator in a second embodiment)

[0041] FIG. 5A schematically illustrates a side view of a refrigerator 2 in a second embodiment of the present invention. FIG. 5B schematically illustrates a side view of flow of air remaining between an outer cabinet 6 and an inner cabinet 4 in the refrigerator shown in FIG. 5A.

[0042] As in FIG. 1, FIGS. 5A-5B also show the following case: the refrigerator 2 lies down horizontally with a door side facing downward, so that a liquid-state foam thermally-insulating material 30 is injected between the outer cabinet 6 and the inner cabinet 4 of the refrigerator 2. The figures also show a side surface of a lateral side of the refrigerator 2. As in FIG. 1, FIG. 1A and FIG. 5B show the vacuum thermally-insulating material 10 and the refrigerant pipe 20 provided between the outer cabinet 6 and inner cabinet 4, the injected liquid-state foam thermally-insulating material 30 being shown in gray.

[0043] In the present embodiment, the vacuum thermally-insulating material 10 is disposed an entire region between the outer cabinet 6 and the inner cabinet 4. Therefore, refrigerant pipe 20 and vacuum thermally-insulating material 10 are arranged in a wider area than the first embodiment shown in FIG. 1. In addition, an injection port Q of liquid-state foam thermally-insulating material 30 is disposed in an upper region (i.e., the left side in the figure) of the refrigerator 2. The liquid-state foam thermally-insulating material 30 is injected through an injection device P mounted at the injection port Q. Therefore, for example, an air flow path needs to be reliably ensured in order to discharge the air from a region R farthest from the injection port Q on the right side of the figure.

[0044] In the present embodiment, in the plan view of the outer cabinet 6 and the inner cabinet 4 shown in FIG. 5A, three buffering members 40 are disposed at positions where the vacuum thermally-insulating material 10 and refrigerant pipe 20 are provided, in a direction connecting the injection port Q of the liquid-state foam thermally-insulating material 30 with the position R which is in an injection region of the liquid-state foam thermally-insulating material 30 provided with the vacuum thermally-insulating material 10 and is farthest from the injection port Q.

[0045] Thus, a reliable space is ensured between the vacuum thermally-insulating material 10 and the refrigerant pipe 20, along the direction in which the buffering member 40 is configured. That is, in the region surrounded by a dot-dash line in FIG. 5A, a sufficient space is ensured between the vacuum thermally-insulating material 10 and the refrigerant pipe 20.

[0046] Therefore, by injecting the liquid-state foam thermally-insulating material 30 so that the liquid-state foam thermally-insulating material 30 flows into the region which is between the outer cabinet 6 and inner cabinet 4 and in which air A exists, the air can be pushed out along the direction connecting the farthest position R with the injection port Q as shown in FIG. 5B, so that the air escapes through the injection port Q to the external. In this way, the formation of air accumulation A can be prevented.

[0047] Although embodiments and implementations of the present invention are described above, the disclosed content may vary in details of structures, and furthermore, changes of combinations of and the order of factors in the embodiments and implementations can be achieved without departing from the scope and spirit of the claimed invention.

Claims

1. A refrigerator, **characterized in that**, comprising:

    a refrigerator body having an outer cabinet and an inner cabinet, a storage region being arranged inside the inner cabinet;
    a refrigerant pipe in which a refrigerant flows and which is disposed between the outer cabinet and the inner cabinet;
    a vacuum thermally-insulating material disposed between the outer cabinet and the inner cabinet;
    a foam thermally-insulating material filled between the outer cabinet and the inner cabinet; and,
    in a region where the refrigerant pipe and the vacuum thermally-insulating material are disposed between the outer cabinet and the inner cabinet,
    an inner surface of the outer cabinet is connected to the refrigerant pipe,
    a buffering member is provided between the refrigerant pipe and the vacuum thermally-insulating material,
    the space between the inner surface of the outer cabinet and the vacuum thermally-insulating material is filled with the foam thermally-insulating material.

2. The refrigerator according to claim 1, where the space between the vacuum thermally-insulating material and the inner surface of the inner cabinet is filled with the foam thermally-insulating material.

3. The refrigerator according to claim 1, wherein the buffering member is a material with elasticity and thermal insulation.

4. The refrigerator according to claim 3, wherein the buffering member is formed from EPS (Expanded polystyrene).

5. The refrigerator according to claim 1, wherein a concave portion having a shape along the outer shape of the refrigerant pipe is formed on a surface of the buffering member connected to the refrigerant pipe.

6. The refrigerator according to claim 5, wherein an outer shape of the refrigerant pipe is cylindrical, the concave portion has a smooth curved surface, and a cross section of the curved surface is arcuate corresponding to the cylindrical refrigerant pipe.

7. The refrigerator according to claim 5, wherein a portion of the buffering member in contact with the vacuum thermally-insulating material is a plane.

8. The refrigerator according to claim 5, wherein a portion of the buffering member in contact with the vacuum thermally-insulating material has a curved shape.

9. The refrigerator according to claim 1, wherein at least two of the buffering members are disposed spaced-apart a specified distance, enabling the liquid-state foam thermally-insulating material to have a sufficient flow space between the two buffering members.

10. The refrigerator according to claim 9, wherein buffering members are disposed at positions where the vacuum thermally-insulating material and the refrigerant pipe are provided, in a direction connecting an injection port with the farthest position in a planar view of the outer cabinet and the inner cabinet, the injection port is the injection port of the liquid-state foam thermally-insulating material, and the farthest position is a position which is in an injection region of the liquid-state foam thermally-insulating material provided with the vacuum thermally-insulating material and is farthest from the injection port.

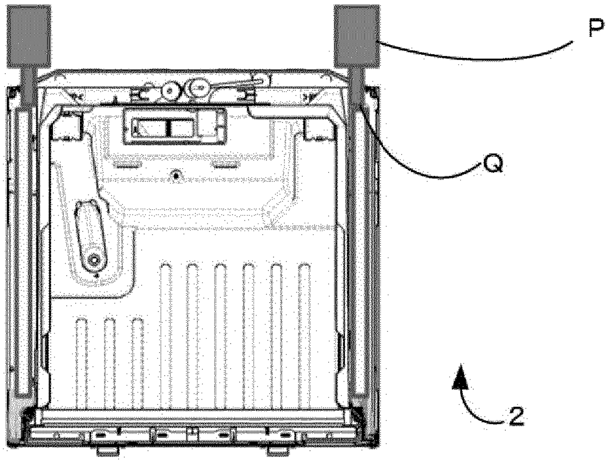

FIG. 1A

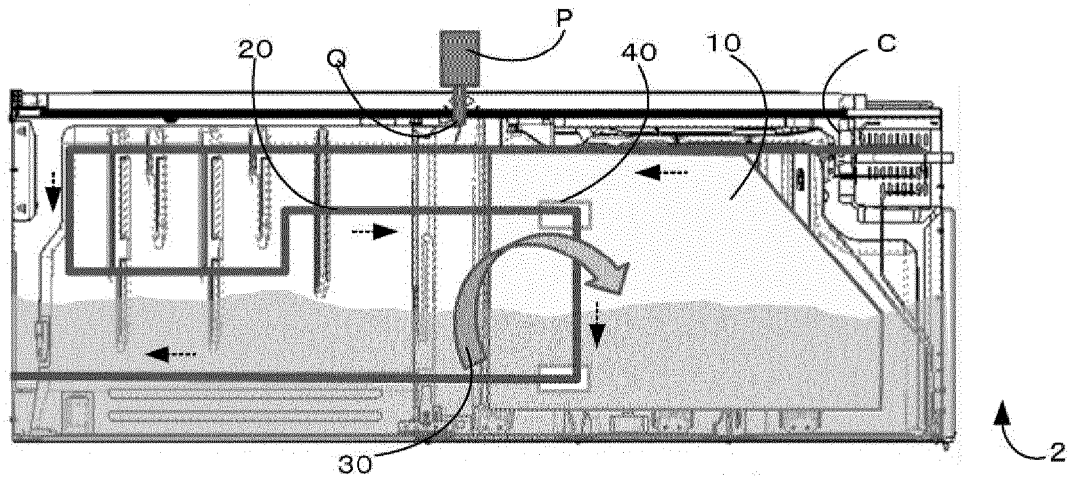

FIG. 1B

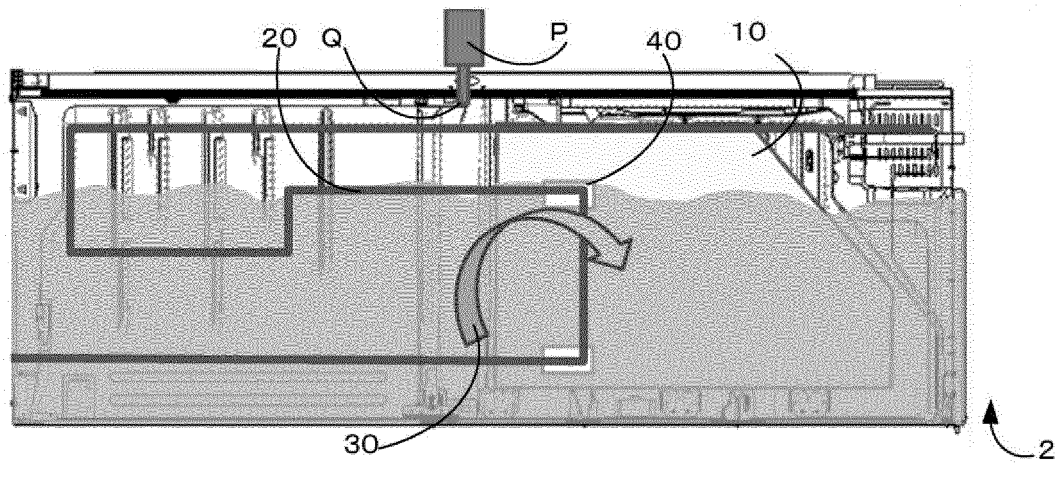

FIG. 1C

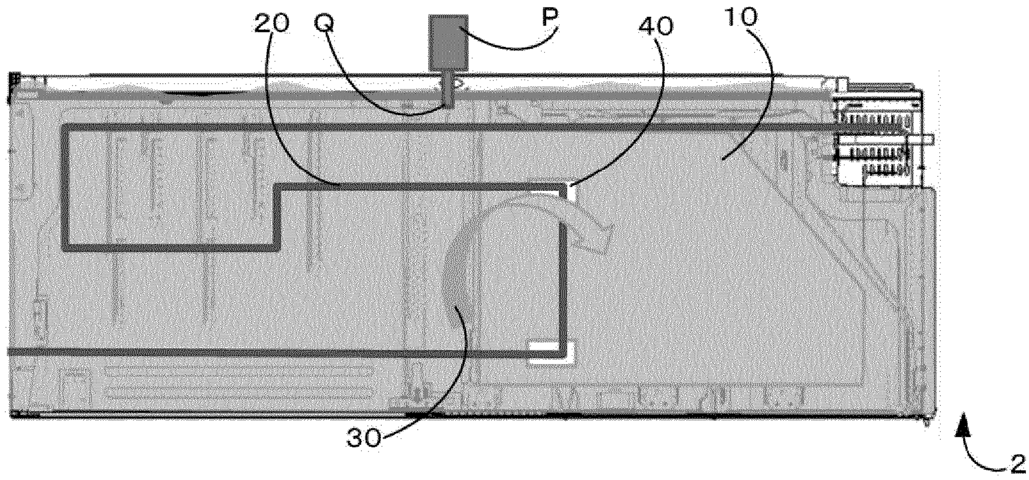

FIG. 1D

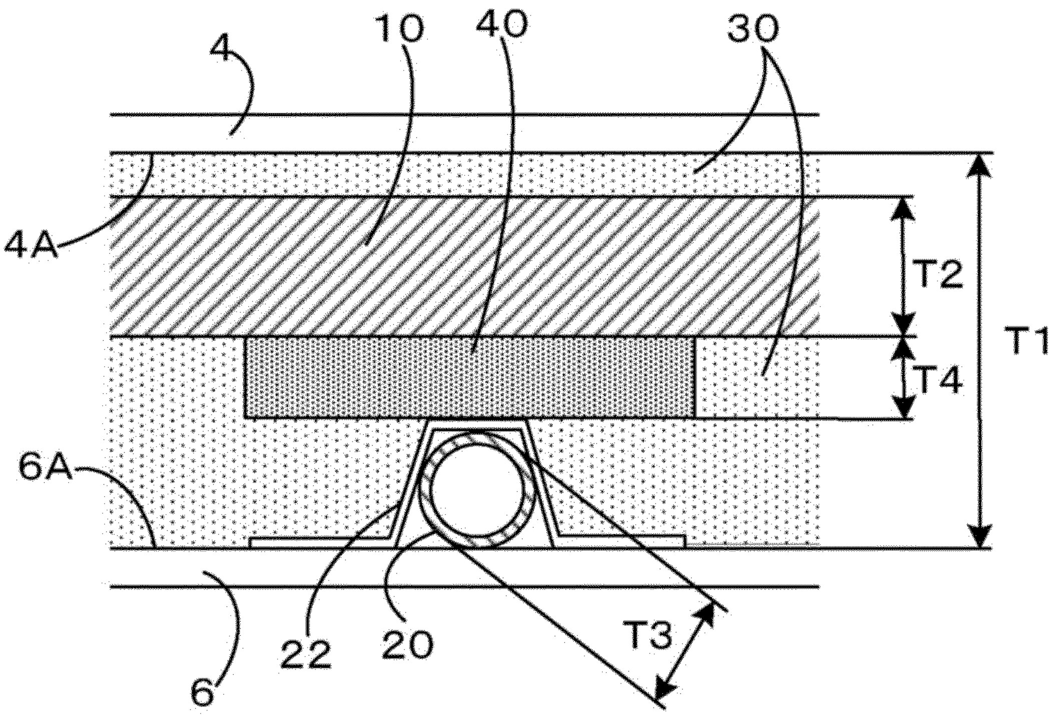

FIG. 2

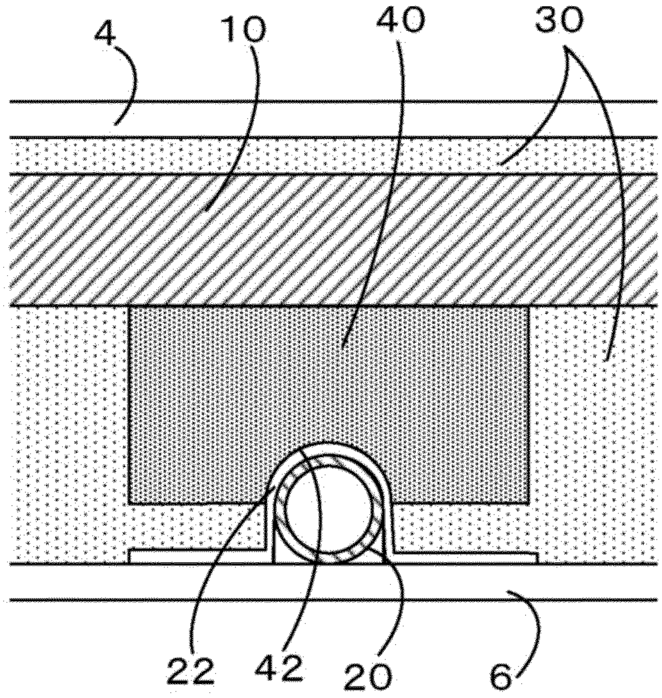

FIG. 3A

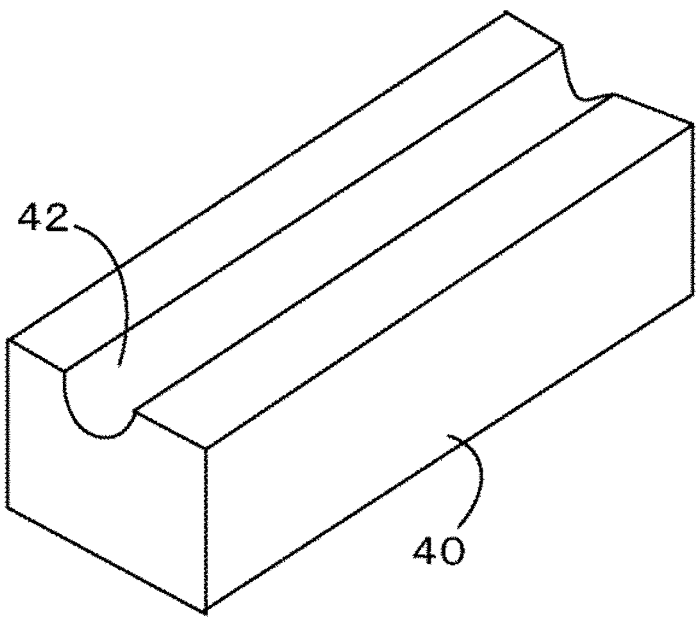

FIG. 3B

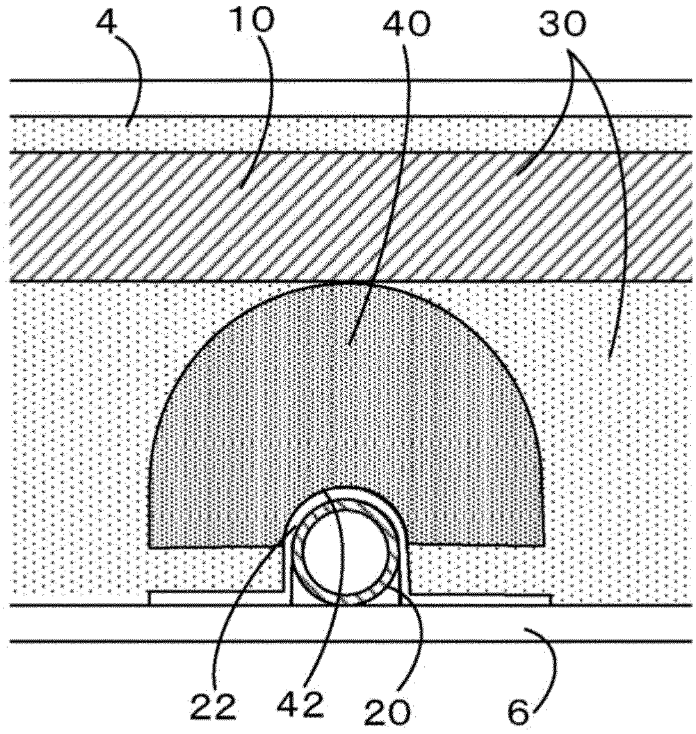

FIG. 4A

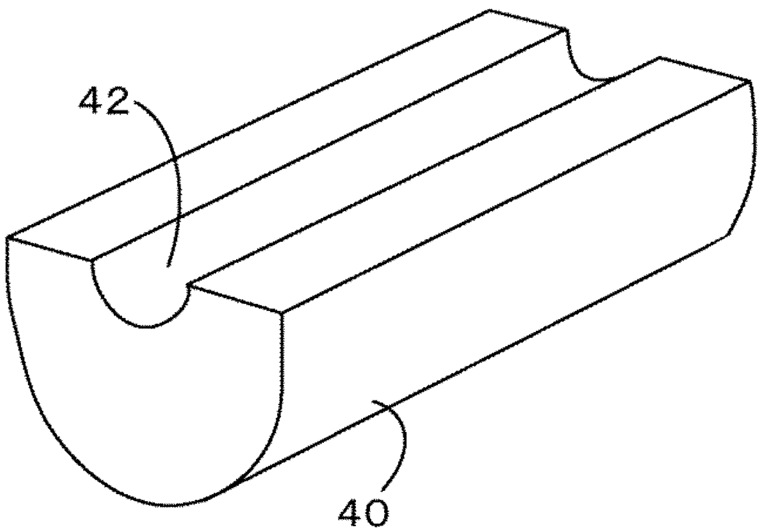

FIG. 4B

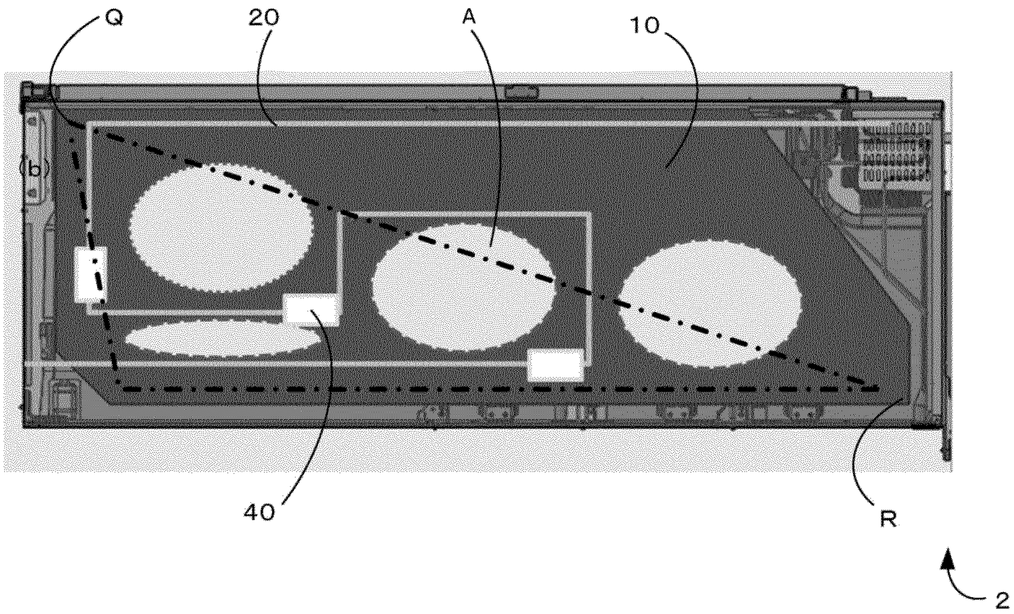

FIG. 5A

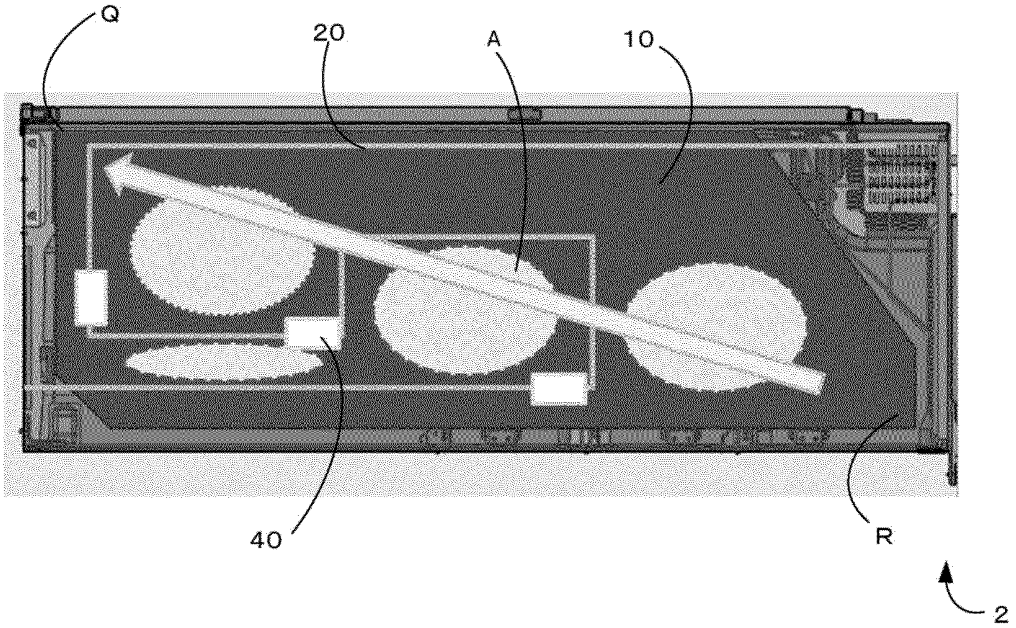

FIG. 5B

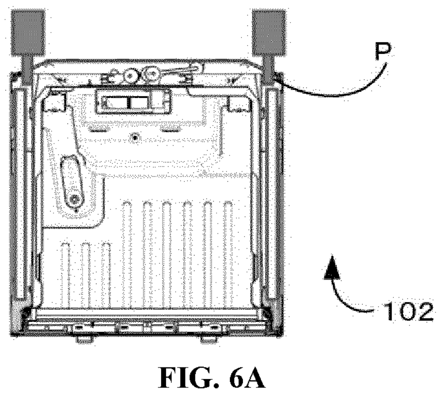

FIG. 6A

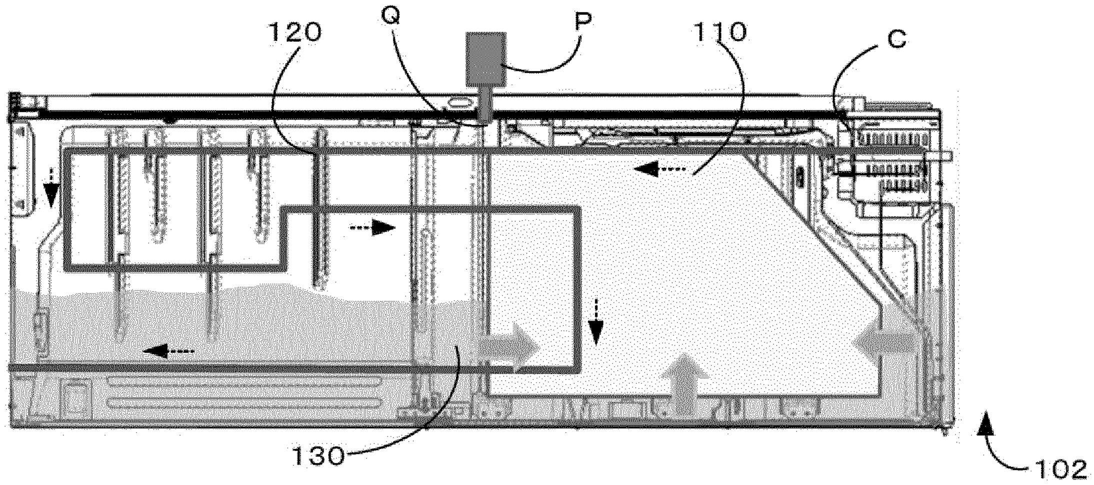

FIG. 6B

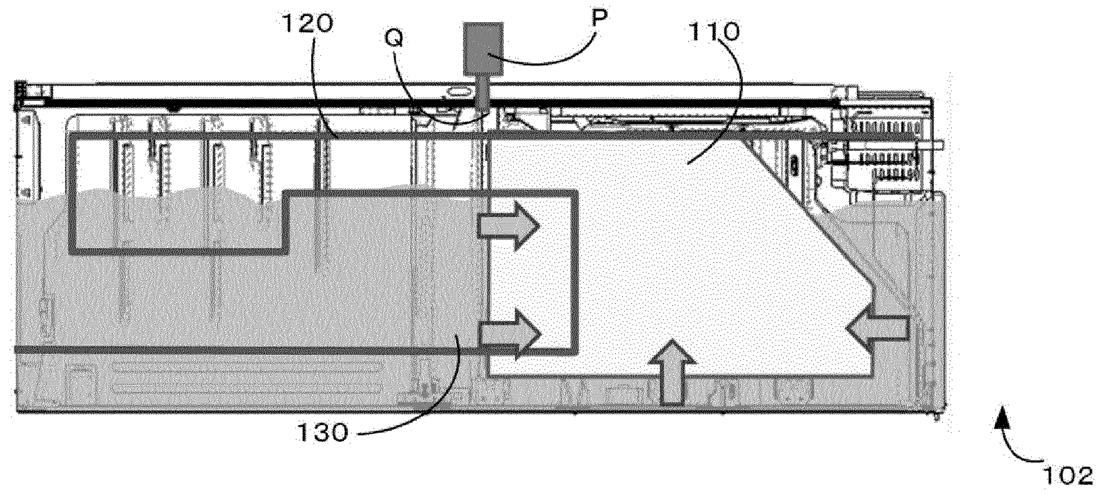

FIG. 6C

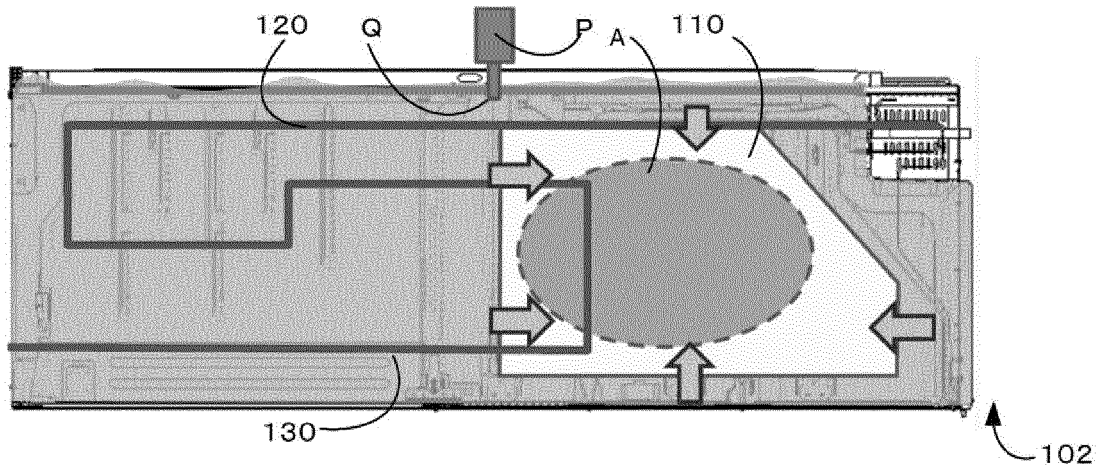

FIG. 6D

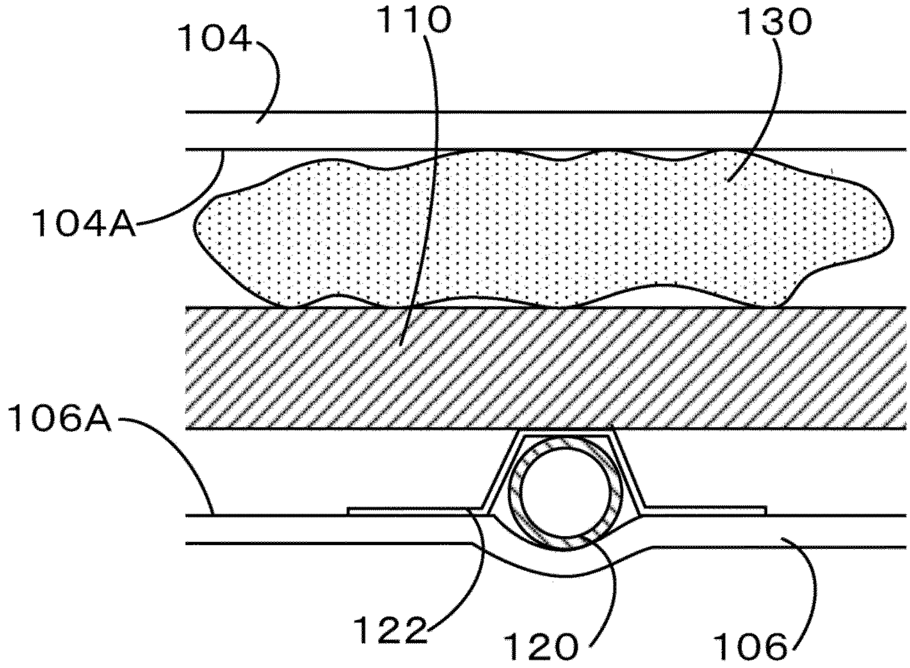

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/129835

A. CLASSIFICATION OF SUBJECT MATTER

F25D 23/06(2006.01)i；F25D 11/02(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 F25D11

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

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

CNABS, CNTXT, CNKI, DWPI: 泡沫 发泡 真空 隔热 绝热 管 foam+ vacuum innsulat+ duct pipe conduit

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 201522164 U (HEFEI MEILING COMPANY LIMITED) 07 July 2010 (2010-07-07) description, paragraphs [0024]-[0025] and figure 7	1-10
A	CN 205593277 U (TCL HOME APPLIANCES (HEFEI) CO., LTD.) 21 September 2016 (2016-09-21) entire document	1-10
A	CN 102735015 A (MITSUBISHI ELECTRIC CORPORATION) 17 October 2012 (2012-10-17) entire document	1-10
A	CN 102449417 A (HITACHI APPLIANCES INC.) 09 May 2012 (2012-05-09) entire document	1-10
A	JP 2012063025 A (HITACHI APPLIANCES, INC.) 29 March 2012 (2012-03-29) entire document	1-10
A	JP 2005164193 A (MATSUSHITA ELECTRIC IND. CO., LTD.) 23 June 2005 (2005-06-23) entire document	1-10

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

* Special categories of cited documents:
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"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
11 January 2022	**28 January 2022**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/129835

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 201522164 U	07 July 2010	None	
CN 205593277 U	21 September 2016	None	
CN 102735015 A	17 October 2012	CN 102735015 B	20 August 2014
		JP 2012225540 A	15 November 2012
		JP 5506733 B2	28 May 2014
CN 102449417 A	09 May 2012	JP 2010276310 A	09 December 2010
		WO 2010137081 A1	02 December 2010
		KR 20120024665 A	14 March 2012
JP 2012063025 A	29 March 2012	JP 5544254 B2	09 July 2014
JP 2005164193 A	23 June 2005	None	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2005055086 A **[0002]**